PETITION TO UPGRADE ZONES 3 AND 4 OF THE DELAWARE RIVER TO INCLUDE RESIDENT AND MIGRATORY FISH PROPAGATION

I. PETITIONER INFORMATION

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II. PETITION INFORMATION

A. The petitioner requests the Environmental Quality Board to amend a regulation (citation 25 Pa. Code § 93.9e).

The Delaware Riverkeeper Network (DRN) requests that the Environmental Quality Board (EQB) and the Department of Environmental Protection (Department) upgrade the existing and designated uses of Zones 3 and 4 of the Delaware River, River Miles 78.8-108.4, to include fish propagation for the warm water fishes (WWF) use and fish maintenance and propagation for the migratory fishes (MF) use. DRN's suggested regulatory language is to amend 25 Pa. Code § 93.9e as follows:

Stream	Zone	County	Water Uses Protected	Exceptions To Specific Criteria
1—Delaware Estuary	Tidal Portions of Basin, RM 108.4 to Big Timber Creek (NJ)	Philadelphia	WWF ~~(Maintenance Only)~~; MF ~~(Passage Only)~~; ***Delete*** WC	See DRBC regulations—Water Quality Zone 3

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1—Delaware Estuary	Tidal Portions of Basin, Big Timber Creek (NJ) to Philadelphia- Delaware County Border	Philadelphia-Delaware	WWF ~~(Maintenance Only)~~; MF ~~(Passage Only)~~; N Delete WC, PWS, LWS and IRS	See DRBC regulations—Water Quality Zone 4

For clarification, the only proposed amendments to 25 Pa. Code § 93.9e are to strike "(Maintenance Only)" from the WWF use and "(Passage Only)" from the MF use in the Water Use Protected column. Currently, the water uses that are identified for Zones 3 and 4 do not protect resident fish propagation or migratory fish maintenance and propagation.[1]

DRN also requests that the Department update its Existing Use List[2] to reflect that the existing uses of Zones 3 and 4 of Delaware River include the full WWF (maintenance and propagation) use and the full MF (passage, maintenance and propagation) use.

B. Why is the petitioner requesting this action from the Board? (Describe problems encountered under current regulations and the changes being recommended to address the problems. State factual and legal contentions and include supporting documentation that establishes a clear justification for the requested action.)

DRN submits this petition to upgrade the existing and designated uses of Zones 3 and 4, River Mile 78.8-108.4, of the Delaware River to include resident fish propagation and migratory fish maintenance and propagation. Currently, Zones 3 and 4 of the Delaware River have the designated use of WWF maintenance only and MF passage only.[3] However, data clearly demonstrate that resident and migratory fish propagation is occurring in Zones 3 and 4, necessitating the EQB's and the Department's recognition that the existing and designated use for these zones is **WWF maintenance and propagation** and **MF passage, maintenance and propagation**. Findings by the Delaware River Basin Commission's (DRBC) staff, the Environmental Protection Agency (EPA) Regions 2 and 3, and the Department itself support upgrading these existing and designated uses.

[1] See 25 Pa. Code § 93.9e.

[2] Per the Department's website "The department maintains a publicly accessible list of surface water segments where data has been evaluated that indicates an existing use classification of a waterbody that is more protective than the designated use (including those segments which are HQ or EV). The list is maintained and updated by the Bureau of Clean Water and will be used by DEP and county conservation district staff with responsibility to protect surface water quality in reviewing requests for permits and approvals. Only an existing use that is more stringent than the designated use in 93.9a - 93.9z for a particular waterbody is placed on the existing use list." (http://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/Pages/ExistingUse.aspx)

[3] 25 Pa. Code § 93.9e. (Drainage List E).

Importantly, the Department's regulatory scheme also mandates that these upgrades be made as it requires time-to-time upgrade of existing and designated uses.[4] Specifically, the regulations require that:

> Existing use protection shall be provided when the Department's evaluation of information (including data gathered at the Department's own initiative, data contained in a petition to change a designated use submitted to the EQB under §93.4d(a) (relating to processing of petitions, evaluations and assessments to change a designated use), or data considered in the context of a Department permit or approval action) indicates that a surface water attains or has attained an existing use.[5]

By definition, existing water uses are those actually attained by the waterbody whether or not they are listed in the regulations.[6] All of the water uses listed in 25 Pa. Code § 93.3 are protected as existing uses. These water uses include warm water fishes, migratory fishes, trout stocking (TSF), cold water fishes (CWF), as well as others designed to protect water supply, recreation, and special protection waterways.[7] Existing water uses are protected on a waterbody segment when the Department makes a decision to issue or deny a permit or approval request for an activity that may impact the use.[8] Specifically, existing uses are protected during the Department's antidegradation review of a permit or approval request whereby the Department is required to ensure that the "[e]xisting instream water uses and the level of water quality necessary to protect the existing uses" are protected and maintained. [9] For example, when a facility applies for a discharge permit from the Department, the Department must review the pollutants in the facility's discharge to ensure that the existing uses of the receiving waterbody (like WWF, MF, CWF and/or potable water supply) are not degraded.

Designated uses, conversely, are water uses for each water body identified in 25 Pa. Code § 93.9a-93.9z, whether or not they are being attained. Designated uses may be thought of as water quality goals and expectations for how each water body is to be used. Department regulations mandate that "designated surface water uses shall be protected" in addition to existing uses.[10] If the designated use becomes impaired, in that the use is no longer being met, the Department then must begin the process of implementing a total maximum daily load, which requires assignment of wasteload allocations to point source discharges and load allocations to nonpoint sources so that designated use can be recovered.[11] In some circumstances, while a designated use may be made less stringent or protective through rulemaking, it may not be lowered to a use that is less stringent than the existing use for the water.[12]

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[4] See 25 Pa. Code § 93.4c.(a).
[5] 25 Pa. Code § 93.4c(a)(1)(i).
[6] 25 Pa. Code § 93.1.
[7] 25 Pa. Code § 93.3.
[8] 25 Pa. Code § 93.4c(a)(1)(i).
[9] 25 Pa. Code § 93.4a(b); 40 C.F.R. 131.12(a)(1).
[10] 25 Pa. Code § 96.3(a).
[11] See 25 Pa. Code § 96.1 - 4.
[12] See PA DEP's Water Quality Antidegradation Implementation Guidance (Nov. 28, 2003, Doc. No. 391-0300-002), p. 6.

Furthermore, this proposed upgrade of Zones 3 and 4 of the Delaware River is supported by Article I, Section 27 of the Constitution, which provides:

> The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.[13]

As identified below, the data demonstrate that both resident and migratory fish are propagating in Zones 3 and 4 of the Delaware River. Thus, the Department must recognize this propagation by upgrading the existing and designated uses of those reaches to conserve and maintain the Commonwealth's natural resources as required under Article I, Section 27 of the Commonwealth's Constitution, the federal Clean Water Act and the Pennsylvania Clean Streams Law.

The Data Clearly Demonstrate that Resident and Migratory Fish Propagation is Occurring in Zones 3 and 4 of the Delaware River

In 2013, DRN[14] submitted a petition to the DRBC requesting it to upgrade the designated uses of Delaware River Estuary Zones 3, 4, and River Miles 78.8 to 70.0 of Zone 5 to include, among other things, propagation of fish. As outlined in DRN's Upgrade Petition, data gathered by the Public Service Enterprise Group (PSEG) as well as other research on anadromous fish species demonstrate that resident fish and other aquatic life populations are propagating in these zones. See DRN Upgrade Petition at p. 5-9, enclosed as Attachment 1.

As a result of the DRN's upgrade petition, DRBC staff evaluated whether propagation was occurring in these zones and summarized its findings in its September 30, 2015 report entitled "Existing Use Evaluation for Zones 3, 4, & 5 of the Delaware Estuary Based on Spawning and Rearing of Resident and Anadromous Fishes" (DRBC Existing Use Report), enclosed as Attachment 2.[15] DRBC's Existing Use Report relied on data from PSEG Nuclear Generating Station's robust 2002-2004 ichthyoplankton surveys, New Jersey Div. of Fish and Wildlife's Delaware Estuary beach seine surveys, and Delaware Div. of Fish and Wildlife's juvenile Atlantic sturgeon sampling.[16] Additionally, to complete their review of the data, DRBC staff coordinated with fishery biologists at the Delaware River Basin Fish and Wildlife Cooperative technical committee and with fishery biologists from Delaware, New Jersey and Pennsylvania.[17] The DRBC Existing Use Report's key findings are that:

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[13] Pa. Const. Art. I, § 27.
[14] The Delaware River Shad Fishermen's Association and the Lehigh River Stocking Association we co-petitioners on the Upgrade Petition.
[15] The DRBC Existing Use Report evaluated White Perch, a resident fish species, and Atlantic Sturgeon, Striped Bass, American Shad, Blueback Herring, Alewife, Atlantic Menhaden, Bay Anchovy and Atlantic Silverside, all migratory or marine/estuarine species (note: White Perch is sometimes characterized as semi-migratory).
[16] DRBC Existing Use Report, pp. 6-8.
[17] DRBC Existing Use Report, p. 11.

- "Successful 'propagation' in Zones 3, 4, and upper Zone 5 of the Delaware Estuary is clearly supported by the three primary data sources evaluated in this report."[18]

- "The 'Existing Use' for Zones 3, 4, and upper Zone 5 . . . substantially exceeds the 'designated use' of only 'maintenance.'"[19]

- "DRBC staff recommends that partial restoration of the 'propagation' use be recognized as the existing use for Zones 3, 4, and upper Zone 5 of the Delaware Estuary."[20]

DRBC's recommendation of a partial propagation standard is based on the premise that propagation could be stronger for a few of the species reviewed. Nonetheless, DRBC recognizes that "[f]or all species evaluated, successful reproduction was clearly demonstrated in one or more of the compromised estuary zones . . ." and that "moderate to strong reproduction was demonstrated for multiple species in each zone indicating substantial recovery in the 'propagation' use for Zones 3, 4, and upper Zone 5."[21] Thus, DRBC's findings clearly demonstrate that fish propagation is now occurring and that the existing use of Zones 3 and 4 of the Delaware River is **WWF maintenance and propagation** as well as **MF passage, maintenance, and propagation**.

EPA Regions 2 and 3 confirm that the existing use in Zones 3 and 4 must be upgraded to include propagation. In their comments on the DRBC Existing Use Report, EPA stated:

> With respect to maintenance and propagation of aquatic life, the [DRBC] report indicates that the full Clean Water Act Section 101(a)(2) use exists in Zones 3, 4, and upper Zone 5 of the Delaware estuary. The report states that, for all nine fish species evaluated, successful reproduction was clearly demonstrated. Demonstration of propagation, even if "weak and inconsistent" and spatially limited, is nonetheless demonstration of this existing use.[22]

EPA further advised,"[i]n conducting a use evaluation, it is important to address the most sensitive aquatic life species to which the maintenance and propagation use applies in order to ensure subsequent promulgation of Water Quality Criteria is truly protective of the designated use."[23] Thus, protecting the most sensitive aquatic life species requires the Department to recognize that propagation is occurring and is an existing use in these zones of the river.

Lastly, PADEP's own staff recognizes that propagation is occurring in these zones. During PADEP's March 24, 2016 presentation to its Water Resources Advisory Committee

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[18] DRBC Existing Use Report, p. 30.
[19] DRBC Existing Use Report, p. 32.
[20] DRBC Existing Use Report, p. 1.
[21] DRBC Existing Use Report, p. 1.
[22] EPA Regions 2 and 3 Comments on DRBC Existing Use Report, January 15, 2016 email from Angela McFadden, on behalf of Evelyn MacKinght, Associate Director, Office of Standards, Assessment, and TMDLs, Water Protection Division, EPA Region 3, to Tom Fikslin of DRBC. Enclosed as Attachment 3.
[23] Id.

(WRAC), PADEP staff provided a summary of its proposed rulemaking regarding its triennial review of water quality standards, stating "[t]here is new evidence that strongly indicates fish propagation has improved for several key species in portions of the Delaware Estuary, and that the warm water use (WWF) should be restored."[24]

There is demonstrated and uniform agreement among DRBC staff, EPA Regions 2 and 3 and the Department's staff that propagation is occurring in Zones 3 and 4 of the Delaware River. This position is the result of significant and verified scientific findings. As such, during the EQB's review it must determine that propagation is the existing and/ or designated use of these zones. A failure to do so would violate the Pennsylvania Clean Streams Law, the federal Clean Water Act and the Pennsylvania Constitution.

C. Describe the types of persons, businesses and organizations likely to be impacted by this proposal.

Most persons, businesses, and organizations in and around Zones 3 and 4 of the Delaware River will benefit from this upgrade. Some of the benefits include increased fish landings, improved fishing, hunting, and bird/wildlife viewings, and increased property values.

A recognition that fish propagation is occurring in these zones will safeguard and increase fish populations as the Department will be required to ensure that propagation is maintained and protected when the Department issues a permit or takes an approval action.[25] The annual value of fish landings in the tidal Delaware River and Bay has been calculated as $25.4 million in year 2000 dollars or $34.1 million in 2010 dollars.[26] Striped Bass alone, a species identified as having regular evidence of successful reproduction in Zones 3 and 4,[27] has a value of $2.3 million per year.[28] As fish populations grow, fish landings will increase as well.

With increased fish populations and landings, improved fishing, hunting, and bird/wildlife viewings can reasonably be expected. According to Kauffman's report on the Socioeconomic Value of the Delaware River Basin:

> In Delaware, New Jersey, New York, and Pennsylvania, the U. S. Fish and Wildlife Service (2008) estimated the annual economic value of fishing, hunting, birding and wild-life/bird watching recreation was $9.2 billion in $2006. Trip-related expenditures include food and lodging, transportation, and hunting, fishing, and wildlife watching equipment. Most fishing, hunting, and birding/wildlife recreation occurs on farm, forest, wetlands, and open water ecosystems such as the Prime Hook and Bombay Hook National Wildlife Refuges

[24] The Department's summary of its 2016 Triennial Review of Water Quality Standards recommendations (a.k.a. TR17 Proposed Rulemaking) presented to the Department's Water Resources Advisory Committee on March 24, 2016, p. 2. Enclosed as Attachment 4.
[25] See 25 Pa. Code §§ 93.4a and 93.4c.
[26] Kauffman, G. (October 11, 2011). Socioeconomic Value of the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania, p. 44 ("Kauffman Report"). Enclosed as Attachment 5.
[27] DRBC Existing Use Report (Attachment 2), see p. 17-18
[28] See Kauffman Report (Attachment 5), p. 44.

> in Delaware, the Cape May National Wildlife Refuge and Pine Barrens National Reserve in New Jersey, the Catskill Mountain Preserve in New York, the Delaware Water Gap National Recreation Area in Pennsylvania, and on the Delaware River and Bay and tributaries as well.[29]

In particular, recreational opportunities and wildlife viewing may be enhanced at the John Heinz National Wildlife Refuge. The refuge is a tremendous natural area that is home to many migratory birds and native fish. It is America's First Urban Refuge and was established in 1972 for the purpose of preserving, restoring, and developing the natural area known as Tinicum Marsh, to promote environmental education, and to afford visitors an opportunity to study wildlife in its natural habitat. This national refuge, one of 548 throughout the entire nation, protects the largest remaining freshwater tidal marsh in PA. This marsh is a vital feeding and resting place for birds migrating along the Atlantic Flyway. The refuge also provides diverse habitats for a wide range of wildlife, from deer to butterflies and fish to eagles. The refuge provides a welcome break from the busy urban setting of the metropolitan Philadelphia area and environmental education opportunities to thousands of area students. A canoe trail also flows through the Darby Creek and wetlands complex of the refuge that provides additional recreational opportunities.[30]

Additional recreational opportunities and wildlife viewing may occur along the Tidal Delaware Water Trail, a 56 mile trail with public access to the Delaware River, stretches from Trenton, New Jersey to Marcus Hook, Pennsylvania. One of 25 designated Pennsylvania Water Trails, the Tidal Delaware is a hub of environmental features, historic resources, and recreational activities for Pennsylvania and New Jersey.

Increased property values are also expected by upgrading Zones 3 and 4 to include fish propagation. By protecting fish propagation, improved water quality will follow with the Department's enforcement of its antidegradation regulations to maintain and protect propagation. Improved water quality can increase the property values of nearby communities. Per Kauffman:

> Several studies along rivers, estuaries, and coasts throughout the United States indicate that improved water quality can increase shoreline property values by 6% to 25% (Table 17). The EPA (1973) estimated that improved water quality can raise property values by up to 18% next to the water, 8% at 1000 feet from the water, 4% at 2000 feet from the water, and 1.5% at 3000 feet from the water. Leggett, et al. (2000) estimated that improved bacteria levels to meet state water quality standards along the western shore of the Chesapeake Bay in Maryland raised shoreline property values by 6%. The Brookings Institution (2007) projected that investments of $26 billion to restore the Great Lakes would increase shoreline property values by up to 10%. For this analysis, shoreline property values within 2000 feet of the waterways are estimated to increase by an average of 8% due to improved water quality in the Delaware Estuary.[31]

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[29] Kauffman Report, p. 50.
[30] See generally https://www.fws.gov/refuge/John_Heinz/about.html.
[31] Kauffman Report, p. 35.

Finally, as the federal Clean Water Act and the Pennsylvania Clean Streams Law require that those uses actually attained in a waterbody (an "existing use") be protected and maintained,[32] any adverse impact to NPDES dischargers potentially affected by this upgrade has already been contemplated by the U.S. Congress and the PA legislature when they passed the laws that call for iterative improvement in the quality of the Commonwealth's surface waters.

D. Does the action requested in the petition concern a matter currently in litigation? If yes, please explain.

No, to our knowledge, the action requested in the petition does not concern a matter currently in litigation.

E. For stream redesignation petitions, the following information must be included for the petition to be considered complete. Attach supporting material as necessary.

1. A clear delineation of the watershed or stream segment to be redesignated, both in narrative form and on a map.

DRN requests that the existing and designated uses of Zones 3 and Zones 4 of the Delaware River, River Mile 78.8 to 108.4, be upgraded to WWF maintenance and propagation and MF passage, maintenance, and propagation.

A map of the Delaware River Basin Commission's Delaware River Main Stem Interstate Zones has been provided to identify the location of Zones 3 and 4 of the Delaware River. The map is enclosed as Attachment 6.

2. The current designated use(s) of the watershed or segment.

The current designated uses of the Zone 3, RM 95.0 to 108.4, of the Delaware River is Warm Water Fishes (Maintenance Only); Migratory Fishes (Passage Only); with a notation to delete Water Contact Sports. See 25 Pa. Code § 93.9e (Drainage List E).

The current designated uses of the Zone 4, RM 78.8 to 95.0, of the Delaware River is Warm Water Fishes (Maintenance Only); Migratory Fishes (Passage Only); and Navigation; with a notation to delete Water Contact Sports, Potable Water Supply, Livestock Water Supply and Irrigation. See 25 Pa. Code § 93.9e (Drainage List E).

3. The requested designated use(s) of the watershed or segment.

DRN requests that the existing and designated uses of Zones 3 and Zones 4 of the Delaware River, River Mile 78.8 to 108.4, be upgraded to WWF maintenance and propagation and MF passage, maintenance and propagation.

[32] 25 Pa. Code § 93.4a; 40 C.F.R. 131.12(a)(1).

DRN also requests that the Department update its Existing Use List to reflect that the existing uses of Zones 3 and 4 of Delaware River include WWF maintenance and propagation and MF passage, maintenance and propagation.

4. **Available technical data on instream conditions for the following: water chemistry, the aquatic community (benthic macroinvertebrates and/or fishes), or instream habitat. If such data are not included, provide a description of the data sources investigated.**

The data sources investigated, some of which are identified and referenced in section II.B. above, include:

- PSEG's 2002-2004 ichthyoplankton surveys submitted as part of the Biological Monitoring Program at its Salem Nuclear Generating Station facility. The ichthyoplankton surveys are included in this petition.[33]

- PSEG's 2000-2009 dissolved oxygen measurements which were included in its Baywide Finfish Monitoring surveys, which were also submitted as part of the Biological Monitoring Program at its Salem Nuclear Generating Station facility.[34]

- Delaware Department of Natural Resources and Environmental Control's (DNREC) data regarding the presence of Atlantic sturgeon[35] and researchers' publications on sturgeon spawning habitat[36] and juvenile tracking[37].

- DRBC Staff's summary of Dissolved Oxygen Data from 2000 to 2014 from USGS Sensors at the Ben Franklin Bridge (01467200) and Chester, PA (01477050).[38]

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[33] See DRN's Upgrade Petition, Appendix A (Attachment 1). See also DRBC's Existing Use Report, Appendix D (Attachment 2).
[34] See DRN's Upgrade Petition, Appendix B (Attachment 1).
[35] See DRN's Upgrade Petition, p. 8 (Attachment 1).
[36] See DRN's Upgrade Petition, p. 8 (Attachment 1). The specific citation is Philip C. Simpson & Dewayne A. Fox, Del. State Univ., Completion Report: Award NA05NMF4051093, Atlantic sturgeon in the Delaware River: Contemporary Population Status and Identification of Spawning Areas (2006).
[37] See DRN's Upgrade Petition, p. 8 (Attachment 1). The specific citation is Matthew Fisher, Delaware DNREC, Atlantic Sturgeon Final Report: State Wildlife Grant, Project T-4-1 10 (2011), note 10, at 15-16 (noting usage of Marcus Hook by late stage juveniles); Dewayne A. Fox & Matthew W. Breece, Del. State Univ., NOAA Award NA08NMF4050611, Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) in the New York Bight DPS: Identification of Critical Habitat and Rates of Interbasin Exchange 13 (2010), note 10, at 25, 29-30 (suggesting spawning in the vicinity of Marcus Hook may have been overlooked); Delaware DNREC, Award No. NAI0NMF4720030, Semi-annual Progress Report 3 (Jan. 2012) (noting capture of 48 young-of- year at Marcus Hook).
[38] See DRBC Existing Use Report, Appendix B (Attachment 2).

- The New Jersey Division of Fish and Wildlife, Bureau of Marine Fisheries, Beach Seine Surveys from 1980 to 2013.[39]

5. **A description of existing and proposed point and nonpoint source discharges and their impact on water quality and/or the aquatic community. The names, locations, and permit numbers of point source discharges and a description of the types and locations of nonpoint source discharges should be listed.**

Zones 3 and 4 of the Delaware River have approximately 49 active or inactive point source discharge facilities holding NPDES permits. The types of discharges include industrial waste, municipal sewage, municipal separate storm sewer system (MS4), and industrial stormwater. The information presented below was collected using the Department's list of NPDES dischargers.[40]

NPDES Permit Number	Facility Name	County
Industrial Waste NPDES Permits		
PA0012882	PHILA GAS WORKS	Philadelphia
PA0013021	PQ CORP	Delaware
PA0013081	KIMBERLY CLARK OF PA LLC	Delaware
PA0013714	EXELON GENERATION CO LLC	Delaware
PA0036447	NAVAL SURFACE WARFARE CTR	Philadelphia
PA0057479	RHOADS IND INC	Philadelphia
PA0057690	AKER PHILA SHIPYARD	Philadelphia
PA0244449	FPL ENERGY MARCUS HOOK LP	Delaware
PA0011096	SUNOCO PARTNERS MKT & TERM LP	Delaware
PA0011533	Philadelphia Energy Solutions (PES), Girard Point refinery	Philadelphia
PA0012629	Philadelphia Energy Solutions (PES), Point Breeze refinery	Philadelphia
PA0012637	Monroe Energy, Trainer Refinery	Delaware
PA0051713	Evonik Degussa Corporation	Delaware
Municipal Sewage NPDES Permits		
PA0026662	PHILA WATER DEPT	Philadelphia
PA0026671	PHILA WATER DEPT	Philadelphia
PA0026689	PHILA WATER DEPT	Philadelphia

[39] See DRBC Existing Use Report, pp. 7-8 and 45-60 (Attachment 2).
[40] Available here: http://www.dep.pa.gov/Business/Water/CleanWater/WastewaterMgmt/Pages/NPDESWQM.aspx

PA0027103	DELCORA	Delaware
PA0028380	TINICUM TWP DELAWARE CNTY	Delaware

MS4 Municipal SW NPDES Permit

PA0054712	Philadelphia Water Dept.	Philadelphia

PAG-03 General NPDES Permits for Storm Water Associated with Industrial Activities

PAG030018	NAVAL FOUNDRY & PROPELLER CTR	Philadelphia
PAR200005	FISHER TANK CO	Delaware
PAR230043	DICKLER CHEMICAL LABORATORIES	Philadelphia
PAR230044	ASHLAND CHEMICAL CO	Philadelphia
PAR230089	UNITED COLOR MFG INC	Philadelphia
PAR230097	MAJESTIC PROD LLC	Delaware
PAR600030	ORTHODOX AUTO CO INC	Philadelphia
PAR600114	ANGEL MARTINEZ DBA CLEARFIELD RECYCLING	Philadelphia
PAR600115	KUUSAKOSKI PHILADELPHIA LLC	Philadelphia
PAR800067	WASTE MGMT OF PA INC	Philadelphia
PAR800088	CSX INTERMODAL-GREENWICH YARD	Philadelphia
PAR800099	AIRCRAFT SVC INTL GROUP	Delaware
PAR800146	REPUBLIC SVC INC	Philadelphia
PAR800154	CSX INTERMODAL INC	Philadelphia
PAR800158	GREENWICH TERM LLC	Philadelphia
PAR800170	WESTWAY TERMINAL CO LLC	Philadelphia
PAR120002	DIETZ & WATSON INC	Philadelphia
PAR140016	KIMBERLY-CLARK CORP	Delaware
PAR150006	LAWRENCE-MCFADDEN CO	Philadelphia
PAR600028	CIMCO TERMINALS INC-CAMDEN IRO	Philadelphia
PAR600034	JIMMIES AUTO PARTS	Philadelphia
PAR600039	MORRIS IRON & STEEL CO INC	Philadelphia
PAR600042	PHILADELPHIA CITY POLICE DEPT	Philadelphia
PAR800019	CROWLEY AMERICAN TRANSPORTATIO	Philadelphia
PAR800030	ABF FREIGHT SYSTEM INC	Delaware
PAR800055	CONSOLIDATED FREIGHTWAYS	Philadelphia

	INC	
PAR900002	DELAWARE CO REGIONAL WATER QUA	Delaware
PAR900015	SOIL REMEDIATION SYSTEMS INC	Delaware

PAG-10 General NPDES Permits for Discharges from Hydrostatic Testing of Tanks and Pipelines

PAG100036	WESTWAY TERMINAL CO LLC	Philadelphia

PAG-13 General NPDES Permits for MS4 Municipal Stormwater

PAG130071	MARCUS HOOK BORO DELAWARE CNTY	Delaware

The nonpoint source discharges in Zone 3 and 4 of the Delaware River include roads and parking lots (discharging hydrocarbons, heavy metals and road salt), lawns (discharging fertilizers, pesticides, pet waste), and other stormwater management facilities.

Discharges from point and nonpoint sources can adversely impact water quality and the aquatic community. For example, nutrients, like nitrogen and phosphorus, in "concentrations above natural background levels can lead to shifts in the algal community that can affect aquatic life and promote growth of excessive amounts of algae. Excessive algae growth (algal blooms) causes streams to be esthetically unpleasant as well as causing large biomass accumulations that lead to nocturnal oxygen depletion that can negatively affect fish and macroinvertebrates."[41]

Heated stormwater runoff from pavement and hard surfaces can wash in contaminants and cause thermal impacts to the River. Improper erosion and sedimentation controls on the land or exacerbated flooding due to impervious conditions causing bank downcutting and entrenchment and bank erosion during storms can lead to sediment pollution/TSS/turbidity and runoff that can further impact temperature in the water column and create possible adverse impacts to aquatic life. Maintenance dredging is also a source of sediment disturbance and potential disruption of contaminants present in the river bottom. Sedimentation has serious consequences for the benthic invertebrates and fish species whose vitality is crucial for healthy aquatic ecosystems. There have been documented reductions in benthic invertebrate densities, changes to the structure of aquatic communities, changes in fish foraging behavior, reductions in the availability of food, and increases in fish egg mortality rates.[42]

6. **Information regarding any of the qualifiers for designation as high quality waters (HQ) or exceptional value waters (EV) in §93.4b (relating to qualifying as High Quality or Exceptional Value waters) used as a basis for the requested designation**.

[41] USGS (2009). Nutrient Enrichment Study from the Upper, Middle, and Lower Sections of the Non-tidal Delaware River, p. 1 (available here: https://pubs.usgs.gov/ds/ds555/ds555.pdf).
[42] James Norman, et al., *Utility Stream Crossing Policy*, ETOWAH AQUATIC HABITAT CONSERVATION PLAN, July 13, 2008, at 9-10.

This section is not applicable to DRN's petition because DRN is not petitioning to upgrade Zones 3 and 4 of the Delaware River main stem to High Quality or Exceptional Value.

7. **A general description of land use and development patterns in the watershed. Examples include the amount or percentage of public lands (including ownership) and the amount or percentage of various land use types (such as residential, commercial, industrial, agricultural and the like).**

The city of Philadelphia is heavily developed. Approximately 50% of the city's land area is zoned for single-use residential buildings, 24% of the city's land area is zoned is industrial, 7.4% of the city's land area is zoned for mix-use commercial, and parks and open space cover about 13.5% of the city's zoned land area.[43]

The land use in the municipalities in Delaware County that border the Delaware River (Tinicum Township, Ridley Township, Eddystone Borough, Chester City, Trainer Borough, and Marcus Hook Borough) is largely industrial, commercial and/or residential. There are, however, a number of public lands, like Henry Johnson Park (Trainer Borough), Crozer Park (Chester City), and John Heinz National Wildlife Refuge (Tinicum Township) which provide great recreational opportunities for those citizens in the area.

8. **The names of all municipalities through which the watershed or segment flows, including an official contact name and address.**

Philadelphia County (1)
City of Philadelphia
James Kenney, Mayor
City Hall, Office 215
Philadelphia, PA, 19107

Delaware County (6)
Tinicum Township
David D Scheiber, Township Manager
629 N Governor Printz Blvd.
Tinicum Township, PA 19029

Ridley Township
Ed Pisani, Township Manager
100 MacDade Boulevard
Folsom, PA 19033

Eddystone Borough
Allen Reeves, Jr., Mayor
1300 East 12th Street
Eddystone, PA 19022

City of Chester
Thaddeus Kirkland, Mayor
1 E. 4th St.,
Chester, PA 19013

[43] See http://planphilly.com/articles/2015/09/11/what-percentage-of-philly-s-land-area-do-the-different-zoning-categories-cover. Further information on Philadelphia's land use can be found here: http://phila2035.org/wp-content/uploads/2011/06/summaryVision.pdf, see p. 9.

Trainer Borough
Fran Zalewski, Mayor
824 Main Street
Trainer, PA 19061

Marcus Hook Borough
Gene Taylor, Mayor
Municipal Building
10th and Green St.
Marcus Hook, PA 19061

Attachment 1

March 5, 2013

Commissioners
Delaware River Basin Commission
25 State Police Drive
P.O. Box 7360
West Trenton, NJ 08628-0360

Re: Petition by the Delaware Riverkeeper, the Delaware Riverkeeper Network, the Delaware River Shad Fishermen's Association and the Lehigh River Stocking Association, Inc., to:

1) immediately upgrade the designated uses of Zones 3, 4, and River Miles 78.8 to 70.0 of Zone 5 to include propagation of resident fish and other aquatic life;

2) immediately upgrade the designated uses of Zones 2 through 5 to include spawning and nursery habitat for anadromous fish; and

3) upgrade all applicable stream quality objectives necessary to preserve these uses; including setting immediate interim standards for dissolved oxygen and setting a 3 year time limit for the establishment of permanent dissolved oxygen and nutrient objectives.

Dear Commissioners:

The Delaware Riverkeeper, the Delaware Riverkeeper Network, the Delaware River Shad Fishermen's Association, and the Lehigh River Stocking Association, Inc., hereby petition the Delaware River Basin Commission (DRBC) to upgrade the designated use of Delaware River Estuary Zones 3, 4, and River Miles 78.8 to 70.0 of Zone 5 to include propagation of fish and other aquatic life. Data collected by the Public Service Electric and Gas Company (PSEG) clearly demonstrate the occurrence of fish propagation within these Zones of the Estuary. Additionally, the designated use of Zones 2 through 5 should be amended to include spawning and nursery habitat for anadromous fish. The propagation of anadromous fish in these Zones is demonstrated by the PSEG data as well as by recent research on the Atlantic sturgeon. As explained below, these upgrades in recognition of existing usage are necessary in order to effectuate the purposes of the Delaware River Basin Compact ("Compact") as well as DRBC's antidegradation policy for interstate waters. These upgrades will also bring DRBC into conformance with the antidegradation mandates of the Clean Water Act, thereby avoiding state, federal and/or interstate conflicts over the designated and existing uses of these Delaware River

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waters. Existing stream quality objectives (most importantly for dissolved oxygen) should be modified to accommodate and preserve the newly incorporated designated uses (collectively, "fish propagation uses"). In addition, DRBC should set immediate interim standards for dissolved oxygen and setting a 3 year time limit for the establishment of permanent dissolved oxygen and nutrient objectives.

While DRBC has undertaken a process to consider needed upgrades to the designated uses of Delaware Estuary waters and associated stream quality objectives, the 3 to 5 year trajectory for this consideration is unjustified and unnecessary in light of existing data documenting the current uses of Zones 2 thru 5. While additional knowledge may be justified for assessing some resulting stream quality objectives, an immediate upgrade in use designations and dissolved oxygen stream quality objectives are already supported and mandated by existing data, information, uses and water quality needs regarding aquatic life of the Delaware Estuary.

I. The Unification of Existing and Designated Uses Is Necessary to Effectuate the Purposes of the Compact as well as DRBC's Antidegradation Policy for Interstate Waters

Following the entry of a consent decree in New Jersey v. New York, 347 U.S. 995 (1954), the States of New York, New Jersey, Pennsylvania, and Delaware and the federal government negotiated the Compact, which entered into force in 1961. The Compact created the DRBC to conserve and manage the resources of the Delaware River. In forming the Compact, the parties agreed that "the conservation, utilization, development, management, and control of the water and related resources of the Delaware River Basin under a comprehensive multipurpose plan [would] bring the greatest benefits and produce the most efficient service in the public welfare." Compact, Second Whereas Clause (introducing a Comprehensive Plan). One such envisioned benefit was the propagation of fish and game. See Compact, Third Whereas Clause. Indeed, DRBC considers fish propagation benefits so significant that, rather than merely allowing such benefits to slowly accrue, DRBC actively seeks to safeguard fish resources in the Basin. Water Code § 2.200.1 ("The quality of Basin waters shall be maintained in a safe and satisfactory condition for…wildlife, fish and other aquatic life."); see also id. § 3.10.2.B.2.

In developing water quality standards, DRBC begins by setting designated uses for each zone. Stream quality objectives and effluent limitations are then developed using the designated uses as a baseline. Id. § 3.10.2.A ("Water uses shall be paramount in determining stream quality objectives which, in turn, shall be the basis for determining effluent quality requirements."); id. § 3.10.3.C ("It is the policy of the Commission to designate numerical stream quality objectives for the protection of aquatic life for the Delaware River Estuary and Bay (Zones 2 through 6) which correspond to the designated uses of each zone." (emphasis added)).

Because stream quality objectives and effluent limitations are calibrated to protect the designated, rather than actual, uses of each zone, existing uses will not receive protection unless those uses are formally adopted as designated uses. It is therefore necessary that DRBC 1) upgrade the designated uses of Zones 3, 4, and River Miles 78.8 to 70.0 of Zone 5 to include propagation of resident fish and other aquatic life, and 2) upgrade the designated uses of Zones 2 through 5 to include spawning and nursery habitat for anadromous fish.

Further, movement to upgrade the designated uses for these Zones would effectuate DRBC's antidegradation policy for interstate waters:

> It is the policy of the Commission to maintain the quality of interstate waters, where existing quality is better than the established stream quality objectives, unless it can be affirmatively demonstrated to the Commission that such change is justifiable as a result of necessary economic or social development or to improve significantly another body of water. In implementing this policy, the Commission will require the highest degree of waste treatment determined to be practicable. No change will be considered which would be injurious to any designated present or future use.

Id. § 3.10.3.A.1. As demonstrated by the actual occurrence of fish propagation, the waters of Estuary Zones 2 through 5 are necessarily of a quality sufficient to allow for resident and anadromous fish propagation. See Appendix A.[1] Yet as stated above, because stream quality objectives and effluent limitations are calibrated to protect the designated, rather than actual, uses of each zone, the existing quality of these Zones may only be protected by upgrading their designated use to include fish propagation. Significantly, neither need for "economic or social development" nor need to "improve significantly another body of water" exists to justify a degradation of water quality—as may occur under current water quality standards—in this instance. Certainly, neither the DRBC nor any other party has made an affirmative demonstration to that effect.

An upgrade in the designated uses of Zones 2 through 5 will also effectuate the purposes of the Compact:

> to promote interstate comity . . . to provide for cooperative planning and action by the signatory parties with respect to such water resources; and to apply the principle of equal and uniform treatment to all water users who are similarly situated and to all users of related facilities, without regard to established political boundaries.

Compact § 1.3(e); see also id. § 3.1 ("[The Commission] shall adopt and promote uniform and coordinated policies for water conservation, control, use and management in the basin."); id. Fifth Whereas Clause.

Under the Clean Water Act and its implementing regulations, "[s]tates . . . are responsible for reviewing, establishing, and revising water quality standards." 40 C.F.R. § 131.4. At minimum, each state's water quality standards must include "[u]se designations consistent with the

[1] Appendix A includes a series of tables documenting the presence of ichthyoplankton within the Delaware River Estuary. These tables are excerpted from the 2002-2004 PSEG Annual Reports. Public Service Enterprise Group, Biological Monitoring Program, 2002 Annual Report 4-74, 4-89 to 4-104; Public Service Enterprise Group, Biological Monitoring Program, 2003 Annual Report 4-73, 4-88 to 4-103; Public Service Enterprise Group, Biological Monitoring Program, 2004 Annual Report 4-74, 4-89 to 4-104.

provisions of sections 101(a)(2) and 303(c)(2) of the [Clean Water] Act"[2] as well as "[a]n antidegradation policy consistent with [40 C.F.R.] § 131.12."[3] 40 C.F.R. § 131.6(a), (d). "Where existing water quality standards specify designated uses less than those which are presently being attained, the State shall revise its standards to reflect the uses actually being attained." 40 C.F.R. § 131.10(i) (emphasis added).[4]

Insofar as the DRBC was created to help the Basin states work cooperatively to achieve their common goal of protecting the water resources of the Delaware River and tributary streams, and has increasingly helped the Basin states work cooperatively to achieve the mandates of federal law, upgrading the designated uses of these Delaware River waters so as to protect existing uses also ensures the Basin states are able to most effectively achieve the anti-degradation mandates of the federal Clean Water Act.

Although the Basin states presently defer to DRBC in setting water quality standards for the mainstem Delaware River and Bay,[5] if DRBC fails to upgrade the designated uses (and, as appropriate, associated stream quality objectives) for Zones 2 through 5, the Basin states must do so themselves for those portions of the Estuary and River within their state boundaries.[6] In so doing, the states may set divergent standards, thereby frustrating the purposes of the Compact as stated in Section 1.3(e). See WQR § 1.10.3.B ("Where applicable state standards require higher quality water than these Standards and Regulations, state standards will be controlling."). It is therefore imperative that DRBC upgrade the designated uses of Zones 2 through 5 to reflect their existing uses.

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[2] Section 101(a)(2) provides: "it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983." Section 303(c)(2)(A) provides: "Whenever the State revises or adopts a new standard, such revised or new standard shall be submitted to the Administrator. Such revised or new water quality standard shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act [33 USCS §§ 1251 et seq.]. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation."

[3] 40 C.F.R. § 131.12(a) provides, in relevant part: "The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following: (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected."

[4] States must further "adopt those water quality criteria that protect the designated use." 40 C.F.R. § 131.11(a).

[5] See 7-7000-7401 Del. Admin. Code § 4.4; N.J. Admin. Code § 7:9B-1.13(a); id. § 7:9B-1.14(h); id. § 7:9B-1.15(a); 25 Pa. Code § 93.2(b); id. § 93.9(b).

[6] 40 C.F.R. § 131.10(i); see also 7-7000-7401 Del. Admin. Code § 5.1; N.J. Admin. Code § 7:9B-1.5(d)(1); id. § 7:9B-1.11(e); 25 Pa. Code § 93.4a(b); 25 Pa. Code § 93.4c(a)(1)(i).

II. Designated and Existing Uses of DRBC Zones 2 Through 5

A. Designated Uses Exclude Propagation of Resident and / or Anadromous Fish

The DRBC has designated the following uses in Zones 2 through 5:

Table 1: Designated Uses by Zone

DRBC Zone	Corresponding River Miles	Water Uses to be Protected (Designated Use)
2	133.4 – 108.4	Maintenance and propagation of resident fish and other aquatic life; passage of anadromous fish; wildlife
3	108.4 – 95.0	Maintenance of resident fish and other aquatic life; passage of anadromous fish; wildlife
4	95.0 – 78.8	Maintenance of resident fish and other aquatic life; passage of anadromous fish; wildlife
5	78.8 – 48.2	Maintenance of resident fish and other aquatic life; propagation of resident fish from R.M. 70.0 to R.M. 48.2; passage of anadromous fish; wildlife

WQR §§ 3.30.2 – 3.30.5. Fish propagation is excluded as a designated use in Zones 3, 4, and River Miles 78.8 – 70.0 of Zone 5. Moreover, River Miles 70.0 – 48.2 of Zone 5 are designated for the propagation of resident fish only; propagation of anadromous fish is omitted. Indeed, no portion of Zones 2 through 5 is designated as spawning and nursery habitat for anadromous fish.

B. Fish Propagation Is an Existing Use Throughout Zones 2 Through 5

Since 1995, PSEG of New Jersey has conducted ongoing ecological monitoring as required under a condition of the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for the discharge of cooling water from the Salem Generating Station. Public Service Electric and Gas, Biological Monitoring Program, 2002 Annual Report 1-1. The 2001 renewal of the Salem Generating Station NJPDES permit provided for continuation and expansion of these studies. Id. Between 2002 and 2004, PSEG collected detailed data on ichthyoplankton abundance in the Delaware River Estuary, clearly demonstrating the occurrence of fish propagation within Delaware River Estuary Zones 2 through 5.[7] Because the period from 2002

[7] PSEG has chosen to divide the Delaware River Basin into different zones than the ones used by the DRBC. DRBC Zone 2 includes PSEG Zones 13, 14, and a section of Zone 12. DRBC Zone 3 includes sections of PSEG Zones 11 and 12. DRBC Zone 4 includes PSEG Zone 10 and sections of Zones 9 and 11. DRBC Zone 5 includes PSEG Zone 8 and sections of Zones 7 and 9. DRBC river miles 70.0 – 78.8 correspond to sections of PSEG Zones 8 and 9. Compare Public Service Enterprise Group, Biological Monitoring Program, 2004 Annual Report 4-105 (providing map of PSEG Zones and also displaying major tributaries to the Delaware River), with River Mileage System, DRBC, http://www.state.nj.us/drbc/basin/river/ (last updated Oct. 28, 2011) (displaying selected river miles on map of Delaware River including major tributaries), and Map Depicting Delaware River Main Stem Interstate Water Quality Zones, DRBC, http://www.state.nj.us/drbc/library/documents/maps/InterstateZones-MainStem.pdf (last visited Aug. 16, 2012) (displaying DRBC Zones and associated River Miles); see also River Mileage System Spreadsheet, DRBC, http://www.state.nj.us/drbc/library/documents/StreamMileageJuly2007.pdf (last visited Aug.

to 2004 is representative of Estuary water quality throughout the last decade,[8] the ichthyoplankton data collected during those years consequently provides a representative depiction of fish propagation in the Delaware River Basin over the last decade.

The data collected by PSEG show that multiple species, including striped bass, white perch, American shad, and other *Alosa* spp., were consistently propagating within the Delaware River Basin during 2002, 2003, and 2004. Eggs, yolk sac larvae, and post-yolk sac larvae of these species were, with minor exceptions, present in all relevant DRBC Zones during this three-year period. Other species propagating within the Estuary include alewife, Atlantic menhaden, and *Morone* spp. Post-yolk sac larvae were collected for the Atlantic menhaden and *Morone* spp. in all three years. Atlantic menhaden eggs were collected in 2003. Further, yolk sac larvae and post-yolk sac larvae were found for the Atlantic silverside in all three years. Because several of the species surveyed by PSEG are anadromous, the PSEG dataset supports upgrades in designated use to both propagation of resident fish and other aquatic life, and spawning and nursery habitat for anadromous fish. See Appendix A; Table 2.

16, 2012) (listing major and minor tributaries as well as other features and providing corresponding river mileage for each).

[8] See Appendix B for documentation of mean dissolved oxygen levels by year. These graphs are excerpted from PSEG Annual Reports between 2000 and 2009 (2000, p. 5-17; 2001, p. 5-24; 2002, p. 5-26; 2003, p. 5-25; 2004, p. 5-25; 2005, p. 5-26; 2006, p. 5-22; 2007, p. 5-22; 2008, p. 5-26; 2009, p. 5-29). Dissolved oxygen levels may be used as a proxy for overall water quality. All PSEG Annual Reports are included on the DVD enclosed with this petition.

Table 2: Evidence of Propagation by Species and PSEG Zone

	2002								2003								2004							
	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14
Alewife	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Alosa spp.			X	X	X	X	X	X			X	X	X	X	X	X	X		X	X	X	X	X	X
Amer. shad			X	X	X	X	X	X			X	X	X	X	X	X			X	X	X	X	X	X
Atl. croaker			X																					
Atl. menhaden	X	X	X	X	X	X		X	X			X	X				X	X	X	X	X	X		
Atl. silverside	X	X	X						X	X	X		X				X	X	X					
Bay anchovy	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Blueback herring								X			X			X										
Bluefish																								
Clupeidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Morone spp.	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X
Spot																								
Striped bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weakfish	X	X		X					X	X		X					X	X				X		
White perch	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X – Eggs, yolk sac larvae, post-yolk sac larvae, and/or undetermined larvae detected
* All data drawn from PSEG-generated tables provided in Appendix A

Additional data demonstrate that the anadromous Atlantic sturgeon is also spawning in the Delaware River. Delaware Department of Natural Resources and Environmental Control (DNREC) personnel captured thirty-four young-of-year Atlantic sturgeon during the fall of 2009. Proposed Listing Determinations for Three Distinct Population Segments of Atlantic sturgeon in the Northeast Region, 75 Fed. Reg. 61,872, 61,875 (proposed Oct. 6, 2010) (to be codified at 50 C.F.R. pts. 223-24).[9] Moreover, researchers have noted the existence of a haplotype unique to Atlantic sturgeon spawned in the Delaware River.[10] This haplotype could not have survived absent the persistence of Atlantic sturgeon reproduction in the Delaware River. Although Atlantic sturgeon eggs have not yet been detected, suitable spawning habitat (requiring freshwater and a hardbottom substrate) exists between Marcus Hook (rm 78) and Tinicum Island (rm 85) as well as between Tinicum Island and the mouth of the Schuylkill River (rm 92); suitable habitat is also believed to exist between the mouth of the Schuylkill and Trenton (rm 131).[11] Available tracking data on juvenile and adult Atlantic sturgeon establishes the Marcus Hook area as critical nursery habitat and a likely spawning site.[12]

In sum, the PSEG dataset and recent Atlantic sturgeon data together demonstrate that resident and anadromous fish are propagating throughout Zones 2 through 5 of the Estuary and therefore support an upgrade to the designated uses for those Zones.

III. The Dissolved Oxygen Stream Quality Objectives for Zones 2 Through 5 Are Insufficiently Protective of Fish Propagation Uses and Must Be Revised to Reflect a 24-hour Minimum of 6.5 mg/l

Because stream quality objectives are calibrated to protect designated rather than actual uses, DRBC must reevaluate all presently enumerated stream quality objectives for Zones 2 through 5 in conjunction with upgrading their designated uses to include 1) propagation of resident fish and other aquatic life, and 2) spawning and nursery habitat for anadromous fish. Although all stream quality objectives should be reviewed, data suggests that the dissolved oxygen stream quality objectives in particular are inadequately protective.

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[9] The final rule listing the New York Bight Distinct Population Segment of Atlantic sturgeon as endangered was published in February 2012. Threatened and Endangered Status for Distinct Population Segments of Atlantic sturgeon in the Northeast Region, 77 Fed. Reg. 5880 (Feb. 6, 2012) (codified at 50 C.F.R. pts. 223-24).

[10] Delaware DNREC, Award No. NAI0NMF4720030, Semi-annual Progress Report 28 (June 2011); Matthew Fisher, Delaware DNREC, Atlantic Sturgeon Final Report: State Wildlife Grant, Project T-4-1 10 (2011); Dewayne A. Fox & Matthew W. Breece, Del. State Univ., NOAA Award NA08NMF4050611, Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) in the New York Bight DPS: Identification of Critical Habitat and Rates of Interbasin Exchange 13 (2010).

[11] See Philip C. Simpson & Dewayne A. Fox, Del. State Univ., Completion Report: Award NA05NMF4051093, Atlantic sturgeon in the Delaware River: Contemporary Population Status and Identification of Spawning Areas (2006).

[12] See Fisher, supra note 10, at 15-16 (noting usage of Marcus Hook by late stage juveniles); Fox & Breece, supra note 10, at 25, 29-30 (suggesting spawning in the vicinity of Marcus Hook may have been overlooked); Delaware DNREC, Award No. NAI0NMF4720030, Semi-annual Progress Report 3 (Jan. 2012) (noting capture of 48 young-of-year at Marcus Hook).

Table 3: Dissolved Oxygen Stream Quality Objectives by Zone

DRBC Zone	Corresponding River Miles	Dissolved Oxygen Stream Quality Objective
2	133.4 – 108.4	24-hour average concentration shall not be less than 5.0 mg/l; during the periods from April 1 to June 15, and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l.
3	108.4 – 95.0	24-hour average concentration shall not be less than 3.5 mg/l; during the periods from April 1 to June 15, and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l.
4	95.0 – 78.8	24-hour average concentration shall not be less than 3.5 mg/l; during the periods from April 1 to June 15, and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l.
5	78.8 – 48.2	24-hour average concentration shall not be less than 1) 3.5 mg/l at R.M. 78.8, 2) 4.5 mg/l at R.M. 70.0, and 3) 6.0 mg/l at R.M. 59.5; during the periods from April 1 to June 15, and September 16 to December 31, the dissolved oxygen shall not have a seasonal average less than 6.5 mg/l in the entire zone.

WQR §§ 3.30.2 – 3.30.5. The present limits set for Zones 3 through 5 permit 24-hour average concentrations of 3.5 mg/l. However, low dissolved oxygen levels are known to significantly affect fish populations, reducing growth and increasing mortality rates. Ichthyoplankton and juveniles are particularly vulnerable to these effects, necessitating an increase in minimally acceptable dissolved oxygen concentration limits to accommodate fish propagation uses. See, e.g., David H. Secor & Troy E. Gunderson, Effects of Hypoxia and Temperature on Survival, Growth, and Respiration of Juvenile Atlantic Surgeon, Acipenser oxyrinchus, 96 Fishery Bulletin 603 (1998) (indicating high mortality in juveniles exposed to low dissolved oxygen levels (~3.0 mg/l), particularly in association with higher temperatures (~26ºC)); Atl. States Marine Fisheries Comm'n, Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring (River Herring Management) 7-24 (2009) (indicating 5.0 mg/l as minimum dissolved oxygen level tolerable by several alewife life-stages). The minimally acceptable 24-hour average concentration throughout Zones 2 through 5 should be revised upward to 6.5 mg/l so as to adequately preserve fish propagation uses.

While the DRBC may want to embark a more detailed scientific analysis for setting permanent dissolved oxygen objectives, an interim standard should be immediately set. The minimum interim standard should be a minimum 5.0 mg/l. This will ensure that all dockets under consideration during the more rigorous analysis for the setting of a permanent objective are achieving a more realistic standard for the protection and propagation of resident and anadromous species and will give present and future dischargers notice that needed upgrades should be anticipated, planned for and installed as soon as possible.

Conclusion

For the foregoing reasons, the Delaware Riverkeeper, the Delaware Riverkeeper Network, the Delaware River Shad Fishermen's Association, and the Lehigh River Stocking Association, Inc., petition DRBC to 1) immediately upgrade the designated uses of Zones 3, 4, and River Miles 78.8 to 70.0 of Zone 5 to include propagation of resident fish and other aquatic life, 2) immediately upgrade the designated uses of Zones 2 through 5 to include spawning and nursery habitat for anadromous fish, and 3) upgrade all applicable stream quality objectives necessary to preserve these uses; including setting immediate interim standards for dissolved oxygen and setting a 3 year time limit for the establishment of permanent dissolved oxygen and nutrient objectives.

Thank you for your consideration of this petition.

Sincerely,

Maya K. van Rossum, the Delaware Riverkeeper, Delaware Riverkeeper Network
Charles Furst, President, Delaware River Shad Fishermen's Association
Matt MacConnell, President, Lehigh River Stocking Association

encl.

Appendix A

2002 PSEG Data 1

2003 PSEG Data 19

2004 PSEG Data 37

2002 PSEG Data

Table 4-31
PSEG Estuary Enhancement Program
Total abundance of ichthyoplankton and macrozooplankton target species collected by zone,
April-July 2002

Species (Taxon)	All Zones	Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Alewife	9,416	0	0	0	0	24	2	12	420	806	1,313	1,520	3,971	1,185	163
Alosa spp.	7,595	0	0	0	0	0	0	0	0	15	164	1,522	4,270	622	1,002
American Shad	3,402	0	0	0	0	248	0	0	0	206	235	186	587	1,832	108
Atlantic Croaker	398	0	0	32	0	6	77	129	107	34	12	1	0	0	0
Atlantic Menhaden	54,935	27,476	19,912	5,979	757	244	122	139	54	171	31	12	36	0	2
Atlantic Silverside	2,178	33	314	463	796	294	78	154	44	2	0	0	0	0	0
Bay Anchovy	1,559,283	622,648	187,411	229,712	460,652	25,231	31,439	1,769	223	170	18	1	8	1	0
Blueback Herring	9	0	0	0	0	0	0	0	1	0	5	0	1	1	1
Bluefish	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Clupeidae	13,310	210	0	10	0	100	10	60	481	3,264	2,593	1,109	783	3,160	1,530
Morone spp.	9,800	0	0	0	0	0	339	622	702	1,553	3,886	1,315	1,079	303	1
Spot	8	1	6	0	0	0	0	1	0	0	0	0	0	0	0
Striped Bass	62,365	0	0	0	0	82	1,414	3,139	15,388	40,294	1,657	75	54	261	1
Weakfish	252,079	108,015	115,672	22,272	5,350	355	379	34	1	0	1	0	0	0	0
White Perch	51,406	0	2	0	0	2,841	5	116	934	4,315	8,081	12,179	13,059	5,359	4,515
Total Ichthyoplankton	2,026,186	758,384	323,317	258,468	467,556	29,425	33,865	6,175	18,355	50,830	17,996	17,920	23,848	12,724	7,323
Gammarus spp.	1,402,330	5,721	18,978	40,376	27,676	53,968	6,987	38,483	148,450	286,162	327,735	161,421	122,040	103,442	60,891
Neomysis americana	16,374,338	4,197,218	1,835,105	6,128,577	1,994,753	1,887,271	174,046	134,028	22,241	984	8	5	57	30	15

2

Table 4-39 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.91	0.00	0.00	0.00	15.26	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	18.14	114.68	6.90	12.94	7.17	3.40	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.65	57.41	11.47	0.00	2.63	42.02	3.66	0.00	0.00
juvenile	4.15	3.55	0.00	11.46	10.11	2.45	3.76	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07
yolk sac larvae	6.80	0.00	0.00	13.02	0.00	3.54	29.38	8.45	0.00
post-yolk sac larvae	13.32	0.00	1.49	4.70	2.34	32.30	21.74	43.35	3.56
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	6.65	0.00	0.00	0.00	24.47	0.00	0.00	27.51	1.19
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	166.49	0.00	3.90	0.00	0.00	227.49	510.47	370.01	220.07
juvenile	15.20	3.86	3.90	0.00	0.00	0.00	49.87	16.67	47.27
adult	18.63	41.52	34.00	25.85	42.84	0.00	3.66	0.00	1.19
undetermined larvae	26.19	0.00	0.00	0.00	0.00	0.00	0.00	209.48	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.14	0.00	0.00	1.14	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.35	0.00	0.00	2.30	6.52	17.16	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	5.51	0.00	0.00	7.11	25.98	11.03	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	86.37	0.00	0.00	661.76	2.26	26.97	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.14	0.00	0.00	1.14	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	22.81	5.92	5.01	134.24	36.22	1.08	0.00	0.00	0.00
yolk sac larvae	82.03	2.37	7.99	323.21	320.40	2.31	0.00	0.00	0.00
post-yolk sac larvae	317.59	0.00	0.00	236.32	1,809.49	490.31	4.62	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	37.75	0.00	0.00	0.00	302.03	0.00	0.00	0.00	0.00
Weakfish									
egg	0.14	0.00	0.00	0.00	1.13	0.00	0.00	0.00	0.00
yolk sac larvae	0.28	0.00	0.00	0.00	2.26	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.89	0.00	0.00	0.00	0.00	1.09	6.03	0.00	0.00
juvenile	2.93	2.89	0.00	0.00	0.00	0.00	20.56	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.64	1.18	0.00	5.74	6.17	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.78	0.00	0.00	1.14	7.67	105.65	3.76	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	869	233	75	1,442	2,625	967	658	675	274
***Gammarus* spp.**	5,257	2,736	221	7,106	15,039	5,612	9,608	1,162	572
Neomysis americana	18,395	8,808	26,684	2,249	67,371	1,671	13,674	17,079	9,625

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-40 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	107.71	0.00	4.08	8.37	839.58	9.65	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	29.47	40.51	172.09	4.18	7.01	9.91	2.06	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	12.70	29.11	58.02	0.00	0.00	2.21	12.24	0.00	0.00
juvenile	1.94	0.00	0.00	6.28	4.67	2.48	2.06	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	4.18	2.28	0.00	2.58	0.00	0.00	2.06	10.45	16.88
post-yolk sac larvae	6.70	0.00	8.47	2.09	0.00	0.00	16.31	17.12	9.64
juvenile	0.82	0.00	6.58	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.51	0.00	17.55	0.00	0.00	0.00	65.12	119.28	146.16
juvenile	15.17	0.00	38.58	0.00	0.00	0.00	20.48	2.07	60.23
adult	3.01	4.56	7.56	11.93	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.29	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	18.61	0.00	0.00	9.99	131.97	6.91	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	112.32	0.00	0.00	0.00	652.81	245.74	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	207.54	0.00	0.00	0.00	615.88	1,044.43	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	2,111.79	34.46	227.75	16,437.24	194.90	0.00	0.00	0.00	0.00
yolk sac larvae	1,682.94	2.28	983.27	11,685.59	792.38	0.00	0.00	0.00	0.00
post-yolk sac larvae	208.66	0.00	7.86	495.62	935.02	193.72	37.05	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.41
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	34.23	32.18	61.42	129.06	48.98	2.21	0.00	0.00	0.00
post-yolk sac larvae	218.65	0.00	10.36	15.80	861.61	842.98	18.42	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.58	0.00	0.00	0.00	4.67	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	4,821	148	1,604	28,809	5,089	2,360	176	149	235
***Gammarus* spp.**	40,420	2,040	23,397	20,899	75,881	135,009	35,174	12,113	18,849
Neomysis americana	6,391	53	63	230	65	263	22	15,918	34,509

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-41 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.11	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	89.26	2.52	21.26	75.56	515.45	79.28	19.17	0.87	0.00
juvenile	0.22	0.00	0.00	0.00	0.00	0.00	0.88	0.87	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.72	0.00	5.75	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.45	0.00	0.00	0.00	0.00	0.00	0.00	3.56	0.00
juvenile	0.43	0.00	0.00	0.00	0.00	0.00	0.00	3.45	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.22	0.00	0.00	0.00	1.76	0.00	0.00	0.00	0.00
yolk sac larvae	15.61	0.00	0.00	0.00	0.00	124.92	0.00	0.00	0.00
post-yolk sac larvae	5.50	0.00	0.00	0.00	0.00	44.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	3.48	0.83	10.76	10.89	3.78	0.84	0.75	0.00	0.00
adult	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	15.39	9.13	63.32	1.83	0.00	35.78	12.09	0.95	0.00
juvenile	2.56	0.00	0.00	4.35	8.56	0.00	1.48	6.09	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.18	0.00	0.00	0.00	0.00	0.00	1.48	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.81	0.00	0.00	0.00	0.00	0.00	5.94	15.77	72.79
juvenile	6.46	0.00	0.00	0.00	0.00	0.00	5.16	0.00	46.56
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	64.93	0.85	4.08	324.58	134.45	59.26	7.65	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	291.44	0.00	0.81	362.67	1,380.64	587.37	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	164.20	0.00	0.00	439.18	287.32	579.28	1.75	6.03	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	2,724.59	9.91	290.49	21,200.22	294.33	1.75	0.00	0.00	0.00
yolk sac larvae	1,437.35	0.00	6,272.87	4,465.36	759.66	0.89	0.00	0.00	0.00
post-yolk sac larvae	233.00	0.00	18.95	699.48	968.38	146.53	61.56	3.41	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	46.32	0.00	0.00	0.00	370.59	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	5.54	29.92	0.81	7.97	5.59	0.00	0.00	0.00	0.00
yolk sac larvae	41.32	59.23	63.31	122.40	66.69	18.88	0.00	0.00	0.00
post-yolk sac larvae	412.92	0.00	155.68	255.37	491.29	2,092.69	247.35	60.02	0.92
juvenile	0.21	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	5,575	113	6,911	27,970	5,288	3,771	365	102	121
***Gammarus* spp.**	31,177	344	9,596	42,369	73,441	72,400	26,912	11,301	13,050
Neomysis americana	108	0	11	0	2	3	1	0	846

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-42 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	148.02	0.93	121.50	523.93	313.12	172.65	22.41	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	3.71	4.53	16.13	5.39	2.90	0.00	0.00	0.00	0.00
yolk sac larvae	14.53	0.00	33.74	55.04	24.53	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.02	0.00	0.00	0.00	0.00	0.00	7.96	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.13	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	12.15	0.00	0.00	0.00	26.04	66.77	0.00	1.92	0.00
post-yolk sac larvae	13.68	0.00	0.00	8.52	38.76	41.86	2.65	9.25	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.12	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.42	0.00	2.79	3.24	1.96	0.85	0.00	1.91	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.04	0.72	16.51	0.96	3.75	0.00	1.80	0.00	0.00
juvenile	0.56	0.00	0.00	0.00	0.00	0.00	0.00	4.39	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.66	0.00	0.00	0.00	0.00	5.17	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.05	0.00	0.00	0.00	0.00	0.00	0.88	1.79	6.88
juvenile	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.88	2.24
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.58	0.00	0.00	0.00	0.00	1.65	0.00	2.86	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	29.87	0.72	17.05	22.00	7.26	172.83	8.94	8.40	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	248.38	0.00	0.00	476.68	365.28	1,045.83	0.00	2.82	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.64	0.00	0.00	12.79	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	428.68	0.00	0.00	140.35	1,523.19	1,680.19	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	11.81	1.72	0.00	83.19	7.22	0.00	0.00	0.00	0.00
yolk sac larvae	5.21	0.00	31.57	5.39	1.94	0.00	1.76	0.00	0.00
post-yolk sac larvae	124.96	0.00	15.43	140.56	489.99	323.99	4.68	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	46.63	0.00	0.00	0.00	363.72	0.00	0.00	0.00	0.00
Weakfish									
egg	0.11	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	31.91	72.45	4.69	128.26	37.48	6.05	0.00	0.00	0.00
yolk sac larvae	67.08	32.14	280.52	76.60	97.37	33.75	2.84	0.00	0.00
post-yolk sac larvae	836.10	0.00	543.80	211.97	3,562.74	1,586.83	477.57	137.76	1.12
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.09	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,034	114	1,084	1,897	6,867	5,139	532	173	10
***Gammarus* spp.**	37,561	279	28,261	20,251	105,818	42,128	33,840	48,501	17,369
Neomysis americana	1	0	0	0	0	3	0	3	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-43 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.10	0.00	0.00	0.00	8.81	0.00	0.00	0.00	0.00
post-yolk sac larvae	164.16	1.85	1,019.88	63.55	14.21	189.62	17.50	6.69	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.64	0.00	0.00	0.00	21.14	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	53.05	5.90	270.24	144.06	2.60	1.61	0.00	0.00	0.00
yolk sac larvae	103.16	0.00	710.45	53.48	51.50	9.85	0.00	0.00	0.00
post-yolk sac larvae	13.32	0.00	0.00	0.00	83.07	0.00	23.52	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	3.84	0.00	0.00	0.00	30.72	0.00	0.00	0.00	0.00
yolk sac larvae	7.43	0.00	1.84	3.39	0.88	53.34	0.00	0.00	0.00
post-yolk sac larvae	7.72	0.00	1.86	25.03	5.16	28.77	0.00	0.96	0.00
juvenile	0.11	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.21	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.11	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.98	3.53	4.32	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.36	0.00	0.00	0.00	0.00	0.00	0.00	2.87	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	2.53	0.00	0.00	0.00	20.26	0.00	0.00	0.00	0.00
post-yolk sac larvae	13.66	0.00	8.66	1.65	3.55	63.09	13.37	18.12	0.86
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	97.61	0.00	2.45	247.29	205.51	290.17	0.00	3.83	1.71
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	48.48	0.00	0.00	0.00	0.00	387.83	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	86.65	0.00	0.00	263.51	0.00	429.69	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.68	2.59	0.00	1.71	5.23	3.94	0.00	0.00	0.00
yolk sac larvae	0.53	0.00	0.00	0.00	1.74	1.64	0.85	0.00	0.00
post-yolk sac larvae	5.80	0.00	3.65	21.11	11.01	4.93	0.00	5.68	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	59.86	73.73	8.35	322.06	48.55	26.21	0.00	0.00	0.00
yolk sac larvae	121.15	27.43	602.28	16.71	252.13	63.84	6.79	0.00	0.00
post-yolk sac larvae	1,056.64	2.90	1,208.16	309.89	627.21	6,061.54	107.66	134.88	0.86
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	30.93	0.00	0.00	2.46	244.97	0.00	0.00	0.00	0.00
Total IP	1,884	118	3,843	1,478	1,639	7,616	170	173	4
***Gammarus* spp.**	17,688	226	6,505	27,186	17,182	21,073	9,048	35,832	24,455
Neomysis americana	1	0	0	1	4	0	0	0	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-44 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.46	0.00	0.00	12.01	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	428.22	0.68	3,005.00	14.46	273.29	201.18	15.82	0.97	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	181.19	159.69	501.05	813.67	11.37	0.00	0.00	0.00	0.00
yolk sac larvae	256.94	3.22	1,788.97	28.11	278.24	8.39	0.00	0.00	0.00
post-yolk sac larvae	19.19	0.00	0.00	0.00	149.82	0.00	3.55	3.96	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	5.13	17.47	13.81	0.00	10.78	0.00	0.00	0.00	0.00
yolk sac larvae	7.96	0.00	20.88	17.28	27.11	0.00	0.00	0.00	0.00
post-yolk sac larvae	46.75	0.00	99.70	206.15	34.61	39.10	0.00	5.28	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.59	0.00	0.00	21.26	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.30	0.00	0.00	0.00	0.00	35.28	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.83	0.00	0.00	0.00	0.00	0.00	0.89	0.74	4.35
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	21.50	0.00	0.00	0.00	76.76	44.04	30.21	6.26	17.27
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	62.53	0.00	0.00	12.06	271.17	226.77	0.00	2.74	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	123.89	0.00	0.00	99.10	630.65	286.16	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.55	0.00	9.39	0.86	2.46	0.00	0.00	0.00	0.00
yolk sac larvae	1.07	0.00	6.13	0.00	0.00	0.00	2.66	0.00	0.00
post-yolk sac larvae	3.14	0.00	0.00	2.56	1.63	18.92	2.66	0.00	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	208.49	465.31	64.08	1,087.85	92.38	0.00	0.00	0.00	0.00
yolk sac larvae	210.20	215.45	827.35	31.95	403.03	244.07	1.78	0.00	0.00
post-yolk sac larvae	1,009.17	0.00	2,619.90	174.91	2,539.05	2,017.48	734.86	186.31	2.21
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,596	862	8,956	2,522	4,802	3,121	794	206	25
***Gammarus* spp.**	12,881	63	3,610	19,525	10,469	1,609	8,185	37,121	20,869
Neomysis americana	7	0	0	0	0	53	0	3	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-45 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	128.71	0.95	700.15	1.61	86.00	220.23	11.26	8.92	9.06
juvenile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.57	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	6.41	11.60	10.47	0.00	0.00	29.17	0.00	0.00	0.00
yolk sac larvae	61.63	5.21	417.04	38.94	0.00	31.00	0.84	0.00	0.00
post-yolk sac larvae	0.46	0.00	0.00	0.00	0.00	0.00	3.66	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	15.96	0.00	117.97	0.00	5.38	4.32	0.00	0.00	0.00
yolk sac larvae	30.43	0.00	201.12	16.71	14.71	10.91	0.00	0.00	0.00
post-yolk sac larvae	153.90	0.00	847.10	153.97	146.09	78.25	0.00	5.77	0.00
juvenile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.62	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	3.46	0.00	0.00	0.00	0.00	27.67	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	88.50	0.00	38.10	0.00	669.88	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.03	0.00	41.08	0.00	145.55	100.18	32.95	5.48	31.01
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	207.96	0.00	19.13	0.00	202.70	1,429.00	5.75	7.10	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	32.72	0.00	0.00	0.00	0.00	261.75	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.33	0.00	0.00	0.80	1.82	0.00	0.00	0.00	0.00
yolk sac larvae	25.34	0.00	0.00	202.68	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.52	0.00	0.00	0.00	0.00	1.72	1.64	0.83	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	32.05	8.70	2.73	2.63	14.94	227.44	0.00	0.00	0.00
yolk sac larvae	302.72	13.43	324.64	52.93	1,712.02	314.69	1.62	0.00	0.00
post-yolk sac larvae	251.45	0.00	939.96	7.57	199.01	662.85	122.21	78.50	1.51
juvenile	0.42	0.00	0.00	0.00	0.00	0.00	0.00	3.33	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,387	40	3,659	478	3,198	3,399	180	115	42
***Gammarus* spp.**	10,254	70	491	2,349	3,073	13,273	5,673	28,595	28,509
Neomysis americana	3	0	0	3	17	0	0	1	2

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

Table 4-46 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	17.26	0.00	58.20	0.00	49.95	21.47	1.71	2.59	4.19
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	45.50	15.63	348.34	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	57.77	0.00	174.07	22.27	182.85	82.95	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.73	0.00	1.79	0.80	3.28	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.01	0.00	60.01	10.72	0.00	16.40	0.00	0.91	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.20	0.00	0.78	0.80	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	13.37	0.00	105.28	0.00	1.70	0.00	0.00	0.00	0.00
post-yolk sac larvae	31.28	0.00	25.42	0.00	183.95	7.07	0.00	1.83	32.81
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	116.88	0.00	0.00	0.00	749.24	184.20	0.00	1.60	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	226.20	28.66	0.00	0.00	1,780.93	0.00	0.00	0.00	0.00
yolk sac larvae	260.00	13.41	77.55	260.63	1,394.46	333.95	0.00	0.00	0.00
post-yolk sac larvae	3.35	0.00	8.94	0.00	0.00	4.87	6.02	6.09	0.85
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	784	58	860	295	4,347	651	10	14	38
***Gammarus* spp.**	6,677	152	142	2,862	1,182	2,128	38,793	4,328	3,825
Neomysis americana	2	0	0	4	5	3	0	0	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not he total across each row.

2003 PSEG Data

Table 4-31
PSEG Estuary Enhancement Program
Total abundance of ichthyoplankton and macrozooplankton target species collected by zone,
April-July 2003

Species (Taxon)	All Zones	Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Alewife	18,803	0	0	1	0	0	1	4	339	1,205	2,368	4,191	4,624	4,755	1,315
Alosa spp.	13,536	0	0	0	0	0	0	0	0	75	566	4,157	2,138	3,284	3,316
American Shad	5,412	0	0	1	0	0	0	0	0	29	58	730	1,888	2,357	349
Atlantic Croaker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Menhaden	20,387	15,672	2,532	1,108	1,028	17	10	1	0	0	1	18	0	0	0
Atlantic Silverside	182	9	20	10	33	72	31	2	2	2	0	1	0	0	0
Bay Anchovy	1,633,701	793,044	457,387	184,678	162,628	13,390	4,519	877	16,820	334	13	5	1	2	3
Blueback Herring	143	0	0	0	0	0	1	1	0	52	4	56	20	2	7
Bluefish	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Clupeidae	15,295	19	14	19	0	2	4	24	1,314	1,737	2,399	3,073	2,837	2,409	1,444
Morone spp.	139,869	0	0	0	0	2	33	438	135,386	2,629	872	377	102	4	26
Spot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped Bass	238,493	0	0	0	0	30	98	2,640	229,043	3,393	2,299	863	106	15	6
Weakfish	7,886	4,346	1,220	894	409	729	154	101	32	0	1	0	0	0	0
White Perch	78,028	0	0	0	0	0	0	93	58,624	3,425	4,586	5,482	3,651	1,025	1,142
Total Ichthyoplankton	2,171,736	813,090	461,173	186,711	164,099	14,242	4,851	4,181	441,560	12,881	13,167	18,953	15,367	13,853	7,608
Gammarus spp.	4,579,228	7,758	42,441	117,231	8,055	14,154	152,085	718,923	1,149,274	1,124,586	455,517	331,142	345,261	72,103	40,698
Neomysis americana	16,894,133	2,911,771	3,302,514	2,976,626	2,063,021	2,208,869	3,009,064	356,871	59,900	2,076	24	32	63	3,199	103

Table 4-39 (page 13 of 28)

PSEG Estuary Enhancement Program

Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.58	0.00	0.00	0 00	4.62	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0 00	1.05	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0 00	0.00	0.00	1.02	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.13	0.00	0.00	0 00	0.00	0.00	1.07	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.12	0.00	0.00	0 00	0.00	0.98	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	113.13	0.00	0.00	0 00	0.00	0.00	0.00	221.16	683.86
juvenile	0.65	0.00	0.00	0 00	0.00	0.98	0.00	0.00	4.23
adult	1.23	0.00	0.00	2.16	5.62	0.98	0.00	0.00	1.07
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.12	0.00	0.00	0 00	0.00	0.00	0.98	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 14 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.28	0.00	0.00	0 00	0.00	2.21	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.48	0.00	0.00	3 82	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.30	0.00	0.00	0 00	0.00	17.67	0.00	72.74	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	65.03	0.00	0.00	517.90	0.00	2.33	0.00	0.00	0.00
yolk sac larvae	156.75	0.00	0.00	1,216.26	36.85	0.00	0.93	0.00	0.00
post-yolk sac larvae	110.79	0.00	0.00	0 00	404.35	163.13	69.19	247.33	2.31
juvenile	1.95	0.00	0.00	0 00	0.00	0.00	1.07	7.56	6.94
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.77	0.00	0.00	0 00	0.00	0.00	0.00	0.00	94.15
juvenile	2.21	0.00	0.00	0 00	0.00	0.00	0.00	0.00	17.65
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	2.77	0.00	0.00	22.14	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	9.24	0.00	0.00	17.57	2.38	44.71	4.01	5.28	0.00
juvenile	0.38	0.00	0.00	0 00	0.00	0.00	1.96	1.09	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	489	0	0	1,780	455	233	80	555	810
***Gammarus* spp.**	92,262	4,943	1,400	33,023	15,424	123,673	441,296	70,765	47,570
Neomysis americana	46,393	23	622	152,879	8,860	27,273	241	49,527	131,715

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-40 (page 15 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	99.45	0.00	0.00	67.55	561.83	85.58	37.57	43.10	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.52	0.00	0.00	0 00	0.00	0.00	0.00	0.00	4.18
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.61	0.00	0.00	0 00	0.00	0.00	0.00	4.86	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	5,050.46	0.00	0.00	0 00	0.00	0.00	0.00	39,824.23	579.47
juvenile	29.93	0.00	0.00	0 00	0.00	0.00	0.00	0.00	239.47
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 16 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	16.92	0.00	0.00	0 00	57.93	9.51	37.57	25.86	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.08	0.00	0.00	0 00	0.00	0.00	0.00	8.62	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	109.12	0.00	0.00	858.56	9.65	4.75	0.00	0.00	0.00
yolk sac larvae	286.34	0.00	0.00	1,949.17	196.84	9.51	135.24	0.00	0.00
post-yolk sac larvae	66,035.43	0.00	0.00	0 00	8,522.94	1,779.38	393.41	517,579 36	8.35
juvenile	3,117 02	0.00	0.00	0 00	0.00	0.00	0.00	24,892.30	43.89
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	5.01	0.00	0.00	0 00	0.00	0.00	0.00	0.00	40.10
juvenile	4.58	0.00	0.00	0 00	0.00	0.00	0.00	0.00	36.63
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	1.65	0.00	8.54	4.67	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	11.94	0.00	0.00	95 52	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	10,859 30	0.00	0.00	180.86	1,847.08	2,813.33	2,137.51	79,874.76	20.88
juvenile	6,845.10	0.00	0.00	0 00	0.00	0.00	0.00	54,758.32	2.44
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	92,474	0	9	3,156	11,196	4,702	2,741	717,011	975
***Gammarus* spp.**	340,119	379	8,804	21,183	1,032,951	666,243	534,997	329,003	127,394
Neomysis americana	18,206	0	152	660	0	14	18	131	144,671

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-41 (page 17 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	138.98	0.00	1.22	35.22	141.46	512.20	0.00	394.19	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	3.82	0.00	30.41	2.48	0.00	3.00	0.00	0.00	0.00
yolk sac larvae	3.10	0.00	8.39	16.61	0.00	0.87	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.69	0.00	0.00	0 00	0.00	0.00	0.00	0.00	13.22
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.20	0.00	0.00	0 98	0.00	9.54	1.62	5.05	0.00
juvenile	0.97	0.00	0.00	0 00	0.00	0.00	0.81	2.58	4.14
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.22	0.00	0.00	0 00	0.00	0.87	0.00	0.83	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.41	0.00	0.00	0 00	0.00	0.86	2.37	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	28.49	0.00	0.00	0 00	0.00	0.00	0.00	0.00	222.22
juvenile	6.37	0.00	0.00	0 00	0.00	0.00	0.00	0.00	49.71
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.54	0.00	0.00	0 00	0.00	0.00	0.00	0.00	4.17
juvenile	5.00	0.00	0.00	0 00	0.00	0.00	0.86	0.00	38.13
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 18 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.12	0.00	1.22	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	19.09	0.00	0.00	5.47	62.65	30.38	0.00	50.39	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	9.25	0.00	0.00	0 00	0.00	0.00	0.86	71.28	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	203.68	0.00	15.49	17.64	1,546.21	10.75	1.73	0.00	0.00
yolk sac larvae	35.81	0.00	0.00	39.40	47.52	188.37	3.17	0.83	0.00
post-yolk sac larvae	156.43	0.00	0.00	0 00	629.54	400.41	1.59	181.05	7.54
juvenile	8.88	0.00	0.00	0 00	0.00	0.00	0.81	2.51	65.96
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	66.07	0.00	489 00	121.63	0.99	1.50	0.00	0.00	0.00
yolk sac larvae	12.19	0.00	1.22	49 96	1.93	42.23	0.00	0.00	0.00
post-yolk sac larvae	305.69	0.00	0.00	153.79	502.50	526.59	2.47	1,141.23	57.79
juvenile	12.36	0.00	0.00	0 00	0.00	0.00	0.00	18.09	78.35
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,021	0	547	443	2,933	1,728	16	1,868	541
***Gammarus* spp.**	125,130	51	170	1,296	84,806	323,908	31,622	124,799	409,394
Neomysis americana	211	0	8	12	0	1	1,621	1	6

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-42 (page 19 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	266.61	0.00	0.85	226.13	1,172.29	279.81	391.76	60.43	1.63
juvenile	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.83	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	6.66	8.13	9.48	19.28	12.32	4.04	0.00	0.00	0.00
yolk sac larvae	56.03	0.00	3.51	432.14	9.12	1.78	0.00	1.68	0.00
post-yolk sac larvae	0.20	0.00	0.00	0 00	0.00	0.00	0.00	0.00	1.61
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.11	0.00	0.00	0 85	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.86	0.00	0.00	1 84	0.00	5.04	0.00	0.00	0.00
post-yolk sac larvae	5.24	0.00	0.00	5 55	6.77	21.18	3.48	4.96	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0 85	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.33	0.00	0.00	0 00	0.00	0.00	0.00	0.00	10.67
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.41	0.00	0.00	0 00	0.00	0.00	0.00	0.84	2.41
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 20 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	33.57	0.00	0.00	60.38	100.03	17.44	57.21	21.65	6.50
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.98	0.00	0.00	7 86	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	61.80	0.00	0.00	7 36	472.22	14.81	0.00	0.00	0.00
yolk sac larvae	30.51	0.00	0.00	67.15	112.17	3.16	59.18	2.45	0.00
post-yolk sac larvae	169.76	0.00	0.00	0 00	1,253.39	9.49	87.03	8.20	0.00
juvenile	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.81
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0 00	0.00	0.89	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	39.25	2.44	78.70	182.98	46.67	3.23	0.00	0.00	0.00
yolk sac larvae	27.02	0.00	0.00	104.84	48.50	27.49	15.66	19.62	0.00
post-yolk sac larvae	435.81	0.00	0.00	375.76	497.04	174.95	2,245.69	166.14	26.89
juvenile	0.21	0.00	0.00	0 00	0.00	0.00	0.00	0.00	1.71
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,137	11	93	1,493	3,731	563	2,860	287	52
***Gammarus* spp.**	47,626	17	49	1,437	29,494	55,213	54,786	16,458	223,553
Neomysis americana	3	0	1	6	4	6	1	0	3

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-43 (page 21 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	489.53	0.00	2.53	1,190.32	652.02	1,773.00	195.43	98.70	4.24
juvenile	0.84	0.00	0.00	0 00	0.00	0.00	0.00	6.72	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	38.23	0.00	67.47	220.53	14.46	3.41	0.00	0.00	0.00
yolk sac larvae	451.06	0.86	5.69	3,564.95	17.62	19.38	0.00	0.00	0.00
post-yolk sac larvae	2.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	16.85
juvenile	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.86
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.46	0.00	0.86	0 94	1.89	0.00	0.00	0.00	0.00
yolk sac larvae	24.79	0.00	0.00	85.65	10.35	102.29	0.00	0.00	0.00
post-yolk sac larvae	53.40	0.00	0.00	47.96	12.62	302.40	34.09	29.21	0.90
juvenile	1.67	0.00	0.00	0 00	0.00	0.00	0.82	6.72	5.83
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	2.19	0.00	0.00	17.52	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.12	0.00	0.00	0 00	0.99	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.23	0.00	0.00	0 00	0.00	1.87	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.30	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.43
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	5.86	0.00	0.00	0 00	0.00	0.00	0.00	0.81	46.08
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 22 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	93.78	0.00	0.00	490.12	78.59	67.45	19.02	16.59	14.92
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	37.01	0.00	0.00	5.72	212.39	75.17	2.76	0.00	0.00
yolk sac larvae	11.85	0.00	0.00	57 36	32.43	0.00	3.29	1.68	0.00
post-yolk sac larvae	54.83	0.00	0.00	4 23	410.40	17.30	0.00	5.15	1.57
juvenile	0.32	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.59
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	35.91	0.00	14.15	199.47	63.83	6.96	2.87	0.00	0.00
yolk sac larvae	107.42	0.00	0.00	212.88	27.22	549.69	53.67	15.94	0.00
post-yolk sac larvae	481.82	0.00	0.00	737.81	415.33	874.48	1,073.22	686.82	66.89
juvenile	0.32	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.58
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,894	1	91	6,835	1,950	3,793	1,385	868	166
***Gammarus* spp.**	36,059	17	57	284	7,707	51,249	45,484	6,034	177,643
Neomysis americana	4	0	0	11	3	4	1	0	10

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-44 (page 23 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	551.20	0.00	0.00	1,175.42	2,924.89	269.47	13.55	20.81	5.43
juvenile	0.34	0.00	0.00	0 00	0.00	0.00	0.00	2.72	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	132.57	0.00	72 85	714.61	269.34	3.75	0.00	0.00	0.00
yolk sac larvae	105.92	0.00	0.80	422.71	102.72	312.89	8.25	0.00	0.00
post-yolk sac larvae	2.56	0.00	0.00	0 00	0.00	0.00	0.00	0.00	20.48
juvenile	0.33	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.63
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	57.00	0.00	2.60	393.43	32.18	23.65	4.13	0.00	0.00
yolk sac larvae	35.36	0.00	0.00	148.89	102.27	29.06	2.64	0.00	0.00
post-yolk sac larvae	121.75	0.00	0.00	326.52	287.40	163.26	88.77	36.49	71.52
juvenile	1.77	0.00	0.00	0 00	0.00	0.00	0.00	3.42	10.77
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.90
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.89
juvenile	2.13	0.00	0.00	0 00	0.00	0.00	0.00	0.00	17.02
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 24 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	42.58	0.00	0.80	127.93	179.19	11.71	17.05	0.00	9.06
juvenile	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.83	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	9.88	0.00	2.60	0 81	20.66	8.61	46.32	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.79	0.00	0.00	0 00	5.86	3.12	0.83	0.92	3.58
juvenile	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.88
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	37.91	0.00	13 86	102.56	166.41	16.85	3.58	0.00	0.00
yolk sac larvae	70.26	0.00	0.00	170.82	284.08	46.69	47.72	12.81	0.00
post-yolk sac larvae	303.47	0.00	0.00	89.32	570.07	243.91	3.65	756.08	764.76
juvenile	1.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	8.85
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,478	0	94	3,673	4,945	1,133	236	834	917
***Gammarus* spp.**	38,349	11	27	197	1,958	18,549	11,924	9,393	264,730
Neomysis americana	7	0	1	50	1	3	0	1	0

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-45 (page 25 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	473.65	0.00	0.00	899.97	2,795.45	6.06	35.08	26.57	26.08
juvenile	0.21	0.00	0.00	0 00	0.00	0.00	0.00	1.67	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	11.84	3.28	0.00	8.49	8.57	38.49	35.91	0.00	0.00
yolk sac larvae	316.59	0.00	1.85	1,490.09	828.03	178.40	34.36	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	30.01	0.00	24.17	83.14	39.78	29.65	63.34	0.00	0.00
yolk sac larvae	65.40	0.00	0.00	355.28	136.02	6.66	24.41	0.81	0.00
post-yolk sac larvae	144.85	0.00	0.00	356.29	550.95	5.03	144.27	71.59	30.71
juvenile	1.67	0.00	0.00	0 00	0.00	0.00	0.00	4.38	8.99
adult	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.86	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.23	0.00	0.00	0 00	0.00	0.00	0.00	0.00	1.82
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.21	0.00	0.00	0 00	0.00	0.00	0.00	0.00	1.72
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 26 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.21	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	17.91	0.00	0.00	4 36	88.18	2.05	10.56	7.47	32.10
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.64	0.00	0.00	0 00	0.00	0.00	0.00	5.16	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.39	0.00	0.00	0 00	0.00	8.22	2.89	0.00	0.00
yolk sac larvae	0.11	0.00	0.87	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.24	0.00	0.00	0 00	0.00	0.00	0.98	0.00	0.97
juvenile	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.85
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	19.70	0.00	0.00	26 84	48.13	77.04	5.57	0.00	0.00
yolk sac larvae	52.69	0.00	0.00	149.69	133.34	3.00	85.97	49.53	0.00
post-yolk sac larvae	37.71	0.00	0.00	0 00	20.40	0.00	1.97	40.75	238.59
juvenile	0.22	0.00	0.00	0 00	0.00	0.00	0.00	0.00	1.53
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,176	3	27	3,376	4,649	355	445	209	343
***Gammarus* spp.**	8,056	18	23	273	2,691	1,055	3,548	6,166	50,676
Neomysis americana	357	3	0	33	0	9	10	1	2,804

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-46 (page 27 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	130.83	0.00	0.00	16.93	855.79	1.88	6.09	1.89	19.07
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	22.79	0.00	27.63	100.71	0.98	24.04	3.48	25.48	0.00
yolk sac larvae	326.41	0.00	0.00	368.68	1,598.65	637.25	6.71	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	1.93	0.00	0.00	3.48	2.45	7.53	1.95	0.00	0.00
yolk sac larvae	1.26	0.00	0.00	1 98	7.15	0.00	0.00	0.94	0.00
post-yolk sac larvae	34.74	0.00	0.00	0 00	231.82	1.02	0.87	9.29	34.95
juvenile	2.58	0.00	0.00	0 00	0.00	0.00	0.00	0.90	19.70
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.34	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.74
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.78	0.00	0.00	0 00	0.00	0.00	0.00	0.00	6.25
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 28 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.40	0.00	0.00	0 87	17.37	0.00	0.00	0.94	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.49	0.00	0.00	0 00	0.00	0.00	3.90	0.00	0.00
yolk sac larvae	0.12	0.00	0.00	0 00	0.00	0.00	0.00	0.97	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.12	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.92
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	63.03	0.00	0.00	162.80	205.40	37.71	98.32	0.00	0.00
yolk sac larvae	59.72	0.00	0.00	9.43	131.84	7.19	139.88	189.45	0.00
post-yolk sac larvae	4.43	0.00	0.00	0 87	30.08	1.79	0.00	0.90	1.79
juvenile	0.33	0.00	0.00	0 00	0.00	0.00	0.00	0.00	2.67
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	652	0	28	666	3,082	718	261	231	88
***Gammarus* spp.**	4,603	27	41	281	4,445	1,071	894	4,531	25,530
Neomysis americana	12	0	1	87	1	3	0	0	3

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

2004 PSEG Data

Table 4-31
PSEG Estuary Enhancement Program
Total abundance of ichthyoplankton and macrozooplankton target species collected by zone,
April-July 2004

Species (Taxon)	All Zones	Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Alewife	11,446	0	0	0	0	0	0	0	48	494	825	3,058	3,044	3,736	241
Alosa spp.	2,625	0	0	0	0	0	0	1	0	22	236	579	1,129	411	247
American Shad	9,986	0	0	0	0	0	0	0	0	11	115	675	4,917	3,354	914
Atlantic Croaker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Menhaden	10,492	6,523	556	2,651	713	9	15	11	2	6	1	4	1	0	0
Atlantic Silverside	434	5	48	85	97	110	56	25	7	1	0	0	0	0	0
Bay Anchovy	3,442,828	2,077,045	599,828	454,225	256,313	47,477	5,526	1,296	308	424	131	181	45	23	6
Blueback Herring	57	0	0	0	0	0	0	0	2	11	11	10	10	4	9
Bluefish	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Clupeidae	18,444	16	0	1	1	3	0	34	255	1,005	2,066	4,017	6,782	3,863	401
Morone spp.	6,379	0	0	0	0	0	2	850	911	734	689	1,022	1,672	462	37
Spot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped Bass	5,516	0	0	0	0	0	2	2,093	1,512	819	727	169	173	18	3
Weakfish	268,077	173,031	16,539	75,172	2,316	383	125	489	20	0	0	0	2	0	0
White Perch	39,151	0	0	0	0	0	3	72	279	2,291	2,973	8,433	17,189	6,088	1,823
Total Ichthyoplankton	3,815,437	2,256,620	616,972	532,134	259,441	47,982	5,729	4,871	3,344	5,818	7,774	18,148	34,964	17,959	3,681
Gammarus spp.	15,221,738	12,067	31,995	6,616	13,286	2,782	30,196	660,928	909,299	2,167,754	3,279,099	2,672,131	1,368,475	1,885,920	2,181,190
Neomysis americana	7,740,007	1,371,508	1,321,988	1,100,494	1,428,339	1,708,711	556,992	219,896	31,973	72	21	2	0	1	10

Table 4-39 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.15	0.00	1.17	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.50	0.00	0.00	0 00	12.01	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.68	0.00	0.00	0 00	6.05	1.21	0.00	14.15	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.43	0.00	0.00	0 00	1.08	0.00	2.40	0.00	0.00
Bay anchovy									
egg	1.95	0.00	0.00	0 00	10.82	4.74	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	160.95	0.00	0.00	0 00	0.00	296.11	623.87	236.28	131.37
juvenile	10.20	0.00	0.00	0 00	0.00	0.00	0.00	21.07	60.57
adult	1.73	0.00	0.00	3.41	6.94	0.00	2.28	1.24	0.00
undetermined larvae	4.22	0.00	0.00	0 00	0.00	33.80	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0 00	0.00	0.00	1.07	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	4.37	0.00	0.00	0 00	34.93	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	115.68	0.00	0.00	10.49	893.27	21.69	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	207.86	0.00	1,661.87	1 03	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.15	0.00	0.00	1 21	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	70.39	0.00	0.00	0 00	469.63	86.88	6.62	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	54.00	0.00	0.00	0 00	0.00	89.86	320.14	11.95	10.05
juvenile	15.98	0.00	0.00	0 00	0.00	2.74	121.84	1.24	2.02
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.96	0.00	4.13	0 00	0.00	3.58	0.00	0.00	0.00
yolk sac larvae	1.46	0.00	11.69	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	6.72	0.00	0.00	0 00	53.74	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.73	1.11	3.51	1 21	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	662	1	1,682	17	1,488	541	1,078	286	204
***Gammarus* spp.**	88,366	20,702	104,348	80,379	295,645	19,429	27,749	39,543	119,132
Neomysis americana	30,200	43,982	68	303	613	27,333	25,747	104,242	39,310

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-40 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.07	0.00	0.00	0 00	112.53	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.57	0.00	0.00	0 00	2.41	0.00	2.11	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.63	0.00	0.00	0 00	0.00	5.97	0.00	4.75	2.30
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	72.76	0.00	0.00	0 00	0.00	266.91	128.51	138.34	48.35
juvenile	4.51	0.00	0.00	0 00	0.00	0.00	0.00	11.08	25.02
adult	0.56	0.00	0.00	0 00	0.00	4.46	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.50	0.00	0.00	0 00	0.00	3.98	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.97	0.00	0.00	0 00	37.51	0.00	0.00	2.22	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	69.81	0.00	0.00	0 00	558.51	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	273.54	0.00	0.00	930.43	1,222.13	35.73	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	384.47	0.00	3,063.62	12.10	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.59	0.00	0.00	0 00	4.69	0.00	0.00	0.00	0.00
post-yolk sac larvae	57.36	0.00	0.00	0 00	292.08	148.00	18.80	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.17	0.00	0.00	0 00	0.00	1.99	29.83	1.58	0.00
juvenile	1.02	0.00	0.00	0 00	0.00	0.00	6.61	1.58	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	14.17	0.00	110 94	2.42	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	66.96	0.00	0.00	19.36	463.98	45.20	7.15	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.31	0.00	0.00	0 00	0.00	2.47	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	972	0	3,175	964	2,694	515	193	160	76
***Gammarus* spp.**	267,270	2,330	5,104	111,964	1,566,651	45,625	101,271	153,411	151,805
Neomysis americana	7,137	2	0	5	0	20,097	1,313	35,672	10

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-41 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	58.57	0.00	0.00	146.62	321.91	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.30	0.00	2.42	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.69	0.00	0.81	10.89	1.83	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.40	0.00	0.00	0 00	0.00	2.36	0.00	0.82	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.11	0.00	0.00	0 91	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.85	0.00	0.00	0 00	6.80	0.00	0.00	0.00	0.00
juvenile	0.30	0.00	0.00	0 00	0.00	0.84	0.82	0.00	0.76
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.33	0.00	0.00	0 00	0.00	1.94	0.00	0.70	0.00
juvenile	0.31	0.00	0.00	0 00	0.00	1.60	0.86	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.10	0.00	0.83	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	34.93	0.00	0.00	0 00	0.00	0.00	72.14	139.83	67.45
juvenile	6.14	0.00	0.00	0 00	0.00	0.00	0.00	19.40	29.74
adult	0.20	0.00	0.00	0 00	0.00	1.58	0.00	0.00	0.00
undetermined larvae	1.24	0.00	0.00	0 00	0.00	0.00	9.90	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.15	0.00	0.00	0 00	0.00	4.47	1.60	0.83	2.27
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.20	0.00	1.61	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	57.79	0.00	0.00	2.72	458.93	0.00	0.00	0.69	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	59.57	0.00	0.00	177.88	289.26	9.39	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	78.07	0.00	0.00	51.29	62.46	486.19	24.59	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	4.96	0.00	0.00	33.87	5.83	0.00	0.00	0.00	0.00
yolk sac larvae	17.82	0.00	0.00	24 07	118.47	0.00	0.00	0.00	0.00
post-yolk sac larvae	68.68	0.00	0.00	198.13	33.70	288.57	28.34	0.69	0.00
juvenile	0.36	0.00	0.00	0 00	0.00	0.00	0.80	2.08	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	12.27	1.63	66 82	28 83	0.92	0.00	0.00	0.00	0.00
yolk sac larvae	13.32	0.00	7.54	26 98	72.08	0.00	0.00	0.00	0.00
post-yolk sac larvae	229.24	0.00	0.00	410.19	646.44	745.08	31.31	0.00	0.90
juvenile	1.76	0.00	0.00	0 00	0.00	1.67	2.51	7.61	2.26
adult	0.44	0.00	0.00	0 90	0.00	0.97	1.64	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	651	2	80	1,113	2,019	1,545	174	173	103
***Gammarus* spp.**	227,946	371	2,264	146,756	68,591	375,855	996,070	129,995	103,663
Neomysis americana	8	0	0	4	3	24	1	31	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-42 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	95.33	0.00	6.32	232.24	444.68	77.92	1.50	0.00	0.00
juvenile	0.66	0.00	0.00	0 00	0.00	0.00	1.50	3.79	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	11.78	0.97	4.27	5 55	83.47	0.00	0.00	0.00	0.00
yolk sac larvae	10.97	0.00	10 96	69 37	7.47	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.96	0.00	0.00	0 00	0.00	22.16	1.55	0.00	0.00
juvenile	0.34	0.00	0.00	0 00	0.00	2.69	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.82	0.00	0.00	4.64	1.92	0.00	0.00	0.00	0.00
post-yolk sac larvae	10.02	0.00	0.00	1 83	52.76	25.55	0.00	0.00	0.00
juvenile	1.52	0.00	0.00	0 00	0.00	9.60	1.61	0.91	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.78	0.00	0.00	6 22	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.12	0.00	0.00	0 00	0.00	0.00	0.00	0.94	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	13.70	0.00	0.00	0 00	0.00	0.00	31.82	74.36	3.39
juvenile	1.28	0.00	0.00	0 00	0.00	0.00	0.00	8.51	1.70
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.11	0.00	0.00	0 00	0.00	4.07	4.84	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	27.55	0.00	0.00	0 00	162.32	58.05	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	211.37	0.00	0.00	78.85	1,230.10	361.52	3.11	17.35	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0 00	0.00	0.00	0.86	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	75.29	0.00	0.00	3.60	207.55	364.80	26.40	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.35	0.00	2.69	5.43	2.67	0.00	0.00	0.00	0.00
yolk sac larvae	2.44	0.00	0.00	0 93	18.60	0.00	0.00	0.00	0.00
post-yolk sac larvae	72.44	0.00	0.00	0 00	18.43	547.13	12.06	1.92	0.00
juvenile	0.42	0.00	0.00	0 00	0.00	0.00	1.67	0.94	0.74
adult	0.09	0.00	0.00	0 00	0.00	0.00	0.75	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	18.04	0.00	56.78	17.66	69.06	0.84	0.00	0.00	0.00
yolk sac larvae	29.79	0.00	9.45	86.74	142.16	0.00	0.00	0.00	0.00
post-yolk sac larvae	281.37	0.00	0.00	123.09	928.74	1,164.68	34.43	0.00	0.00
juvenile	1.69	0.00	0.00	0 00	0.00	0.00	4.23	9.33	0.00
adult	0.34	0.00	1.83	0 00	0.00	0.90	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	874	1	92	636	3,370	2,640	126	118	6
***Gammarus* spp.**	346,700	153	910	5,471	29,167	1,406,435	612,808	357,946	360,711
Neomysis americana	2	0	0	19	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-43 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	345.47	0.00	0.00	530.14	1,991.79	232.83	9.00	0.00	0.00
juvenile	0.29	0.00	0.00	0 00	0.00	0.00	2.29	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	50.42	0.00	13.12	71 39	318.88	0.00	0.00	0.00	0.00
yolk sac larvae	8.45	0.00	20.78	35.44	11.39	0.00	0.00	0.00	0.00
post-yolk sac larvae	5.97	0.00	0.00	0 00	0.00	36.39	8.64	2.70	0.00
juvenile	0.41	0.00	0.00	0 00	0.00	3.30	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.53	0.00	0.94	3 28	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	23.94	0.00	0.00	39 02	152.46	0.00	0.00	0.00	0.00
post-yolk sac larvae	44.95	0.00	0.00	54.13	189.01	114.96	1.53	0.00	0.00
juvenile	3.68	0.00	0.00	0 00	0.00	26.44	3.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.03	0.00	0.00	16.25	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.44	0.00	0.00	0 00	0.00	0.00	0.00	3.56	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	19.58	0.00	0.00	0 00	0.00	0.00	7.80	142.96	5.91
juvenile	0.46	0.00	0.00	0 00	0.00	0.00	0.00	3.68	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.19	0.00	0.00	0 00	0.00	0.00	1.51	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.05	0.00	0.00	0 00	0.00	1.73	2.35	1.79	2.56
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	89.55	0.00	0.00	1.72	672.24	42.43	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	365.15	0.00	0.00	423.98	1,956.91	522.46	17.85	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.30	0.00	0.00	0 00	0.00	10.36	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	105.71	0.00	0.00	18.92	347.43	124.58	354.75	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	3.68	0.00	2.80	0 00	26.67	0.00	0.00	0.00	0.00
yolk sac larvae	6.59	0.00	0.00	0 00	52.75	0.00	0.00	0.00	0.00
post-yolk sac larvae	8.89	0.00	0.00	0 00	29.95	37.42	3.76	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	125.17	0.00	213.79	60.17	702.39	25.04	0.00	0.00	0.00
yolk sac larvae	38.30	0.00	11.63	56.68	237.19	0.86	0.00	0.00	0.00
post-yolk sac larvae	749.09	0.00	0.00	144.19	2,337.82	3,217.20	290.97	1.72	0.82
juvenile	0.43	0.00	0.00	0 00	0.00	2.53	0.88	0.00	0.00
adult	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.85	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	2,002	0	263	1,455	9,027	4,399	704	157	9
***Gammarus* spp.**	275,895	24	94	2,134	26,508	879,973	316,597	607,005	374,829
Neomysis americana	0	0	0	2	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-44 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	329.30	0.00	0.00	455.82	1,847.67	310.44	20.43	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	104.06	8.94	95 58	618.37	109.62	0.00	0.00	0.00	0.00
yolk sac larvae	11.76	0.00	34 04	44.45	15.55	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.62	0.00	0.00	0 00	0.00	0.00	26.43	2.56	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	56.27	0.00	360.78	75.11	14.24	0.00	0.00	0.00	0.00
yolk sac larvae	82.71	0.00	14 34	238.18	409.14	0.00	0.00	0.00	0.00
post-yolk sac larvae	377.74	0.00	0.00	404.67	2,206.86	398.93	9.74	0.84	0.86
juvenile	1.98	0.00	0.00	0 00	0.00	15.83	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	16.80	0.00	0.00	134.39	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.78	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.36	0.00	0.00	0 00	0.00	0.00	4.38	22.70	7.76
juvenile	0.59	0.00	0.00	0 00	0.00	0.00	0.00	4.73	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.13	0.00	0.00	0 00	0.00	0.00	0.00	5.39	3.61
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.47	0.00	0.00	0 00	282.41	23.84	41.48	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	722.74	0.00	3.17	355.47	5,043.41	315.83	59.75	4.30	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	187.00	0.00	0.00	0 00	765.54	562.43	168.06	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	7.76	0.00	0.87	0 00	61.20	0.00	0.00	0.00	0.00
yolk sac larvae	2.92	0.00	0.00	0 00	23.32	0.00	0.00	0.00	0.00
post-yolk sac larvae	8.72	0.00	0.00	0 00	7.84	53.48	8.44	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.20	0.00	0.00	0 00	0.00	0.00	1.60	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	64.09	7.61	127.11	266.03	111.99	0.00	0.00	0.00	0.00
yolk sac larvae	127.49	0.00	57 52	172.55	789.85	0.00	0.00	0.00	0.00
post-yolk sac larvae	1,712 93	0.00	0.00	55.28	5,862.90	6,929.56	850.37	5.34	0.00
juvenile	0.11	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.92
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	3,868	17	693	2,820	17,552	8,610	1,191	47	13
***Gammarus* spp.**	150,966	13	66	1,728	16,547	205,377	212,560	375,652	395,787
Neomysis americana	0	0	0	0	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-45 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	383.80	0.00	0.86	55.21	932.75	1,744.32	337.25	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	38.58	2.48	3.76	300.77	1.61	0.00	0.00	0.00	0.00
yolk sac larvae	7.65	0.00	9.36	25.10	26.76	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.12	0.00	0.00	0 00	0.00	0.00	18.62	6.31	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	20.69	0.00	95 56	62.69	7.28	0.00	0.00	0.00	0.00
yolk sac larvae	43.26	0.00	0.79	248.60	90.41	6.31	0.00	0.00	0.00
post-yolk sac larvae	222.60	0.00	0.00	199.67	423.55	1,124.90	31.74	0.95	0.00
juvenile	2.49	0.00	0.00	0 00	0.00	15.96	3.10	0.87	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	69.93	0.00	0.00	184.71	0.00	374.74	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.23	0.00	0.00	0 00	0.00	0.00	0.64	14.08	3.11
juvenile	0.21	0.00	0.00	0 00	0.00	0.00	0.00	0.86	0.78
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.42	0.00	0.00	0 00	0.00	0.00	0.00	0.00	3.34
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	100.31	0.00	0.00	1 00	0.00	552.37	68.31	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	295.21	0.00	0.00	33.33	1,019.08	1,087.04	216.78	5.45	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.81	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	47.75	0.00	0.00	0 00	5.01	344.11	31.97	0.95	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.67	0.00	4.44	0 00	0.90	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.13	0.00	0.00	0 00	0.00	0.00	9.02	0.00	0.00
juvenile	0.12	0.00	0.00	0 00	0.00	0.00	0.00	0.95	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	36.08	1.65	62 56	220.88	3.52	0.00	0.00	0.00	0.00
yolk sac larvae	123.57	0.00	10.45	88.57	875.27	14.28	0.00	0.00	0.00
post-yolk sac larvae	462.94	0.00	0.00	3 98	18.50	3,272.34	408.70	0.00	0.00
juvenile	0.12	0.00	0.00	0 00	0.00	0.00	0.00	0.95	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	1,863	5	188	1,425	3,405	8,536	1,126	31	7
***Gammarus* spp.**	194,590	4	42	683	6,413	53,148	72,689	407,494	1,016,248
Neomysis americana	0	0	0	0	0	0	0	1	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-46 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	24.21	0.00	0.00	20.32	34.10	104.82	29.61	0.00	0.00
juvenile	0.10	0.00	0.00	0 00	0.00	0.00	0.77	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	7.65	21.84	7.53	33 89	0.77	0.00	0.00	0.00	0.00
yolk sac larvae	18.63	0.00	0.96	47.47	96.88	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.38	0.00	0.00	0 00	0.00	0.00	2.97	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	2.54	0.00	17 25	2 58	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	3.48	0.00	0.00	22.11	5.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	84.21	0.00	0.00	5.13	14.86	605.23	31.63	0.00	0.00
juvenile	1.89	0.00	0.00	0 00	0.00	10.95	3.05	0.71	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.60	0.00	0.00	0 00	4.71	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.54	0.00	0.00	0 00	0.00	0.00	0.00	4.23	0.00
juvenile	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.80	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	1.00	0.00	0.00	0 00	0.00	0.00	0.00	7.06	0.77
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during he Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.21	0.00	0.00	0 00	0.00	0.00	0.00	1.60	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.99	0.00	0.00	2 54	0.83	16.17	3.80	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	37.03	0.00	0.00	21.99	66.95	138.68	59.82	1.42	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	3.46	0.00	0.00	0 00	0.00	4.59	22.43	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.19	0.00	0.00	0 00	0.00	0.70	0.77	0.00	0.00
juvenile	0.09	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.74
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	26.63	1.03	82.12	114.31	8.35	2.09	0.00	0.00	0.00
yolk sac larvae	154.12	0.00	0.94	422.81	773.60	4.76	0.00	0.00	0.00
post-yolk sac larvae	13.19	0.00	0.00	0 00	0.00	92.59	8.01	1.51	0.77
juvenile	0.45	0.00	0.00	0 00	0.00	0.00	0.00	3.55	0.00
adult	0.10	0.00	0.00	0 00	0.00	0.00	0.00	0.75	0.00
undetermined larvae	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00
Total IP	384	23	109	693	1,006	981	163	22	2
***Gammarus* spp.**	220,169	12	203	373	1,408	7,988	28,266	477,485	1,201,589
Neomysis americana	1	6	0	1	0	0	1	1	2

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Appendix B

2000 PSEG Data 1

2001 PSEG Data 3

2002 PSEG Data 5

2003 PSEG Data 7

2004 PSEG Data 9

2005 PSEG Data 11

2006 PSEG Data 13

2007 PSEG Data 15

2008 PSEG Data 17

2009 PSEG Data 19

2000 PSEG Data

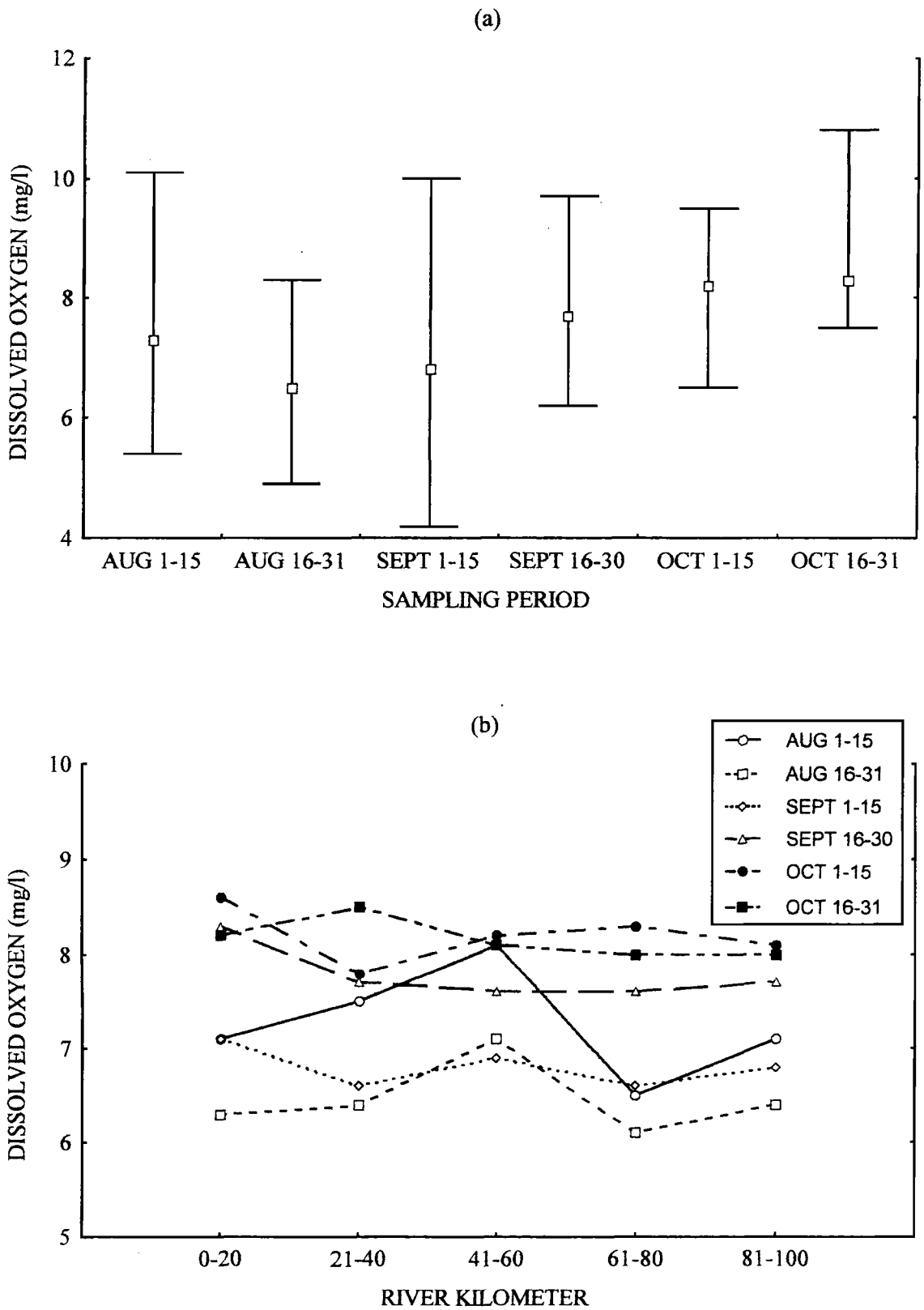


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2000 baywide seine survey.

2001 PSEG Data

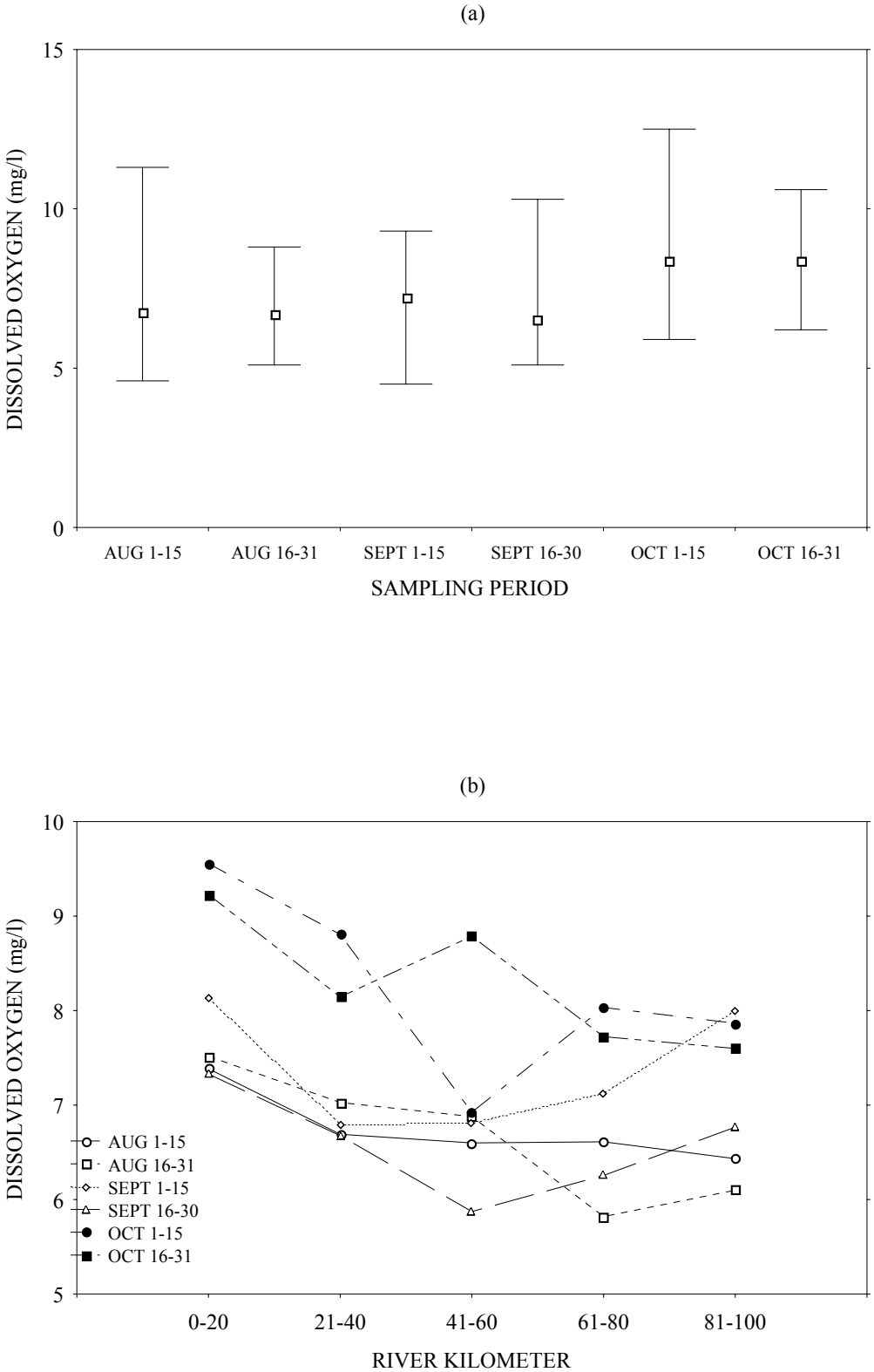


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2001 baywide seine survey.

2002 PSEG Data

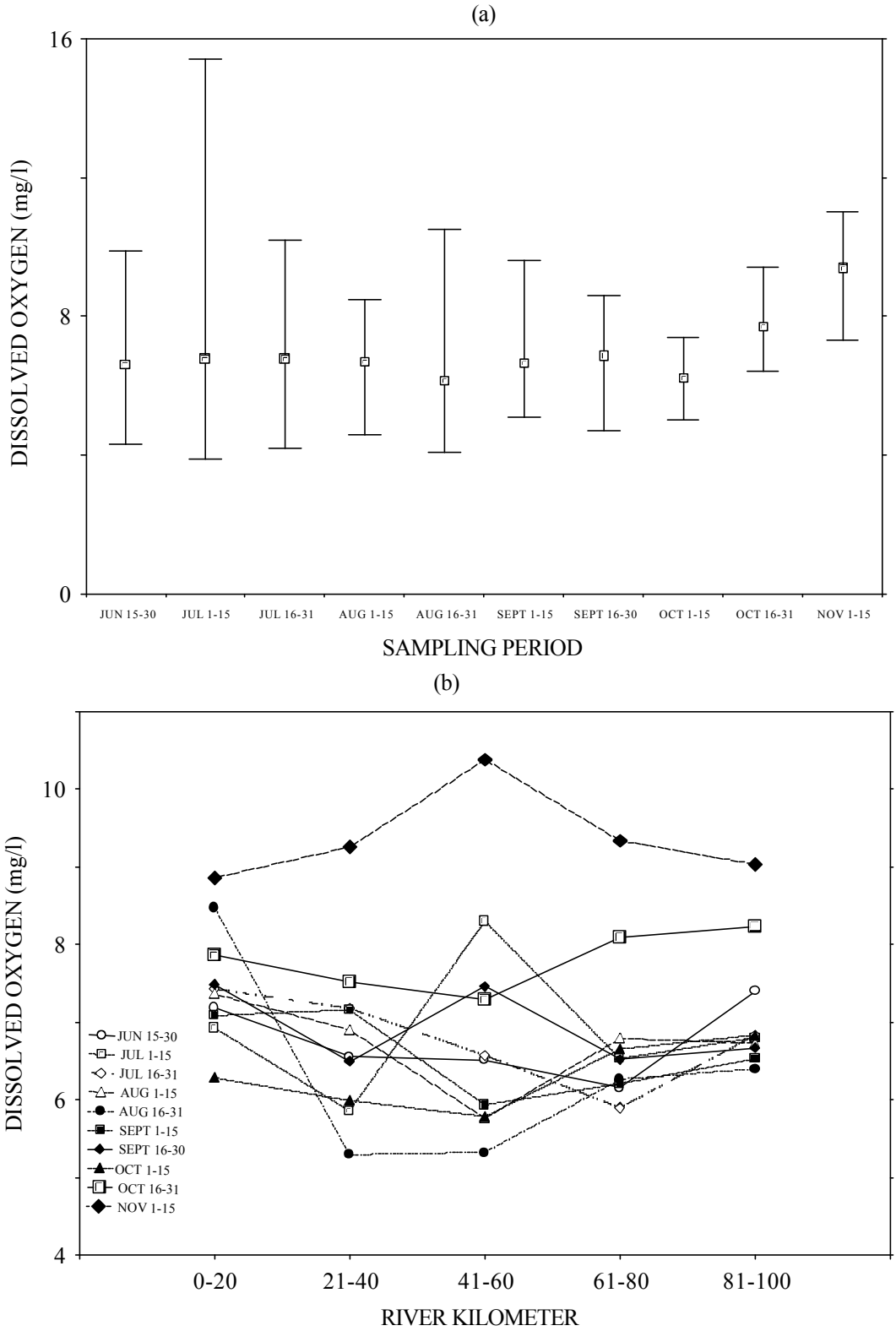


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2002 baywide seine survey.

2003 PSEG Data

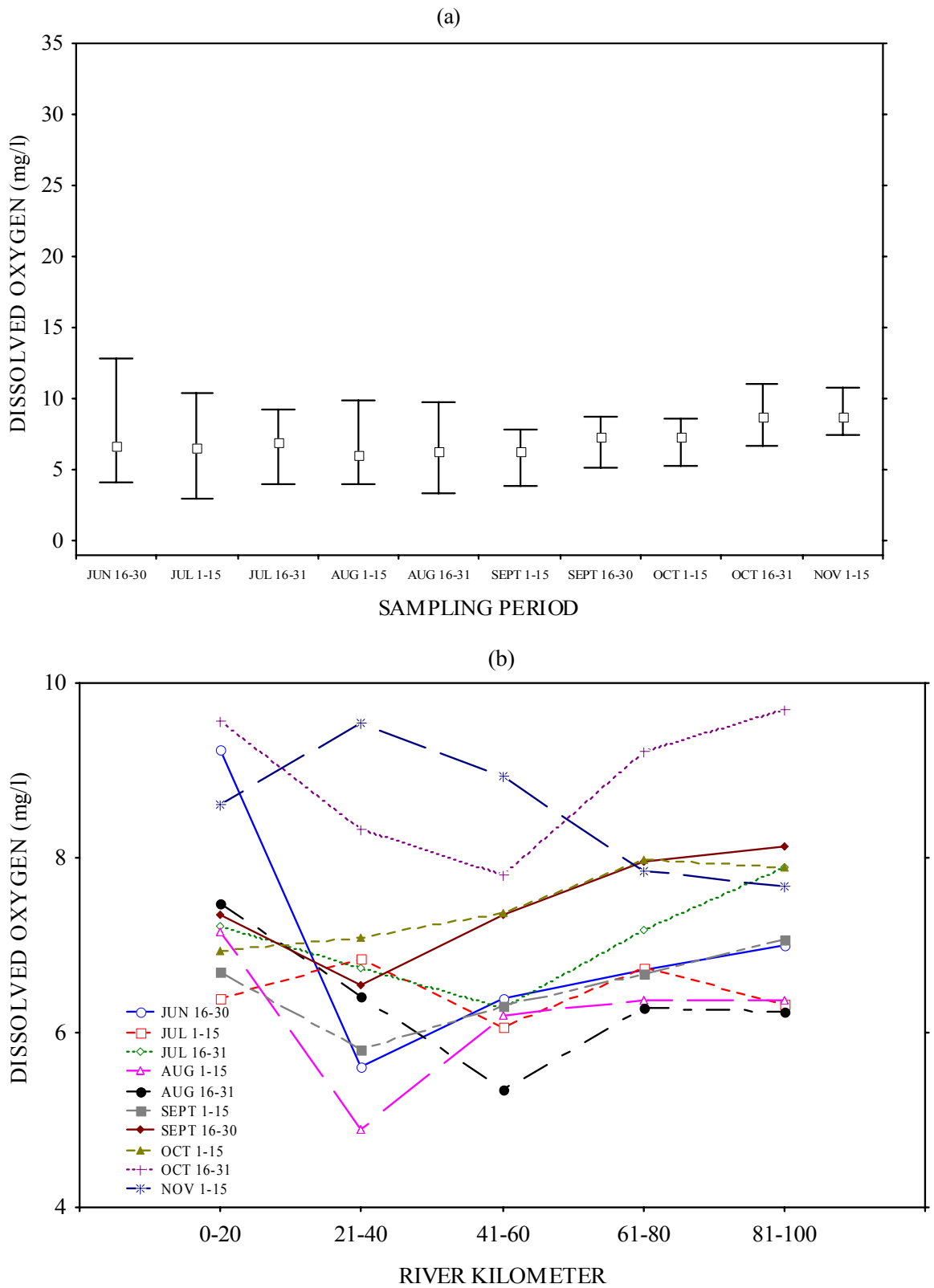


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2003 baywide seine survey.

2004 PSEG Data

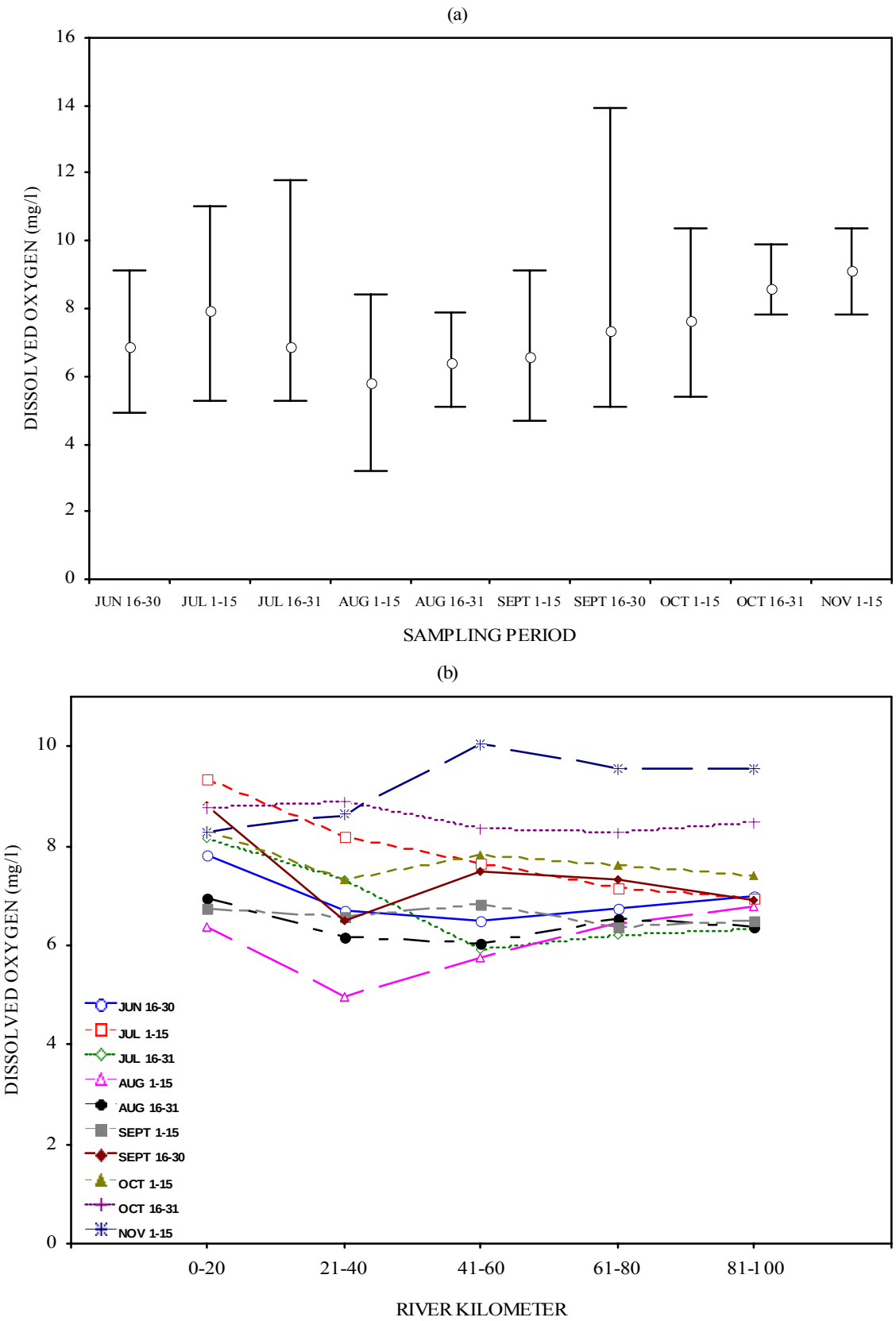


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2004 baywide seine survey.

2005 PSEG Data

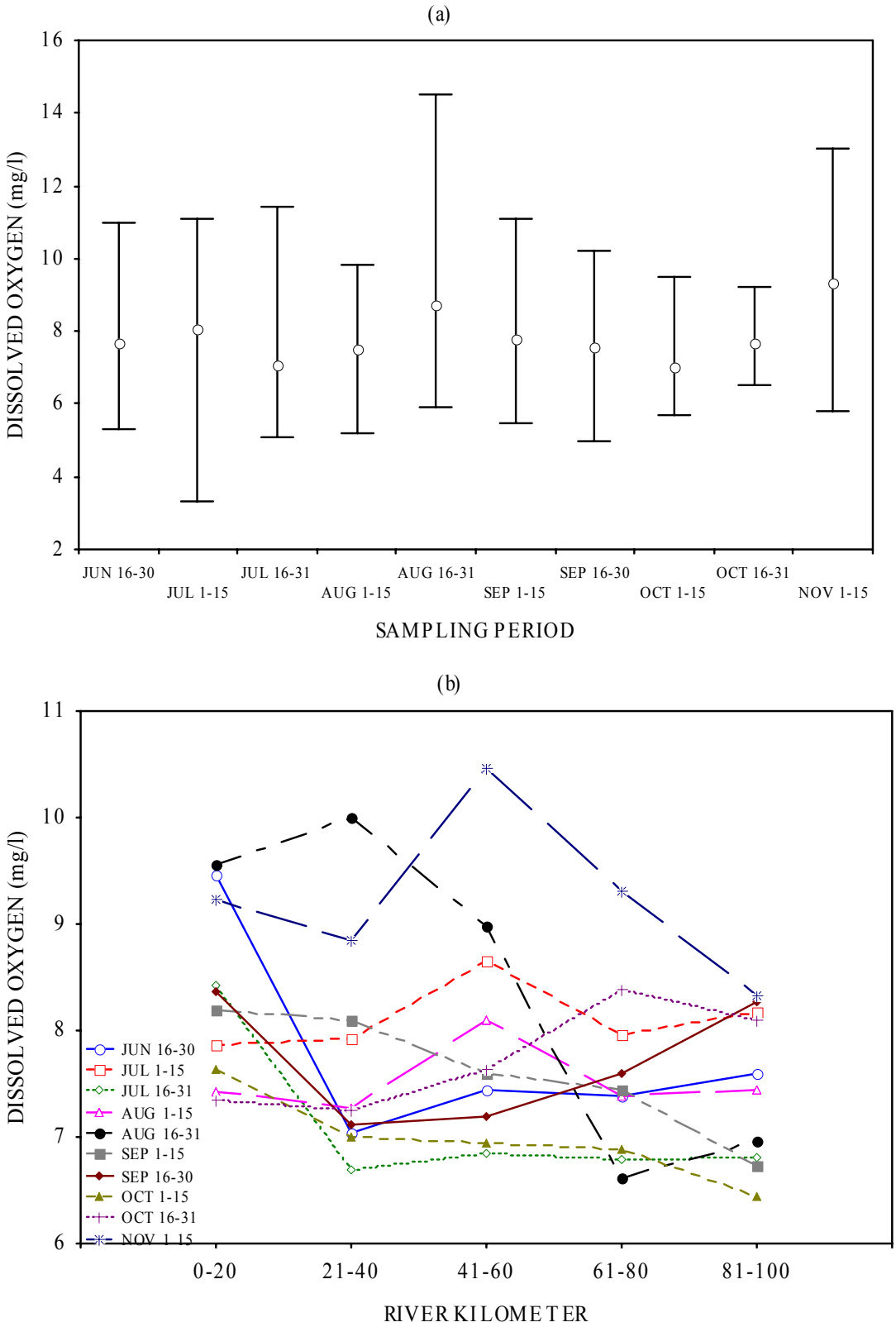
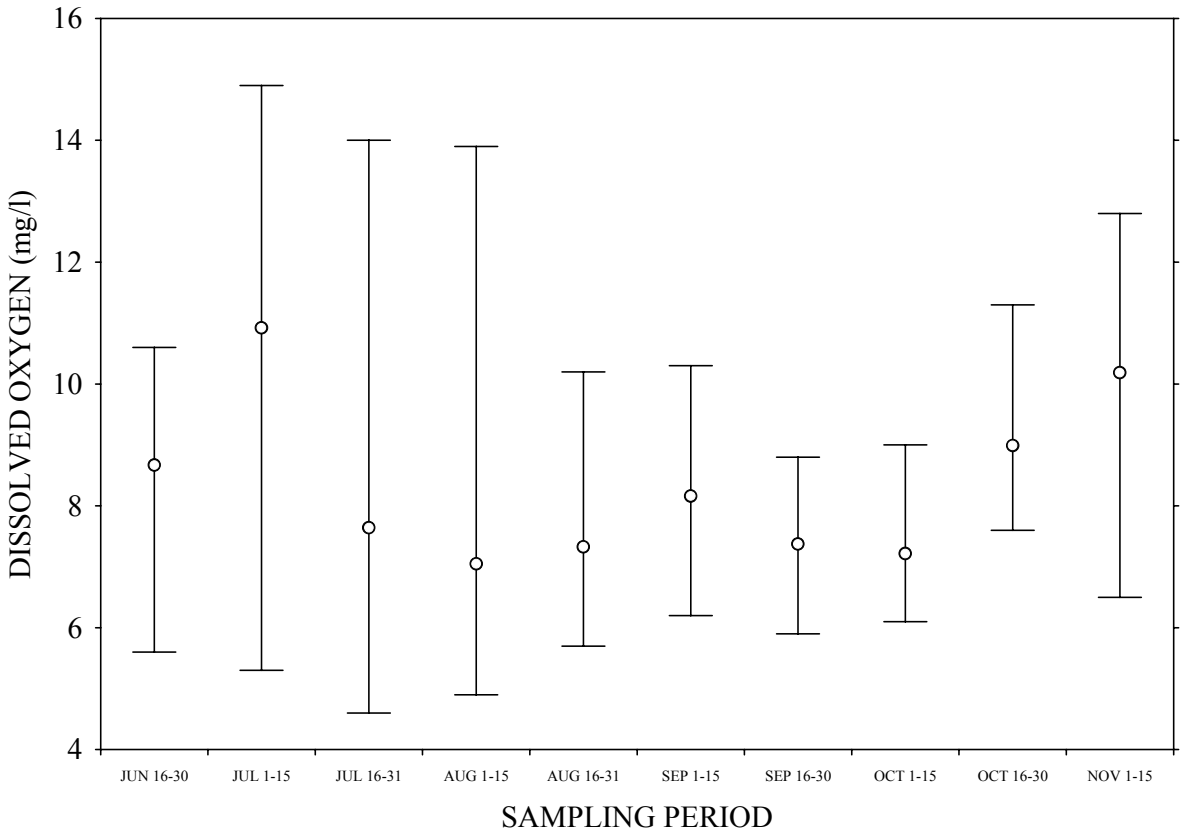


Figure 5-4. Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2005 baywide seine survey.

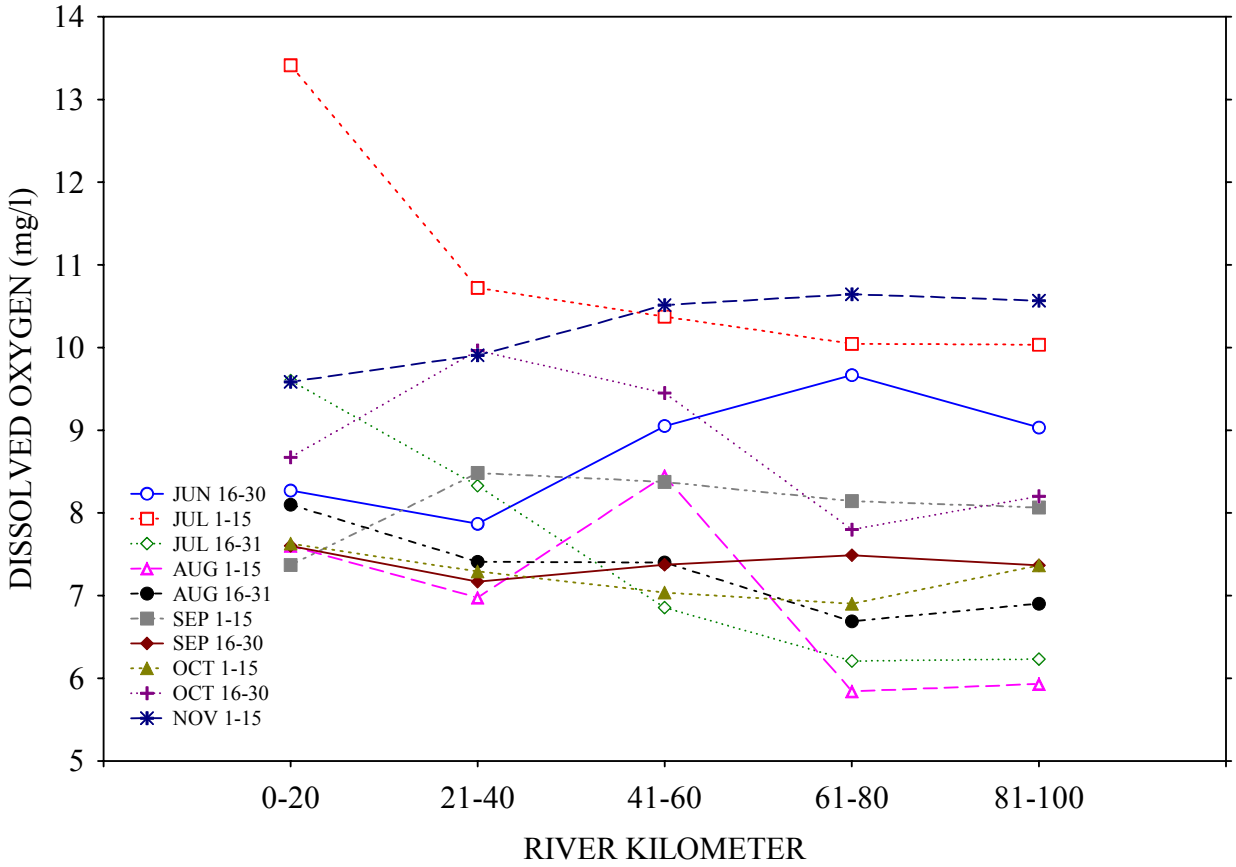
2006 PSEG Data

Figure 5-3. Mean salinity by sampling period (a) showing minimum and maximum values, and by river kilometer (b) as observed during the 2006 baywide seine survey.

(a)



(b)



2007 PSEG Data

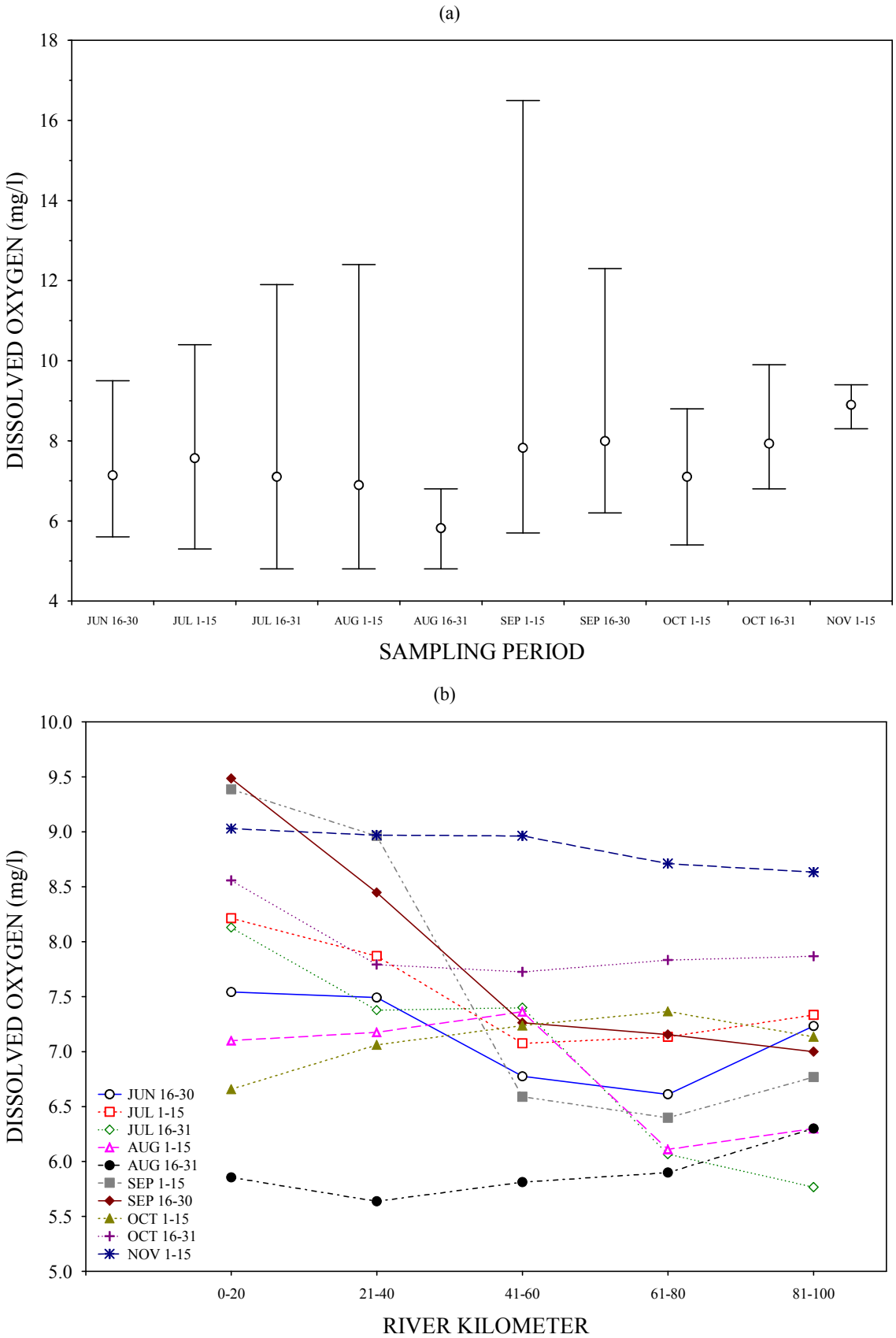


Figure 5-4 Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2007 baywide seine survey.

2008 PSEG Data

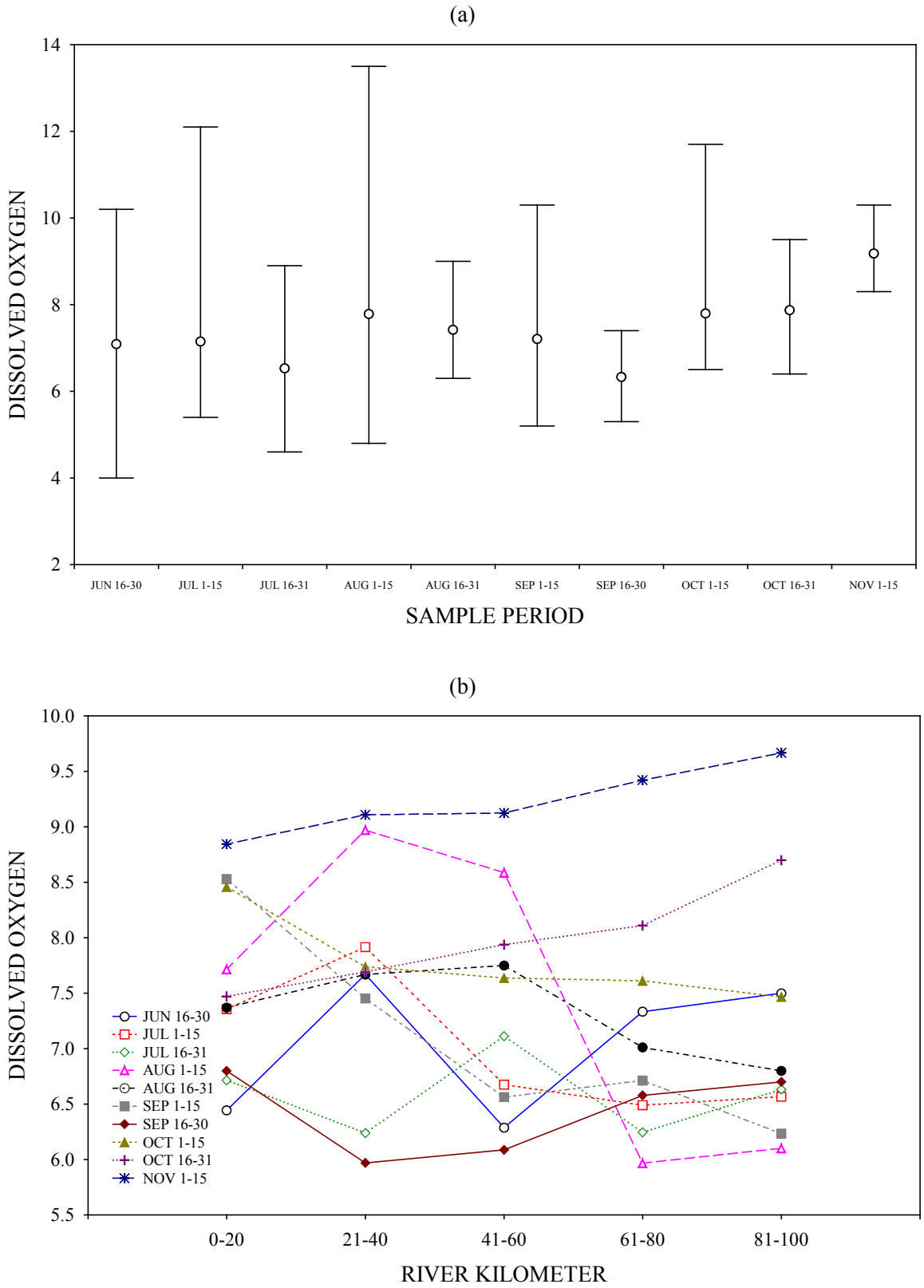


Figure 5-4 Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2008 baywide seine survey.

2009 PSEG Data

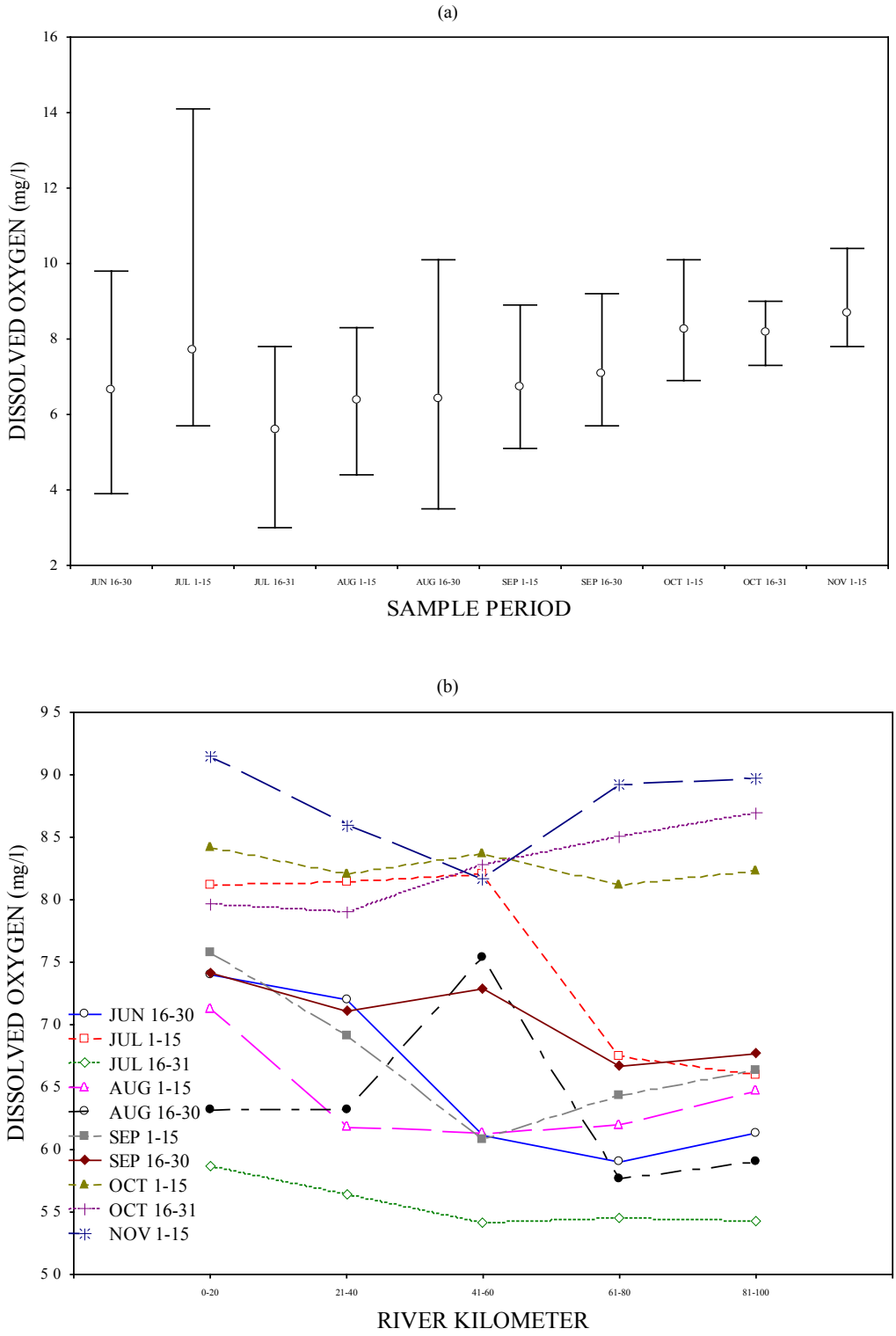


Figure 5-4 Mean dissolved oxygen by sampling period (a) showing minimum and maximum values, by river kilometer (b) as observed during the 2009 baywide seine survey.

Attachment 2

Existing Use Evaluation for Zones 3, 4, & 5 of the Delaware Estuary Based on Spawning and Rearing of Resident and Anadromous Fishes

September 30, 2015

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA
WWW.DRBC.NET

Summary

Severe pollution problems have affected the Delaware Estuary for over 100 years. A key component to the estuary's restoration was the establishment of water quality criteria by the Delaware River Basin Commission in 1967. Faced with technical and financial challenges, these 1967 standards included a compromise position for 38 miles of the 133 mile long estuary: a limited "use" for Zones 3, 4, and upper Zone 5 that did not include "propagation" along with lower dissolved oxygen water quality criteria. Yet the 1967 goals were ambitious nonetheless, and the recovery in both dissolved oxygen and the living resources in these urban zones of the estuary have been tremendous. Recent data suggest that part of this recovery has been an exceedance of the 1967 goals for the "use" of the estuary, with substantial recovery in "propagation" even in Zones 3, 4, and 5. Because of Clean Water Act regulations requiring reconciliation of "existing uses" and "designated uses", these recent data warranted an evaluation to determine the extent to which a "propagation" use had been achieved for Zones 3, 4, and 5.

To evaluate the "propagation" use, DRBC reviewed available data for resident and anadromous fishes collected since 2000 that quantified spawning and/or rearing of early life stages of these estuarine species. This evaluation attempted to both assess whether any evidence of successful reproduction existed for each species in each estuary zone, and the degree to which successful reproduction had been restored for that species. Detailed reviews were possible for 9 fish species: Atlantic Sturgeon, American Shad, Striped Bass, White Perch, Bay Anchovy, Atlantic Silverside, Alewife, Blueback Herring, and Atlantic Menhaden. For all species evaluated, successful reproduction was clearly demonstrated in one or more of the compromised estuary zones. In addition, moderate to strong reproduction was demonstrated for multiple species in each zone indicating substantial recovery in the "propagation" use for Zones 3, 4, and upper Zone 5. Weak and inconsistent spawning by Atlantic Sturgeon, and limited spatial recovery in spawning and rearing by American Shad and Striped Bass, suggested that full restoration of the "propagation" use is not supported by the current available data. Based on this evaluation, DRBC staff recommends that partial restoration of the "propagation" use be recognized as the existing use for Zones 3, 4, and upper Zone 5 of the Delaware Estuary.

Introduction

Water quality problems have plagued the tidal Delaware River for decades, with early evidence of severe hypoxia extending at least to 1912 (Philadelphia 1914). The USGS began daily recordings of dissolved oxygen at the Ben Franklin Bridge and at Chester, PA, in the 1960s and these records provide the most comprehensive documentation on the timing and magnitude of the estuary's historic hypoxia. The dissolved oxygen conditions for 1967 (see Figure 1) are largely representative of this severe hypoxia, and show hypoxic conditions beginning in May and extending into November.

By the 1950s, the various water quality problems (including dissolved oxygen) and their effects on both human populations and the Delaware Estuary ecosystem warranted federal investment to circumscribe the problem and chart a course for recovery (FWPCA 1966). The U.S. Public Health Service initiated the Delaware Estuary Comprehensive Study (DECS) in 1961, focusing on a computer model for the effects of municipal and industrial wastewater inputs to the Delaware Estuary, and how reductions in those wastewater loadings could lead to recovery of the dissolved oxygen within the estuary.

Near the conclusion of this study, the 1965 revisions to the Federal Water Pollution Control Act authorized interstate water quality standards to protect both human uses and ecological uses (i.e., "propagation of fish and wildlife", PL 89-234) of such interstate waters. Combined with the recent formation of the Delaware River Basin Commission in 1961 to address both interstate water supply and interstate water quality problems, the 1965 revisions to the Federal Water Pollution Control Act established the requisite authorities and framework for DRBC to adopt water quality standards for the Delaware River in 1967.

Controversy surrounded the initial establishment of dissolved oxygen criteria for the Delaware Estuary because of the significant cost-benefit tradeoffs in terms of ecological restoration versus wastewater treatment costs (FWPCA 1966, Wright and Porges 1971). Dissolved oxygen goals as high as 4.5 mg/L and as low as 1.0 mg/L were evaluated in the policy making process of the 1960s, with a compromise being reached where a dissolved oxygen criterion of 3.5 mg/L would be selected for Zones 3, 4, and upper Zone 5 of the estuary[1]. This 3.5 mg/L daily average dissolved oxygen criterion was then established through the 1967 adoption of DRBC's first Water Quality Regulations. It is important to note that this dissolved oxygen criterion has remained unchanged since 1967 (DRBC 2013).
In setting a dissolved oxygen criterion at the compromise value of 3.5 mg/L, and thus below the recognized requirements for fish and other aquatic life (e.g., FWPCA 1968), the DRBC, its member

[1] Zone 3 extends from River Mile (RM) 95 to RM 108.4; Zone 4 extends from RM 78.8 to RM 95; and the upper portion of Zone where the designated use and the dissolved oxygen criterion are consistent with Zone 3 and Zone 4 extends from RM 70 to RM 78.8. For an explanation of the River Mileage system, see DRBC's website at www.nj.gov/drbc/basin/river/

states, and the federal government set a goal for estuary restoration in these zones that protected only migratory fish passage and "low level maintenance of resident fish in the critical reaches of the estuary" (Wright and Porges 1971, pg. I-3/9). In terms of current water quality standards language, two levels of aquatic life use protection were established for the estuary in 1967. For Zone 2 upstream of the hypoxia, and in lower Zone 5 and throughout Zone 6 below the hypoxia, full aquatic life use protections were established with the designated use of "wildlife, maintenance and propagation of fish and other aquatic life, passage of anadromous fish" or similar language (DRBC 1967; see Appendix A). In the estuary's hypoxia regions of Zones 3, 4, and upper Zone 5, the "propagation" component to this use was removed and the aquatic life designated use (and thus the restoration goal) in these estuary zones was set to "wildlife, maintenance of resident fish and other aquatic life, passage of anadromous fish".

Despite these compromises and the recognition in 1967 that full restoration of dissolved oxygen would be difficult, the recovery of both dissolved oxygen and most fish stocks in the Delaware Estuary have been remarkable. Striped Bass runs currently rival those of other major estuaries (e.g., Kahn et al. 2015), American Shad now freely migrate through, and spawn in, the Delaware Estuary (DRBFWMC 2011), and broader surveys of the fish assemblage show high catch rates and remarkable diversity (e.g., Pyle 2015). Sustained funding by DRBC and the USGS for the dissolved oxygen sensors at the Ben Franklin Bridge and Chester, PA, have documented the remarkable recovery in dissolved oxygen concentrations (see *waterdata.usgs.gov*). Figure 2 presents the full daily mean distribution of July dissolved oxygen at the Ben Franklin Bridge since the 1960s, showing the steady rise of summer dissolved oxygen beginning around 1980 and extending to ca. 2000, although dissolved oxygen has been quite variable since 2000 (see detailed summaries of 2000 to 2014 data in Appendix B).

As part of the recovery in dissolved oxygen and fish stocks, data began emerging that some degree of "propagation"[2] was occurring in Zones 3, 4, and upper Zone 5 where such fishery restoration was not anticipated in 1967. Because Clean Water Act regulations require any improvement in conditions to be captured and recognized, in part to prevent "backsliding" or loss of improvements gained through restoration efforts, data demonstrating successful reproduction in Zones 3, 4 and upper Zone 5 would serve as the initial basis for a re-evaluation of the designated uses for these estuary zones. Specifically, 40 CFR § 131.10(i) states "*Where existing water quality standards specify designated uses less than those which are presently being attained, the State shall revise its standards to reflect the uses actually being attained*." In other words, if the "Existing Use" (i.e, the use presently being attained) is higher than the "Designated Use" currently adopted in regulations, reconciliation is needed under federal rules.

[2] The term "propagation" is not defined in DRBC's Water Quality Regulations. Often used in the context of artificial rearing (e.g., fish hatcheries), other regulatory agencies have defined propagation as "reproduction of fish, aquatic life and wildlife within their natural environment." (Delaware 2014). Based on the historical context of the aquatic life uses established in 1967, this report recognizes propagation somewhat more broadly as both the reproduction and the critical early life stage rearing necessary to recruit aquatic life into the population. For the fish species examined in detail in this report, this definition of propagation would include protection of spawning, eggs, larvae, and early stage juveniles.

The DRBC's Water Quality Advisory Committee began deliberations on this issue in 2009 as part of a broader evaluation of nutrient and dissolved oxygen conditions for the Delaware Estuary (see meeting minutes at *www.drbc.net*). A petition by three non-profit organizations in 2013 emphasized the need to proceed in reconciling the Existing Use with the Designated Use based on their evaluation of fishery data from the Delaware Estuary. Finally, the Water Quality Advisory Committee discussions culminated in a September 2013 resolution recommending the following:

> *"The WQAC recommends that within one year the DRBC staff will prepare for the Committee a description of the existing aquatic life uses of the Delaware Estuary with citation to source materials which will be used to craft a formal Finding of Existing Uses that will be presented by the Committee to the Commissioners."*

In this report, DRBC conducts an evaluation of available data for resident and anadromous fishes to directly address the question as to whether, and to what degree, a broader "propagation" use has occurred in Zones 3, 4, and upper Zone 5 of the Delaware Estuary. The data sources and the methods for evaluating these data are first described. The results of the evaluation are then provided for each species in each of the three downgraded zones of the estuary. Finally, the individual evaluations are synthesized into a zone-specific assessment of the "propagation" use.

In addition, DRBC documents the dissolved oxygen conditions in the Delaware Estuary during a matching data window as an appendix to this report (see Appendix B). Although many factors interact to determine the population sizes of estuarine fish, the historic efforts to restore dissolved oxygen in the estuary as well as guidance from EPA on documenting existing uses together suggested that a summary of contemporary dissolved oxygen data would be a valuable component to a more comprehensive report.

Data Sources

This report uses the results from three separate data collection efforts for resident and migratory fish species inhabiting the Delaware Estuary in order to evaluate the extent and consistency of "propagation" in Zones 3, 4, and 5. These data sets are described in detail below, but the decision to focus on these three data sets for the current evaluation is first discussed.

The evaluation of "propagation" in the broadest sense could include an evaluation of the reproductive success of many aquatic assemblages in the tidal Delaware Estuary, from planktonic invertebrates to freshwater mussels to anadromous fish. All are aerobic organisms utilizing the tidal Delaware River for reproductive output and subsequent nursery of juvenile organisms. Yet two factors recommend the use of the resident and migratory fish assemblages above other aquatic organisms. First, from a historical context, the restoration of dissolved oxygen in the Delaware Estuary centered on the restoration of fishery resources such as American Shad and Striped Bass. In order to assess the efficacy of the past 40+ years of dissolved oxygen restoration, its origins in fishery restoration argue for an evaluation of that fishery resource and the extent of successful "propagation" in this resource. Second, and more importantly, is the pragmatic reality that little or no data currently exist on the extent of successful reproduction for most organisms in the Delaware Estuary, and even less data exist on the spatial and temporal patterns in that reproductive success. Only the intensive monitoring of fishery resources for both regulatory and management objectives produces quantitative data on the location and timing of successful spawning as well as the later rearing stages. Therefore, the current evaluation of "Existing Use" for Zones 3, 4, and 5 of the Delaware Estuary relies exclusively on previously collected fishery data for eggs, larvae, and juveniles of resident and migratory fishes utilizing these zones of the Delaware Estuary.

Fishery surveys in the Delaware Estuary have been (and continue to be) conducted to fulfill many objectives, from permit compliance to fishery management obligations to basic academic research. Much of this effort is directed at assessment of adult populations, and such surveys provide limited utility for the current assessment of "propagation" in the Existing Use context because of their focus on older life stages. Other surveys do capture and quantify early life stages for many fish species, but have limited spatial and/or temporal resolution and thus only provide presence/absence answers to questions that (as shown later) require evaluations of strength and consistency. Impingement and entrainment reports at a single facility in an isolated year are examples of such valuable fishery data which have not been incorporated into this evaluation because they shed little additional light on the core questions beyond what is already established with more comprehensive data sources.

Three data collection efforts, however, directly target early life stages of one or more fish species and provide data that directly answer questions about the relative strength of spawning and early life stage survival in the Delaware Estuary across a broader spatial and temporal extent. In particular, these three data sets share three common features that make them particularly well-

suited for evaluating the "Existing Use" questions relative to the full "maintenance & propagation" use within DRBC's water quality regulations:

i. Quantitative data on the success of early life stages in Zones 3, 4, and/or 5 of the Delaware Estuary;
ii. Multiple years of data at known and consistent spatial locations;
iii. Data collection during the period from ca. 2000 to 2014 when dissolved oxygen conditions exhibited no long-term trends (see Figures 3 and 4).

The first of these three data sets was identified through discussions at the Delaware River Basin Fish & Wildlife Management Cooperative and comes from regulatory monitoring for the PSEG Salem Nuclear Generation Station, a large nuclear power plant located near the lower boundary of DRBC Zone 5 within the Delaware Estuary (~RM 51; see Figure 3). In advance of PSEG's submission of its renewal application in 2006, ichthyoplankton surveys were required throughout the tidal Delaware Estuary (river and bay) during 2002, 2003, and 2004. Detailed descriptions of the methodology can be found in the respective Biological Monitoring Program annual reports (PSEG 2002, PSEG 2003, PSEG 2004). In summary, the entire estuary from Trenton to the Atlantic Ocean was divided into 14 "zones" (see Figure 4; henceforth referred to as "reaches" to avoid confusion with DRBC water quality management zones), with multiple grids within each reach. Surveys were conducted twice monthly from April through July resulting in 8 surveys each year. During any survey, station locations were randomly selected within each reach from among the grids, with multiple stations (ranging from 2 to 14) within each reach and somewhat even effort per unit area across the estuary. Sampling consisted of a 1 m diameter conical plankton net with 500 µm mesh netting and 500 µm mesh capture bucket. Depending on depth, single integrated tows proceeded at successively deeper vertical positions for a total trawl time of 4 to 6 minutes. Equal amounts of time were sampled at each depth, with no surveys at station locations with depths 10 ft or less, and increasing numbers of strata for increasing depths: for 10-20 ft depth, sampling at 5 ft and 15 ft strata; for 20-30 ft depths, sampling at 5 ft, 15 ft, and 25 ft strata; etc. Samples were preserved in the field with 10% formalin and stained with Rose Bengal. In the lab, a complex subsampling procedure was used, and identifications were made to species level, if possible, for each life stage. However, only "target species" were enumerated for all samples. These target species were Blueback Herring, Alewife, American Shad, Atlantic Menhaden, Bay Anchovy, Atlantic Silversides, White Perch, Striped Bass, Bluefish, Weakfish, Spot, and Atlantic Croaker along with two invertebrate groups (*Neomysis americana, Gammarus* spp.).

Data from the PSEG Ichthyoplankton surveys are provided as event summaries for each of PSEG's reaches, with results broken out by species for the following life stages: eggs, yolk sac larvae, post-yolk sac larvae, juveniles, adult, and undetermined larvae (see Appendix D). Thus, data from multiple survey stations are pooled to represent each of the PSEG reaches in the estuary for each survey date. The PSEG Ichthyoplankton results provide the most direct measure of spawning activity for key species such as American Shad and Striped Bass, although the high variability in catch rates for eggs and yolk sac larvae are important to keep in mind given their episodic occurrence and short life-stage duration. In addition, the PSEG Ichthyoplankton data provide some measure of the success by tracking each fish species through each of their early life stages, a key component in the overall assessment of successful "propagation" for the target species

included in the PSEG surveys. As shown in Figure 4, however, the PSEG reaches cross the boundaries for DRBC zones, leading to ichthyoplankton data that apply to more than a single DRBC zone.

The second data set identified for inclusion in this evaluation originated from a member of the Delaware River Basin Fish & Wildlife Management Cooperative. The NJ Division of Fish & Wildlife, Bureau of Marine Fisheries, conducts Delaware Estuary beach seine surveys from June through November each year, with initial sampling for these surveys beginning in 1980 and continuing every year through the present. These surveys constitute a key fishery independent monitoring project that is required under the Atlantic State Marine Fisheries Commission's "Fishery Management Plan for Striped Bass." Designed primarily for monitoring juvenile Striped Bass, the survey also currently records the abundance of all species captured. Full survey details are contained in annual reports posted on the Bureau of Marine Fisheries website (e.g., 2014 report at www.njfishandwildlife.com/artdelstudy15.htm), with key survey details summarized here. Seining occurs during daylight hours at beach locations within the tidal Delaware River with a 100 ft long, 6 ft deep bag-containing seine net with ¼ inch mesh. In addition to counts by species, lengths are measured for target species (see web report for list) and the range of sizes is recorded for non-target species. Sampling currently occurs at 32 fixed stations beginning upstream at RM 126 (Newbold Island) in DRBC Zone 2 and extending downstream to RM 53 (Augustine Beach) near the lower end of DRBC Zone 5 (Figure 3). Sampling stations and effort have remained highly consistent for the 2000-2013 period used in the current evaluation of Existing Use. Greater sampling effort occurs in Zones 2, 4, and 5 than in Zone 3 because fewer suitable "beach" seining locations are available in Zone 3. Fish species are typically identified in the field, with nearly 100 species identified through the duration of the survey.

It is important to distinguish the nature of data collected in the New Jersey Seine Survey from the data collected in the PSEG Ichthyoplankton survey, and to acknowledge the limitations with respect to the Existing Use question evaluated in this report. The New Jersey Seine Survey begins to capture fish of different species typically when they reach between 20 mm and 30 mm in length. Depending on the species, this could represent nearly mature fish (e.g., Bay Anchovy) or it could represent early young-of-year fish recently spawned and reared near an individual beach seine location (e.g., Striped Bass). In addition, because of varying fidelity to the estuary itself beyond the early nursery stage, some species can be more clearly identified as young-of-year juveniles spawned and/or reared within the estuary (e.g., American Shad) while other species use the estuary for all or a larger portion of their lifecycle, thus mixing young-of-year juveniles with older juvenile and adult fish (e.g., White Perch). As a result, the New Jersey Seine Survey provides a measure of the combined success of both spawning and rearing through the minimum size threshold for those species where young-of-year fish can be clearly identified (American Shad, Alewife, Blueback Herring, Striped Bass [note: although Striped Bass utilize the estuary for multiple years, the NJ Bureau of Marine Fisheries uses a suite of criteria to accurately distinguish young-of-year from older fish]). For species where the distinction between young-of-year and older fish cannot be made (e.g., Atlantic Silversides, Bay Anchovy, Hogchoker, White Perch), these data provide more of a combined population estimate and an indicator of whether successful reproduction and rearing had occurred, but not a more narrow measures of

"propagation" alone. In addition, and in contrast to the PSEG Ichthyoplankton surveys, the New Jersey Seine Survey samples and identifies all fish species collected in their survey. For the current Existing Use assessment, the New Jersey Seine Survey data are therefore more important for species whose young-of-year could be clearly distinguished.

The New Jersey Seine Survey thus provides important data for assessing propagation and, in particular, provides a historical context upon which to assess the current results. The survey's origins in the early 1980s cover the period when dissolved oxygen was only beginning to recover from decades of chronic hypoxia and when some migratory fishes were initiating their recovery within the Delaware Estuary. Such origins, combined with an unbroken time series, provide an insightful perspective on current spawning efforts. Those early years of the survey typically showed very low young-of-year abundance, especially in Zones 3 & 4, and these low catches delineate the lower end of the "propagation" scale when fish spawning and recruitment was either low or failing. Although the lower end of the "propagation" scale is therefore clearly delineated, the upper end of the recruitment scale (e.g., pre-European numbers) that would establish a benchmark for highly successful propagation remains uncertain making it difficult to assess how complete the recovery of spawning and rearing has been without that historical upper range clearly delineated. Nevertheless, the temporal extent of the New Jersey Seine Survey at a minimum provides a clear measurement scale for both poor recruitment as well as moderate to strong recruitment for many estuarine species, yielding a scale that is well-positioned to answer questions about the success or failure of spawning and recruitment of estuarine fish species.

The third and final data set used for this report involves multiple targeted collections and tracking of early stage juvenile Atlantic Sturgeon (also known as river-resident juveniles; see species results below). Beginning in 2009, Delaware's Division of Fish & Wildlife shifted their sampling methods for juvenile Atlantic Sturgeon to better capture spring spawned young-of-year fish from the Delaware Estuary as well as both age-1 and age-2 fish which had overwintered in the Delaware Estuary. These targeted surveys for early stage, river-resident juvenile Atlantic Sturgeon were completed in 2009, 2010, 2011, 2012, and 2014. In addition, Brundage and O'Herron conducted separate surveys in order to tag and track juvenile Atlantic and Shortnose Sturgeon (Brundage and O'Herron 2010). For both research groups, surveys primarily involved small-mesh gill net deployment in targeted locations, with supplemental data collected through active and passive tracking of tagged individuals collected in the gill net surveys. Tracking also provided spatial data to improve the placement of gill net surveys. Gill net surveys focused on areas between Carney's Point, NJ (RM 71) and Marcus Hook, PA (RM 81) covering the upper portion of Zone 5 and the lower portion of Zone 4, although additional surveys further upstream and downstream were also included. Passive and active tracking extended throughout the Delaware Estuary from Zone 2 through Zone 6 (Delaware Bay). Detailed methods and results can be found in the various annual reports (Brundage & O'Herron 2010, Fisher 2010, Fisher 2011a, Fisher 2011b, Fisher 2012, Fisher 2013, Brundage & O'Herron 2014).

Evaluation Methodology

The recovery of fish spawning and rearing in the Delaware Estuary involves a gradual process of increasing success as water quality, habitat, and overall stocks improve toward conditions existing prior to severe human alteration. Initially, some limited spawning and rearing may occur in the estuary, particularly for fish species tolerant of heavy human influences such as the hypoxia historically present in the Delaware Estuary. With continued recovery of impaired conditions, further increases in the spawning and rearing would be expected as more species of fish and more individuals of each species find increasingly suitable conditions for growth and development. With substantial restoration of conditions and with the resulting increases in population sizes, the utilization of the estuary may approach levels seen historically for many, if not most, fish species.

Recognizing the continuum in this recovery spectrum, the current report seeks to go beyond a simple yes/no (or binary) answer to the question about fish "propagation" in the estuary. To achieve a more continuous representation in the restoration of fish "propagation" for the Delaware Estuary, and to seek a relatively objective answer to these questions which undoubtedly contain many subjective elements, the evaluation of data for each fish species was broken into a series of yes/no questions that represent increasing levels of success in restoring each species' use of the Delaware Estuary. An example is shown in Table 1. These yes/no questions were evaluated separately for each fish species and for each of the three DRBC water quality zones where the "propagation" use is not currently designated in the DRBC Water Quality Regulations (Zones 3, 4, & 5; note that Zone 5 has different "uses" in the upper and lower portion; these two sections of Zone 5 were evaluated separately[3]). And to acknowledge the lack of clear objective thresholds for decisions on each question, a middle category between "yes" and "no" was allowed and used in numerous settings when the data were considered equivocal.

Initial stages in "propagation" success can be demonstrated with some evidence of eggs, larvae, and/or early juvenile stages in a specific estuary zones. Even if such data are not consistent year after year, the presence of measureable numbers of early life stage individuals allows for an affirmative answer to the question, "Is there any evidence of successful reproduction?" This is the first question addressed along the continuum.

Further restoration would then be demonstrated with increased numbers of early life stage individuals and/or increased consistency among years in catch data for these early life stages. Such moderate levels of consistency would permit an affirmative answer to the question, "Is there regular evidence of successful reproduction for this species?" This is the second and middle category for evaluating the degree of successful reproduction.
More complete restoration is then demonstrated with a high level of consistency and substantial numbers of these early life stage individuals in most years. Of course, estimates of population sizes and spawning success are notoriously uncertain or variable for many fish species, so a high

[3] Upper Zone 5 has "maintenance" only while lower Zone 5 has the full "maintenance and propagation" use

degree of consistency does not necessarily require equal numbers year after year without any breaks in the string of successful year classes. Instead, this high variability is acknowledged and helps establish expectations for the third question, "Are there strong numbers and high consistency of successful reproduction?"

Table 1. Example of the Evaluation Matrix. (Overall structure is explained in text. The first three color-coded columns in the table indicate priorities in different studies. The first shows whether the 1979 Task Force (Nadeau et al. 1979) identified the species as a key "migratory or marine/estuarine" (m), "resident (freshwater/brackish water)" (f). The second shows a red box for those species included as part of PSEG Salem's targeted species list. The third column shows in blue species averaging more than 10,000 fish caught per year and in green species averaging more than 10 fish caught per year in the NJ Seine Survey.

		Species X								
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		**Common name**	**Scientific name**		**Any evidence of successful reproduction?**	**Regular evidence of successful reproduction?**	**Strong numbers & high consistency of successful reproduction?**	**"Nursery" with juveniles**
m				Species X	*Genus species*					
						Zone 3	Y	Y	?	Y
						RM 95-108.4				
						Zone 4	Y	?	N	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	N	N	Y
						RM 70-78.8				
						Zone 5 (lower)	N	N	N	?
						RM 48.2-70				

This third and highest level of "propagation" restoration used in this report proved to be the most problematic and ambiguous of the three categories for evaluating the fishery data. Two issues arose. First, it was not always clear how consistent and how high catch data needed to be to qualify for a "yes" in this category, with discussions of a more rigorous threshold. Although a number of candidate thresholds were considered, a clear choice for a threshold was not apparent and none was employed in the current evaluation. The second limitation with this highest category involves the degree to which it represents full successful restoration of "propagation" for any particular species. Although some managed stocks (e.g., Striped Bass) have officially been designated as "restored" by management agencies, quantitative historical data are typically sparse and involve comparisons across different sampling methods. Thus, even for populations who have seen substantial recovery, it is difficult or impossible to infer whether population sizes have recovered to levels seen prior to major alteration of the estuarine ecosystem (water quality, habitat, etc.). In the absence of such comparative data, this study contends that an affirmative

answer to this highest category of "propagation" still leads to ambiguity on the question of whether the "propagation" use has been fully restored or whether continued improvement toward full restoration remains possible; both levels of restoration may be implied by a "yes" to this question.

Because subjectivity persisted even with these attempts to minimize its influence, initial evaluations for key species were presented to fishery biologists both at a Delaware River Basin Fish & Wildlife Cooperative technical committee meeting, and in smaller group settings with fishery biologists from the states of Delaware, New Jersey, and Pennsylvania. Data from multiple sources were reviewed for the key species, and the decisions for each question were evaluated. Typically, a consensus could be reached on the appropriate answer to each question, but complete agreement was not always possible.

Two additional and important clarifications are needed to understand the current data evaluation, with the two issues being related. The first relates to different evaluation standards for different species. The second relates to different expectations for fish species in different zones of the estuary.

This report did not typically apply different standards in the data evaluation matrix for different species. As described above, the data that would qualify for an affirmative or negative evaluation to the "any" vs "regular" vs "strong" questions were largely the same for all species. One important distinction was made to account for the salinity regime in which spawning occurs for each species. For obligate freshwater spawning fish, affirmative answers to the questions in freshwater zones (i.e., Zones 3 and 4) required increasing demonstration of eggs and larval presence and abundance. However, a number of marine and brackish water fish species use different salinity regimes for different stages in their spawning and larval rearing phases (e.g., Bay Anchovy, Atlantic Menhaden). For these more marine or brackish water species, the demonstration of low to moderate levels of "use" for an estuary zone could be demonstrated without substantial data on eggs, in particular. Thus, the use of upper Zone 5 for Bay Anchovy was assessed as affirmative for the "regular" level because substantial and moderately consistent numbers of larval and juvenile fish were observed even though eggs were not similarly strong. In contrast, the lack of consistent egg numbers in Zone 4 for American Shad, despite substantial evidence of larval and juvenile use in this zone, led to an ambiguous evaluation for whether American Shad use qualified as "regular evidence of successful reproduction". This approach constituted the only incorporation of life history and habitat use into the evaluation matrices, and the only change in the standards by which different species were evaluated.

More broadly, each fish species evaluated in this report does not have the same expected use in all zones of the estuary. As mentioned above and in the species descriptions below, different salinity requirements and preferences among species leads to substantially different expectations for which fish should be "propagating" in the brackish lower Zone 5 than in the purely freshwater Zone 3. In addition to salinity, each species has different habitat preferences that make even similar salinity zones (e.g., Zones 2, 3, and 4) more or less suitable for each species. These differences in the basic ecology for each fish leads to different expectations for

what “successful propagation” looks across multiple species for each zone of the estuary. A group of primarily fisheries biologists attempted to define these different expectations for many of the key species (although Atlantic Sturgeon were omitted) in 1979 when evaluating the fishery and D.O. requirements in the estuary (Nadeau et al. 1979; see Appendix C for Table 1 of their evaluation). Given the history of gross pollution in the estuary and the sparse availability of reliable historic data, any such attempt at setting the precise expectations for fish recovery in the estuary is subject to debate, and the evaluation in Nadeau et al. would benefit from an updated review of these expectation in light of the observed recovery seen since 1979. Unfortunately, a thorough review of the expectations for each species based on both historical data and current biological requirements was beyond the scope of the current study. Nevertheless, the Table 1 expectations in Appendix C begin to distinguish the varying expectations for “successful propagation” among the estuary’s zones. In particular, the 1979 evaluation shows, for instance, that Bay Anchovy were not expected to use Zone 4 in appreciable numbers for spawning or nursery, while American Shad were not expected to use Zone 5 in appreciable numbers for spawning and nursery activities. These broader expectations for each zone are therefore used in the final evaluation for each zone of the estuary (see Conclusions section), while acknowledging some uncertainly for the exact expectation in each zone.

Results – Species Level Evaluations for Successful "Propagation"

Each species' evaluation is presented separately below beginning with fish whose data most directly addresses the questions of "propagation" for the estuary

ATLANTIC STURGEON

Atlantic Sturgeon (*Acipenser oxyrhynchus*) are large (to 14 ft / 4 m), long-lived (60 years), and late-maturing (5 to 22 years) anadromous fish that use tidal estuaries for spawning (ASSRT 2007 and references therein). Spawning occurs in a zone beginning at the salt front and extending upstream to the fall line, although exact locations are not known for each estuary. In the Delaware Estuary, this zone extends from upper Zone 5 through Zone 2. Spawning occurs in spring and early summer, perhaps as late as mid to late June in the Delaware River (Simpson and Fox 2007). Individuals are not believed to spawn every year but instead may return every 1 to 5 years to their spawning grounds. Juvenile sturgeon become tolerant to brackish water and reside in both freshwater and brackish water areas within their natal estuary for one or more years (river-resident juveniles). Juveniles migrate out of their natal estuaries beginning at age 2 and will mix with Atlantic Sturgeon from other estuaries is coastal and estuarine habitats, but will then return to their natal estuary to spawn (McCord et al. 2007). It is important to note that laboratory work has shown that young juvenile fish sustain high mortality under depressed dissolved oxygen conditions (e.g., Secor and Gunderson 1998).

Recent surveys have confirmed successful reproduction and recruitment of Atlantic Sturgeon in the Delaware Estuary. Although isolated young-of-year catches have been noted for decades, the first documentation of at least a small to moderate year class occurred with the capture of over 60 young-of-year sturgeon beginning in the fall of 2009 (Fisher 2010, Brundage & O'Herron 2010). However, subsequent surveys have documented only sporadic success for Atlantic Sturgeon spawning and rearing. The following year in 2010, no young-of-year Atlantic Sturgeon were captured when fishing in a manner consistent with the 2009 efforts but at reduced efforts. In 2011, another successful year class was documented when nearly 50 young-of-year were captured (Fisher 2012). In 2012, only two young-of-year Atlantic Sturgeon were captured during targeted surveys (Fisher 2013). Limited surveys were conducted in 2013, so no comparable data

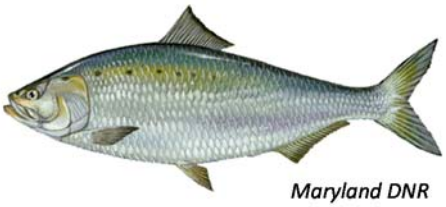
exist. Then in 2014, another successful year class was documented with over 200 river-resident juveniles captured during the targeted surveys, although size ranges prevented clear indications for the number of young-of-year fish (I. Park *personal communication*, H. Brundage *personal communication*). It is important to note that survey effort was not consistent among years, so variations in catches may partly be attributable to variable effort.

Gill net captures of young-of-year Atlantic Sturgeon were all made in lower Zone 4 and upper Zone 5 (above RM 70) within the Delaware Estuary. Tagging of select individuals subsequently showed extensive use of all zones in the Delaware Estuary for juvenile rearing (Brundage & O'Herron 2010, Fisher 2011b, Brundage & O'Herron 2014). Although the location of Atlantic Sturgeon spawning grounds within the Delaware River remains unknown and somewhat controversial (Simpson 2008, Breece et al. 2013), the initial collection of young-of-year fish in both upper Zone 5 and lower Zone 4 leads to an affirmative answer within these two zones for the question, "Is there any evidence of successful reproduction?" For Zone 3 and lower Zone 5, the movement of tagged age-0 fish into and through these zones, combined with the possibility of suitable spawning habitat in both Zone 2 and Zone 3, leads to the uncertain and inconclusive answer of "?" for the question, "Is there any evidence of successful reproduction?" for Zone 3 and for lower Zone 5. Furthermore, the initial positive results in 2009 combined with the failure or near failure to capture young-of-year fish in both 2010 and 2012 leads to a "no" decision for all zones with respect to both of the two higher classifications: "Is there regular evidence of successful reproduction for this species?" and "Are there strong numbers and high consistency of successful reproduction?"

Table 2. Evaluation Matrix for Atlantic Sturgeon in Zones 3, 4, and 5 of the Delaware Estuary

		Atlantic Sturgeon								
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		**Common name**	**Scientific name**		**Any evidence of successful reproduction?**	**Regular evidence of successful reproduction?**	**Strong numbers & high consistency of successful reproduction?**	**"Nursery" with juveniles**
				Atlantic Sturgeon	*Acipenser oxyrhynchus*					
						Zone 3	?	N	N	Y
						RM 95-108.4				
						Zone 4	Y	N	N	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	N	N	Y
						RM 70-78.8				
						Zone 5 (lower)	?	N	N	Y
						RM 48.2-70				

AMERICAN SHAD



American Shad (*Alosa sapidissima*) are an anadromous fish of the western Atlantic Ocean, with spawning runs extending from the Saint Johns River, Florida, to the Saint Lawrence River, Canada. Spawning occurs in both tidal and non-tidal freshwater regions of coastal rivers and streams during spring and early summer. Juvenile shad spend their first summer within their natal river and migrate to the Atlantic Ocean in late summer and fall of that same year. American Shad have been the focus of fisheries and water quality management programs for over 100 years in the Delaware River (e.g., Gay 1892, Hardy 2009) and were a key component to the dissolved oxygen recovery programs of the 1960s and 1970s (FWPCA 1966, Wright and Porges 1971). American Shad have been shown to be sensitive to low dissolved oxygen levels (Stier and Crance 1985).

Summary results from PSEG Ichthyoplankton data are presented in Figure 5. American Shad eggs were primarily caught in lower Zone 2 and upper Zone 3, with broader distributions for both yolk sac larvae and post-yolk sac larvae. The broader distribution of post-yolk sac larva likely represents passive movement via river currents as well as increased catchability for this life stage due to its longer persistence time in the estuary. Overall, these data show successful "propagation" for American Shad in Zones 2, 3, and 4 of the estuary, with some utilization of upper Zone 5, as well. The strength and consistency, however, varies by zone. In Zone 3, relatively high and consistent larval fish numbers were collected in the three survey years, but egg numbers varied markedly within the zone in all three years, with higher egg densities collected in the lower areas of Zone 2 and the upper areas of Zone 3 compared to the lower areas of Zone 3. In Zone 4, moderately strong densities of larvae were collected in all three years, but American Shad eggs were rarely collected.

Figure 6 presents the young-of-year catches for American Shad in Zone 3, 4, and 5 for the New Jersey Seine Survey. The main pattern in these results is the restoration of the nursery in the Delaware Estuary beginning in the late 1980s. In addition, even with fewer stations and thus lower sampling effort in Zone 3, these results show high and relatively consistent use of Zone 3 when compared to Zones 4 and 5 downstream. Zone 4 results are similar to the Zone 3 results, although greater frequency of low catches is seen in Zone 4 than in Zone 3 for any given year. Finally, young-of-year American Shad show substantially less use of Zone 5 than of the upstream zones

Based on the combined results from the two surveys, American Shad propagation has been documented in Zones 3 and 4 since 2000, with some sparse evidence for larval fish use and stronger evidence for juvenile fish use in upper Zone 5. An affirmative answer is indicated in all three zones for this first question, "Is there any evidence of successful reproduction?" while a

negative response is indicated for lower Zone 5. For Zone 3, the high egg catches in the upper areas of the zone and the strong larval fish numbers in all years further indicate an affirmative answer to the second question, “Is there regular evidence of successful reproduction for this species?” However, the inconsistent egg densities in all three years within Zone 3 indicate some decrease in the utilization of lower sections of Zone 3, and an ambiguous “?” is thus provided for the highest level of use and the question, “Are there strong numbers and high consistency of successful reproduction?”

In Zone 4, the sparse egg catches and the tapering numbers of larval fish provide ambiguity to the question, “Is there regular evidence of successful reproduction for this species?” Certainly some regular use of Zone 4 is indicated, but for later stages of immature and juvenile American Shad, and an ambiguous “?” answer is provided for Zone 4 at this second level. Furthermore, these same patterns and the lower catches of young-of-year American Shad in Zone 4 together indicate a “no” answer to the highest utilization question, “Are there strong numbers and high consistency of successful reproduction?”

Finally in Zone 5, only sparse numbers of larval American Shad have been collected in the upper section above RM 70, although increased use by young-of-year fish is noted. This indicates substantial use by later stages of juvenile American Shad more consistent with a nursery function. Thus, a negative response is indicated for both of the higher use questions: “Is there regular evidence of successful reproduction for this species?” and “Are there strong numbers and high consistency of successful reproduction?” For lower Zone 5, the absence of any eggs or larvae leads to negative responses for all questions.

Table 3. Evaluation Matrix for American Shad in Zones 3, 4, and 5 of the Delaware Estuary

1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups	Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
American Shad									
m			American Shad	*Alosa sapidissima*					
					Zone 3	Y	Y	?	Y
					RM 95-108.4				
					Zone 4	Y	?	N	Y
					RM 78.8-95				
					Zone 5 (upper)	Y	N	N	Y
					RM 70-78.8				
					Zone 5 (lower)	N	N	N	?
					RM 48.2-70				

STRIPED BASS

Striped Bass (*Morone saxatilis*) are an anadromous species native to the western Atlantic Ocean from Florida to Canada. They are long-lived (up to 30 years) with males maturing relatively early (100% at 3 years) while females mature later at a much larger size (50% at 6 years; ASMFC 2013). The Delaware Estuary is one of the four primary spawning grounds for Striped Bass including the Hudson River and the Chesapeake Bay and its tributaries (Able and Fahay 1998). Spawning occurs in tidal freshwater to oligohaline zones (less than 3 ppt salinity; Wang and Kernehan 1979). For the Delaware Estuary, spawning begins in early April and can extend into June and July, although peak activity occurs in late April or early May (Wang and Kernehan 1979). Juvenile fish spend 2 or more years in coastal estuaries (and may move upstream into non-tidal areas) before joining coastal migratory populations. Striped Bass population management and recovery has been a model for other species' management, with Striped Bass populations largely recovering from historic lows by the 1990s (e.g., ASMFC 1995).

Summary results from the PSEG Ichthyoplankton surveys are presented in Figure 7. Consistent patterns are seen across the three years of surveys, with egg and larval catches extending from Zone 2 through Zone 5 each year and peak abundances in Zone 4 and, particularly, Zone 5. Reduced numbers are apparent in Zone 3. Overall, these ichthyoplankton data largely match adult Striped Bass spawning survey patterns, with consistent documentation of Striped Bass spawning beginning in Zone 2 and peaking in Zones 4 and 5 (M. Kaufman *personal communication*, G. Murphy *personal communication*).

Results from the New Jersey Seine Survey are presented in Figure 8. It is worth emphasizing that the New Jersey Seine Survey is primarily designed and implemented to accurately represent Striped Bass young-of-year recruitment. Among the many strengths in these data, New Jersey fisheries biologists use highly developed length criteria that vary through the season to separate young-of-year fish from age-1 and older fish. The most striking pattern in these data, like with the American Shad, is the overall recovery of Striped Bass spawning in the Delaware Estuary since the 1980s that is related to both the restoration of dissolved oxygen within the Delaware Estuary and the broader restoration of the Striped Bass stock along the Atlantic coast. Within the more recent past, Figure 8 largely corroborates the patterns seen in the PSEG Ichthyoplankton results, with Zone 4 and Zone 5 demonstrating notably similar data distributions for young-of-year fish. In the seine data, however, there is even greater similarity in the Zone 4 and Zone 5 results indicating both the upstream shift in Striped Bass towards Zone 4 as summer progresses (and the salt line within the Delaware Estuary moves increasingly upstream), as well as an increased use of Zone 4 for young-of-year nursery grounds. Like the ichthyoplankton results, decreased catches

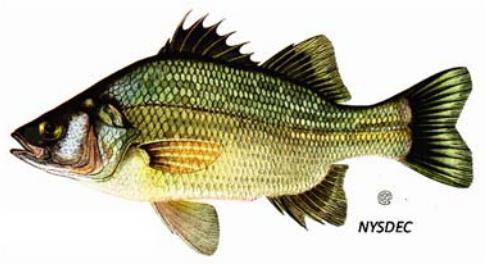
in Zone 3 further highlight the more limited use of Zone 3 by Striped Bass early life stages compared to both Zone 4 and Zone 5 downstream.

The combined and largely consistent patterns from the ichthyoplankton surveys and the seine surveys clearly demonstrate successful reproduction by Striped Bass in all zones of the Delaware Estuary. Within the evaluation matrix, an affirmative answer to the question, "Is there any evidence of successful reproduction?" is thus indicated for Zones 3, 4, and 5. In addition, the regularity in even the modest ichthyoplankton and young-of-year catches for Zone 3, combined with the stronger catches in Zones 4 and 5, indicate an affirmative answer for all three zones to the questions, "Is there regular evidence of successful reproduction for this species?" Finally, the consistently high catches of eggs and larvae in Zone 5 provides a clear indication for "strong numbers and high consistency of successful reproduction" while the somewhat reduced egg and larval catches in Zone 4 create an ambiguous response to this question. In Zone 3, where numbers are clearly reduced for all early life stages, a negative response is indicated for this third question within the evaluation matrix.

Table 4. Evaluation Matrix for Striped Bass in Zones 3, 4, and 5 of the Delaware Estuary

1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups	Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
			Striped Bass						
m			Striped Bass	*Morone saxatilis*					
					Zone 3	Y	Y	N	Y
					RM 95-108.4				
					Zone 4	Y	Y	?	Y
					RM 78.8-95				
					Zone 5 (upper)	Y	Y	Y	Y
					RM 70-78.8				
					Zone 5 (lower)	Y	Y	Y	Y
					RM 48.2-70				

WHITE PERCH



White Perch (*Morone americana*) is the second of two species in the genus *Morone* native to the Delaware Estuary, and is one of the most abundant fish species in the Delaware Estuary. In contrast to Striped Bass, White Perch are semi-anadromous and typically remain resident within a river system while conducting seasonal migrations from brackish waters to tidal freshwaters as well as migrating above the head-of-tide into non-tidal rivers and streams. Spawning occurs in oligohaline tidal areas (less than 3 ppt salinity) as well as both tidal and non-tidal freshwater zones (Wang and Kernehan 1979). For the Delaware Estuary, spawning begins in late March and can extend into June (Wang and Kernehan 1979).

White Perch results from the PSEG Ichthyoplankton surveys are presented in Figure 9. These results demonstrate a broad utilization across most of the Delaware Estuary by White Perch, with high egg catches beginning in the upper reaches of Zone 2 and extending into Zone 5. Likewise, larval fish densities persisted in all three years at high levels through Zones 2, 3, 4, and much of Zone 5. Although Zone 5 shows some tapering in the distribution, it is noteworthy that one or more reaches in Zone 5 meet or exceed the catches for larval White Perch demonstrated in the upstream estuary zones.

White Perch catches in the New Jersey Seine Survey are presented in Figure 10. It is important to recognize that the results in Figure 10, unlike the seine results from previously reviewed species, do not represent young-of-year fish alone. Instead, because of the resident behavior of White Perch and because of overlapping size distributions among age classes, the results in Figure 10 indicate the combined abundance of both young-of-year fish and mostly younger age classes of resident White Perch. This blending of age classes limits the ability to infer the degree of successful "propagation" for White Perch based on these data. These results (and additional length distribution data provided by NJ Bureau of Marine Fisheries) primarily assist in demonstrating broad utilization by young-of-year and older age classes throughout the estuary, and confirm that young-of-year fish are indeed using Zones 3, 4, and 5 as early life stage rearing habitat.

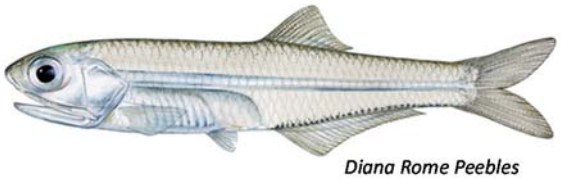
As mentioned, the assessment of reproductive success and the extent of "propagation" for White Perch can mainly be inferred through the PSEG Ichthyoplankton surveys. The New Jersey Seine Surveys clearly demonstrate that young-of-year juveniles currently use Zones 2, 3, 4, and 5, helping to support an affirmative answer to the question, "Is there any evidence of successful reproduction?" The PSEG Ichthyoplankton provide even greater insight into the strength of this utilization by White Perch, demonstrating strong and relatively consistent egg and larval catches

in Zones 2, 3, 4, and upper Zone 5. Combined, these data reveal a broad and highly successful utilization of the Delaware Estuary and demonstrate an affirmative assessment to the two additional matrix questions of "Is there regular evidence of successful reproduction for this species?" and "Are there strong numbers and high consistency of successful reproduction?" for all zones except lower Zone 5. Indeed, the success of White Perch across such a broad extent of the Delaware Estuary provides a scale upon which to evaluate the other estuarine fish species. Only in lower Zone 5 did the data show decreasing use by White Perch, with low egg catches and inconsistent larval densities within the zone and among years. These results provide some ambiguity to the second question, "Is there regular evidence of successful reproduction for this species?" within lower Zone 5, and a negative response to the question, "Are there strong numbers and high consistency of successful reproduction?"

Table 5. Evaluation Matrix for White Perch in Zones 3, 4, and 5 of the Delaware Estuary

				White Perch						
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
f				White Perch	*Morone americana*					
						Zone 3	Y	Y	Y	Y
						RM 95-108.4				
						Zone 4	Y	Y	Y	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	Y	Y	Y
						RM 70-78.8				
						Zone 5 (lower)	Y	?	N	Y
						RM 48.2-70				

BAY ANCHOVY



Bay Anchovy (*Anchoa mitchilli*) is perhaps the most abundant fish of the Delaware Estuary (Wang and Kernehan 1979). They inhabit a broad range of estuarine and coastal marine habitats, and their distribution spans all salinity regimes of the Delaware Estuary. They are short-lived (typically 3 years or less) and repetitively spawn throughout late spring and summer in moderate to high salinity waters (typically 5 ppt or higher). Larval fish appear to have some ability to migrate up-estuary, with both viable larvae and juvenile fish collected at higher densities in more freshwater areas than eggs (Wang and Kernehan 1979, Able and Fahay 1998).

Bay Anchovy results from the PSEG Ichthyoplankton surveys are presented in Figure 11. It is important to note that even higher densities of eggs and larvae (peaks annually exceeding 100,000 and thus natural log scale of 12 on Figure 11) were collected further downstream in Delaware Bay; these higher Delaware Bay catches are not shown in the figure. Given the Bay Anchovy's natural history, the pattern in Figure 11 primarily demonstrates a preference for higher salinities in spawning. However, substantial and somewhat consistent catches of eggs are seen lower Zone 5, with sizable catches of larvae in upper Zone 5 and even into Zone 4. Only in 2004 were catches of Bay Anchovy larvae still appreciable upstream in Zone 3. This suggests upstream transport of Bay Anchovy larvae from principal spawning areas further downstream.

The results from New Jersey Seine Surveys are presented in Figure 12 for Bay Anchovy. Two important notes are warranted about this figure. First, because catches in Zone 3 were typically very low with many zero catches, data are presented for Zone 4, upper Zone 5 (RM 70 to 78.8), and lower Zone 5 (RM 48.2 to 70). Second, seine surveys for Bay Anchovy will necessarily capture relatively late stages of juveniles given their size range, and all catches will represent a mixture of juveniles and mature adults, some of whom are also young-of-year. Thus, the results presented in Figure 12 do not narrowly represent "propagation" success by focusing on early life stages. Supplemental length distribution data provided by NJ Bureau of Marine Fisheries help to demonstrate that juvenile fish were included in the Bay Anchovy catch, and that some nursery use exists for these early life stages.

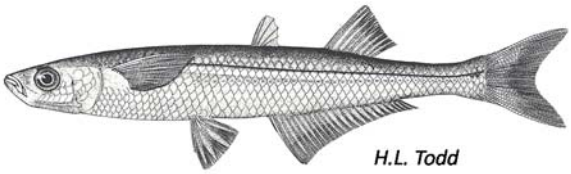
The combined results from the Bay Anchovy ichthyoplankton and seine surveys primarily confirms the more intense and complete use of higher salinity areas of the Delaware Estuary for spawning and rearing activities. Nevertheless, the capture of eggs in lower Zone 5 and the capture of larvae relatively consistently in both Zone 4 and Zone 5 suggests a broader utilization of the Delaware Estuary for early life stages of the Bay Anchovy than simply the higher salinity waters of Delaware Bay (Zone 6). For Zone 3 of the estuary, the presence of larval fish in 2004 provides some ambiguity for the question, "Is there any evidence of successful reproduction?"

while it is clear that a negative answer is warranted in Zone 3 for the two higher demonstrations of early life stages. For Zone 4, the increased regularity of both larval fish catches and capture in the seine surveys leads to an affirmative response to the question, “Is there any evidence of successful reproduction?” Yet there remains uncertainty about how regular this use is, and it does not include the earlier spawning and egg stages of reproduction, leading to an ambiguous answer for the question, “Is there regular evidence of successful reproduction for this species?” and a negative response to the question, “Are there strong numbers and high consistency of successful reproduction?” In upper Zone 5, more regular larval catches indicate an affirmative answer to the questions, “Is there any evidence of successful reproduction?” and “Is there regular evidence of successful reproduction for this species?”, while the lack of eggs and the much higher catches downstream indicate a negative response to the question, “Are there strong numbers and high consistency of successful reproduction?” Finally in lower Zone 5, the regular presence of eggs and larvae combined with juvenile catches in the seine surveys demonstrates an affirmative answer to both of the first two “use” questions. However, comparisons to data from Delaware Bay also demonstrate that much stronger and more complete utilization occurs further down in the estuary and thus a negative response is warranted for the final question, “Are there strong numbers and high consistency of successful reproduction?”

Table 6. Evaluation Matrix for Bay Anchovy in Zones 3, 4, and 5 of the Delaware Estuary

		Bay Anchovy								
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		**Common name**	**Scientific name**		**Any evidence of successful reproduction?**	**Regular evidence of successful reproduction?**	**Strong numbers & high consistency of successful reproduction?**	**"Nursery" with juveniles**
m				Bay Anchovy	*Anchoa mitchilli*					
						Zone 3	?	N	N	Y
						RM 95-108.4				
						Zone 4	Y	?	N	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	Y	N	Y
						RM 70-78.8				
						Zone 5 (lower)	Y	Y	N	Y
						RM 48.2-70				

ATLANTIC SILVERSIDE



Atlantic Silverside (*Menidia menidia*) is also among the most abundant species in the Delaware Estuary (Wang and Kerhehan 1979). Atlantic Silverside are short-lived fish, with typical lifespans of 2 yrs or less (Fay et al. 1983). Although found from freshwater to saltwater zones, they are most common in the higher salinity waters of Delaware Bay and its associated tidal wetlands. Spawning occurs in intertidal areas in spring and summer, typically at salinities greater than 15 ppt, with repeat spawning occurring through the spawning season. For the current data evaluation, it is worth emphasizing that the intertidal spawning and adhesive eggs likely lead to poor representation of the eggs stage with open-water ichthyoplankton surveys such as the PSEG surveys of 2002, 2003, and 2004. Despite this limitation for eggs, larval Atlantic Silverside can be a dominant catch in ichthyoplankton samples (Able and Fahay 1998).

Atlantic Silverside results from the PSEG Ichthyoplankton surveys are presented in Figure 13 showing larvae in these three years largely confined to the lower portions of Zone 5 (RM 48.2 to RM 70), and eggs poorly represented in these open-water samples. Not shown in Figure 13 are the results further downstream in Delaware Bay, where larval abundances were typically as high or higher than those seen in lower Zone 5. As mentioned above, the lack of eggs in the ichthyoplankton collections is expected given spawning behaviors and egg characteristics. Overall, these results demonstrate nearly exclusive use of lower Zone 5 and seaward for reproduction and early life stages (where propagation is already a designated use), with little or no use of Zones 3 or 4 by these life stages.

New Jersey Seine Survey results are presented in Figure 14. Like with Bay Anchovy, catches of Atlantic Silverside were typically very low in Zone 3 and thus Figure 14 focuses on the patterns in Zone 4, upper Zone 5, and lower Zone 5. Also like Bay Anchovy, seine catches represent multiple overlapping year classes and stages of maturity, and cannot narrowly quantify the numbers of immature young-of-year fish in each sample. As a result, the results in Figure 14 do not capture patterns in “propagation” alone but more broadly assess habitat use by multiple life stages. Additional length distribution data from the NJ Bureau of Marine Fisheries, however, establishes that some young-of-year fish are using all zones of the Delaware Estuary, including upstream in Zone 2. Yet the seine data for Atlantic Silverside primarily indicate use of zones in the estuary with moderate to high salinities and sparse use of the freshwater and oligohaline areas.

The patterns from the ichthyoplankton and seine surveys indicate that the “propagation” use for Atlantic Silverside resides mainly in the high salinity zones of the estuary. For Zone 3 and Zone 4, no eggs or appreciable larval numbers indicate a negative response to all three matrix questions. For upper Zone 5, the sporadic larval fish catches leave ambiguous the response to even the basic question, “Is there any evidence of successful reproduction?” Thus, in upper Zone 5, the higher two matrix questions are negative with no “regular” nor “consistent” or “strong”

indications of early life stage use. Instead, these zones primarily are utilized as nursery areas by some small fraction of the juveniles as well as small numbers of adult fish. Only in lower Zone 5 do the data indicate an affirmative answer to the propagation questions, with both of the first use questions, “Is there any evidence of successful reproduction?” and “Is there regular evidence of successful reproduction for this species?” being supported with an affirmative answer from the regular larval fish catches. However, these catches in lower Zone 5 were at times less consistent and weaker than Delaware Bay catches, leading to an ambiguous assessment for the final question, “Are there strong numbers and high consistency of successful reproduction?”

Table 7. Evaluation Matrix for Atlantic Silverside in Zones 3, 4, and 5 of the Delaware Estuary

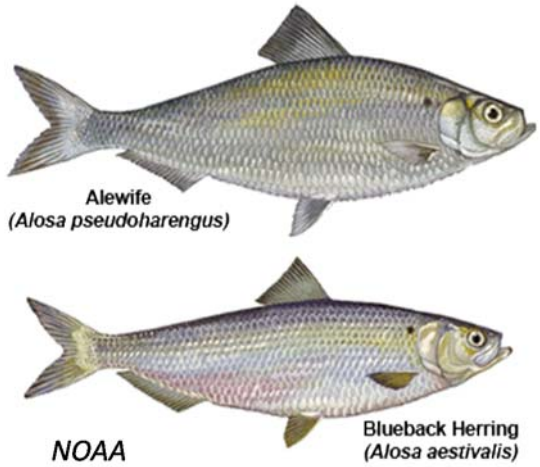
Atlantic Silverside

1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups	Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
m			Atlantic Silverside	*Menidia menidia*					
					Zone 3	N	N	N	N
					RM 95-108.4				
					Zone 4	N	N	N	?
					RM 78.8-95				
					Zone 5 (upper)	?	N	N	?
					RM 70-78.8				
					Zone 5 (lower)	Y	Y	?	Y
					RM 48.2-70				

ALEWIFE

&

BLUEBACK HERRING



Alewife and Blueback Herring (*Alosa pseudoharengus* and *Alosa aestivalis*, respectively) are regularly considered and managed together as a pair of species referred to as River Herring. These two species can be somewhat difficult to distinguish in the field, and their behaviors and life histories broadly overlap. Like American Shad, the River Herring are anadromous fish which return to freshwater habitats from the ocean to spawn, although the exact preferences and localities for spawning of the two species continue to be researched and evaluated across their distributional range. For the current data review and assessment, these two species are likewise considered together because of the mixed and confounding patterns within the data sets that suggest possible confusion of the species or poor delineation of the timing and location of reproductive behaviors.

Results from the PSEG Ichthyoplankton surveys are presented in three figures (Figures 15, 16, and 17). These data show Alewife to be the dominant species spawning and rearing across many estuary zones, with Blueback Herring rarely detected in sampling, and the undetermined eggs/larvae of "*Alosa* spp." mirroring the Alewife patterns. Results from the New Jersey Seine Survey are presented in Figures 18 and 19 for Alewife and Blueback Herring, respectively. These data represent primarily young-of-year production in the two species (some limited numbers of adults and age-1 fish are also caught), and are thus expected to provide some correspondence to the earlier life stages monitored via the ichthyoplankton surveys. Yet the patterns from the seine surveys reveal opposite dominance patterns, with Blueback Herring catches orders of magnitude higher than the Alewife catches. Moreover, field observations in the Delaware Estuary more closely match the results from the seine survey, with Blueback Herring frequently encountered while Alewife remain rare (M. Kaufman *personal communication*).

Multiple explanations could individually or collectively reconcile the apparent conflicting patterns from the two data sets. First, incorrect identifications could have reversed the species identity in either the ichthyoplankton or the seine surveys. Second, each sampling technique could be biased toward sampling one species preferentially over the other species. For instance, the daytime, near-shore seine sampling is well-suited for collecting young-of-year Striped Bass but likely under-samples schooling pelagic fish such as Alewife. Third, the spatial and temporal extents of each survey may lend themselves to increased efficiency in sampling one species over the other. These and other explanations highlight the challenge in distinguishing successful reproduction and rearing for each of these species, and underscore the decision by many

agencies and organizations to simply pool the two species as the broader River Herring complex despite important distinctions in their life histories.

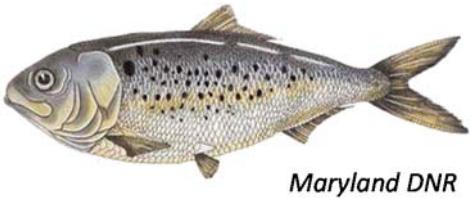
Regardless of the reasons, the conflicting patterns in the ichthyoplankton and seine surveys severely limit the current assessment of "propagation" for each species. At the very least, eggs, larvae, and juveniles of both species have been identified in Zones 3 and 4 as well as the upper portion of Zone 5, leading to an affirmative response to the question, "Is there any evidence of successful reproduction?" The ichthyoplankton data further indicate moderate to strong spawning success in multiple years across Zones 2, 3, 4, and upper 5. However, it is not clear which of the two species (or perhaps both) are broadly utilizing the estuary for spawning and rearing. The assessment of the two higher "use" questions results is the ambiguous "?" for both species in Zones 3 and 4 because of these unresolved discrepancies between the two data sets, For upper Zone 5, weaker results regardless of species ID leads to an ambiguous answer to the question, "Is there regular evidence of successful reproduction for this species?" and a negative answer to the highest question, "Are there strong numbers and high consistency of successful reproduction?" For lower Zone 5, this initial question of "Is there any evidence of successful reproduction?" is answered in the affirmative because of moderate post-yolk sac larval catches in multiple years, while the remaining categories are not supported given the lack of eggs and inconsistencies in larval catches for either species.

Table 8. Evaluation Matrix for Alewife & Blueback Herring in Zones 3, 4, and 5 of the Delaware Estuary

Alewife & Blueback Herring

1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
m				Alewife	*Alosa pseudoharengus*					
						Zone 3	Y	?	?	Y
						RM 95-108.4				
						Zone 4	Y	?	?	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	?	N	Y
						RM 70-78.8				
						Zone 5 (lower)	Y	N	N	Y
						RM 48.2-70				
m				Blueback Herring	*Alosa aestivalis*					
						Zone 3	Y	?	?	Y
						RM 95-108.4				
						Zone 4	Y	?	?	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	?	N	Y
						RM 70-78.8				
						Zone 5 (lower)	Y	N	N	Y
						RM 48.2-70				

ATLANTIC MENHADEN



Atlantic Menhaden (*Brevoortia tyrannus*) is another member of the Clupeidae family along with American Shad, Alewife, and Blueback Herring. Atlantic Menhaden adults are migratory coastal fish, with estuaries utilized as both nursery and seasonal adult habitats. Spawning primarily occurs in near-shore oceanic settings and can occur during both northward and southward migrations along the coast. Larval and juvenile Atlantic Menhaden then utilize estuaries as nursery grounds, with "ingress" into the Delaware Estuary peaking from December through May (Wang and Kernehan 1979). Juvenile fish continue to move further up-estuary into oligohaline and the lower freshwater portions of estuaries. Thus, both larval and juvenile Atlantic Menhaden (but not eggs/spawning) may use multiple zones within the Delaware Estuary.

For the current data evaluation, a limitation needs to be acknowledged for Atlantic Menhaden since the timing of both PSEG Ichthyoplankton and NJ Seine surveys only partially overlap with the period of larval and juvenile use of the Delaware Estuary. The current data sets can, therefore, only partly describe to use of the Delaware Estuary for "propagation" by Atlantic Menhaden.

Results from the PSEG Ichthyoplankton surveys are presented in Figure 20 for Atlantic Menhaden. Strong differences were seen among the three years surveyed, with 2002 showing a broad distribution of post-yolk sac larvae in many estuarine zones, while 2003 showed very low catches everywhere (low catches of larvae were also seen in Delaware Bay in 2003). In 2004, lower catches were observed than in 2002 but some utilization of Zone 5 was seen in addition to moderate catches in Delaware Bay (Zone 6).

Results from the New Jersey Seine Survey are shown in Figure 21 (overall catches very low in Zone 3; results from Zone 4 are presented along with separate analyses for upper and lower Zone 5). Juvenile Atlantic Menhaden were captured in all estuary zones, but only sporadically in Zones 2 and 3. In Zone 4, Atlantic Menhaden were not captured on a typical survey (i.e., median is zero for most years) but moderate to high catches are nevertheless somewhat common. In both upper and lower Zone 5, Atlantic Menhaden are more frequently encountered, although occasional very large catches (e.g., more than 1000 juvenile fish in a single seine haul) are seen at a frequency similar to Zone 4.

The combined results from the two surveys suggest some utilization of Zones 4 and 5 by larval and juvenile Atlantic Menhaden. Ichthyoplankton results were more variable, suggesting strong among-year difference in use (perhaps reflecting broader stock status or variable larval transport within the estuary). For Zone 3, low and inconsistent catches of larvae and juveniles provides only an ambiguous "?" answer to the first question, "Is there any evidence of successful reproduction?" and clear "no" answers for higher use questions. For Zone 4, increased

consistency and use across both larval and juveniles indicates “yes” for the initial question, “Is there any evidence of successful reproduction?” However, although juvenile catches were seen occasionally each year, moderate larval catches in Zone 4 only occurred in 2002, leading to an ambiguous answer to the question, “Is there regular evidence of successful reproduction for this species?” and a negative answer to the question “Are there strong numbers and high consistency of successful reproduction?” Finally, little or no distinction can be made between the results from upper Zone 5 and lower Zone 5, both in the ichthyoplankton surveys and the seine surveys. In addition, the larval catches in Zone 5 were among the highest seen throughout the estuary (including Zone 6) for both 2002 and 2004, even if large differences were seen among years. These results indicate that both upper and lower Zone 5 show regular Atlantic Menhaden use, and thus a “yes” to the questions, “Is there any evidence of successful reproduction?” and “Is there regular evidence of successful reproduction for this species?” However, both the inconsistency among years and the complex use of the estuary year-round without sufficient data during all seasons provides an ambiguous answer for the final question, “Are there strong numbers and high consistency of successful reproduction?”

Table 9. Evaluation Matrix for Atlantic Menhaden in Zones 3, 4, and 5 of the Delaware Estuary

Atlantic Menhaden

1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name		Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?	"Nursery" with juveniles
m				Atlantic Menhaden	*Brevoortia tyrannus*					
						Zone 3	?	N	N	?
						RM 95-108.4				
						Zone 4	Y	?	N	Y
						RM 78.8-95				
						Zone 5 (upper)	Y	Y	N	Y
						RM 70-78.8				
						Zone 5 (lower)	Y	Y	N	Y
						RM 48.2-70				

ADDITIONAL SPECIES EVALUATED

A number of additional fish species use Zones 3, 4, and 5 as important parts of their spawning and/or nursery habitat. Data were evaluated for these additional species, but either the data were too sparse to provide any specific insight or the results were ambiguous and did not establish whether a given zone was being used for successful reproductive effort. For four species (Spot, Atlantic Croaker, Weakfish, Bluefish), the primary use centered on Delaware Bay (Zone 6) and catches in the upper zones of the estuary were so sparse that no clear indication of successful reproduction could be established. For Hogchoker, larval and juvenile use is expected throughout the estuary based on life history information, and Hogchokers were captured across all zones of the estuary. However data were not collected on larval fish, and juveniles could not be reliably identified in the seine surveys. As a result, the extent of use by Hogchokers in each zone could not be established. For Inland Silverside, a species similar to Atlantic Silverside but with a lower salinity preference, substantial use of Zones 3, 4, and 5 may be possible for spawning and rearing but no larval fish data were available and seine data could not separate mature from juvenile fish. Finally, Gizzard Shad were not directly assessed in the PSEG Ichthyoplankton surveys but may have been recorded in some of the broader taxonomic categories like "Clupeidae" undetermined. The NJ Seine Survey data also provided little specificity on the location and extent of juvenile use of the different estuary zones by Gizzard Shad.

Many more species of fish were captured and recorded as part of the New Jersey Seine Surveys. Shortnose Sturgeon data, for instance, were too sparse in any data set to assess this endangered fish species within this report. In addition, distribution and abundance data exist for species such as freshwater mussels and benthic invertebrates, but these data sets typically provide little specific information on the question of "successful reproduction". As a result, although some data were available for many additional fish and non-fish species, these additional data sources were not used in the current evaluation of the Existing Use with respect to questions of "propagation".

Conclusions

Successful "propagation" in Zones 3, 4, and upper Zone 5 of the Delaware Estuary is clearly supported by the three primary data sources evaluated in this report. Thus, the goals for fishery restoration established in 1967 through DRBC's designated uses have been exceeded, at least in part by the successful restoration of dissolved oxygen to 3.5 mg/L as a daily average concentration. The current designated use in Zone 3, 4, and the upper 8.8 miles of Zone 5 includes only "maintenance" of fish and other aquatic life; the "Existing Use" based on data collected since 2000 indicates that at least some degree of "propagation" (i.e., spawning and/or rearing of early stage larvae and juveniles) has been achieved in these 38 miles of the 133 mile long Delaware Estuary.

The current data evaluation also seeks to determine the strength of that "propagation" use across the suite of species for which specific relevant data were available. Because of different expectations for each species in the three estuary zones, each of these zones will be summarized separately.

In Zone 3 (Table 10), the evaluations for Atlantic Sturgeon, American Shad, and Striped Bass all fall short of the highest possible expectations for their recovery (e.g., see Appendix C). In particular, Atlantic Sturgeon catch rates and tracking data show sparse use of Zone 3. Both American Shad and Striped Bass exhibit moderate numbers and some consistency in eggs, larvae, and juveniles, but numbers are not as strong or as consistent as in other zones of the estuary. White Perch, on the other hand, shows strong numbers and high consistency in eggs, larvae, and juvenile use of Zone 3. Unfortunately, although some sizeable numbers exist for either Alewife or Blueback Herring, the ambiguity in these data sets precludes a more specific evaluation on the strength of these two species' recovery in Zone 3. Finally, the three marine or brackish water species (Atlantic Menhaden, Bay Anchovy, Atlantic Silverside) are not expected to show extensive use of this freshwater zone of the estuary, and their weaker evaluation for Zone 3 does not reflect a failure in the "propagation" use. Overall, then, some moderate to strong recovery in "propagation" has been seen in Zone 3, but full "propagation" is not established.

The evaluation of Zone 4 (Table 11) is similar to Zone 3. Atlantic Sturgeon young-of-year have been caught in recent years in this zone, but overall numbers are small and year-to-year catches are highly sporadic. American Shad numbers also show substantial weakness in Zone 4, with a near absence of eggs in the 2002, 2003, and 2004 PSEG Ichthyoplankton surveys despite sizeable larval catches and similar habitats as upstream in Zone 3. Striped Bass numbers are moderately strong across eggs, larvae, and juveniles, but somewhat higher and more consistent data are seen further downstream in Zone 5 for eggs and larvae, indicating somewhat less use of Zone 4 than Zone 5 by Striped Bass for spawning and rearing. White Perch continue to show strong numbers in Zone 4 indicating a high degree of use of this zone, while both Alewife and Blueback Herring continue to be uncertain for Zone 4 because of ambiguity in the data sets. For the marine or brackish species, both Atlantic Menhaden and Bay Anchovy begin to show appreciable use of

Zone 4, which is not surprising given the beginning of the salinity transition in lower Zone 4 depending on the time of year and freshwater inflows. Together, these data (like in Zone 3) demonstrate moderate to strong recovery in "propagation" for Zone 4, but again full "propagation" has not been established.

In upper Zone 5 (RM70 to RM78.8; Table 12), some level of Atlantic Sturgeon spawning has been demonstrated, but the numbers and consistency again are weak and fall far short of attaining the full expectations for a successful population. By contrast, both White Perch and Striped Bass demonstrate strong numbers and high consistency across all early life stages examined. For both species, nearly complete or complete attainment of "propagation" is seen. For the three freshwater Clupeidae (American Shad, Alewife, and Blueback Herring), numbers begin to or strongly taper off in this zone where the transition to brackish water is more evident than upstream. These reductions in use for the three species may be a natural attenuation and therefore may not be a failure to attain an expected use in these 8.8 miles of the estuary, although appreciable ambiguity exists, particularly for Alewife and Blueback Herring (see Appendix C). Finally, the increased use by larval and juvenile Atlantic Menhaden and Bay Anchovy matches the life history expectations for these species. Across all species, then, the data for upper Zone 5 largely reflect moderate to strong attainment of expectations, with Atlantic Sturgeon numbers representing the weakest recovery and poorest demonstration of successful reproduction by species expected to use upper Zone 5. Thus, full "propagation" has not been established for upper Zone 5.

Finally, in lower Zone 5 (RM48.2 to RM70), both strength and weakness are seen in Table 13. However, in this lower portion of Zone 5, the designated use for these 22 miles of the estuary currently includes both "maintenance" and "propagation" and, indeed, the data evaluation reflects the more complete attainment of expected "propagation" for this estuary zone. Specifically, this reach of estuary represents the more distinct salinity transition, with only Striped Bass clearly expected to use lower Zone 5 as a core part of its spawning during early spring when freshwater inflows are typically higher and the salt line is shifted down-estuary. As Table 13 indicates, Striped Bass demonstrate strong and consistent evidence of successful reproduction here in lower Zone 5. Other species show less extensive use of lower Zone 5, but all of these shifts are expected based on their life history. The marine and brackish species primarily spawn either further down in Delaware Bay or the Atlantic Ocean, so the "regular" use of lower Zone 5 demonstrates a high degree of expected use. For the freshwater species, the tapering down of spawning and rearing in this salinity transition zone likewise matches the life history expectations for these species. Together, these data demonstrate a more complete use of lower Zone 5 for spawning and rearing in a manner consistent with each species' life history.

A cautionary note is needed at this point. The evaluation of "propagation" in each estuary zone, and particularly the current attempt to identify the strength of any demonstrated spawning and rearing for these fish species, must not be confused with an evaluation of the causes for any failure to completely attain the expected patterns of spawning and rearing of these fish species. This report does not demonstrate, for instance, that water quality (e.g., dissolved oxygen) is the reason for the weaker-than-expected spawning and rearing numbers of any species, although

improvements to water quality have been a key component in the documented recovery of these fish populations (see Appendix B for a summary of contemporary dissolved oxygen data). Many factors, both natural and anthropogenic, continue to impact the populations of all fish species evaluated in this report (e.g., Iannuzzi et al. 2009). Most notable are the current population sizes for some species (e.g., Atlantic Sturgeon) that likely are too low to saturate the spawning and rearing grounds in any given year. But additional factors, such as habitat conditions and climate, likely play an important role in the strength of spawning and rearing for all species. The failure to demonstrate full attainment of the "propagation" use in Zones 3, 4, and upper Zone 5 may, therefore, reflect both limitations in water quality conditions as well as limitations in many other facets of each species' biology. It is beyond the scope of this report to attempt to attribute the limitations in "propagation" to any one or any suite of causative agents.

The combined data sets evaluated for this report nevertheless indicate that the "Existing Use" attained within the Delaware Estuary in the period between 2000 and 2014 includes "propagation" for Zones 3, 4, and the upper 8.8 miles of Zone 5. In each of these zones, the evidence is moderate or even strong for one or more species, indicating substantial progress in attaining the full Clean Water Act aquatic life goal of "maintenance and propagation" for the species evaluated. The "Existing Use" for Zones 3, 4, and upper Zone 5 therefore substantially exceeds the "designated use" of only "maintenance". But the data evaluated in this report also indicates that weakness in successful reproduction exists for one or more species for all three zones. Thus, full attainment of a "maintenance and propagation" use has not been demonstrated at this time based on the data available and examined for this existing use evaluation.

Table 10. Final Evaluation Matrix for Zone 3 across all species with sufficient data

Zone 3 (RM 95 to RM 108.4)								
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name	Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?
				Atlantic Sturgeon	*Acipenser oxyrhynchus*	?	N	N
m				Striped Bass	*Morone saxatilis*	Y	Y	N
f				White Perch	*Morone americana*	Y	Y	Y
m				Alewife	*Alosa pseudoharengus*	Y	?	?
m				Blueback Herring	*Alosa aestivalis*	Y	?	?
m				American Shad	*Alosa sapidissima*	Y	Y	?
m				Atlantic Menhaden	*Brevoortia tyrannus*	?	N	N
m				Bay Anchovy	*Anchoa mitchilli*	?	N	N
m				Atlantic Silverside	*Menidia menidia*	N	N	N

Table 11. Final Evaluation Matrix for Zone 4 across all species with sufficient data

Zone 4 (RM 78.8 to RM 95)								
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name	Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?
				Atlantic Sturgeon	*Acipenser oxyrhynchus*	Y	N	N
m				Striped Bass	*Morone saxatilis*	Y	Y	?
f				White Perch	*Morone americana*	Y	Y	Y
m				Alewife	*Alosa pseudoharengus*	Y	?	?
m				Blueback Herring	*Alosa aestivalis*	Y	?	?
m				American Shad	*Alosa sapidissima*	Y	?	N
m				Atlantic Menhaden	*Brevoortia tyrannus*	Y	?	N
m				Bay Anchovy	*Anchoa mitchilli*	Y	?	N
m				Atlantic Silverside	*Menidia menidia*	N	N	N

Table 12. Final Evaluation Matrix for upper Zone 5 across all species with sufficient data

Zone 5 upper (RM 70 to RM 78.8)							
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name	Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?
				Atlantic Sturgeon	*Acipenser oxyrhynchus*	Y	N	N
m				Striped Bass	*Morone saxatilis*	Y	Y	Y
f				White Perch	*Morone americana*	Y	Y	Y
m				Alewife	*Alosa pseudoharengus*	Y	?	N
m				Blueback Herring	*Alosa aestivalis*	Y	?	N
m				American Shad	*Alosa sapidissima*	Y	N	N
m				Atlantic Menhaden	*Brevoortia tyrannus*	Y	Y	N
m				Bay Anchovy	*Anchoa mitchilli*	Y	Y	N
m				Atlantic Silverside	*Menidia menidia*	?	N	N

Table 13. Final Evaluation Matrix for lower Zone 5 across all species with sufficient data

Zone 5 lower (RM 48.2 to RM70)							
1979 Task Force	PSEG target (12 spp)	NJ: 10 K/yr and 10/yr groups		Common name	Scientific name	Any evidence of successful reproduction?	Regular evidence of successful reproduction?	Strong numbers & high consistency of successful reproduction?
				Atlantic Sturgeon	*Acipenser oxyrhynchus*	?	N	N
m				Striped Bass	*Morone saxatilis*	Y	Y	Y
f				White Perch	*Morone americana*	Y	?	N
m				Alewife	*Alosa pseudoharengus*	Y	N	N
m				Blueback Herring	*Alosa aestivalis*	Y	N	N
m				American Shad	*Alosa sapidissima*	N	N	N
m				Atlantic Menhaden	*Brevoortia tyrannus*	Y	Y	N
m				Bay Anchovy	*Anchoa mitchilli*	Y	Y	N
m				Atlantic Silverside	*Menidia menidia*	Y	Y	?

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Figure 1. USGS Dissolved Oxygen Data for the sensor at the Ben Franklin Bridge (station 01467200) showing daily average, daily minimum, and daily maximum values from April 1, 1967, thru November 1, 1967 (data available at [waterdata.usgs.gov)](waterdata.usgs.gov)

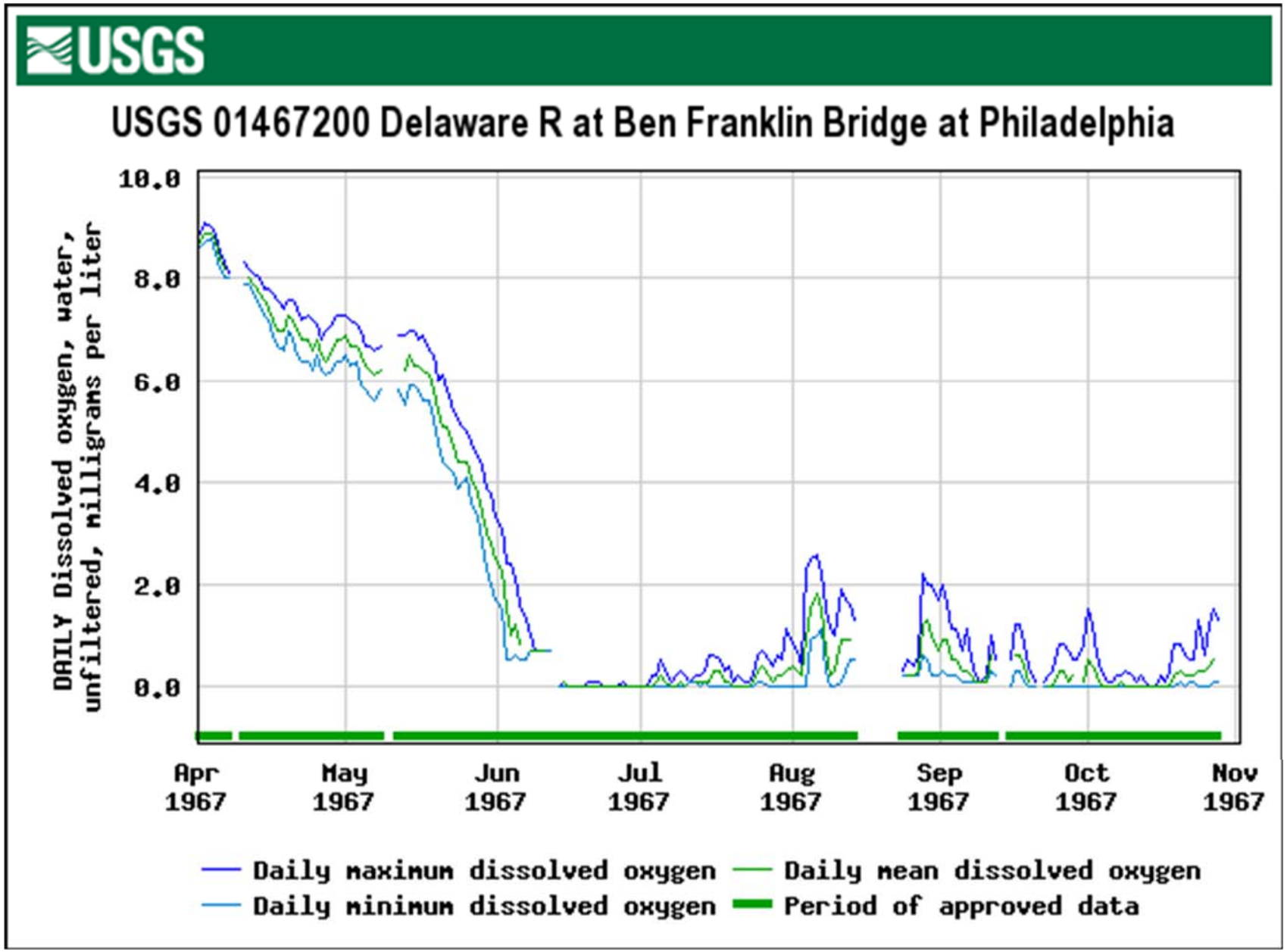


Figure 2. USGS Dissolved Oxygen Data for the sensor at the Ben Franklin Bridge (station 01467200) the distribution of 24-hour daily average values during the month of July from 1965 thru 2014 (data available at *waterdata.usgs.gov).*

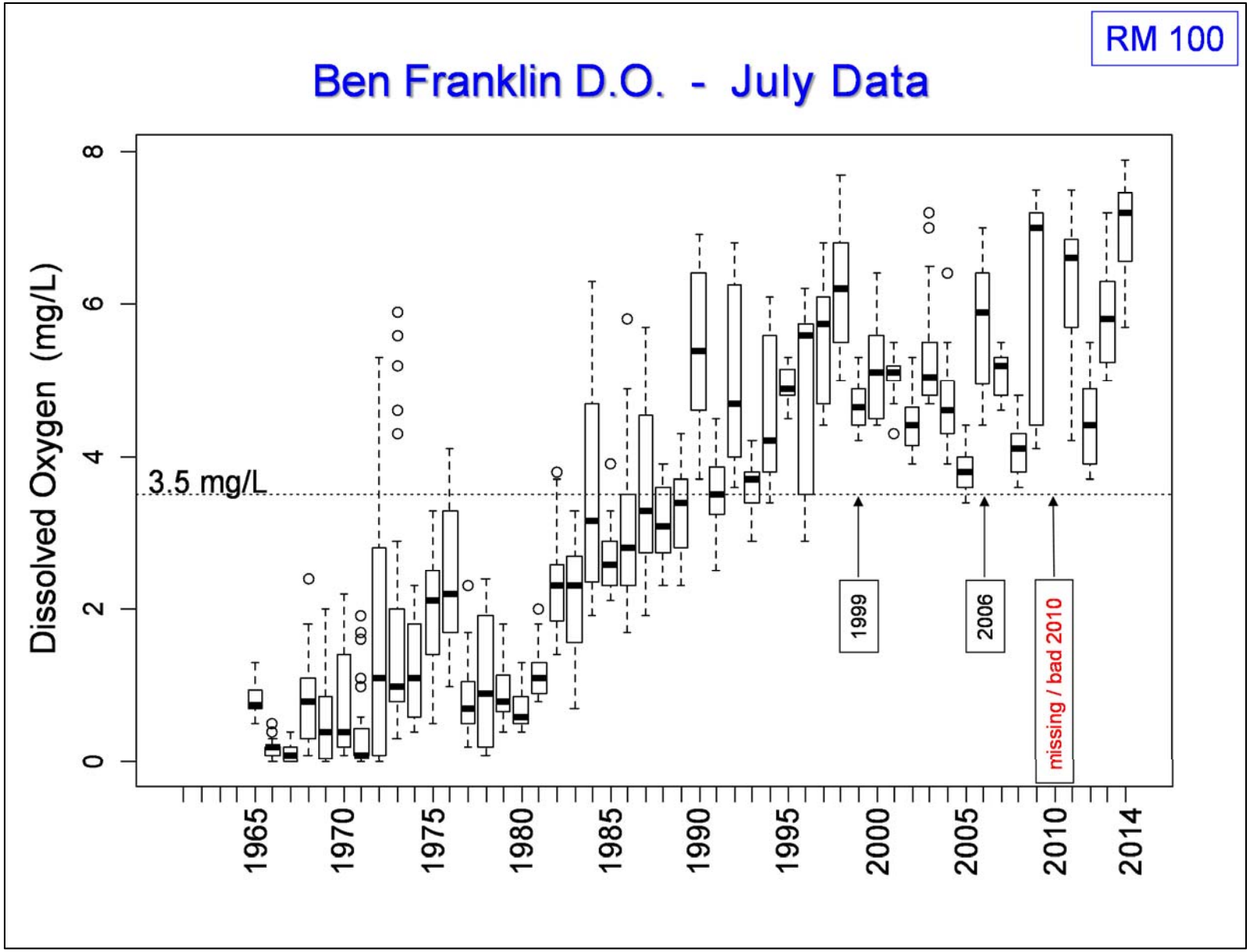


Figure 3. Map of the Delaware Estuary and DRBC Water Quality Zones

Figure 4. Map of the Delaware Estuary with DRBC Water Quality Zones and PSEG survey "zones" or reaches for 2002-2004 Ichthyoplankton surveys

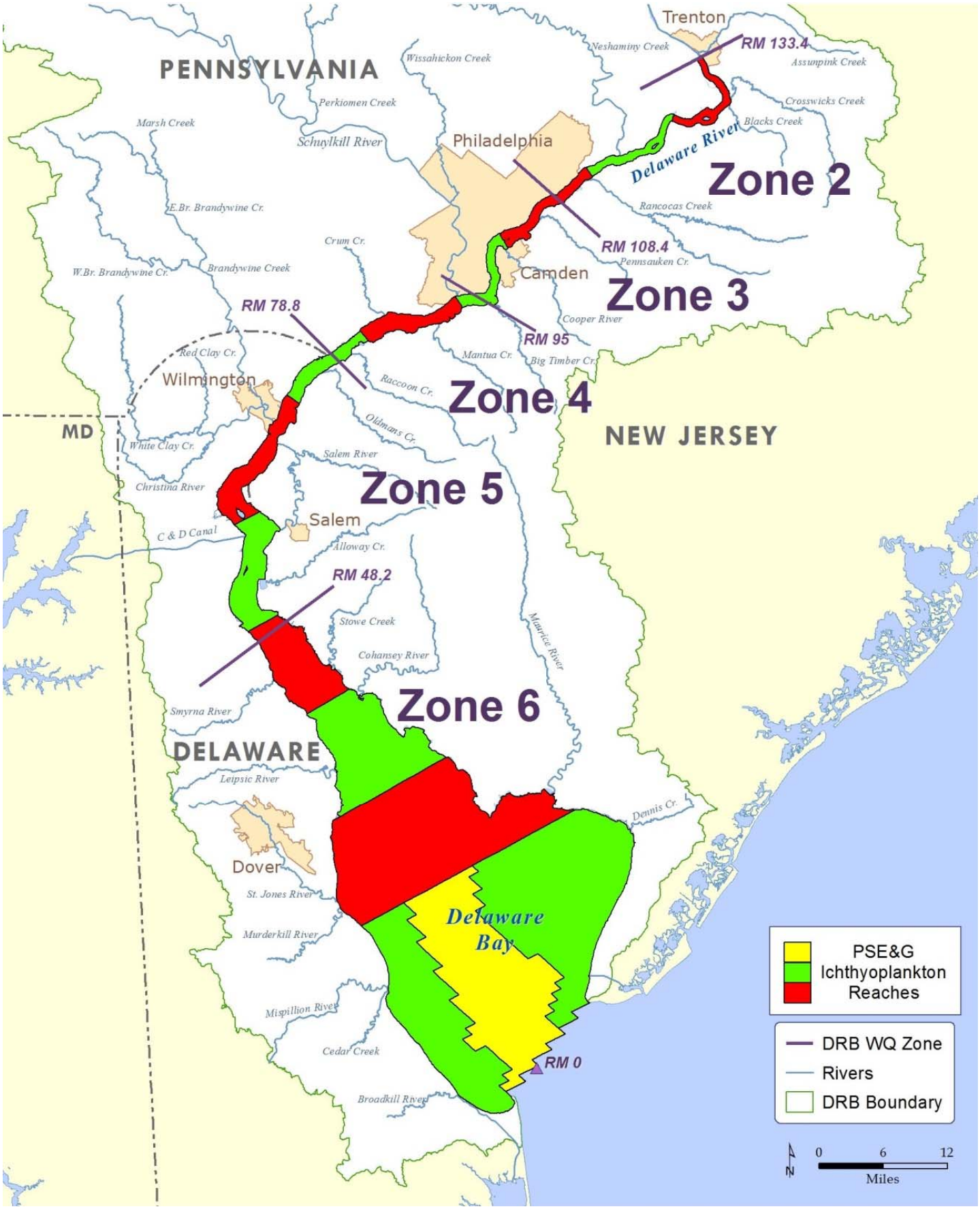


Figure 5. American Shad data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

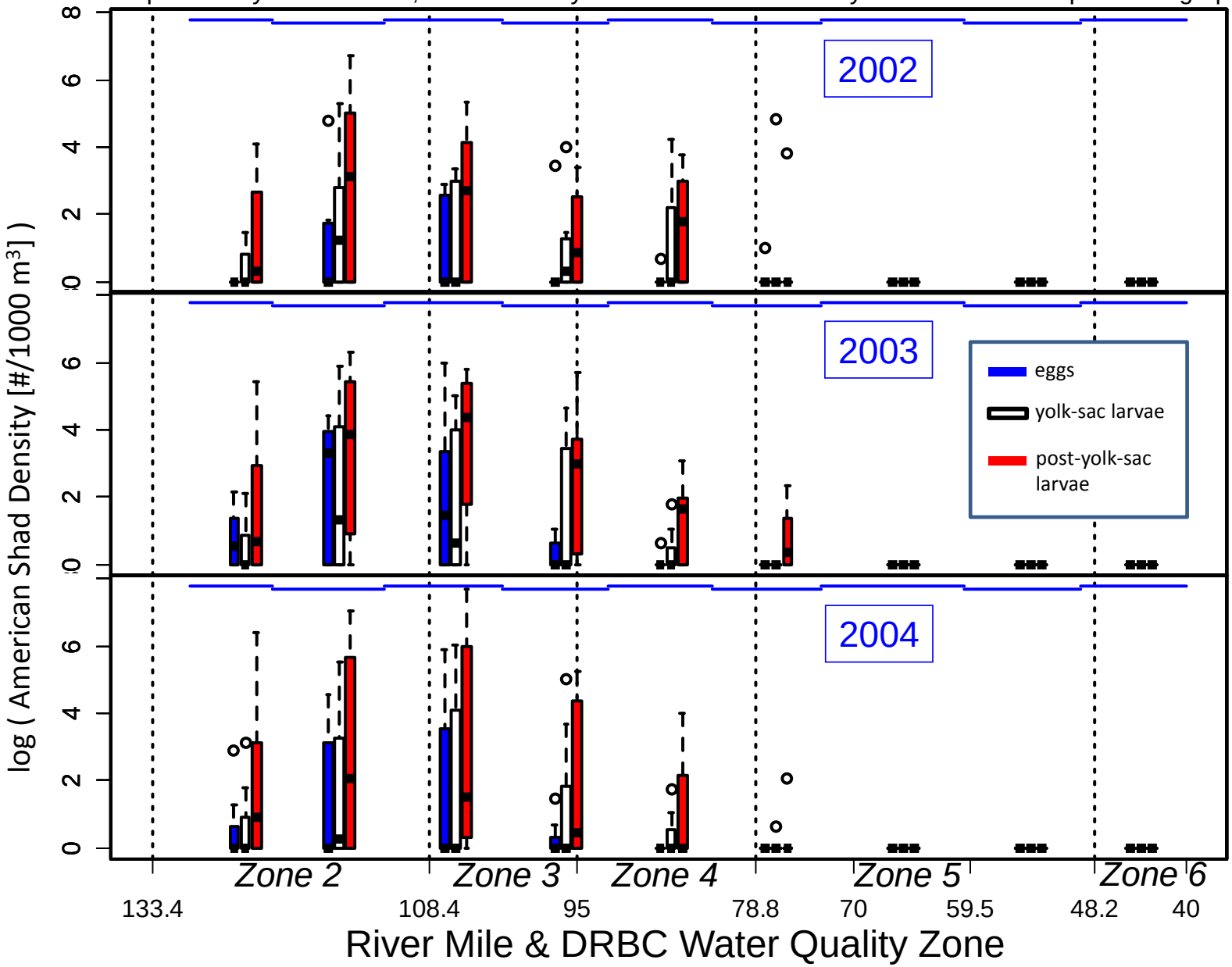


Figure 6. American Shad Young-of-Year data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 3, 4, and 5. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots.

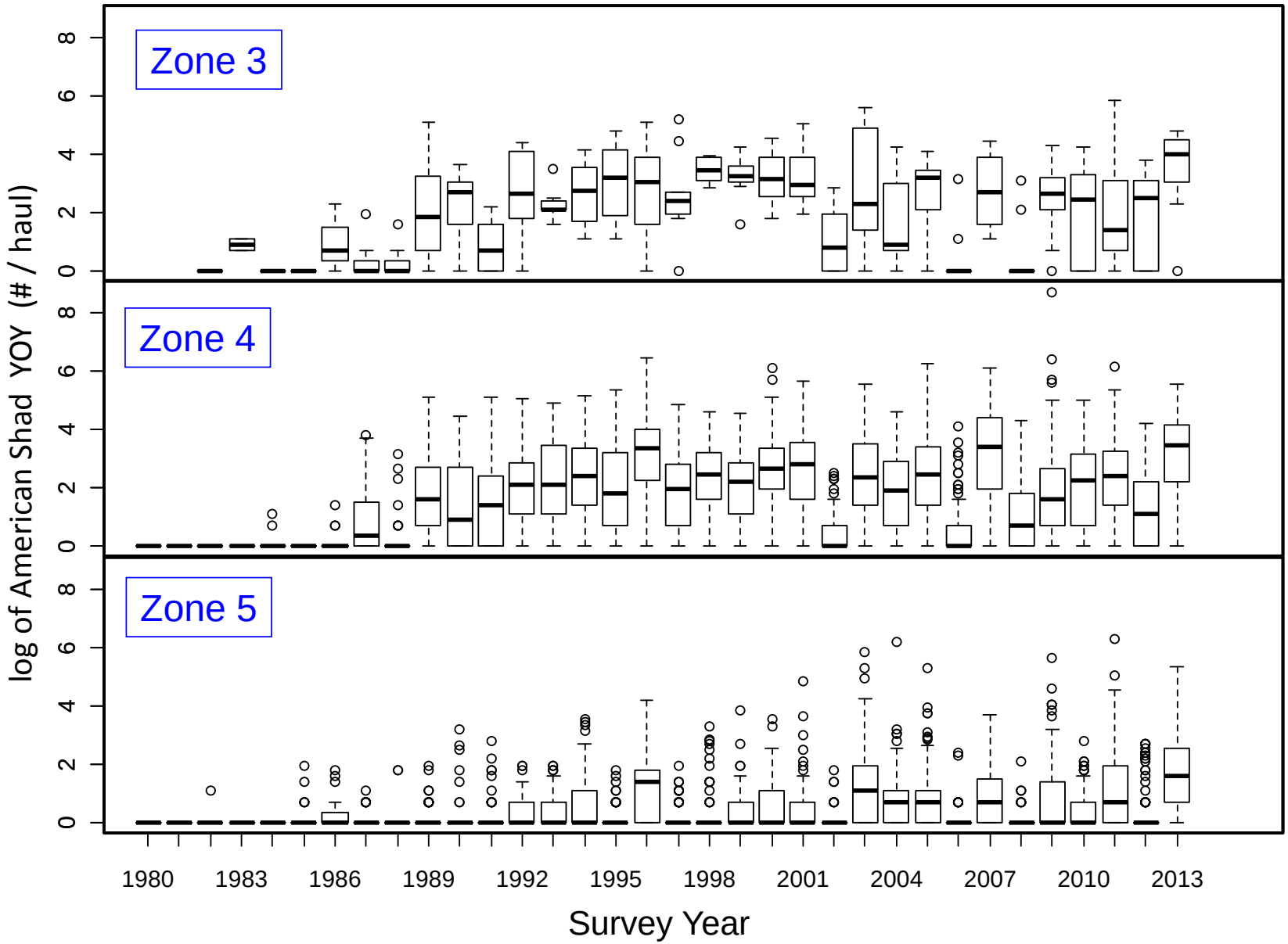


Figure 7. Striped Bass data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

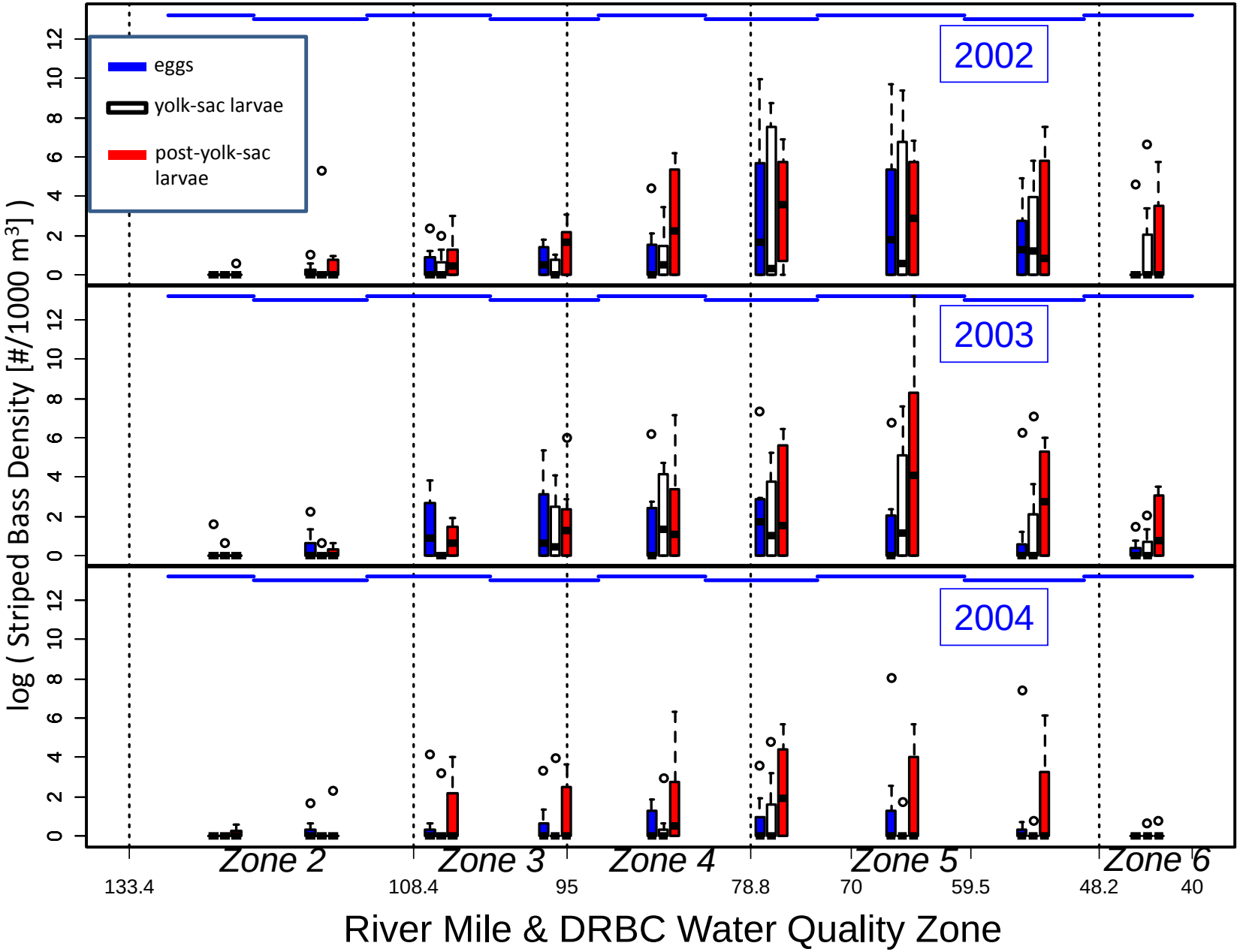


Figure 8. Striped Bass Young-of-Year data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 3, 4, and 5. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots.

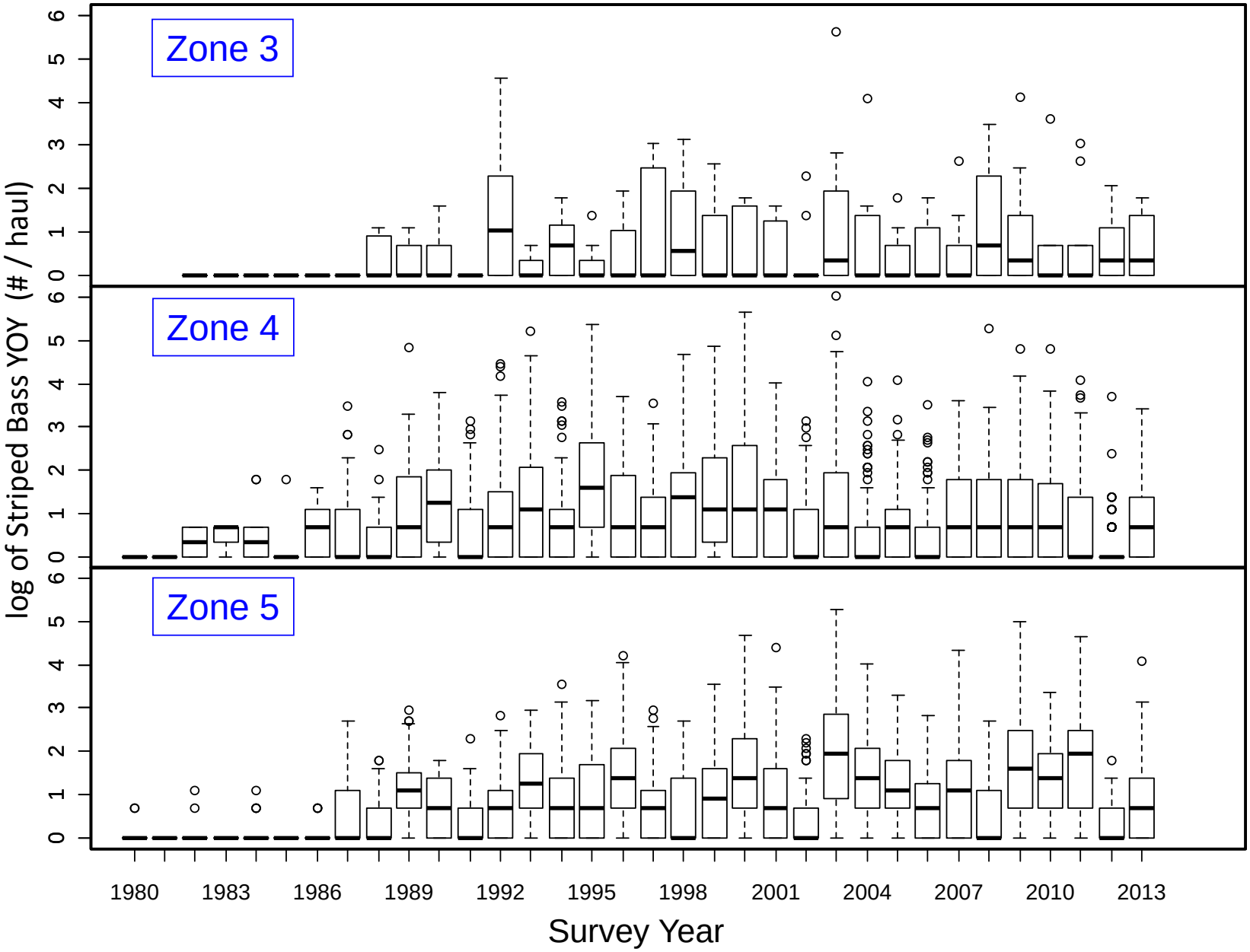


Figure 9. White Perch data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

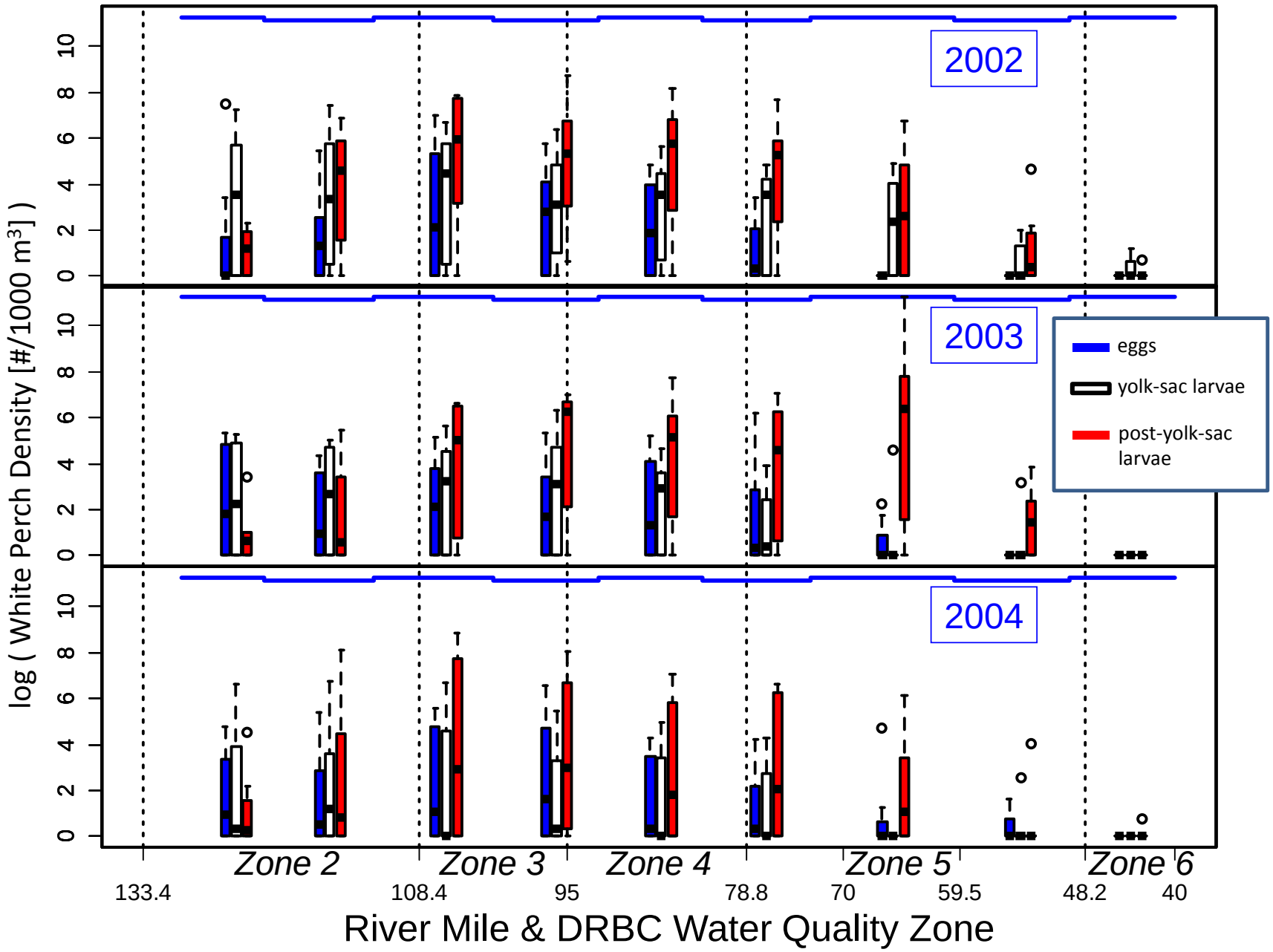


Figure 10. White Perch data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 3, 4, and 5. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: catches are for multiple year classes; these data do not solely represent young-of-year fish)*

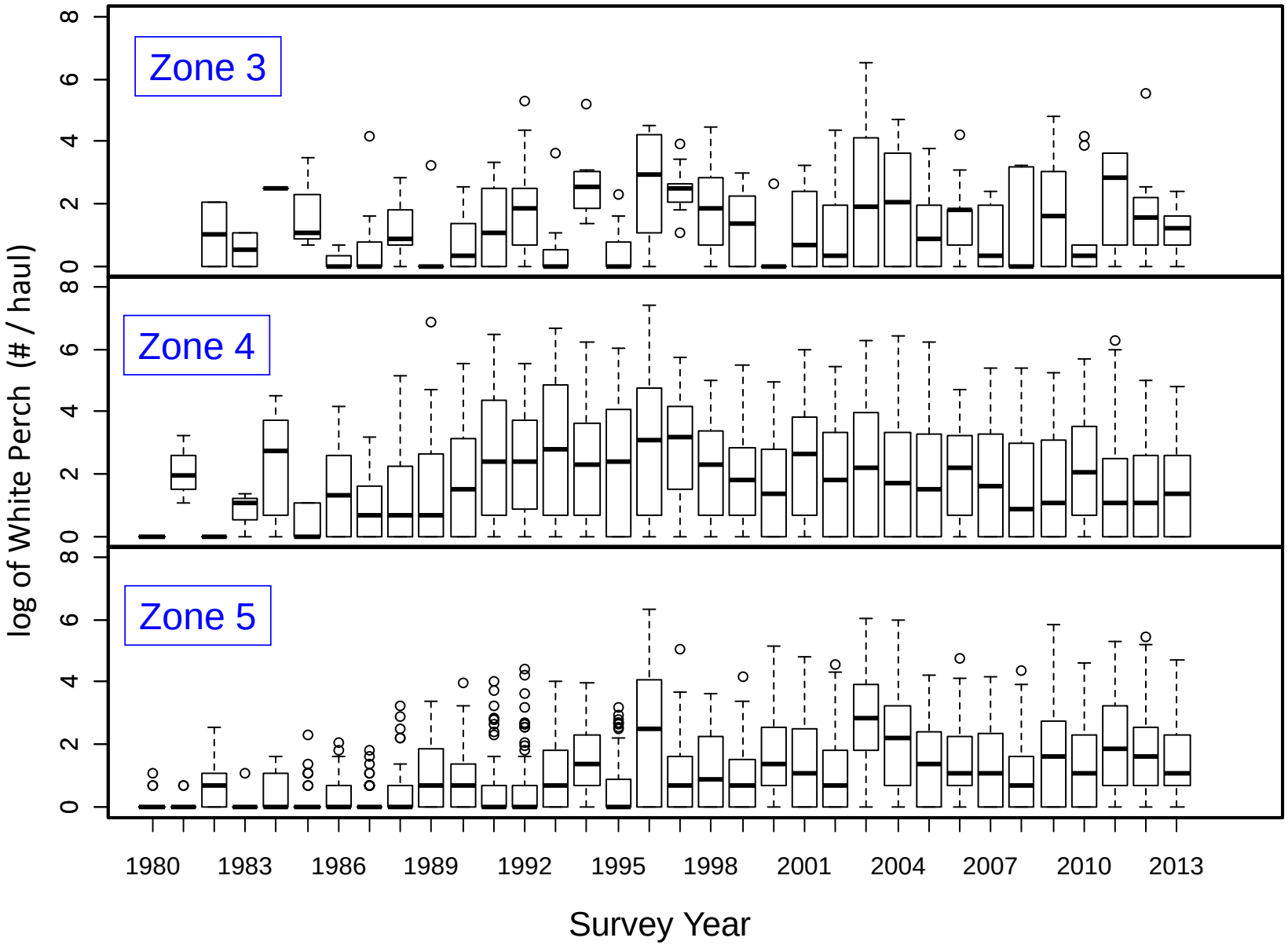


Figure 11. Bay Anchovy data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph; higher salinity reaches of PSEG surveys with peak abundance for Bay Anchovy are not shown)

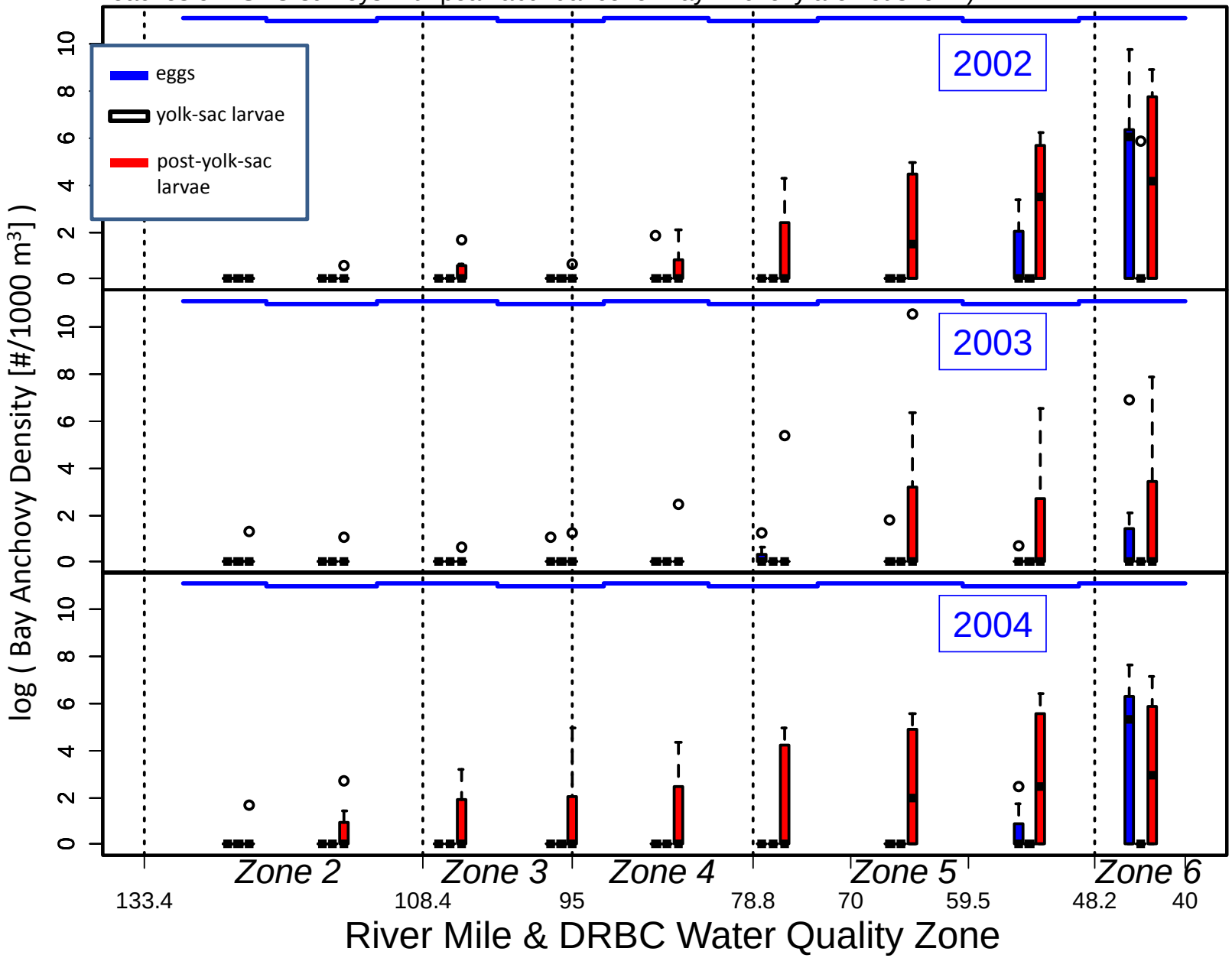


Figure 12. Bay Anchovy data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 4 and 5, with data from the two sub-zones of Zone 5 presented separately. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: catches are for both juvenile and mature fish across multiple year classes; these data do not solely represent immature fish)*

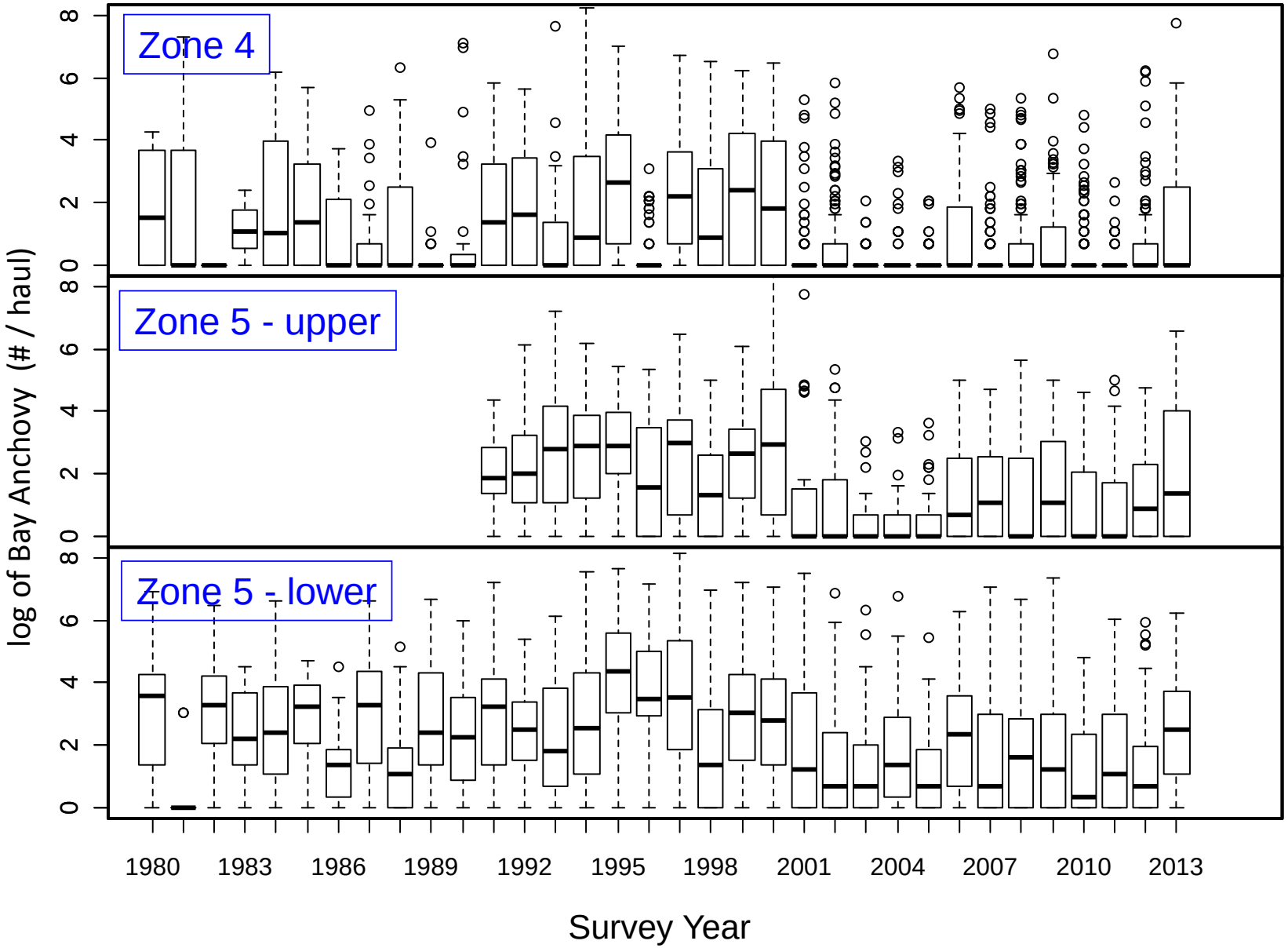


Figure 13. Atlantic Silverside data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph; higher salinity reaches of PSEG surveys with peak abundance for Bay Anchovy are not shown)

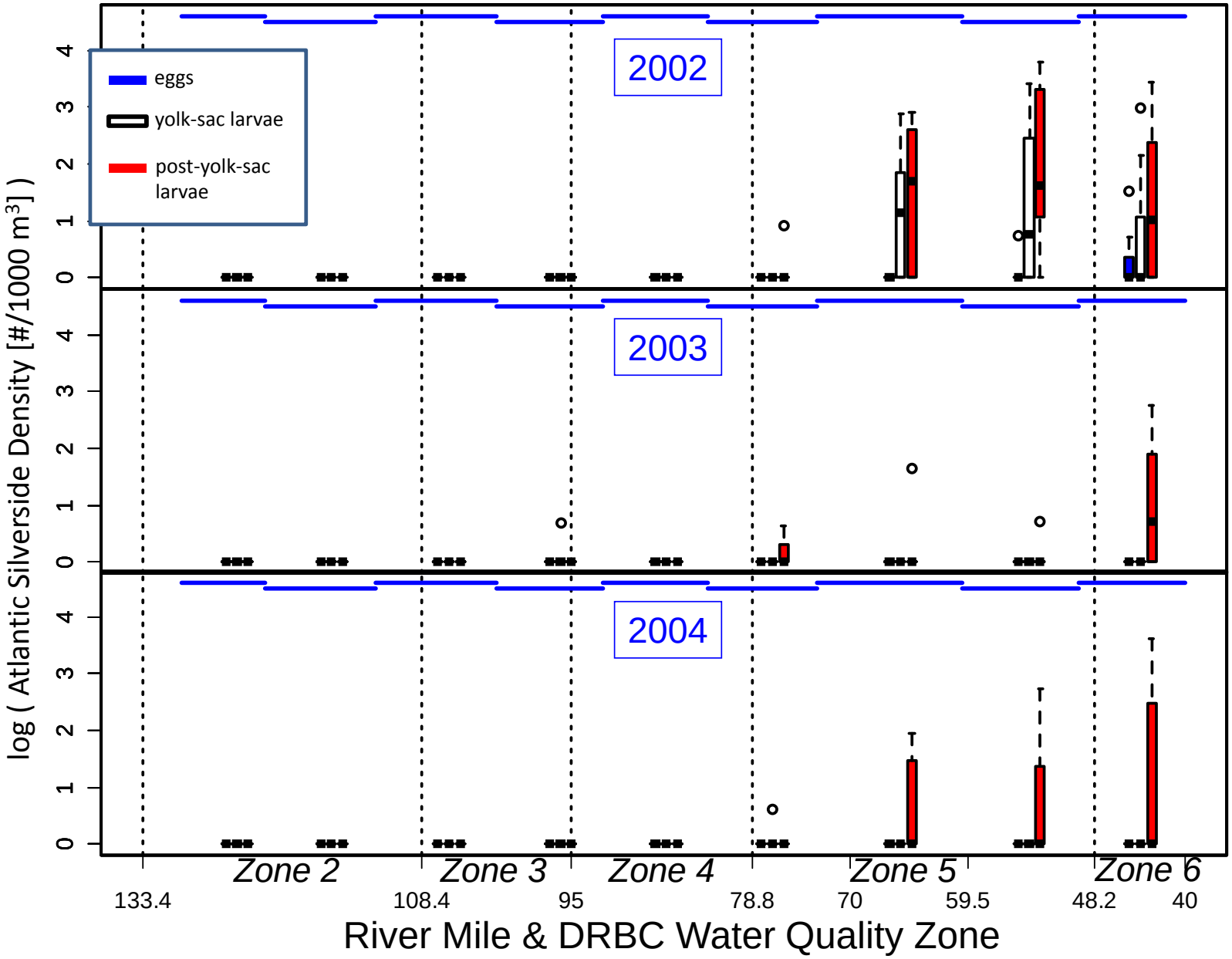


Figure 14. Atlantic Silverside data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 4 and 5, with data from the two sub-zones of Zone 5 presented separately. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: catches are for both juvenile and mature fish across multiple year classes; these data do not solely represent immature fish)*

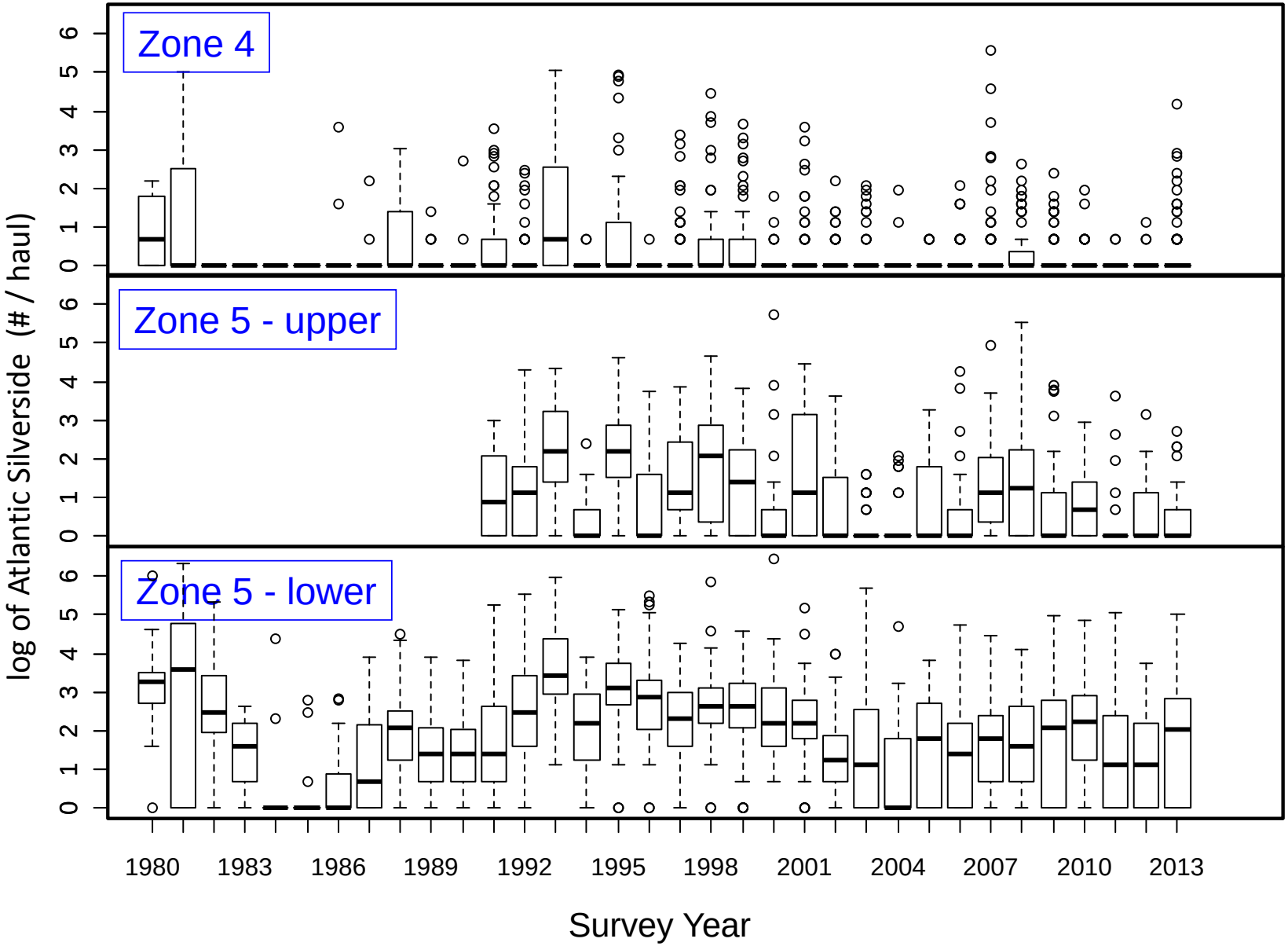


Figure 15. Alewife data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

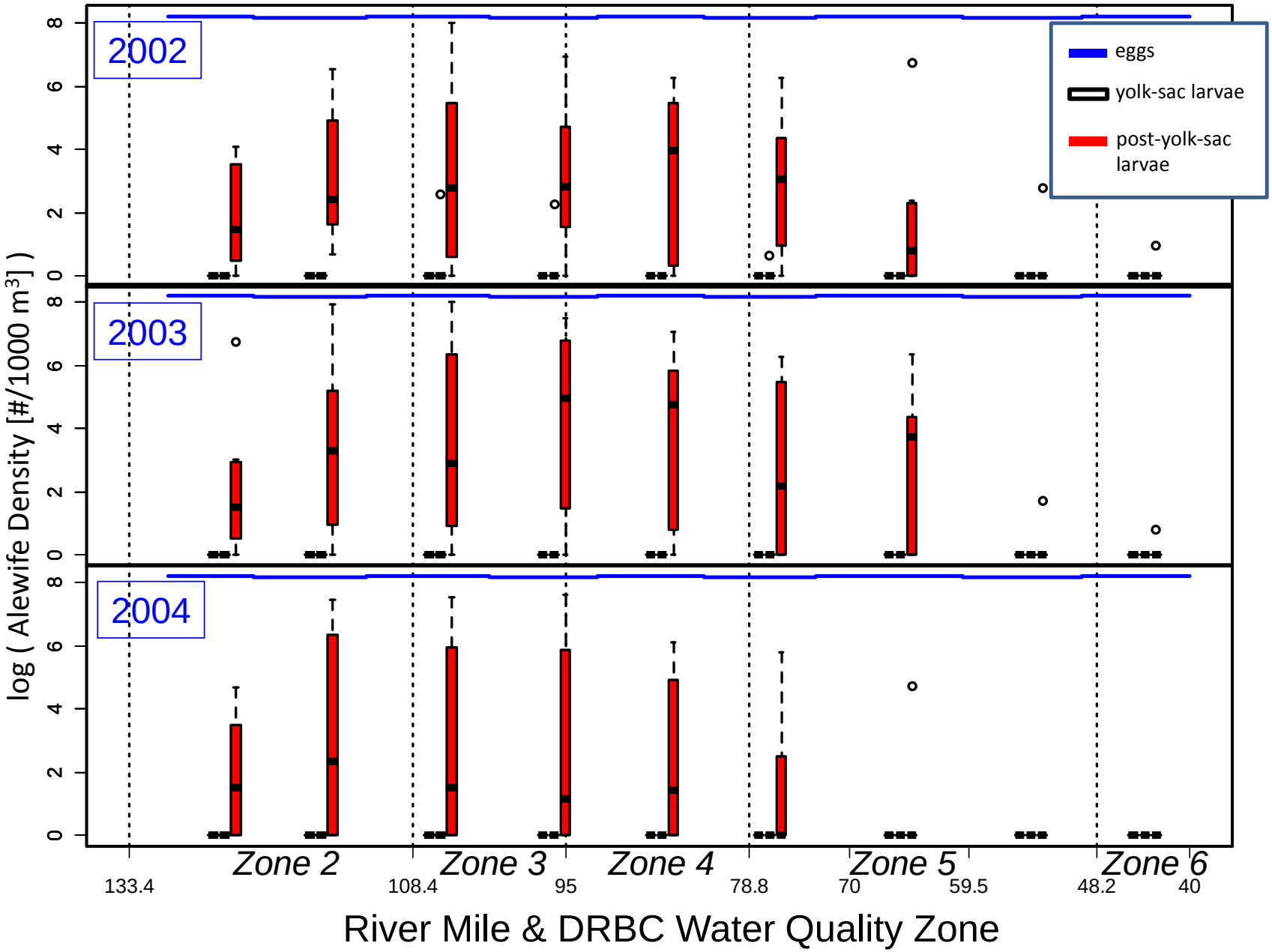


Figure 16. Blueback Herring data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

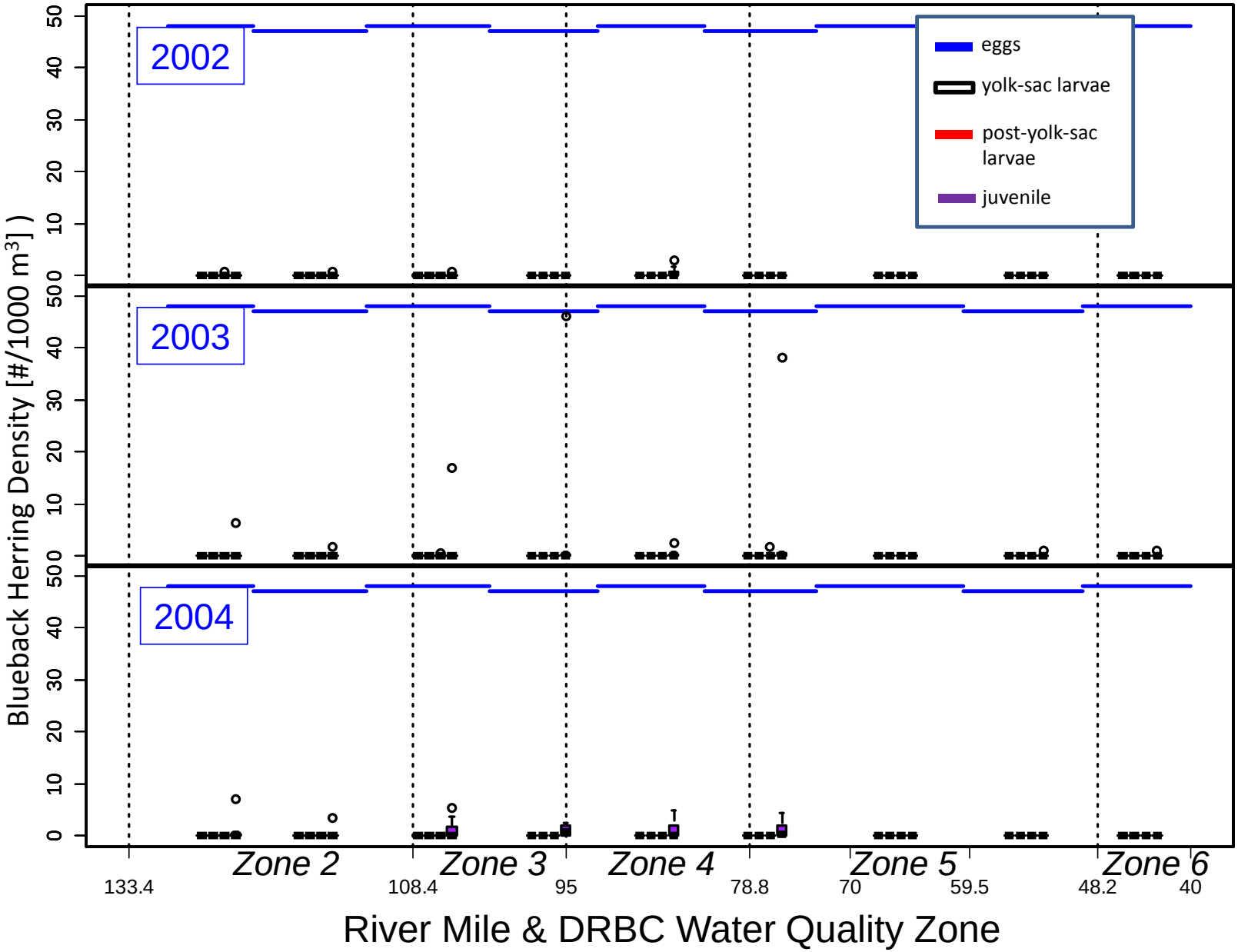


Figure 17. "*Alosa* spp." (indistinguishable Alewife & Blueback Herring eggs & larvae) data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

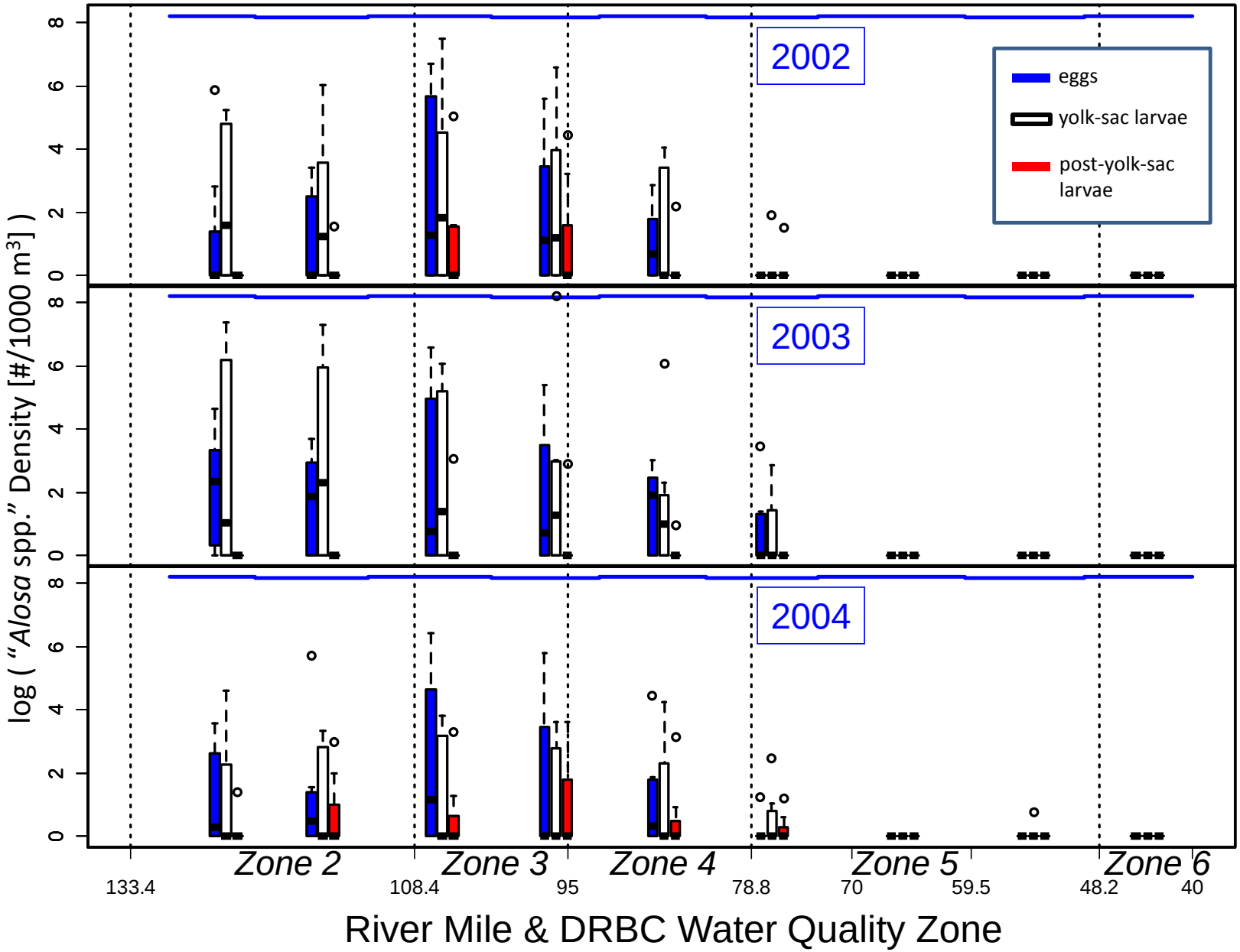


Figure 18. Alewife data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 3, 4, and 5. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: primarily young-of-year fish, with some age-1 and adult fish at times collected)*

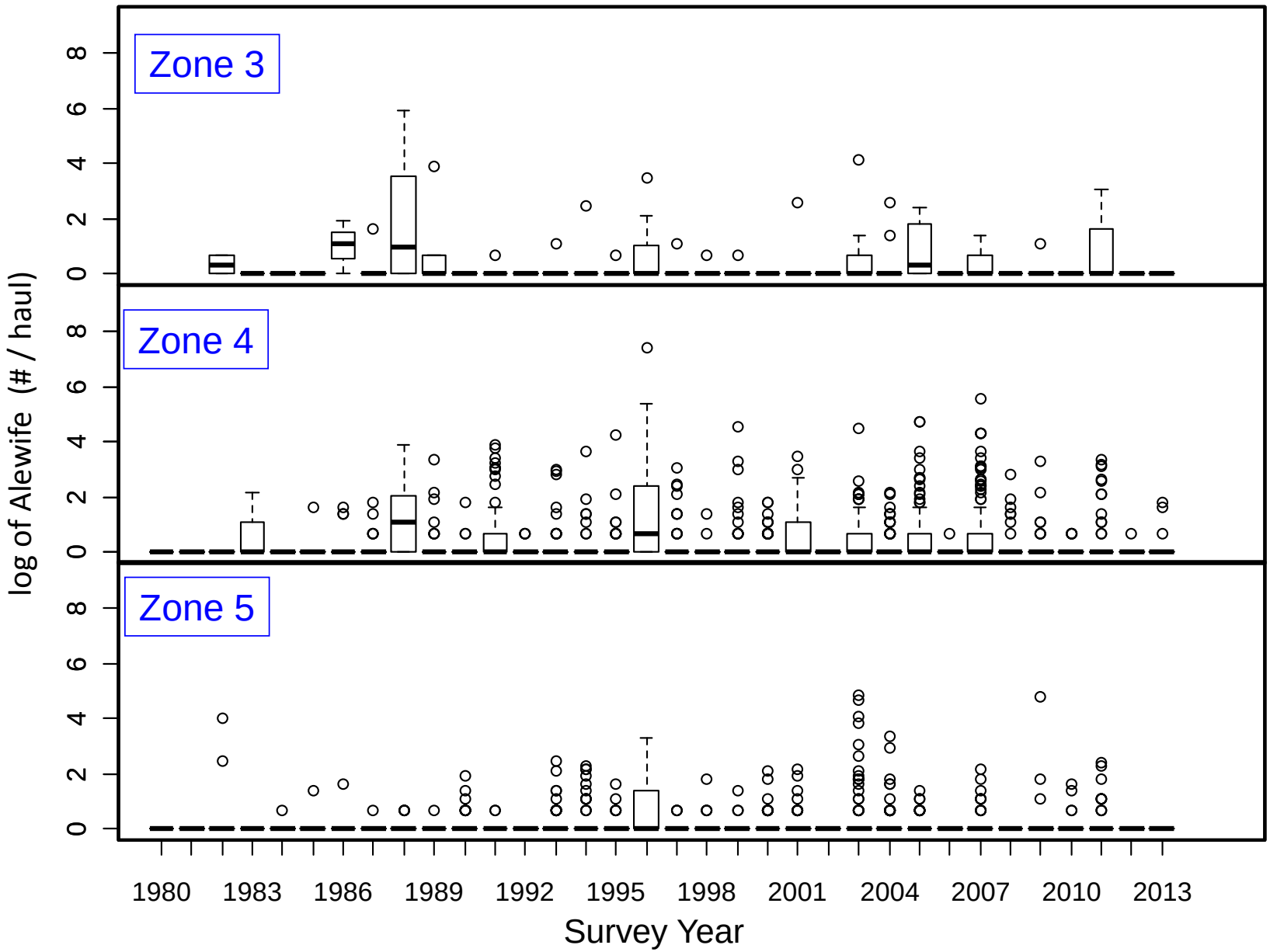


Figure 19. Blueback Herring data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 3, 4, and 5. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: primarily young-of-year fish, with some age-1 and adult fish at times collected)*

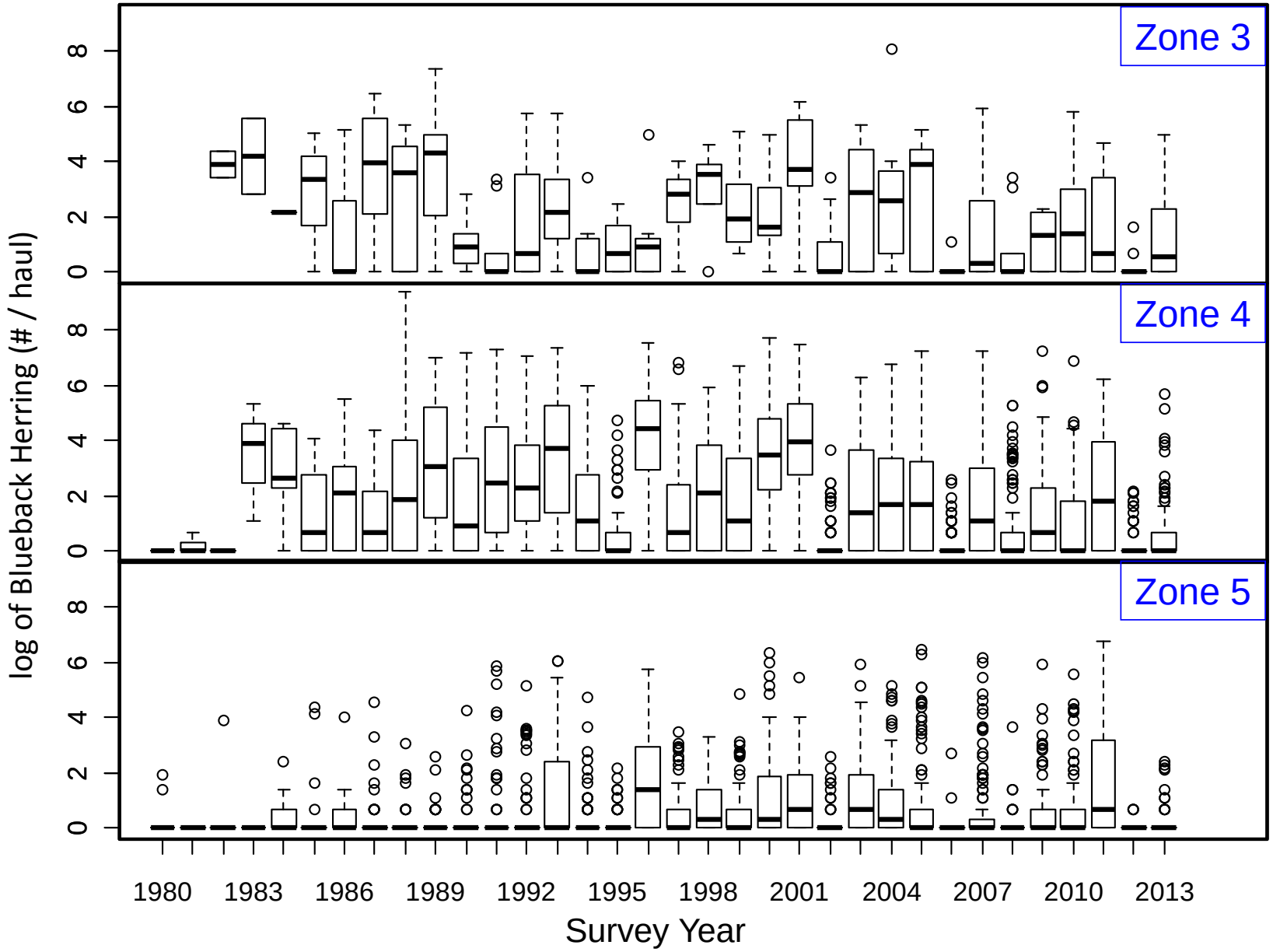


Figure 20. Atlantic Menhaden data summary from PSEG Ichthyoplankton surveys of 2002-2004 showing data distribution for all 8 surveys in each zone for each year as box-and-whisker plots (DRBC water quality zones are separated by dashed lines; PSEG survey reaches are indicated by blue bars at the top of each graph)

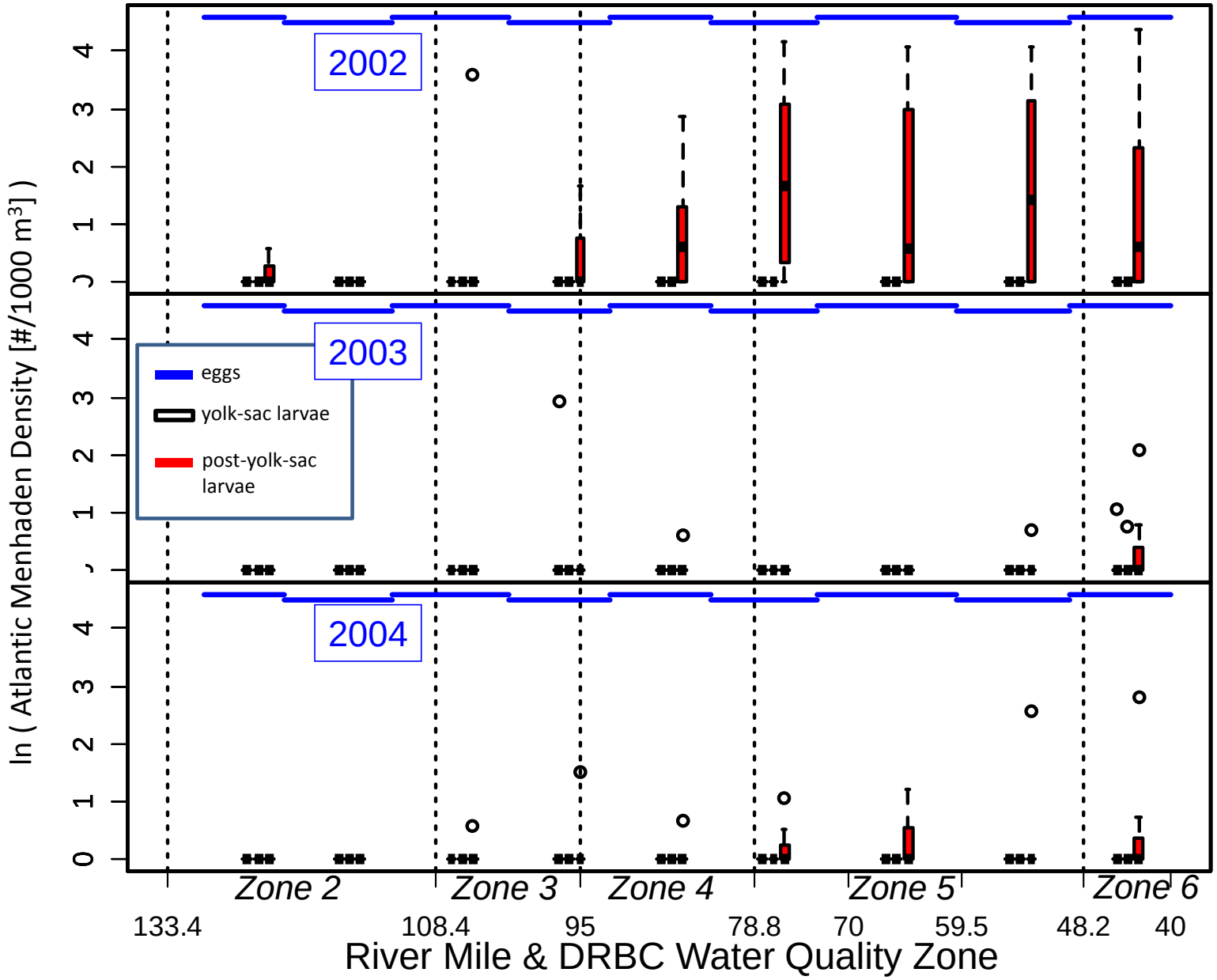
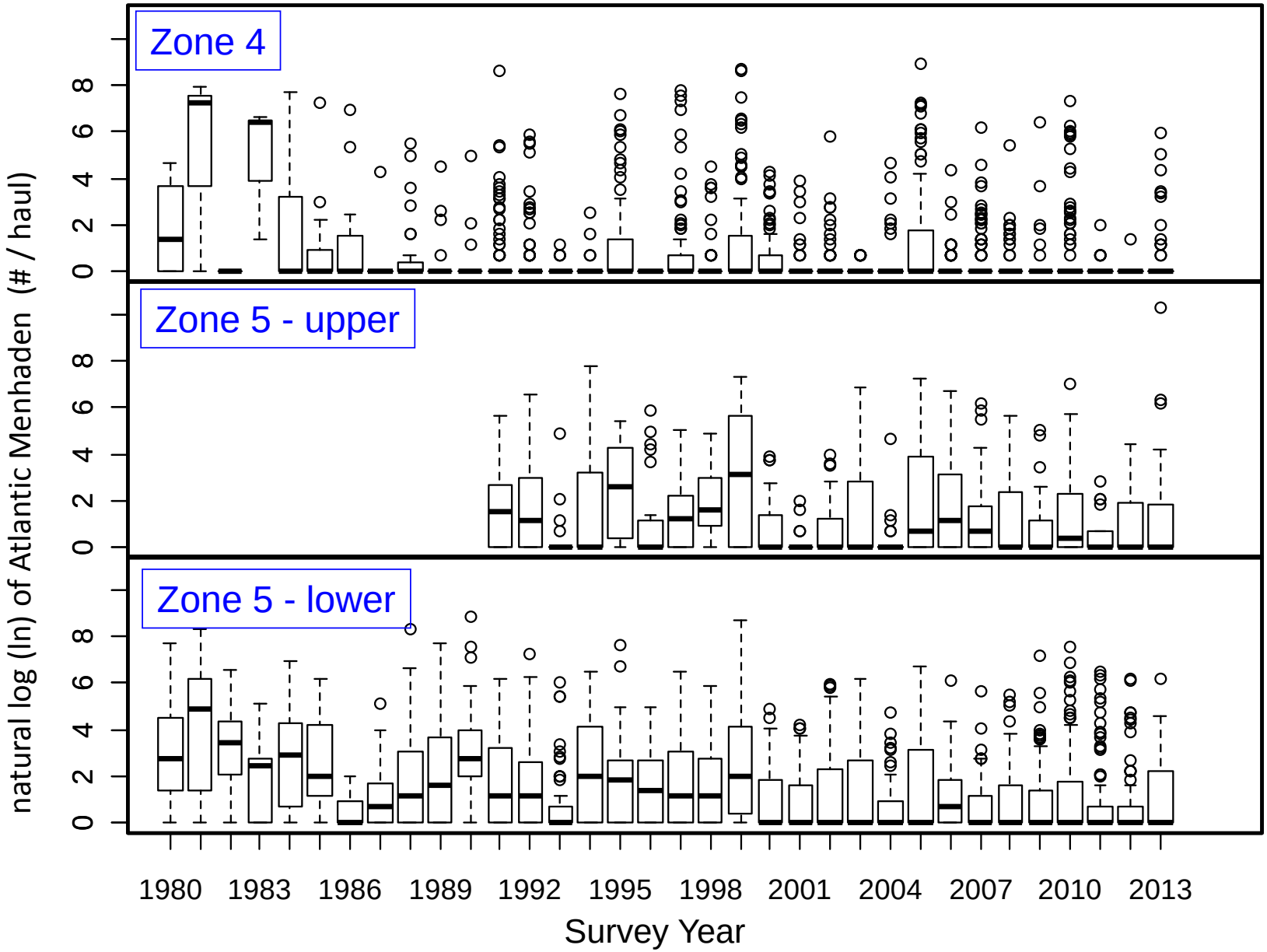


Figure 21 Atlantic Menhaden data summary from New Jersey Seine Surveys for DRBC Water Quality Zones 4 and 5, with data from the two sub-zones of Zone 5 presented separately. Full data distributions across all surveys within a Zone for a given year are presented as box-and-whisker plots. *(note: primarily young-of-year fish, with some age-1 and adult fish at times collected)*



Appendix A. 1967 Water Quality Regulations & DRBC Resolution Approval

NO. 67-2

A RESOLUTION to amend the Comprehensive Plan with respect to water quality standards for the Delaware River Estuary and Bay.

WHEREAS, the Commission undertook a basinwide water pollution abatement and control program as authorized by its resolution of May 6, 1966 (No. 66-7), and as a first step in the formulation of that program, the Commission conducted a major conference on water pollution problems of the basin in Philadelphia on July 27, 1966; and

WHEREAS, the Commission has received and considered the preliminary report of the Delaware River Estuary Comprehensive Study conducted and prepared by the Federal Water Pollution Control Administration of the United States Department of the Interior, and the various findings and conclusions thereof; and

WHEREAS, a public hearing was duly held by the Commission on the 26th day of January, 1967, at Trenton, New Jersey, upon proposed water quality standards, as authorized or required by the Federal Water Pollution Control Act, as amended, and Articles 5 and 13 of the Delaware River Basin Compact, following the publication of notice pursuant to law; and

WHEREAS, the Commission has duly considered the results of its staff investigations, the facts and arguments presented at the public hearings, and all of the data and communications received by the Commission, and has consulted with interested parties in accordance with the Compact, and in consideration thereof the Commission has made certain determinations with respect to water quality standards for the Delaware River Estuary and Bay, and the tributaries thereof; and

WHEREAS, upon such investigations, public hearings and otherwise, the Commission finds and determines that the effectuation of national policy as set forth in the Water Pollution Control Act (Public Law 84-660) as last amended by the Clean Water Restoration Act of 1966 (P.L. 89-753), and of the purposes and provisions of the Delaware River Basin Compact and the Comprehensive Plan adopted pursuant thereto, requires that the Commission assume jurisdiction to control future pollution and abate existing pollution in the waters of the Delaware River Basin, by amendment of the Comprehensive Plan and by the adoption and promulgation of rules, regulations and standards pursuant to Article 5 of the Delaware River Basin Compact; now therefore

BE IT RESOLVED by the Delaware River Basin Commission:

1. The Comprehensive Plan is hereby amended by renumbering the existing Section X to Section XII and by the addition thereto of a new section, to be designated Section X Water Quality Standards, to read as follows:

Section X

Water Quality Standards

(The text of the standards is attached)

2. This resolution shall take effect immediately. All resolutions and parts of resolutions, and all parts of the Comprehensive Plan, heretofore adopted which are inconsistent with any provision of this resolution are, to the extent of such inconsistency, hereby repealed. This resolution will not apply to existing effluents pending the adoption by the Commission of rules and regulations to implement the Comprehensive Plan as amended, pursuant to Article 5 of the Compact.

Raymond P. Shafer
Chairman

W. Binton Whitall
Secretary

ADOPTED: March 2, 1967

Amended by 67-7

QUALITY STANDARDS FOR THE INTERSTATE WATERS OF THE DELAWARE RIVER BASIN

ARTICLE I

ESTUARY GENERALLY

Water uses

Uses paramount. Water uses shall be paramount in determining stream quality objectives which, in turn, shall be the basis for determining effluent quality requirements.

Uses to be protected. The quality of waters shall be maintained in a safe and satisfactory condition for the following uses: (a) agricultural, industrial, and public water supplies after reasonable treatment, except where natural salinity precludes such uses; (b) wildlife, fish and other aquatic life; (c) recreation; (d) navigation; (e) controlled and regulated waste assimilation in reasonable compatibility with other uses; and (f) such other uses as may be provided by the Comprehensive Plan.

Stream quality objectives

Limits. The waters shall not contain substances attributable to municipal, industrial, or other discharges in concentrations or amounts sufficient to preclude the specified water uses to be protected. Within this requirement, the waters shall be substantially free from unsightly or malodorous nuisances due to floating solids, sludge deposits, debris, oil, scum, substances, in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life, or that produce color, taste, or odor.

Effluent quality requirements

Disinfection. Wastes (exclusive of stormwater bypass) containing human excreta shall be effectively disinfected before being discharged into surface bodies of water.

Public safety. Effluents shall not create a menace to public health or safety at the point of discharge.

Limits. Discharges shall not contain more than negligible amounts of debris, oil, scum or other floating materials, suspended matter which will settle to form sludge, toxic substances or substances that produce color, taste and odors.

Other considerations

Combined sewers. Any new facility or project combining sanitary or industrial waste with stormwater drainage, which would have a substantial effect on the quality of waters of the basin, shall not be permitted, whether or not any such project or facility discharges into an existing combined system.

Access and reports. The Commission, or its duly authorized representatives, shall have access, at reasonable hours, to observe and inspect waste treatment facilities and to collect samples for analyses. Upon written request, operation reports shall be submitted to the Commission.

Zones. The Delaware River and Bay may be divided into zones which will facilitate the management of surface and underground water quality. The required percentage reduction of biochemical oxygen demand of all wastes will be uniform within zones.

Definitions

Biochemical oxygen demand. Biochemical oxygen demand as determined under standard laboratory procedures for 5-days at 20° C.

Carbonaceous oxygen demand. That part of the ultimate oxygen demand associated with biochemical oxidation of carbonaceous, as distinct from nitrogenous, material.

Effective disinfection. The destruction of pathogenic organisms in such manner and under such controls as shall be prescribed by Commission regulations.

River mile. The distance, in statute miles, of a location or item measured from "mile zero" essentially along the centerline of the navigation channel. Mile zero is located [illegible]

intersection of a line between the Cape May Light and the tip of Cape Henlopen.

Application

This Article shall apply to the Delaware River Estuary and Bay, including the tidal portions of the tributaries thereof.

ARTICLE II

ZONE 2

Description

Zone 2 is that part of the Delaware River extending from the head of tidewater at Trenton, New Jersey, R.M. (River Mile) 133.4 (Trenton-Morrisville Toll Bridge) to R.M. 108.4 below the mouth of Pennypack Creek, including the tidal portions of the tributaries thereof.

Water uses

Uses to be protected. The quality of Zone 2 waters shall be maintained in a safe and satisfactory condition for the following uses: (a) agricultural, industrial, and public water supplies after reasonable treatment; (b) wildlife, maintenance and propagation of resident fish and other aquatic life, passage of anadromous fish; (c) recreation; and (d) navigation.

Stream quality objectives

Dissolved oxygen, daily average concentration shall not be less than 5.0 mg/l (milligrams per liter) except during the periods from April 1 to June 15 and September 16 to December 31 when the dissolved oxygen shall not average less than 6.5 mg/l; chlorides, maximum 15-day mean 50 mg/l; pH; between 6.5 and 8.5; total alkalinity, between 20 and 100 mg/l; hardness, maximum monthly mean 95 mg/l; temperature, shall not exceed 5° F above the average daily temperature gradient displayed during the 1961 - 1966 period, or a maximum of 86° F, whichever is less; phenols, maximum 0.005 mg/l; threshold odor number not to exceed 24 @ 60° C; syndets (synthetic detergents) measured as M.B.A.S. (methylene blue active substances), maximum monthly mean 0.5 mg/l; turbidity, maximum monthly mean 40 units, maximum 150 units; radioactivity, alpha emitters, maximum 3 pc/l (picocuries per liter), beta emitters, maximum 1,000 pc/l.

Effluent quality requirements

All discharges shall meet the effluent quality requirements of Article 1. The biochemical oxygen demand shall be reduced at all times by at least 85 percent. The carbonaceous oxygen demand from all outfalls in the Zone (exclusive of stormwater bypass) shall not exceed that assigned by Commission regulations.

ZONE 3

Description

Zone 3 is that part of the Delaware River extending from R. M. 108.4 to R. M. 95.0, below the mouth of Big Timber Creek, including the tidal portions of the tributaries thereof.

Water uses

Uses to be protected. The quality of Zone 3 waters shall be maintained in a safe and satisfactory condition for the following uses: (a) agricultural, industrial, and public water supplies after reasonable treatment; (b) wildlife, maintenance of resident fish and other aquatic life, passage of anadromous fish; (c) recreation; and (d) navigation.

Stream quality objectives

Dissolved oxygen, daily average concentration shall not be less than 3.5 mg/l, except during the periods from April 1 to June 15 and September 16 to December 31 when the dissolved oxygen shall not average less than 6.5 mg/l; chlorides, maximum 200 mg/l; pH, between 6.5 and 8.5; total alkalinity, between 20 and 120 mg/l; hardness, maximum monthly mean 150 mg/l; temperature, shall not exceed 5° F above the average daily temperature gradient displayed during the 1961 - 1966 period, or a maximum of 86° F, whichever is less; phenols, maximum 0.005 mg/l; threshold odor number not to exceed 24 @ 60° C; syndets (M.B.A.S.), maximum monthly mean 1.0 mg/l; turbidity, maximum monthly mean 40 units; maximum 150 units; radioactivity, alpha emitters, maximum 3 pc/l, beta emitters, maximum 1,000 pc/l.

Effluent quality requirements

All discharges shall meet the effluent quality requirements of Article I. The biochemical oxygen demand shall be reduced at all times by at least 85 percent. The carbonaceous oxygen demand from all outfalls in the Zone (exclusive of stormwater bypass) shall not exceed that assigned by Commission regulations.

ZONE 4

Description

Zone 4 is that part of the Delaware River extending from R. M. 95.0 to R. M. 78.8, the Pennsylvania-Delaware boundary line, including the tidal portions of the tributaries thereof.

Water uses

Uses to be protected. The quality of Zone 4 waters shall be maintained in a safe and satisfactory condition for the following uses: (a) industrial water supply after reasonable treatment; (b) wildlife, maintenance of resident fish and other aquatic life, passage of anadromous fish; (c) recreation; and (d) navigation.

Stream quality objectives

Dissolved oxygen, daily average concentration shall not be less than 3.5 mg/l, except during the periods from April 1 to June 15 and September 16 to December 31 when the dissolved oxygen shall not average less than 6.5 mg/l; chlorides, maximum 250 mg/l at R. M. 92.47; pH, between 6.5 and 8.5; total alkalinity, between 20 and 120 mg/l; temperature, shall not exceed 5° F above the average daily temperature gradient displayed during the 1961 - 1966 period, or a maximum of 86° F, whichever is less; phenols, maximum 0.02 mg/l; threshold odor number not to exceed 24 @ 60° C; syndets (M.B.A.S.), maximum monthly mean 1.0 mg/l; turbidity, maximum monthly mean 40 units, maximum 150 units; radioactivity, alpha emitters, maximum 3 pc/l, beta emitters, maximum 1,000 pc/l.

Effluent quality requirements

All discharges shall meet the effluent quality requirements of Article 1. The biochemical oxygen demand shall be reduced at all times by at least 85 percent. The carbonaceous oxygen demand from all outfalls in the Zone (exclusive of stormwater bypass) shall not exceed that assigned by Commission regulations.

ZONE 5

Description

Zone 5 is that part of the Delaware River extending from R. M. 78.8 to R. M. 48.2, Liston Point, including the tidal portions of the tributaries thereof.

Water uses

Uses to be protected. The quality of Zone 5 waters shall be maintained in a safe and satisfactory condition for the following uses: (a) industrial water supply after reasonable treatment; (b) wildlife, maintenance of resident fish and other aquatic life, propagation of resident fish from R. M. 70.0 to R. M. 48.2, passage of anadromous fish; (c) recreation; and (d) navigation.

Stream quality objectives

Dissolved oxygen, daily average concentration shall not be less than 3.5 mg/l at R. M. 78.8, 4.5 mg/l at R. M. 70.0 and 6.0 mg/l at R. M. 59.5, except during periods from April 1 to June 15 and September 16 to December 31 when the dissolved oxygen shall not average less than 6.5 mg/l in the entire zone; pH, betwen 6.5 and 8.5; total alkalinity, between 20 and 120 mg/l; temperature shall not exceed 5° F above the average daily temperature gradient displayed during the 1961 - 1966 period, or a maximum of 86° F, whichever is less; phenols, maximum 0.02 mg/l; threshold odor number not to exceed 24 @ 60° C; syndets (M.B.A.S.), maximum monthly mean 1.0 mg/l; turbidity, maximum monthly mean 40 units, maximum 150 units; radioactivity, alpha emitters, maximum 3 pc/l, beta emitters, maximum 1,000 pc/l.

Effluent quality requirements

All discharges shall meet the effluent quality requirements of Article 1. The biochemical oxygen demand shall be reduced at all times by at least 85 percent. The carbonaceous oxygen demand from all outfalls in the Zone (exclusive of stormwater bypass) shall not exceed that assigned by Commission regulations.

ZONE 6

Description

Zone 6 is that part of Delaware Bay extending from R. M. 48.2 to R. M. 0.00, the Atlantic Ocean, including the tidal portions of the tributaries thereof.

Water uses

Uses to be protected. The quality of Zone 6 waters shall be maintained in a safe and satisfactory condition for the following uses: (a) industrial water supply after reasonable treatment; (b) wildlife, maintenance and propagation of resident fish, shellfish, and other aquatic life, and passage of anadromous fish; (c) recreation and (d) navigation.

Stream quality objectives

Dissolved oxygen, daily average concentration shall not be less than 6.0 mg/l; pH, between 6.5 and 8.5; total alkalinity, between 20 and 120 mg/l; temperature, shall not exceed 5° F above the average daily temperature gradient displayed during the 1961 - 1966 period, or a maximum of 86° F, whichever is less; phenols, maximum 0.02 mg/l; threshold odor number not to exceed 24 @ 60° C; syndets (M.B.A.S.), maximum monthly mean 1.0 mg/l; turbidity, maximum monthly mean 40 units, maximum 150 units; radioactivity, alpha emitters, maximum 3 pc/l, beta emitters, maximum 1,000 pc/l; coliform, MPN (most probable number) not to exceed U. S. Public Health Service's shellfish standards in designated shellfish areas.

Effluent quality requirements

All discharges shall meet the effluent quality requirements of Article 1. The biochemical oxygen demand shall be reduced at all times by at least 85 percent.

Appendix B. Summary of Dissolved Oxygen Data from 2000 to 2014 from USGS Sensors at the Ben Franklin Bridge (01467200) and Chester, PA (01477050)

Motivation for Dissolved Oxygen Data Summary

USEPA guidance on existing uses indicates that the description of an existing use should include both a description of the use itself as well as documentation of the water quality associated with, and protective of, that existing use (USEPA 2008[1]). The water quality in the Delaware Estuary consists of many complex and interacting components, from pH and dissolved oxygen, to turbidity and suspended sediments, to metals and toxic compounds, etc. It is beyond the scope of this Existing Use Evaluation to quantify the spatial and temporal variation in all water quality parameters for Zones 3, 4, and upper Zone 5. However, the historic hypoxia in the Delaware Estuary served as both the motivation for early estuary restoration efforts as well as regulatory actions such as DRBC's wasteload allocation of CBOD (aka, FSOD or First Stage Oxygen Demand). Moreover, the restoration in the fishery resources described in this Existing Use Evaluation could not have been attained without significant improvements in dissolved oxygen concentrations for the estuary. Because of the key link between this one facet of water quality and the restoration of the fishery resources, this appendix summarizes dissolved oxygen conditions for the same data window used in the fishery evaluation: 2000 to 2014. The cautions presented in the Conclusion section of this report are worth reiterating; the presentation of dissolved oxygen data does not presume that dissolved oxygen alone is responsible for the population variations, and either the recovery or the lack of recovery for any estuarine fish species.

Dissolved Oxygen Data

The continuous water quality sensors maintained by the USGS and in part funded by the DRBC at the Ben Franklin Bridge and at Chester, PA, provide the most comprehensive documentation on the timing and magnitude of the dissolved oxygen conditions in Zones 3, 4 and the upper 8.8 miles of Zone 5. These sensors were established in the early 1960s and have been maintained every year for over 50 years, including the period 2000 to 2014 that serves as the basis for the fishery data evaluation of this report. The Ben Franklin Bridge sensor sits at the end of a pier on the Pennsylvania side of the river at RM 100 near the center of Zone 3. The Chester, PA, sensor is located at the Kimberly-Clark manufacturing facility at RM 83 near the lower limit of Zone 4. Each sensor records a suite of *in situ* water quality parameters at set intervals each day (currently every 15 minutes; see stations 01467200 and 01477050 at *waterdata.usgs.gov*) and the sensors are deployed in all months except winter (typically April through November).

As the graphs and tables included in this appendix demonstrate, the dissolved oxygen conditions in Zones 3 and 4 remain highly variable, with important changes seen among weeks, among months, and among years. To adequately capture the nature and details of these patterns of variation, full data distributions are presented across daily, monthly, and yearly time steps in either graphical or tabular form. Because DRBC's current dissolved oxygen criteria for these estuary zones rely on a 24-hour mean value, the focus for much of this appendix is on the patterns in the daily average dissolved oxygen concentration. But because of diel and tidal variations

[1] EPA 2008: September 5, 2008 letter from USEPA HQ (D. Keehner, Director, Standards and Health Protection Division) to Oklahoma Water Resources Board (D. Smithee) in response to Oklahoma Water Resources Board (D. Smithee, Chief, Water Quality Programs Division) letter and questions to USEPA-HQ (D. Keehner). *{available at water.epa.gov/scitech/swguidance/standards/upload/Smithee-existing-uses-2008-09-23.pdf}*

within each day, and because aquatic organisms can be highly sensitive to minimum dissolved oxygen levels, data distributions are also presented for the daily minimum dissolved oxygen concentrations.

Although the data summaries themselves provide the best insight into the nature of dissolved oxygen variations from 2000 to 2014, a couple general statements can be made:

- Dissolved oxygen typically remains above the 3.5 mg/L criterion for most years, but both daily minima and 24-hour daily averages at times fall below 3.5 mg/L (more often at Ben Franklin Bridge than Chester);
- Dissolved oxygen typically is somewhat lower at the Ben Franklin Bridge site than the Chester site, but the reverse can be true;
- Patterns in high or low dissolved oxygen may be related to a number of contributing factors (e.g., freshwater inflow, water temperature, individual storm events) but the relative importance of these factors is not immediately evident when comparing among years

The following yearly summaries also provide narrative descriptions of key components of the variation within and among years at each of the two stations:

Conditions during 2000

- Ben Franklin daily average dissolved oxygen remained above 4.0 mg/L for most days during the summer, with 10% of days during September 2000 falling between 3.6 and 4.0 mg/L. Minimum dissolved oxygen at Ben Franklin remained above 3.5 mg/L for most of the summer, with a short period below 3.5 mg/L in September.
- Chester daily average dissolved oxygen remained above 4.3 mg/L during 2000, with higher concentrations earlier in the summer. Minimum dissolved oxygen fell below 4 mg/L on only one day during 2000, and remained between 4 mg/L and 5 mg/L for all of August and over half of September.

Conditions during 2001

- Ben Franklin daily average dissolved oxygen remained above 3.5 mg/L for the entire summer, but there were two periods (June, August) when mean dissolved oxygen fell below 4 mg/L. Minimum dissolved oxygen fell below 3.5 mg/L during those same two periods. Overall, however, dissolved oxygen remained above 4 mg/L (both minimum and daily average) for most of the summer.

- Chester daily average dissolved oxygen fell to 3.5 mg/L and remained between 3.5 mg/L and 4.0 mg/L for a period in June 2001, and fell to 3.7 mg/L during August 2001; between these low periods, daily average dissolved oxygen remained above 5 mg/L for most of the time. Minimum dissolved oxygen likewise was lowest during windows of reduced dissolved oxygen in June (3.1 mg/L) and August (3.2 mg/L).

Conditions during 2002

- Ben Franklin daily average dissolved oxygen fell below 3.5 mg/L on one day in August 2002. In addition, multiple periods of either mean or minimum dissolved oxygen below 4 mg/L were noted. Dissolved oxygen remained in the 4 mg/L to 5 mg/L range for a protracted period, extending through September 2002.
- Chester daily average dissolved oxygen remained above 5 mg/L for most days in 2002, with periods between 4 mg/L and 5 mg/L during June, July, and August. Minimum dissolved oxygen fell below 4 mg/L on one during 2002, and remained between 4 mg/L and 5 mg/L for much of the summer.

Conditions during 2003

- Ben Franklin dissolved oxygen concentrations remained relatively high throughout 2003, with the median of the daily averages remaining above 5 mg/L and the minimum dissolved oxygen never falling below 4 mg/L.
- Chester dissolved oxygen remained high through early July 2003, and then fell to more modest levels for the remainder of the summer. Daily average dissolved oxygen remained above 6 mg/L in June 2003, with median values of 5.2 mg/L in July and 4.6 mg/L in August. Daily minimum dissolved oxygen also remained above 6 mg/L in June 2003, but was lower in July, August, and early September.

Conditions during 2004

- Ben Franklin daily average dissolved oxygen remained above 3.5 mg/L and only ranged between 3.5 mg/L and 4 mg/L for a few days in late June and early July *[note: missing data in late July 2004 could be a period of reduced dissolved oxygen]*. Minimum dissolved oxygen fell as low as 3.2 mg/L in late June, but typically remained above 4 mg/L, and also remained above 5 mg/L for over half the days in June and August.
- Chester daily average dissolved oxygen fell below 4 mg/L during two periods in July and August 2004, but otherwise remained above 4 mg/L. Minimum dissolved oxygen also fell below 4 mg/L only during these same windows in July and August, and remained between 4 mg/L and 5 mg/L for most of June, July, and August.

Conditions during 2005

- Ben Franklin dissolved oxygen was moderately depressed in 2005. Daily average dissolved oxygen fell below 3.5 mg/L in July and remained between 3.5 mg/L and 4 mg/L for most days in both July and August. Minimum dissolved oxygen fell below 3.5 mg/L in June, July, August, and September, falling as low as 3.1 mg/L in July 2005.

- Chester daily average dissolved oxygen fell below 4 mg/L for four days in July 2005, and remained between 4 mg/L and 5 mg/L for most of the summer. Daily minimum dissolved oxygen fell as low as 3.4 mg/L on two days during July 2005 and had short periods in June and July below 4 mg/L; from June into September, daily minima typically ranged between 4 and 5 mg/L.

Conditions during 2006

- Ben Franklin dissolved oxygen remained moderately high during 2006 *[note: historic flooding occurred in the middle of summer 2006 on the non-tidal Delaware River; see pubs.usgs.gov/of/2008/1203/pdf/ofr2008-1203.pdf]*. Periods of low dissolved oxygen occurred in early June 2006 and in August 2006, but daily average dissolved oxygen remained above 4 mg/L for most days. Minimum dissolved oxygen fell below 3.5 mg/L briefly in August and remained between 3.5 mg/L and 4 mg/L on most days during August, but was above 4 mg/L for most days through the rest of summer.
- Chester daily average dissolved oxygen remained above 4 mg/L during 2006, with most days during summer 2006 above 5 mg/L. Daily minima dissolved oxygen typically ranged between 4 mg/L and 5 mg/L for June, July, and August 2006.

Conditions during 2007

- Ben Franklin dissolved oxygen was depressed in June 2007, although dissolved oxygen remained moderate for the rest of the summer *[note: too much missing data from early September precludes an accurate summary of September 2007 data]*. Average daily dissolved oxygen fell below 3.5 mg/L on five separate days in June 2007, and minimum dissolved oxygen fell to 2.5 mg/L. Minimum dissolved oxygen fell below 3.5 mg/L again at the end of August, at which point the USGS censored the data presumably because of sensor problems.
- Chester average daily dissolved oxygen remained above 5 mg/L for all of 2007 except a period during June when average dissolved oxygen fell between 4.7 mg/L and 5 mg/L. Minimum dissolved oxygen remained above 4.5 mg/L except for that same period in June 2007 when minimum dissolved oxygen fell between 4.2 mg/L and 4.5 mg/L.

Conditions during 2008

- Ben Franklin daily average dissolved oxygen remained above 3.5 mg/L during 2008, although periods of dissolved oxygen below 4 mg/L were seen in both June and July. Daily minimum dissolved oxygen fell as low as 2.2 mg/L in June and 2.7 mg/L in July, among the lowest dissolved oxygen values recorded during the 2000-2014 data window. Overall, dissolved oxygen remained between 4 mg/L and 5 mg/L for a protracted period, extending toward the end of September 2008.
- Chester daily average dissolved oxygen fluctuated around 5 mg/L during the summer of 2008, with the lowest daily average of 4.2 mg/L in July. Minimum dissolved oxygen readings typically were above 4 mg/L, with one day in June, two days in July, and two days in August with daily minima between 3.7 mg/L and 3.9 mg/L.

Conditions during 2009

- Ben Franklin dissolved oxygen concentrations remained relatively high for most of 2009, with only a single period in late July where dissolved oxygen fell substantially. Daily average dissolved oxygen remained above 6 mg/L for nearly all of June and through half of July, which was followed by a short duration where average dissolved oxygen fell to between 4 and 5 mg/L. Minimum dissolved oxygen likewise remained high for most of the summer, with minimum dissolved oxygen below 4 mg/L only during that short period in late July, when the lowest value of 3.3 mg/L was recorded.

- Chester dissolved oxygen remained notably high during 2009. Daily average dissolved oxygen exceeded 6.5 mg/L during most days this summer, with more typical values around 5 mg/L during only one period from late July into early August. Daily minima were also relatively high, often approaching or exceeding 6 mg/L, and again ranging in the more typical 4 mg/L to 5 mg/L range only during late July and early August.

Conditions during 2010

- Ben Franklin dissolved oxygen in 2010 is difficult to characterize because of equipment problems at this station. Real-time measurements in late June and early July indicated marked depressions in dissolved oxygen, but QA/QC checks showed the sensor was biased low in its readings during this period. Although spot measurements included dissolved oxygen readings as low as 3.3 mg/L, insufficient data exist during the period when the Ben Franklin sensor was inoperable to adequately and accurately characterize dissolved oxygen for 2010, although some depressed dissolved oxygen readings were recorded.
- Chester daily average dissolved oxygen exceeded 5 mg/L on most days during 2010 *[note: sensor failure in late June and early July occurred during a period when spot measurements showed depressed dissolved oxygen].* Minimum dissolved oxygen remained above 4 mg/L on all days with approved data, and exceeded 5 mg/L on most days during the summer of 2010.

Conditions during 2011

- Ben Franklin dissolved oxygen remained relatively high through 2011, with a small depression in June and a more substantial drop in dissolved oxygen in late July and early August. Daily average dissolved oxygen remained above 5 mg/L for most of the year, and fell below 4 mg/L only on 2 days in August. Daily minimum dissolved oxygen fell to 3.4 mg/L on two days in August and remained between 4 and 5 mg/L through early August; minimum dissolved oxygen values were typically above 5 mg/L, however, during the remainder of 2011.
- Chester daily average dissolved oxygen remained above 5 mg/L for nearly every day during 2011, with just 5 days across June, July, and August with recorded average dissolved oxygen below 5 mg/L. Minimum dissolved oxygen remained above 4.2 mg/L during the summer, and stayed above 5 mg/L on most days during 2011.

Conditions during 2012

- Ben Franklin dissolved oxygen remained high in June 2012, but then fell to moderate to low values for the remainder of the summer. Daily average dissolved oxygen fell to 3.7 mg/L in July, and remained between 4 mg/L and 5 mg/L for all of August. Daily minimum dissolved oxygen fell to 3.1 mg/L in July, and remained between 3.5 and 4 mg/L for over half of August.
- Chester dissolved oxygen remained high through June 2012, and then fell to more typical values for July, August, and September. The median of the June daily averages was 6.7 mg/L, with medians in July, August, and September ranging from 4.9 to 5.5 mg/L. Minimum dissolved oxygen fell below 4 mg/L on 10 days during 2012, with the lowest value of 3.4 mg/L in August 2012.

Conditions during 2013

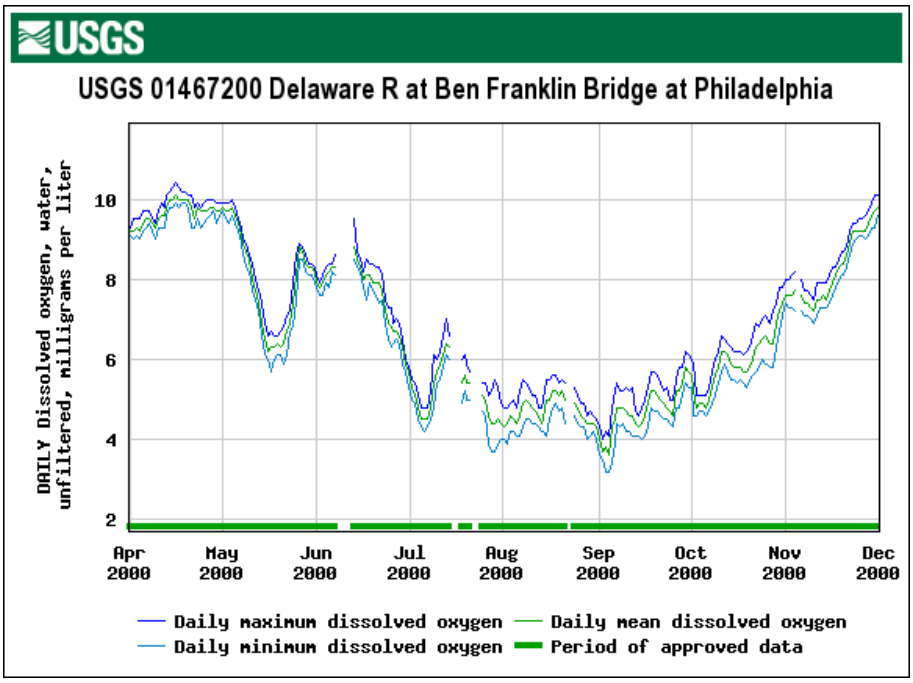
- Ben Franklin daily average dissolved oxygen remained relatively high throughout 2013, with only brief periods of daily average dissolved oxygen below 5 mg/L in August and September. Daily minimum dissolved oxygen remained above 4 mg/L for nearly all of the summer, falling below 4 mg/L on 2 days in September, with a minimum of 3.7 mg/L recorded that month.
- Chester daily average dissolved oxygen remained above 5 mg/L during the summer of 2013, with median or typical values approaching or exceeding 6 mg/L. Minimum dissolved oxygen remained above 5 mg/L for most days during 2013, falling to 4.9 mg/L on one day in July and as low as 4.7 mg/L on five days in August 2013.

Conditions during 2014

- Ben Franklin dissolved oxygen exhibited the highest sustained levels during 2014 compared to other years between 2000 and 2014, with daily average dissolved oxygen remaining above 5 mg/L for the only year during this period. Daily minimum dissolved oxygen also remained relatively high, with most minima at or above 6 mg/L through June and July, and the lowest value of 4.3 mg/L recorded in August.
- Official approved records for minimum dissolved oxygen during 2014 show a peculiar pattern, with dissolved oxygen concentrations as low as 3 mg/L despite the moderate to high daily average dissolved oxygen values. Official approved daily average dissolved oxygen remained near or above 5 mg/L. *[note: Closer inspection of the 15-minute interval data from USGS shows an unusual pattern of highly erratic dissolved oxygen readings during 2014. The dissolved oxygen data for 2014 are therefore so highly unusual that definitive statements on their distribution are tentative, as best.*]

BEN FRANKLIN BRIDGE (RM 100)
DATA DISTRIBUTIONS

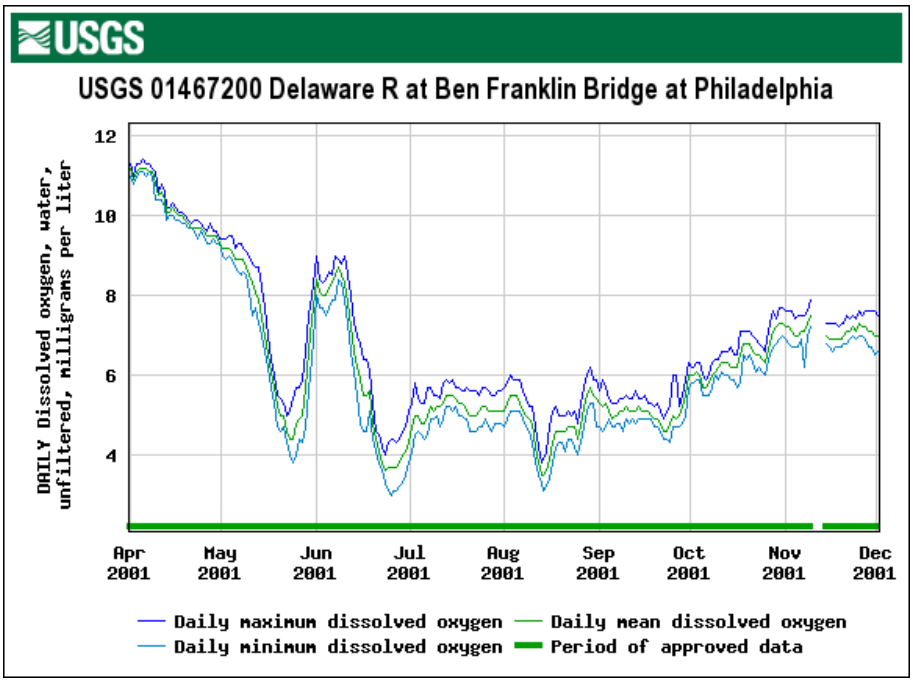
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2000**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2000	Jan	0	*insufficient data to estimate percentiles and statistics*							
2000	Feb	0	*insufficient data to estimate percentiles and statistics*							
2000	Mar	0	*insufficient data to estimate percentiles and statistics*							
2000	Apr	30	9.2	9.3	9.5	9.7	9.7	9.8	10.0	10.1
2000	May	31	6.2	6.3	6.8	8.2	8.0	8.9	9.7	9.8
2000	June	25	5.9	6.6	6.9	7.9	7.6	8.1	8.3	8.8
2000	July	25	4.4	4.4	4.5	5.1	5.2	5.6	6.0	6.4
2000	Aug	29	4.3	4.4	4.4	4.6	4.7	5.0	5.1	5.2
2000	Sept	30	3.6	4.0	4.4	4.8	4.7	5.1	5.2	5.8
2000	Oct	31	4.8	4.9	5.6	5.8	5.9	6.4	6.6	7.4
2000	Nov	29	7.2	7.4	7.6	7.9	8.2	9.2	9.2	9.7
2000	Dec	3	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2000	Jan	0	*insufficient data to estimate percentiles and statistics*							
2000	Feb	0	*insufficient data to estimate percentiles and statistics*							
2000	Mar	0	*insufficient data to estimate percentiles and statistics*							
2000	Apr	30	9.0	9.1	9.3	9.4	9.4	9.7	9.8	9.9
2000	May	31	5.7	6.0	6.4	7.9	7.7	8.6	9.4	9.7
2000	June	25	5.7	6.3	6.5	7.6	7.4	7.9	8.2	8.5
2000	July	25	3.7	3.9	4.3	4.8	4.8	5.2	5.7	6.1
2000	Aug	29	3.9	4.0	4.1	4.3	4.3	4.5	4.7	4.9
2000	Sept	30	3.2	3.5	4.1	4.3	4.3	4.7	4.8	5.4
2000	Oct	31	4.6	4.7	5.2	5.5	5.5	5.8	6.0	7.1
2000	Nov	29	6.9	7.1	7.3	7.6	7.9	8.9	9.1	9.3
2000	Dec	3	*insufficient data to estimate percentiles and statistics*							

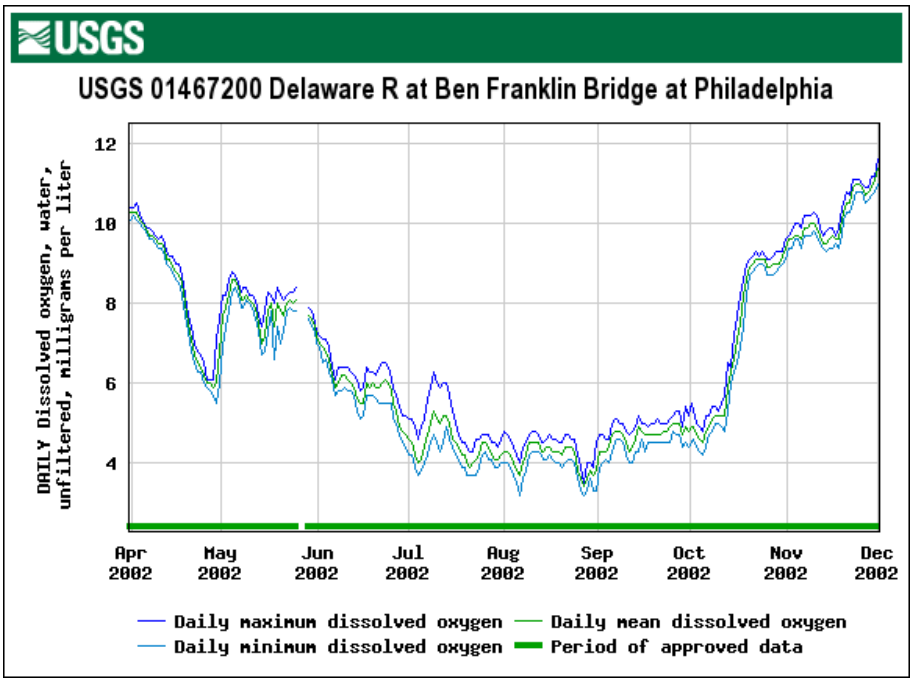
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2001**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2001	Jan	0	*insufficient data to estimate percentiles and statistics*							
2001	Feb	0	*insufficient data to estimate percentiles and statistics*							
2001	Mar	4	*insufficient data to estimate percentiles and statistics*							
2001	Apr	30	9.3	9.5	9.7	10.1	10.2	10.9	11.2	11.2
2001	May	31	4.4	4.8	5.1	7.4	7.0	8.8	9.1	9.2
2001	June	30	3.6	3.7	4.0	5.8	6.0	8.1	8.4	8.7
2001	July	31	4.3	4.8	5.0	5.1	5.1	5.2	5.4	5.5
2001	Aug	31	3.5	3.8	4.5	4.7	4.8	5.3	5.5	5.7
2001	Sept	30	4.6	4.8	4.9	5.1	5.1	5.2	5.3	6.0
2001	Oct	31	5.7	6.0	6.1	6.3	6.4	6.7	7.1	7.3
2001	Nov	26	6.9	6.9	7.0	7.1	7.1	7.2	7.3	7.5
2001	Dec	3	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2001	Jan	0	*insufficient data to estimate percentiles and statistics*							
2001	Feb	0	*insufficient data to estimate percentiles and statistics*							
2001	Mar	4	*insufficient data to estimate percentiles and statistics*							
2001	Apr	30	9.3	9.3	9.6	9.9	10.1	10.7	11.0	11.1
2001	May	31	3.8	4.3	4.7	6.6	6.5	8.5	8.9	9.0
2001	June	30	3.0	3.1	3.5	5.0	5.5	7.7	7.9	8.4
2001	July	31	3.8	4.5	4.6	4.8	4.7	4.9	5.1	5.2
2001	Aug	31	3.1	3.4	4.1	4.4	4.4	4.9	5.1	5.3
2001	Sept	30	4.3	4.6	4.7	4.8	4.8	4.9	4.9	5.7
2001	Oct	31	5.5	5.7	5.9	6.0	6.1	6.4	6.7	7.0
2001	Nov	26	6.2	6.7	6.7	6.8	6.8	6.9	7.0	7.2
2001	Dec	3	*insufficient data to estimate percentiles and statistics*							

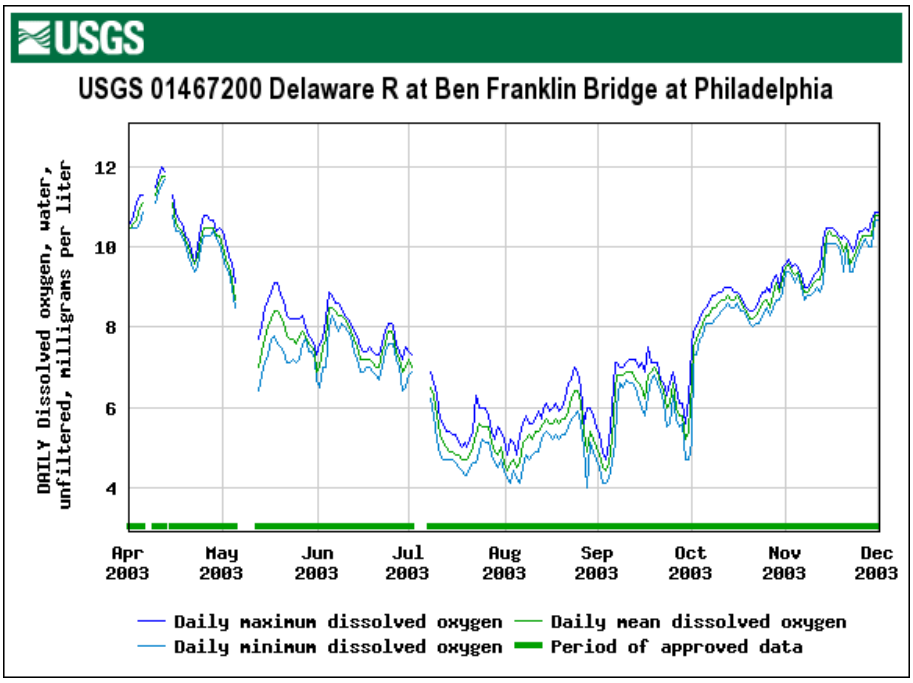
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2002**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2002	Jan	0	*insufficient data to estimate percentiles and statistics*							
2002	Feb	0	*insufficient data to estimate percentiles and statistics*							
2002	Mar	5	*insufficient data to estimate percentiles and statistics*							
2002	Apr	30	5.9	6.0	6.7	8.9	8.4	9.7	10.1	10.3
2002	May	28	7.0	7.4	7.7	8.0	7.9	8.1	8.3	8.6
2002	June	30	4.7	5.3	5.7	6.0	5.9	6.2	6.8	7.2
2002	July	31	3.9	4.0	4.2	4.4	4.5	4.7	5.1	5.3
2002	Aug	31	3.4	3.7	3.8	4.3	4.1	4.4	4.5	4.5
2002	Sept	30	4.3	4.3	4.6	4.7	4.7	4.8	4.9	5.0
2002	Oct	31	4.5	4.8	5.2	7.1	7.0	9.0	9.1	9.2
2002	Nov	30	9.4	9.6	9.6	9.9	10.1	10.7	10.9	11.1
2002	Dec	1	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2002	Jan	0	*insufficient data to estimate percentiles and statistics*							
2002	Feb	0	*insufficient data to estimate percentiles and statistics*							
2002	Mar	5	*insufficient data to estimate percentiles and statistics*							
2002	Apr	30	5.5	5.9	6.4	8.7	8.2	9.6	10.0	10.2
2002	May	28	6.6	6.9	7.3	7.7	7.6	7.9	8.1	8.4
2002	June	30	4.4	5.0	5.4	5.7	5.6	5.8	6.5	7.0
2002	July	31	3.7	3.7	3.9	4.1	4.1	4.3	4.5	4.9
2002	Aug	31	3.2	3.3	3.6	4.0	3.8	4.1	4.2	4.3
2002	Sept	30	3.9	4.0	4.3	4.5	4.4	4.5	4.6	4.8
2002	Oct	31	4.2	4.4	4.8	6.5	6.7	8.8	8.9	9.0
2002	Nov	30	9.1	9.4	9.4	9.7	9.9	10.5	10.8	10.8
2002	Dec	1	*insufficient data to estimate percentiles and statistics*							

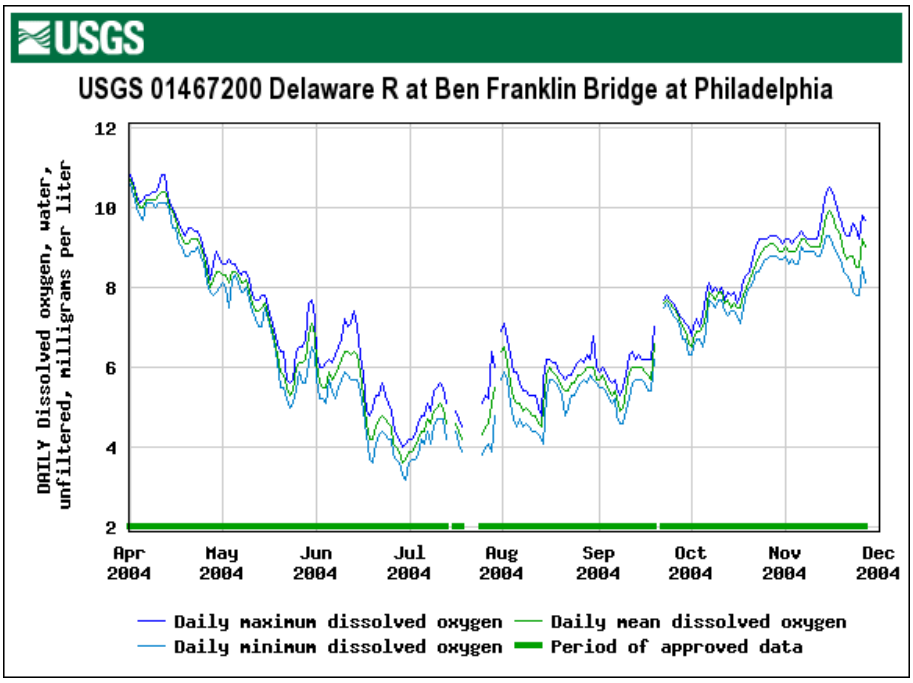
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2003**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2003	Jan	0	*insufficient data to estimate percentiles and statistics*							
2003	Feb	0	*insufficient data to estimate percentiles and statistics*							
2003	Mar	3	*insufficient data to estimate percentiles and statistics*							
2003	Apr	25	9.6	9.9	10.3	10.5	10.6	11.0	11.5	11.8
2003	May	24	7.0	7.4	7.7	7.9	8.1	8.4	9.4	10.0
2003	June	30	6.9	7.0	7.2	7.5	7.6	7.9	8.3	8.5
2003	July	26	4.7	4.8	4.8	5.1	5.3	5.5	6.4	7.2
2003	Aug	31	4.4	4.6	5.1	5.4	5.4	5.7	6.1	6.4
2003	Sept	30	4.4	4.8	5.8	6.5	6.2	6.8	6.9	7.0
2003	Oct	31	6.7	7.9	8.3	8.5	8.4	8.7	8.8	9.2
2003	Nov	30	8.9	9.1	9.3	9.8	9.8	10.3	10.3	10.8
2003	Dec	1	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2003	Jan	0	*insufficient data to estimate percentiles and statistics*							
2003	Feb	0	*insufficient data to estimate percentiles and statistics*							
2003	Mar	3	*insufficient data to estimate percentiles and statistics*							
2003	Apr	25	9.4	9.7	10.1	10.4	10.4	10.6	11.3	11.7
2003	May	24	6.4	7.1	7.2	7.4	7.7	7.7	9.3	9.8
2003	June	30	6.4	6.7	6.9	7.1	7.3	7.8	8.0	8.3
2003	July	26	4.3	4.5	4.6	4.7	5.0	5.1	6.0	6.9
2003	Aug	31	4.0	4.2	4.6	5.0	5.0	5.3	5.6	5.9
2003	Sept	30	4.1	4.5	5.2	6.0	5.8	6.5	6.6	6.8
2003	Oct	31	5.1	7.7	8.1	8.3	8.2	8.5	8.6	8.9
2003	Nov	30	8.7	8.9	9.1	9.4	9.6	10.0	10.1	10.7
2003	Dec	1	*insufficient data to estimate percentiles and statistics*							

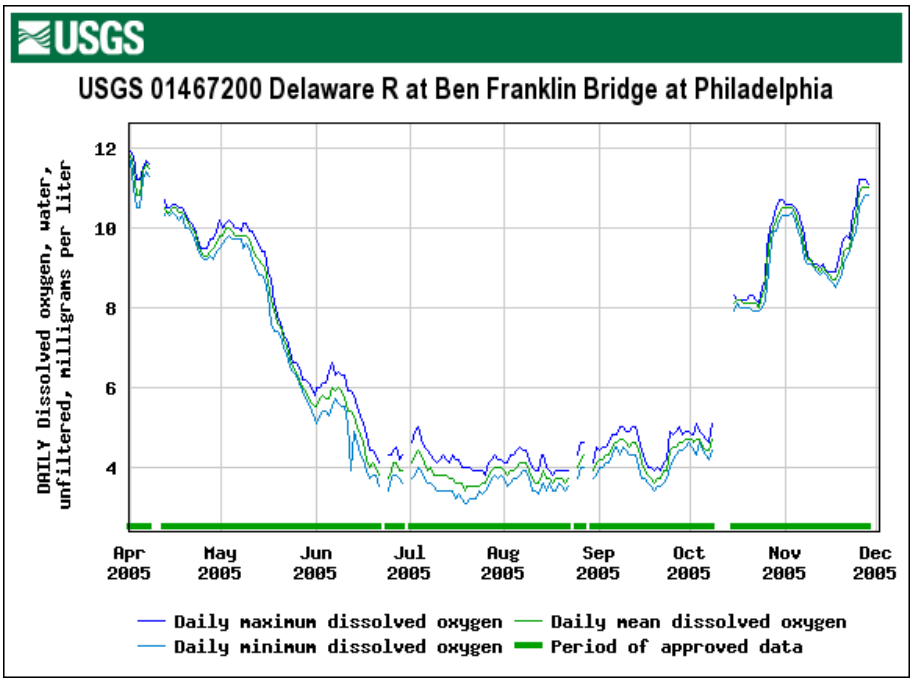
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2004**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2004	Jan	0	*insufficient data to estimate percentiles and statistics*							
2004	Feb	0	*insufficient data to estimate percentiles and statistics*							
2004	Mar	2	*insufficient data to estimate percentiles and statistics*							
2004	Apr	30	8.0	8.4	9.1	9.8	9.6	10.2	10.4	10.7
2004	May	31	5.3	5.8	6.2	7.3	7.1	8.1	8.3	8.4
2004	June	30	3.6	4.0	4.5	5.4	5.2	6.0	6.3	6.4
2004	July	22	3.9	4.0	4.3	4.6	4.7	5.0	5.1	6.4
2004	Aug	31	4.5	4.8	5.1	5.6	5.5	5.9	6.0	6.5
2004	Sept	28	4.9	5.3	5.6	6.0	6.2	6.9	7.5	7.7
2004	Oct	31	6.5	6.9	7.5	7.9	8.0	8.9	9.0	9.1
2004	Nov	27	8.5	8.8	8.9	9.0	9.1	9.2	9.6	9.9
2004	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2004	Jan	0	*insufficient data to estimate percentiles and statistics*							
2004	Feb	0	*insufficient data to estimate percentiles and statistics*							
2004	Mar	2	*insufficient data to estimate percentiles and statistics*							
2004	Apr	30	7.8	8.0	8.8	9.5	9.3	10.1	10.1	10.6
2004	May	31	5.0	5.4	5.8	7.0	6.8	7.8	8.1	8.3
2004	June	30	3.2	3.6	4.1	5.0	4.8	5.7	5.7	5.9
2004	July	22	3.6	3.7	3.9	4.1	4.2	4.5	4.7	5.7
2004	Aug	31	4.1	4.4	4.6	5.3	5.1	5.6	5.7	5.9
2004	Sept	28	4.6	4.9	5.2	5.6	5.9	6.7	7.4	7.6
2004	Oct	31	6.3	6.7	7.3	7.7	7.7	8.5	8.7	8.8
2004	Nov	27	7.8	8.0	8.5	8.8	8.6	8.9	9.0	9.3
2004	Dec	0	*insufficient data to estimate percentiles and statistics*							

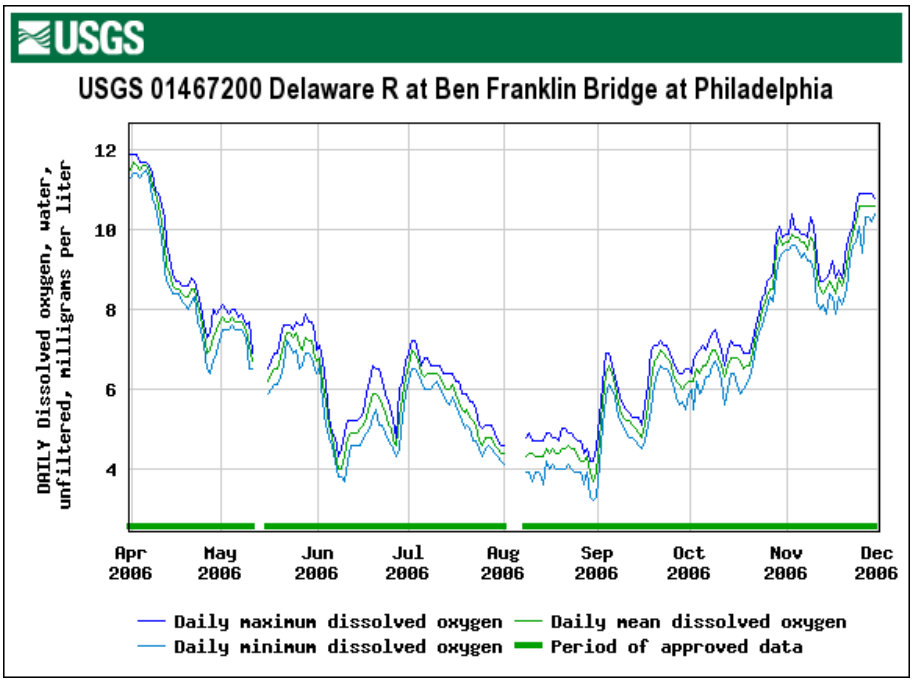
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2005**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2005	Jan	0	*insufficient data to estimate percentiles and statistics*							
2005	Feb	0	*insufficient data to estimate percentiles and statistics*							
2005	Mar	2	*insufficient data to estimate percentiles and statistics*							
2005	Apr	26	9.3	9.4	9.7	10.4	10.3	10.7	11.5	11.8
2005	May	31	5.5	5.9	6.6	8.6	8.2	9.8	9.8	10.0
2005	June	27	3.7	3.9	4.1	5.0	4.9	5.7	5.9	6.0
2005	July	30	3.4	3.5	3.6	3.8	3.8	4.0	4.1	4.4
2005	Aug	27	3.6	3.6	3.7	3.9	3.9	4.0	4.1	4.3
2005	Sept	30	3.6	3.7	4.0	4.5	4.3	4.6	4.7	4.7
2005	Oct	25	4.4	4.5	4.7	8.1	7.5	8.5	10.1	10.5
2005	Nov	28	8.7	8.9	9.0	9.5	9.7	10.4	10.9	11.0
2005	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2005	Jan	0	*insufficient data to estimate percentiles and statistics*							
2005	Feb	0	*insufficient data to estimate percentiles and statistics*							
2005	Mar	2	*insufficient data to estimate percentiles and statistics*							
2005	Apr	26	9.2	9.3	9.5	10.3	10.2	10.5	11.3	11.7
2005	May	31	5.2	5.7	6.5	8.3	7.9	9.6	9.7	9.8
2005	June	27	3.4	3.7	3.8	4.3	4.5	5.4	5.5	5.7
2005	July	30	3.1	3.2	3.3	3.4	3.5	3.7	3.8	4.0
2005	Aug	27	3.3	3.4	3.5	3.6	3.6	3.7	3.9	4.0
2005	Sept	30	3.4	3.5	3.7	4.2	4.1	4.4	4.5	4.6
2005	Oct	25	4.2	4.3	4.5	8.0	7.2	8.2	9.9	10.3
2005	Nov	28	8.5	8.7	8.9	9.3	9.5	10.2	10.6	10.8
2005	Dec	0	*insufficient data to estimate percentiles and statistics*							

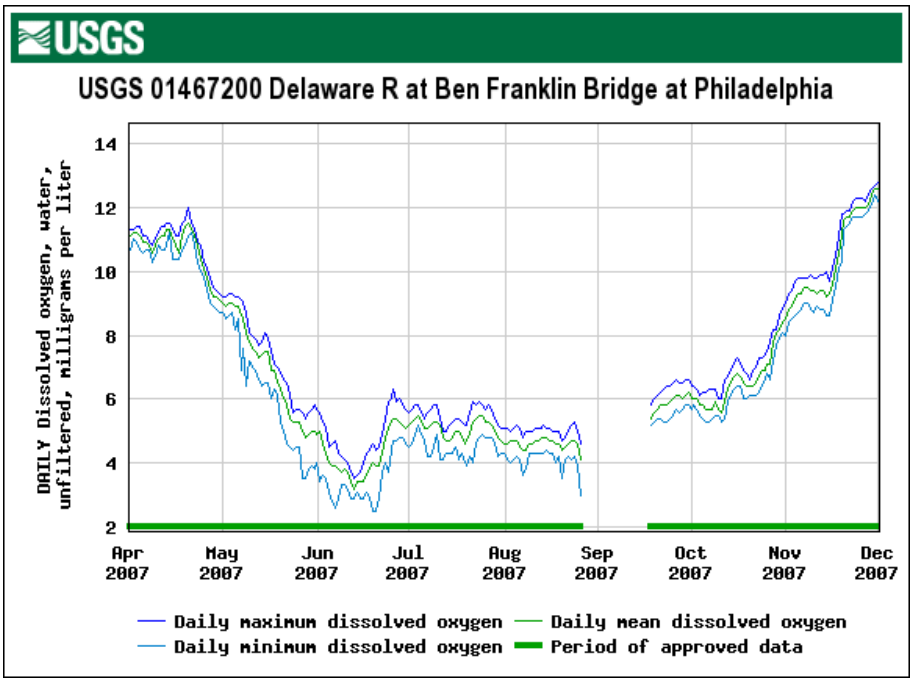
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2006**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2006	Jan	0	*insufficient data to estimate percentiles and statistics*							
2006	Feb	0	*insufficient data to estimate percentiles and statistics*							
2006	Mar	1	*insufficient data to estimate percentiles and statistics*							
2006	Apr	30	6.9	7.4	8.2	8.6	9.3	11.1	11.6	11.7
2006	May	27	6.2	6.5	6.9	7.3	7.2	7.7	7.7	7.8
2006	June	30	4.0	4.4	4.8	5.1	5.3	5.8	6.1	6.8
2006	July	31	4.4	4.6	5.0	5.9	5.7	6.4	6.6	7.0
2006	Aug	25	3.7	4.0	4.3	4.4	4.3	4.5	4.5	4.6
2006	Sept	30	4.7	5.0	5.2	6.1	5.9	6.4	6.8	7.0
2006	Oct	31	6.2	6.4	6.6	6.8	7.2	7.8	8.5	9.8
2006	Nov	30	8.4	8.5	8.7	9.7	9.5	9.9	10.6	10.6
2006	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2006	Jan	0	*insufficient data to estimate percentiles and statistics*							
2006	Feb	0	*insufficient data to estimate percentiles and statistics*							
2006	Mar	1	*insufficient data to estimate percentiles and statistics*							
2006	Apr	30	6.4	6.9	7.8	8.4	9.0	10.8	11.4	11.5
2006	May	27	5.9	6.1	6.5	6.9	6.9	7.5	7.5	7.6
2006	June	30	3.7	4.2	4.5	4.8	4.9	5.1	5.7	6.6
2006	July	31	4.2	4.4	4.7	5.6	5.4	6.0	6.2	6.5
2006	Aug	25	3.2	3.4	3.8	3.9	3.8	4.0	4.1	4.2
2006	Sept	30	4.1	4.7	5.0	5.6	5.5	6.1	6.4	6.6
2006	Oct	31	5.5	5.9	6.1	6.4	6.8	7.5	8.3	9.4
2006	Nov	30	7.9	8.1	8.3	9.3	9.1	9.6	10.2	10.4
2006	Dec	0	*insufficient data to estimate percentiles and statistics*							

Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2007**

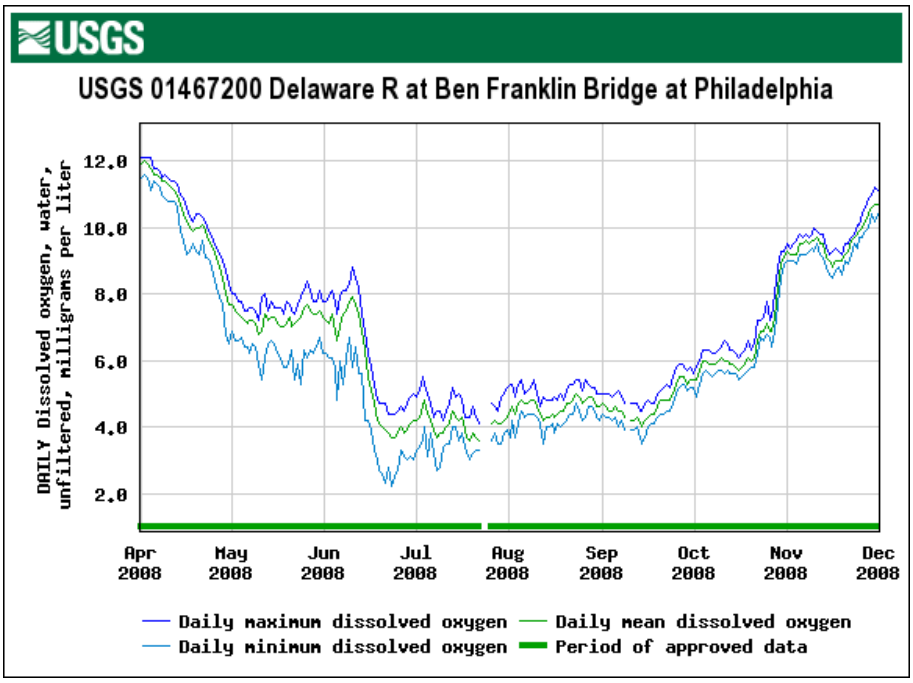


Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2007	Jan	0	*insufficient data to estimate percentiles and statistics*							
2007	Feb	0	*insufficient data to estimate percentiles and statistics*							
2007	Mar	1	*insufficient data to estimate percentiles and statistics*							
2007	Apr	30	9.1	9.4	10.6	11.0	10.7	11.1	11.3	11.5
2007	May	31	4.8	5.0	5.4	7.3	7.0	8.3	8.9	9.0
2007	June	30	3.2	3.4	3.7	4.0	4.3	5.0	5.3	5.4
2007	July	31	4.6	4.7	4.8	5.2	5.1	5.3	5.4	5.5
2007	Aug	26	4.1	4.4	4.6	4.6	4.6	4.7	4.8	4.8
2007	Sept [a]	13	*insufficient data to estimate percentiles and statistics*							
2007	Oct	31	5.6	5.7	5.9	6.4	6.5	6.9	7.8	8.4
2007	Nov	30	8.5	9.1	9.3	9.6	10.4	11.9	12.0	12.6
2007	Dec	18	12.6	12.7	12.9	13.3	13.2	13.4	13.6	13.7

[a] *– sensor failure early in September 2007 could lead to bias in representing data distribution*

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2007	Jan	0	*insufficient data to estimate percentiles and statistics*							
2007	Feb	0	*insufficient data to estimate percentiles and statistics*							
2007	Mar	1	*insufficient data to estimate percentiles and statistics*							
2007	Apr	30	8.7	9.0	10.3	10.7	10.4	10.8	11.0	11.2
2007	May	31	3.5	3.8	4.5	6.4	6.1	7.1	8.5	8.7
2007	June	30	2.5	2.8	2.9	3.3	3.5	3.9	4.7	4.8
2007	July	31	3.9	4.1	4.2	4.5	4.5	4.8	4.9	5.2
2007	Aug	26	3.0	3.7	4.0	4.2	4.1	4.3	4.3	4.4
2007	Sept [a]	13	*insufficient data to estimate percentiles and statistics*							
2007	Oct	31	5.3	5.4	5.5	6.1	6.2	6.4	7.2	8.1
2007	Nov	30	8.0	8.6	8.7	9.1	9.9	11.7	11.8	12.4
2007	Dec	18	12.2	12.5	12.7	12.9	12.9	13.2	13.3	13.4

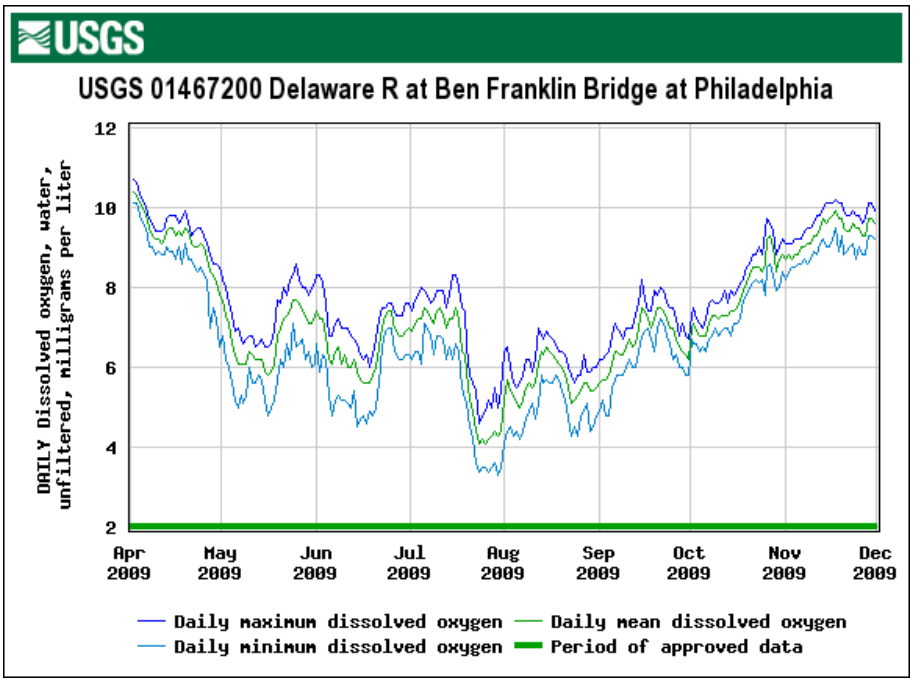
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2008**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2008	Jan	0	*insufficient data to estimate percentiles and statistics*							
2008	Feb	0	*insufficient data to estimate percentiles and statistics*							
2008	Mar	0	*insufficient data to estimate percentiles and statistics*							
2008	Apr	30	7.7	8.8	9.8	10.3	10.4	11.4	11.8	12.0
2008	May	31	6.8	7.0	7.1	7.3	7.3	7.4	7.5	7.7
2008	June	30	3.7	3.8	4.0	5.3	5.6	7.2	7.5	7.9
2008	July	28	3.6	3.7	3.8	4.1	4.1	4.3	4.4	4.8
2008	Aug	31	4.2	4.3	4.5	4.7	4.6	4.8	4.9	5.0
2008	Sept	29	4.0	4.2	4.3	4.6	4.7	4.8	5.4	5.5
2008	Oct	31	5.4	5.7	5.9	6.0	6.4	6.9	7.3	9.1
2008	Nov	30	8.8	9.0	9.2	9.5	9.5	9.7	10.2	10.7
2008	Dec	17	10.7	11.3	11.5	11.6	11.6	11.7	12.1	12.2

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2008	Jan	0	*insufficient data to estimate percentiles and statistics*							
2008	Feb	0	*insufficient data to estimate percentiles and statistics*							
2008	Mar	0	*insufficient data to estimate percentiles and statistics*							
2008	Apr	30	6.5	7.9	9.1	9.6	9.8	11.0	11.4	11.6
2008	May	31	5.3	5.8	6.1	6.3	6.2	6.5	6.6	6.9
2008	June	30	2.2	2.6	3.0	4.1	4.3	5.8	6.1	6.7
2008	July	28	2.7	3.1	3.3	3.5	3.5	3.8	3.9	4.0
2008	Aug	31	3.5	3.8	4.1	4.2	4.2	4.4	4.5	4.7
2008	Sept	29	3.5	3.9	4.0	4.3	4.4	4.5	5.2	5.3
2008	Oct	31	4.9	5.4	5.6	5.7	6.1	6.5	6.9	8.9
2008	Nov	30	8.5	8.7	8.9	9.2	9.2	9.5	9.9	10.4
2008	Dec	17	10.4	10.9	11.1	11.3	11.3	11.4	11.8	12.1

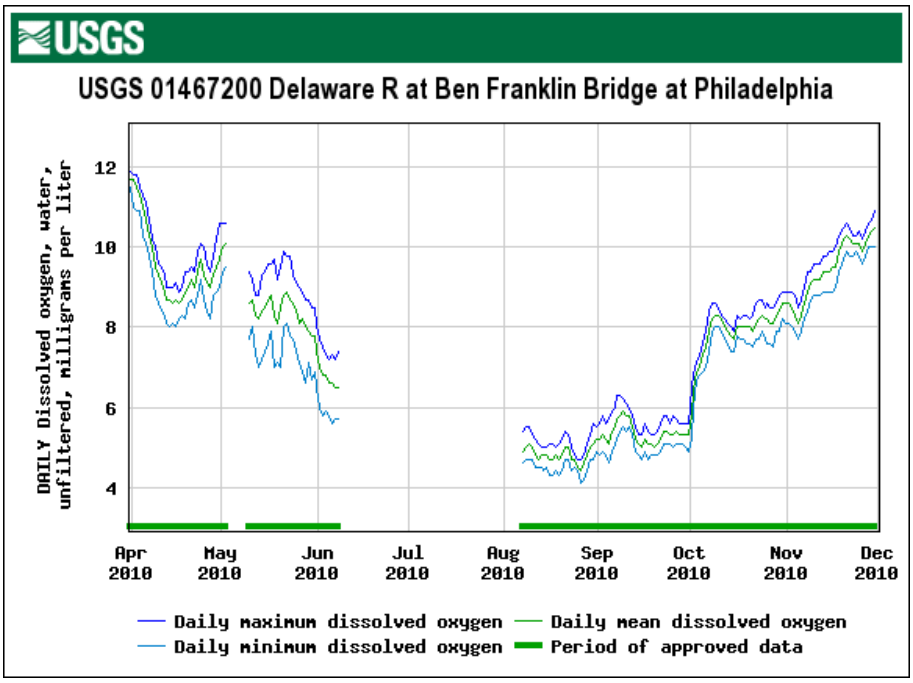
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2009**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2009	Jan	0	*insufficient data to estimate percentiles and statistics*							
2009	Feb	0	*insufficient data to estimate percentiles and statistics*							
2009	Mar	0	*insufficient data to estimate percentiles and statistics*							
2009	Apr	29	7.8	8.4	9.0	9.3	9.2	9.5	10.0	10.4
2009	May	31	5.8	6.1	6.2	6.8	6.8	7.3	7.6	7.7
2009	June	30	5.6	5.7	6.0	6.5	6.5	7.0	7.3	7.4
2009	July	31	4.1	4.2	4.4	7.0	6.1	7.2	7.4	7.5
2009	Aug	31	5.0	5.2	5.4	5.5	5.7	6.1	6.3	6.5
2009	Sept	30	5.6	5.8	6.3	6.6	6.7	7.2	7.4	7.5
2009	Oct	31	6.8	6.9	7.3	7.5	7.8	8.5	8.8	9.3
2009	Nov	30	8.7	8.8	9.1	9.5	9.4	9.7	9.7	9.9
2009	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2009	Jan	0	*insufficient data to estimate percentiles and statistics*							
2009	Feb	0	*insufficient data to estimate percentiles and statistics*							
2009	Mar	0	*insufficient data to estimate percentiles and statistics*							
2009	Apr	29	6.5	7.4	8.5	8.8	8.7	9.0	9.6	10.1
2009	May	31	4.8	5.1	5.3	6.0	5.9	6.2	6.6	7.1
2009	June	30	4.5	4.8	5.0	5.4	5.6	6.3	6.6	7.0
2009	July	31	3.3	3.5	3.6	6.2	5.4	6.5	6.8	7.1
2009	Aug	31	4.1	4.3	4.4	4.8	4.9	5.3	5.7	5.8
2009	Sept	30	4.8	5.2	5.8	6.0	6.1	6.7	7.0	7.2
2009	Oct	31	6.4	6.6	6.8	7.1	7.4	8.1	8.3	8.6
2009	Nov	30	8.2	8.5	8.7	8.9	8.9	9.1	9.3	9.5
2009	Dec	0	*insufficient data to estimate percentiles and statistics*							

Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2010**

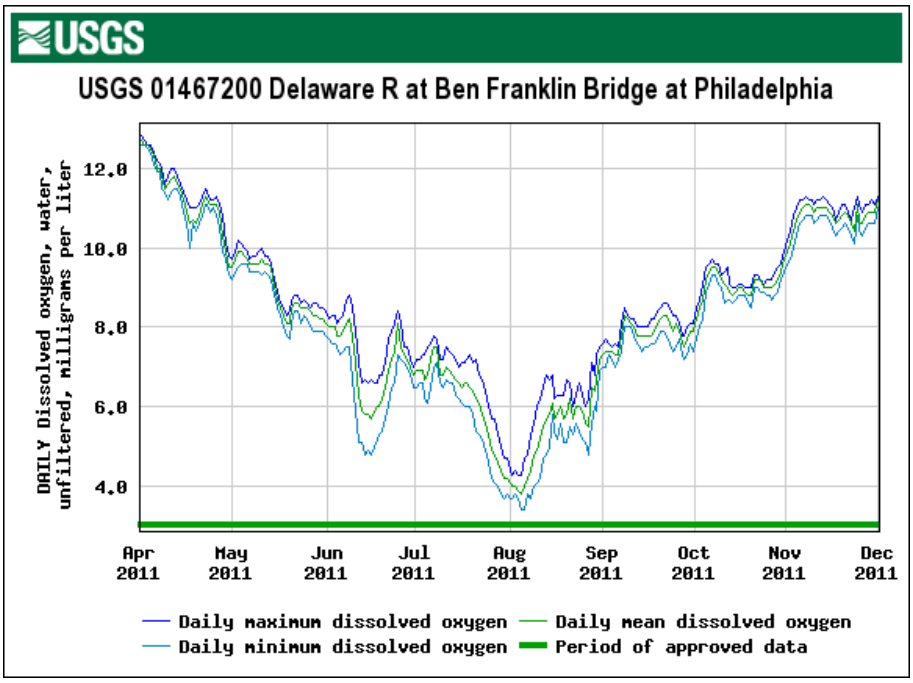


Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2010	Jan	0	*insufficient data to estimate percentiles and statistics*							
2010	Feb	0	*insufficient data to estimate percentiles and statistics*							
2010	Mar	0	*insufficient data to estimate percentiles and statistics*							
2010	Apr	30	8.6	8.7	8.9	9.3	9.6	9.9	11.3	11.7
2010	May	24	7.8	7.9	8.2	8.5	8.5	8.7	8.9	10.1
2010	June [a]	8	*insufficient data to estimate percentiles and statistics*							
2010	July [a]	0	*insufficient data to estimate percentiles and statistics*							
2010	Aug	25	4.4	4.6	4.7	4.8	4.8	5.0	5.1	5.2
2010	Sept	30	5.0	5.1	5.2	5.3	5.3	5.4	5.8	5.9
2010	Oct	31	5.8	7.0	7.9	8.0	7.9	8.2	8.3	8.6
2010	Nov	30	8.1	8.5	9.0	9.5	9.5	10.1	10.3	10.5
2010	Dec	0	*insufficient data to estimate percentiles and statistics*							

[a] *– although sensor failed, spot measurements indicated D.O. as low as 3.3 mg/L during July 2010*

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2010	Jan	0	*insufficient data to estimate percentiles and statistics*							
2010	Feb	0	*insufficient data to estimate percentiles and statistics*							
2010	Mar	0	*insufficient data to estimate percentiles and statistics*							
2010	Apr	30	8.0	8.1	8.3	8.7	9.0	9.4	10.9	11.5
2010	May	24	6.6	6.9	7.0	7.4	7.5	7.8	8.1	9.5
2010	June [a]	8	*insufficient data to estimate percentiles and statistics*							
2010	July [a]	0	*insufficient data to estimate percentiles and statistics*							
2010	Aug	25	4.1	4.3	4.4	4.5	4.5	4.7	4.7	4.9
2010	Sept	30	4.6	4.8	4.8	5.0	5.0	5.1	5.4	5.5
2010	Oct	31	5.2	6.8	7.4	7.6	7.5	7.9	7.9	8.2
2010	Nov	30	7.7	8.0	8.5	8.9	9.0	9.8	9.9	10.0
2010	Dec	0	*insufficient data to estimate percentiles and statistics*							

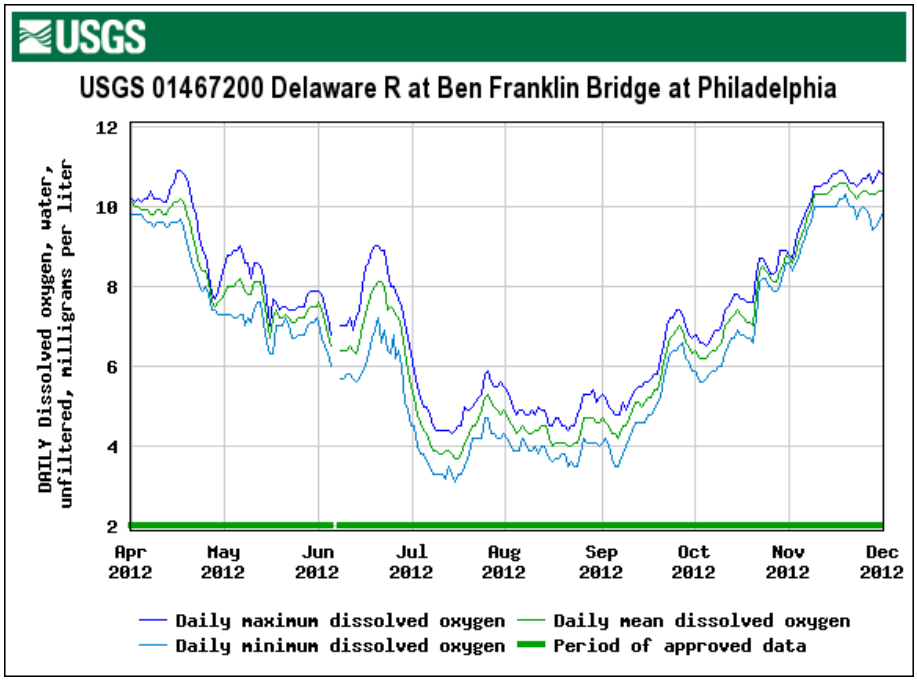
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2011**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2011	Jan	0	*insufficient data to estimate percentiles and statistics*							
2011	Feb	0	*insufficient data to estimate percentiles and statistics*							
2011	Mar	3	*insufficient data to estimate percentiles and statistics*							
2011	Apr	30	9.5	10.6	10.9	11.3	11.4	11.8	12.5	12.7
2011	May	31	8.1	8.2	8.5	8.7	9.0	9.6	9.7	9.9
2011	June	30	5.7	5.9	6.2	7.2	7.1	7.9	8.1	8.2
2011	July	31	4.2	4.6	5.7	6.6	6.2	6.9	7.0	7.5
2011	Aug	31	3.8	4.0	4.6	5.7	5.4	6.0	6.4	7.2
2011	Sept	30	7.3	7.4	7.6	7.8	7.8	8.1	8.2	8.3
2011	Oct	31	7.9	8.7	8.9	9.0	9.0	9.2	9.4	9.7
2011	Nov	30	9.9	10.4	10.6	10.9	10.8	11.0	11.0	11.1
2011	Dec	12	10.9	10.9	11.1	11.2	11.2	11.3	11.6	11.8

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2011	Jan	0	*insufficient data to estimate percentiles and statistics*							
2011	Feb	0	*insufficient data to estimate percentiles and statistics*							
2011	Mar	3	*insufficient data to estimate percentiles and statistics*							
2011	Apr	30	9.3	10.0	10.6	11.1	11.1	11.5	12.4	12.6
2011	May	31	7.7	7.9	8.1	8.5	8.7	9.4	9.5	9.6
2011	June	30	4.8	5.0	5.3	6.7	6.4	7.4	7.6	7.8
2011	July	31	3.7	4.0	5.1	6.1	5.7	6.6	6.6	7.1
2011	Aug	31	3.4	3.7	3.9	5.1	4.8	5.5	5.8	6.9
2011	Sept	30	7.0	7.2	7.3	7.5	7.5	7.7	7.9	8.0
2011	Oct	31	7.4	8.2	8.7	8.8	8.7	9.0	9.2	9.4
2011	Nov	30	9.6	10.1	10.3	10.6	10.5	10.7	10.8	10.8
2011	Dec	12	10.7	10.7	10.9	10.9	11.0	11.1	11.3	11.6

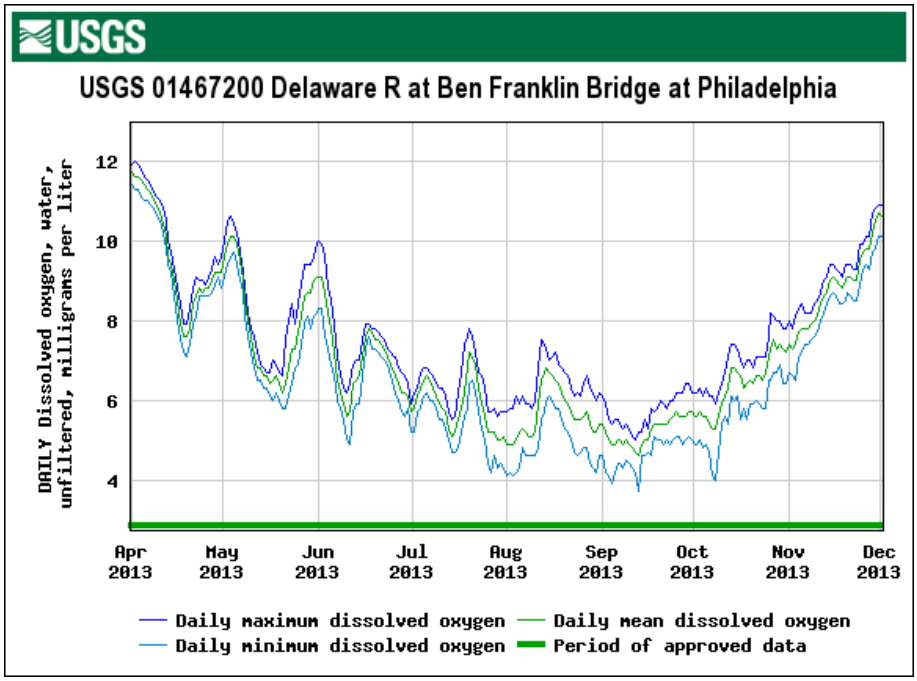
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2012**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2012	Jan	0	*insufficient data to estimate percentiles and statistics*							
2012	Feb	0	*insufficient data to estimate percentiles and statistics*							
2012	Mar	5	*insufficient data to estimate percentiles and statistics*							
2012	Apr	30	7.5	7.7	8.6	9.8	9.4	10.0	10.1	10.2
2012	May	31	6.7	7.2	7.2	7.5	7.6	8.0	8.1	8.2
2012	June	28	5.9	6.4	6.5	7.2	7.1	7.5	8.0	8.1
2012	July	31	3.7	3.8	3.9	4.4	4.4	4.9	5.2	5.5
2012	Aug	31	4.0	4.1	4.1	4.4	4.4	4.6	4.7	4.8
2012	Sept	30	4.2	4.3	4.6	5.2	5.4	6.4	6.8	7.0
2012	Oct	31	6.2	6.3	6.5	7.2	7.3	8.2	8.4	8.8
2012	Nov	30	8.6	9.1	10.0	10.3	10.1	10.4	10.5	10.6
2012	Dec	2	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2012	Jan	0	*insufficient data to estimate percentiles and statistics*							
2012	Feb	0	*insufficient data to estimate percentiles and statistics*							
2012	Mar	5	*insufficient data to estimate percentiles and statistics*							
2012	Apr	30	7.3	7.4	8.1	9.5	9.0	9.6	9.8	9.8
2012	May	31	6.3	6.7	6.9	7.1	7.0	7.3	7.3	7.6
2012	June	28	4.9	5.7	5.8	6.3	6.2	6.6	6.9	7.2
2012	July	31	3.1	3.3	3.3	3.8	3.8	4.2	4.5	4.7
2012	Aug	31	3.5	3.6	3.8	3.9	3.9	4.1	4.1	4.2
2012	Sept	30	3.5	3.7	4.1	4.7	4.9	6.0	6.4	6.6
2012	Oct	31	5.6	5.8	6.0	6.7	6.9	8.0	8.2	8.6
2012	Nov	30	8.4	8.7	9.5	10.0	9.7	10.0	10.1	10.3
2012	Dec	2	*insufficient data to estimate percentiles and statistics*							

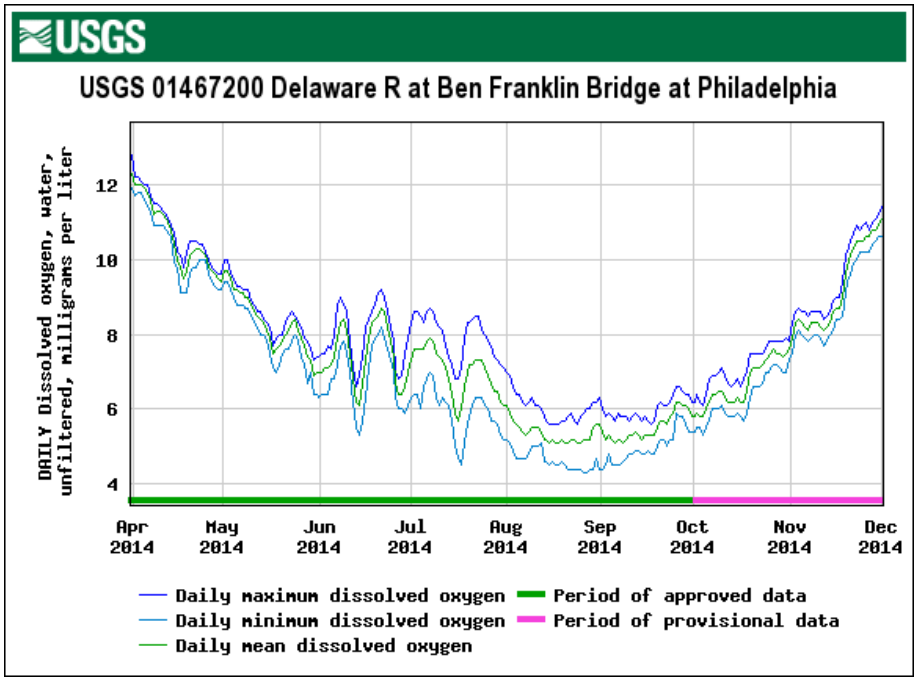
Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2013**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2013	Jan	0	*insufficient data to estimate percentiles and statistics*							
2013	Feb	0	*insufficient data to estimate percentiles and statistics*							
2013	Mar	5	*insufficient data to estimate percentiles and statistics*							
2013	Apr	30	7.6	7.9	8.7	9.2	9.7	11.0	11.5	11.7
2013	May	31	6.2	6.4	6.7	7.7	7.9	9.0	9.9	10.1
2013	June	30	5.6	6.1	6.4	7.0	7.1	7.6	8.3	9.1
2013	July	31	5.0	5.1	5.3	5.8	5.9	6.3	6.8	7.2
2013	Aug	31	4.9	5.0	5.2	5.5	5.7	6.1	6.6	6.8
2013	Sept	30	4.6	4.9	4.9	5.3	5.2	5.5	5.6	5.7
2013	Oct	31	5.3	5.6	5.7	6.5	6.4	6.8	7.3	7.5
2013	Nov	30	7.3	7.7	7.9	9.0	8.8	9.1	9.8	10.7
2013	Dec	5	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2013	Jan	0	*insufficient data to estimate percentiles and statistics*							
2013	Feb	0	*insufficient data to estimate percentiles and statistics*							
2013	Mar	5	*insufficient data to estimate percentiles and statistics*							
2013	Apr	30	7.1	7.5	8.6	9.0	9.3	10.8	11.1	11.4
2013	May	31	5.8	6.0	6.3	7.2	7.4	8.2	9.4	9.7
2013	June	30	4.9	5.6	5.8	6.6	6.5	7.3	7.6	8.3
2013	July	31	4.2	4.4	4.8	5.3	5.3	5.8	6.2	6.5
2013	Aug	31	4.1	4.2	4.5	4.7	4.9	5.4	5.8	6.1
2013	Sept	30	3.7	4.2	4.3	4.6	4.6	5.0	5.1	5.1
2013	Oct	31	4.0	4.7	5.0	5.8	5.6	6.1	6.5	6.9
2013	Nov	30	6.5	7.1	7.5	8.5	8.3	8.7	9.4	10.1
2013	Dec	5	*insufficient data to estimate percentiles and statistics*							

Distribution of USGS Dissolved Oxygen Data from Ben Franklin Bridge for the Year **2014**

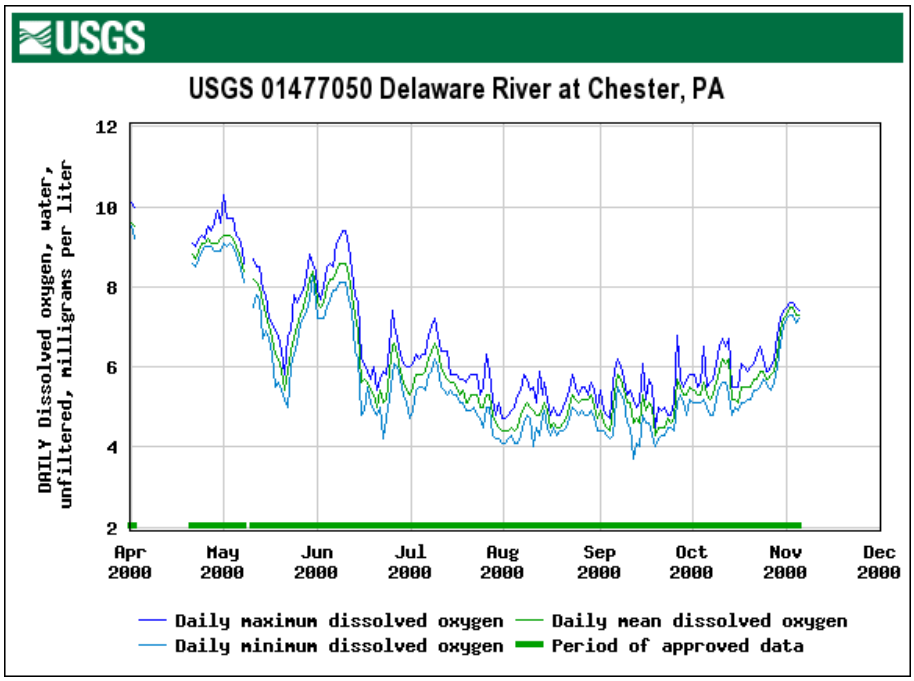


Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2014	Jan	0	*insufficient data to estimate percentiles and statistics*							
2014	Feb	0	*insufficient data to estimate percentiles and statistics*							
2014	Mar	5	*insufficient data to estimate percentiles and statistics*							
2014	Apr	30	9.4	9.6	9.9	10.4	10.7	11.3	12.0	12.3
2014	May	31	6.9	7.4	7.8	8.3	8.3	9.0	9.2	9.7
2014	June	30	6.1	6.4	6.9	7.4	7.4	8.2	8.4	8.7
2014	July	31	5.7	6.1	6.6	7.2	7.0	7.5	7.6	7.9
2014	Aug	31	5.1	5.1	5.2	5.2	5.4	5.5	5.6	6.1
2014	Sept	30	5.1	5.2	5.2	5.3	5.5	5.8	6.1	6.2
2014	Oct	31	5.8	5.9	6.2	6.5	6.7	7.3	7.5	7.6
2014	Nov	30	7.6	8.1	8.3	8.7	9.2	10.5	10.6	10.9
2014	Dec	3	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2014	Jan	0	*insufficient data to estimate percentiles and statistics*							
2014	Feb	0	*insufficient data to estimate percentiles and statistics*							
2014	Mar	5	*insufficient data to estimate percentiles and statistics*							
2014	Apr	30	9.1	9.2	9.6	10.0	10.3	10.9	11.7	11.9
2014	May	31	6.4	7.0	7.3	7.8	7.9	8.7	9.0	9.4
2014	June	30	5.3	5.9	6.2	6.8	6.8	7.6	7.9	8.2
2014	July	31	4.5	5.1	5.7	6.1	5.9	6.3	6.6	7.0
2014	Aug	31	4.3	4.4	4.4	4.6	4.6	4.8	5.0	5.2
2014	Sept	30	4.4	4.5	4.7	4.9	5.0	5.2	5.6	5.9
2014	Oct	31	5.3	5.5	5.8	6.0	6.2	6.9	7.1	7.2
2014	Nov	30	7.3	7.8	7.9	8.3	8.8	10.0	10.2	10.6
2014	Dec	3	*insufficient data to estimate percentiles and statistics*							

CHESTER, PA (RM 83)
DATA DISTRIBUTIONS

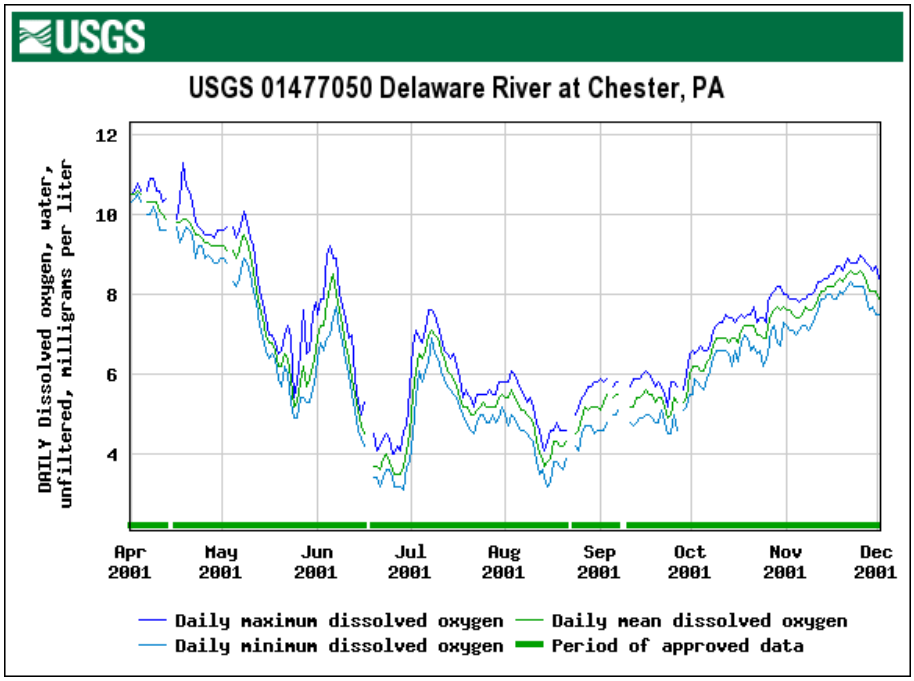
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2000**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2000	Jan	0	*insufficient data to estimate percentiles and statistics*							
2000	Feb	0	*insufficient data to estimate percentiles and statistics*							
2000	Mar	0	*insufficient data to estimate percentiles and statistics*							
2000	Apr	12	8.7	8.8	9.1	9.1	9.1	9.2	9.5	9.6
2000	May	29	5.4	6.1	6.7	7.8	7.6	8.4	9.2	9.3
2000	June	30	5.0	5.3	5.6	6.6	6.7	8.0	8.4	8.6
2000	July	31	4.4	4.8	5.2	5.4	5.5	5.8	6.2	6.6
2000	Aug	31	4.4	4.5	4.6	4.9	4.8	5.1	5.2	5.3
2000	Sept	30	4.3	4.5	4.6	5.0	5.0	5.3	5.6	5.8
2000	Oct	31	5.1	5.2	5.4	5.6	5.7	5.9	6.2	7.2
2000	Nov	5	*insufficient data to estimate percentiles and statistics*							
2000	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2000	Jan	0	*insufficient data to estimate percentiles and statistics*							
2000	Feb	0	*insufficient data to estimate percentiles and statistics*							
2000	Mar	0	*insufficient data to estimate percentiles and statistics*							
2000	Apr	12	8.5	8.6	8.9	8.9	8.9	9.0	9.2	9.5
2000	May	29	5.0	5.5	6.3	7.4	7.3	8.3	9.0	9.1
2000	June	30	4.2	4.8	5.1	6.1	6.3	7.5	7.9	8.1
2000	July	31	4.1	4.3	4.9	5.1	5.1	5.4	5.8	6.2
2000	Aug	31	4.0	4.1	4.3	4.5	4.5	4.8	4.9	5.0
2000	Sept	30	3.7	4.1	4.3	4.5	4.6	5.0	5.2	5.5
2000	Oct	31	4.8	4.9	5.1	5.2	5.4	5.6	5.7	7.0
2000	Nov	5	*insufficient data to estimate percentiles and statistics*							
2000	Dec	0	*insufficient data to estimate percentiles and statistics*							

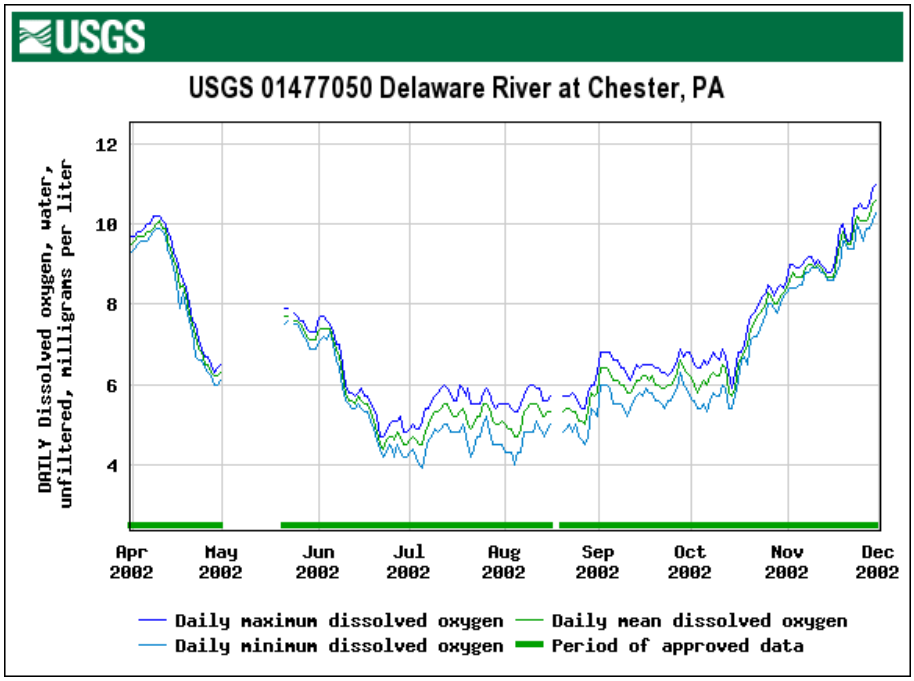
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2001**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2001	Jan	0	*insufficient data to estimate percentiles and statistics*							
2001	Feb	0	*insufficient data to estimate percentiles and statistics*							
2001	Mar	4	*insufficient data to estimate percentiles and statistics*							
2001	Apr	26	9.2	9.2	9.4	9.9	9.8	10.3	10.5	10.6
2001	May	30	5.2	5.8	6.2	6.8	7.3	9.0	9.2	9.5
2001	June	28	3.5	3.6	3.7	4.9	5.4	7.2	7.9	8.5
2001	July	31	4.5	5.1	5.2	5.5	5.8	6.4	6.9	7.1
2001	Aug	29	3.7	3.9	4.3	4.9	4.7	5.2	5.4	5.6
2001	Sept	25	4.9	5.1	5.3	5.4	5.4	5.5	5.5	6.0
2001	Oct	31	6.1	6.2	6.8	6.9	6.9	7.2	7.6	7.7
2001	Nov	30	7.4	7.5	7.6	8.1	8.1	8.4	8.5	8.6
2001	Dec	2	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2001	Jan	0	*insufficient data to estimate percentiles and statistics*							
2001	Feb	0	*insufficient data to estimate percentiles and statistics*							
2001	Mar	4	*insufficient data to estimate percentiles and statistics*							
2001	Apr	26	8.8	8.9	9.1	9.6	9.6	10.0	10.3	10.5
2001	May	30	4.9	5.3	5.6	6.5	6.8	8.3	8.8	8.9
2001	June	28	3.1	3.2	3.4	4.5	5.0	6.7	7.0	7.7
2001	July	31	3.8	4.6	4.8	5.2	5.3	5.9	6.3	6.9
2001	Aug	29	3.2	3.5	3.8	4.4	4.2	4.7	4.7	5.0
2001	Sept	25	4.5	4.6	4.8	4.9	4.9	5.0	5.1	5.5
2001	Oct	31	5.5	5.8	6.2	6.6	6.5	6.7	7.0	7.3
2001	Nov	30	7.0	7.1	7.2	7.9	7.7	8.1	8.2	8.3
2001	Dec	2	*insufficient data to estimate percentiles and statistics*							

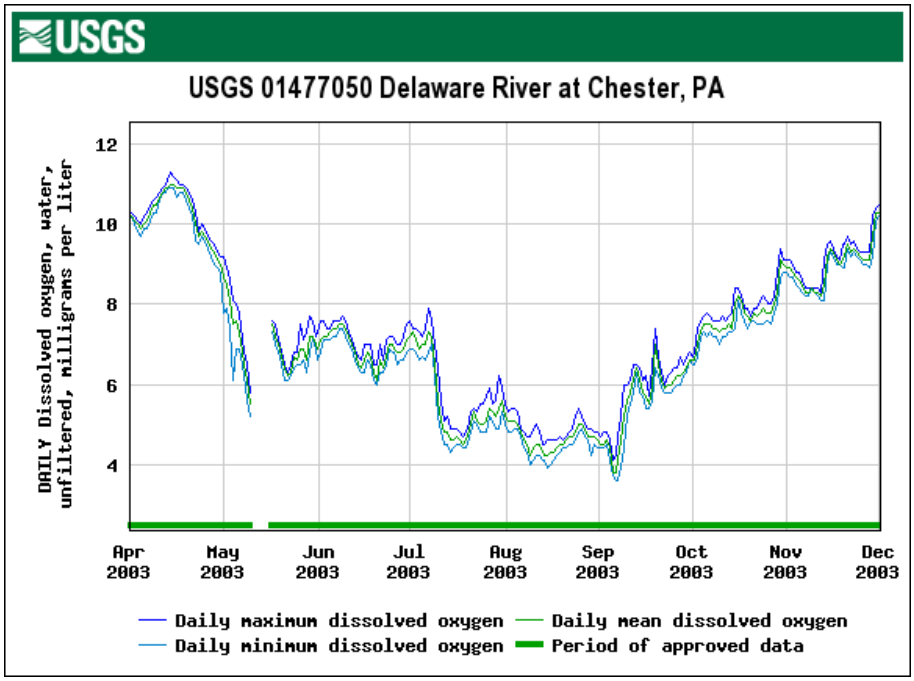
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2002**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2002	Jan	0	*insufficient data to estimate percentiles and statistics*							
2002	Feb	0	*insufficient data to estimate percentiles and statistics*							
2002	Mar	5	*insufficient data to estimate percentiles and statistics*							
2002	Apr	30	6.2	6.3	7.0	9.0	8.5	9.7	9.9	10.1
2002	May	10	*insufficient data to estimate percentiles and statistics*							
2002	June	30	4.4	4.5	4.7	5.5	5.7	6.6	7.4	7.4
2002	July	31	4.5	4.6	5.0	5.2	5.1	5.3	5.5	5.5
2002	Aug	28	4.7	4.9	5.1	5.3	5.3	5.4	5.6	5.8
2002	Sept	30	5.8	5.9	6.0	6.1	6.1	6.3	6.4	6.6
2002	Oct	31	5.7	5.9	6.1	6.5	6.9	7.9	8.2	8.3
2002	Nov	30	8.4	8.7	8.7	9.0	9.3	9.9	10.2	10.6
2002	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2002	Jan	0	*insufficient data to estimate percentiles and statistics*							
2002	Feb	0	*insufficient data to estimate percentiles and statistics*							
2002	Mar	5	*insufficient data to estimate percentiles and statistics*							
2002	Apr	30	6.0	6.2	6.6	8.7	8.3	9.6	9.8	9.9
2002	May	10	*insufficient data to estimate percentiles and statistics*							
2002	June	30	4.2	4.2	4.4	5.4	5.4	6.3	7.1	7.3
2002	July	31	3.9	4.2	4.5	4.7	4.6	4.8	5.0	5.2
2002	Aug	28	4.0	4.3	4.6	4.8	4.8	4.9	5.1	5.4
2002	Sept	30	5.2	5.4	5.5	5.7	5.7	5.9	6.0	6.3
2002	Oct	31	5.3	5.4	5.6	6.1	6.5	7.5	8.0	8.2
2002	Nov	30	8.3	8.4	8.6	8.9	9.1	9.6	9.9	10.3
2002	Dec	0	*insufficient data to estimate percentiles and statistics*							

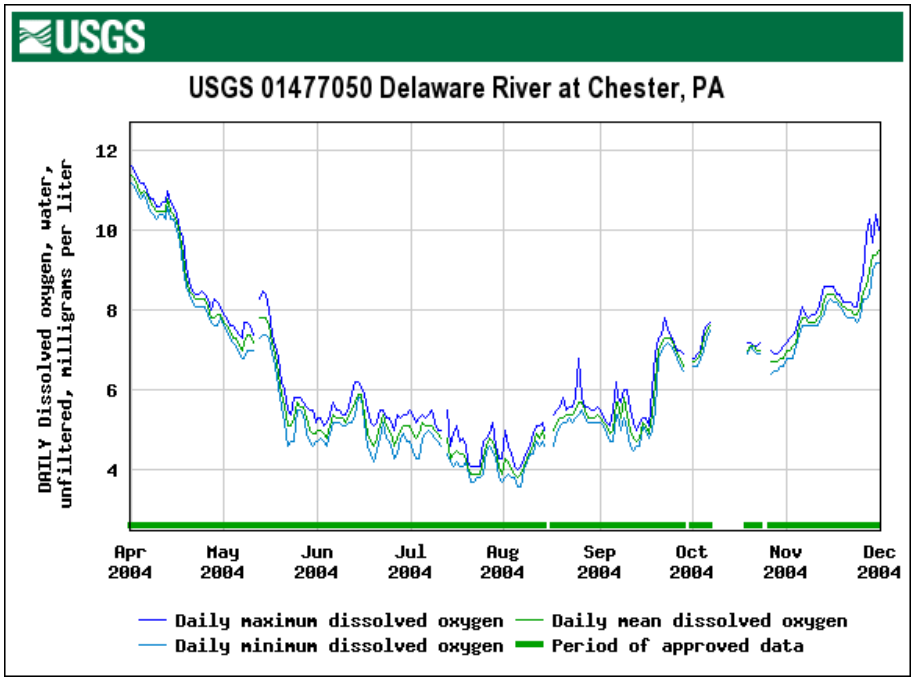
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2003**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2003	Jan	0	*insufficient data to estimate percentiles and statistics*							
2003	Feb	0	*insufficient data to estimate percentiles and statistics*							
2003	Mar	5	*insufficient data to estimate percentiles and statistics*							
2003	Apr	30	9.0	9.4	9.8	10.3	10.2	10.8	10.9	11.0
2003	May	25	5.5	6.2	6.6	6.9	7.0	7.3	7.9	8.7
2003	June	30	6.1	6.4	6.7	6.9	6.9	7.2	7.4	7.5
2003	July	31	4.5	4.6	4.8	5.2	5.6	6.7	7.2	7.3
2003	Aug	31	4.2	4.3	4.5	4.6	4.6	4.9	5.1	5.2
2003	Sept	30	3.8	4.4	4.8	5.9	5.6	6.2	6.4	7.0
2003	Oct	31	6.6	7.3	7.4	7.7	7.7	7.9	8.2	9.1
2003	Nov	30	8.2	8.3	8.5	9.1	9.0	9.3	9.4	10.3
2003	Dec	1	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2003	Jan	0	*insufficient data to estimate percentiles and statistics*							
2003	Feb	0	*insufficient data to estimate percentiles and statistics*							
2003	Mar	5	*insufficient data to estimate percentiles and statistics*							
2003	Apr	30	8.8	9.2	9.6	10.2	10.1	10.7	10.8	10.9
2003	May	25	5.2	6.1	6.2	6.5	6.6	6.9	7.4	7.9
2003	June	30	6.0	6.3	6.5	6.7	6.7	7.1	7.2	7.4
2003	July	31	4.3	4.4	4.5	4.9	5.3	6.4	6.8	7.0
2003	Aug	31	3.9	4.1	4.2	4.4	4.4	4.7	4.9	5.0
2003	Sept	30	3.6	3.9	4.4	5.8	5.3	6.0	6.3	6.6
2003	Oct	31	6.5	7.0	7.2	7.4	7.5	7.6	8.0	8.8
2003	Nov	30	8.1	8.2	8.4	8.9	8.8	9.2	9.3	10.1
2003	Dec	1	*insufficient data to estimate percentiles and statistics*							

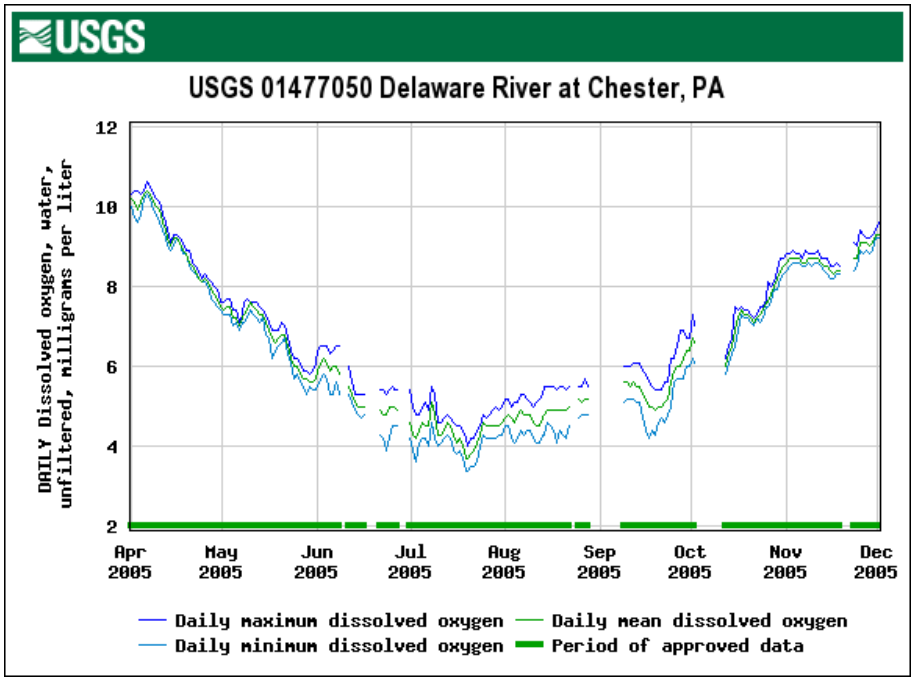
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2004**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2004	Jan	0	*insufficient data to estimate percentiles and statistics*							
2004	Feb	0	*insufficient data to estimate percentiles and statistics*							
2004	Mar	2	*insufficient data to estimate percentiles and statistics*							
2004	Apr	30	7.8	7.9	8.3	10.3	9.7	10.7	11.0	11.4
2004	May	30	4.9	5.1	5.6	7.1	6.5	7.4	7.7	7.8
2004	June	30	4.6	4.8	4.9	5.1	5.1	5.4	5.5	5.9
2004	July	30	3.9	3.9	4.3	4.6	4.6	4.9	5.1	5.2
2004	Aug	29	3.8	4.0	4.3	5.0	4.9	5.4	5.5	5.7
2004	Sept	28	4.7	4.9	5.1	5.4	5.8	6.8	7.2	7.3
2004	Oct	17	6.7	6.7	6.7	6.9	7.0	7.1	7.4	7.6
2004	Nov	30	7.0	7.2	7.7	8.0	8.0	8.4	8.6	9.4
2004	Dec	9	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2004	Jan	0	*insufficient data to estimate percentiles and statistics*							
2004	Feb	0	*insufficient data to estimate percentiles and statistics*							
2004	Mar	2	*insufficient data to estimate percentiles and statistics*							
2004	Apr	30	7.6	7.8	8.1	10.2	9.5	10.5	10.9	11.2
2004	May	30	4.6	4.7	5.3	6.8	6.2	7.2	7.4	7.6
2004	June	30	4.2	4.4	4.6	4.8	4.9	5.2	5.2	5.8
2004	July	30	3.7	3.8	4.0	4.3	4.3	4.6	4.8	5.0
2004	Aug	29	3.6	3.8	4.2	4.7	4.7	5.2	5.3	5.5
2004	Sept	28	4.5	4.6	4.9	5.2	5.6	6.7	7.0	7.2
2004	Oct	17	6.4	6.5	6.6	6.8	6.8	7.0	7.2	7.5
2004	Nov	30	6.8	7.1	7.6	7.8	7.8	8.2	8.3	9.2
2004	Dec	9	*insufficient data to estimate percentiles and statistics*							

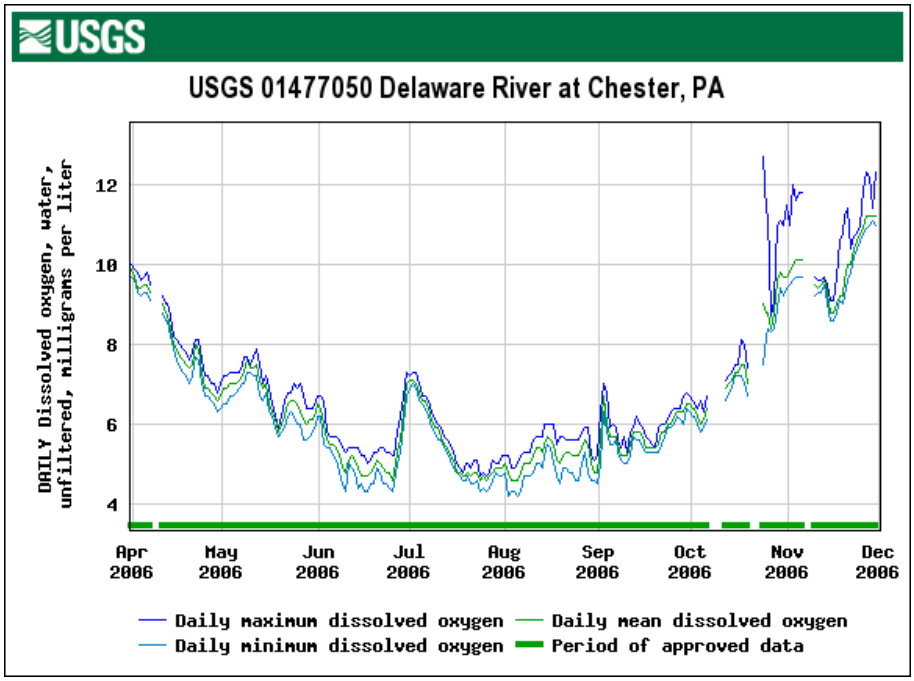
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2005**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2005	Jan	0	*insufficient data to estimate percentiles and statistics*							
2005	Feb	0	*insufficient data to estimate percentiles and statistics*							
2005	Mar	2	*insufficient data to estimate percentiles and statistics*							
2005	Apr	30	7.5	7.9	8.3	9.2	9.1	10.0	10.2	10.4
2005	May	31	5.6	5.7	6.1	6.9	6.7	7.3	7.5	7.6
2005	June	21	4.8	4.9	5.0	5.1	5.4	5.9	6.1	6.2
2005	July	31	3.7	3.9	4.2	4.4	4.4	4.5	4.6	5.1
2005	Aug	26	4.5	4.6	4.7	4.9	4.8	4.9	5.2	5.2
2005	Sept	22	4.9	5.0	5.1	5.5	5.5	5.8	6.2	6.4
2005	Oct	22	6.0	6.5	7.0	7.3	7.3	7.6	8.2	8.5
2005	Nov	26	8.3	8.4	8.6	8.7	8.7	8.7	9.1	9.3
2005	Dec	12	9.3	9.6	10.0	10.2	10.1	10.3	10.4	10.5

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2005	Jan	0	*insufficient data to estimate percentiles and statistics*							
2005	Feb	0	*insufficient data to estimate percentiles and statistics*							
2005	Mar	2	*insufficient data to estimate percentiles and statistics*							
2005	Apr	30	7.4	7.7	8.2	9.0	8.9	9.7	10.0	10.3
2005	May	31	5.3	5.5	6.0	6.7	6.5	7.2	7.3	7.4
2005	June	21	3.9	4.2	4.5	4.9	4.9	5.3	5.7	5.8
2005	July	31	3.4	3.5	3.9	4.1	4.0	4.2	4.3	4.6
2005	Aug	26	4.1	4.1	4.2	4.4	4.4	4.5	4.8	4.8
2005	Sept	22	4.2	4.4	4.6	5.1	5.1	5.5	5.7	6.0
2005	Oct	22	5.8	6.1	6.6	7.2	7.1	7.5	7.9	8.3
2005	Nov	26	8.2	8.3	8.4	8.5	8.6	8.6	8.9	9.2
2005	Dec	12	9.2	9.4	9.9	10.0	9.9	10.1	10.3	10.4

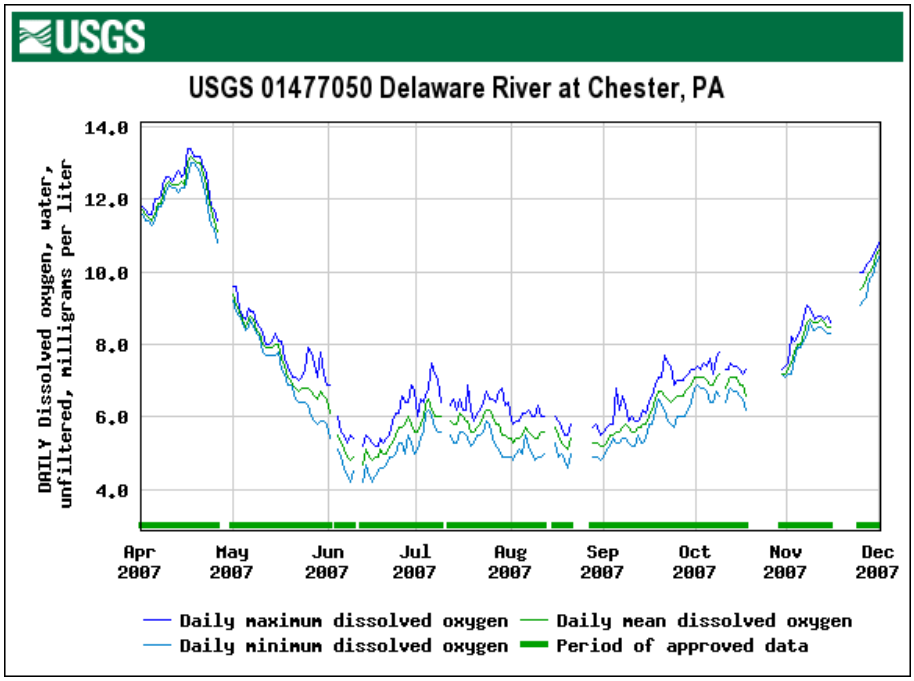
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2006**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2006	Jan	0	*insufficient data to estimate percentiles and statistics*							
2006	Feb	0	*insufficient data to estimate percentiles and statistics*							
2006	Mar	1	*insufficient data to estimate percentiles and statistics*							
2006	Apr	27	6.6	6.8	7.4	7.9	8.1	9.2	9.5	9.9
2006	May	31	5.8	6.1	6.3	6.6	6.7	7.1	7.4	7.6
2006	June	30	4.6	4.7	4.8	5.1	5.3	5.5	6.3	7.0
2006	July	31	4.6	4.7	4.8	4.9	5.4	6.0	6.8	7.1
2006	Aug	31	4.6	4.8	5.0	5.2	5.1	5.4	5.5	5.7
2006	Sept	30	5.2	5.4	5.5	5.8	5.8	6.0	6.3	6.7
2006	Oct	22	6.0	6.2	6.5	7.3	7.6	8.8	9.5	9.8
2006	Nov	27	8.8	9.1	9.5	10.0	10.0	10.5	11.2	11.2
2006	Dec	0	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2006	Jan	0	*insufficient data to estimate percentiles and statistics*							
2006	Feb	0	*insufficient data to estimate percentiles and statistics*							
2006	Mar	1	*insufficient data to estimate percentiles and statistics*							
2006	Apr	27	6.3	6.6	7.0	7.6	7.9	9.0	9.3	9.7
2006	May	31	5.6	5.7	6.0	6.3	6.4	6.8	7.2	7.3
2006	June	30	4.3	4.3	4.5	4.8	5.0	5.3	6.0	6.7
2006	July	31	4.3	4.4	4.6	4.8	5.3	5.9	6.6	7.0
2006	Aug	31	4.2	4.3	4.6	4.8	4.8	5.0	5.2	5.5
2006	Sept	30	5.0	5.1	5.3	5.6	5.6	5.9	6.2	6.4
2006	Oct	22	5.8	6.0	6.3	7.1	7.3	8.3	8.9	9.4
2006	Nov	27	8.6	8.9	9.2	9.6	9.7	10.3	10.9	11.1
2006	Dec	0	*insufficient data to estimate percentiles and statistics*							

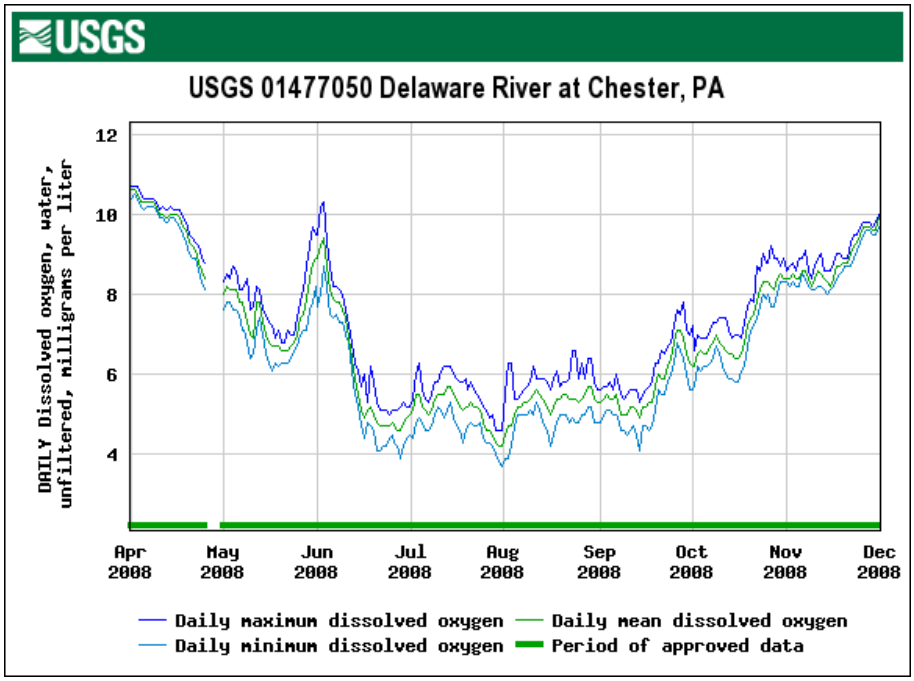
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2007**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2007	Jan	0	*insufficient data to estimate percentiles and statistics*							
2007	Feb	0	*insufficient data to estimate percentiles and statistics*							
2007	Mar	1	*insufficient data to estimate percentiles and statistics*							
2007	Apr	26	11.1	11.5	11.7	12.4	12.2	12.5	13.0	13.2
2007	May	31	6.5	6.7	6.8	7.9	7.7	8.5	8.8	9.4
2007	June	26	4.7	4.9	4.9	5.2	5.3	5.7	5.9	6.5
2007	July	29	5.4	5.6	5.8	5.9	5.9	6.0	6.2	6.5
2007	Aug	22	5.1	5.2	5.3	5.4	5.4	5.5	5.6	5.7
2007	Sept	30	5.2	5.5	5.6	5.9	6.1	6.6	6.7	6.9
2007	Oct	19	6.6	6.9	6.9	7.1	7.0	7.1	7.2	7.2
2007	Nov	21	7.3	7.8	8.3	8.6	8.7	9.5	10.0	10.4
2007	Dec	18	10.6	10.8	11.2	11.3	11.3	11.4	11.9	12.3

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2007	Jan	0	*insufficient data to estimate percentiles and statistics*							
2007	Feb	0	*insufficient data to estimate percentiles and statistics*							
2007	Mar	1	*insufficient data to estimate percentiles and statistics*							
2007	Apr	26	10.8	11.3	11.5	12.1	12.0	12.4	12.8	13.0
2007	May	31	5.8	5.9	6.4	7.7	7.4	8.4	8.7	9.2
2007	June	26	4.2	4.3	4.5	4.8	4.8	5.1	5.4	5.8
2007	July	29	4.9	5.1	5.3	5.5	5.5	5.6	5.9	6.2
2007	Aug	22	4.6	4.8	4.9	4.9	5.0	5.0	5.2	5.5
2007	Sept	30	4.9	5.2	5.3	5.6	5.7	6.0	6.2	6.5
2007	Oct	19	6.2	6.4	6.6	6.7	6.7	6.8	6.9	7.2
2007	Nov	21	7.2	7.6	8.1	8.4	8.5	9.1	9.8	10.2
2007	Dec	18	10.4	10.6	11.1	11.2	11.2	11.3	11.6	12.2

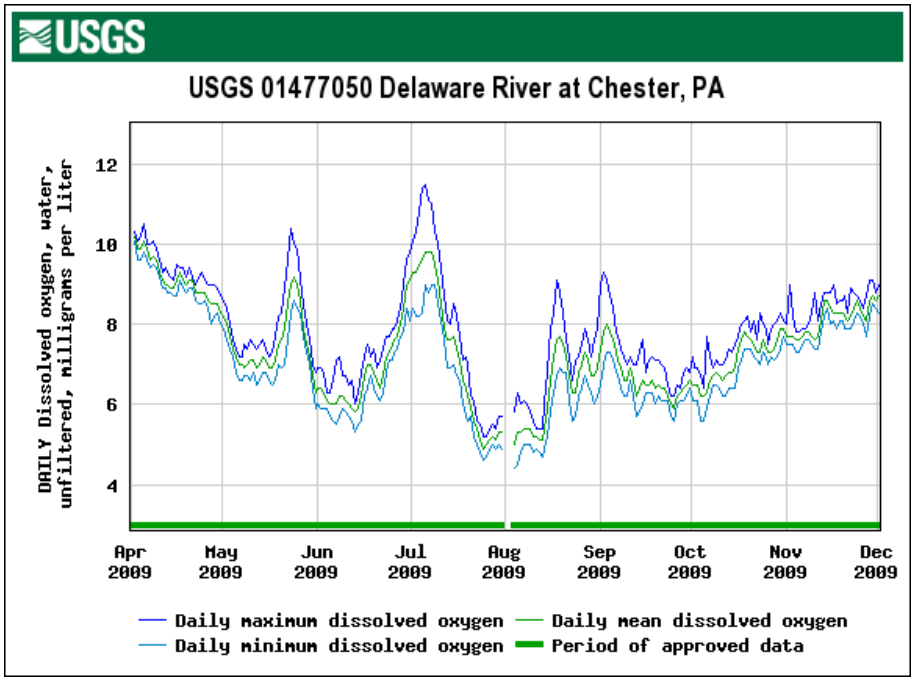
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2008**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2008	Jan	0	*insufficient data to estimate percentiles and statistics*							
2008	Feb	0	*insufficient data to estimate percentiles and statistics*							
2008	Mar	0	*insufficient data to estimate percentiles and statistics*							
2008	Apr	25	8.4	8.9	9.6	10.0	9.8	10.3	10.4	10.6
2008	May	31	6.6	6.7	6.8	7.4	7.4	8.0	8.2	8.9
2008	June	30	4.6	4.7	4.8	5.2	6.2	7.8	8.7	9.4
2008	July	31	4.2	4.5	5.0	5.2	5.1	5.5	5.5	5.7
2008	Aug	31	4.5	5.0	5.2	5.4	5.3	5.5	5.5	5.7
2008	Sept	30	4.9	5.0	5.2	5.4	5.7	6.2	6.8	7.1
2008	Oct	31	6.2	6.4	6.5	6.8	7.2	8.1	8.3	8.5
2008	Nov	30	8.2	8.4	8.4	8.6	8.8	9.2	9.6	9.7
2008	Dec	17	9.8	9.9	9.9	10.6	10.6	11.3	11.5	11.8

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2008	Jan	0	*insufficient data to estimate percentiles and statistics*							
2008	Feb	0	*insufficient data to estimate percentiles and statistics*							
2008	Mar	0	*insufficient data to estimate percentiles and statistics*							
2008	Apr	25	8.1	8.7	9.3	9.9	9.7	10.2	10.3	10.5
2008	May	31	6.1	6.3	6.4	7.0	7.0	7.6	7.8	8.2
2008	June	30	3.9	4.2	4.3	4.8	5.7	7.3	7.7	8.7
2008	July	31	3.7	4.2	4.4	4.7	4.6	4.9	5.1	5.3
2008	Aug	31	3.9	4.2	4.8	4.9	4.8	5.0	5.1	5.3
2008	Sept	30	4.1	4.6	4.7	5.0	5.2	5.6	6.3	6.8
2008	Oct	31	5.6	5.8	6.1	6.4	6.8	7.7	8.0	8.3
2008	Nov	30	8.0	8.1	8.2	8.4	8.6	8.9	9.5	9.6
2008	Dec	17	9.6	9.7	9.8	10.3	10.4	11.0	11.3	11.6

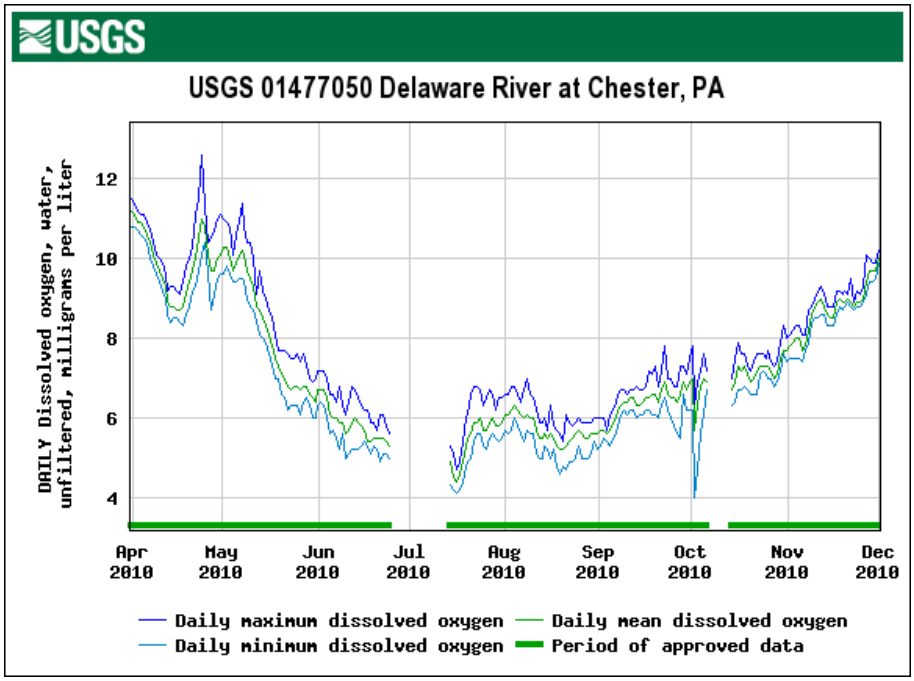
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2009**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2009	Jan	0	*insufficient data to estimate percentiles and statistics*							
2009	Feb	0	*insufficient data to estimate percentiles and statistics*							
2009	Mar	0	*insufficient data to estimate percentiles and statistics*							
2009	Apr	29	8.3	8.5	8.8	9.1	9.2	9.6	9.9	10.2
2009	May	31	6.3	6.9	7.0	7.2	7.5	7.9	8.6	9.2
2009	June	30	5.8	6.0	6.1	6.4	6.7	7.2	7.7	9.0
2009	July	31	4.9	5.1	5.4	7.4	7.3	9.2	9.6	9.8
2009	Aug	28	5.0	5.2	5.4	6.5	6.3	7.0	7.4	7.7
2009	Sept	30	5.9	6.2	6.4	6.6	6.7	6.9	7.6	8.0
2009	Oct	31	6.2	6.5	6.7	7.3	7.1	7.6	7.7	7.9
2009	Nov	30	7.6	7.7	7.7	8.2	8.1	8.4	8.6	8.7
2009	Dec	10	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2009	Jan	0	*insufficient data to estimate percentiles and statistics*							
2009	Feb	0	*insufficient data to estimate percentiles and statistics*							
2009	Mar	0	*insufficient data to estimate percentiles and statistics*							
2009	Apr	29	8.0	8.3	8.6	8.9	8.9	9.4	9.6	10.1
2009	May	31	5.9	6.5	6.6	6.8	7.1	7.5	8.3	8.6
2009	June	30	5.3	5.6	5.7	6.1	6.3	6.8	7.4	8.4
2009	July	31	4.6	4.9	5.0	6.7	6.7	8.2	8.8	9.0
2009	Aug	28	4.4	4.8	4.9	5.8	5.7	6.3	6.7	6.9
2009	Sept	30	5.6	5.8	6.1	6.2	6.3	6.5	7.0	7.3
2009	Oct	31	5.6	6.1	6.2	6.9	6.7	7.2	7.4	7.7
2009	Nov	30	7.3	7.4	7.5	7.9	7.9	8.1	8.3	8.5
2009	Dec	10	*insufficient data to estimate percentiles and statistics*							

Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2010**

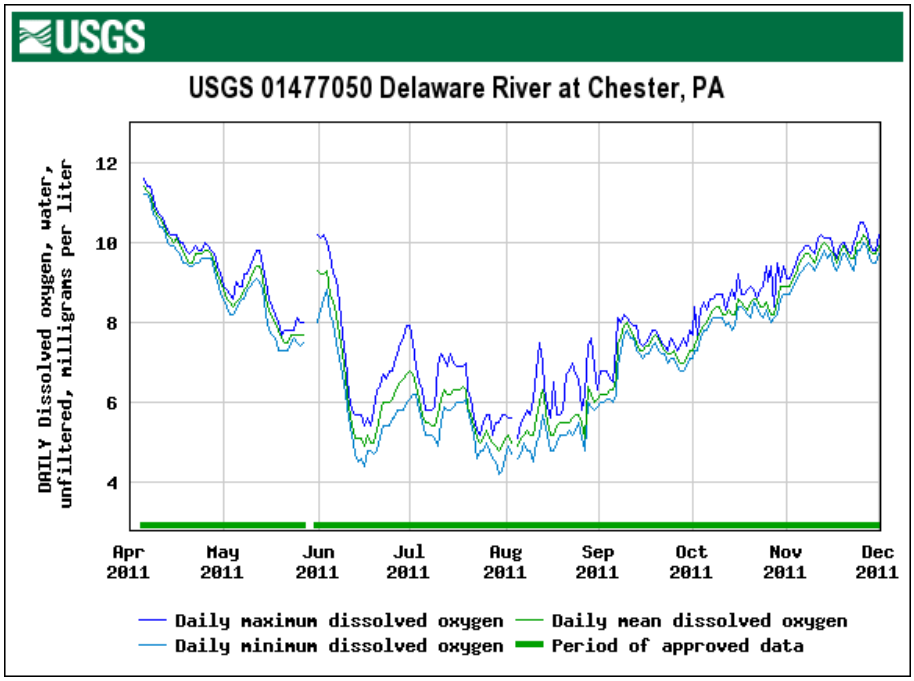


Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2010	Jan	0	*insufficient data to estimate percentiles and statistics*							
2010	Feb	0	*insufficient data to estimate percentiles and statistics*							
2010	Mar	0	*insufficient data to estimate percentiles and statistics*							
2010	Apr	30	8.7	8.8	9.3	10.0	9.9	10.6	10.9	11.2
2010	May	31	6.4	6.7	6.8	8.1	8.2	9.7	10.1	10.3
2010	June	24	5.3	5.4	5.5	5.9	5.9	6.0	6.6	6.7
2010	July [a]	18	*insufficient data to estimate percentiles and statistics*							
2010	Aug	31	5.2	5.3	5.5	5.6	5.7	6.0	6.1	6.3
2010	Sept	30	5.6	5.7	6.3	6.5	6.4	6.6	6.7	6.9
2010	Oct	24	5.7	6.7	6.9	7.1	7.0	7.3	7.3	7.7
2010	Nov	30	7.7	7.8	8.3	8.9	8.7	9.0	9.4	9.7
2010	Dec	1	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2010	Jan	0	*insufficient data to estimate percentiles and statistics*							
2010	Feb	0	*insufficient data to estimate percentiles and statistics*							
2010	Mar	0	*insufficient data to estimate percentiles and statistics*							
2010	Apr	30	8.3	8.5	8.7	9.5	9.5	10.1	10.6	10.8
2010	May	31	6.0	6.2	6.4	7.6	7.7	9.2	9.5	9.8
2010	June	24	4.9	5.0	5.1	5.3	5.4	5.6	6.2	6.4
2010	July [a]	18	*insufficient data to estimate percentiles and statistics*							
2010	Aug	31	4.6	4.8	5.0	5.2	5.2	5.6	5.7	6.0
2010	Sept	30	5.3	5.5	5.7	6.1	6.0	6.2	6.2	6.6
2010	Oct	24	4.0	5.8	6.4	6.7	6.5	7.0	7.2	7.6
2010	Nov	30	7.4	7.5	8.0	8.6	8.4	8.8	9.1	9.5
2010	Dec	1	*insufficient data to estimate percentiles and statistics*							

[a] – *missing data during early July 2010 precludes accurate estimation; known period of depressed D.O.*

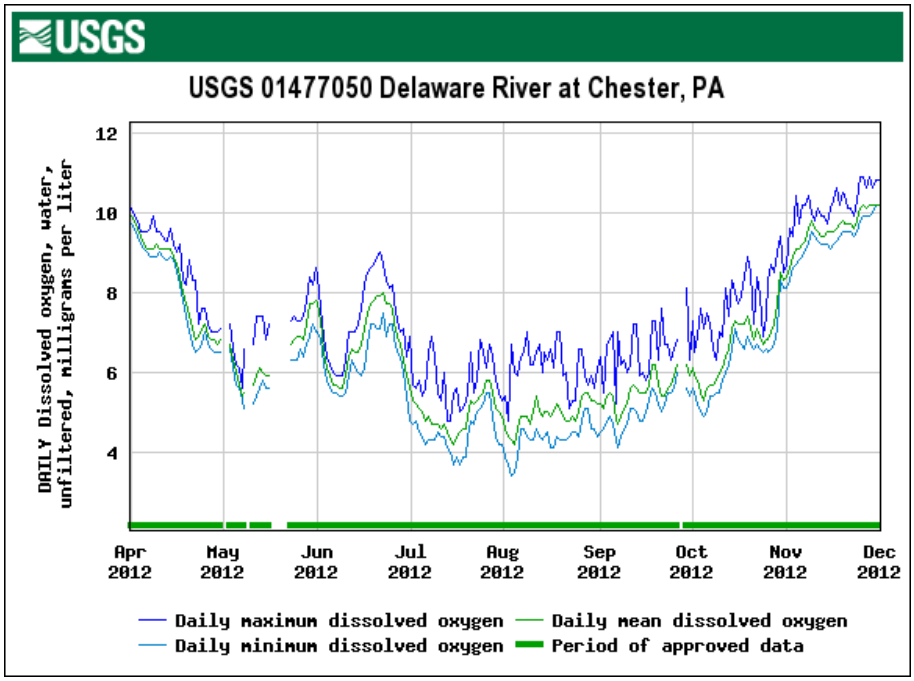
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2011**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2011	Jan	0	*insufficient data to estimate percentiles and statistics*							
2011	Feb	0	*insufficient data to estimate percentiles and statistics*							
2011	Mar	0	*insufficient data to estimate percentiles and statistics*							
2011	Apr	26	9.0	9.5	9.7	9.9	10.1	10.5	11.1	11.4
2011	May	27	7.5	7.7	7.7	8.5	8.4	8.8	9.2	9.4
2011	June	30	4.9	5.1	5.3	6.2	6.6	7.6	9.2	9.3
2011	July	31	4.8	5.0	5.2	5.7	5.7	6.3	6.4	6.8
2011	Aug	30	4.9	5.1	5.2	5.5	5.5	5.7	6.1	6.4
2011	Sept	30	6.2	6.3	7.0	7.3	7.2	7.6	7.7	8.0
2011	Oct	31	7.3	7.8	8.2	8.3	8.3	8.5	8.6	8.9
2011	Nov	30	8.9	9.2	9.6	9.7	9.7	9.9	10.0	10.2
2011	Dec	1	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2011	Jan	0	*insufficient data to estimate percentiles and statistics*							
2011	Feb	0	*insufficient data to estimate percentiles and statistics*							
2011	Mar	0	*insufficient data to estimate percentiles and statistics*							
2011	Apr	26	8.7	9.4	9.5	9.7	9.9	10.4	10.9	11.2
2011	May	27	7.3	7.3	7.5	8.2	8.1	8.6	8.9	9.1
2011	June	30	4.4	4.7	4.9	5.6	6.0	7.0	8.2	8.8
2011	July	31	4.2	4.6	4.9	5.5	5.4	5.9	6.1	6.2
2011	Aug	30	4.5	4.7	4.8	5.2	5.1	5.3	5.8	6.0
2011	Sept	30	6.0	6.1	6.8	7.1	7.0	7.3	7.6	7.8
2011	Oct	31	7.1	7.6	7.9	8.1	8.1	8.3	8.4	8.7
2011	Nov	30	8.7	9.0	9.3	9.5	9.5	9.7	9.8	10.0
2011	Dec	1	*insufficient data to estimate percentiles and statistics*							

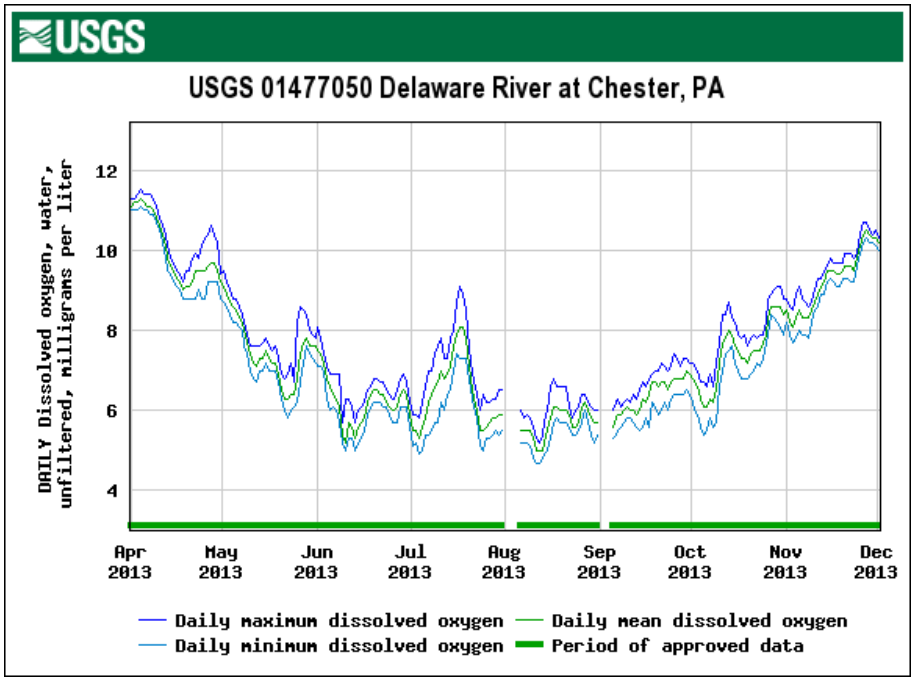
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2012**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Means**							
			min	10th	25th	median	mean	75th	90th	max
2012	Jan	0	*insufficient data to estimate percentiles and statistics*							
2012	Feb	0	*insufficient data to estimate percentiles and statistics*							
2012	Mar	3	*insufficient data to estimate percentiles and statistics*							
2012	Apr	30	6.7	6.8	7.1	8.8	8.3	9.1	9.4	9.9
2012	May	21	5.4	5.7	5.9	6.3	6.5	6.9	7.7	7.8
2012	June	30	5.6	5.7	6.2	6.7	6.8	7.7	7.8	8.0
2012	July	31	4.2	4.5	4.7	4.9	5.0	5.3	5.5	5.8
2012	Aug	31	4.2	4.6	4.8	4.9	4.9	5.2	5.4	5.5
2012	Sept	28	4.7	5.0	5.4	5.5	5.5	5.7	6.2	6.2
2012	Oct	31	5.3	5.7	6.0	6.8	6.7	7.2	7.4	8.5
2012	Nov	30	8.4	9.1	9.4	9.6	9.6	9.8	10.2	10.2
2012	Dec	2	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour **Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2012	Jan	0	*insufficient data to estimate percentiles and statistics*							
2012	Feb	0	*insufficient data to estimate percentiles and statistics*							
2012	Mar	3	*insufficient data to estimate percentiles and statistics*							
2012	Apr	30	6.5	6.5	6.7	8.7	8.0	8.9	9.2	9.7
2012	May	21	5.1	5.3	5.6	6.1	6.1	6.6	6.9	7.2
2012	June	30	5.4	5.5	5.8	6.3	6.3	7.0	7.2	7.5
2012	July	31	3.7	3.9	4.2	4.4	4.5	4.8	5.1	5.5
2012	Aug	31	3.4	3.9	4.3	4.4	4.3	4.6	4.6	5.1
2012	Sept	28	4.1	4.5	4.7	5.0	5.0	5.4	5.6	6.0
2012	Oct	31	4.9	5.2	5.5	6.6	6.3	6.7	7.1	8.3
2012	Nov	30	8.1	8.7	9.1	9.4	9.3	9.5	9.9	10.2
2012	Dec	2	*insufficient data to estimate percentiles and statistics*							

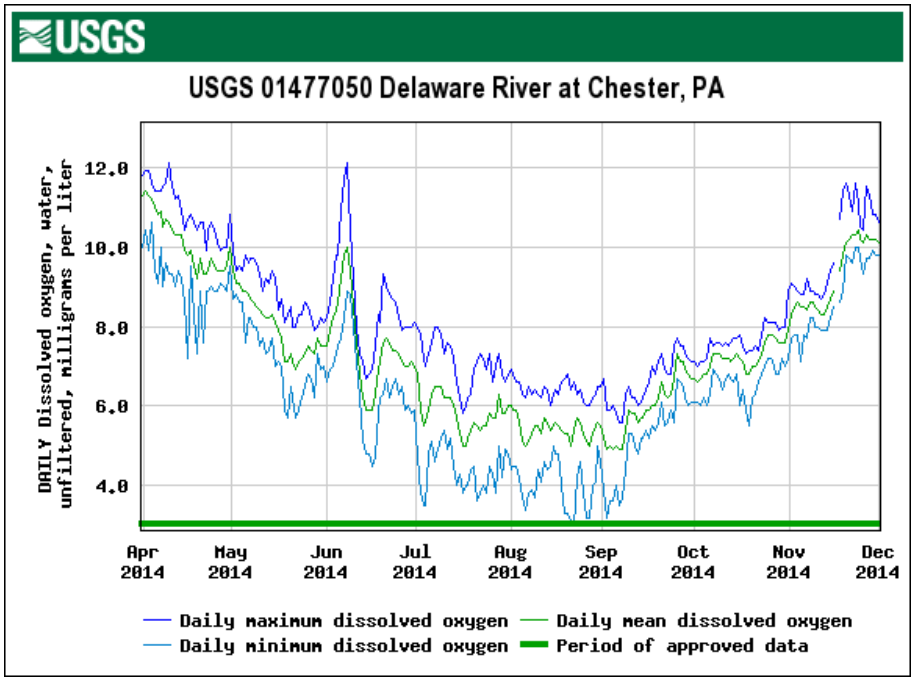
Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2013**



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means							
			min	10th	25th	median	mean	75th	90th	max
2013	Jan	0	*insufficient data to estimate percentiles and statistics*							
2013	Feb	0	*insufficient data to estimate percentiles and statistics*							
2013	Mar	3	*insufficient data to estimate percentiles and statistics*							
2013	Apr	30	9.0	9.2	9.5	9.7	10.0	11.0	11.2	11.3
2013	May	31	6.3	6.4	7.2	7.4	7.5	7.9	8.6	9.1
2013	June	30	5.2	5.6	5.9	6.3	6.2	6.5	6.8	7.5
2013	July	31	5.3	5.5	5.8	6.2	6.4	7.0	7.8	8.1
2013	Aug	26	5.0	5.1	5.5	5.7	5.7	6.0	6.1	6.2
2013	Sept	26	5.6	5.9	6.0	6.5	6.4	6.7	6.8	7.0
2013	Oct	31	6.1	6.3	6.8	7.5	7.4	7.9	8.6	8.6
2013	Nov	30	8.1	8.3	8.5	9.5	9.3	9.6	10.3	10.5
2013	Dec	2	*insufficient data to estimate percentiles and statistics*							

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums							
			min	10th	25th	median	mean	75th	90th	max
2013	Jan	0	*insufficient data to estimate percentiles and statistics*							
2013	Feb	0	*insufficient data to estimate percentiles and statistics*							
2013	Mar	3	*insufficient data to estimate percentiles and statistics*							
2013	Apr	30	8.8	8.8	8.9	9.2	9.7	10.9	11.0	11.1
2013	May	31	5.8	6.1	6.7	7.0	7.2	7.6	8.2	8.7
2013	June	30	5.0	5.2	5.6	6.0	5.9	6.1	6.4	7.1
2013	July	31	4.9	5.1	5.4	5.6	5.9	6.5	7.3	7.4
2013	Aug	26	4.7	4.8	5.1	5.4	5.3	5.7	5.7	6.0
2013	Sept	26	5.3	5.5	5.6	5.9	5.9	6.3	6.4	6.5
2013	Oct	31	5.4	5.6	6.1	7.0	6.9	7.6	8.1	8.4
2013	Nov	30	7.7	7.9	8.2	9.2	9.0	9.3	10.2	10.3
2013	Dec	2	*insufficient data to estimate percentiles and statistics*							

Distribution of USGS Dissolved Oxygen Data from Chester, PA, for the Year **2014****



Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Means**							
			min	10th	25th	median	mean	75th	90th	max
2014	Jan	0	*insufficient data to estimate percentiles and statistics*							
2014	Feb	0	*insufficient data to estimate percentiles and statistics*							
2014	Mar	3	*insufficient data to estimate percentiles and statistics*							
2014	Apr	30	9.2	9.4	9.5	10.0	10.1	10.7	11.2	11.4
2014	May	31	6.9	7.1	7.3	7.9	8.0	8.6	8.9	9.4
2014	June	30	5.9	6.2	7.0	7.4	7.5	8.1	9.2	10.0
2014	July	31	5.0	5.3	5.5	5.8	5.8	6.2	6.5	6.8
2014	Aug	31	5.0	5.1	5.3	5.5	5.4	5.6	5.7	6.0
2014	Sept	30	4.9	4.9	5.5	5.9	6.0	6.5	6.9	7.3
2014	Oct	31	6.6	6.8	7.0	7.2	7.2	7.5	7.7	7.8
2014	Nov	29	7.9	8.3	8.5	8.7	9.2	10.2	10.3	10.4
2014	Dec	31	10.1	10.3	10.9	11.3	11.1	11.5	11.6	11.7

*** - erratic 15-min interval dissolved oxygen data raises questions about these statistical summaries*

Year	Month	n	Dissolved Oxygen: Distribution of 24-hour Minimums**							
			min	10th	25th	median	mean	75th	90th	max
2014	Jan	0	*insufficient data to estimate percentiles and statistics*							
2014	Feb	0	*insufficient data to estimate percentiles and statistics*							
2014	Mar	3	*insufficient data to estimate percentiles and statistics*							
2014	Apr	30	7.2	8.2	8.9	9.1	9.1	9.5	10.0	10.6
2014	May	31	5.7	5.9	6.5	7.1	7.2	7.9	8.6	8.8
2014	June	30	4.5	4.8	5.9	6.4	6.5	7.1	8.0	8.9
2014	July	31	3.5	3.8	3.9	4.4	4.4	4.9	5.1	5.4
2014	Aug	31	3.0	3.2	3.7	4.1	4.1	4.5	4.8	5.0
2014	Sept	30	3.2	3.6	4.5	5.4	5.2	5.8	6.2	6.7
2014	Oct	31	5.5	6.0	6.2	6.7	6.6	6.8	7.1	7.2
2014	Nov	29	7.1	7.7	7.9	8.2	8.6	9.7	9.8	10.0
2014	Dec	31	9.0	9.8	10.3	10.8	10.6	11.1	11.3	11.3

Appendix C. Table 1 and Selected Text from Nadeau et al. 1979

Nadeau, R., R. Hemmett, J. Miller, R.W. Miller, D.M. Clark, D. Jacangelo, L. Skinner, R.W. Marshall, T.A. Strekal, C. Emery, S.D. Selzer, D.P. Pollison, R.C. Albert, R.C. Kausch, and A.A. Anderson. 1979. Dissolved Oxygen Requirements of a "Fishable" Delaware River Estuary. Report to the Delaware River Basin Commission by the Ad Hoc Task Force to Evaluate Dissolved Oxygen Requirements of Indigenous Estuary Fish. *{available online at http://www.state.nj.us/drbc/library/documents/del-estuary_DOrequirements_1979report.pdf}*

Nadeau et al. 1979 introduce Table 1 on pages 1 & 2 of their report:

> *"Based on the knowledge of individual Task Force members and data concerning past and present Delaware Estuary Fisheries, the Task Force developed a list of thirteen migratory fish, thirteen resident fish, and one endangered fish species (Table 1). This tabulation represents a target Estuary Fish population in terms of sensitive game, forage, commercial and desired fish species rather than a total anticipated population. Total estuary fish populations are assumed to increase proportionately to the target species.*
>
> *"For each target fish, Table 1 presents existing and potential activities (spawning, nursery, passage) by Estuary zone. The Task Force feels that current limitations on existing activities and population sizes, particularly in Zone 4, do not meet the intent of the National "fishable" goal. Restoration of fish populations to include the listed potential activities, however, will result in a minimal level of fisheries required to satisfy the national goal."*

TABLE I

Selected Fish of Interest by Zone and Activity

Aquatic Species	DELAWARE RIVER ZONE*											
	2			3			4			5		
Migratory or Marine/Estuarine:	S	N	P	S	N	P	S	N	P	S	N	P
Striped bass	o	o	x	o	o	x	o	o	x	x	x	x
Alewife	x	x	x		x	x		o	x		x	x
Blueback herring	x	x	x		x	x		o	x		x	x
American shad	o	x	x	o	o	x	o	o	x			x
Mummichog			x**			x	x	x	x	x	x	x
Bay anchovy											x	x
Menhaden								x	x		x	x
Bluefish											x	x
Weakfish											x	x
Spot											x	x
Atlantic croaker											x	x
Atlantic silversides											x	x
Blue crab			x**			x**			x**		x	x
Resident (freshwater/brackish water):												
Pumpkinseed/bluegill	x	x	x	x	x	x	o	o	x	x	x	x
Largemouth bass	x	x	x	o	o	x	o	o	o	o	o	o
Walleye	x+	x	x									
Channel catfish	x	x	x	x	x	x	o	o	x	x	x	x
Black crappie	x	x	x	o	o	o	o	o	o			x
Golden shiner	x	x	x	x	x	x	o	o	o			x
White perch	x	x	x	x	x	x	o	o	x	x	x	x
Silvery minnow	x	x	x	x	x	x	o	o	x	x	x	x
Carp	x	x	x	x	x	x	x	x	x	x	x	x
Goldfish	x	x	x	x	x	x	x	x	x	x	x	x
Brown bullhead	x	x	x	x	x	x	x	x	x	x	x	x
Yellow perch												x
Endangered Species												
Short nose sturgeon	x	x	x		o	x		o	x		x	x

*Key

S = Spawning
N = Nursery
P = Passage
o = potential
x = existing

**Limited or occasional presence (limited for reasons other than water quality)
+ Limited spawning in area (limited for reasons other than water quality)

Appendix D. PSEG Ichthyoplankton Data from 2002, 2003, and 2004 Biological Monitoring Program Annual Reports

Report Citations:

PSEG (Public Service Enterprise Group). 2002. Biological Monitoring Program Annual Report-2002. 754 pp.

PSEG (Public Service Enterprise Group). 2003. Biological Monitoring Program Annual Report-2003. 740 pp.

PSEG (Public Service Enterprise Group). 2004. Biological Monitoring Program Annual Report-2004. 762 pp.

2002 DATA

Table 4-33 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	1,118.14	0.00	1,035.82	5,681.23	153.39	157.84	0.00	0.00	0.00
yolk sac larvae	84.45	0.00	13.04	506.70	9.54	1.52	0.00	0.00	0.00
post-yolk sac larvae	80.17	7.44	11.08	142.98	326.23	1.38	2.73	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	12.12	0.00	15.82	60.33	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.05	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.28	0.00	0.00	5.19	1.47	1.38	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41
undetermined larvae	0.26	0.00	0.00	0.00	1.65	0.00	0.00	0.00	0.00
Bay anchovy									
egg	33,247.03	0.00	306.40	48,213.95	43,354.13	107,106.65	19,064.96	1,073.10	489.09
yolk sac larvae	0.05	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	151.96	0.28	11.67	92.68	13.69	297.82	413.67	38.63	508.23
juvenile	2.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.04
adult	0.25	0.00	0.71	0.29	0.00	0.60	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.05	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-33 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	7.23	0.00	0.00	0.00	45.43	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.97	0.00	0.00	0.00	17.76	0.89	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.04	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	5,765.58	0.00	1.00	15,502.52	7,990.41	7,768.09	1,718.81	28,835.66	0.00
yolk sac larvae	6.03	0.00	0.00	21.12	0.00	16.77	0.00	0.00	0.00
post-yolk sac larvae	20.41	0.00	10.24	33.82	26.45	35.77	44.02	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	40,501	8	1,406	70,261	51,940	115,389	21,244	29,947	1,023
***Gammarus* spp.**	281	133	387	166	542	455	13	39	116
Neomysis americana	210,668	9,565	212,993	171,560	687,653	53,729	228,877	367,598	33,827

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-34 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	1,352.49	0.00	248.59	8,317.16	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	91.22	0.00	0.36	575.51	1.87	0.00	0.00	0.00	0.00
post-yolk sac larvae	31.49	11.77	2.86	142.08	42.34	0.50	0.00	0.00	0.00
juvenile	0.13	0.00	0.00	0.00	0.00	1.06	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	15.20	0.00	13.10	83.15	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.30	0.00	0.00	7.09	0.53	0.00	0.00	0.00	0.00
post-yolk sac larvae	22.37	0.00	3.30	45.97	80.61	6.80	3.85	0.00	0.00
juvenile	0.17	0.00	0.00	0.00	0.00	1.36	0.00	0.00	0.00
adult	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.53
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	14,432.95	0.00	77.04	49,019.94	32,529.57	6,948.29	7,518.83	276.54	162.93
yolk sac larvae	0.07	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00
post-yolk sac larvae	405.18	0.00	7.99	184.16	7.73	1,509.84	1,250.51	374.90	558.38
juvenile	30.05	0.00	0.00	0.00	0.00	0.00	0.00	5.85	282.53
adult	5.49	4.76	11.20	12.59	3.35	1.06	1.93	0.00	1.53
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-34 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.47	0.45	2.53	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	8,462.40	0.00	0.00	49,850.05	864.43	1,503.97	2,762.46	526.51	1.12
yolk sac larvae	3.19	0.00	0.00	17.78	0.00	3.11	0.00	0.00	0.00
post-yolk sac larvae	46.66	0.00	1.75	76.68	4.97	142.91	174.48	2.92	4.57
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.12	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	24,901	17	369	108,332	33,536	10,120	11,712	1,187	1,013
***Gammarus* spp.**	1,465	412	2,652	704	2,375	2,767	334	1,550	271
Neomysis americana	174,555	36,898	191,769	158,156	273,737	111,460	612,125	28,015	13,280

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-35 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	2.26	0.00	10.42	2.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	356.61	0.00	1,052.20	0.00	1,309.44	123.50	0.00	0.00	0.00
yolk sac larvae	8.22	0.00	20.93	0.00	0.72	23.87	0.00	0.00	0.00
post-yolk sac larvae	42.55	2.48	78.14	114.63	15.82	22.10	0.00	0.00	0.00
juvenile	28.91	0.00	1.07	157.94	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.26	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	34.46	0.00	9.03	173.56	2.79	4.40	4.28	0.00	0.00
juvenile	0.68	0.00	0.46	0.00	0.00	0.00	16.54	0.00	0.00
adult	1.63	0.00	1.27	0.89	0.00	0.00	0.00	9.73	0.00
undetermined larvae	2.62	0.00	0.00	14.42	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	20,154.21	0.00	156.07	1,180.70	19,645.13	97,644.28	0.00	114.34	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	716.43	0.39	10.72	4.19	42.91	2,888.13	3,183.33	636.79	0.00
juvenile	157.05	0.00	0.00	0.00	0.00	2.39	1,647.28	759.88	0.00
adult	24.36	2.49	69.63	55.40	0.00	0.99	12.83	4.13	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-35 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.84	0.00	0.00	0.00	2.68	2.99	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	2,521.60	0.00	0.00	459.67	450.35	13,131.09	0.00	11.20	0.00
yolk sac larvae	0.25	0.00	0.00	0.00	0.68	0.96	0.00	0.00	0.00
post-yolk sac larvae	38.59	0.00	0.00	0.45	44.65	173.34	16.54	11.90	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	24,092	5	1,410	2,165	21,515	114,018	4,881	1,548	0
***Gammarus* spp.**	3,718	205	477	13,742	1,000	524	6,139	5,251	0
Neomysis americana	485,405	81,323	202,453	1,960,906	623,378	33,164	6,175	23,743	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-36 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.99	0.00	4.71	1.68	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.34	0.00	0.00	7.23	0.87	0.00	0.00	0.00	0.00
post-yolk sac larvae	34.31	30.37	7.15	151.88	0.00	6.76	0.00	0.00	0.00
juvenile	7.14	0.00	0.00	40.32	0.52	2.57	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	13.39	0.00	1.33	79.17	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	2.81	0.00	0.00	16.44	0.45	0.00	0.00	0.00	0.00
post-yolk sac larvae	39.72	0.00	6.29	231.83	0.95	0.00	0.00	0.00	0.00
juvenile	4.03	0.00	0.00	0.00	0.00	0.00	0.00	114.72	1.25
adult	0.28	0.00	0.00	0.00	0.00	0.00	0.00	4.08	0.84
undetermined larvae	11.36	0.00	0.00	68.16	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	32,976.39	0.37	2.80	35,789.19	159,837.60	21,238.81	712.40	131.31	1,052.64
yolk sac larvae	1.63	0.00	0.00	0.00	10.89	0.00	0.00	0.00	0.00
post-yolk sac larvae	659.28	0.47	2.59	11.00	4.65	1,320.84	5,213.47	2,443.21	1,349.71
juvenile	76.92	0.00	0.00	1.91	0.00	0.00	40.31	299.35	391.68
adult	11.78	27.13	6.23	32.49	0.55	0.00	20.15	0.00	0.93
undetermined larvae	5.41	0.00	1.42	0.00	0.00	0.00	0.00	0.00	31.18
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.07	0.00	0.00	0.41	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-36 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	410.85	0.00	0.56	1,699.21	0.00	866.93	0.00	0.00	71.85
yolk sac larvae	0.72	0.00	0.00	0.84	3.58	0.00	0.00	0.00	0.00
post-yolk sac larvae	5.73	0.00	0.00	7.54	0.43	31.77	5.04	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	34,264	58	33	38,139	159,860	23,468	5,991	2,993	2,900
***Gammarus* spp.**	1,985	1,148	203	1,801	112	1,356	220	18,011	4,137
Neomysis americana	145,806	95,735	562,307	104,271	55,579	76,286	221,479	15,301	19,367

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-37 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.91	0.00	0.00	0.00	15.26	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	13.35	0.00	0.00	0.00	106.79	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	6.36	0.00	0.00	0.00	50.85	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.43	1.68	0.00	0.88	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.14	0.00	1.13	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	12.61	85.48	11.99	1.69	0.00	0.00	0.00	0.00	0.00
juvenile	3.75	0.00	0.60	13.98	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	3.12	0.00	2.61	11.17	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	18.96	0.00	34.99	52.30	0.69	7.55	3.83	0.00	0.00
juvenile	0.44	0.00	0.00	0.00	0.00	0.00	3.53	0.00	0.00
adult	0.08	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	924.51	0.91	0.00	743.33	2,995.26	706.36	1,532.57	674.34	0.00
yolk sac larvae	0.08	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1,010.62	0.00	0.00	3.49	3,847.17	2,238.94	1,900.20	91.62	0.00
juvenile	22.14	0.00	0.00	0.00	3.27	24.38	55.53	93.98	0.00
adult	9.21	31.81	15.30	11.89	0.00	1.40	0.68	0.70	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-37 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.90	0.00	0.00	3.60	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	6.99	0.00	0.00	0.00	55.94	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.61	0.00	0.00	2.46	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	5.01	0.00	0.00	19.35	0.00	1.40	0.00	0.00	0.00
post-yolk sac larvae	0.78	0.00	0.00	3.14	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	19.33	0.00	0.00	19.64	0.00	115.36	0.00	0.00	0.00
yolk sac larvae	0.07	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	7.41	0.00	0.00	0.00	7.34	46.54	4.72	0.66	0.00
juvenile	1.25	0.00	0.00	0.00	0.00	9.98	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.09	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	225.66	0.00	0.00	0.00	1,805.29	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,296	120	67	888	8,888	3,152	3,501	861	0
***Gammarus* spp.**	4,178	895	1,275	5,521	1,610	14,004	2,759	1,837	0
Neomysis americana	136,561	258,373	25,478	106,353	400,286	134,830	21,502	39,312	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-38 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.20	0.00	0.00	1.59	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	9.90	8.69	11.54	43.33	15.67	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	12.84	5.14	16.06	0.00	0.00	79.13	2.38	0.00	0.00
juvenile	4.59	0.00	2.86	9.58	24.26	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.57	0.00	0.00	0.00	0.00	3.52	1.03	0.00	0.00
yolk sac larvae	3.28	0.00	0.00	0.00	7.51	18.75	0.00	0.00	0.00
post-yolk sac larvae	6.91	0.00	0.00	0.00	2.39	29.76	15.95	5.97	1.21
juvenile	0.28	0.00	0.00	0.00	0.00	0.00	0.00	1.01	1.20
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.30	0.00	0.00	0.00	0.00	2.42	0.00	0.00	0.00
Bay anchovy									
egg	2,493.46	0.00	0.00	0.00	554.53	596.41	17,951.44	441.24	404.08
yolk sac larvae	45.33	0.00	0.00	0.00	0.00	0.00	362.61	0.00	0.00
post-yolk sac larvae	1,621.48	0.00	0.00	0.00	19.65	3,596.82	7,556.32	1,585.80	213.29
juvenile	34.12	0.00	5.51	0.00	0.00	2.40	135.56	52.79	76.73
adult	15.44	4.01	17.78	6.73	91.66	2.37	0.00	0.00	0.95
undetermined larvae	0.15	0.00	0.00	0.00	0.00	0.00	0.00	1.22	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-38 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.98	0.00	0.00	7.80	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.30	0.00	0.00	2.36	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	50.05	0.00	0.00	400.38	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	12.05	0.00	0.00	96.40	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	99.61	1.15	0.00	766.75	28.94	0.00	0.00	0.00	0.00
post-yolk sac larvae	52.64	0.00	0.00	302.08	109.38	9.67	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	16.89	0.00	0.00	0.00	2.50	0.00	132.63	0.00	0.00
yolk sac larvae	3.70	0.00	0.00	0.00	10.88	0.00	18.70	0.00	0.00
post-yolk sac larvae	28.67	0.00	0.00	0.00	0.00	151.76	77.59	0.00	0.00
juvenile	3.26	0.00	1.03	0.00	0.00	17.94	7.13	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.59	0.00	0.00	2.36	2.39	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.12	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	4,518	19	55	1,640	870	4,511	26,261	2,088	697
***Gammarus* spp.**	935	44	245	2,790	830	965	2,342	202	64
Neomysis americana	23,067	3,015	32,163	9,991	39,508	20,938	26,765	14,719	37,438

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-39 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.91	0.00	0.00	0.00	15.26	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	18.14	114.68	6.90	12.94	7.17	3.40	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.65	57.41	11.47	0.00	2.63	42.02	3.66	0.00	0.00
juvenile	4.15	3.55	0.00	11.46	10.11	2.45	3.76	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07
yolk sac larvae	6.80	0.00	0.00	13.02	0.00	3.54	29.38	8.45	0.00
post-yolk sac larvae	13.32	0.00	1.49	4.70	2.34	32.30	21.74	43.35	3.56
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	6.65	0.00	0.00	0.00	24.47	0.00	0.00	27.51	1.19
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	166.49	0.00	3.90	0.00	0.00	227.49	510.47	370.01	220.07
juvenile	15.20	3.86	3.90	0.00	0.00	0.00	49.87	16.67	47.27
adult	18.63	41.52	34.00	25.85	42.84	0.00	3.66	0.00	1.19
undetermined larvae	26.19	0.00	0.00	0.00	0.00	0.00	0.00	209.48	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.14	0.00	0.00	1.14	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.35	0.00	0.00	2.30	6.52	17.16	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	5.51	0.00	0.00	7.11	25.98	11.03	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	86.37	0.00	0.00	661.76	2.26	26.97	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.14	0.00	0.00	1.14	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	22.81	5.92	5.01	134.24	36.22	1.08	0.00	0.00	0.00
yolk sac larvae	82.03	2.37	7.99	323.21	320.40	2.31	0.00	0.00	0.00
post-yolk sac larvae	317.59	0.00	0.00	236.32	1,809.49	490.31	4.62	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	37.75	0.00	0.00	0.00	302.03	0.00	0.00	0.00	0.00
Weakfish									
egg	0.14	0.00	0.00	0.00	1.13	0.00	0.00	0.00	0.00
yolk sac larvae	0.28	0.00	0.00	0.00	2.26	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.89	0.00	0.00	0.00	0.00	1.09	6.03	0.00	0.00
juvenile	2.93	2.89	0.00	0.00	0.00	0.00	20.56	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.64	1.18	0.00	5.74	6.17	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.78	0.00	0.00	1.14	7.67	105.65	3.76	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	869	233	75	1,442	2,625	967	658	675	274
***Gammarus* spp.**	5,257	2,736	221	7,106	15,039	5,612	9,608	1,162	572
Neomysis americana	18,395	8,808	26,684	2,249	67,371	1,671	13,674	17,079	9,625

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-40 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	107.71	0.00	4.08	8.37	839.58	9.65	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	29.47	40.51	172.09	4.18	7.01	9.91	2.06	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	12.70	29.11	58.02	0.00	0.00	2.21	12.24	0.00	0.00
juvenile	1.94	0.00	0.00	6.28	4.67	2.48	2.06	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	4.18	2.28	0.00	2.58	0.00	0.00	2.06	10.45	16.88
post-yolk sac larvae	6.70	0.00	8.47	2.09	0.00	0.00	16.31	17.12	9.64
juvenile	0.82	0.00	6.58	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.51	0.00	17.55	0.00	0.00	0.00	65.12	119.28	146.16
juvenile	15.17	0.00	38.58	0.00	0.00	0.00	20.48	2.07	60.23
adult	3.01	4.56	7.56	11.93	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.29	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	18.61	0.00	0.00	9.99	131.97	6.91	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	112.32	0.00	0.00	0.00	652.81	245.74	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	207.54	0.00	0.00	0.00	615.88	1,044.43	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	2,111.79	34.46	227.75	16,437.24	194.90	0.00	0.00	0.00	0.00
yolk sac larvae	1,682.94	2.28	983.27	11,685.59	792.38	0.00	0.00	0.00	0.00
post-yolk sac larvae	208.66	0.00	7.86	495.62	935.02	193.72	37.05	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.41
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	34.23	32.18	61.42	129.06	48.98	2.21	0.00	0.00	0.00
post-yolk sac larvae	218.65	0.00	10.36	15.80	861.61	842.98	18.42	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.58	0.00	0.00	0.00	4.67	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	4,821	148	1,604	28,809	5,089	2,360	176	149	235
***Gammarus* spp.**	40,420	2,040	23,397	20,899	75,881	135,009	35,174	12,113	18,849
Neomysis americana	6,391	53	63	230	65	263	22	15,918	34,509

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-41 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.11	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	89.26	2.52	21.26	75.56	515.45	79.28	19.17	0.87	0.00
juvenile	0.22	0.00	0.00	0.00	0.00	0.00	0.88	0.87	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.72	0.00	5.75	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.45	0.00	0.00	0.00	0.00	0.00	0.00	3.56	0.00
juvenile	0.43	0.00	0.00	0.00	0.00	0.00	0.00	3.45	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.22	0.00	0.00	0.00	1.76	0.00	0.00	0.00	0.00
yolk sac larvae	15.61	0.00	0.00	0.00	0.00	124.92	0.00	0.00	0.00
post-yolk sac larvae	5.50	0.00	0.00	0.00	0.00	44.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	3.48	0.83	10.76	10.89	3.78	0.84	0.75	0.00	0.00
adult	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	15.39	9.13	63.32	1.83	0.00	35.78	12.09	0.95	0.00
juvenile	2.56	0.00	0.00	4.35	8.56	0.00	1.48	6.09	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.18	0.00	0.00	0.00	0.00	0.00	1.48	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.81	0.00	0.00	0.00	0.00	0.00	5.94	15.77	72.79
juvenile	6.46	0.00	0.00	0.00	0.00	0.00	5.16	0.00	46.56
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	64.93	0.85	4.08	324.58	134.45	59.26	7.65	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	291.44	0.00	0.81	362.67	1,380.64	587.37	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	164.20	0.00	0.00	439.18	287.32	579.28	1.75	6.03	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	2,724.59	9.91	290.49	21,200.22	294.33	1.75	0.00	0.00	0.00
yolk sac larvae	1,437.35	0.00	6,272.87	4,465.36	759.66	0.89	0.00	0.00	0.00
post-yolk sac larvae	233.00	0.00	18.95	699.48	968.38	146.53	61.56	3.41	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	46.32	0.00	0.00	0.00	370.59	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	5.54	29.92	0.81	7.97	5.59	0.00	0.00	0.00	0.00
yolk sac larvae	41.32	59.23	63.31	122.40	66.69	18.88	0.00	0.00	0.00
post-yolk sac larvae	412.92	0.00	155.68	255.37	491.29	2,092.69	247.35	60.02	0.92
juvenile	0.21	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	5,575	113	6,911	27,970	5,288	3,771	365	102	121
***Gammarus* spp.**	31,177	344	9,596	42,369	73,441	72,400	26,912	11,301	13,050
Neomysis americana	108	0	11	0	2	3	1	0	846

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-42 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	148.02	0.93	121.50	523.93	313.12	172.65	22.41	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	3.71	4.53	16.13	5.39	2.90	0.00	0.00	0.00	0.00
yolk sac larvae	14.53	0.00	33.74	55.04	24.53	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.02	0.00	0.00	0.00	0.00	0.00	7.96	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.13	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	12.15	0.00	0.00	0.00	26.04	66.77	0.00	1.92	0.00
post-yolk sac larvae	13.68	0.00	0.00	8.52	38.76	41.86	2.65	9.25	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.12	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.42	0.00	2.79	3.24	1.96	0.85	0.00	1.91	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.04	0.72	16.51	0.96	3.75	0.00	1.80	0.00	0.00
juvenile	0.56	0.00	0.00	0.00	0.00	0.00	0.00	4.39	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.66	0.00	0.00	0.00	0.00	5.17	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.05	0.00	0.00	0.00	0.00	0.00	0.88	1.79	6.88
juvenile	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.88	2.24
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.58	0.00	0.00	0.00	0.00	1.65	0.00	2.86	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	29.87	0.72	17.05	22.00	7.26	172.83	8.94	8.40	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	248.38	0.00	0.00	476.68	365.28	1,045.83	0.00	2.82	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.64	0.00	0.00	12.79	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	428.68	0.00	0.00	140.35	1,523.19	1,680.19	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	11.81	1.72	0.00	83.19	7.22	0.00	0.00	0.00	0.00
yolk sac larvae	5.21	0.00	31.57	5.39	1.94	0.00	1.76	0.00	0.00
post-yolk sac larvae	124.96	0.00	15.43	140.56	489.99	323.99	4.68	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	46.63	0.00	0.00	0.00	363.72	0.00	0.00	0.00	0.00
Weakfish									
egg	0.11	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	31.91	72.45	4.69	128.26	37.48	6.05	0.00	0.00	0.00
yolk sac larvae	67.08	32.14	280.52	76.60	97.37	33.75	2.84	0.00	0.00
post-yolk sac larvae	836.10	0.00	543.80	211.97	3,562.74	1,586.83	477.57	137.76	1.12
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.09	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,034	114	1,084	1,897	6,867	5,139	532	173	10
***Gammarus* spp.**	37,561	279	28,261	20,251	105,818	42,128	33,840	48,501	17,369
Neomysis americana	1	0	0	0	0	3	0	3	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-43 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.10	0.00	0.00	0.00	8.81	0.00	0.00	0.00	0.00
post-yolk sac larvae	164.16	1.85	1,019.88	63.55	14.21	189.62	17.50	6.69	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.64	0.00	0.00	0.00	21.14	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	53.05	5.90	270.24	144.06	2.60	1.61	0.00	0.00	0.00
yolk sac larvae	103.16	0.00	710.45	53.48	51.50	9.85	0.00	0.00	0.00
post-yolk sac larvae	13.32	0.00	0.00	0.00	83.07	0.00	23.52	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	3.84	0.00	0.00	0.00	30.72	0.00	0.00	0.00	0.00
yolk sac larvae	7.43	0.00	1.84	3.39	0.88	53.34	0.00	0.00	0.00
post-yolk sac larvae	7.72	0.00	1.86	25.03	5.16	28.77	0.00	0.96	0.00
juvenile	0.11	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.21	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.11	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.98	3.53	4.32	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.36	0.00	0.00	0.00	0.00	0.00	0.00	2.87	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	2.53	0.00	0.00	0.00	20.26	0.00	0.00	0.00	0.00
post-yolk sac larvae	13.66	0.00	8.66	1.65	3.55	63.09	13.37	18.12	0.86
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	97.61	0.00	2.45	247.29	205.51	290.17	0.00	3.83	1.71
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	48.48	0.00	0.00	0.00	0.00	387.83	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	86.65	0.00	0.00	263.51	0.00	429.69	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.68	2.59	0.00	1.71	5.23	3.94	0.00	0.00	0.00
yolk sac larvae	0.53	0.00	0.00	0.00	1.74	1.64	0.85	0.00	0.00
post-yolk sac larvae	5.80	0.00	3.65	21.11	11.01	4.93	0.00	5.68	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	59.86	73.73	8.35	322.06	48.55	26.21	0.00	0.00	0.00
yolk sac larvae	121.15	27.43	602.28	16.71	252.13	63.84	6.79	0.00	0.00
post-yolk sac larvae	1,056.64	2.90	1,208.16	309.89	627.21	6,061.54	107.66	134.88	0.86
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	30.93	0.00	0.00	2.46	244.97	0.00	0.00	0.00	0.00
Total IP	1,884	118	3,843	1,478	1,639	7,616	170	173	4
***Gammarus* spp.**	17,688	226	6,505	27,186	17,182	21,073	9,048	35,832	24,455
Neomysis americana	1	0	0	1	4	0	0	0	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-44 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.46	0.00	0.00	12.01	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	428.22	0.68	3,005.00	14.46	273.29	201.18	15.82	0.97	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	181.19	159.69	501.05	813.67	11.37	0.00	0.00	0.00	0.00
yolk sac larvae	256.94	3.22	1,788.97	28.11	278.24	8.39	0.00	0.00	0.00
post-yolk sac larvae	19.19	0.00	0.00	0.00	149.82	0.00	3.55	3.96	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	5.13	17.47	13.81	0.00	10.78	0.00	0.00	0.00	0.00
yolk sac larvae	7.96	0.00	20.88	17.28	27.11	0.00	0.00	0.00	0.00
post-yolk sac larvae	46.75	0.00	99.70	206.15	34.61	39.10	0.00	5.28	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.59	0.00	0.00	21.26	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.30	0.00	0.00	0.00	0.00	35.28	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.83	0.00	0.00	0.00	0.00	0.00	0.89	0.74	4.35
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	21.50	0.00	0.00	0.00	76.76	44.04	30.21	6.26	17.27
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	62.53	0.00	0.00	12.06	271.17	226.77	0.00	2.74	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	123.89	0.00	0.00	99.10	630.65	286.16	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.55	0.00	9.39	0.86	2.46	0.00	0.00	0.00	0.00
yolk sac larvae	1.07	0.00	6.13	0.00	0.00	0.00	2.66	0.00	0.00
post-yolk sac larvae	3.14	0.00	0.00	2.56	1.63	18.92	2.66	0.00	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	208.49	465.31	64.08	1,087.85	92.38	0.00	0.00	0.00	0.00
yolk sac larvae	210.20	215.45	827.35	31.95	403.03	244.07	1.78	0.00	0.00
post-yolk sac larvae	1,009.17	0.00	2,619.90	174.91	2,539.05	2,017.48	734.86	186.31	2.21
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,596	862	8,956	2,522	4,802	3,121	794	206	25
***Gammarus* spp.**	12,881	63	3,610	19,525	10,469	1,609	8,185	37,121	20,869
Neomysis americana	7	0	0	0	0	53	0	3	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-45 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	128.71	0.95	700.15	1.61	86.00	220.23	11.26	8.92	9.06
juvenile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.57	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	6.41	11.60	10.47	0.00	0.00	29.17	0.00	0.00	0.00
yolk sac larvae	61.63	5.21	417.04	38.94	0.00	31.00	0.84	0.00	0.00
post-yolk sac larvae	0.46	0.00	0.00	0.00	0.00	0.00	3.66	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	15.96	0.00	117.97	0.00	5.38	4.32	0.00	0.00	0.00
yolk sac larvae	30.43	0.00	201.12	16.71	14.71	10.91	0.00	0.00	0.00
post-yolk sac larvae	153.90	0.00	847.10	153.97	146.09	78.25	0.00	5.77	0.00
juvenile	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.62	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	3.46	0.00	0.00	0.00	0.00	27.67	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	88.50	0.00	38.10	0.00	669.88	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.03	0.00	41.08	0.00	145.55	100.18	32.95	5.48	31.01
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	207.96	0.00	19.13	0.00	202.70	1,429.00	5.75	7.10	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	32.72	0.00	0.00	0.00	0.00	261.75	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.33	0.00	0.00	0.80	1.82	0.00	0.00	0.00	0.00
yolk sac larvae	25.34	0.00	0.00	202.68	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.52	0.00	0.00	0.00	0.00	1.72	1.64	0.83	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	32.05	8.70	2.73	2.63	14.94	227.44	0.00	0.00	0.00
yolk sac larvae	302.72	13.43	324.64	52.93	1,712.02	314.69	1.62	0.00	0.00
post-yolk sac larvae	251.45	0.00	939.96	7.57	199.01	662.85	122.21	78.50	1.51
juvenile	0.42	0.00	0.00	0.00	0.00	0.00	0.00	3.33	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,387	40	3,659	478	3,198	3,399	180	115	42
***Gammarus* spp.**	10,254	70	491	2,349	3,073	13,273	5,673	28,595	28,509
Neomysis americana	3	0	0	3	17	0	0	1	2

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-46 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	17.26	0.00	58.20	0.00	49.95	21.47	1.71	2.59	4.19
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	45.50	15.63	348.34	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	57.77	0.00	174.07	22.27	182.85	82.95	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.73	0.00	1.79	0.80	3.28	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.01	0.00	60.01	10.72	0.00	16.40	0.00	0.91	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.20	0.00	0.78	0.80	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage of each target species caught during the Delaware Baywide Ichthyoplankton Effort, April-July 2002

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	13.37	0.00	105.28	0.00	1.70	0.00	0.00	0.00	0.00
post-yolk sac larvae	31.28	0.00	25.42	0.00	183.95	7.07	0.00	1.83	32.81
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	116.88	0.00	0.00	0.00	749.24	184.20	0.00	1.60	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	226.20	28.66	0.00	0.00	1,780.93	0.00	0.00	0.00	0.00
yolk sac larvae	260.00	13.41	77.55	260.63	1,394.46	333.95	0.00	0.00	0.00
post-yolk sac larvae	3.35	0.00	8.94	0.00	0.00	4.87	6.02	6.09	0.85
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	784	58	860	295	4,347	651	10	14	38
***Gammarus* spp.**	6,677	152	142	2,862	1,182	2,128	38,793	4,328	3,825
Neomysis americana	2	0	0	4	5	3	0	0	0

Note: Event 1 occurred April 9-18.
Event 2 occurred April 23-May 2.
Event 3 occurred May 6-21.
Event 4 occurred May 22-30.
Event 5 occurred June 7-18.
Event 6 occurred June 24-29.
Event 7 occurred July 8-17.
Event 8 occurred July 23-30.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

2003 DATA

Table 4-33 (page 1 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	553.66	0.00	0.00	3,780.08	0.00	573.80	35.88	0.00	0.00
yolk sac larvae	1.19	0.00	0.00	5.26	4.51	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.00	0.00	0.00	3.21	2.35	0.00	2.55	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.17	0.00	0.00	0.00	0.29	0.00	1.04	0.00	0.00
juvenile	0.04	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	27,948.25	0.00	0.00	1,132.80	30,692.63	72,242.18	26,748.43	63,878.49	29,087.50
yolk sac larvae	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.06
post-yolk sac larvae	695.64	0.00	0.00	0.00	0.00	0.28	26.72	2,908.75	2,579.65
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.68	0.32	0.00	0.00	0.30	1.98	1.37	1.47	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-33 (page 2 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	142.40	0.00	3.77	0.00	251.84	0.00	823.88	53.03	14.53
yolk sac larvae	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00
post-yolk sac larvae	9.09	0.00	0.00	0.00	0.30	0.00	0.99	52.78	18.04
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	29,353	0	4	4,921	30,952	72,818	27,641	66,895	31,705
***Gammarus* spp.**	279	87	64	322	376	175	265	732	220
Neomysis americana	98,573	3,624	1,324	20,092	124,409	58,956	323,311	118,727	123,929

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-34 (page 3 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	149.45	0.00	0.00	1,098.37	0.37	113.40	0.00	0.00	0.00
yolk sac larvae	0.89	0.00	0.00	6.25	0.86	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.36	0.97	0.00	1.04	6.94	1.29	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.03	0.44	0.00	0.00	0.38	6.66	0.86	0.00	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	23,517.46	0.00	0.00	0.00	9,375.70	35,432.24	124,206.37	11,344.44	9,352.28
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1,363.06	0.00	0.00	0.00	0.00	0.89	134.46	941.48	9,979.11
juvenile	0.43	0.00	0.00	0.00	0.00	0.00	0.42	0.00	3.05
adult	5.72	0.51	0.00	2.20	22.56	8.87	0.92	8.45	0.38
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-34 (page 4 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	50.06	0.00	406.07	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	12.43	0.00	0.00	0.52	0.00	0.00	0.94	3.63	95.76
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	25,102	2	406	1,108	9,407	35,563	124,345	12,298	19,431
***Gammarus* spp.**	2,237	186	187	86	13,991	225	397	699	821
Neomysis americana	176,371	80,958	7,175	47,709	218,177	127,289	242,297	386,249	296,468

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-35 (page 5 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.05	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.05	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	59.61	0.00	0.00	467.97	5.79	3.13	0.00	0.00	0.00
yolk sac larvae	1.02	0.00	0.00	3.38	4.34	0.00	0.47	0.00	0.00
post-yolk sac larvae	1.40	0.00	0.45	5.48	5.30	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.56	0.00	0.00	2.29	2.15	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	8,613.25	0.00	0.00	4,834.16	4,425.96	36,525.37	18,734.65	1,672.38	2,713.47
yolk sac larvae	0.05	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1,219.15	0.00	0.00	0.48	0.00	0.43	3.31	4,635.29	5,113.70
juvenile	41.23	0.00	0.00	0.00	0.00	0.00	0.00	266.28	63.58
adult	3.60	0.00	0.00	23.40	4.19	0.81	0.43	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-35 (page 6 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.16	0.43	0.00	0.87	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	16.65	0.00	5.13	0.00	0.00	0.00	121.79	0.00	6.30
yolk sac larvae	0.39	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.00
post-yolk sac larvae	28.96	0.00	0.00	0.00	0.00	0.00	0.00	191.13	40.53
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	9,986	0	6	5,339	4,448	36,530	18,861	6,768	7,938
***Gammarus* spp.**	5,903	268	393	121	404	65	23,395	2,851	17,981
Neomysis americana	154,467	78,277	111,753	101,046	106,151	26,991	173,338	353,283	284,894

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-36 (page 7 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	48.10	0.00	0.00	320.42	64.38	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.09	0.38	0.00	0.00	15.11	0.89	0.34	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.91	0.00	0.00	0.00	2.06	1.21	0.69	3.33	0.00
juvenile	0.08	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00
adult	0.55	0.40	0.00	0.00	0.00	0.00	0.34	0.43	3.25
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	7,589.86	0.00	0.00	32.45	7,486.21	21,788.54	7,199.77	21,870.90	2,341.02
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	952.14	0.00	0.00	0.00	0.00	0.00	157.84	3,687.95	3,771.33
juvenile	27.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	220.83
adult	7.08	0.00	0.44	6.95	35.29	2.59	1.81	5.63	3.90
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.05	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-36 (page 8 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	16.90	0.00	5.21	0.42	0.00	0.00	0.00	129.54	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.96	0.00	0.00	0.00	0.00	0.00	5.17	18.63	7.90
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	8,649	1	6	360	7,603	21,794	7,367	25,716	6,348
***Gammarus* spp.**	406	125	117	155	765	148	793	1,018	129
Neomysis americana	97,138	23,908	15,443	251,430	79,626	63,736	91,817	194,767	56,381

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-37 (page 9 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.08	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.63	0.00	0.00	1.03	2.34	0.53	1.16	0.00	0.00
juvenile	0.40	3.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.07	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.79	0.00	0.00	0.00	8.26	0.66	3.60	11.10	6.69
juvenile	0.35	0.54	0.00	0.00	0.00	0.00	2.26	0.00	0.00
adult	0.92	1.65	0.00	0.00	0.00	0.00	0.53	0.56	4.66
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	203.95	0.00	0.00	0.00	26.41	2.00	100.11	1,212.24	290.84
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	734.43	0.00	0.00	0.00	0.00	0.00	264.56	3,561.41	2,049.45
juvenile	44.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	356.46
adult	23.46	1.62	0.52	22.42	120.39	11.45	7.28	22.76	1.22
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-37 (page 10 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.75	0.00	0.00	0.00	0.00	0.00	6.00	0.00	0.00
juvenile	1.53	0.00	0.00	0.00	0.00	0.00	0.00	12.27	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.26	0.00	0.00	0.00	0.00	2.10	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	55.29	0.00	0.00	0.00	0.00	0.66	11.71	334.40	95.56
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,070	8	1	24	157	17	397	5,155	2,805
***Gammarus* spp.**	1,028	47	60	14	3,364	324	3,220	536	659
Neomysis americana	168,755	162,507	700,082	234,705	44,737	56,186	110,717	25,946	15,164

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-38 (page 11 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.15	0.00	0.00	0.00	0.00	1.23	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.24	0.00	0.00	1.93	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.14	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.03	0.00	1.23	0.00	7.01	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.77	0.00	0.00	0.00	3.15	3.69	0.00	14.67	8.63
juvenile	0.14	0.00	0.00	0.00	0.00	0.00	1.11	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	123.18	0.00	0.00	0.00	6.99	1.23	0.00	0.00	977.20
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	460.83	0.00	0.00	0.00	0.00	0.00	0.00	941.39	2,745.26
juvenile	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.45
adult	6.98	0.00	0.00	20.91	22.60	7.30	0.00	2.79	2.28
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-38 (page 12 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.58	0.00	0.00	1.14	3.47	0.00	0.00	0.00	0.00
yolk sac larvae	1.24	0.00	0.00	2.94	7.01	0.00	0.00	0.00	0.00
post-yolk sac larvae	9.82	0.00	0.00	0.00	26.80	3.67	32.56	15.57	0.00
juvenile	1.05	0.00	0.00	0.00	0.00	0.00	1.11	7.33	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	17.85	0.00	0.00	0.00	0.00	0.00	0.00	61.74	81.07
juvenile	2.46	0.00	0.00	0.00	0.00	0.00	0.00	3.77	15.91
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	630	0	1	27	78	17	36	1,047	3,833
***Gammarus* spp.**	19,495	14,681	1,474	1,025	1,650	3,065	122,670	4,967	6,424
Neomysis americana	436,387	7,472	130,343	3,053,597	56,741	41,804	77,677	86,081	37,383

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-39 (page 13 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.58	0.00	0.00	0.00	4.62	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0.00	0.00	0.00	1.02	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.13	0.00	0.00	0.00	0.00	0.00	1.07	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.12	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	113.13	0.00	0.00	0.00	0.00	0.00	0.00	221.16	683.86
juvenile	0.65	0.00	0.00	0.00	0.00	0.98	0.00	0.00	4.23
adult	1.23	0.00	0.00	2.16	5.62	0.98	0.00	0.00	1.07
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 14 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.28	0.00	0.00	0.00	0.00	2.21	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.48	0.00	0.00	3.82	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.30	0.00	0.00	0.00	0.00	17.67	0.00	72.74	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	65.03	0.00	0.00	517.90	0.00	2.33	0.00	0.00	0.00
yolk sac larvae	156.75	0.00	0.00	1,216.26	36.85	0.00	0.93	0.00	0.00
post-yolk sac larvae	110.79	0.00	0.00	0.00	404.35	163.13	69.19	247.33	2.31
juvenile	1.95	0.00	0.00	0.00	0.00	0.00	1.07	7.56	6.94
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	11.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	94.15
juvenile	2.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.65
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	2.77	0.00	0.00	22.14	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	9.24	0.00	0.00	17.57	2.38	44.71	4.01	5.28	0.00
juvenile	0.38	0.00	0.00	0.00	0.00	0.00	1.96	1.09	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	489	0	0	1,780	455	233	80	555	810
***Gammarus* spp.**	92,262	4,943	1,400	33,023	15,424	123,673	441,296	70,765	47,570
Neomysis americana	46,393	23	622	152,879	8,860	27,273	241	49,527	131,715

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-40 (page 15 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	99.45	0.00	0.00	67.55	561.83	85.58	37.57	43.10	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.18
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.61	0.00	0.00	0.00	0.00	0.00	0.00	4.86	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	5,050.46	0.00	0.00	0.00	0.00	0.00	0.00	39,824.23	579.47
juvenile	29.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	239.47
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 16 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	16.92	0.00	0.00	0.00	57.93	9.51	37.57	25.86	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.08	0.00	0.00	0.00	0.00	0.00	0.00	8.62	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	109.12	0.00	0.00	858.56	9.65	4.75	0.00	0.00	0.00
yolk sac larvae	286.34	0.00	0.00	1,949.17	196.84	9.51	135.24	0.00	0.00
post-yolk sac larvae	66,035.43	0.00	0.00	0.00	8,522.94	1,779.38	393.41	517,579.36	8.35
juvenile	3,117.02	0.00	0.00	0.00	0.00	0.00	0.00	24,892.30	43.89
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	5.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.10
juvenile	4.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.63
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	1.65	0.00	8.54	4.67	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	11.94	0.00	0.00	95.52	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	10,859.30	0.00	0.00	180.86	1,847.08	2,813.33	2,137.51	79,874.76	20.88
juvenile	6,845.10	0.00	0.00	0.00	0.00	0.00	0.00	54,758.32	2.44
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	92,474	0	9	3,156	11,196	4,702	2,741	717,011	975
***Gammarus* spp.**	340,119	379	8,804	21,183	1,032,951	666,243	534,997	329,003	127,394
Neomysis americana	18,206	0	152	660	0	14	18	131	144,671

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-41 (page 17 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	138.98	0.00	1.22	35.22	141.46	512.20	0.00	394.19	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	3.82	0.00	30.41	2.48	0.00	3.00	0.00	0.00	0.00
yolk sac larvae	3.10	0.00	8.39	16.61	0.00	0.87	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.22
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.20	0.00	0.00	0.98	0.00	9.54	1.62	5.05	0.00
juvenile	0.97	0.00	0.00	0.00	0.00	0.00	0.81	2.58	4.14
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.22	0.00	0.00	0.00	0.00	0.87	0.00	0.83	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.41	0.00	0.00	0.00	0.00	0.86	2.37	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	28.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	222.22
juvenile	6.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.71
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17
juvenile	5.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	38.13
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 18 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.12	0.00	1.22	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	19.09	0.00	0.00	5.47	62.65	30.38	0.00	50.39	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	9.25	0.00	0.00	0.00	0.00	0.00	0.86	71.28	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	203.68	0.00	15.49	17.64	1,546.21	10.75	1.73	0.00	0.00
yolk sac larvae	35.81	0.00	0.00	39.40	47.52	188.37	3.17	0.83	0.00
post-yolk sac larvae	156.43	0.00	0.00	0.00	629.54	400.41	1.59	181.05	7.54
juvenile	8.88	0.00	0.00	0.00	0.00	0.00	0.81	2.51	65.96
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	66.07	0.00	489.00	121.63	0.99	1.50	0.00	0.00	0.00
yolk sac larvae	12.19	0.00	1.22	49.96	1.93	42.23	0.00	0.00	0.00
post-yolk sac larvae	305.69	0.00	0.00	153.79	502.50	526.59	2.47	1,141.23	57.79
juvenile	12.36	0.00	0.00	0.00	0.00	0.00	0.00	18.09	78.35
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,021	0	547	443	2,933	1,728	16	1,868	541
***Gammarus* spp.**	125,130	51	170	1,296	84,806	323,908	31,622	124,799	409,394
Neomysis americana	211	0	8	12	0	1	1,621	1	6

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	266.61	0.00	0.85	226.13	1,172.29	279.81	391.76	60.43	1.63
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	6.66	8.13	9.48	19.28	12.32	4.04	0.00	0.00	0.00
yolk sac larvae	56.03	0.00	3.51	432.14	9.12	1.78	0.00	1.68	0.00
post-yolk sac larvae	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.11	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.86	0.00	0.00	1.84	0.00	5.04	0.00	0.00	0.00
post-yolk sac larvae	5.24	0.00	0.00	5.55	6.77	21.18	3.48	4.96	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.67
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.84	2.41
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 20 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	33.57	0.00	0.00	60.38	100.03	17.44	57.21	21.65	6.50
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.98	0.00	0.00	7.86	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	61.80	0.00	0.00	7.36	472.22	14.81	0.00	0.00	0.00
yolk sac larvae	30.51	0.00	0.00	67.15	112.17	3.16	59.18	2.45	0.00
post-yolk sac larvae	169.76	0.00	0.00	0.00	1,253.39	9.49	87.03	8.20	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	39.25	2.44	78.70	182.98	46.67	3.23	0.00	0.00	0.00
yolk sac larvae	27.02	0.00	0.00	104.84	48.50	27.49	15.66	19.62	0.00
post-yolk sac larvae	435.81	0.00	0.00	375.76	497.04	174.95	2,245.69	166.14	26.89
juvenile	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.71
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,137	11	93	1,493	3,731	563	2,860	287	52
***Gammarus* spp.**	47,626	17	49	1,437	29,494	55,213	54,786	16,458	223,553
Neomysis americana	3	0	1	6	4	6	1	0	3

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-43 (page 21 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	489.53	0.00	2.53	1,190.32	652.02	1,773.00	195.43	98.70	4.24
juvenile	0.84	0.00	0.00	0.00	0.00	0.00	0.00	6.72	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	38.23	0.00	67.47	220.53	14.46	3.41	0.00	0.00	0.00
yolk sac larvae	451.06	0.86	5.69	3,564.95	17.62	19.38	0.00	0.00	0.00
post-yolk sac larvae	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.85
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.46	0.00	0.86	0.94	1.89	0.00	0.00	0.00	0.00
yolk sac larvae	24.79	0.00	0.00	85.65	10.35	102.29	0.00	0.00	0.00
post-yolk sac larvae	53.40	0.00	0.00	47.96	12.62	302.40	34.09	29.21	0.90
juvenile	1.67	0.00	0.00	0.00	0.00	0.00	0.82	6.72	5.83
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	2.19	0.00	0.00	17.52	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.12	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.23	0.00	0.00	0.00	0.00	1.87	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.43
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	5.86	0.00	0.00	0.00	0.00	0.00	0.00	0.81	46.08
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 22 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	93.78	0.00	0.00	490.12	78.59	67.45	19.02	16.59	14.92
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	37.01	0.00	0.00	5.72	212.39	75.17	2.76	0.00	0.00
yolk sac larvae	11.85	0.00	0.00	57.36	32.43	0.00	3.29	1.68	0.00
post-yolk sac larvae	54.83	0.00	0.00	4.23	410.40	17.30	0.00	5.15	1.57
juvenile	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.59
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	35.91	0.00	14.15	199.47	63.83	6.96	2.87	0.00	0.00
yolk sac larvae	107.42	0.00	0.00	212.88	27.22	549.69	53.67	15.94	0.00
post-yolk sac larvae	481.82	0.00	0.00	737.81	415.33	874.48	1,073.22	686.82	66.89
juvenile	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.58
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,894	1	91	6,835	1,950	3,793	1,385	868	166
***Gammarus* spp.**	36,059	17	57	284	7,707	51,249	45,484	6,034	177,643
Neomysis americana	4	0	0	11	3	4	1	0	10

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-44 (page 23 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	551.20	0.00	0.00	1,175.42	2,924.89	269.47	13.55	20.81	5.43
juvenile	0.34	0.00	0.00	0.00	0.00	0.00	0.00	2.72	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	132.57	0.00	72.85	714.61	269.34	3.75	0.00	0.00	0.00
yolk sac larvae	105.92	0.00	0.80	422.71	102.72	312.89	8.25	0.00	0.00
post-yolk sac larvae	2.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.48
juvenile	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.63
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	57.00	0.00	2.60	393.43	32.18	23.65	4.13	0.00	0.00
yolk sac larvae	35.36	0.00	0.00	148.89	102.27	29.06	2.64	0.00	0.00
post-yolk sac larvae	121.75	0.00	0.00	326.52	287.40	163.26	88.77	36.49	71.52
juvenile	1.77	0.00	0.00	0.00	0.00	0.00	0.00	3.42	10.77
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89
juvenile	2.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.02
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 24 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	42.58	0.00	0.80	127.93	179.19	11.71	17.05	0.00	9.06
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	9.88	0.00	2.60	0.81	20.66	8.61	46.32	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.79	0.00	0.00	0.00	5.86	3.12	0.83	0.92	3.58
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	37.91	0.00	13.86	102.56	166.41	16.85	3.58	0.00	0.00
yolk sac larvae	70.26	0.00	0.00	170.82	284.08	46.69	47.72	12.81	0.00
post-yolk sac larvae	303.47	0.00	0.00	89.32	570.07	243.91	3.65	756.08	764.76
juvenile	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.85
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,478	0	94	3,673	4,945	1,133	236	834	917
***Gammarus* spp.**	38,349	11	27	197	1,958	18,549	11,924	9,393	264,730
Neomysis americana	7	0	1	50	1	3	0	1	0

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-45 (page 25 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	473.65	0.00	0.00	899.97	2,795.45	6.06	35.08	26.57	26.08
juvenile	0.21	0.00	0.00	0.00	0.00	0.00	0.00	1.67	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	11.84	3.28	0.00	8.49	8.57	38.49	35.91	0.00	0.00
yolk sac larvae	316.59	0.00	1.85	1,490.09	828.03	178.40	34.36	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	30.01	0.00	24.17	83.14	39.78	29.65	63.34	0.00	0.00
yolk sac larvae	65.40	0.00	0.00	355.28	136.02	6.66	24.41	0.81	0.00
post-yolk sac larvae	144.85	0.00	0.00	356.29	550.95	5.03	144.27	71.59	30.71
juvenile	1.67	0.00	0.00	0.00	0.00	0.00	0.00	4.38	8.99
adult	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.82
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 26 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.21	0.00	0.00	1.71	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	17.91	0.00	0.00	4.36	88.18	2.05	10.56	7.47	32.10
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.64	0.00	0.00	0.00	0.00	0.00	0.00	5.16	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.39	0.00	0.00	0.00	0.00	8.22	2.89	0.00	0.00
yolk sac larvae	0.11	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.24	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.97
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	19.70	0.00	0.00	26.84	48.13	77.04	5.57	0.00	0.00
yolk sac larvae	52.69	0.00	0.00	149.69	133.34	3.00	85.97	49.53	0.00
post-yolk sac larvae	37.71	0.00	0.00	0.00	20.40	0.00	1.97	40.75	238.59
juvenile	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.53
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,176	3	27	3,376	4,649	355	445	209	343
***Gammarus* spp.**	8,056	18	23	273	2,691	1,055	3,548	6,166	50,676
Neomysis americana	357	3	0	33	0	9	10	1	2,804

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-46 (page 27 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	130.83	0.00	0.00	16.93	855.79	1.88	6.09	1.89	19.07
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	22.79	0.00	27.63	100.71	0.98	24.04	3.48	25.48	0.00
yolk sac larvae	326.41	0.00	0.00	368.68	1,598.65	637.25	6.71	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	1.93	0.00	0.00	3.48	2.45	7.53	1.95	0.00	0.00
yolk sac larvae	1.26	0.00	0.00	1.98	7.15	0.00	0.00	0.94	0.00
post-yolk sac larvae	34.74	0.00	0.00	0.00	231.82	1.02	0.87	9.29	34.95
juvenile	2.58	0.00	0.00	0.00	0.00	0.00	0.00	0.90	19.70
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic Croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.74
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.25
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 28 of 28)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2003

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.40	0.00	0.00	0.87	17.37	0.00	0.00	0.94	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.49	0.00	0.00	0.00	0.00	0.00	3.90	0.00	0.00
yolk sac larvae	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	63.03	0.00	0.00	162.80	205.40	37.71	98.32	0.00	0.00
yolk sac larvae	59.72	0.00	0.00	9.43	131.84	7.19	139.88	189.45	0.00
post-yolk sac larvae	4.43	0.00	0.00	0.87	30.08	1.79	0.00	0.90	1.79
juvenile	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.67
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	652	0	28	666	3,082	718	261	231	88
***Gammarus* spp.**	4,603	27	41	281	4,445	1,071	894	4,531	25,530
Neomysis americana	12	0	1	87	1	3	0	0	3

Note: Event 1 occurred April 1-14.
Event 2 occurred April 15-24.
Event 3 occurred May 6-15.
Event 4 occurred May 19-27.
Event 5 occurred June 2-10.
Event 6 occurred June 17-25.
Event 7 occurred July 1-15.
Event 8 occurred July 15-25.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

2004 DATA

Table 4-33 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	230.75	0.00	8.56	1,148.30	418.79	270.35	0.00	0.00	0.00
yolk sac larvae	0.03	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.91	0.00	0.00	0.00	3.83	3.42	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.76	0.00	0.00	0.00	6.05	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.17	0.00	0.00	0.00	0.28	0.82	0.00	0.30	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	66,811.36	0.00	0.00	2.96	121,447.44	367,156.82	11,071.54	32,429.71	2,382.44
yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00
post-yolk sac larvae	5,048.84	0.00	0.00	0.00	1.39	152.58	6,916.87	3,801.20	29,518.71
juvenile	2.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.45
adult	0.34	0.00	0.00	0.00	2.22	0.54	0.00	0.00	0.00
undetermined larvae	190.47	0.00	0.00	0.00	1,523.76	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-33 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 1) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.57	0.00	0.00	0.30	4.28	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	6,552.68	0.00	1,150.28	4,411.03	0.00	224.44	2,967.63	42,114.82	1,553.23
yolk sac larvae	0.49	0.00	0.00	0.00	0.00	0.00	0.00	3.95	0.00
post-yolk sac larvae	57.75	0.00	0.00	0.00	0.28	11.48	84.89	127.99	237.36
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.28	0.00	0.00	0.00	0.00	0.00	0.00	2.20	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	78,898	0	1,159	5,563	123,409	367,821	21,041	78,480	33,713
***Gammarus* spp.**	442	162	25	187	505	317	243	1,484	616
Neomysis americana	49,867	19,367	6,553	78,625	31,801	64,057	60,231	85,590	52,714

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-34 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	31.72	0.00	0.00	253.30	0.42	0.00	0.00	0.00	0.00
yolk sac larvae	0.05	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00
post-yolk sac larvae	0.79	0.00	0.00	0.00	4.18	2.13	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.16	0.00	0.00	0.00	1.28	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.05	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.46	0.00	0.00	0.00	13.36	3.02	2.31	0.97	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.06	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	30,213.70	0.00	0.00	4.84	79,149.75	109,967.01	9,359.32	27,882.37	15,346.29
yolk sac larvae	0.65	0.00	0.00	0.00	0.00	1.35	0.00	3.86	0.00
post-yolk sac larvae	3,471.64	0.00	0.00	0.00	0.87	604.02	13,306.27	6,366.00	7,495.94
juvenile	5.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.25
adult	5.76	0.00	0.50	12.17	31.20	0.89	0.00	0.43	0.87
undetermined larvae	0.68	0.00	0.00	0.00	5.42	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.05	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-34 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 2) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	878.09	0.00	375.18	986.42	0.00	0.00	295.02	3,706.62	1,661.51
yolk sac larvae	0.48	0.00	0.00	0.00	0.00	0.00	0.00	3.86	0.00
post-yolk sac larvae	117.76	0.00	0.00	0.00	6.45	13.64	429.09	295.89	197.05
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	34,730	0	376	1,257	79,214	110,592	23,392	38,260	24,746
***Gammarus* spp.**	1,868	488	72	578	421	283	3,378	3,532	6,193
Neomysis americana	77,354	73,687	36,658	287,156	71,877	68,912	17,474	7,725	55,345

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-35 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	143.34	0.00	0.00	161.16	25.50	960.03	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.25	0.00	0.00	0.82	14.71	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00
post-yolk sac larvae	4.48	0.00	0.00	3.23	6.08	17.18	0.00	9.32	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	18,541.81	0.00	0.00	0.83	9,774.21	131,195.29	6,488.37	783.55	92.22
yolk sac larvae	3.75	0.00	0.00	0.00	0.00	23.80	6.19	0.00	0.00
post-yolk sac larvae	5,708.95	0.00	0.00	0.00	0.00	3,687.23	15,585.06	13,303.00	13,096.31
juvenile	58.72	0.00	0.00	0.00	0.00	0.00	0.00	112.65	357.08
adult	3.54	0.00	0.00	2.04	24.57	1.71	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-35 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 3) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.05	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	3,771.01	0.00	1,820.92	534.37	102.45	21,765.37	5,242.59	418.33	284.07
yolk sac larvae	4.45	0.00	0.00	0.00	0.36	35.22	0.00	0.00	0.00
post-yolk sac larvae	214.59	0.00	0.00	0.00	0.00	706.79	723.53	130.09	156.31
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	28,457	0	1,821	702	9,948	158,393	28,046	14,757	13,986
***Gammarus* spp.**	338	67	146	104	113	25	88	949	1,209
Neomysis americana	59,213	10,277	23,256	206,814	29,424	20,511	42,503	120,588	20,332

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-36 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	34.59	0.00	0.00	276.69	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.26	0.00	0.00	0.00	11.63	0.00	6.47	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.38	0.00	0.00	0.41	5.60	3.41	9.59	0.00	0.00
juvenile	1.24	0.00	0.00	0.00	0.00	0.00	6.47	3.02	0.41
adult	1.29	0.00	0.00	0.00	0.00	0.00	0.00	3.21	7.08
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	10,550.34	0.00	0.00	0.00	27,425.85	52,182.40	1,191.87	46.54	3,556.04
yolk sac larvae	1.42	0.00	0.00	0.00	0.00	11.36	0.00	0.00	0.00
post-yolk sac larvae	2,500.80	0.00	0.00	0.00	0.39	2,184.59	11,566.53	3,102.37	3,152.57
juvenile	67.28	0.00	0.00	0.00	0.00	0.00	0.00	184.21	354.07
adult	4.92	0.00	10.65	0.85	25.82	1.21	0.38	0.41	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.05	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-36 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 4) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.05	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	91.54	0.00	81.83	439.20	0.00	0.00	7.16	0.00	204.12
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	27.62	0.00	0.00	0.00	0.44	90.32	102.31	18.55	9.31
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	13,286	0	92	718	27,470	54,474	12,891	3,358	7,284
***Gammarus* spp.**	693	30	226	50	29	73	807	1,020	3,313
Neomysis americana	74,170	49,459	125,445	215,777	87,450	58,332	14,746	24,145	18,005

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-37 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.08	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.59	0.62	0.00	0.58	3.52	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.07	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	7.03	0.00	0.00	13.22	19.89	7.80	10.81	1.15	3.36
juvenile	0.14	0.00	0.00	0.00	0.00	0.00	0.58	0.56	0.00
adult	0.78	0.00	0.62	0.00	0.00	1.14	0.60	1.72	2.18
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	2,591.10	0.00	0.00	0.00	15,784.31	2,121.65	2,269.28	165.77	387.78
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	859.89	0.00	0.00	0.00	0.60	1,539.40	2,731.23	1,047.13	1,560.74
juvenile	95.55	0.00	0.00	0.00	0.00	0.00	0.00	161.80	602.58
adult	13.73	0.62	15.07	4.98	42.76	2.48	7.74	34.51	1.68
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-37 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 5) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.23	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.08	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	29.42	0.00	0.00	0.00	0.00	188.26	16.69	7.23	23.22
juvenile	0.25	0.00	0.00	0.00	0.00	0.00	0.00	2.02	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	3,599	3	16	20	15,851	3,861	5,037	1,422	2,582
***Gammarus* spp.**	210	47	187	101	21	544	233	363	187
Neomysis americana	127,455	280,538	485,140	63,434	73,408	29,109	57,520	20,853	9,637

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-38 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.06	1.11	0.00	0.00	15.38	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	7.32	0.00	0.00	0.00	35.61	15.64	0.00	7.31	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.26	0.00	0.00	0.00	1.16	0.00	0.00	0.89	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	457.07	0.00	0.00	0.00	548.31	2,144.30	296.79	517.13	150.05
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	277.93	0.00	0.00	0.00	3.49	1,304.14	622.93	209.51	83.40
juvenile	16.52	0.00	0.00	0.00	0.00	0.00	0.00	40.21	91.95
adult	8.24	0.00	2.06	16.79	25.13	5.67	10.44	1.84	3.99
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-38 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 6) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.30	0.00	0.00	0.00	2.36	0.00	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.12	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.15	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.15	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	16.52	0.00	0.00	0.00	1.16	37.81	72.31	2.70	18.22
juvenile	0.69	0.00	0.00	0.00	0.00	1.15	0.00	2.19	2.15
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.15	0.00	0.00	0.00	1.18	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.26	0.00	2.07	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	788	1	4	17	636	3,509	1,004	782	350
***Gammarus* spp.**	4,007	439	20,953	1,410	2,906	1,203	1,870	396	2,881
Neomysis americana	73,868	327,875	130,101	17,576	50,979	14,387	4,229	12,641	33,159

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-39 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.15	0.00	1.17	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.50	0.00	0.00	0.00	12.01	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.68	0.00	0.00	0.00	6.05	1.21	0.00	14.15	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.43	0.00	0.00	0.00	1.08	0.00	2.40	0.00	0.00
Bay anchovy									
egg	1.95	0.00	0.00	0.00	10.82	4.74	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	160.95	0.00	0.00	0.00	0.00	296.11	623.87	236.28	131.37
juvenile	10.20	0.00	0.00	0.00	0.00	0.00	0.00	21.07	60.57
adult	1.73	0.00	0.00	3.41	6.94	0.00	2.28	1.24	0.00
undetermined larvae	4.22	0.00	0.00	0.00	0.00	33.80	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-39 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 7) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.13	0.00	0.00	0.00	0.00	0.00	1.07	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	4.37	0.00	0.00	0.00	34.93	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	115.68	0.00	0.00	10.49	893.27	21.69	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	207.86	0.00	1,661.87	1.03	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.15	0.00	0.00	1.21	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	70.39	0.00	0.00	0.00	469.63	86.88	6.62	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	54.00	0.00	0.00	0.00	0.00	89.86	320.14	11.95	10.05
juvenile	15.98	0.00	0.00	0.00	0.00	2.74	121.84	1.24	2.02
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	0.96	0.00	4.13	0.00	0.00	3.58	0.00	0.00	0.00
yolk sac larvae	1.46	0.00	11.69	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	6.72	0.00	0.00	0.00	53.74	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.73	1.11	3.51	1.21	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	662	1	1,682	17	1,488	541	1,078	286	204
***Gammarus* spp.**	88,366	20,702	104,348	80,379	295,645	19,429	27,749	39,543	119,132
Neomysis americana	30,200	43,982	68	303	613	27,333	25,747	104,242	39,310

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-40 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	14.07	0.00	0.00	0.00	112.53	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.57	0.00	0.00	0.00	2.41	0.00	2.11	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.63	0.00	0.00	0.00	0.00	5.97	0.00	4.75	2.30
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	72.76	0.00	0.00	0.00	0.00	266.91	128.51	138.34	48.35
juvenile	4.51	0.00	0.00	0.00	0.00	0.00	0.00	11.08	25.02
adult	0.56	0.00	0.00	0.00	0.00	4.46	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.50	0.00	0.00	0.00	0.00	3.98	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-40 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 8) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.97	0.00	0.00	0.00	37.51	0.00	0.00	2.22	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	69.81	0.00	0.00	0.00	558.51	0.00	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	273.54	0.00	0.00	930.43	1,222.13	35.73	0.00	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	384.47	0.00	3,063.62	12.10	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.59	0.00	0.00	0.00	4.69	0.00	0.00	0.00	0.00
post-yolk sac larvae	57.36	0.00	0.00	0.00	292.08	148.00	18.80	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.17	0.00	0.00	0.00	0.00	1.99	29.83	1.58	0.00
juvenile	1.02	0.00	0.00	0.00	0.00	0.00	6.61	1.58	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	14.17	0.00	110.94	2.42	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	66.96	0.00	0.00	19.36	463.98	45.20	7.15	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.31	0.00	0.00	0.00	0.00	2.47	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	972	0	3,175	964	2,694	515	193	160	76
***Gammarus* spp.**	267,270	2,330	5,104	111,964	1,566,651	45,625	101,271	153,411	151,805
Neomysis americana	7,137	2	0	5	0	20,097	1,313	35,672	10

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-41 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	58.57	0.00	0.00	146.62	321.91	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	0.30	0.00	2.42	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	1.69	0.00	0.81	10.89	1.83	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.40	0.00	0.00	0.00	0.00	2.36	0.00	0.82	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.11	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.85	0.00	0.00	0.00	6.80	0.00	0.00	0.00	0.00
juvenile	0.30	0.00	0.00	0.00	0.00	0.84	0.82	0.00	0.76
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.33	0.00	0.00	0.00	0.00	1.94	0.00	0.70	0.00
juvenile	0.31	0.00	0.00	0.00	0.00	1.60	0.86	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.10	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	34.93	0.00	0.00	0.00	0.00	0.00	72.14	139.83	67.45
juvenile	6.14	0.00	0.00	0.00	0.00	0.00	0.00	19.40	29.74
adult	0.20	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00
undetermined larvae	1.24	0.00	0.00	0.00	0.00	0.00	9.90	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.15	0.00	0.00	0.00	0.00	4.47	1.60	0.83	2.27
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-41 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 9) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.20	0.00	1.61	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	57.79	0.00	0.00	2.72	458.93	0.00	0.00	0.69	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	59.57	0.00	0.00	177.88	289.26	9.39	0.00	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	78.07	0.00	0.00	51.29	62.46	486.19	24.59	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	4.96	0.00	0.00	33.87	5.83	0.00	0.00	0.00	0.00
yolk sac larvae	17.82	0.00	0.00	24.07	118.47	0.00	0.00	0.00	0.00
post-yolk sac larvae	68.68	0.00	0.00	198.13	33.70	288.57	28.34	0.69	0.00
juvenile	0.36	0.00	0.00	0.00	0.00	0.00	0.80	2.08	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	12.27	1.63	66.82	28.83	0.92	0.00	0.00	0.00	0.00
yolk sac larvae	13.32	0.00	7.54	26.98	72.08	0.00	0.00	0.00	0.00
post-yolk sac larvae	229.24	0.00	0.00	410.19	646.44	745.08	31.31	0.00	0.90
juvenile	1.76	0.00	0.00	0.00	0.00	1.67	2.51	7.61	2.26
adult	0.44	0.00	0.00	0.90	0.00	0.97	1.64	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	651	2	80	1,113	2,019	1,545	174	173	103
***Gammarus* spp.**	227,946	371	2,264	146,756	68,591	375,855	996,070	129,995	103,663
Neomysis americana	8	0	0	4	3	24	1	31	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-42 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	95.33	0.00	6.32	232.24	444.68	77.92	1.50	0.00	0.00
juvenile	0.66	0.00	0.00	0.00	0.00	0.00	1.50	3.79	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	11.78	0.97	4.27	5.55	83.47	0.00	0.00	0.00	0.00
yolk sac larvae	10.97	0.00	10.96	69.37	7.47	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.96	0.00	0.00	0.00	0.00	22.16	1.55	0.00	0.00
juvenile	0.34	0.00	0.00	0.00	0.00	2.69	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.82	0.00	0.00	4.64	1.92	0.00	0.00	0.00	0.00
post-yolk sac larvae	10.02	0.00	0.00	1.83	52.76	25.55	0.00	0.00	0.00
juvenile	1.52	0.00	0.00	0.00	0.00	9.60	1.61	0.91	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.78	0.00	0.00	6.22	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	13.70	0.00	0.00	0.00	0.00	0.00	31.82	74.36	3.39
juvenile	1.28	0.00	0.00	0.00	0.00	0.00	0.00	8.51	1.70
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.11	0.00	0.00	0.00	0.00	4.07	4.84	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-42 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 10) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	27.55	0.00	0.00	0.00	162.32	58.05	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	211.37	0.00	0.00	78.85	1,230.10	361.52	3.11	17.35	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.11	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	75.29	0.00	0.00	3.60	207.55	364.80	26.40	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	1.35	0.00	2.69	5.43	2.67	0.00	0.00	0.00	0.00
yolk sac larvae	2.44	0.00	0.00	0.93	18.60	0.00	0.00	0.00	0.00
post-yolk sac larvae	72.44	0.00	0.00	0.00	18.43	547.13	12.06	1.92	0.00
juvenile	0.42	0.00	0.00	0.00	0.00	0.00	1.67	0.94	0.74
adult	0.09	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	18.04	0.00	56.78	17.66	69.06	0.84	0.00	0.00	0.00
yolk sac larvae	29.79	0.00	9.45	86.74	142.16	0.00	0.00	0.00	0.00
post-yolk sac larvae	281.37	0.00	0.00	123.09	928.74	1,164.68	34.43	0.00	0.00
juvenile	1.69	0.00	0.00	0.00	0.00	0.00	4.23	9.33	0.00
adult	0.34	0.00	1.83	0.00	0.00	0.90	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	874	1	92	636	3,370	2,640	126	118	6
***Gammarus* spp.**	346,700	153	910	5,471	29,167	1,406,435	612,808	357,946	360,711
Neomysis americana	2	0	0	19	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-43 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	345.47	0.00	0.00	530.14	1,991.79	232.83	9.00	0.00	0.00
juvenile	0.29	0.00	0.00	0.00	0.00	0.00	2.29	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	50.42	0.00	13.12	71.39	318.88	0.00	0.00	0.00	0.00
yolk sac larvae	8.45	0.00	20.78	35.44	11.39	0.00	0.00	0.00	0.00
post-yolk sac larvae	5.97	0.00	0.00	0.00	0.00	36.39	8.64	2.70	0.00
juvenile	0.41	0.00	0.00	0.00	0.00	3.30	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	0.53	0.00	0.94	3.28	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	23.94	0.00	0.00	39.02	152.46	0.00	0.00	0.00	0.00
post-yolk sac larvae	44.95	0.00	0.00	54.13	189.01	114.96	1.53	0.00	0.00
juvenile	3.68	0.00	0.00	0.00	0.00	26.44	3.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	2.03	0.00	0.00	16.25	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.44	0.00	0.00	0.00	0.00	0.00	0.00	3.56	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	19.58	0.00	0.00	0.00	0.00	0.00	7.80	142.96	5.91
juvenile	0.46	0.00	0.00	0.00	0.00	0.00	0.00	3.68	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.19	0.00	0.00	0.00	0.00	0.00	1.51	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.05	0.00	0.00	0.00	0.00	1.73	2.35	1.79	2.56
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-43 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 11) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	89.55	0.00	0.00	1.72	672.24	42.43	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	365.15	0.00	0.00	423.98	1,956.91	522.46	17.85	0.00	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.30	0.00	0.00	0.00	0.00	10.36	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	105.71	0.00	0.00	18.92	347.43	124.58	354.75	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	3.68	0.00	2.80	0.00	26.67	0.00	0.00	0.00	0.00
yolk sac larvae	6.59	0.00	0.00	0.00	52.75	0.00	0.00	0.00	0.00
post-yolk sac larvae	8.89	0.00	0.00	0.00	29.95	37.42	3.76	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	125.17	0.00	213.79	60.17	702.39	25.04	0.00	0.00	0.00
yolk sac larvae	38.30	0.00	11.63	56.68	237.19	0.86	0.00	0.00	0.00
post-yolk sac larvae	749.09	0.00	0.00	144.19	2,337.82	3,217.20	290.97	1.72	0.82
juvenile	0.43	0.00	0.00	0.00	0.00	2.53	0.88	0.00	0.00
adult	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	2,002	0	263	1,455	9,027	4,399	704	157	9
***Gammarus* spp.**	275,895	24	94	2,134	26,508	879,973	316,597	607,005	374,829
Neomysis americana	0	0	0	2	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-44 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	329.30	0.00	0.00	455.82	1,847.67	310.44	20.43	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	104.06	8.94	95.58	618.37	109.62	0.00	0.00	0.00	0.00
yolk sac larvae	11.76	0.00	34.04	44.45	15.55	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.62	0.00	0.00	0.00	0.00	0.00	26.43	2.56	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	56.27	0.00	360.78	75.11	14.24	0.00	0.00	0.00	0.00
yolk sac larvae	82.71	0.00	14.34	238.18	409.14	0.00	0.00	0.00	0.00
post-yolk sac larvae	377.74	0.00	0.00	404.67	2,206.86	398.93	9.74	0.84	0.86
juvenile	1.98	0.00	0.00	0.00	0.00	15.83	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	16.80	0.00	0.00	134.39	0.00	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	4.36	0.00	0.00	0.00	0.00	0.00	4.38	22.70	7.76
juvenile	0.59	0.00	0.00	0.00	0.00	0.00	0.00	4.73	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.13	0.00	0.00	0.00	0.00	0.00	0.00	5.39	3.61
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-44 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 12) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	43.47	0.00	0.00	0.00	282.41	23.84	41.48	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	722.74	0.00	3.17	355.47	5,043.41	315.83	59.75	4.30	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	187.00	0.00	0.00	0.00	765.54	562.43	168.06	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	7.76	0.00	0.87	0.00	61.20	0.00	0.00	0.00	0.00
yolk sac larvae	2.92	0.00	0.00	0.00	23.32	0.00	0.00	0.00	0.00
post-yolk sac larvae	8.72	0.00	0.00	0.00	7.84	53.48	8.44	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.20	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	64.09	7.61	127.11	266.03	111.99	0.00	0.00	0.00	0.00
yolk sac larvae	127.49	0.00	57.52	172.55	789.85	0.00	0.00	0.00	0.00
post-yolk sac larvae	1,712.93	0.00	0.00	55.28	5,862.90	6,929.56	850.37	5.34	0.00
juvenile	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	3,868	17	693	2,820	17,552	8,610	1,191	47	13
***Gammarus* spp.**	150,966	13	66	1,728	16,547	205,377	212,560	375,652	395,787
Neomysis americana	0	0	0	0	0	0	0	0	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-45 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	383.80	0.00	0.86	55.21	932.75	1,744.32	337.25	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	38.58	2.48	3.76	300.77	1.61	0.00	0.00	0.00	0.00
yolk sac larvae	7.65	0.00	9.36	25.10	26.76	0.00	0.00	0.00	0.00
post-yolk sac larvae	3.12	0.00	0.00	0.00	0.00	0.00	18.62	6.31	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	20.69	0.00	95.56	62.69	7.28	0.00	0.00	0.00	0.00
yolk sac larvae	43.26	0.00	0.79	248.60	90.41	6.31	0.00	0.00	0.00
post-yolk sac larvae	222.60	0.00	0.00	199.67	423.55	1,124.90	31.74	0.95	0.00
juvenile	2.49	0.00	0.00	0.00	0.00	15.96	3.10	0.87	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	69.93	0.00	0.00	184.71	0.00	374.74	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.23	0.00	0.00	0.00	0.00	0.00	0.64	14.08	3.11
juvenile	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.78
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.34
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-45 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 13) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	100.31	0.00	0.00	1.00	0.00	552.37	68.31	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	295.21	0.00	0.00	33.33	1,019.08	1,087.04	216.78	5.45	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.10	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	47.75	0.00	0.00	0.00	5.01	344.11	31.97	0.95	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.67	0.00	4.44	0.00	0.90	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	1.13	0.00	0.00	0.00	0.00	0.00	9.02	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	36.08	1.65	62.56	220.88	3.52	0.00	0.00	0.00	0.00
yolk sac larvae	123.57	0.00	10.45	88.57	875.27	14.28	0.00	0.00	0.00
post-yolk sac larvae	462.94	0.00	0.00	3.98	18.50	3,272.34	408.70	0.00	0.00
juvenile	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	1,863	5	188	1,425	3,405	8,536	1,126	31	7
***Gammarus* spp.**	194,590	4	42	683	6,413	53,148	72,689	407,494	1,016,248
Neomysis americana	0	0	0	0	0	0	0	1	0

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Table 4-46 (page 1 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Alewife									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	24.21	0.00	0.00	20.32	34.10	104.82	29.61	0.00	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Alosa* spp.**									
egg	7.65	21.84	7.53	33.89	0.77	0.00	0.00	0.00	0.00
yolk sac larvae	18.63	0.00	0.96	47.47	96.88	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.38	0.00	0.00	0.00	0.00	0.00	2.97	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
American shad									
egg	2.54	0.00	17.25	2.58	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	3.48	0.00	0.00	22.11	5.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	84.21	0.00	0.00	5.13	14.86	605.23	31.63	0.00	0.00
juvenile	1.89	0.00	0.00	0.00	0.00	10.95	3.05	0.71	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.60	0.00	0.00	0.00	4.71	0.00	0.00	0.00	0.00
Atlantic croaker									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic menhaden									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Atlantic silverside									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.54	0.00	0.00	0.00	0.00	0.00	0.00	4.23	0.00
juvenile	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blueback herring									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	1.00	0.00	0.00	0.00	0.00	0.00	0.00	7.06	0.77
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bluefish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-46 (page 2 of 2)

PSEG Estuary Enhancement Program
Mean density (#/1000 m^3) by sampling event (collected in Zone 14) for each life stage
of each target species caught during the Ichthyoplankton Effort, April-July 2004

Species (Taxon) by Life Stage	All Events*	April		May		June		July	
		Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8
Clupeidae									
egg	0.21	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	2.99	0.00	0.00	2.54	0.83	16.17	3.80	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	37.03	0.00	0.00	21.99	66.95	138.68	59.82	1.42	0.00
***Morone* spp.**									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	3.46	0.00	0.00	0.00	0.00	4.59	22.43	0.00	0.00
Spot									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Striped bass									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.19	0.00	0.00	0.00	0.00	0.70	0.77	0.00	0.00
juvenile	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weakfish									
egg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
post-yolk sac larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
juvenile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White perch									
egg	26.63	1.03	82.12	114.31	8.35	2.09	0.00	0.00	0.00
yolk sac larvae	154.12	0.00	0.94	422.81	773.60	4.76	0.00	0.00	0.00
post-yolk sac larvae	13.19	0.00	0.00	0.00	0.00	92.59	8.01	1.51	0.77
juvenile	0.45	0.00	0.00	0.00	0.00	0.00	0.00	3.55	0.00
adult	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
undetermined larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total IP	384	23	109	693	1,006	981	163	22	2
***Gammarus* spp.**	220,169	12	203	373	1,408	7,988	28,266	477,485	1,201,589
Neomysis americana	1	6	0	1	0	0	1	1	2

Note: Event 1 occurred April 1-15.
Event 2 occurred April 19-27.
Event 3 occurred May 3-7.
Event 4 occurred May 13-20.
Event 5 occurred June 1-8.
Event 6 occurred June 14-25.
Event 7 occurred July 1-10.
Event 8 occurred July 19-28.

*The "All Events" column contains the mean density for all events combined. It is not the total across each row.

Attachment 3

Nick Patton

From: MacKnight, Evelyn <MacKnight.Evelyn@epa.gov>
Sent: Wednesday, July 27, 2016 5:45 PM
To: Nick Patton
Subject: FW: EPA comments on DRBC Existing Use Report

Per your request. See message below.

Evelyn MacKnight
Associate Director, Office of Standards, Assessment, and TMDLs (3WP30)
Water Protection Division
U.S. EPA Region III
Tel (215) 814-5717
Fax (215) 814-2318
macknight.evelyn@epa.gov

From: McFadden, Angela
Sent: Friday, January 15, 2016 12:55 PM
To: Fikslin, Tom <Tom.Fikslin@drbc.nj.gov>
Cc: Jackson, Wayne <Jackson.Wayne@epa.gov>; Keating, Jim <Keating.Jim@epa.gov>; Hakowski, Denise <Hakowski.Denise@epa.gov>; Richardson, William <Richardson.William@epa.gov>; Lai, Kuo-Liang <Lai.Kuo-Liang@epa.gov>; Ambrogio, Edward <Ambrogio.Edward@epa.gov>; Capacasa, Jon <Capacasa.jon@epa.gov>; MacKnight, Evelyn <MacKnight.Evelyn@epa.gov>; Erik.Silldorff@drbc.nj.gov; Jensen, Heather N NAP <Heather.N.Jensen@usace.army.mil>
Subject: EPA comments on DRBC Existing Use Report

Tom,

In response to a request from Heather Jenson of the U.S. Army Corps of Engineers Philadelphia District Planning Division, EPA has prepared formal comments on the September 30, 2015 Delaware River Basin Commission report, "Existing Use Evaluation for Zones 3, 4, &5 of the Delaware Estuary Based on spawning and Rearing of Resident and Anadromous Fishes".

We also wanted to provide these comments, which were prepared in coordination with EPA's Region 2 office, to DRBC directly. I am providing them to you on behalf of Evelyn MacKnight, who is out of the office today.

EPA's comments are as follows:

- With respect to maintenance and propagation of aquatic life, the report indicates that the full Clean Water Act Section 101(a)(2) use exists in Zones 3, 4, and upper Zone 5 of the Delaware estuary. The report states that, for all nine fish species evaluated, successful reproduction was clearly demonstrated. Demonstration of propagation, even if "weak and inconsistent" and spatially limited, is nonetheless demonstration of this existing use.

- In conducting its evaluation, DRBC considered nine fish species: Atlantic Sturgeon, American Shad, Striped Bass, White Perch, Bay Anchovy, Atlantic Silverside, Alewife, Blueback Herring, and Atlantic Menhaden. This analysis appears to have focused on migratory or semi-migratory fish species. DRBC's evaluation should include resident

Delaware River fish species and freshwater mussel species in Zones 3, 4, 5 (e.g., catfish species, centrarchids, resident cyprinids) for evaluating the extent of propagation of aquatic life in these urban zones.

Page 30 of the report states:

> "Many more species of fish were captured and recorded as part of the New Jersey Seine Surveys. Shortnose Sturgeon data, for instance, were too sparse in any data set to assess this endangered fish species within this report. In addition, distribution and abundance data exist for species such as freshwater mussels and benthic invertebrates, but these data sets typically provide little specific information on the question of "successful reproduction"."

EPA notes that the references cited in the report do not include freshwater mussel survey findings from the Partnership for the Delaware Estuary (PDE), which found both juvenile and adult native mussel species in the estuary during 2012 and 2013 surveys in PDE mussel research (see PDE Report 15-01, "Freshwater Mussel Scientific Research and Community Involvement for Improved Water Quality in the Urban PA Coastal Zone"). In addition, EPA recommends that DRBC review and consider Appendix I of the document "Guidance for Carrying Out Endangered Species Act Section 7 Consultations with NMFS Greater Atlantic Regional Fisheries Office" provided to the U.S. Army Corps of Engineers by the National Marine Fisheries Service. This appendix includes a discussion of the occurrence of Shortnose Sturgeon in the Delaware River.

There may be additional valuable data available for resident fish species from PA Fish and Boat Commission and/or Philadelphia Water Department Office of Watersheds that could indicate resident fish and mussel species are reproducing in these zones. In conducting a use evaluation, it is important to address the most sensitive aquatic life species to which the maintenance and propagation use applies in order to ensure subsequent promulgation of Water Quality Criteria is truly protective of the designated use.

- EPA's implementing regulations require that Water Quality Standards protect for full fishable swimmable uses unless such uses are demonstrated to be unattainable through a Use Attainability Analysis, effectively creating a rebuttable presumption of attainability.

If there are any questions please don't hesitate to let us know.

Thank you,

Angela

Angela McFadden
Regional Technical Advisor - Oil & Gas Sector

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Attachment 4

Summary
Triennial Review of Water Quality Standards
TR17 Proposed Rulemaking

Federal regulations at 40 CFR Section 131.20 require that states periodically, but at least once every 3 years, review and revise as necessary, their water quality standards. Pennsylvania's Water Quality Standards are set forth in 25 *Pa Code* Chapter 93 (Water Quality Standards) and Chapter 16 (Water Quality Toxics Management Strategy – Statement of Policy).

Pennsylvania's most recent triennial review of water quality standards (TR13) was approved by EPA on May 22, 2014; received by letter at DEP on June 14, 2014. Therefore, the next triennial review of the Commonwealth's water quality standards will be due, in final-form, to EPA by 2017. The Department of Environmental Protection (DEP) has developed proposed rulemaking that will lead to fulfilling this federal requirement for the triennial review of water quality standards, as mandated by the Federal Clean Water Act. The triennial review of water quality standards proposed rulemaking (TR17) is expected to be presented to the Environmental Quality Board (EQB) early Spring 2016.

This proposed rulemaking is being made under the authority of sections 5(b)(1) and 402 of The Clean Streams Law (35 P.S. §§ 691.5 (b)(1) and 691.402), which authorize the Board to develop and adopt rules and regulations to implement the provisions of The Clean Streams Law (35 P.S. §§ 691.1 – 691.1001), and section 1920-A of The Administrative Code of 1929 (71 P.S. § 510-20), which grants to the Board the power and duty to formulate, adopt, and promulgate rules and regulations for the proper performance of the work of DEP. In addition, section 303 of the federal Clean Water Act (33 U.S.C.A. § 1313) sets forth requirements for water quality standards.

The following is a summary of what DEP will recommend to EQB as revisions, updates, and amendments for the Commonwealth's triennial review of water quality standards:

- Adopt the U.S. Environmental Protection Agency's (EPA) 2013 Ammonia Aquatic Life Criterion (NOTE: EPA made specific mention in TR13 approval letter)
- Adopt EPA's 2012 Bacteria / Recreation Use Criteria (NOTE: EPA made specific mention in TR13 approval letter)
    - Adopt criteria for *E. coli* indicator, replacing current fecal coliform criteria.
    - Clarification for Coastal Rec Waters – §93.9x Lake Erie; the federal promulgation at 40 CFR 131.41under the BEACH Act will no longer apply to Pennsylvania.
    - 2012 Recommended criteria for statewide application to primary contact recreation only; does not relate to secondary contact or non-swimming season; EPA still working on recommendations for secondary contact recreation use
- Adopt new Chloride Aquatic Life Criteria; being developed by DEP, to include new data approved by EPA and on sensitive mayflies from research conducted on Pennsylvania waters and mayflies, by Stroud Water Research Center
- Remove lingering reference to 40 CFR 131.32(a) at §93.8a(j)(3); this federal promulgation (re: Antidegradation Policy) has been withdrawn by EPA and the reference will be removed from Chapter 93.

- Review and adopt EPA's 2015 Updated Human Health Criteria for 94 toxic substances, at §93.8c, Table 5, which are based on the latest science and implementation of new health and risk input factors for human health criteria development. Review and update other criteria in Table 5, where sufficient data exists to recalculate criteria based on these new risk factor inputs.
- Clarification and specific reference (in §93.8d(c)) to the use of the Biotic Ligand Model (BLM) for development of site-specific water quality criteria for copper; describe any specific conditions and prerequisites for use of BLM or related to site-specific Copper criteria. Currently, BLM is only available for copper in freshwater systems.
- Delete references to Appendix A, Table 1A throughout Chapter 93 (Sections 93.1, 93.8a(b), and 93.8c(a)), since DEP is proposing to delete Table 1A in Chapter 16.
- Clarify in Section 93.8d(f)(2), that DEP has developed a new on-line resource to maintain a publicly available list of site-specific criteria that have been developed, and are being used by the Department in permitting and other pollution control measures. This new on-line resource to house site-specific / provisional criteria is similar to the Existing Use List, also located on the Division of Water Quality Standards (DWQS) webpage.
- Great Lakes WQ Criteria – recommend we default to statewide (Table 5) criteria if none are available in Table 6. This is more appropriate now that statewide fish consumption rate is 17.5 g/day; closer to GLWQA's rate of 15 g/day than when our earlier statewide rate was just 6.5 g/day. Note, the following would need to change or be clarified:
  - §93.8c(b) – "The criteria in Table 5 do not apply to the Great Lakes System."
  - §93.8e(b) – "For any pollutant not listed in the table (Table 6), criteria … will be developed, … in accordance with …" Ch 93 and §16.61
- Clarification in §93.2(b) & §93.9(b) about application of WQS established under interstate or international compacts or agreements such as the Delaware River Basin Commission (DRBC), Ohio River Valley Sanitation Commission (ORSANCO), Great Lakes Water Quality Agreement (GLWQA), regarding "… the more stringent apply." and "Exceptions to Specific Criteria"

<u>Non-Fishable / Swimmable Re-evaluation</u>:
DEP routinely, and must as part of its triennial review of water quality standards, re-evaluate, the two water bodies where the fishable or swimmable uses specified in Section 101(a)(2) of the federal Clean Water Act uses are not being met in Pennsylvania: (1) the Harbor Basin and entrance channel to Outer Erie Harbor/ Presque Isle Bay and (2) several zones in the Delaware Estuary.

Because the same conditions and hazards exist for the Outer Erie Harbor/ Presque Isle Bay and specicified zones of the Delaware Estuary today as during the original use attainability assessments (UAA), no change to the designated use, deleting Water Contact Sports (WC) is anticipated for these waters.

There is new evidence that strongly indicates fish propagation has improved for several key species in portions of the Delaware Estuary, and that the warm water use (WWF) should be restored. Currently, the use is defined as Warm Water Fishes (Maintenance Only) for select waters. However, this evaluation is still in development by DRBC and the member states. Therefore, until a final UAA is completed, which describes the new use designations and related

recommended criteria, no change to the criteria are currently recommended for these Delaware Estuary waters.

Corrections and Clarifications:
DEP also routinely reviews and will make updates, revisions, and corrections to the water quality standards chapters for typographical and translation errors, and missed references associated with prior rulemaking and/or publication activities. This includes corrections to use designations and stream entries found in Drainage Lists at Sections 93.9a-93.9z; for stream redesignations not already being addressed by separate stream redesignation rulemakings.

DEP is also considering Proposed Revisions, Updates, and Amendments to the Chapter 16 – Statement of Policy:
The Chapter 16 – Statement of Policy amendments are provided as a companion and are intended to be a supplement to the TR17 Chapter 93 rulemaking. The Chapter 16 package travels with the triennial rulemaking, but is a DEP action, not an EQB rulemaking. The recommended revisions are summarized as follows:

- Update lingering reference to Chapter 92 at §16.22(1); should reference Ch 92a.
- Updates to Human Health Criteria development methodologies / protocols
  - Incorporate the new health and risk factors at §§16.32 and 16.33 to reflect updates used for body weight, and water and fish intakes in the 2015 updates to human health criteria for 94 toxic substances. (see §93.8c, Table 5):
    - **Body Weight** – From 70 kilograms (154 lbs.) to **80 kilograms** (176 lbs.);
    - **Drinking Water** – From 2 liters per day to **2.4 liters per day**;
    - **Fish Consumption** – From 17.5 grams per day to **22 grams per day**.
  - Correct reference at §16.32(c)(2) to the Water Quality Standards Handbook, Second Edition; should be EPA-823-B-94-005a.
- Delete Table 1A in Appendix A since DEP will now maintain the on-line table of updated site-specific criteria on the DEP webpage.
- Revise Section §16.102 - Approved EPA Analytical Methods and Detection Limits to clarify these are maintained and updated by EPA, so include cross reference to EPA approved methodologies; delete Methods Tables 2A, 2B and 3. Retain reference, repurpose, or create a new table for the few non-EPA developed / approved methods.

Persons with proposed or existing discharges into surface waters of the Commonwealth, including small businesses, industry, municipalities, and agriculture must comply with the regulation. Each activity that will result in pollution to waters of this Commonwealth requires a review that is based on site-specific considerations. National Pollutant Discharge Elimination System (NPDES) permits will be required for discharges to waters and water quality standards identified in the proposed regulations. Existing Department procedures will be used to implement this proposed regulation.

Attachment 5

Socioeconomic Value of the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania

The Delaware River Basin, an economic engine for over 400 years

October 11, 2011

Prepared by:

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Executive Summary

What do the Guggenheim Museum, New York Yankees, Boeing, Sunoco, Campbell's Soup, DuPont, Wawa, Starbucks, Iron Hill Brewery, Philadelphia Phillies, Camelback Ski Area, Pt. Pleasant Canoe Livery, Salem Nuclear Power Plant, and United States Navy all have in common? They all depend on the waters of the Delaware River Basin to sustain their businesses.

The Delaware River Basin is an economic engine that supplies drinking water to the 1st (New York City) and 7th (Philadelphia) largest metropolitan economies in the United States and supports the largest freshwater port in the world. The Delaware Basin's water supplies, natural resources, and ecosystems in Delaware, New Jersey, New York, Pennsylvania and a small sliver of Maryland:

- Contribute $25 billion in annual economic activity from recreation, water quality, water supply, hunting/fishing, ecotourism, forest, agriculture, open space, potential Marcellus Shale natural gas, and port benefits.

- Provide ecosystem goods and services (natural capital) of $21 billion per year in 2010 dollars with net present value (NPV) of $683 billion discounted over 100 years.

- Are directly/indirectly responsible for 600,000 jobs with $10 billion in annual wages.

The Basin

The Delaware River Basin occupies almost 13,000 sq mi (not including the river and bay) in Delaware, Maryland, New Jersey, New York, and Pennsylvania. In 2010, over 8.2 million residents lived in the basin including 654,000 people in Delaware, 2,300 in Maryland, 1,964,000 in New Jersey, 131,000 in New York, and 5,469,000 in Pennsylvania. Nearly 3,500,000 people work in the basin with 316,000 jobs in Delaware, 823,000 jobs in New Jersey, 70,000 jobs in New York, and 2,271,000 jobs in Pennsylvania. An additional 8 million people in New York City and northern New Jersey receive drinking water from the Delaware River via interbasin transfers. The Delaware Basin occupies just 0.4% of the continental U.S. yet supplies drinking water to 5% of the U.S. population.

The Delaware Basin population exceeds 8.2 million which if counted together would be the 12th most populous state after New Jersey but ahead of Virginia. The Delaware Basin occupies:

- Delaware (50% of the State's area and 74% of the First State's population)
- New Jersey (40% of the State's area and 22% of the Garden State's population)
- New York (5% of the State's area and 0.7% of the Empire State's population)
- Pennsylvania (14% of the State's area and 43% of the Keystone State's population.

Between 2000 and 2010, the population in the Delaware Basin increased by 6.1% or 472,066 people. Over the last decade, the population increased by 30% in Pike County, Pa.; by over 20% in Kent and Sussex counties, Del. and Monroe County, Pa.; and by over 10% in Gloucester and Ocean counties, NJ, Orange County, NY, and Chester, Lehigh, and Northampton counties, Pa. For the first time in two generations, Philadelphia gained population. Several counties in the basin lost population since 2000: Cape May, NJ; Broome, Delaware, and Greene counties, NY; and Lackawanna, Luzerne, and Schuylkill counties, Pa.

Watersheds of the Delaware River Basin

East-West Branch Watersheds

Lackawaxen Watersheds

Neversink-Mongaup Watersheds

Upper Central Watersheds

Lower Central Watersheds

Lehigh Valley

Schuylkill Valley

Upper Estuary Watersheds

Lower Estuary Watersheds

Delaware Bay Watersheds

N

0 10 20

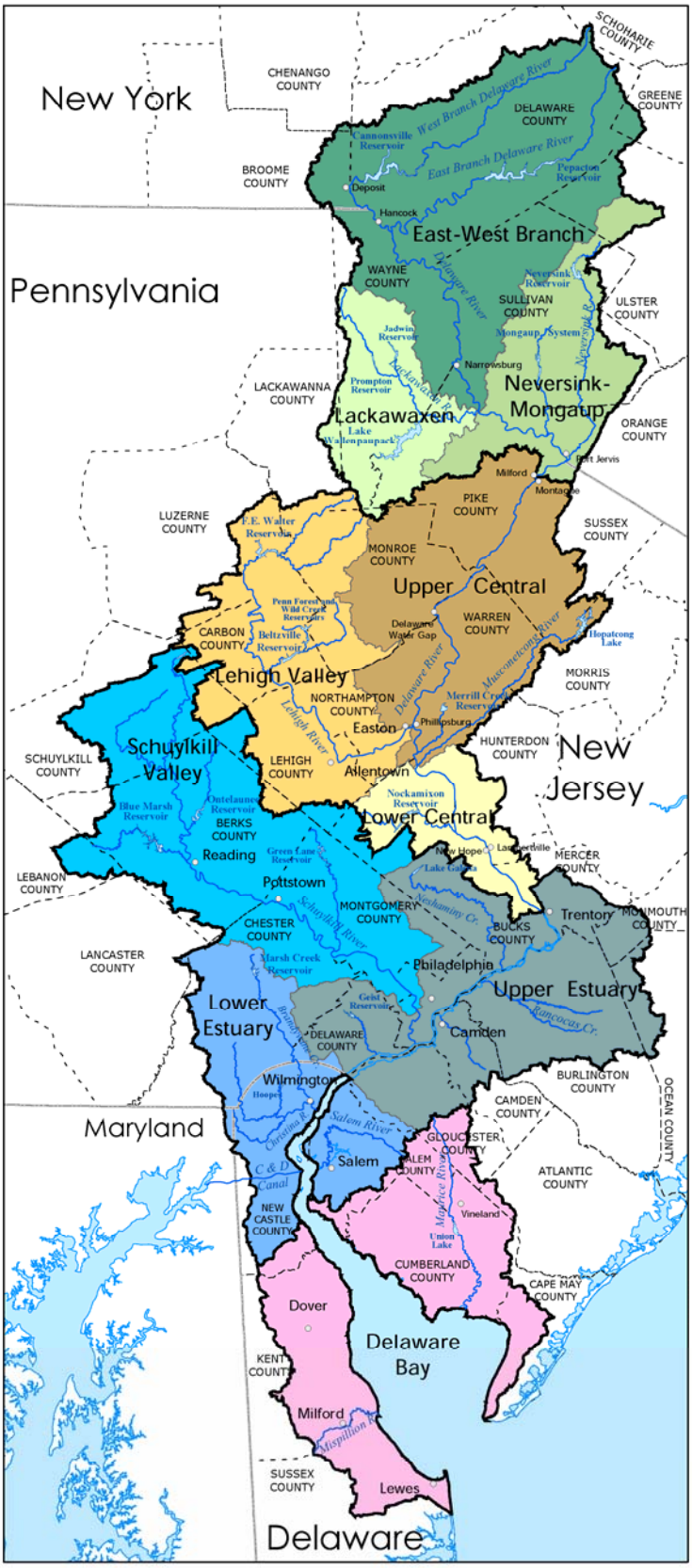
Miles

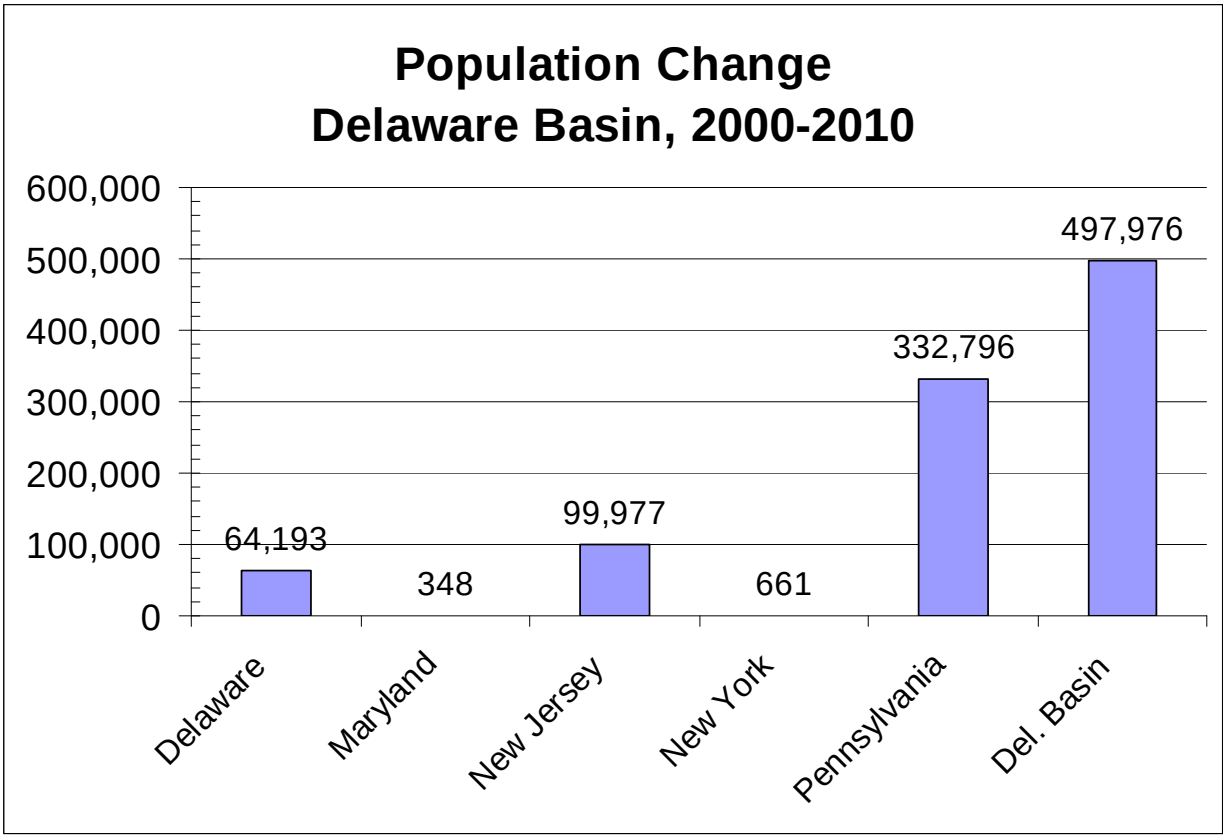
Delaware River Basin Commission

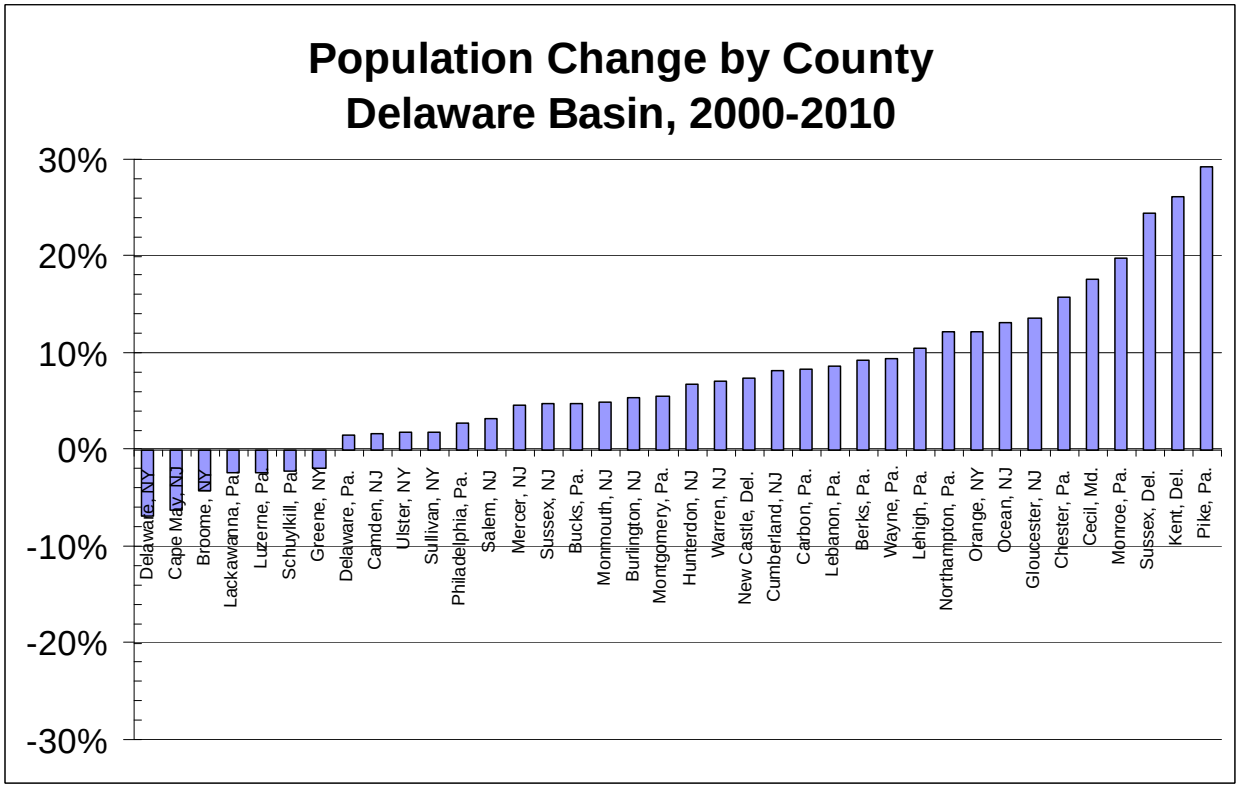
DELAWARE · NEW JERSEY

PENNSYLVANIA · NEW YORK

UNITED STATES OF AMERICA




Population Change
Delaware Basin, 2000-2010
600,000
500,000
400,000
300,000
200,000
100,000
0
64,193
348
99,977
661
332,796
497,976
Delaware
Maryland
New Jersey
New York
Pennsylvania
Del. Basin


Population Change by County
Delaware Basin, 2000-2010
30%
20%
10%
0%
-10%
-20%
-30%
Delaware, NY
Cape May, NJ
Broome, NY
Lackawanna, Pa.
Luzerne, Pa.
Schuylkill, Pa.
Greene, NY
Delaware, Pa.
Camden, NJ
Ulster, NY
Sullivan, NY
Philadelphia, Pa.
Salem, NJ
Mercer, NJ
Sussex, NJ
Bucks, Pa.
Monmouth, NJ
Burlington, NJ
Montgomery, Pa.
Hunterdon, NJ
Warren, NJ
New Castle, Del.
Cumberland, NJ
Carbon, Pa.
Lebanon, Pa.
Berks, Pa.
Wayne, Pa.
Lehigh, Pa.
Northampton, Pa.
Orange, NY
Ocean, NJ
Gloucester, NJ
Chester, Pa.
Cecil, Md.
Monroe, Pa.
Sussex, Del.
Kent, Del.
Pike, Pa.

Annual Economic Activity

The Delaware Basin contributes over $25 billion in annual market/non-market value to the regional economy from the following activities:

- Recreation $1.22 billion
- Fish and Wildlife $1.55 billion
- Public Parks $1.83 billion
- Water Quality $2.46 billion
- Navigation/Ports $2.62 billion
- Marcellus Shale Natural Gas (potential) $3.30 billion
- Agriculture $3.37 billion
- Water Supply $3.82 billion
- Forests $5.13 billion

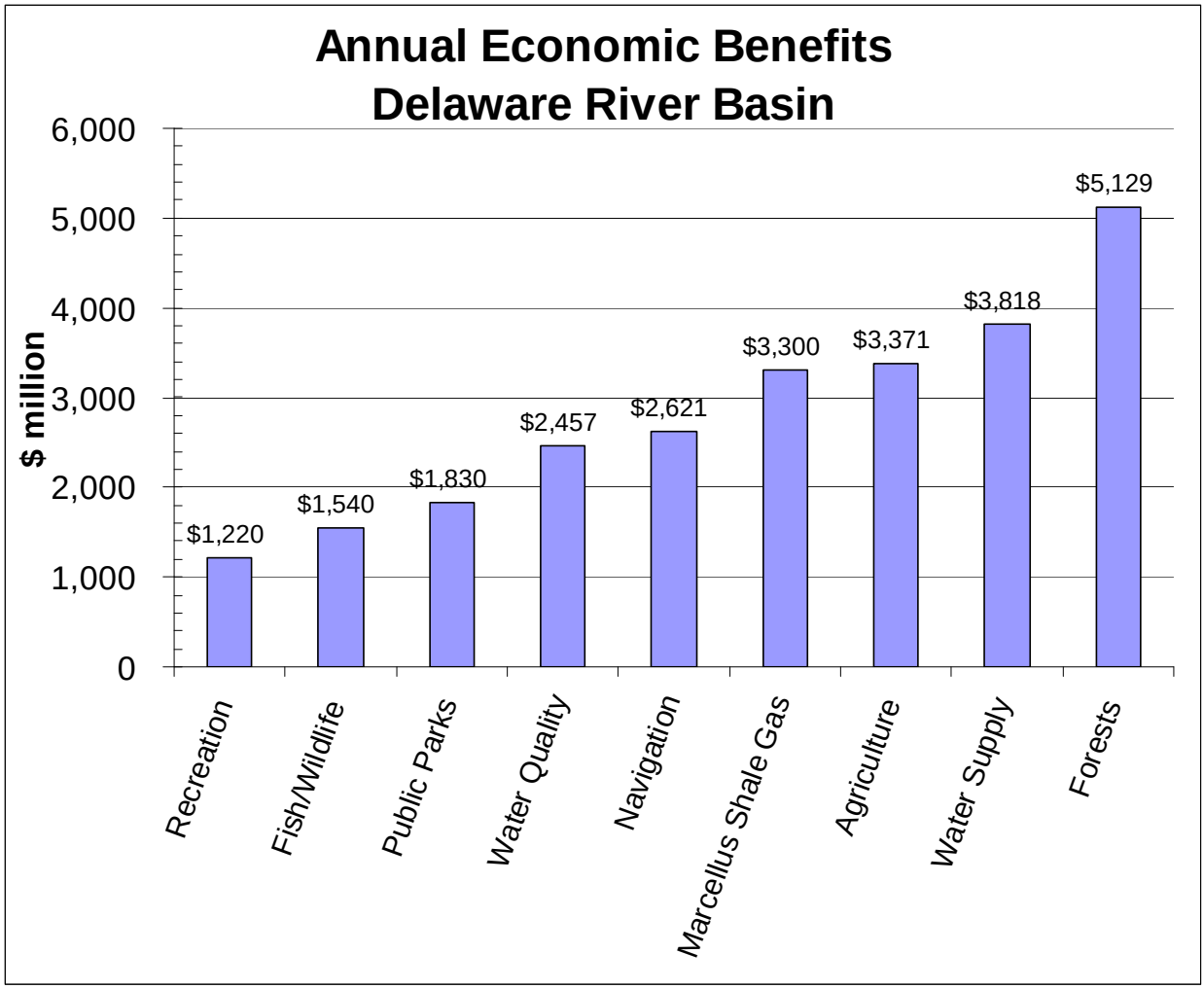


Table E1. Annual economic value supported by the Delaware River Basin.

Market Value	2010 ($ million)	Sources
Recreation (Boating, Fishing, Swimming)		
Skiing (1.9 million ski-days @ $45/day)	325	Penna Ski Areas Association (2010
Paddling-based Recreation (620,860 paddlers)	362	Outdoor Industry Association (2006)
Del. Water Gap River Recreation (267,000 visits)	41	U.S. Forest Service, Nat'l Park Service (1990)
Canoe/Kayak/Rafting (225,000 visits)	9	Canoe and Kayak Liveries (2010)
Powerboating (232,000 boat registrations)	395	National Marine Manufacturers Assoc. (2010)
Water Quality		
Water Treatment by Forests ($96/mgd)	63	Trust for Public Land, AWWA (2004)
Wastewater Treatment ($4.00/1000 gal)	1,722	DRBC and USEPA
Increased Property Value (+8%, 2000 ft of river)	13	EPA (1973), Brookings Institute (2010)
Water Supply		
Drinking Water Supply ($4.78/1000 gal)	3,145	UDWRA and DRBC (2010)
Reservoir Storage ($0.394/1000 gal)	145	UDWRA and DRBC (2010)
Irrigation Water Supply ($300/ac-ft)	32	Resources for Future (1996), USDA (2007)
Thermoelectric Power Water Supply ($44/ac-ft)	297	EIA (2002), NETL (2009)
Industrial Water Supply ($200/ac-ft)	179	Resources for Future (1996), DRBC (2010)
Hydropower Water Supply ($32/ac-ft)	20	Resources for Future (1996), DRBC (2010)
Fish/Wildlife		
Commercial Fish Landings ($0.60/lb)	34	NMFS, Nat'l. Ocean Econ. Program (2007)
Fishing (11-18 trips/angler, $53/trip)	576	U. S. Fish and Wildlife Service (2001)
Hunting (16 trips/hunter, $50/trip)	340	U. S. Fish and Wildlife Service (2001)
Wildlife/Bird-watching (8-13 trips/yr, $27/trip)	561	U. S. Fish and Wildlife Service (2001)
Shad Fishing (63,000 trips, $102/trip)	6	Pennsylvania Fish & Boat Comm. (2011)
Wild Trout Fishing	29	Sportfishing Assn./Trout Unlimited (1998)
Agriculture		
Crop, poultry, livestock value ($1,180/ac)	3,371	USDA Census of Agriculture 2007 (2009)
Public Parks		
Del. Water Gap Natl. Rec. Area (4.9 million visits)	100	U.S. National Park Service (2002)
Marcellus Shale		
Natural Gas (potential)	3,300	USGS (2011), EIA (2011)
Maritime Transportation		
Navigation ($15/ac-ft)	220	Resources for the Future (1996)
Port Activity	2,400	Economy League of Greater Phila. (2008)
Delaware Basin Market Value	**≈ $17.7 billion**	
Non-Market Value		
Recreation (Boating, Fishing, Swimming)		
Clean Water Act Restoration		
Viewing/Aesthetics ($0.58/person)	5	University of Delaware (2003)
Boating ($0.76/person)	6	University of Delaware (2003)
Fishing ($2.95/person)	24	University of Delaware (2003)
Swimming ($6.88/person)	57	University of Delaware (2003)
Water Quality		
WTP for Clean Water ($38/nonuser-$121/user)	659	University of Maryland (1989)
Forests		
Carbon Storage ($827/ac)	3,592	U.S. Forest Service, Del. Center Hort. (2008)
Carbon Sequestration ($29/ac)	126	U.S. Forest Service, Del. Center Hort. (2008)
Air Pollution Removal ($266/ac)	1,155	U.S. Forest Service, Del. Center Hort. (2008)
Building Energy Savings ($56/ac)	243	U.S. Forest Service, Del. Center Hort. (2008)
Avoided Carbon Emissions ($3/ac)	13	U.S. Forest Service, Del. Center Hort. (2008)
Public Parks		
Health Benefits ($9,734/ac)	1,283	Trust for Public Land (2009)
Community Cohesion ($2,383/ac)	314	Trust for Public Land (2009)
Stormwater Benefit ($921/ac)	121	Trust for Public Land (2009)
Air Pollution ($88/ac)	12	Trust for Public Land (2009)
Delaware Basin Non-Market Value	**≈ $7.6 billion**	

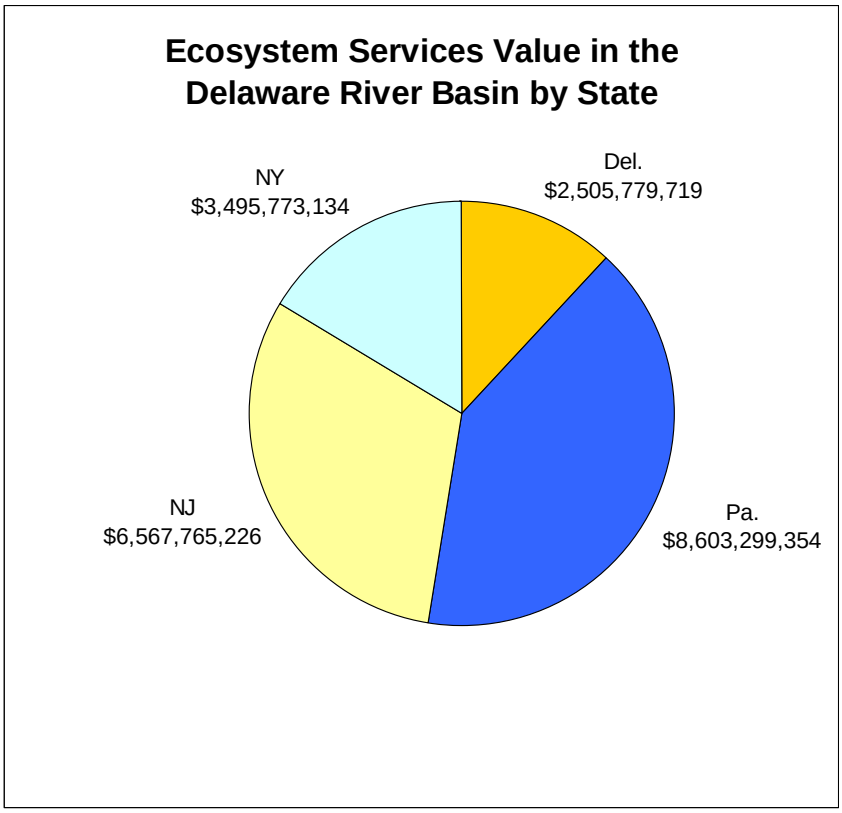
Ecosystem Services

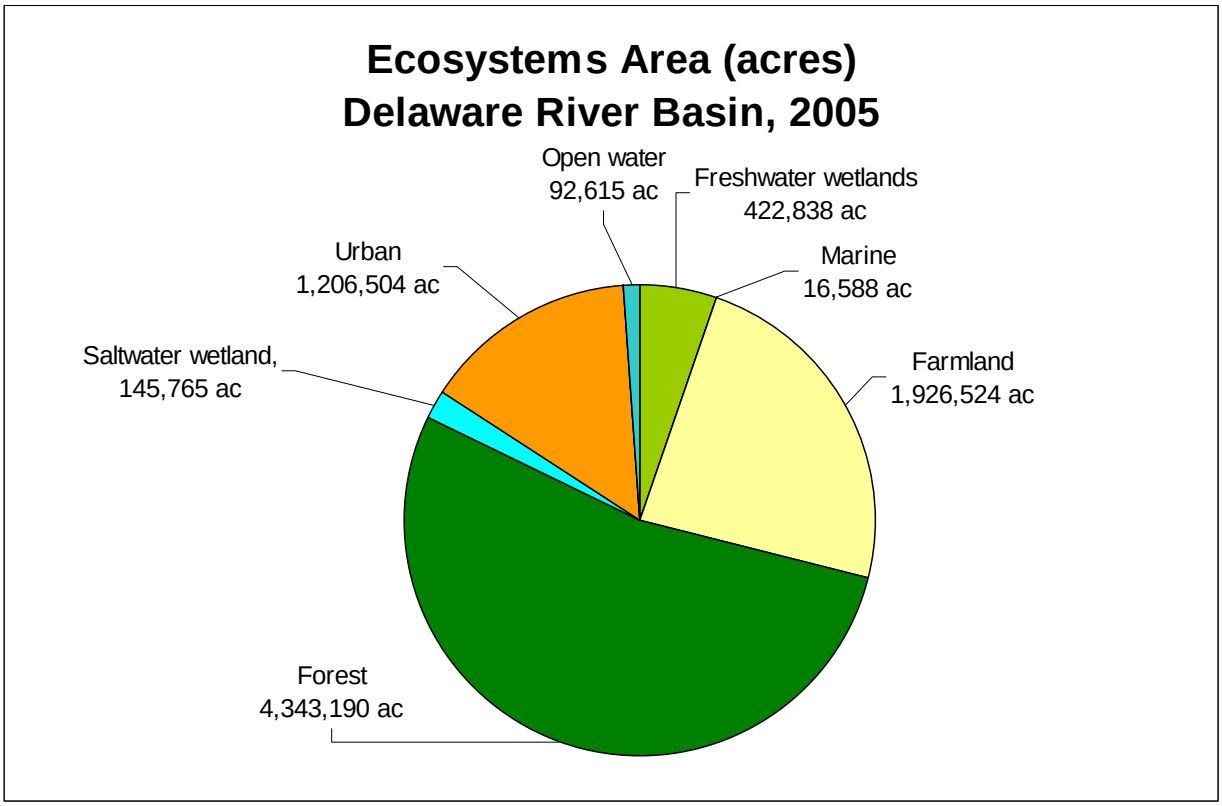
The value of natural goods and services from ecosystems in the Delaware Basin is $21 billion ($2010) with net present value (NPV) of $683 billion using a discount of 3% over 100 years. The contributions of ecosystem services by state include:

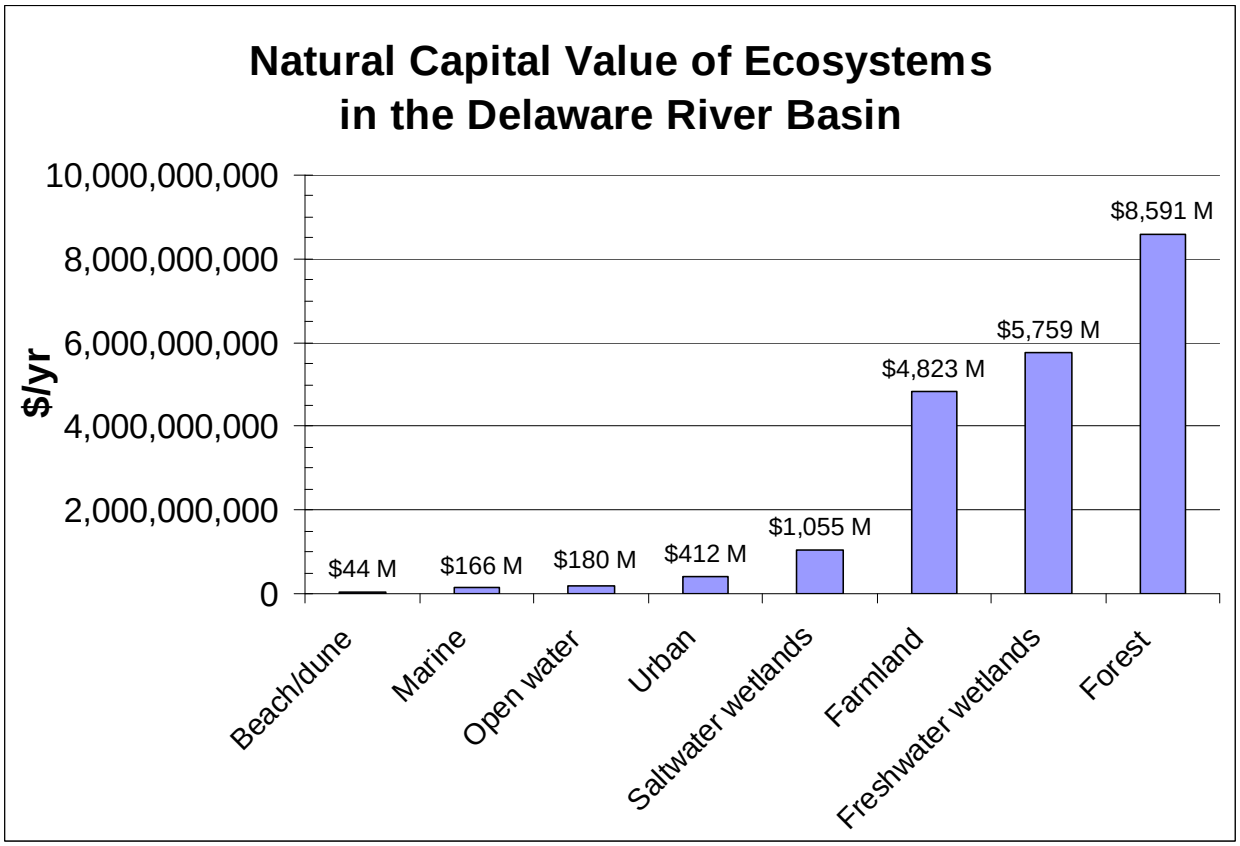
- Delaware ($2.5 billion, NPV $81.4 billion)
- New Jersey ($6.6 billion, NPV $213.4 billion)
- New York ($3.5 billion, NPV $113.6 billion)
- Pennsylvania ($8.6 billion, NPV $279.6 billion)

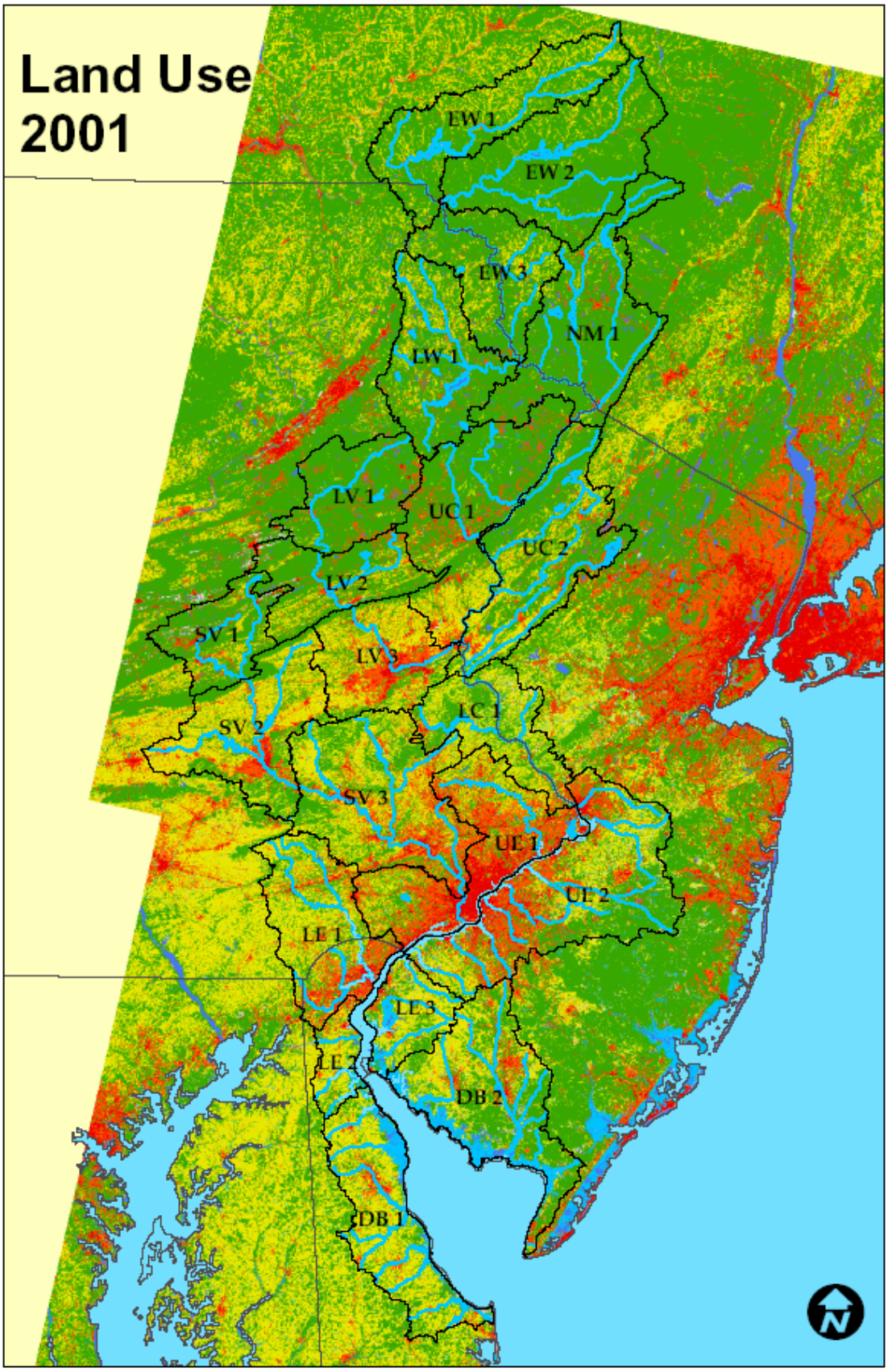
Table E2. Ecosystem goods and services provided by the Delaware River Basin

Ecosystem	Area (ac)	$/ac/yr 2010	$/yr 2010	NPV $
Freshwater wetlands	422,838	13,621	5,759,329,048	187,178,194,067
Marine	16,588	10,006	165,982,947	5,394,445,767
Farmland	1,926,524	2,503	4,823,030,404	156,748,488,136
Forest land	4,343,190	1,978	8,591,367,360	279,219,439,184
Saltwater wetland	145,765	7,235	1,054,617,851	34,275,080,170
Urban	1,206,504	342	412,157,579	13,395,121,322
Beach/dune	900	48,644	43,758,633	1,422,155,566
Open water	92,615	1,946	180,210,703	5,856,847,857
Total	**8,154,924**		**$21,030,454,525**	**$683,489,772,069**




Ecosystems Area (acres)
Delaware River Basin, 2005
Open water
92,615 ac
Freshwater wetlands
422,838 ac
Urban
1,206,504 ac
Marine
16,588 ac
Saltwater wetland,
145,765 ac
Farmland
1,926,524 ac
Forest
4,343,190 ac


Natural Capital Value of Ecosystems
in the Delaware River Basin
$/yr
10,000,000,000
8,000,000,000
6,000,000,000
4,000,000,000
2,000,000,000
0
$44 M
$166 M
$180 M
$412 M
$1,055 M
$4,823 M
$5,759 M
$8,591 M
Beach/dune
Marine
Open water
Urban
Saltwater wetlands
Farmland
Freshwater wetlands
Forest


Land Use
2001
EW 1
EW 2
EW 3
NM 1
LW 1
LV 1
UC 1
UC 2
LV 2
SV 1
LV 3
LC 1
SV 2
SV 3
UE 1
UE 2
LE 1
LE 3
LE 2
DB 2
DB 1
N

Jobs and Wages

The Delaware River Basin is a jobs engine that supports 600,000 direct/indirect jobs with $10 billion in annual wages in the coastal, farm, ecotourism, water/wastewater, ports, and recreation industries.

Table E3. Jobs and wages directly and indirectly supported by the Delaware River Basin

Sector	Jobs	Wages ($ million)	Source
Direct Basin Related	240,621	4,900	U.S. Bureau of Labor Statistics, 2009
Indirect Basin Related	288,745	4,000	U.S. Census Bureau, 2009
Coastal	44,658	947	National Coastal Economics Program, 2009
Farm	45,865	1,376	USDA Census of Agriculture, 2007
Fishing/Hunting/Birding	44,941	1,476	U.S. Fish and Wildlife Service, 2008
Water Supply Utilities	8,750	485	UDWRA and DRBC, 2010
Wastewater Utilities	1,298	61	UDWRA and DRBC, 2010
Watershed Organizations	201	10	UDWRA and DRBC, 2010
Ski Area Jobs	1,753	88	Penna. Ski Areas Association
Paddling-based Recreation	4,226		Outdoor Industry Association (2006
River Recreation	448	9	U. S. Forest Service/Nat'l. Park Service, 1990
Canoe/Kayak/Rafting	225		Canoe Liveries and UDWRA, 2010
Wild Trout Fishing	350	4	Maharaj, McGurrin, and Carpenter, 1998
Del. Water Gap Nat'l. Rec. Area	7,563	101	Stynes and Sun, 2002
Port Jobs	12,121	772	Economy League of Greater Phila., 2008
Delaware Basin Total	**> 600,000**	**>$10 billion**	

Within the Delaware Basin are 3,480,483 jobs earning $172.6 billion in wages including:

- Delaware (316,014 jobs earning $16.5 billion in wages)
- New Jersey (823,294 jobs, $38.1 billion in wages)
- New York (69,858 jobs earning $2.5 billion in wages)
- Pennsylvania (2,271,317 jobs earning $115.5 billion in wages)

Jobs directly associated with the Delaware River Basin (such as water/sewer construction, water utilities, fishing, recreation, tourism, and ports) employ 240,621 with $4.9 billion in wages including:

- Delaware (15,737 jobs earning $340 million in wages)
- New Jersey (62,349 jobs earning $1.3 billion in wages)
- New York (32,171 jobs earning $550 million in wages)
- Pennsylvania (130,364 jobs earning $2.8 billion in wages)

Jobs indirectly related to the waters of the Delaware Basin (based on multipliers of 2.2 for jobs and 1.8 for salaries) employ 288,745 people with $4.0 billion in wages including:

- Delaware (18,884 jobs earning $270 million in wages)
- New Jersey (74,819 jobs earning $1.0 billion in wages)
- New York (38,605 jobs earning $400 million in wages)
- Pennsylvania (156,437 jobs earning $2.2 billion in wages)

According to the National Coastal Economy Report (2009), coastal employment sectors within the Delaware River Basin are responsible for 44,658 jobs earning $947 million in wages with contributions of $1.8 billion toward the GDP including:

- Delaware (12,139 jobs, $214 million in wages, $392 million toward the GDP)
- New Jersey (4,423 jobs, $140 million in wages, $235 million toward the GDP).
- Pennsylvania (28,096 jobs, $593 million in wages, $1.2 billion toward the GDP.

Over 21,800 farms provide 45,865 jobs with $1.9 billion in wages in the Delaware Basin including:

- Delaware (3,140 farm jobs earning $129 million in wages)
- New Jersey (14,305 farm jobs earning $587 million in wages)
- New York (2,410 farm jobs earning $99 million in wages)
- Pennsylvania (26,010 farm jobs earning $1.1 billion in wages)

Fishing, hunting, and bird watching/wildlife associated recreation employ 44,941 jobs with $1.5 billion in wages in the Delaware Basin including:

- Delaware (4,080 jobs earning $134 million in wages)
- New Jersey (17,477 jobs earning $574 million in wages)
- New York (4,872 jobs earning $160 million in wages)
- Pennsylvania (18,512 jobs earning $608 million in wages)
-

Public and private water utilities that withdraw drinking water from the Delaware River Basin employ 8,750 people with wages of $485 million including:

- Delaware (141 jobs earning $7.8 million in wages)
- New Jersey (823 jobs earning $46 million in wages)
- New York (5,600 jobs earning $310 million in wages)
- Pennsylvania (2,186 jobs earning $121 million in wages)

Wastewater utilities that treat and discharge wastewater to the Delaware River Basin employ 1,298 people with wages of $61 million including:

- Delaware (108 jobs earning $5 million in wages)
- New Jersey (257 jobs earning $12 million in wages)
- New York (20 jobs earning $1 million in wages)
- Pennsylvania (913 jobs earning $43 million in wages)

Over 100 nonprofit watershed and environmental organizations employ at least 200 staff who earn at least $9.5 million in wages to restore the watersheds in the Delaware River Basin.

In the Pocono Mountains of Pennsylvania, 9 ski resorts support 1,753 direct jobs in the Delaware Basin from aggregate annual revenues of $87,655,063 from 1,908,228 skier visits.

Paddling-based recreation in the Delaware Basin is responsible for 620,860 participants and 4,226 jobs according to data prorated from the Outdoor Industry Association (2006).

The U. S. Forest Service and U.S. National Park Service estimated river recreation along the Upper Delaware River and Delaware Water Gap was responsible for 448 jobs with wages of $8.8 million in $1986.

The 37 canoe/kayak liveries along the Delaware, Lehigh, and Schuylkill, and Brandywine Rivers have earnings of $9 million per year and employ 225 people to lease watercraft to 225,000 visitors.

Along the Beaverkill, East Branch, West Branch, and upper main stem of the Delaware River in New York, wild trout fishing provides for 350 jobs with $3.6 million in wages.

The Delaware Water Gap National Recreation Area recorded 4,867,272 recreation visits in 2001 that generated $106 million in sales and 7,563 direct/indirect jobs with $100 million in wages.

Delaware River ports from Wilmington to Philadelphia to Trenton are collectively the 5th largest port in the U.S. based on imports and the 20 largest U.S. port based on exports. These ports:

- Employ 4,056 workers who earn $326 million in wages.
- Provide port jobs that support an additional two jobs each in port activity and employee spending for a total of 12,121 port related jobs with $772 million in wages.
- Most of the 4,056 direct port jobs are in cargo handling and warehousing with petroleum port jobs adding up to less than 10% of employment
- Provides good jobs, the average salary of a port employee (with benefits) is over $80,000.

1. Introduction

Objectives

This report summarizes the socioeconomic value of water, natural resources and ecosystems in the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania estimated as:

- Economic activity including market use and nonuse value of water supply, fishing, hunting, recreation, boating, ecotourism, agriculture, and navigation/port benefits in the basin.

- Natural capital or ecosystem services value of natural goods and services provided by habitat such as wetlands, forests, farms and open water.

- Jobs and wages directly and indirectly associated with the Delaware River Basin.

Two decades ago, researchers conducted a series of studies that indicated the Delaware River and Bay was worth hundreds of millions if not billions of dollars. Latham and Stapleford (1990) from the University of Delaware estimated total contributions of Delaware Estuary (the tidal river and bay) activities within the State of Delaware accounted for 10,500 jobs with $222 million in annual wages, each direct estuary job created 2.2 indirect jobs, and the multiplier of direct/indirect wages was 1.8. The Greeley-Polhemus Group (1993) estimated the Delaware Estuary supported 123,000 jobs, $4.3 billion in wages, $24 billion in sales, $25 million in sport fishing non-market value, $1 million in commercial fish landings, and wetlands replacement values up to $638 million.

This report is designed to update economic analyses for the Delaware River and Bay conducted 20 years ago and incorporate more recent valuation data from the emerging fields of ecological economics and ecosystem services.

The Value of a Watershed

Studies for the Chesapeake Bay, Great Lakes, and Florida Everglades conclude that watersheds have significant economic value and restoration can result in green jobs and favorable cost-benefit investment ratios. The University of Maryland reported in 1988 that the Chesapeake Bay was worth $678 billion and the Chesapeake Blue Ribbon Panel (2003) reported with inflation the present value of the bay would exceed $1 trillion.

The Brookings Institution (Austin et al. 2007) found restoration of the Great Lakes would cost $26 billion in present value and aggregate economic benefits would exceed $50 billion (2:1 B/C ratio). Great Lakes benefits include $6.5-11.8 billion in tourism, fishing, and recreation dollars, $12-19 billion increase in property values from contaminated sediment cleanup, $50-125 million in reduced municipal water treatment costs, and $30 billion in short time multiplier benefits. The Great Lakes Coalition (2010) concluded investment in watershed restoration creates good paying jobs and leads to economic benefits while restoring the environment (Table 1).

The Everglades Foundation estimated that the Comprehensive Everglades Restoration Plan (CERP) would result in $6 billion in benefits and 443,000 jobs over 50 years (McCormick 2010). Net present

value of the Everglades's restoration benefits would be $46 billion resulting from investments of $11.5 billion or a benefit to cost ratio of 4:1.

Table 1. Jobs and salaries created by watershed restoration work
(Great Lakes Coalition (2010) from U. S. Bureau of Labor Statistics)

Job	Mean Salary	Job	Mean Salary
Wetland scientist	$45,730	Fisheries Biologist	$60,670
Research scientist	$45,730	Archeologist	$57,230
Construction manager	$93,290	Operating Engineer	$44,180
Biologist	$69,430	Environmental Engr.	$80,750
Toxicologist	$70,000	Hydrogeologist	$92,710
Chemist	$72,740	Environmental Planner	$64,680
Geologist	$58,000	Plumber/Pipefitter	$9,870
Helicopter Pilot	$90,000	Carpenter	$43,640
Info. Technology	$70,930	Electrician	$50,850
Admin. Staff	$32,990	Truck Driver	$39,260
Mechanics	$37,000	Concrete Workers	$39,410
Excavator	$38,540	Dredge Operator	$38,330
Landscape Architect	$65,910	Conservation Scientist	$61,180
Civil Engineer	$81,180	Biological technician	$41,140
General Laborer	$33,190	Pile Drive Operator	$51,410

An Economic Engine

What do the Guggenheim Museum, Boeing, Sunoco, Campbell's Soup, DuPont, Wawa, Starbucks, Iron Hill Brewery, Philadelphia Philadelphia Phillies, New York Yankees, Camelback Ski Area, Pt. Pleasant Canoe Livery, Salem Nuclear Power Plant, and the United States Navy have in common? They all depend on the waters of the Delaware River Basin to sustain their businesses.

Most economists agree that water is an undervalued resource. The astronomer Copernicus and Adam Smith of the invincible hand of the economy fame both considered the "diamond-water paradox". If water is more valuable to society than a precious gem, then why is water sold for a fraction of a penny per gallon for drinking water or not even valued at all as an ecological resource in the river or bay? Just as under-compensated police officers or teachers are more valuable to society than multimillion dollar movie stars, perhaps the value of water is just as marginalized. We tend to underprice water based on its marginal value for single uses (i.e. drinking water) and not consider the full value of water for all its myriad uses. This report attempts to quantify the highest multiobjective value of water *in toto* for its wide range of habitat, recreation, ecological, and industrial benefits in the Delaware River Basin.

If water is society's most valuable chemical, then the Delaware River with a mean annual flow of 2.7 trillion gallons per year at Trenton is the Delaware Valley's (and by aqueduct Manhattan Island's) most invaluable economic asset. For 400 years, the Delaware River has been an economic engine ever since Henry Hudson discovered the bay off Cape May in August 1609 for commerce and the Dutch East India Company during his unsuccessful quest for an inner trade route to Asia.

When William Penn founded the City of Brotherly Love in 1681 seeking refuge from religious persecution in Europe, he also found a safe harbor between the Delaware and the Schuylkill in a colony rich with lumber, fertile land, beaver pelts, and in later centuries coal and oil reserves. By the 18th century frugal yet prosperous Philadelphia Quaker merchants established triangle trade route connections to Europe and the Caribbean from their home port along the Delaware. During the American Revolution, Philadelphia was the largest city in the colonies and the 3rd largest port in the British Empire after London and Liverpool. In 1790 Ben Franklin, America's first environmentalist, was so concerned about pollution in the river that he willed funds to build the first municipal water system in the United States at Philadelphia to tap the Delaware and Schuylkill for drinking water.

The economic engine kicked into high gear during the 19th century with hydropower and steam power during the Industrial Revolution. In 1802, the DuPont family searched up and down the Atlantic Seaboard and established gunpowder mills along the falls of the Brandywine River above Wilmington as one of the first industries in the Delaware Valley. Delaware River ports grew when anthracite coal was discovered in the Lehigh Valley in 1792 and steam railroads were built in the 1830s. By the Gay Nineties, every Philadelphia wharf had railroad access and the advent of steam ships made for faster transatlantic shipping. In 1895, the Corps of Engineers dredged the Delaware River to 26 feet from the natural depth of 17 feet (Economy League 2008).

By the end of the 19th century, the Delaware River supported the largest commercial American shad and sturgeon fishery along the Atlantic coast. The sturgeon was such a lucrative fish that boom town Caviar (Bayside) near Greenwich, New Jersey was founded to process the roe for worldwide export. By the 1880s, 1,400 sailing vessels harvested 22 million pounds of oysters from the Delaware Bay. In 1886, nationally famous hotels in Gloucester, N. J. served 10,000 planked shad dinners at events that resembled modern day blue crab feasts. In 1896 over 14 million pounds of shad were caught with a value of $400,000 ($10 million in 2008 dollars). In 1896, a fisheries report to the governor of Pennsylvania listed the catch of a 76-pound striped bass above Gloucester, NJ.

At the turn of the 20th century, Delaware River ports supported a premier ship building industry. By the First World War the Delaware was known as the "Clyde of America" with ship building and repair production that rivaled its Scottish cousin. By 1912, Philadelphia and environs built and manufactured 5% of all goods in the United States. Export markets included coal, iron, cotton, leather, grain, lumber and tobacco, and gunpowder from Wilmington. By 1914, the Panama Canal opened access from the East Coast to Hawaii sugar cane fields and Philadelphia refined and shipped 500,000 tons of raw sugar or 1/6 of all sugar refined in the United States.

After the Delaware River ship channel was deepened to 41 feet in 1941, the port economy boomed during World War II as the Philadelphia Navy Yard employed 40,000 workers who built 53 ships and repaired over 500 vessels. After the war, the "Arsenal of America" manufacturing and export base declined due to decreased demand for Pennsylvania coal and decline of Lehigh Valley steel industries. In 1995, the Department of the Navy closed the Philadelphia Navy Yard and decommissioned the ghost fleet due to decreased ship building needs in the "New Navy."

During the 19th Century, the Delaware Water Gap along the Blue Mountain near Stroudsburg, Pa. was a resort that grew with the railroads from Philadelphia and New York City. In 1965, Congress authorized the National Park Service to form the Delaware Water Gap National Recreation Area that now receives 5 million visits per year, the 8th most visited unit in the National Park System.

In 1931 and amended in 1954, the U. S. Supreme Court issued a decree authorizing New York City to divert 800 mgd of water from three Catskill Mountain reservoirs in the Delaware Basin to the Hudson River Basin. The Delaware River delivers over half the drinking water to New York City.

By 1986, the Salem and Hope Creek nuclear power plants were built on Artificial Island in Salem County, New Jersey that pump 3 billion gallons per day of cooling water to provide 3,500 megawatts of electricity to the tri-state region. In 2010, a billion gallons per day of drinking water and industrial process water were withdrawn from streams and aquifers in the Delaware Basin to sustain the region's jobs and domestic, commercial, and industrial economy. The river, bay, beaches, wetlands, and forests support a billion dollar tourism, recreation, and hunting/fishing/birding economy.

After the turn of the 21st Century, new horizontal drilling and hydraulic fracturing technology kicked off the Marcellus Shale natural gas drilling boom in a 50,000 square mile basin stretching from Kentucky to Pennsylvania and New York. The Marcellus Shale occupies about 36% or 4700 square miles under the upper Delaware Basin. A 2011 USGS report indicates 7 trillion cubic feet of natural gas may be recoverable under the Delaware Basin, a potential multi-billion dollar natural resource.

The Delaware River Basin supplies drinking water to the 1st (New York City) and 5th (Philadelphia) largest metropolitan economies in the United States. The following report tabulates the substantial economic value and worth of this irreplaceable asset for over 8 million residents in Delaware, New Jersey, New York, and Pennsylvania who live in the basin and an additional 8 million people in New York City and northern New Jersey who receive drinking water from the Delaware River.

Governance

For the last fifty years, Federal, state, and local governments, nonprofits, and the private sector have focused efforts on restoring the Delaware River Basin. In 1961, JFK signed the Delaware River Basin Compact that appointed the Governors of Delaware, New Jersey, New York, and Pennsylvania as Commissioners as the first ever Federal-state watershed accord. In 1968 a full four years before the Clean Water Act was passed by Congress, the DRBC issued waste load allocations to reduce pollutant discharges from over 80 wastewater treatment plants. In 1988, the Delaware Estuary was nominated by the Governors of Delaware, New Jersey, and Pennsylvania for the National Estuary Program per Section 320 of the Federal Clean Water Act. In 1996, the Delaware Estuary was designated by Congress as one of only 28 National Estuary Programs in the United States and is now the only tri-state estuary program in the nation. In 1996, the nonprofit Partnership for the Delaware Estuary was established to implement a Comprehensive Conservation and Management Plan (CCMP). In 2011, the DRBC celebrates the 50th anniversary of its founding by JFK, Congress, and the Governors of Delaware, New Jersey, New York, and Pennsylvania.

The Watershed

The Delaware River Basin (Figure 1 and Table 2) occupies 12,769 sq mi (not including the river and bay) in Delaware (8%), New Jersey (23%), New York (20%), and Pennsylvania (49%). In 2010, 8,255,013 residents lived in the basin including 643,418 people in Delaware (9%), 2,324 in Maryland, 1,951,047 in New Jersey (24%), 124,969 in New York (2%), and 5,533,254 in Pennsylvania (66%). In 2009, nearly 3,500,000 people worked in the Delaware Basin with 316,014 jobs in Delaware (9%), 1,172 jobs in Maryland, 823,294 jobs in New Jersey (24%), 69,858 jobs in New York (2%), and 2,271,317 jobs in Pennsylvania (65%).

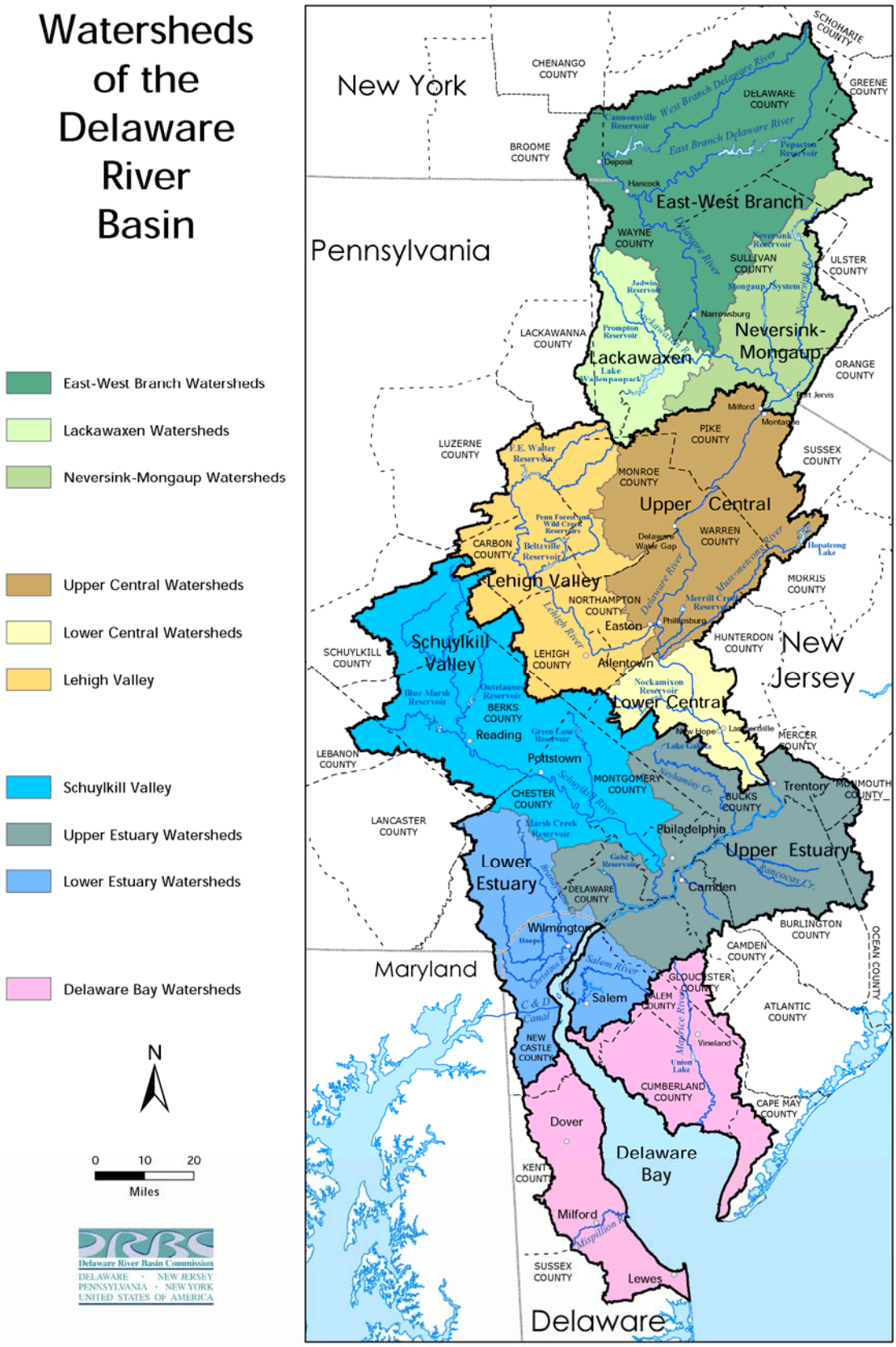


Figure 1. The Delaware River Basin. (DRBC)

Table 2. Land area, population, and employment in the Delaware River Basin

State	Area (sq mi)	Population[1] 2010	Employment[2] 2009
Delaware	965	643,418	316,014
Maryland	8	2,324	1,172
New Jersey	2,961	1,951,047	823,294
New York	2,555	124,969	69,858
Pennsylvania	6,280	5,533,254	2,271,317
Total	12,769	8,255,013	3,481,655

1. U.S. Census Bureau 2009. 2. U.S. Bureau of Labor Statistics

Table 3 summarizes the area, population, and employment by state and county in the Delaware Basin. In Delaware, the basin covers 50% of the land area yet includes 74% of the First State's population. The New Jersey portion of the basin covers 40% of the State's land area and includes 22% of the Garden State's population. New York State covers 5% of the State's land area and the basin includes 0.7% of the Empire State's population. The Pennsylvania part of the basin covers just 14% of the State's area yet includes 43% of the Keystone State's population.

The population of the Delaware Basin now exceeds 8.2 million which if considered as a single jurisdiction, it would be the 12th most populous state in the U.S. after North Carolina and New Jersey but ahead of Virginia and Massachusetts. Between 2000 and 2010, the population in the Delaware Basin increased by 6.1% or 472,066 people (Table 4 and Figure 2). Over the last decade, population increased by 30% in Pike County, Pa.; by over 20% in Kent and Sussex counties, Del. and Monroe County, Pa.; and by over 10% in Gloucester and Ocean counties, NJ, Orange County, NY, and Chester, Lehigh, and Northampton counties, Pa (Figure 3). For the first time in twp generations, Philadelphia gained population. Several counties in the basin lost population since 2000: Cape May, NJ; Broome, Delaware, and Greene counties, NY; and Lackawanna, Luzerne, and Schuylkill counties, Pa.

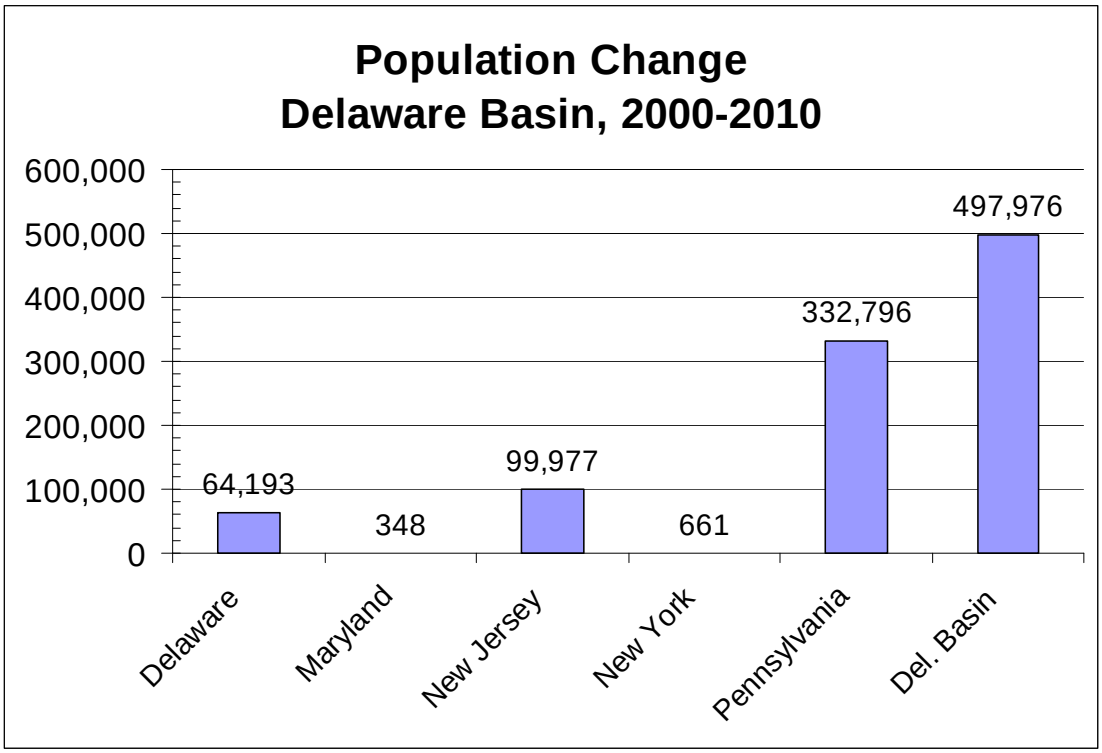
Table 3. Land area, population, and employment by county in the Delaware River Basin

State/county	Area 2005[1] (sq mi)	Population[2] 2010	Employment[3] 2009
Kent	389	108,025	50,412
New Castle	381	493,428	252,534
Sussex	195	41,965	13,068
Delaware	**965**	**643,418**	**316,014**
Cecil	**8**	2,324	**1,172**
Maryland	**8**	**2,324**	**1,172**
Burlington	495	367,157	187,758
Camden	123	432,315	169,909
Cape May	104	52,209	14,545
Cumberland	490	158,289	61,868
Gloucester	279	271,332	89,183
Hunterdon	215	65,132	23,650
Mercer	180	287,685	178,320
Monmouth	20	24,620	9,864
Ocean	30	23,616	7,495
Salem	347	66,342	21,900
Sussex	320	92,689	23,302
Warren	358	109,662	35,500
New Jersey	**2,961**	**1,951,047**	**823,294**
Broome	85	15,038	11,292
Delaware	1,295	26,111	14,240
Greene	25	1,207	572
Orange	65	19,887	10,456
Sullivan	940	47,563	25,511
Ulster	145	15,162	7,787
New York	**2,555**	**124,969**	**69,858**
Berks	777	407,843	150,665
Bucks	607	626,280	244,453
Carbon	381	63,640	16,730
Chester	616	491,070	212,996
Delaware	184	559,776	201,208
Lackawanna	25	11,335	4,830
Lebanon	20	7,221	2,750
Lehigh	347	344,571	166,932
Luzerne	50	17,491	8,074
Monroe	609	166,209	56,025
Montgomery	483	789,862	453,771
Northampton	374	299,646	96,536
Philadelphia	135	1,558,613	619,396
Pike	547	59,859	9,874
Schuylkill	420	79,358	27,077
Wayne	705	50,480	14,114
Pennsylvania	**6,280**	**5,533,254**	**2,271,317**
Delaware Basin	**12,761**	**8,255,013**	**3,481,655**

1. NOAA CSC 2005. 2. U. S. Census Bureau 2010. 3. U. S. Bureau of Labor Statistics 2009.

Table 4. Population change in the Delaware River Basin, 2000-2010 (U. S. Census)

State/ County	Population 2000	Population 2010	Change	%
Kent	85,680	108,025	22,345	26.1%
New Castle	459,829	493,428	33,599	7.3%
Sussex	33,716	41,965	8,249	24.5%
Delaware	**579,225**	**643,418**	**64,193**	**11.1%**
Cecil	1,976	2,324	348	17.6%
Maryland	**1,976**	**2,324**	**348**	**17.6%**
Burlington	348,729	367,157	18,428	5.3%
Camden	425,646	432,315	6,669	1.6%
Cape May	55,679	52,209	-3,470	-6.2%
Cumberland	146,442	158,289	11,847	8.1%
Gloucester	239,012	271,332	32,320	13.5%
Hunterdon	60,995	65,132	4,137	6.8%
Mercer	274,945	287,685	12,740	4.6%
Monmouth	23,465	24,620	1,155	4.9%
Ocean	20,887	23,616	2,729	13.1%
Salem	64,285	66,342	2,057	3.2%
Sussex	88,547	92,689	4,142	4.7%
Warren	102,438	109,662	7,224	7.1%
New Jersey	**1,851,070**	**1,951,047**	**99,977**	**5.9%**
Broome	15,713	15,038	-675	-4.3%
Delaware	28,030	26,111	-1,919	-6.8%
Greene	1,231	1,207	-24	-1.9%
Orange	17,722	19,887	2,165	12.2%
Sullivan	46,712	47,563	851	1.8%
Ulster	14,900	15,162	262	1.8%
New York	**124,308**	**124,969**	**661**	**0.5%**
Berks	373,638	407,843	34,205	9.2%
Bucks	597,632	626,280	28,648	4.8%
Carbon	58,795	63,640	4,845	8.2%
Chester	424,241	491,070	66,829	15.8%
Delaware	551,976	559,776	7,800	1.4%
Lackawanna	11,617	11,335	-282	-2.4%
Lebanon	6,648	7,221	573	8.6%
Lehigh	312,090	344,571	32,481	10.4%
Luzerne	17,916	17,491	-425	-2.4%
Monroe	138,690	166,209	27,519	19.8%
Montgomery	748,987	789,862	40,875	5.5%
Northampton	267,077	299,646	32,569	12.2%
Philadelphia	1,517,542	1,558,613	41,071	2.7%
Pike	46,303	59,859	13,556	29.3%
Schuylkill	81,159	79,358	-1,801	-2.2%
Wayne	46,147	50,480	4,333	9.4%
Pennsylvania	**5,200,458**	**5,533,254**	**332,796**	**6.2%**
Delaware Basin	**7,757,037**	**8,255,013**	**497,976**	**6.4%**



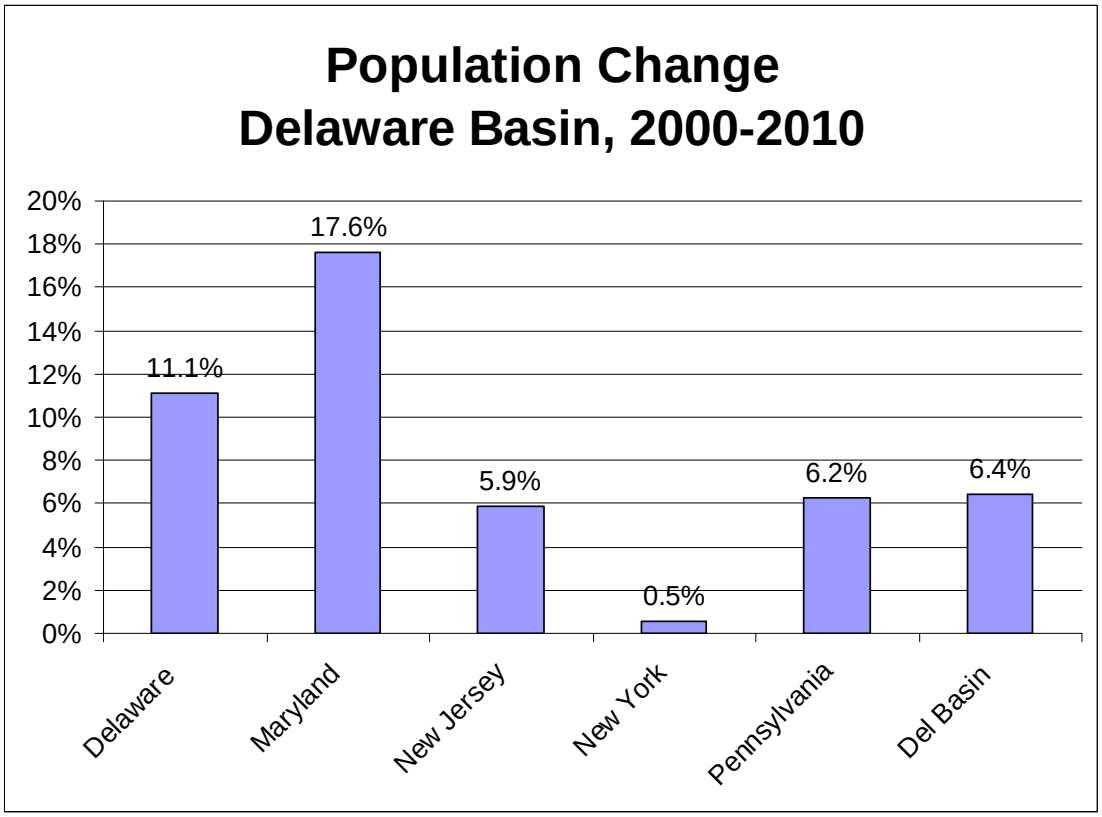
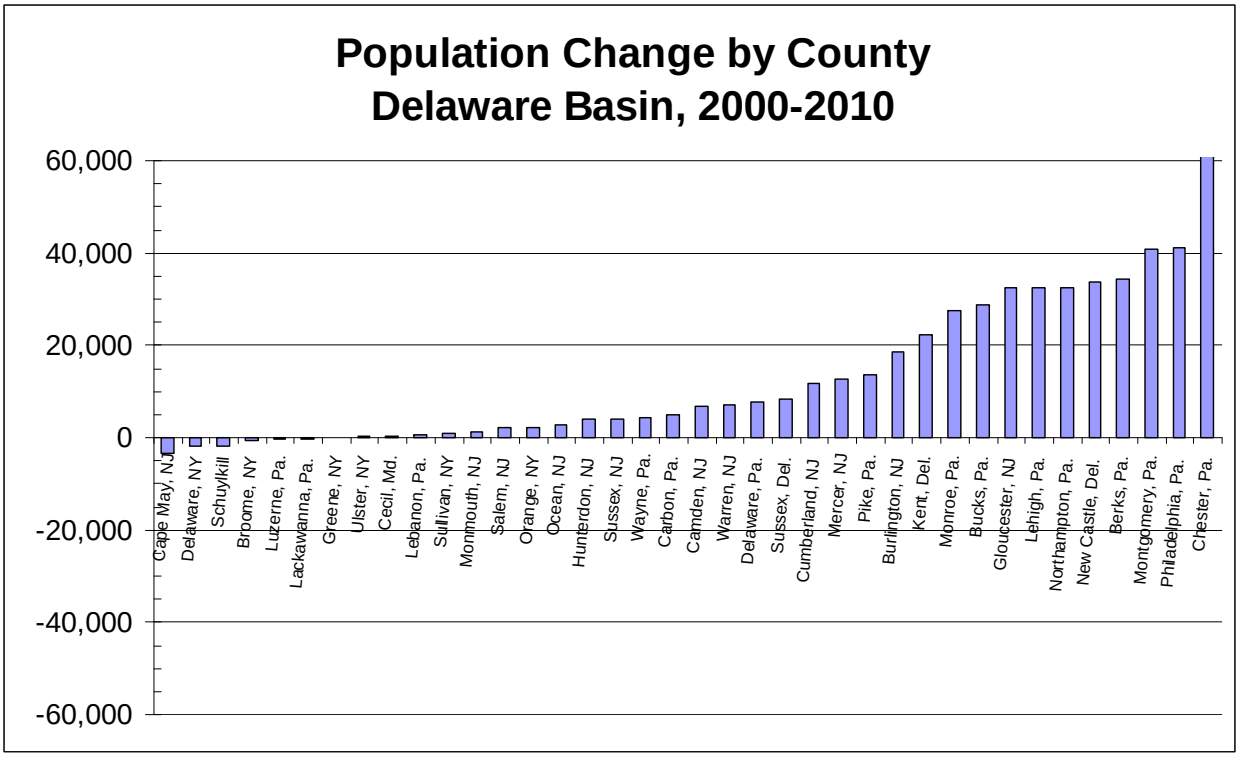


Figure 2. Population change in the Delaware River Basin, 2000-2010 (U.S. Census)



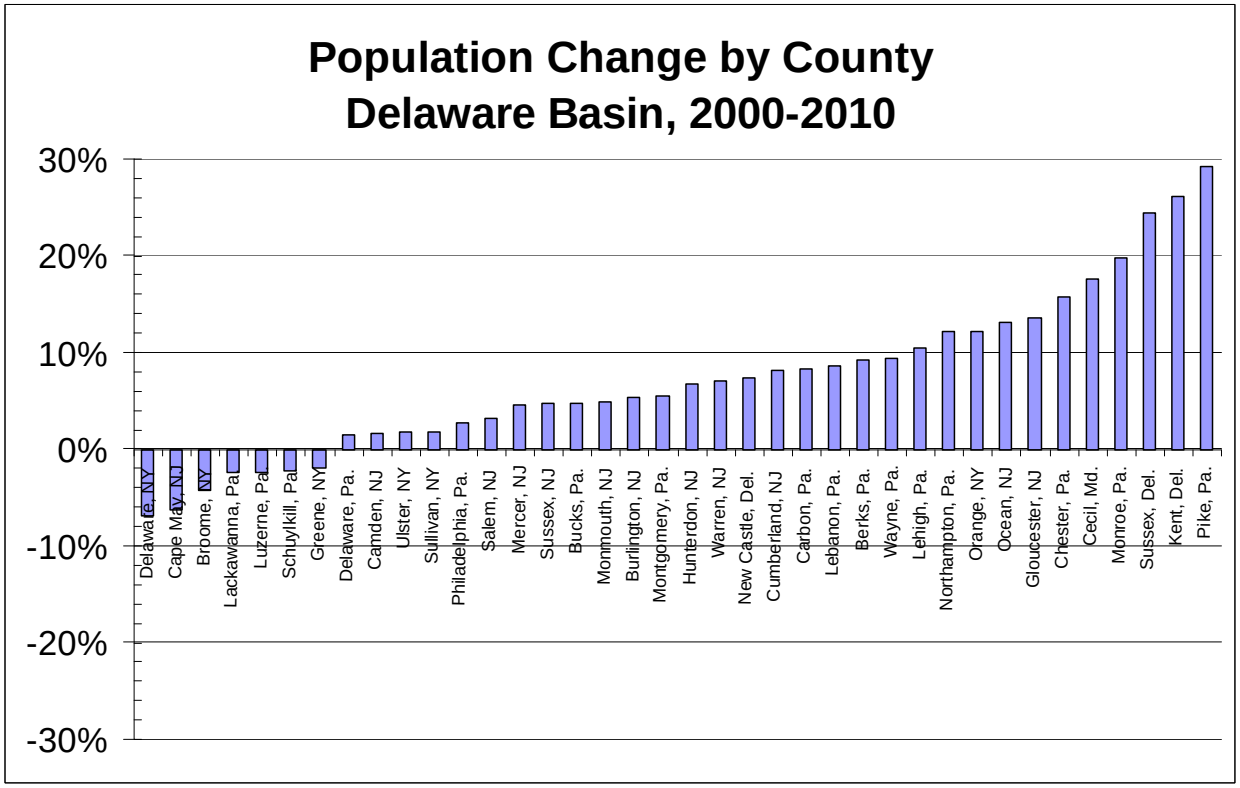


Figure 3. Population change in Delaware River Basin counties, 2000-2010 (U.S. Census)

The Delaware Basin includes 21 watersheds that flow to the river and bay (Table 5 and Figure 4).

Table 5. Watersheds in the Delaware River Basin

Watershed	Area (sq mi)	Population 2000	Pop. Density (pop./sq mi)
LE1 Brandywine/Christina	187	382,703	2,047
LE2 C&D Canal	152	54,960	362
DB1 Delaware Bay	626	141,562	226
Delaware	965	**579,225**	**600**
UC2 NJ Highlands	745	218,638	293
LC1 Del. R. above Trenton	159	55,880	351
UE2 New Jersey Coastal Plain	1,021	1,287,810	1,261
LE3 Salem River	254	54,290	214
DB2 Delaware Bay	782	234,480	300
New Jersey	**2,961**	**1,851,098**	**625**
EW1 East Branch Del. R.	666	23,040	35
EW2 West Branch Del. R.	841	19,263	23
EW3 Del. R. above Pt. Jervis	314	11,840	38
NM1 Neversink R.	734	70,164	96
New York	**2,555**	**124,307**	**49**
EW3 Del. R. above Pt. Jervis	210	7,894	38
NM1 Neversink R.	82	7,796	95
LW1 Lackawaxen R.	598	49,734	83
UC1 Pocono Mt.	779	208,478	268
LV1 Lehigh River above Lehighton	451	37,622	83
LV2 Lehigh River above Jim Thorpe	430	88,349	205
LV3 Lehigh River above Bethlehem	480	478,278	996
LC1 Del. R. above Trenton	295	103,771	352
SV1 Schuylkill above Reading	338	88,681	262
SV2 Schuylkill above Valley Forge	649	321,066	495
SV3 Schuylkill above Philadelphia	874	952,560	1,090
UE1 Penna Fall Line	693	2,579,100	3,722
LE1 Brandywine/Christina	401	277,129	691
Pennsylvania	**6,280**	**5,200,458**	**828**
Delaware Basin	**12,761**	**7,755,088**	**608**

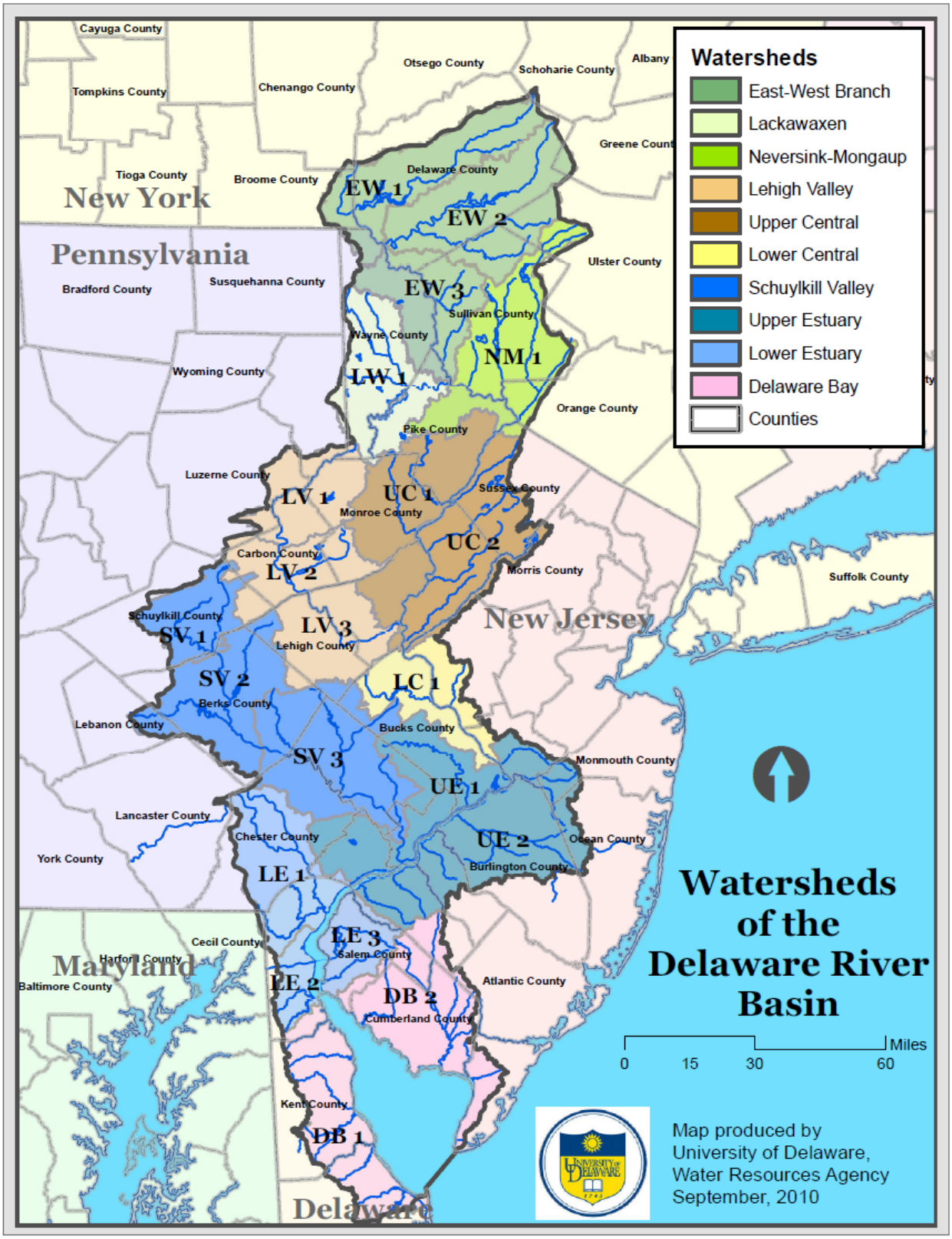


Figure 4. Watersheds in the Delaware River Basin (UDWRA 2010)

2. Methods

Valuation Techniques

The economic value of the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania is derived from published studies and valuation methods such as:

Avoided Cost: Society sustains costs if certain ecosystems are not present or lost. For instance, the loss of wetlands may increase economic flood damages.

Replacement Cost: Natural services are lost and replaced by more expensive manmade systems, i.e. forests provide water filtration benefits that are replaced by costly water filtration plants.

Net Factor Income by Enhancement of Income: Improved water quality water enhances fisheries and crabbing industries and, in turn, boosts jobs and wages.

Travel Cost: Visitors are willing to pay to travel and visit ecosystems and natural resources for hunting, fishing, and birding.

Hedonic Pricing Process: Residents may be willing to pay more for property values that are higher along scenic bay and river coastlines.

Contingent Valuation: Valuation by survey of individual different preferences to preserve ecosystems. People may be willing to pay more in fees to preserve bay water quality.

Scope of Work

The socioeconomic value of the Delaware Basin was established by the following scope of work.

1. **Define and map area of interest:** The area of interest is defined as the Delaware River Basin from the headwaters in the Catskill Mountains of New York to the mouth of the bay at Cape Henlopen, Delaware. ArcGIS map layers of population census blocks, watershed boundaries, and land use/land cover were developed to perform the analysis.

2. **Literature review:** Gather a database of published literature and socioeconomic data relevant to the Delaware River Basin from the U. S. Census Bureau, U. S. Bureau of Labor Statistics, U.S. Department of Agriculture, U. S. Forest Service, and U. S. Fish and Wildlife Service.

3. **Economic activity:** Estimate the direct/indirect value of agriculture, water quality, water supply, fishing, hunting, recreation, boating, ecotourism, and navigation in the watershed from population, employment, industrial activity, and land use data. Total economic activity is defined as the sum of direct/indirect use, option, and non use values (Ingraham and Foster 2008). Direct use values are from natural goods such as drinking water, boating, recreation, and commercial fishing. Indirect values are benefits from ecosystems such as water filtration by forests and flood control/habitat protection from wetlands. Option demand is public willingness to pay for benefits from water quality or scenic value of the bay. Nonuse (existence) values accrue to a public who may never visit the resource but are willing to pay to preserve the existence of the resource.

4. Ecosystem Services: Tabulate the market value of natural resources (ecosystem services value) in the watershed for habitat such as wetlands, forests, farmland, and open water. Prepare GIS based data sets and mapping. Ecosystem services (ecological services) are provided by nature and represent benefits such as water filtration, flood reduction, and drinking water supply.

Using GIS, define ecosystem areas using 2006 NOAA Coastal Services Center land cover data in the following classifications: (a) Freshwater wetlands, (b) Marine, (c) Farmland, (d) Forest, (e) Barren, (f) Saltwater wetland, (g) Urban, (h) Beach/dune, (i) Open freshwater, and (j) Riparian buffer.

Search research studies and gather value ($/acre) data for ecosystem services: (a) carbon sequestration, (b) flood control, (c) drinking water supply, (d) water quality filtration, (e) waste treatment and assimilation, (f) nutrient regulation, (g) fish and wildlife habitat, (h) recreation and aesthetics. Ecosystem services were estimated using value (benefits) transfer where published data and literature are reviewed and applied in the context of the resource in question. Value transfer is used to estimate ecosystem goods and services for the Delaware River Basin.

Compute ecosystem services value by multiplying land use area (acres) by ecosystem value ($/ac). The value transfer techniques employed here involves selecting data from published literature from another watershed or study area and applying the $ per ac values to land use areas computed by GIS. While primary research data from the watershed in question (the Delaware Basin) is preferable and is used in this report, value transfer is the next best practical way to value ecosystems especially when in the absence of such data the worth of ecosystems have previously been deemed zero. Future economic valuation survey research is recommended to develop primary ecosystem service values for the Delaware Basin in particular.

4. Jobs and salaries: Obtain employment and wage data from the U. S. Department of Labor, U. S. Census Bureau, and National Ocean Economics Program. Calculate direct/indirect jobs in the Delaware Basin by North American Industry Classification System (NAICS) codes such as shipbuilding, marine transportation/ports, fisheries, recreation, minerals, trade, agriculture, and others. Total jobs and salaries were summarized for each county within the watershed based on population census block data. NAICS data were supplemented with farm jobs data from the USDA Agricultural Statistics Bureau, U. S. Fish and Wildlife Service ecotourism jobs data, and jobs provided by water purveyors and wastewater treatment utilities.

5. Report: Prepare a report and GIS mapping summarizing the direct and indirect economic values of goods and services provided by the Delaware River Basin updated to 2010 dollars.

3. Annual Economic Activity

Estimated annual economic value of the Delaware River Basin from recreation, fish and wildlife, public parks, water quality, navigation/ports, potential Marcellus Shale natural gas, agriculture, water supply, and forest activities is over $25 billion (Table 6 and Figure 5).

- Recreation $1.22 billion
- Fish and Wildlife $1.55 billion
- Public Parks $1.83 billion
- Water Quality $2.46 billion
- Navigation/Ports $2.62 billion
- Marcellus Shale Natural Gas (potential) $3.30 billion
- Agriculture $3.37 billion
- Water Supply $3.82 billion
- Forests $5.13 billion

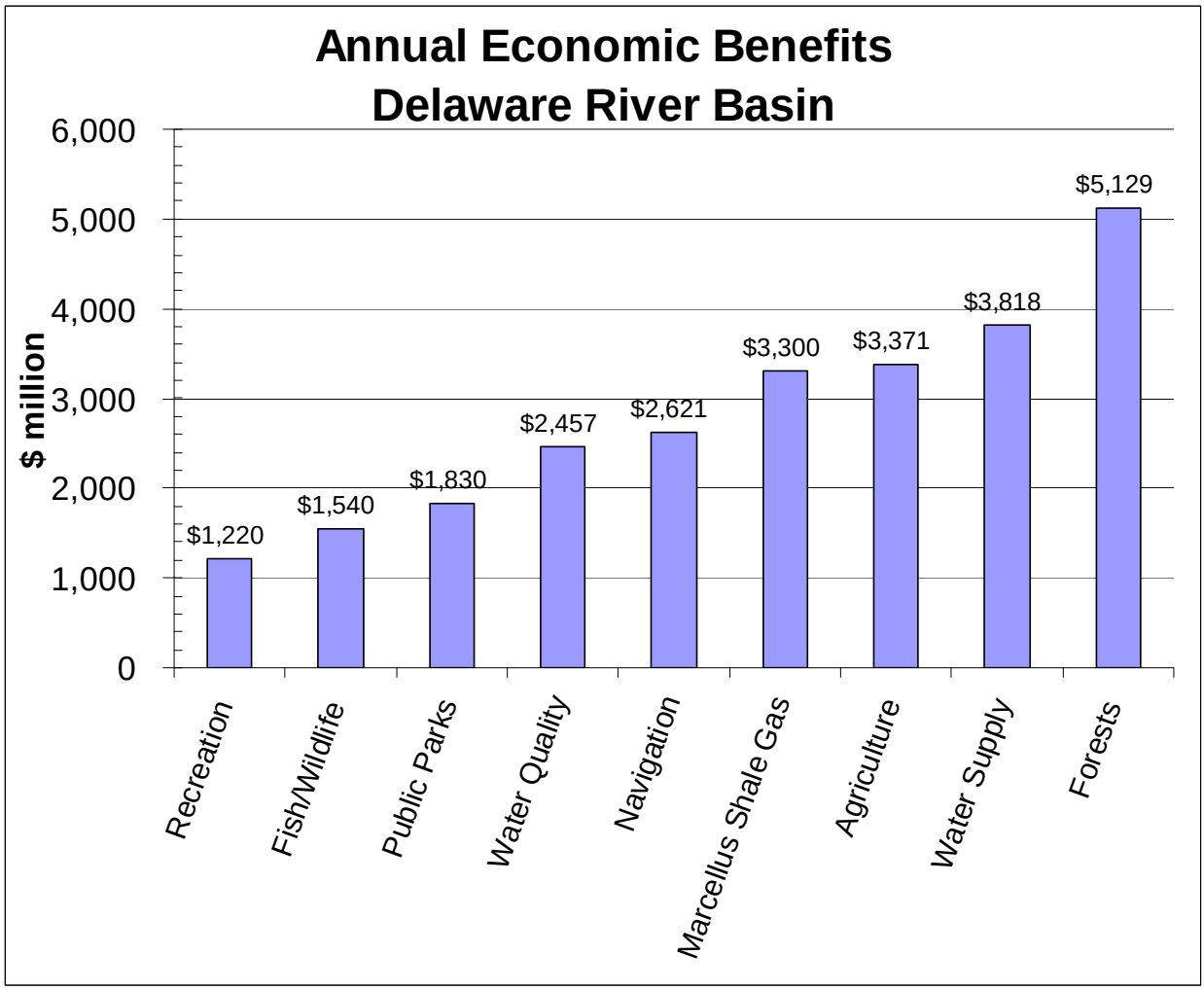


Figure 5. Annual economic activity related to the Delaware River Basin

Table 6. Annual economic activity in the Delaware River Basin, 2010

Activity	2010 ($ million)	Value Transfer Sources
Recreation (Boating, Fishing, Swimming)		
Clean Water Act Restoration		
Viewing/Aesthetics ($0.58/person)	5	University of Delaware (2003)
Boating ($0.76/person)	6	University of Delaware (2003)
Fishing ($2.95/person)	24	University of Delaware (2003)
Swimming ($6.88/person)	57	University of Delaware (2003)
Water Quality Based Recreation		
Swimming ($13.40/trip)	9	University of Rhode Island (2002)
Boating ($30/trip)	47	University of Rhode Island (2002)
Fishing ($62.79/trip)	52	University of Rhode Island (2002)
Wildlife/bird watching ($77.73/trip)	104	University of Rhode Island (2002)
Skiing (1.9 million ski-days @$45/day)	325	Pennsylvania Ski Areas Association (2010)
Paddling-based Recreation (620,860 paddlers)	362	Outdoor Industry Association(2006)
Del. Water Gap River Recreation (267,000 visitors)	41	U.S. Forest Service, U.S. Nat'l Park Service (1990)
Canoe/Kayak/Rafting (225,000 visits)	9	Canoe and Kayak Liveries (2010)
Powerboating (232,000 boat registrations)	395	National Marine Manufacturers Association (2010)
Water Quality		
Willing to Pay for Clean Water ($38-$121/user)	659	University of Maryland (1989)
Water Treatment by Forests ($96/mgd)	63	Trust for Public Land, AWWA (2004)
Wastewater Treatment ($4.00/1000 gal)	1,722	DRBC and USEPA
Increased Property Value (+8%)	13	EPA (1973), Brookings Institute (2010)
Water Supply		
Drinking Water Supply ($4.78/1000 gal)	3,145	UDWRA and DRBC (2010)
Reservoir Storage ($0.394/1000 gal)	145	UDWRA and DRBC (2010)
Irrigation Water Supply ($300/ac-ft)	32	Resources for the Future (1996), USDA (2007)
Thermoelectric Power Water Supply ($44/ac-ft)	297	EIA (2002), NETL (2009)
Industrial Water Supply ($200/ac-ft)	179	Resources for the Future (1996), DRBC (2010)
Hydropower Water Supply ($32/ac-ft)	20	Resources for the Future (1996), DRBC (2010)
Fish/Wildlife		
Commercial Fish Landings ($0.60/lb)	34	NMFS, Nat'l. Ocean Economics Program (2007)
Fishing (11-18 trips/angler, $17-$53/trip))	576	U. S. Fish and Wildlife Service (2001)
Hunting (16 trips/hunter, $16-50/trip)	340	U. S. Fish and Wildlife Service (2001)
Wildlife/Bird-watching (8-13 trip/yr, $15-$27/trip)	561	U. S. Fish and Wildlife Service (2001)
Shad Fishing (63,000 trips, $102/trip)	6	Pennsylvania Fish and Boat Commission (2011)
Wild Trout Fishing	29	Amer. Sportfishing Assn./Trout Unlimited (1998)
Agriculture		
Crop, poultry, livestock value ($1,180/ac)	3,371	USDA Census of Agriculture 2007 (2009)
Forests		
Carbon Storage ($827/ac)	3,592	U.S. Forest Service, Del. Ctr. Horticulture (2008)
Carbon Sequestration ($29/ac)	126	U.S. Forest Service
Air Pollution Removal ($266/ac)	1,155	U.S. Forest Service
Building Energy Savings ($56/ac)	243	U.S. Forest Service
Avoided Carbon Emissions ($3/ac)	13	U.S. Forest Service
Public Parks		
Health Benefits ($9,734/ac)	1,283	Trust for Public Land
Community Cohesion ($2,383/ac)	314	Trust for Public Land
Stormwater Benefit ($921/ac)	121	Trust for Public Land
Air Pollution ($88/ac)	12	Trust for Public Land
Del. Water Gap Natl. Rec. Area (4.9 million visits)	100	U.S. National Park Service (2002)
Marcellus Shale		
Natural Gas (7.3 trillion cf @ $11.21/1000 cf)	3,300	USGS (2011), EIA (2011)
Maritime Transportation		
Navigation ($15/ac-ft)	220	Resources for the Future (1996)
Port Activity	2,400	Economy League of Greater Philadelphia (2008)
Delaware River Basin	**≈$25 billion**	

Recreation

Clean Water Act Restoration

Parsons, Helm, and Bondelid (2003) from the University of Delaware measured the economic benefits of water quality improvements to recreational users in the northeastern states and found annual per person benefits for improvements due to the Clean Water Act ranged from $0.47 for viewing, $0.62 for boating, $2.40 for fishing, to $5.59 for swimming. Table 7 summarizes total water quality benefits to recreational users in the Delaware River Basin by transferring the benefits in $2003 to $2010 assuming an annual rate of 3% and then multiplying the $2010 benefits by the basin population. Total 2010 recreation benefits due to Clean Water Act water quality improvements in the Delaware Basin are $92 million per year or $11.17 per person. Swimming (62%) and fishing (26%) are the highest valued recreational benefits followed by boating (7%) and viewing (5%).

Table 7. Water quality benefits from Clean Water Act improvements in the Delaware River Basin

Recreational Benefit	$2003[1] (per person)	$2010[2] (per person)	Del. Basin Pop. 2010	Benefit/yr	% of Benefit
Viewing	$0.47	$0.58	8,255,013	$4,787,908	5%
Boating	$0.62	$0.76	8,255,013	$6,273,810	7%
Fishing	$2.40	$2.95	8,255,013	$24,352,288	26%
Swimming	$5.59	$6.88	8,255,013	$56,794,489	62%
Total	**$9.08**	**$11.17**	**8,255,013**	**$92,208,495**	**100%**

1. Parsons et al. 2003. 2. $2010 transferred from $2003 at annual rate of 3%.

Water Quality Based Recreation

Using travel cost demand methods, Johnston et al. (2002) from the University of Rhode Island computed the consumer surplus (economic use value per person) for swimming, boating, recreational fishing, and bird watching/wildlife viewing in the Peconic Estuary watershed on Long Island, New York. Swimming, boating, fishing, and wildlife viewing were valued at $8.59, $19.23, $40.25, and $49.83 per trip in $1995, respectively. Table 8 summarizes water quality benefits to recreational users of $211 million per year in the Delaware Basin (estuary only) by transferring unit values from the Peconic Estuary, converting $1995 to $2010 by an annual rate of 3%, and multiplying $2010 benefits by trips per year.

Table 8. Total annual value of recreational benefits in the Delaware River Basin

Recreational Benefit	$1995 Consumer surplus/trip[1]	$2010 Consumer surplus/trip[2]	Trips/year to Del. Estuary	Annual Value	% of Benefit
Swimming	$8.59	$13.40	670,000[3]	$8,978,000	4%
Boating	$19.23	$30.00	1,568,473[4]	$47,054,190	22%
Fishing	$40.25	$62.79	824,249[4]	$51,754,595	24%
Wildlife/bird watching	$49.83	$77.73	3,336,440[5]	$103,700,000	49%
Total				**$211,486,785**	**100%**

1. Johnston et al. 2002. 2. $2010 transferred from $1995 at 3%. 3. 10% of Delaware Estuary population swims. 4. NOEP 2009 for boating (16.8% of pop. and 1.4 trips/p./yr) and fishing (10.3% of pop. and 1.2 trips/p./yr). 5. USFWS 2006 wildlife/bird watching (Del. 427,500, NJ 2,070,900, & Pa. 838,000 trips/yr).

Skiing

In the Pocono Mountains of Pennsylvania, nine ski areas draw approximately 1 mgd from Delaware Basin water supplies for snowmaking on 1,005 skiable acres. The Pennsylvania Ski Areas Association (2009) estimated the economic value at 23 ski resorts statewide was $832,000,000. Prorating from PSAA statewide estimates, the economic value for 9 resorts in the Delaware Basin is $325,000,000. The nine ski resorts in the Delaware Basin have aggregate annual revenues of $87,655,063 from 1,908,228 skier visits based on a mid-week lift ticket rate of $45/day (Table 9).

Table 9. Revenues from ski resorts in the Delaware River Basin

Ski Resort	Ski Area (ac)	Annual Ski Visits	Lift Ticket ($/day)	Revenue ($)
Elk Mountain	235	446,203	$48	$21,417,722
Ski Big Bear	26	49,367	42	2,073,418
Ski Shawnee	125	237,342	43	10,205,696
Alpine Mountain	60	113,924	37	4,215,190
Camelback	160	303,797	48	14,582,278
Jack Frost	100	189,873	44	8,354,430
Big Boulder	55	104,430	44	4,594,937
Blue Mountain	158	300,000	49	14,700,000
Bear Creek	86	163,291	46	7,511,392
Total	**1,005**	**1,908,228**	**$45**	**$87,655,063**

Paddling-based Recreation

Canoeing, kayaking, and rafting are key drivers to the local economy along the Brandywine, Lehigh, Schuylkill, and middle/upper Delaware rivers in the Delaware Basin (Van Rossum, Carluccio, and Blankinship 2010). In the Mid-Atlantic census division (NY, NJ, PA), the Outdoor Industry Association (2006) estimates paddling-based recreation is practiced by 11% of the population and is responsible for 3,356,000 participants, $356 million in gear retail sales, $1.6 billion in trip related sales, and 22,844 jobs. Given the Delaware Basin is the home of 7,611,595 people in NJ, NY, and Pa. or 22% of New Jersey's population (1,951,047), 0.7% of New York State's population, (124,969), and 43% of Pennsylvania's population (5,533,254) or 18.5% of the three state's total population of 40,800,000 people, then prorated paddling-based recreation in the basin is responsible for 620,860 participants, $96 million in gear retail sales, $296 million in trip sales, and 4,226 jobs (Table 10).

Table 10. Economic value of paddling-based recreation in the Delaware River Basin

Paddling Based Recreation	States of NJ, NY, PA[1]	Del. Basin NJ, NY, PA[2]
Population	40,800,000	7,563,762
Participants	3,356,000	620,860
Gear retail sales	$356 million	$66 million
Trip related sales	$1.600 billion	$296 million
Total Sales	$1.956 billion	$362 million
Jobs	22,844	4,226

1. Outdoor Industry Association 2006. 2. Prorated by 18.5% given 40,800,000 people live in NJ, NY, and PA and 7,611,595 people live in these states in the Delaware Basin.

River Recreation

Cordel et al. (1990) from the U. S. Forest Service and U.S. National Park Service estimated river recreation along the Upper Delaware River and Delaware Water Gap was responsible for $13.3 million and $6.9 million in total economic output, respectively, in $1986 (Table 11). Adjusting for 3% annually, river recreation economic output along the Upper Delaware River and Delaware Water Gap is roughly $27.1 million and $14.1 million, respectively, or $41.2 million total in $2010.

Table 11. Economic impacts of river recreation along Upper Delaware and Delaware Water Gap

River	Participants	Jobs	Wages ($1986)	Economic Output ($1986)	Wages ($2010)	Economic Output ($2010)
Upper Delaware	232,000	292	5,582,800	13,351,000	11,408,000	$27,100,000
Del. Water Gap	135,400	156	3,246,300	6,929,000	6,633,743	$14,100,000
Total	**367,400**	**448**	**8,829,100**	**20,280,000**	**18,041,743**	**41,200,000**

1. Cordel et al. 1990. 2. Adjusted to $2010 at 3% annually.

Canoe/Kayak/Rafting

Thirty seven (37) canoe and kayak liveries along the Delaware, Lehigh, and Schuylkill, and Brandywine Rivers lease watercraft to approximately 225,000 visitors with earnings of $9 million per year assuming a daily rental fee of $40 per person (Table 12).

Table 12. Annual revenue from canoe and kayak liveries in the Delaware River Basin

Canoe/Kayak Livery	Address	Daily Rate ($)	Annual Visitors	Revenue ($)
Delaware River				
Adventure Sports Canoe/Raft	Marshalls Creek, PA	$40	9,000	$360,000
Bucks County River Country	Point Pleasant, PA	$40	13,500	$540,000
Catskill Mountain Canoe Rentals	Hankins, NY	$40	7,000	$280,000
Cedar Rapids Kayak/Canoe	Barryville, NY	$40	5,000	$200,000
Chamberlain Canoes Inc	Minisink Hills, PA	$40	5,000	$200,000
Delaware River Rafting/Canoeing	Delaware, NJ	$40	9,000	$360,000
Delaware River Tubing	Frenchtown, NJ	$40	7,000	$280,000
Driftstone on the Delaware	Mount Bethel, PA	$40	5,000	$200,000
GreenWave Paddling	Yardville, New Jersey	$40	3,000	$120,000
Indian Head Canoes & Rafts	Barryville, NY	$40	5,000	$200,000
Jerrys Three River Canoes	Pond Eddy, NY	$40	4,000	$160,000
Kayak East	East Stroudsburg, PA	$40	4,000	$160,000
Kittatinny Canoes, Inc.	Dingmanns Ferry, PA	$40	4,000	$160,000
Landers River Trips	Narrowsburg, NY	$40	15,000	$600,000
Lazy River Outpost	Phillipsburg, NJ	$40	4,000	$160,000
Pack Shack Adventures Inc	Delaware Water Gap, PA	$40	5,000	$200,000
Paint Island Canoe & Kayak	Bordentown, NJ	$40	4,000	$160,000
Portland Outfitters	Portland, PA	$40	5,000	$200,000
River Country	Point Pleasant, PA	$40	9,000	$360,000
Shawnee Canoe Trips	Shawnee on Delaware, PA	$40	12,000	$480,000
Silver Canoe Rentals	Port Jervis, NY	$40	4,000	$160,000
Upper Delaware Campgrounds	Callicoon, NY	$40	5,000	$200,000
Whitewater Willies Canoe Rentals	Pond Eddy, NY	$40	4,000	$160,000
Wild & Scenic River Tours/Rentals	Barryville, NY	$40	5,000	$200,000
Lehigh River				$0
Jim Thorpe River Adventures	Jim Thorpe, PA	$40	9,000	$360,000
Lehigh Rafting Rentals Inc	White Haven, PA	$40	9,000	$360,000
Lehigh River Bait and Bow	Allentown, PA	$40	3,000	$120,000
Northeast PA Kayak School	Lehighton, PA	$40	3,000	$120,000
Pocono Whitewater	Jim Thorpe, PA	$40	8,000	$320,000
Whitewater Challengers, Inc.	White Haven, PA	$40	9,000	$360,000
Whitewater Rafting Adventures Inc.	Nesquehoning, PA	$40	6,000	$240,000
Schuylkill				$0
Schuylkill River Outfitters	Birdsboro, PA	$40	4,500	$180,000
Brandywine River				$0
Brandywine Outfitters	Coatesville, PA	$40	3,000	$120,000
Northbrook Canoe	West Chester, PA	$40	9,000	$360,000
Wilderrness Canoe Trips	Wilmington, DE	$40	9,000	$360,000
Total			**225,000**	**9,000,000**

Powerboating

The National Marine Manufacturers Association (2010) announced that New York, Delaware, Pennsylvania, and New Jersey ranked 3rd, 7th, 17th, and 23rd in the U.S. respectively in total expenditures for new powerboats, outboard engines, boat trailers, and accessories. Table 13 summarizes powerboat expenditures by state and then prorated by percent population of each state within the Delaware Basin. Powerboat expenditures due to boating within the waters of the Delaware Basin are estimated at about $395 million/year

Table 13. Recreational powerboat expenditures in the Delaware River Basin (NMMA 2010)

State	Rank Expenditures	Total Powerboat Expenditures ($)	% Pop. of State in Basin	Del. Basin Powerboat Expenditures ($)
Delaware	7	343,743,963	74%	254,370,533
New Jersey	23	183,044,985	22%	40,269,897
New York	3	401,353,400	0.70%	2,809,474
Pennsylvania	17	226,281,490	43%	97,301,041
Total		**1,154,423,838**		**394,750,944**

New York, Pennsylvania, New Jersey, and Delaware are ranked 7th, 13th, 28th, and 40th in number of recreational boat registrations in 2009. The four states combined had just over $1 million boat registrations in 2009 with 232,000 registrations for boating in the Delaware River Basin (Table 14).

Table 14. Recreational boat registrations in the Delaware River Basin (NMMA 2010)

State	Rank Registrations	Total Boat Registrations	% Pop. of State in Basin	Del. Basin Boat Registrations
Delaware	40	61,523	0.74	45,527
New Jersey	28	173,994	0.22	38,279
New York	7	479,161	0.007	3,354
Pennsylvania	13	337,747	0.43	145,231
Total		**1,052,425**		**232,391**

Water Quality

Willingness to Pay for Clean Water

Bockstael, McConnell, and Strand (1989) from the University of Maryland estimated public annual willingness to pay for a moderate improvements in water quality of the Chesapeake Bay to be $10 to $100 million in 1984 dollars ($21.6 to $216 million in $2010 at 3% annually). The study found 43% of the respondents were users or visitors (boaters, fishermen) to the Chesapeake Bay and were willing to pay $121 per year to make the bay water quality "acceptable". About 57% of respondents were nonusers, those who do not visit or use the bay's resources but were willing to pay $38 per year to restore the bay. Transferring these values to the estuary watershed portion of the Delaware Basin

(pop. 6,700,000) and using proportions of 10% users or visitors to the estuary and 90% nonusers, aggregate willingness to pay to make the Delaware Estuary water quality acceptable to the public is $658 million in $2010 or $99 per person.

Total willingness to pay for acceptable Delaware Estuary water quality
= (0.10)(6,700,000)($121/yr) + (0.90)(6,700,000)($38/yr)
= $310 million ($1984) = $659 million ($2010 at 3% annually).

Water Treatment

The Trust for Public Land and American Water Works Association (2004) found for every 10% increase in forested watershed land, drinking water treatment and chemical costs are reduced by approximately 20% (Table 15). The public drinking water supply is 1,803 mgd and forests cover 6,786 sq mi or 53% of the Delaware River Basin. Loss of these forests would increase drinking water treatment costs by $96 per mil gal ($139 per mil gal @ 0% forested minus $43 per mil gal @ 53% forested) or $173,088 per day for 1,803 mgd = $63,177,120 per year.

Table 15. Drinking water treatment and chemical costs based on percent of forested watershed (Trust for Public Land and AWWA 2004)

% of Watershed Forested	Water Treatment/ Chemical Costs (per mil gal)	% Change in Costs
0%	$139	21%
10%	$115	19%
20%	$93	20%
30%	$73	21%
40%	$58	21%
50%	$46	21%
60%	$37	19%

Wastewater Treatment

The waters of the Delaware Basin provide significant wastewater treatment, discharge, and assimilation services. In accordance with Federal Clean Water Act, DRBC, and state water quality regulations, NPDES municipal wastewater dischargers hold permits to discharge up to 1,180 million gallons per day to the Delaware River Basin or 106 mgd in Delaware, 218 mgd in New Jersey, 7 mgd in New York, and 849 mgd in Pennsylvania (Table 16). The average wastewater rate in the basin is $4.00 per 1000 gal. The fee for an average residence of 4 people @ 50 gpcd is $290 per year. The value of treated wastewater in the Delaware Basin is $4.7 million per day or $1.7 billion per year.

Table 16. Value of NPDES wastewater treatment discharges in the Delaware River Basin

NPDES ID	Facility	Location	State	Flow[1] (mgd)	Value[2] ($/day)	Wastewater Value ($/year)
DE0020338	Kent Co. Levy Court WWTR	Frederica	DE	15.0	60000	21900000
DE0021512	Lewes City POTW	Lewes	DE	0.8	3,200	1,168,000
DE0020320	Wilmington Wastewater Plant	Wilmington	DE	90.0	360,000	131,400,000
Delaware			**DE**	**105.8**	**423,200**	**154,468,000**

NJ0027481	Beverly City Sewer Auth. STP	Beverly	NJ	1.0	4,000	1,460,000
NJ0024678	Bordentown Sewerage Auth.	Bordentown	NJ	3.0	12,000	4,380,000
NJ0024651	Cumberland Co. Auth. WWTP	Bridgeton	NJ	7.0	28,000	10,220,000
NJ0024660	Burlington City STP	Burlington	NJ	2.7	10,800	3,942,000
NJ0021709	Burlington Twp. DPW	Burlington	NJ	1.6	6,400	2,336,000
NJ0026182	Camden County MUA	Camden	NJ	80.0	320,000	116,800,000
NJ0021601	Carneys Point Twp. WWTP	Carneys Point	NJ	1.3	5,200	1,898,000
NJ0024007	Cinnaminson Sewerage Auth.	Cinnaminson	NJ	2.0	8,000	2,920,000
NJ0023701	Florence Twp. DPW Sewer Auth.	Florence	NJ	2.5	10,000	3,650,000
NJ0026301	Hamilton Twp. DPW	Hamilton Twp.	NJ	16.0	64,000	23,360,000
NJ0020915	Lambertville City Sewer Auth.	Lambertville	NJ	1.5	6,000	2,190,000
NJ0024759	Ewing Lawrence Sewer WWTP	Lawrenceville	NJ	16.0	64,000	23,360,000
NJ0069167	Maple Shade Twp. Util, Authority	Maple Shade	NJ	3.4	13,600	4,964,000
NJ0026832	Medford Twp. Sewer Auth. STP	Medford	NJ	1.8	7,200	2,628,000
NJ0029467	Millville City Sewer Auth.	Millville	NJ	5.0	20,000	7,300,000
NJ0024996	Moorestown Twp. WWTP	Moorestown	NJ	3.5	14,000	5,110,000
NJ0024015	Mount Holly Twp. MUA	Mount Holly	NJ	7.7	30,800	11,242,000
NJ0020184	Newton Town DPW	Newton	NJ	1.4	5,600	2,044,000
NJ0024821	Pemberton Twp. MUA STP	Pemberton	NJ	2.5	10,000	3,650,000
NJ0024023	Penns Grove Sewerage Auth.	Penns Grove	NJ	0.8	3,200	1,168,000
NJ0021598	Pennsville Twp. Sewer Auth.	Pennsville	NJ	1.9	7,600	2,774,000
NJ0024716	Phillipsburg Town STP	Phillipsburg	NJ	3.5	14,000	5,110,000
NJ0022519	Riverside Twp. DPW	Riverside	NJ	1.0	4,000	1,460,000
NJ0024856	Salem WWTP Facility	Salem	NJ	1.4	5,600	2,044,000
NJ0024686	Gloucester Co. Util. Auth. STP	Thorofare	NJ	24.1	96,400	35,186,000
NJ0020923	Trenton City DPW Sewer Auth.	Trenton	NJ	20.0	80,000	29,200,000
NJ0023361	Willingboro Twp. MUA	Willingboro	NJ	5.2	20,800	7,592,000
New Jersey				**217.8**	**871,200**	**317,988,000**
NY0020265	Delhi WWTP	Delhi	NY	0.8	3,200	1,168,000
NY0030074	Liberty WWTF	Liberty	NY	1.6	6,400	2,336,000
NY0022454	Monticello STP	Monticello	NY	3.1	12,400	4,526,000
NY0029271	Sidney WWTP	Sidney	NY	1.7	6,800	2,482,000
New York				**7.2**	**28,800**	**10,512,000**
PA0026867	Abington Twp. STP	Abington	PA	3.9	15,600	5,694,000
PA0026000	Allentown City WWTP	Allentown	PA	40.0	160,000	58,400,000
PA0026042	Bethlehem City STP	Bethlehem	PA	90.0	360,000	131,400,000
PA0021181	Bristol Borough Water and Sewer	Bristol	PA	1.2	4,800	1,752,000
PA0027103	Delaware Co. Reg. Water Auth.	Chester	PA	44.0	176,000	64,240,000
PA0026859	Coatesville WWTP	Coatesville	PA	3.8	15,200	5,548,000
PA0026794	Conshohocken Borough Auth.	Conshohocken	PA	2.3	9,200	3,358,000
PA0026531	Downingtown Regional WPCC	Downingtown	PA	7.1	28,400	10,366,000
PA0026549	Borough of Doylestown WWTP	Doylestown	PA	28.5	114,000	41,610,000
PA0027235	Easton Area Joint Auth. WWTP	Easton, PA	PA	10.0	40,000	14,600,000
PA0029441	Upper Dublin Twp. MS4 UA	Ft. Washington	PA	1.1	4,400	1,606,000
PA0051985	Horsham Twp. STP	Horsham	PA	1.0	4,000	1,460,000
PA0024058	Kennett Square Borough WWTP	Kennett Square	PA	1.1	4,400	1,606,000
PA0026298	Whitemarsh STP	Lafayette Hill	PA	2.0	8,000	2,920,000
PA0026182	Lansdale Borough STP	Lansdale	PA	2.6	10,400	3,796,000
PA0039004	U. Gwynedd/Towamencin STP	Lansdale	PA	6.5	26,000	9,490,000
PA0026468	Morrisville Municipal Authority	Morrisville	PA	10.0	40,000	14,600,000
PA0027421	Norristown Borough WWTP	Norristown	PA	9.8	39,200	14,308,000
PA0020532	Upper Montgomery Joint Sewer	Pennsburg	PA	2.0	8,000	2,920,000

PA0026689	Northeast WPCP	Philadelphia	PA	210.0	840,000	306,600,000
PA0026662	Philadelphia Southeast POTW	Philadelphia	PA	112.0	448,000	163,520,000
PA0026671	SW Water Pollution Control	Philadelphia	PA	200.0	800,000	292,000,000
PA0020460	Quakertown WWTP	Quakertown	PA	4.3	17,200	6,278,000
PA0026549	Reading WWTP	Reading	PA	28.5	114,000	41,610,000
PA0020168	East Stroudsburg Filtration Plant	Stroudsburg	PA	2.3	9,200	3,358,000
PA0029289	Stroudsburg STP	Stroudsburg	PA	2.5	10,000	3,650,000
PA0027031	Goose Creek STP	West Chester	PA	1.7	6,800	2,482,000
PA0026018	West Chester Taylor Run STP	West Chester	PA	1.8	7,200	2,628,000
PA0028584	West Goshen STP	West Chester	PA	6.0	24,000	8,760,000
PA0023256	Upper Gwynedd Twp. WWTP	West Point	PA	5.7	22,800	8,322,000
PA0025976	Upper Moreland Hatboro Sewer	Willow Grove	PA	7.2	28,800	10,512,000
Pennsylvania			**PA**	**848.9**	**3,395,600**	**1,239,394,000**
Delaware Basin			**Basin**	**1,179.7**	**4,718,800**	**1,722,362,000**

1. DRBC and USEPA. 2. Value at @ $4.00/1000 gal

Increased Property Values

Several studies along rivers, estuaries, and coasts throughout the United States indicate that improved water quality can increase shoreline property values by 6% to 25% (Table 17). The EPA (1973) estimated that improved water quality can raise property values by up to 18% next to the water, 8% at 1000 feet from the water, 4% at 2000 feet from the water, and 1.5% at 3000 feet from the water. Leggett, et al. (2000) estimated that improved bacteria levels to meet state water quality standards along the western shore of the Chesapeake Bay in Maryland raised shoreline property values by 6%. The Brookings Institution (2007) projected that investments of $26 billion to restore the Great Lakes would increase shoreline property values by up to 10%. For this analysis, shoreline property values within 2000 feet of the waterways are estimated to increase by an average of 8% due to improved water quality in the Delaware Estuary.

Shoreline property values within 2000 feet of the water due to water quality improvements in the Delaware Estuary watershed will increase by $256 million (Table 18). The average riverfront property value in Philadelphia is $92,000 per acre. Multiply this value by the area of property within a 2,000 feet corridor along the Delaware Estuary shore between the C&D Canal and head of tide at Trenton. Multiply by increased property value of 8% due to improved water quality in the Delaware Estuary. Since the increase in property value is a one time benefit, the annual value over a 20 year period where water quality has improved in the Delaware Estuary is estimated as $13 million.

Table 17. Increased property values resulting from improved water quality

Study	Watershed	Increased Value
EPA (1973)	San Diego Bay, CA Kanawha, OH Willamette R., OR	
Next to water		18%
1000 ft from water		8%
2000 ft from water		4%
3,000 ft from water		1.5%
Leggett, et al. (2000)	Chesapeake Bay	6%
Brookings Institution (2007)	Great Lakes	10%

Table 18. Increased shore property value due to improved water quality in the Delaware Basin

State	Length of shoreline (ft)	Area 2000 ft of water (sf)	Area 2000 ft of water (ac)	Property Value @ $92,000/ac ($)	Increased Property Value @ 8% ($)
Delaware	114,048	228,096,000	5,236	481,745,455	38,539,636
New Jersey	357,456	714,912,000	16,412	1,509,915,152	120,793,212
Pennsylvania	285,648	571,296,000	13,115	1,206,593,939	96,527,515
Delaware Estuary	757,152	1,514,304,000	34,764	3,198,254,545	255,860,364

Water Supply

Drinking Water Supply

The Delaware Basin covers just 0.4% of the continental United States (12,769 sq mi/3,000,000 sq mi) yet supplies drinking water to 5% of the U.S. population (16,000,000/309,000,000 people). Delaware Basin aquifers and streams supply drinking water to over 8 million people within the basin to cities like Wilmington, Philadelphia, Allentown, Camden, and Trenton, NJ. Through interbasin transfers, the Delaware Basin also supplies drinking water to an additional 8 million people who live outside the basin by allocated diversions through the New York City Catskill Reservoir system (800 mgd) and the Delaware & Raritan Canal in New Jersey (100 mgd). Table 19 summarizes the economic benefits of groundwater reserve stock to generate ecosystem services (USEPA 1995).

Table 19. Groundwater services and effects (USEPA 2005)

Services	Effects
Drinking Water	Increase of decrease in availability of drinking water Change in human health or health risks
Water for Crop Irrigation	Change in value of crops or production costs Change in human health or health risks
Water for Livestock/Poultry	Change in Value of livestock products or production Change in human health or health risks

The Delaware Basin provides significant public drinking water supplies (1,804 mgd) with 44% in NY (800 mgd), 38% from Pa. (679 mgd), 16% from NJ (284 mgd), and 2% from Del. (40 mgd), Figure 6. The largest public water supply allocations in the Delaware Basin include United Water Delaware and Wilmington in Del.; Delaware & Raritan Canal diversion, New Jersey American, Trenton, and Camden in NJ; New York City, and Philadelphia and Aqua Pennsylvania in Pa. (Table 20). Figure 7 depicts public water supply service areas in the Delaware River Basin.

The annual value of raw (untreated) public water supply allocations in the Delaware Basin (1,803 mgd) is $658 million. When treated and delivered to customers the annual value of drinking water supplies is $3.14 billion (Table 21). Water purveyors in Delaware estimate the value of raw water supply is $1.00/1000 gallons according to cost of services studies for rate setting by the Public Service Commission. In FY13, the New Jersey Water Supply Authority plans to sell raw water supplies from the Manasquan Reservoir system for $1.02/1000 gallons (NJWSA 2011). The average value of treated drinking water based on rates set by public/private water purveyors in Del., NJ, Pa., and Md. is $4.78/1000 gallon (Corrozi and Seymour 2008).

Table 20. Public water supply allocations in the Delaware River Basin (DRBC 2010)

Water Purveyor	Supply (mgd)	Water Purveyor	Supply (mgd)	Water Purveyor	Supply (mgd)
Delaware	**40.10**				
United Water Del.	18.46	Harrington	0.36	Frederica Perkiomen	0.05
Wilmington	10.40	Camden-Wyoming	0.31		
Dover	4.74	Milton	0.17		
Newark	2.22	Milford	0.17		
Lewes BPW	0.98	Georgetown	0.13		
Tidewater Utilities	0.64	Frederica	0.08		
Dover AFB	0.44	Felton	0.08		
New Castle MSC	0.41	Delaware State Fair	0.05		
Smyrna	0.37	Magnolia	0.05		
New Jersey	**284.19**				
Del. & Raritan Canal	100.00	Hackettstown MUS	2.57	Medford Twp.	1.29
NJ American Western	39.37	Millville Water Dept	2.55	NJ American Oxford	1.20
Trenton	26.10	Moorestown	2.51	Florence Twp.	1.17
Camden	10.89	Bordentown	2.21	Salem City	1.12
Vineland	8.33	Burlington Twp.	2.00	Mantua Twp.	1.04
Merchant.-Pennsauken	6.05	Mt. Laurel	1.96	Pennsville Twp.	1.04
Washington Twp.	4.79	Glassboro	1.95	Pemberton Twp.	1.01
Willingboro MUA	4.65	Collingswood	1.93	Gloucester City	0.95
NJ American Mt. Holly	4.48	Maple Shade	1.64	Lower Twp MUA	0.95
Bridgeton	3.63	West Deptford	1.57	Sparta Twp.	0.94
Wildwood	3.59	Woodbury	1.55	Audubon Twp.	0.91
Aqua NJ Phillipsburg	3.46	Burlington City	1.47	Haddon Twp.	0.90
Aqua NJ Hamilton Sq.	3.39	Pennsgrove	1.42	Bellmawr Twp.	0.86
Aqua NJ Blackwood	2.96	Deptford Twp.	1.38	Haddonfield	0.82
Evesham MUA	2.82	Nesqehoning Boro	1.30	Greenwich Twp	0.82
				Misc. Water Purveyors	16.65
New York State	**800.03**				
New York City	800.00				
Pennsylvania	**679.30**				
Philadelphia	287.77	Easton Suburb.Water	4.47	Falls Twp.	2.66
Aqua PA Main System	102.18	Schuylkill Co. Auth.	4.36	Northampton Bucks	2.55
Forest Park	20.16	Muhlenberg Twp.	4.31	Warminster Twp.	2.54
Bethlehem	15.69	Lehigh County	4.22	Horsham Water/Sewer	2.30
Allentown	15.46	PA American Nazareth	4.13	Newtown Artesian	2.24
North Wales Water	15.09	Hazelton	4.12	Milford	1.88
Bucks Co. Water	14.99	PA Amer. Coatesville	4.07	Tamaqua MWA	1.87
Reading Area Auth.	14.31	Allentown City	4.02	Lehighton MWA	1.77
Bucks County SW	13.79	Northampton Boro.	3.74	Ambler Boro	1.75
PA Amer. Norristown	10.10	East Stroudsburg	3.69	Brodhead Cr. Auth.	1.73
Lower Bucks County	8.66	PA American Yardley	3.20	South Whitehall Twp.	1.71
North Penn Water	8.59	Phoenixville	3.01	Emmaus Munic. Water	1.49
Easton	7.13	Morrisville	2.89	Warrington Twp.	1.45
Schuylkill Co. Auth.	5.15	PA American Home	2.88	Wyomissing Boro	1.44
Pottstown Water Auth.	4.64	PA American Penn	2.76	Schuylkill Haven Boro.	1.42
				Misc. Water Purveyors	50.93

Table 21. Value of public drinking water supply allocations in the Delaware River Basin

State	Withdrawal (mgd)	Value/day untreated ($1.00/1000 gal)	Value/year untreated ($1.00/1000 gal)	Value/year treated ($4.78/1000 gal)
Delaware	40	40,000	14,600,000	69,788,000
New Jersey	284	284,000	103,660,000	495,494,800
New York	800	800,000	292,000,000	1,395,760,000
Pennsylvania	679	679,000	247,835,000	1,184,651,300
Delaware Basin	**1,803**	**1,803,000**	**658,095,000**	**3,145,694,100**

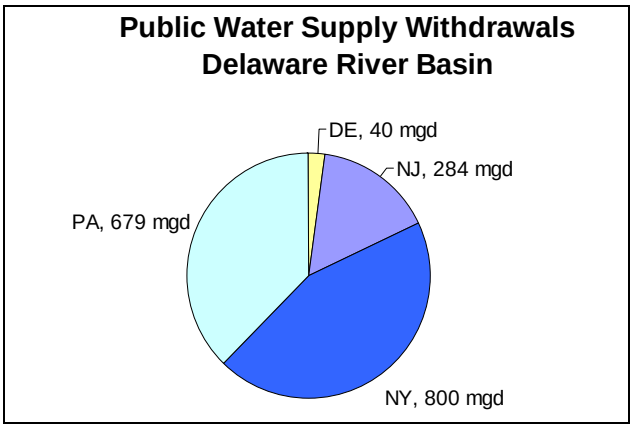


Figure 6. Public water supply withdrawals in the Delaware River Basin (DRBC)

Reservoir Storage

Almost 369 billion gallons of water is stored in reservoirs for interstate flow management and drinking water supply in the Delaware Basin (Table 22). The New Jersey Water Supply Authority operates a reservoir system and Delaware & Raritan Canal diversion from the Delaware River to New Jersey. The NJWSA delivers untreated water to public water purveyors from the Raritan River reservoir system at an estimated market price of $0.394/1,000 gallons (NJWSA 2011). Given the raw water value of drinking water before treatment) is $0.394/1000 gallons, the annual value of reservoir storage for flow management purposes in the Delaware Basin is $145 million.

Table 22. Economic value of reservoir storage in the Delaware River Basin

Reservoir	Storage (BG)	Value ($0.394/1000 gal)
Pepacton	140	55,160,000
Cannonsville	96	37,824,000
Neversink	35	13,790,000
Mongaup	15	5,910,000
Merrill Creek	16	6,304,000
Hoopes	2	788,000
Marsh Creek	4	1,576,000
Blue Marsh	6	2,561,000
Beltzville	13	5,122,000
F. E. Walter	11	4,334,000
L.Waullenpaupack	30	11,820,000
Total	**368**	**145,189,000**

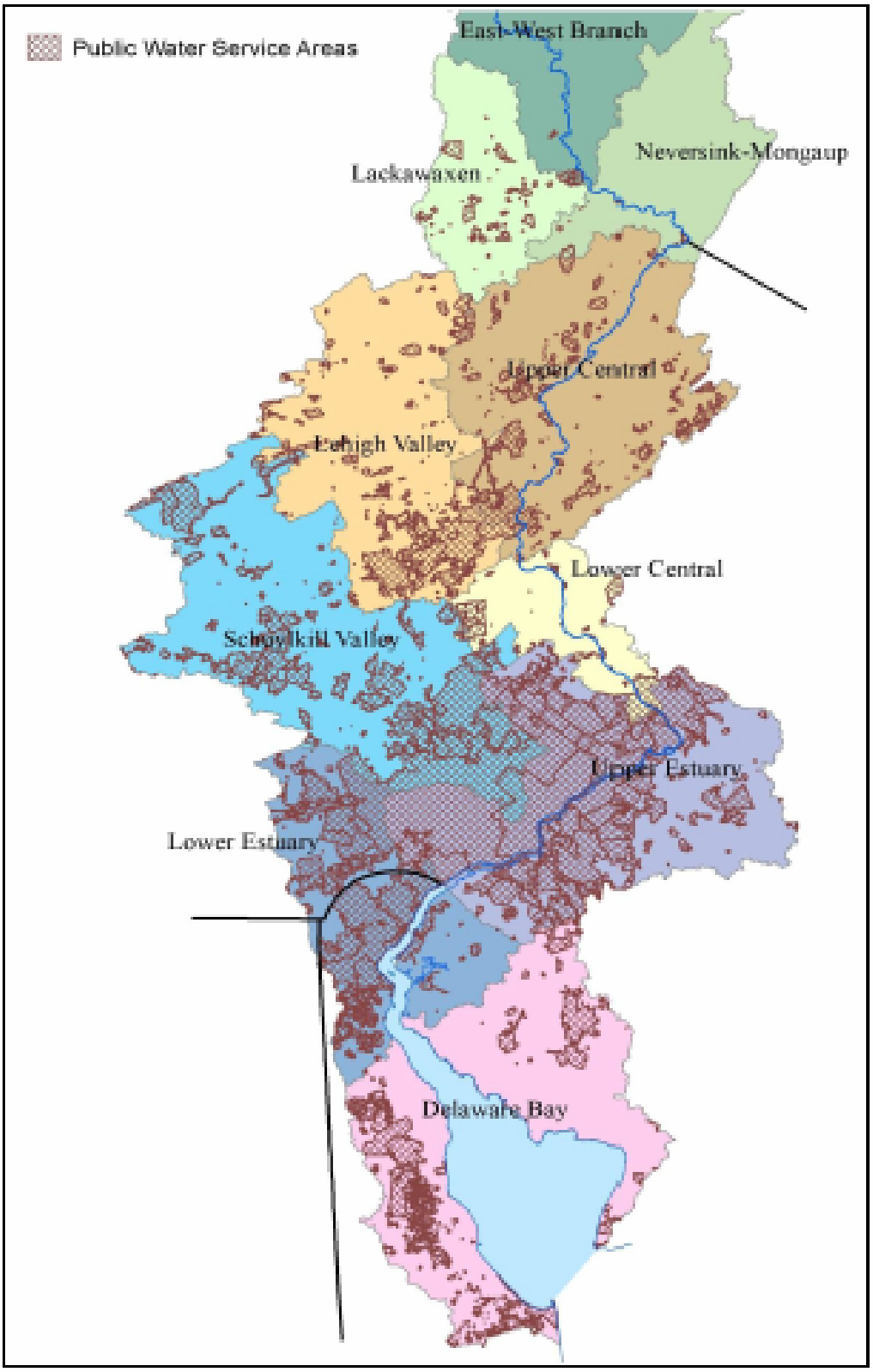


Figure 7. Public water supply service areas in the Delaware River Basin (DRBC 2011)

Irrigation Water Supply

Agricultural irrigation withdrawals allocated by DRBC total 36.5 mgd. The DRBC allocates groundwater withdrawals over 100,000 gpd therefore many small irrigation wells are not included in this total. Resources for the Future studied the economic value of freshwater in the U.S. estimated the median value of irrigation water withdrawals is $198/ac-ft in $1996 (Frederick et al. 1996) or $300/ac-ft ($0.92/1000 gal) in $2010 adjusting for 3% annually (Table 23). The value of irrigation withdrawals based on DRBC allocations is $33,630 per day or $12,275,000 per year (Table 24).

Table 23 Freshwater values in the United States by use

Use	2006 Median[1] ($/ac-ft)	2010 Median[2] ($/ac-ft)	2010 Median ($/1000 gal)
Hydropower	21	32	0.10
Industrial Process	132	200	0.61
Irrigation	198	300	0.92
Navigation	10	15	0.02
Thermoelectric Power	29	44	0.14

1. Frederick et al. 1996. 2. Adjusted to $2010 at 3% annually.

Table 24. Value of agricultural irrigation supply in the Delaware River Basin

Watershed	Withdrawal (mgd)	Irrigation Value/day ($0.92/1000 gal)	Irrigation Value/year ($0.92/1000 gal)
Upper Region	0.65	597	217,731
Upper Central	4.91	4,515	1,647,916
Lehigh Valley	0.20	184	67,118
Lower Central	1.51	1,389	507,084
Schuylkill Valley	0.02	23	8,358
Upper Estuary	4.15	3,819	1,394,036
Lower Estuary	7.58	6,976	2,546,164
Delaware Bay	17.53	16,128	5,886,540
Delaware Basin	**36.55**	**33,630**	**12,274,946**

Over 209,882 acres or 7% of cropland are irrigated in Delaware Basin counties (USDA 2009). About 1,926,524 acres or 24% of the basin is farmland, therefore, by proportion about 141,138 acres are irrigated (Table 25). Annual irrigation water needs from June - September are 9 inches for corn, soybeans, and grain (2,600 gpd/ac, 366 mgd). The economic value of water to irrigate 141,138 acres is $31.8 million, or $13.8 million in Del., $14.3 million in NJ, 0.9 million in NY, and $2.7 million in Pa.. The value of irrigation water demand = (9 in/12 in/ft)(141,138)($300/ac-ft) = $31,756,104/yr.

Table 25. Value of agriculture irrigation water demand in the Delaware River Basin

County	Cropland by county[1] (ac)	Irrigation by county[1] (ac)	Farmland in basin (ac)	Irrigated land in basin (ac)	Value of irrigation[2] @ $300/ac-ft
New Castle	51,913	2,711			
Kent	146,536	29,066			
Sussex	234,324	72,785			
Delaware	**432,773**	**104,562**	**254,143**	**61,403**	**$13,815,748**
Burlington	85,790	12,620			
Camden	8,760	2,647			
Cape May	7,976	2,342			
Cumberland	69,489	18,357			
Gloucester	46,662	12,891			
Hunterdon	100,027	1,501			
Mercer	21,736	1,028			
Monmouth	44,130	5,976			
Ocean	9,833	1,090			
Salem	96,530	18,001			
Sussex	65,242	454			
Warren	74,975	2,426			
New Jersey	**631,150**	**79,333**	**505,507**	**63,540**	**$14,296,541**
Broome	86,613	150			
Delaware	165,572	65			
Greene	44,328	735			
Orange	80,990	4,560			
Sullivan	50,443	75			
Ulster	75,205	4,707			
New York	**503,151**	**10,292**	**187,561**	**3,837**	**$863,230**
Berks	170,760	1,260			
Bucks	58,012	1,421			
Carbon	20,035	132			
Chester	117,145	1,659			
Delaware	1,646	36			
Lackawanna	39,756	258			
Lancaster	326,648	5,366			
Lebanon	89,566	1,276			
Lehigh	72,737	1,189			
Luzerne	66,577	60			
Monroe	29,165	97			
Montgomery	28,563	668			
Northampton	68,252	247			
Philadelphia	150	0			
Pike	27,569	12			
Schuylkill	81,276	1,896			
Wayne	99,939	118			
Pennsylvania	**1,297,796**	**15,695**	**979,313**	**11,843**	**$2,664,765**
Total	**2,864,870**	**209,882**	**1,926,524**	**141,138**	**$31,756,104**

1. Census of Agriculture 2007 (USDA 2009). 2. Frederick, VandenBerg, and Hansen 1996.

Thermoelectric Power Water Supply

Cooling water withdrawals for thermoelectric power plants in the Delaware Basin provide significant economic value. Over 89% of the energy in the United States is produced by thermoelectric power plants which evaporate water during cooling of condensate. The Delaware Basin provides 5,809

mgd of cooling water to run nuclear, coal, and gas fired power plants to generate 13,458 megawatts of electricity along the Delaware, Schuylkill, and Lehigh. About 95% of the cooling water returns to the river or bay (nonconsumptive use) and 5% evaporates (consumptive use). Table 26 lists power plants and associated cooling water withdrawals within the Delaware Basin obtained from U. S. Energy Information Administration (2002) and U.S. National Energy Technology Laboratory (2009) inventories of electric utility power plants and DRBC water allocation dockets.

Resources for the Future in a study of the economic value of freshwater in the United States estimated the median $1996 value of thermoelectric power water withdrawals is $29/ac-ft ($0.09/1000 gal) with a range of $9 to $63/ac-ft (Frederick et al. 1996). Adjusting for 3% annually, the median $2010 value of thermoelectric plant water withdrawals is $44 per ac-ft or $0.14/1000 gal. At $0.14/1000 gal, the value of thermoelectric water withdrawals in the Delaware Basin is $297 million/yr or $24 million/yr in Delaware, $196 million/yr in New Jersey, and $77 million/yr in Pennsylvania (Table 27).

Table 26. Thermoelectric power plant water withdrawals in the Delaware River Basin

State/Power Plant	Type	Capacity[1] (megawatts)	Withdrawal (mgd)	Value/day[2] ($0.14/1000 gal)[1]	Value/year ($0.14/1000 gal)
Delaware		**1,009**	**479**	**67,060**	**24,476,900**
Delmarva Delaware City		9	9		
Conectiv Edgemoor	Coal/Gas	1,000	470		
New Jersey		**4,920**	**3,830**	**536,200**	**195,713,000**
PSEG Salem 1 and 2	Nuclear	2,275	2,643		
PSEG Hope Creek	Nuclear	1,268	52		
Chambers Cogen. Salem	Coal	285			
Deepwater Station	Coal	82	219		
Logan Generating	Coal	242	38		
PSEG Mercer Trenton	Coal	768			
Pennsylvania		**7,529**	**1,500**	**210,000**	**76,650,000**
PECO Chester	Coal	56			
PECO Cromby	Coal	417			
PECO Croyden	Coal	546			
PECO Delaware (Phila.)	Coal	392			
PECO Eddystone	Coal	1,448			
PECO Fairless Hills	Coal	75			
PECO Falls	Coal	64			
PECO Limerick	Nuclear	2,230			
PECO Moser	Coal	64			
PECO Richmond (Phila.)	Coal	132			
PECO Schuylkill (Phila.)	Oil	233			
PECO Southwark (Phila.)	Coal	74			
PGE Northamp. Lehigh	Coal	134			
PPL Martins Creek	Coal	1,664	Shut 2007		
Delaware Basin		**13,458**	**5,809**	**813,260**	**296,839,900**

1. EIA 2002, NETL 2009, and DRBC. 2. Frederick et al. 1996 adjusted to $2010 at 3% annually.

Table 27. Value of thermoelectric power withdrawals in the Delaware River Basin

Watershed	Withdrawal [1] (mgd)	Value/day[2] ($0.14/1000 gal)	Value/year ($0.14/1000 gal)
Upper Region	0	0	0
Upper Central	394	55,160	20,133,400
Lehigh Valley	2	280	102,200
Lower Central	24	3,360	1,226,400
Schuylkill Valley	232	32,480	11,855,200
Upper Estuary	1,461	204,540	74,657,100
Lower Estuary	3,696	517,440	188,865,600
Delaware Bay	0	0	0
Delaware Basin	**5,809**	**813,260**	**296,839,900**

1. DRBC. 2. Frederick et al. 1996 adjusted to $2010 at 3% annually)

Industrial Water Supply

Industrial water withdrawals allocated by DRBC total 804 mgd in the Delaware River Basin (Table 28). A study of the economic value of freshwater in the U.S. indicates the median value of industrial withdrawals is $132/ac-ft in $1996 (Frederick et al. 1996) or $200/ac-ft ($0.61/1000 gal) in $2010 adjusting for 3% annually. The value of industrial withdrawals based on DRBC allocated supplies is $490,684 per day or $179,099,660 per year.

Table 28. Value of industry process water withdrawals in the Delaware River Basin

Watershed	Withdrawal [1] (mgd)	Industry Value/day[2] ($0.61/1000 gal)	Industry Value/year ($0.61/1000 gal)
Upper Region	0	0	0
Upper Central	31	18,727	6,835,355
Lehigh Valley	73	44,591	16,275,715
Lower Central	71	43,188	15,763,620
Schuylkill Valley	40	24,583	8,972,795
Upper Estuary	132	80,703	29,456,595
Lower Estuary	446	271,877	99,235,105
Delaware Bay	12	7,015	2,560,475
Delaware Basin	**804**	**$490,684**	**$179,099,660**

1. DRBC water allocations. 2. Frederick et al. 1996 adjusted to $2010 at 3% annually

Hydropower Water Supply

Hydropower water supply withdrawals allocated by DRBC total 539 mgd in the upper Delaware Basin at the Delaware Water Gap at Yards Creek and above Pt. Jervis (Table 29). A study of the economic value of freshwater in the U.S. indicates the median value of hydropower withdrawals is $21/ac-ft in $1996 (Frederick et al. 1996) or $32/ac-ft ($0.10/1000 gal) in $2010 adjusting for 3%

annually. The value of hydropower water withdrawals based on DRBC allocated supplies is $53,879 per day or $19,662,550 per year.

Table 29. Value of hydroelectric water supplies in the Delaware River Basin

Watershed	Withdrawal[1] (mgd)	Hydropower Value/day[2] ($0.10/1000 gal)	Hydropower Value/year ($0.10/1000 gal)
Upper Region	393	39,330	14,355,450
Upper Central	145	14,540	5,307,100
Lehigh Valley	0	0	0
Lower Central	0	0	0
Schuylkill Valley	0	0	0
Upper Estuary	0	0	0
Lower Estuary	0	0	0
Delaware Bay	0	0	0
Delaware Basin	**539**	**53,870**	**19,662,550**

1. DRBC water allocations. 2. Frederick et al. 1996 adjusted to $2010 at 3% annually

Fish/Wildlife

Fish Landings

The annual value of fish landings (Table 30) in the tidal Delaware River and Bay is $25.4 million in $2000 or $34.1 million in $2010 as reported to the National Marine Fisheries Service and tabulated by the National Ocean Economics Program (2007). Table 31 ranks the most lucrative fisheries in the Delaware Estuary as blue crab ($14.4 million/yr), summer flounder ($5.3 million/yr), Atlantic menhaden ($4.3 million/yr), eastern oyster ($3.7 million/yr), striped bass ($2.3 million/yr), and American eel ($0.8 million/yr). Figure 8 charts fish landings for Delaware Estuary species.

Table 30. Fish landings and landed value in the Delaware Estuary in $2000

	Delaware		New Jersey		Pennsylvania		Delaware Estuary	
Delaware Estuary Species[1]	**Pounds**	**Value ($2000)**	**Pounds**	**Value ($2000)**	**Pounds**	**Value ($2000)**	**Pounds[2]**	**Value[2] ($2000)**
Bass, Striped	188,671	$429,994	564,000	$1,287,000	211	$378	752,882	$1,717,372
Bluefish	19,565	$8,075	1,403,717	$500,053			1,423,282	$508,128
Carp. Common	3,764	$865			6,724	$26,805	10,488	$27,670
Catfish, Channel	6,922	$3,929					6,922	$3,929
Crab, Blue	3,799,820	$5,329,182	4,636,368	$5,471,115			8,436,188	$10,800,297
Crab, Horseshoe	229,602	$48,978					229,602	$48,978
Drum, Black	37,712	$21,867	1,518	$444			39,230	$22,311
Eel, American	139,648	$315,094	159,292	$310,417			298,940	$625,511
Flounder, Summer	5,464	$11,119	1,697,513	$3,988,869			1,702,977	$3,999,988
Herring, Blueback	1,434	$609					1,434	$609
Herring, Atlantic			6,039,473	$563,083			6,039,473	$563,083
Menhaden, Atlantic	85,080	$6,635	37,634,929	$3,193,724			37,720,009	$3,200,359
Oyster, Eastern	79,933	$490,465	444,227	$2,230,835			524,160	$2,721,300
Perch, White	55,973	$46,865	27,527	$29,654	4,560	$7,981	88,060	$84,500
Perch, Yellow					20,527	$71,847	20,527	$71,847
Shad, American	71,445	$42,408	58,981	$77,015			130,426	$119,423
Shellfish	30,130	$76,119					30,130	$76,119
Snails (Conchs)			30,250	$59,016			30,250	$59,016
Weakfish	24,604	$36,177	164,506	$225,051			189,110	$261,228
Whelk,Chan'd/Knob	277,217	$511,172					277,217	$511,172
Total	**5,056,984**	**$7,379,553**	**52,862,301**	**$17,936,276**	**32,022**	**$107,011**	**57,951,307**	**$25,422,840**

1. Dove and Nyman 1995. 2. NMFS and National Ocean Economics Program 2007.

Table 31. Fish landings and value in the Delaware Estuary in $2010

Delaware Estuary Species[1]	Value ($2000)[2]	Value ($2010)[3]
Crab, Blue	$10,800,297	$14,472,398
Flounder, Summer	$3,999,988	$5,359,984
Menhaden, Atlantic	$3,200,359	$4,288,481
Oyster, Eastern	$2,721,300	$3,646,542
Bass, Striped	$1,717,372	$2,301,278
Eel, American	$625,511	$838,185
Herring, Atlantic	$563,083	$754,531
Bluefish	$508,128	$680,892
Whelk,Chan'd/Knob	$511,172	$684,970
Weakfish	$261,228	$350,046
Shad, American	$119,423	$160,027
Perch, White	$84,500	$113,230
Shellfish	$76,119	$101,999
Perch, Yellow	$71,847	$96,275
Snails (Conchs)	$59,016	$79,081
Crab, Horseshoe	$48,978	$65,631
Carp. Common	$27,670	$37,078
Drum, Black	$22,311	$29,897
Catfish, Channel	$3,929	$5,265
Herring, Blueback	$609	$816
Total	**$25,422,840**	**$34,066,606**

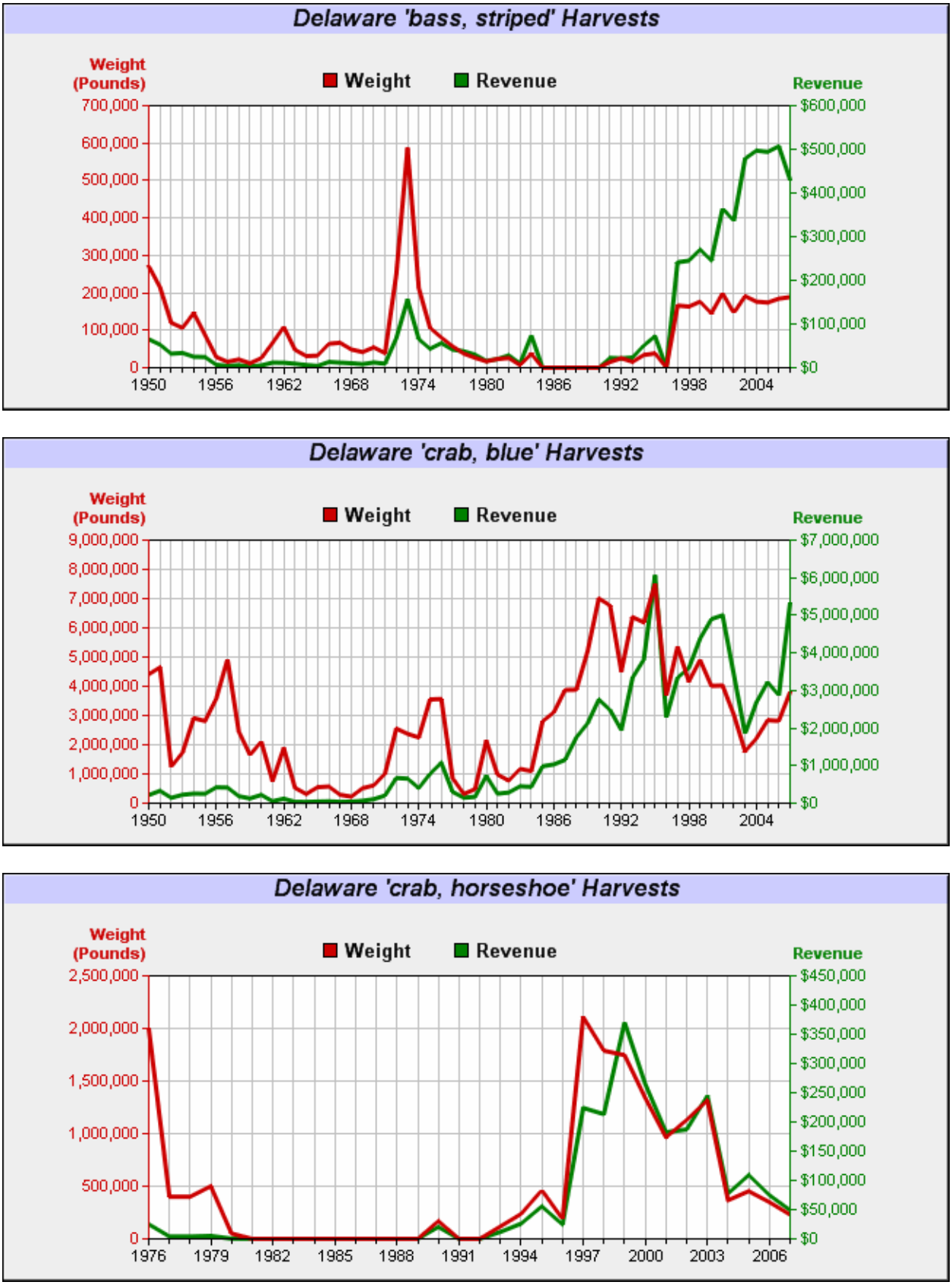
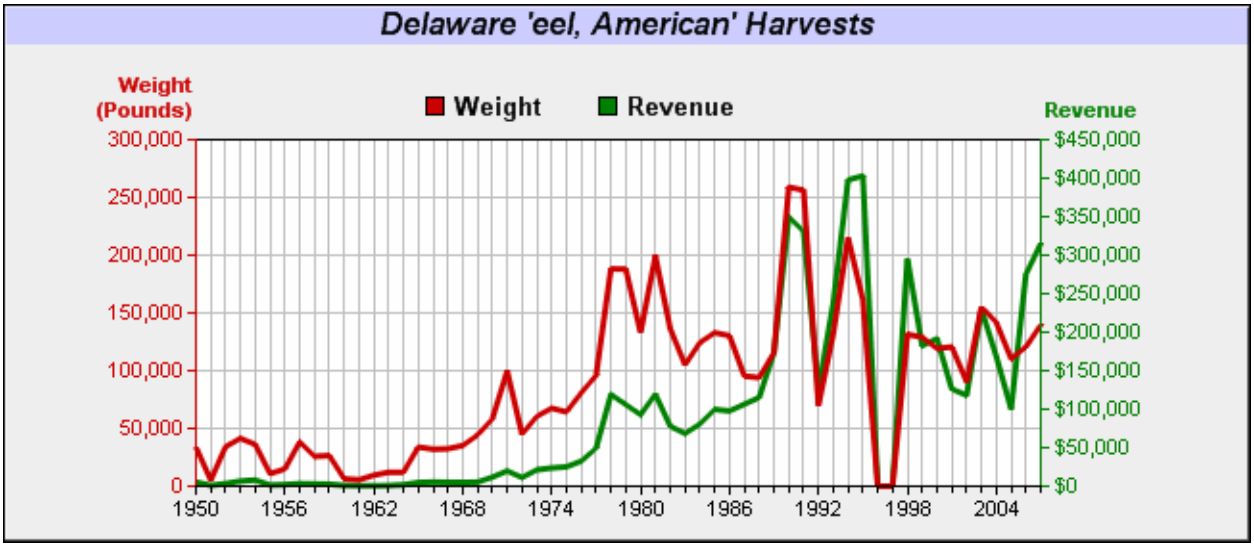
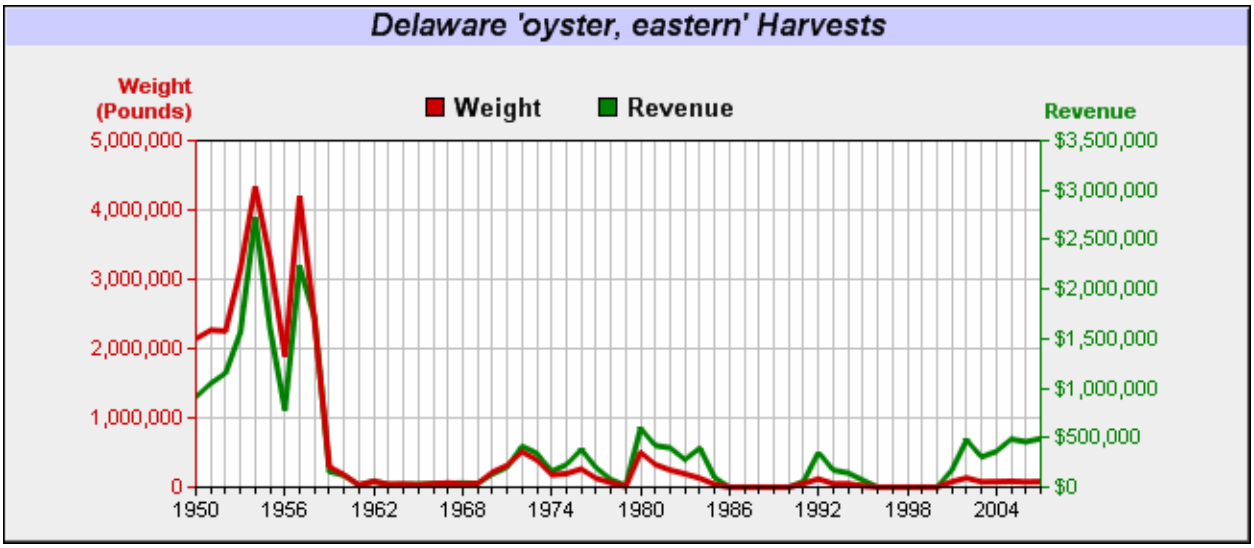


Figure 8. Fish landings in the Delaware Estuary (NMFS and NOEP 2007)





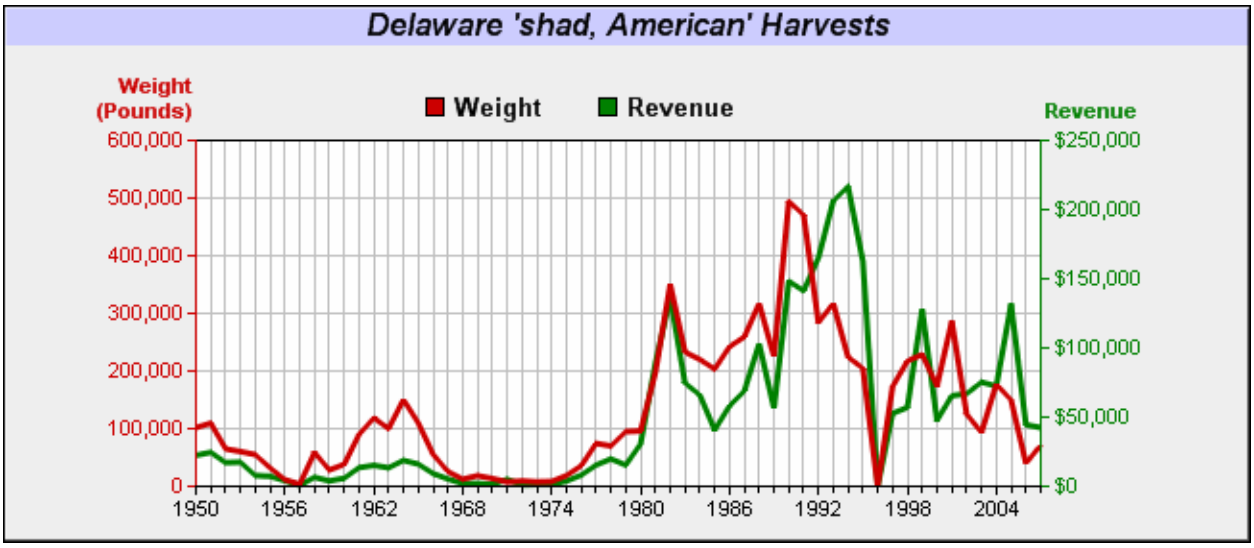
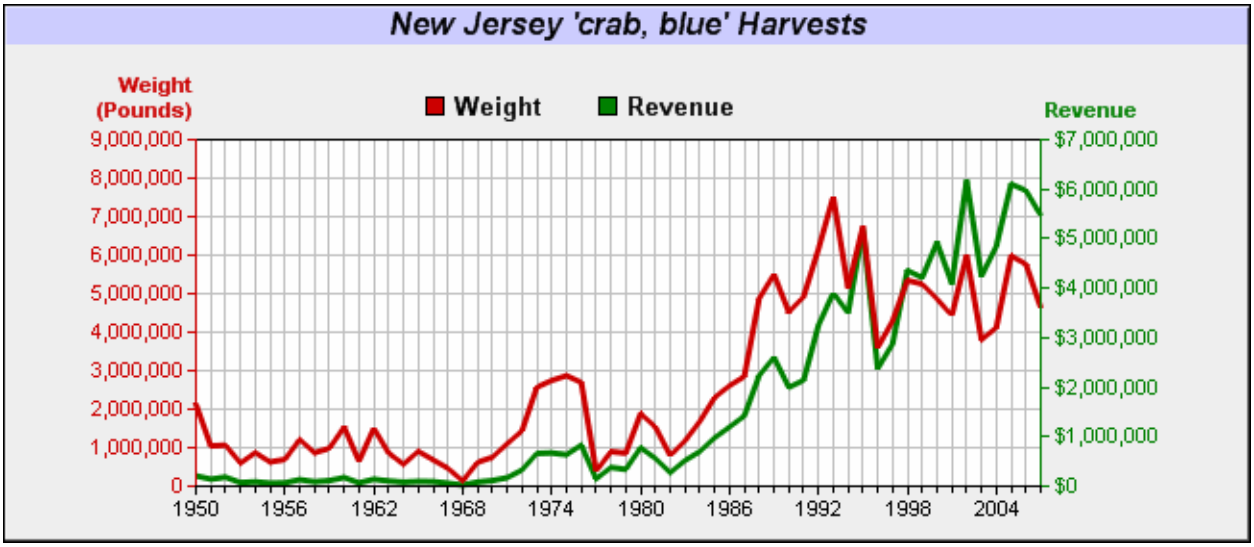
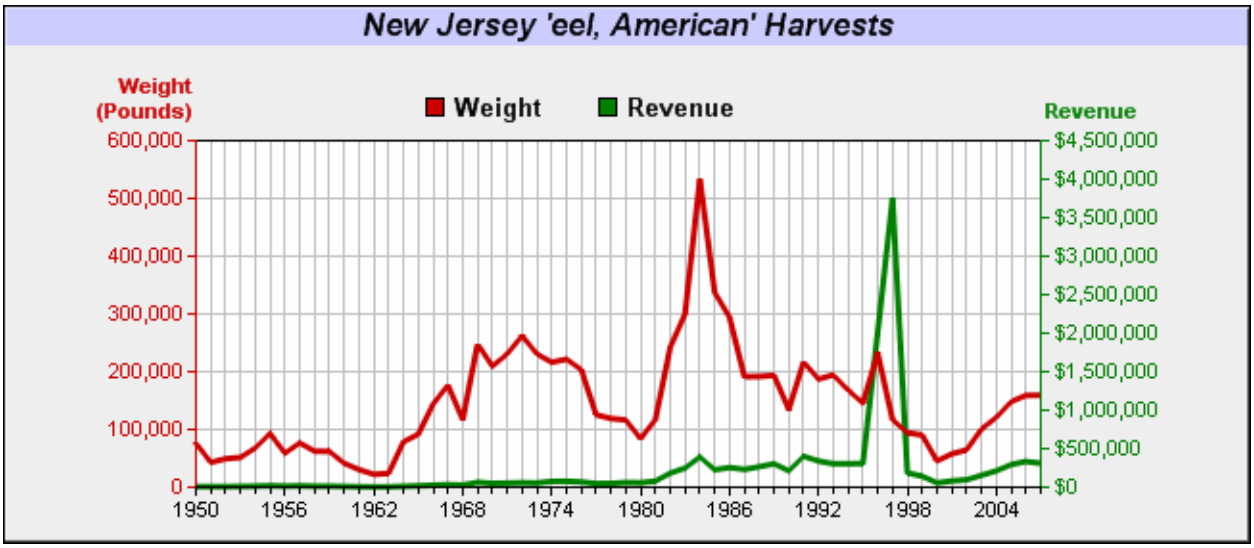


Figure 8. Fish landings in the Delaware Estuary, con't. (NMFS and NOEP 2007)





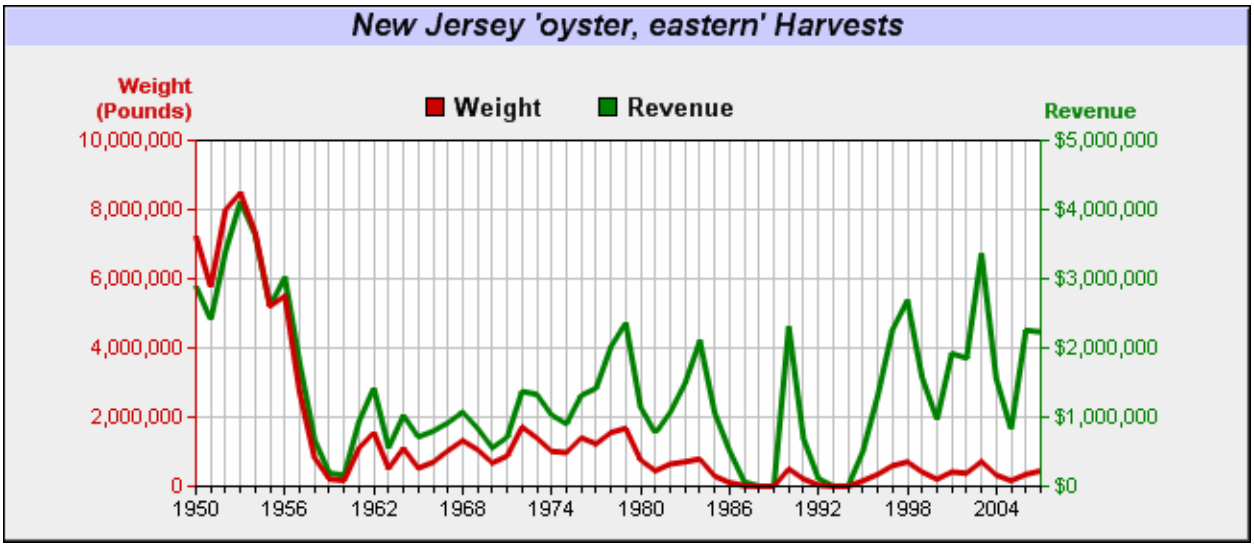
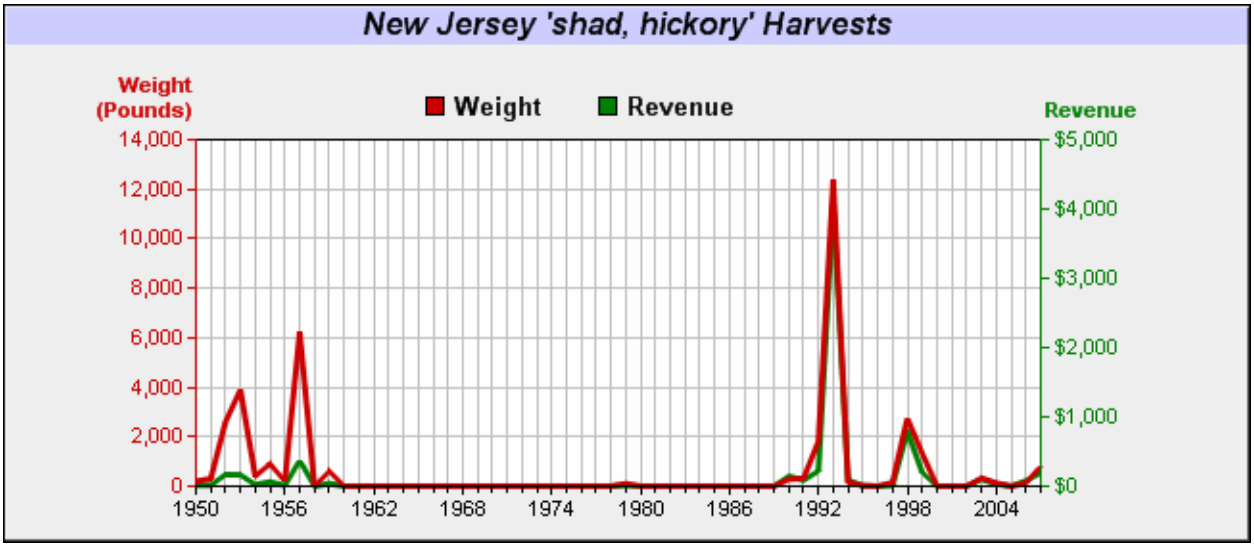
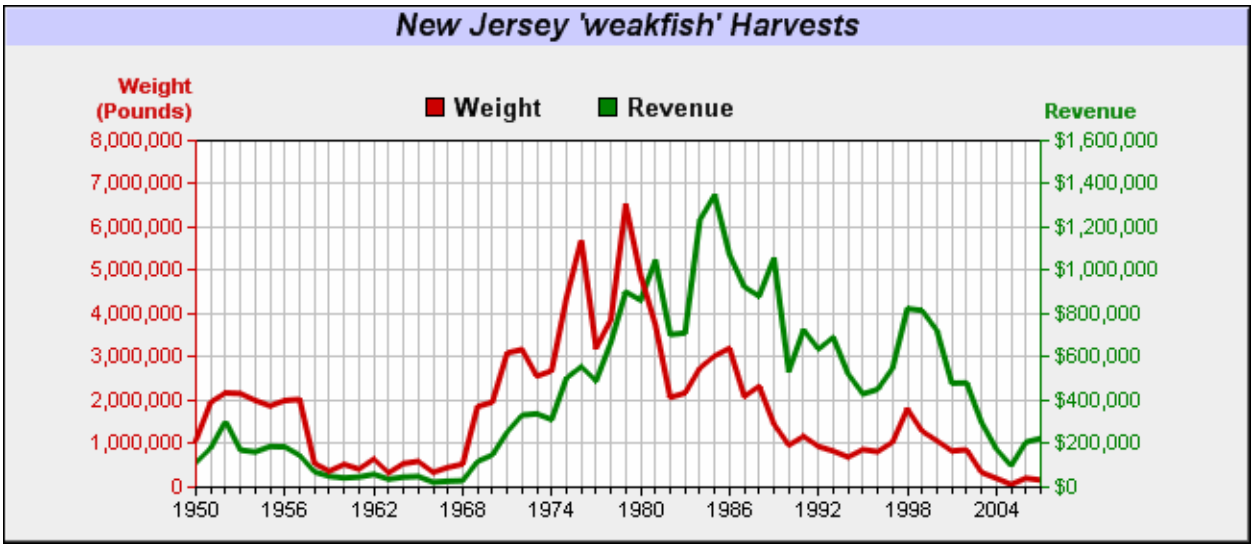


Figure 8. Fish landings in the Delaware Estuary, con't. (NMFS and NOEP 2007)





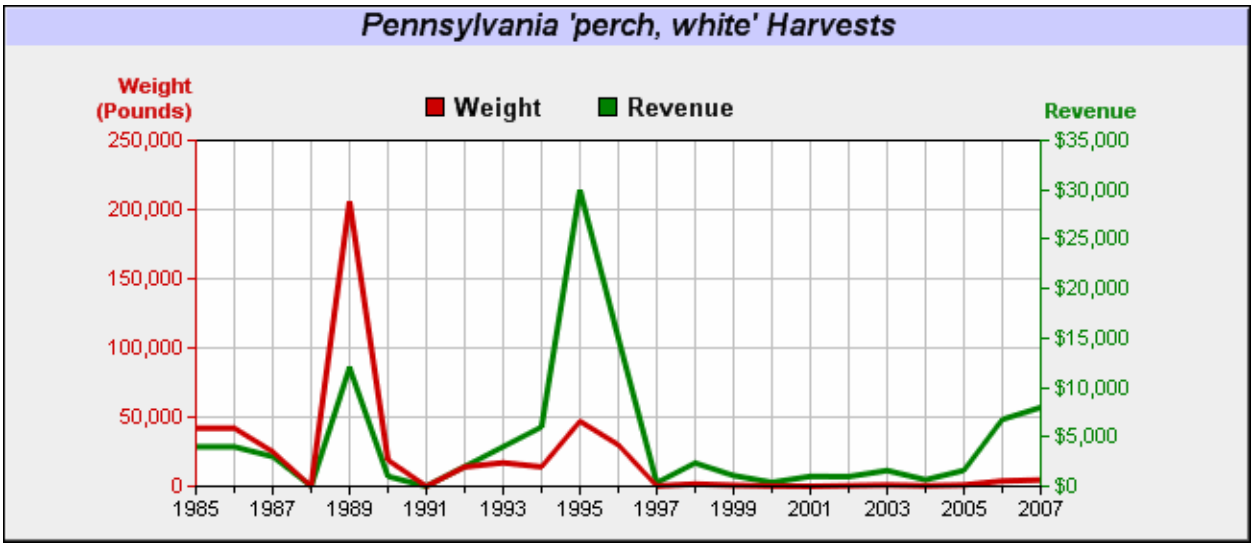


Figure 8. Fish landings in the Delaware Estuary, con't. (NMFS and NOEP 2007)

Fishing, Hunting, and Bird/Wild-life Watching

In Delaware, New Jersey, New York, and Pennsylvania, the U. S. Fish and Wildlife Service (2008) estimated the annual economic value of fishing, hunting, birding and wild-life/bird watching recreation was $9.2 billion in $2006. Trip-related expenditures include food and lodging, transportation, and hunting, fishing, and wildlife watching equipment. Most fishing, hunting, and birding/wildlife recreation occurs on farm, forest, wetlands, and open water ecosystems such as the Prime Hook and Bombay Hook National Wildlife Refuges in Delaware, the Cape May National Wildlife Refuge and Pine Barrens National Reserve in New Jersey, the Catskill Mountain Preserve in New York, the Delaware Water Gap National Recreation Area in Pennsylvania, and on the Delaware River and Bay and tributaries as well.

The Delaware Basin includes 50% of Delaware's land area, 40% of New Jersey's land area, 5% of New York State's land area, 14% of Pennsylvania's land area. Prorating based on the ratio of the area of the state within the basin to total state area, estimated economic value of fishing, hunting, and wild-life associated recreation in the Delaware Basin is $1,477 million/yr in $2006 or $134 million/yr in Delaware, $574 million/yr in New Jersey, $160 million/yr in New York, and $608 million/yr in Pennsylvania (Table 32).

Table 32. Value of fishing, hunting, and wildlife recreation in the Delaware River Basin

Recreation Activity	DE by state[1] ($M)	NJ by state[1] ($M)	NY by state[1] ($M)	PA by state[1] ($M)	DE in basin[2] ($M)	NJ in basin[2] ($M)	NY in basin[2] ($M)	PA in basin[2] ($M)	Del. Basin ($M)
Fishing	**97**	**752**	**926**	**1,291**	**48**	**301**	**46**	**181**	**576**
Trip Related	**49**	**471**	**585**	**299**	**24**	**188**	**29**	**42**	**284**
Equipment/other	**48**	**281**	**341**	**993**	**24**	**112**	**17**	**139**	**293**
Hunting	**41**	**146**	**716**	**1,609**	**21**	**58**	**36**	**225**	**340**
Trip-related	14	73	202	274	7	29	10	38	84
Equipment/other	28	73	514	1,335	14	29	26	187	256
Wildlife/Bird-watching	**131**	**537**	**1,568**	**1,443**	**65**	**215**	**78**	**202**	**561**
Trip Related	13	146	696	325	7	59	35	46	145
Equipment/other	118	391	872	1,118	59	156	44	156	415
Total	**269**	**1,436**	**3,209**	**4,343**	**134**	**574**	**160**	**608**	**1,477**

1. (USFWS 2008). Prorated by ratio of basin to state land area, Del. (50%), NJ (40%), NY (5%), and Pa. (14%).

Shad Fishing

The Pennsylvania Fish and Boat Commission (2011) published a fact sheet on the economic value of fishing and boating in Pennsylvania. A 1986 study of shad fishing on the Delaware River showed:

- Anglers spent an average of $25.40 per trip on gasoline, food, lodging, and tackle. Multiplied by 63,000 trips in 1986, anglers spent $1.6 million during a nine week season. Adjusting by 3% annually, the economic contribution by shad anglers would be about $3.2 million in $2010.
- The average shad angler was willing to pay $50 per day of shad fishing or $102 per day when adjusted to $2010 at 3% annually. Multiplied by 63,000 angler days, the annual economic value based on willingness to pay for the Delaware River shad fishery was $3.2 million in 1986 or $6.5 million adjusted to $2010.

Wild Trout Fishing

Releases from New York City reservoirs and excellent water quality in the forested Catskill watersheds contribute to a thriving cold water fishery in the upper Delaware Basin. Along the Beaverkill and East Branch, West Branch, and upper main stem of the Delaware River in New York, wild trout fishing contributes almost $18 million in annual business revenue, over $29 million in economic activity, and almost 350 jobs with $3.6 million in wages (Maharaj, McGurrin, and Carpenter, 1998).

Agriculture

In Delaware Basin counties, the USDA (2009) estimates the annual market value of agricultural products sold is $4.79 billion on 2,857,870 acres (4,465 sq mi) for crops (corn, wheat, oats, barley, soybeans, potatoes, and vegetables) and livestock and poultry (Table 33). On 1,926,524 acres (3,010 sq mi) of farmland within the Delaware Basin, the prorated annual market value of agricultural products sold is $3.37 billion or $1,750 per acre. The Delaware Basin covers 12,769 sq mi or just 13% of the combined land areas of Delaware (1,953 sq mi), New Jersey (7,417 sq mi), New York (47,214 sq mi), and Pennsylvania (44,816 sq mi) yet accounts for $3.37 billion or 27% of total annual farm products sold in the four states (Table 34).

Table 33. Farm products sold in the Delaware River Basin

State	State area (sq mi)	Area in Del. Basin (sq mi)	Ratio area basin/area state (%)	Farm products sold in state ($ million)	Farm products Del. Basin ($ million)	Products in basin/state (%)
Delaware	1,953	965	49%	1,083	636	59%
New Jersey	7,417	2,961	40%	987	603	61%
New York	47,214	2,555	5%	4,418	105	2%
Pennsylvania	44,816	6,280	14%	5,808	2,027	35%
Total	**101,400**	**12,761**	**13%**	**12,296**	**3,371**	**27%**

Table 34. Value of cropland and agriculture in the Delaware River Basin

County	Farmland by county[1] (ac)	Products sold by county[1] ($ million)	Products sold by county ($/ac)	Farmland in Del. Basin (ac)	Products sold in Del. Basin ($ million)
New Castle	51,913	45.7	880		
Kent	146,536	188.4	1,286		
Sussex	234,324	848.9	3,623		
Delaware	**432,773**	**1,083.0**	**2,502**	**254,143**	**636**
Burlington	85,790	86.3	1,006		
Camden	8,760	18.6	2,123		
Cape May	7,976	14.6	1,830		
Cumberland	69,489	156.9	2,258		
Gloucester	46,662	93.9	2,012		
Hunterdon	100,027	69.7	697		
Mercer	21,736	18.6	856		
Monmouth	44,130	105.4	2,388		
Ocean	9,833	11.5	1,170		
Salem	96,530	80.0	829		
Sussex	65,242	21.2	325		
Warren	74,975	75.5	1,007		
New Jersey	**631,150**	**752.2**	**1,192**	**505,507**	**602**
Broome	86,613	29.9	345		
Delaware	165,572	55.1	333		
Greene	44,328	16.4	370		
Orange	80,990	73.7	910		
Sullivan	50,443	42.1	835		
Ulster	75,205	65.6	872		
New York	**503,151**	**282.8**	**562**	**187,561**	**105**
Berks	170,760	367.8	2,154		
Bucks	58,012	70.6	1,217		
Carbon	20,035	8.9	444		
Chester	117,145	553.3	4,723		
Delaware	1,646	9.4	5,711		
Lackawanna	39,756	16.2	407		
Lancaster	326,648	1,072.1	3,282		
Lebanon	89,566	257.1	2,871		
Lehigh	72,737	72.1	991		
Luzerne	66,577	18.1	272		
Monroe	29,165	7.8	267		
Montgomery	28,563	30.0	1,050		
Northampton	68,252	31.8	466		
Philadelphia	150	0.5	3,333		
Pike	27,569	2.5	91		
Schuylkill	81,276	124.7	1,534		
Wayne	92,939	29.4	316		
Pennsylvania	**1,290,796**	**2,672.3**	**2,070**	**979,313**	**2,027**
Delaware Basin	**2,857,870**	**4,790.3**	**1,676**	**1,926,524**	**3,371**

1. Census of Agriculture 2007 (USDA 2009)

Forests

The U. S. Forest Service and Delaware Center for Horticulture (Nowak et al. 2008) estimated 7,137 acres of forests in New Castle County have a carbon storage benefit of $5.9 million ($827/ac) and air pollution removal of $1.9 million ($266/ac/yr). Applying these multipliers, Tables 35 and 36 indicate 4,343,190 (6,786 sq mi) of forests in the Delaware Basin have economic benefits from carbon storage ($3,591 million), air pollution removal ($1,155 million), building energy savings ($243 million), and carbon sequestration ($126 million).

Table 35. Economic benefits of forests in the Delaware River Basin

Forest Benefits	New Castle County.[1] ($/ac)	Delaware. Basin[2] ($ mil.)
Carbon storage	827	3,592
Carbon Sequestration	29	126
Air Pollution Removal	266	1,155
Building Energy Savings	56	243
Avoided Carbon Emissions	3	13

1. Nowak et al. 2008.
2. Computed for Delaware Basin forests (4,343,190 ac).

Table 36. Economic benefits of forests in the Delaware River Basin by state

Forest Benefits	Del. ($ mil.)	NJ ($ mil.)	NY ($ mil.)	Pa. ($ mil.)	Del. Basin ($ mil.)
Carbon Storage	78.8	564.8	1,147.5	1,800.8	3,592
Carbon Sequest.	2.8	19.8	40.2	63.1	126
Air Pollution Contr.	25.4	181.7	369.1	579.2	1,155
Energy Savings	5.4	38.2	77.7	121.9	243
Avoid Carbon Emiss.	0.3	2.0	4.2	6.5	13

Open Space

Public Parks

The Trust for Public Land (2009) found the 444-acre City of Wilmington park and recreation system provides annual economic value and savings to the public from health benefits from exercise in the parks ($9,734/ac), community cohesion benefit from people socializing in the parks ($2,383/ac), water pollution benefit from parks in treating stormwater ($921/ac), air pollution mitigation value from tree and shrub absorption ($88/ac).

Using value transfer from the data gathered for the City of Wilmington study, Table 37 indicates public parks (169 sq mi) within the Delaware Basin provide the following annual economic value:

- Health benefits from exercise in the parks ($1,283 million).
- Community cohesion benefit from people socializing in the parks ($314 million).
- Water pollution benefit from parks in treating stormwater ($121million).
- Air pollution mitigation value from tree and shrub absorption ($12 million).

Table 37. Value of public parks in the Delaware River Basin

State/county	Parks in Del. Basin (ac)	Health Benefits ($9,734/ac)	Community Cohesion ($2,383/ac)	Stormwater Benefit ($921/ac)	Air Pollution ($88/ac)
Kent	4,587	44,649,858	10,930,821	4,224,627	403,656
New Castle	12,440	121,090,960	29,644,520	11,457,240	1,094,720
Sussex	1,389	13,520,526	3,309,987	1,279,269	122,232
Delaware[1]	**18,416[1]**	**179,261,344**	**43,885,328**	**16,961,136**	**1,620,608**
Burlington	7,970	77,579,980	18,992,510	7,340,370	701,360
Camden	2,985	29,055,990	7,113,255	2,749,185	262,680
Cape May	2,911	28,335,674	6,936,913	2,681,031	256,168
Cumberland	2,640	25,697,760	6,291,120	2,431,440	232,320
Gloucester	4,868	47,385,112	11,600,444	4,483,428	428,384
Hunterdon	3,170	30,856,780	7,554,110	2,919,570	278,960
Mercer	8,283	80,626,722	19,738,389	7,628,643	728,904
Monmouth	105	1,022,070	250,215	96,705	9,240
Ocean	199	1,937,066	474,217	183,279	17,512
Salem	2,144	20,869,696	5,109,152	1,974,624	188,672
Sussex	2,961	28,822,374	7,056,063	2,727,081	260,568
Warren	5,563	54,150,242	13,256,629	5,123,523	489,544
New Jersey[2]	**31,800[2]**	**426,339,466**	**104,373,017**	**40,338,879**	**3,854,312**
Broome	389	3,786,526	926,987	358,269	34,232
Delaware	546	5,314,764	1,301,118	502,866	48,048
Orange	413	4,020,142	984,179	380,373	36,344
Sullivan	1,570	15,282,380	3,741,310	1,445,970	138,160
Ulster	50	486,700	119,150	46,050	4,400
New York[3]		**28,890,512**	**7,072,744**	**2,733,528**	**261,184**
Berks	3,979	38,731,586	9,481,957	3,664,659	350,152
Bucks	11,402	110,987,068	27,170,966	10,501,242	1,003,376
Carbon	2,820	27,449,880	6,720,060	2,597,220	248,160
Chester	12,020	117,002,680	28,643,660	11,070,420	1,057,760
Delaware	6,274	61,071,116	14,950,942	5,778,354	552,112
Lehigh	2,500	24,335,000	5,957,500	2,302,500	220,000
Luzerne	195	1,898,130	464,685	179,595	17,160
Monroe	875	8,517,250	2,085,125	805,875	77,000
Montgomery	14,138	137,619,292	33,690,854	13,021,098	1,244,144
Northampton	1,393	13,559,462	3,319,519	1,282,953	122,584
Philadelphia	9,689	94,312,726	23,088,887	8,923,569	852,632
Pike	125	1,216,750	297,875	115,125	11,000
Schuylkill	829	8,069,486	1,975,507	763,509	72,952
Wayne	350	3,406,900	834,050	322,350	30,800
Pennsylvania[4]	**58,331[3]**	**648,177,326**	**158,681,587**	**61,328,469**	**5,859,832**
Total	**108,547**	**1,282,668,648**	**314,012,676**	**121,362,012**	**11,595,936**

1. State, county, and municipal park land in Delaware from county and local comprehensive plans.
2. County and municipal park land from New Jersey State Comprehensive Outdoor Recreation Plan (SCORP).
3. County/municipal parks in New York from county and local comprehensive plans.
4. County/municipal parks in Pennsylvania from DVRPC 2007 & Berks/Schuylkill counties comprehensive plans.

Delaware Water Gap National Recreation Area

The Delaware Water Gap National Recreation Area (DWGNRA) preserves almost 109 square miles of forest and floodplain along 40 miles of the upper Delaware River and 29 miles of the Appalachian Trail. Stynes and Sun (2002) estimated the DWGNRA had 4,867,272 recreation visits in 2001 including 487,727 local day trips, 3,650,455 non-local day trips, 486,727 motel visits, and

243,364 camping overnights. Total visitor spending in the DWGNRA in 2001 was $100 million including $12.4 million for local day trips, $46.5 million for non-local day trips, $30.9 million for motels, and $10.3 million for camping overnights. In 2001, the DWGNRA generated $106 million in sales, and 7,563 direct/indirect jobs with $100 million in wages.

Marcellus Shale Natural Gas

The U.S. Geological Survey concluded that the Marcellus Shale Formation is a voluminous economic resource that lies under 4,700 square miles or 36% of the Delaware River Basin. Drilling for natural gas through the hydraulic fracturing process requires large quantities of water and has the potential to consume sizable tracts of land in the forested headwaters of the Delaware Basin (Figure 9). Hydraulic fracturing requires pumping water under high pressure to open fractures in the shale to allow natural gas to flow to the well. The hydrofracturing water must be recovered and treated before disposal to surface and ground waters. In forests, natural gas well drilling can require clearing of pads that range from 3 to 5 acres in area.

The DRBC is considering revisions to Article 7 of the Water Quality Regulations to protect the water resources of the Delaware Basin during construction and operation of natural gas projects with the following considerations:

- Gas drilling projects in the Marcellus Shale may reduce the flow in streams and aquifers.
- On-site drilling operations may potentially release pollutants into ground or surface water.
- The recovered hydrofracturing water must be treated and disposed of properly.

The Marcellus Shale Formation covers 54,000 square miles and lies up to a mile and a half below parts of Kentucky, New Jersey, New York, Ohio, Pennsylvania, and West Virginia (Figure 10). The Marcellus Shale lies under 4,700 square miles or 36% of the Delaware River Basin in New York, Pennsylvania, and a small tip of New Jersey (Figure 11). About 8.7% of the Marcellus Shale Formation lies within the Delaware River Basin (4,700 sq mi/54,000 sq mi).

The U.S. Geological Survey (Coleman et al. 2011) estimated the entire 54,000 square-mile Marcellus Shale Formation potentially contains a mean volume of 84 trillion cubic feet of recoverable natural gas with a range of 43 tcf (95 percentile) to 144 tcf (5 percentile). If the Delaware River Basin covers 4,700 sq mi or 8.7% of the Marcellus Shale, then by proportion approximately 7.3 trillion cubic feet of natural gas is potentially recoverable within the basin boundary (0.087 x 54,000). These estimates can vary as the thickness of Marcellus Shale in the Delaware Basin generally increases to the north toward the New York/Pennsylvania border and may range from 50 feet thick near Stroudsburg to more than 250 feet thick at Lackawaxen in Wayne County, Pennsylvania (Figure 12).

The U.S. Energy Information Administration (2011) reported the 2010 mean natural gas wellhead price was $4.16/1000 cf. The price of natural gas for residential customers was $11.21/1000 cf. At these unit prices, the estimated value of natural gas from the Marcellus Shale Formation within the Delaware River Basin is $30.4 billion at the wellhead and $81.8 billion when sold to residential customers (Tables 38 and 39).

Environmental economists classify natural gas as a nonrenewable resource with finite stock value over a defined time frame (say 25 or 50 years). Assuming the natural gas can be recovered within 25

years, the annual value of the Marcellus Shale gas recoverable from within the Delaware Basin is $1.2 billion/year at the wellhead and $3.3 billion/year when sold to residential customers.

Table 38. Wellhead value of Marcellus shale natural gas within the Delaware River Basin

State/Basin	Area Marcellus Shale (sq mi)	Wellhead Natural Gas Price[1] ($/1000 cf)	Volume Natural Gas[2] (tcf)	Wellhead Natural Gas Value ($ billion)	Wellhead Natural Gas Value[3] ($ billion/yr)
Pennsylvania	2,338	$4.16	3.6	$15.0	$0.6
New York	2,362	$4.16	3.7	$15.4	$0.6
Delaware Basin	**4,700**	**$4.16**	**7.3**	**$30.4**	**$1.2**

1. EIA 2010. 2. USGS 2011. 3. Assumes 25 year natural gas recovery period.

Table 39. Residential value of Marcellus shale natural gas within the Delaware River Basin

State/Basin	Area Marcellus Shale (sq mi)	Residential Natural Gas Price[1] ($/1000 cf)	Volume Natural Gas[2] (tcf)	Residential Natural Gas Value ($ billion)	Wellhead Natural Gas Value[3] ($ billion/yr)
Pennsylvania	2,338	$11.21	3.6	$40.4	$1.6
New York	2,362	$11.21	3.7	$41.5	$1.7
Delaware Basin	**4,700**	**$11.21**	**7.3**	**$81.8**	**$3.3**

1. EIA 2010. USGS 2011. 3. Assumes 25 year natural gas recovery period.

On a per volume basis, the value of untreated drinking water in streams and wells (at $7.48/1000 cf or $1.00/1000 gal) exceeds the value of natural gas at the wellhead (at $4.16/1000 cf) in the Delaware Basin. The total value of untreated drinking water from streams/wells (1,803 mgd) in the Delaware Basin is $0.7 billion/year, less than the estimated value of natural gas recoverable at the wellhead ($1.2 billion/year). The value of treated drinking water in the basin (at $35.70/1000 cf or $4.78/1000 gal) is $3.1 billion/year which is comparable to the total natural gas value sold to residential customers or $3.3 billion/year (Table 40).

Table 40. Value of Marcellus shale gas compared to drinking water in the Delaware River Basin

Price/ Value	Natural Gas	Drinking Water
Quantity	7.3 trillion cf	1,803 mgd
Unit Price Wellhead Gas or Untreated Drinking Water	$4.16/1000 cf	$7.48/1000 cf
Total Value Wellhead Gas or Untreated DrinkingWater	$1.2 billion/yr	$0.7 billion/yr
Unit Price Residential Gas or Treated Drinking Water	$11.21/1000 cf	$35.70/1000 cf
Total Value Residential Gas or Treated Drinking Water	$3.3 billion/yr	$3.1 billion/yr

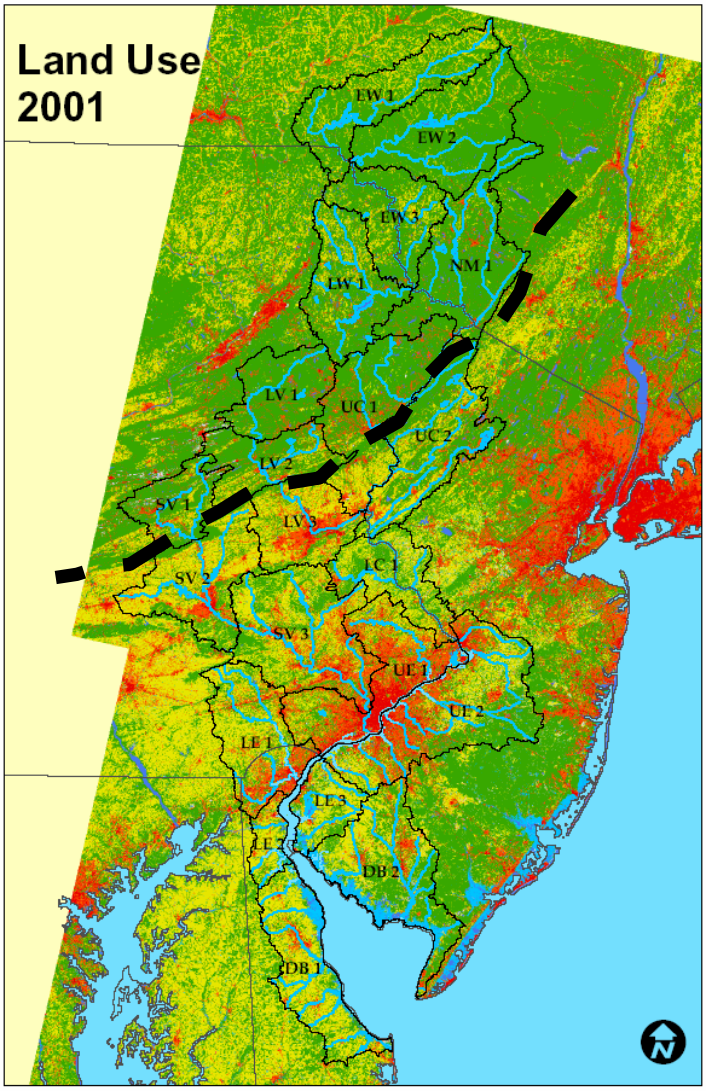


Figure 9. Land use including forested headwaters in the Delaware Basin (Marcellus Shale southerly boundary delineated as dashed line).

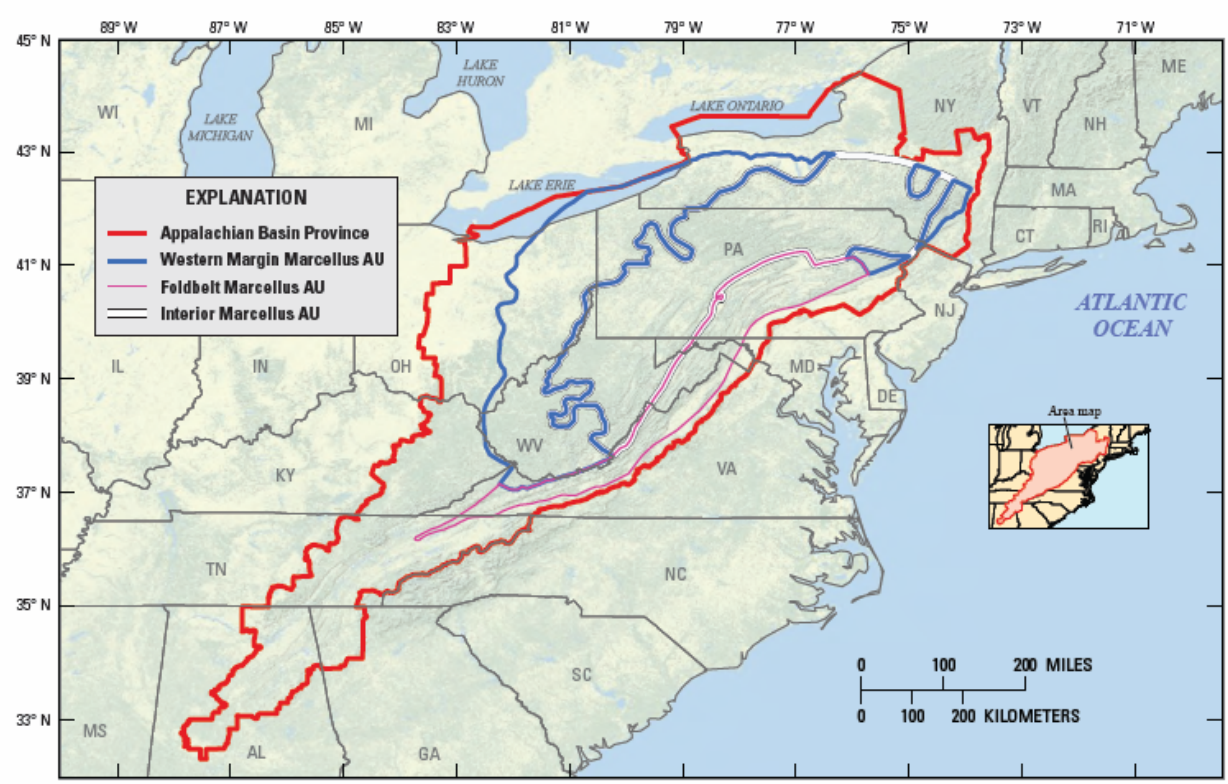


Figure 10. Marcellus Shale Formation in the Appalachian Basin Province (USGS 2011)

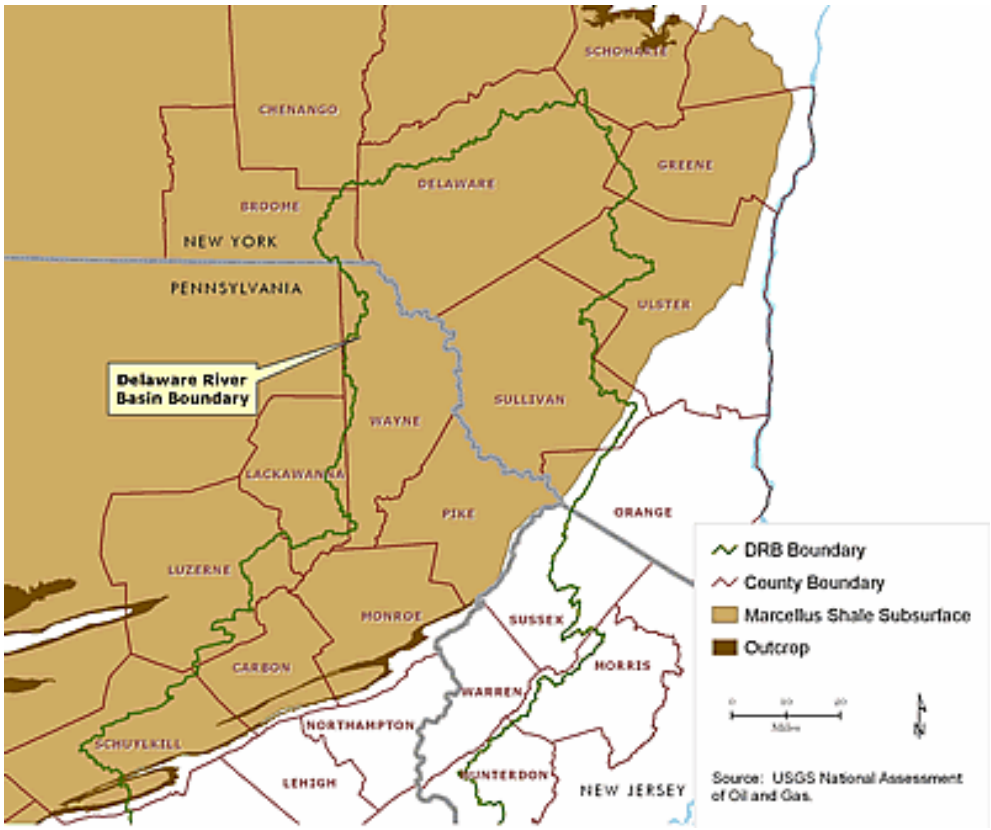


Figure 11. Marcellus Shale Formation within the Delaware River Basin (USGS)

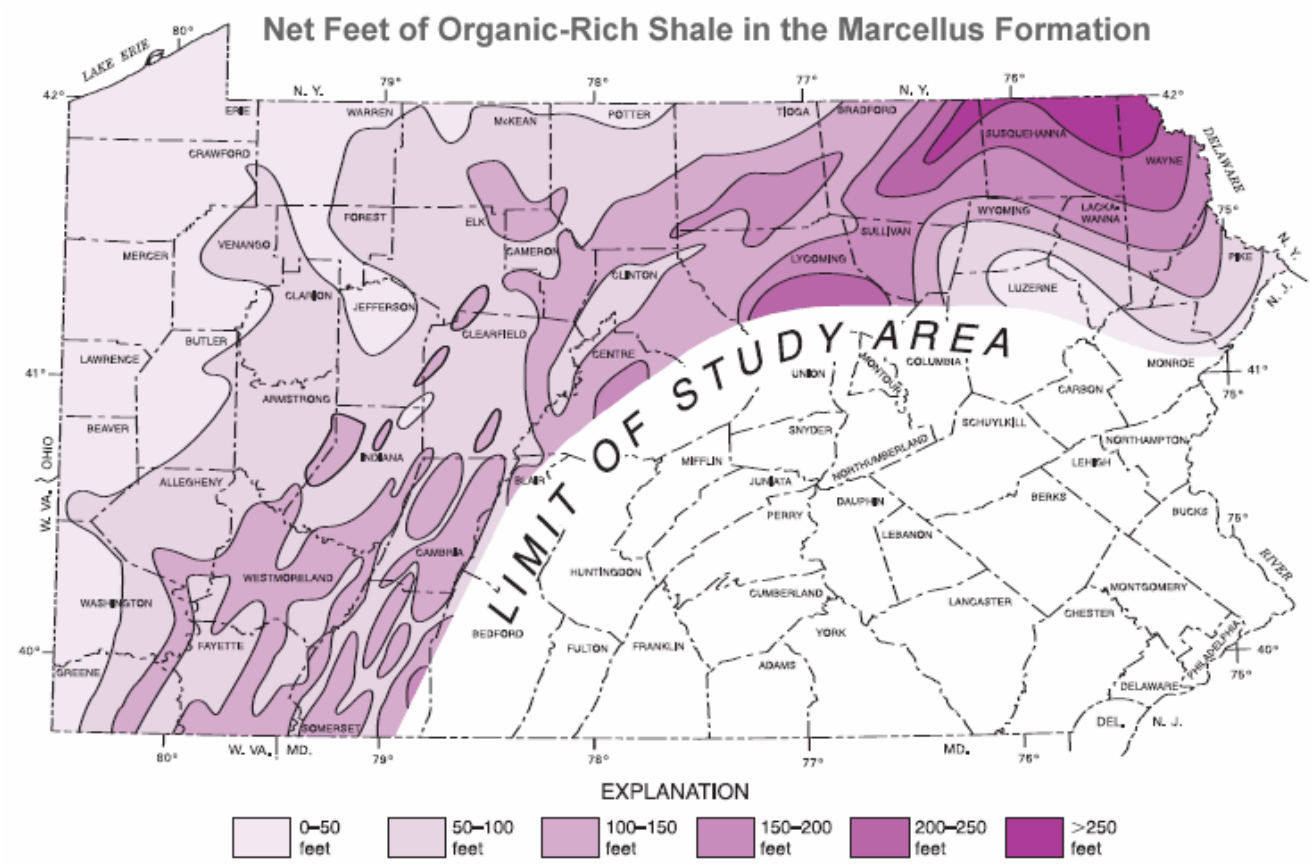


Figure 12. Thickness of Marcellus shale in Pennsylvania (Pennsylvania Geological Survey)

Maritime Transportation

Navigation

The 130-mile long Delaware River and Bay ship channel from Cape Henlopen to the head of navigation at Trenton has significant instream navigation use value. The Delaware River port from Wilmington to Chester, Paulsboro, Camden, and Philadelphia is the 6th largest port in the U.S. based on imports. The volume of the 720 square mile Delaware Estuary at mean depth of 32 feet is 14.7 million ac-ft or 4.8 trillion gallons. A study of the economic value of freshwater in the U.S. estimated the median value of instream navigation uses is $10/ac-ft in $1996 (Frederick et al. 1996) or $15/ac-ft in $2010 based on 3% annually. Accordingly, the instream navigation value of the Delaware River and Bay (14.7 million ac-ft) from the ocean to head of tide at Trenton is $220 million.

C&D Canal

The 35-feet deep Chesapeake & Delaware Canal is a valuable commercial conduit that flows through the Delaware Basin in Delaware and carries 40% of all ship traffic to/from the Port of Baltimore. The C&D Canal trims 300 miles from the trip for ships that would otherwise sail up the Chesapeake Bay to Baltimore from the ocean. Normally 6 to 35 ships per day sail through the C&D Canal.

The Port of Baltimore is responsible for 16,700 direct jobs and $3.7 billion in wages (Maryland Port Administration 2010). Of 360 ports in the U.S., Baltimore is No. 1 in forest product, gypsum, and sugar imports and No. 2 in automobile exports. In 2009, the Port of Baltimore was 11th among all U.S. port districts with $10.8 billion in exports after Seattle (9th) and San Francisco (10th). Baltimore was 12th in the U.S. with $19.4 billion in imports after Norfolk (10th) and Port Arthur, Texas (11th). If 40% of all Baltimore-bound ship traffic sails through the C&D Canal, then 40% of the economic activity generated by the port can be indirectly attributed to this avenue of commerce that cuts through Delaware River Basin in Delaware (Table 41).

Table 41. Economic activity generated by Port of Baltimore through the C&D Canal

Activity	Port of Baltimore[1]	C&D Canal[2]
Jobs	16,700	6,700
Wages	$3.7 billion	$1.5 billion
Imports	$19.4 billion	$7.8 billion
Exports	$10.8 billion	$4.3 billion

1. Maryland Port Authority 2010. 40% of Baltimore-bound shipping sails through C&D Canal.

Port Activity

For over 300 years since the time of William Penn, the Delaware River has been an economic engine that is now the largest freshwater port in the world. The Economy League of Greater Philadelphia (2008) concluded that Delaware River ports from Wilmington to Philadelphia to Trenton:

- Collectively is the largest freshwater port in the world with $2.4 billion in total economic output.
- Generate $81 million in tax revenues to Delaware, Pennsylvania, New Jersey (Table 42).
- Import 1/2 of the nation's cocoa beans, 1/3 of the bananas, and 1/4 of all fruit and nuts.
- Rank 5th among ports in the USA in import cargo value and 20th in export value.
- In Chester, Philadelphia, Wilmington, Camden and Paulsboro handled 16% of container trade in the U.S. and 51% of container trade value nationwide.
- Biggest commodity is petroleum that accounts for 65% of the port's imports while fruits and nuts account for 4%.

Table 42. Tax revenues from Delaware River ports, 2005
(Economy League of Greater Philadelphia 2008)

Type	DE	NJ	PA	Total
Individual Income Tax	$2,538,803	$6,679,380	$13,102,579	$22,320,762
Sales and Use Tax		5,326,255	13,851,735	$19,177,990
Corporate Income Tax	888,055	1,988,447	3,632,195	$6,508,697
Selective Tax	1,075,499	2,674,104	7,807,469	$11,557,072
Other State Tax, License, Fees	2,536,226	1,597,420	5,199,444	$9,333,090
Total State and Local Tax	**7,038,582**	**18,266,605**	**55,974,357**	**$81,279,544**

The Economy League reports that nearly 2,900 ships (8 per day) docked at Delaware River ports in 2006, up 10% from 1995. Most shipping traffic were tankers, containers, bulk, refrigerated (meat/fruits/vegetables) and auto transport vessels (Table 43).

Table 43. Delaware River port vessel calls, 1996-2000
(Economy League of Greater Philadelphia 2008)

Year	General	Container	Roll on	Refrg	Bulk	Tanker	Chem	Auto	Passengr	Total
1995	304	368	84	333	405	812	138	110	16	2,570
2006	248	581	78	373	402	861	144	121	39	2,847
change	-56	213	-6	40	-3	49	6	11	23	277
% change	-18%	-58%	-7%	12%	-1%	6%	4%	10%	144%	11%

Top Delaware River port exports (Table 44) are motor vehicles (31% and petroleum products (12%) and top imports are petroleum (65%) and iron and steel (7%).

Table 44. Top exports and imports at Delaware River ports (Economy League 2008)

Cargo	Exports	Imports
Motor Vehicles	31%	
Petroleum	12%	65%
Precious stones/Metals	7%	
Industrial Machinery	6%	2%
Plastics	6%	
Iron and Steel		7%
Fruits and Nuts		4%
Meat		3%

In 2005, Delaware River ports at Philadelphia, Chester, and Camden were the 6th, 35th, and 37th largest ports in the U.S. based on imports of goods and cargo (Table 45). The five ports along the Delaware River had combined imports of $41 billion, the 5th largest port in the U.S. after Los Angeles, Newark (NJ), Houston, and Long Beach (CA) and ahead of Seattle, Norfolk (VA), and Baltimore. The five ports along the Delaware had combined exports of $6.4 billion making it the 20th largest port in the USA after Oakland (CA) and Baltimore but ahead of Charleston (SC).

Table 45. Rank of Delaware River imports/exports in United States by value of goods, 2005

Imports Rank in U.S.	Port	Imports ($))
6	Philadelphia	$29,500,000,000
35	Chester	$5,700,000,000
37	Wilmington	$5,500,000,000
79	Paulsboro	$250,000,000
103	Camden	67,000,000
5	**Delaware R.**	**$41,017,000,000**
Exports Rank in U.S.	**Port**	**Exports ($)**
22	Philadelphia	$2,400,000,000
24	Wilmington	$2,200,000,000
32	Chester	$1,600,000,000
74	Camden, NJ	$150,000,000
84	Paulsboro, NJ	$89,000,000
20	**Delaware R.**	**$6,439,000,000**

4. Ecosystem Services

Other Studies

Data from the following studies were examined to estimate the value of ecosystem services in the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania:

- Cecil County green infrastructure study by the Conservation Fund, Annapolis, Md (2007).
- New Jersey Department of Environmental Protection with the University of Vermont (2007)
- Ecosystem services value of forests by the Wilderness Society (2001)
- Ecosystem services value of Peconic Estuary watershed by University of Rhode Island (2002)
- U.S. National Wildlife Refuge System by Univ. of Maryland and Nature Conservancy (2008)
- Economic value of ecosystem services in Massachusetts by the Audubon Society (2003).

Ecosystem services include air filtration, water filtration, recycling nutrients, soil conservation, pollinating crops and plants, climate regulation, carbon sequestration, flood/stormwater control, and hydrologic cycle regulation. Ecological resources provide marketable goods and services such as timber, fish and wildlife recreation, hiking, and boating/kayaking. A Cecil County, Md. study by the Conservation Fund (Table 46) found the largest ecosystem services values result from stormwater/flood control, water supply, and clean water functions (Weber 2007).

Table 46. Ecosystem services values for Cecil County, Maryland (Weber 2007)

Ecosystem Service	Upland Forest ($/ac/yr)	Riparian Forest Wetlands ($/ac/yr)	Nonriparian Wetlands ($/ac/yr)	Tidal Marsh ($/ac/yr)
Carbon sequestration	31	65	65	65
Clean air	191	191	191	
Soil and peat formation	17	946	450	1,351
Stormwater/flood control	679	32,000	32,000	1,430
Water supply	8,630	8,630	8,630	
Clean water	1,100	1,925	1,100	11,000
Erosion/sediment control	151	3,418	151	12,700
Water temperature regulation		4,450		
Pest control	50	50	50	
Pollination	75	75	75	
Wood products	142			
Recreation, fish, wildlife habitat	486	534	534	544
Community services savings	439	439	439	439
Increase in property values	42	42		
Total	**12,033**	**52,765**	**43,685**	**28,146**

The New Jersey Department of Environmental Protection (2007) partnered with the University of Vermont and estimated the value of New Jersey's natural capital was $20 billion/year plus or minus

$9 billion/year in $2004 with a net present value of $681 billion based on a discount rate of 3% calculated in perpetuity (over 100 years in the future). Natural capital is the sum of goods (commodities like water, crops, and timber that can be sold) and services (functions like flood control, water filtration, and wildlife/fisheries habitat) provided by watershed ecosystems such as wetlands, forests, farms, and open water. In addition to these direct benefits, ecosystems also provide indirect benefits such as ecotourism by hunters, fishermen, boaters, and hikers who spend money to visit natural sites and realize value from improved water quality and habitat. Table 47 summarizes total ecosystem goods and services in New Jersey. Farm products, fish, minerals, and water supply provide the most ecosystem goods. Nutrient cycling, soil disturbance regulation, water regulation, habitat, aesthetic/recreational, waste treatment, and water supply provide the greatest ecosystem services.

Table 47. Ecosystem goods and services provided by New Jersey natural capital (NJDEP 2007)

Ecosystem	$ million/yr	%
Natural Goods	**$5,864**	**100%**
Farm products	3,676	63%
Commercial/recreational fish	958	16%
Minerals	587	10%
Raw Water	381	7%
Saw timber	147	3%
Fuelwood	95	2%
Game/fur animals	21	1%
Ecoservices	**$19,803**	**100%**
Nutrient cycling	5,074	26%
Disturbance regulation	3,383	17%
Water regulation	2,433	12%
Habitat	2,080	11%
Aesthetic/recreational	1,999	10%
Waste treatment	1,784	9%
Water supply	1,739	9%
Cultural//spiritual	778	4%
Gas/climate regulation	246	1%
Pollination	243	1%
Biological control	35	<1%
Soil formation	8	<1%

The Wilderness Society (Krieger 2001) concluded forest ecosystem services values from climate regulation, water supply, water quality, and recreation benefits totaled $392/ac in $1994 or $631/ac in $2010 at a 3% annual discount rate (Table 48).

Table 48. Forest ecosystem service values for U.S. temperate forests (Krieger 2001)

Ecosystem Good or Service	1994 Value ($/ac)	2010 Value[1] ($/ac)
Climate regulation	57.1	91.9
Disturbance regulation	0.8	1.3
Water regulation	0.8	1.3
Water supply	1.2	1.9
Erosion and sediment control	38.8	62.5
Soil formation	4.0	6.4
Nutrient cycling	146.1	235.2
Waste Treatment	35.2	56.7
Biological Control	0.8	1.3
Food Production	17.4	28.0
Raw Materials	55.8	89.8
Genetic Resources	6.5	10.5
Recreation	26.7	43.0
Cultural	0.8	1.3
Total	**392.1**	**631.3**

1. $2010 computed at 3% annually.

A contingent value study by University of Rhode Island economists found natural resources values in the Peconic Estuary watershed in Suffolk County on Long Island New York ranged from $6,560/ac for wetlands to $9,979/ac for farmland in $1995 (Johnston et al. 2002). The University of Maryland studied the National Wildlife Refuge System and determined ecosystem values of freshwater wetlands and forests were $6,268/ac and $845/ac, respectively (Ingraham and Foster 2008). The Audubon Society found the economic value of ecosystems in Massachusetts ranged from $984/ac for forests to $15,452/ac for saltwater wetlands (Breunig 2003).

According to the 2007 USDA Census of Agriculture (2009) the market value of agricultural crops, poultry, and livestock sold from 1,926,524 acres of farmland in the Delaware River Basin was $3.37 billion or $1,676/ac. The market value of agriculture from 254,143 acres of farmland in Delaware in the basin was $636 million or $2,502/ac. The market value of agriculture from 505,507 acres of farmland in New Jersey was $602 million or $1,192/ac. The market value of agriculture from 187,561 acres of farmland in New York in the basin was $105 million or $562/ac.
The market value of agriculture from 979,313 acres of farmland in Pennsylvania counties in the basin was $2.0 billion or $2,070/ac.

Table 49 compares ecosystem services values ($/acre) from other studies. Data from the NJDEP/University of Vermont study are used for value transfer since the Delaware Basin includes New Jersey ecosystems and two adjacent states in the watershed (Del. and Pa.) share a similar climate (humid continental) at 40 degrees north in latitude, similar physiographic provinces (Piedmont/Coastal Plain) and similar aquifers, soils, and ecosystems. Farmland natural goods values are estimated from market values from the 2007 USDA Census of Agriculture. Cecil County, Maryland occupies a small sliver of the Delaware Basin and utilized higher ecosystem values on a per acre basis for forests and wetlands than the other studies. The NJDEP ecosystem service estimates ($/ac) are lower than Cecil County values for wetlands/forests and Mass Audubon values for

wetlands but higher than Wilderness Society values for forests and U. S. Wildlife Refuge values for freshwater wetlands and forests. Values from previous studies were adjusted to $2010 based on 3% annually. Net present values were calculated based on an annual discount rate of 3% in perpetuity (over 100 years in the future).

Table 49. Comparison of ecosystem service value studies

Ecosystem	Cecil Co. Maryland 2006 ($/ac/yr)	New Jersey DEP 2004 ($/ac/yr)	Wilderness Society 2001 ($/ac/yr)	Peconic Estuary 1995 ($/ac/yr)	US Wildlife Refuge 2008 ($/ac/yr)	Mass Audubon 2003 ($/ac/yr)	USDA Census[1] 2007 ($/ac/yr)
Freshwater wetland	43,685	11,802			6,268	15,452	
Marine		8,670					
Farmland		6,229		9,979		1,387	1,676
Forest land	12,033	1,714	641		845	984	
Saltwater wetland	28,146	6,269		$6,560		12,580	
Undeveloped				$2,080			
Urban		296					
Beach/dune		42,149					
Open freshwater		1,686			217	983	
Riparian buffer	52,765	3,500					
Shellfish areas				$4,555			

1. Value of goods only as measured by agricultural crops, livestock, and poultry sold.

Delaware Basin

The estimated value of natural goods and services provided by ecosystems in the Delaware River Basin (12,742 sq mi) is $21 billion ($2010) with a net present value (NPV) of $683 billion (Table 50). The ecosystems services value of the Delaware portion of the Delaware Basin (965 sq mi) is $2.5 billion ($2010) with a NPV of $81.4 billion (Figure 13). The ecosystems services value of the New Jersey portion of the Delaware Basin (2,960 sq mi) is $6.6 billion ($2010) with a NPV of $213.4 billion. The ecosystems services value of the New York portion of the Delaware Basin (2,556 sq mi) is $3.5 billion ($2010) with a NPV of $113.6 billion. The ecosystems services value of the Pennsylvania portion of the basin (6,290 sq mi) is $8.6 billion ($2010) with a NPV of $279.6 billion. NPV is based on an annual discount rate of 3% over a perpetual life time (>100 years).

Natural goods are commodities that can be sold such as water supply, farm crops, fish, timber, and minerals). Natural services provide ecological benefits to society such as flood control by wetlands, water filtration by forests, and fishery habitat by beach and marine areas. Ecosystems within the Delaware Basin are comprised of forests (53%), farmland (24%), freshwater wetlands (5%), saltwater wetlands (2%), and open water/marine (1%). Over 15% of the Delaware Basin is urban (Figure 14).

Farms, freshwater wetlands, forests, and saltwater wetlands provide the highest total ecosystems goods and services values (Table 51 and Figures 15 and 16). Ecosystems that provided the highest natural good values are farmland ($3.2 billion or $1,676/ac/ yr), followed by forest ($1.2 billion or $275/ac), and freshwater wetlands ($114 million or $270/ac). The highest natural ecosystem services values are provided by forests ($7.4 billion or $1,703/ac) followed by freshwater wetlands

($5.6 billion or $13,351/ac), farmland ($1.6 billion or $827/ac), and saltwater wetlands ($1.0 billion or $7,076/ac).

The DB2 Delaware Bay ($2,497,635,761), UE2 New Jersey Coastal Plain ($2,093,235,974), DB1 Delaware Bay ($1,922,732,778), NM1 Neversink R. ($1,212,219,295), EW2 West Branch Del. R. ($1,137,547,038), UC1 Pocono Mt. ($1,106,108,992), UC2 NJ Highlands ($1,072,263,808), SV3 Schuylkill above Philadelphia ($1,098,758,690), and LW1 Lackawaxen R. ($1,006,865,455) watersheds each provide over $1 billion in annual ecosystem services value (Table 52 and Figure 17).

Watersheds with the highest value of annual ecosystem services per acre include the DB2 Delaware Bay ($4,991/ac), DB1 Delaware Bay ($4,797/ac), LE3 Salem River ($4,288/ac), LE2 C&D Canal ($3,941/ac), UE2 New Jersey Coastal Plain ($3,205/ac), LW1 Lackawaxen R. ($2,631/ac), NM1 Neversink R. ($2,321/ac), SV2 Schuylkill above Valley Forge ($2,276/ac), and LV1 Lehigh River above Lehighton ($2,263/ac) as these systems have high amounts (over 75%).of forests, wetlands, and farm habitat (Figure 18).

The above estimates do not include the ecosystem services value of open water (720 sq mi) in the tidal Delaware River and Bay between the shores of Delaware, Pennsylvania, and New Jersey. The ecosystem services value of open water habitat in the river and bay is $61 billion or $1,946/ac.

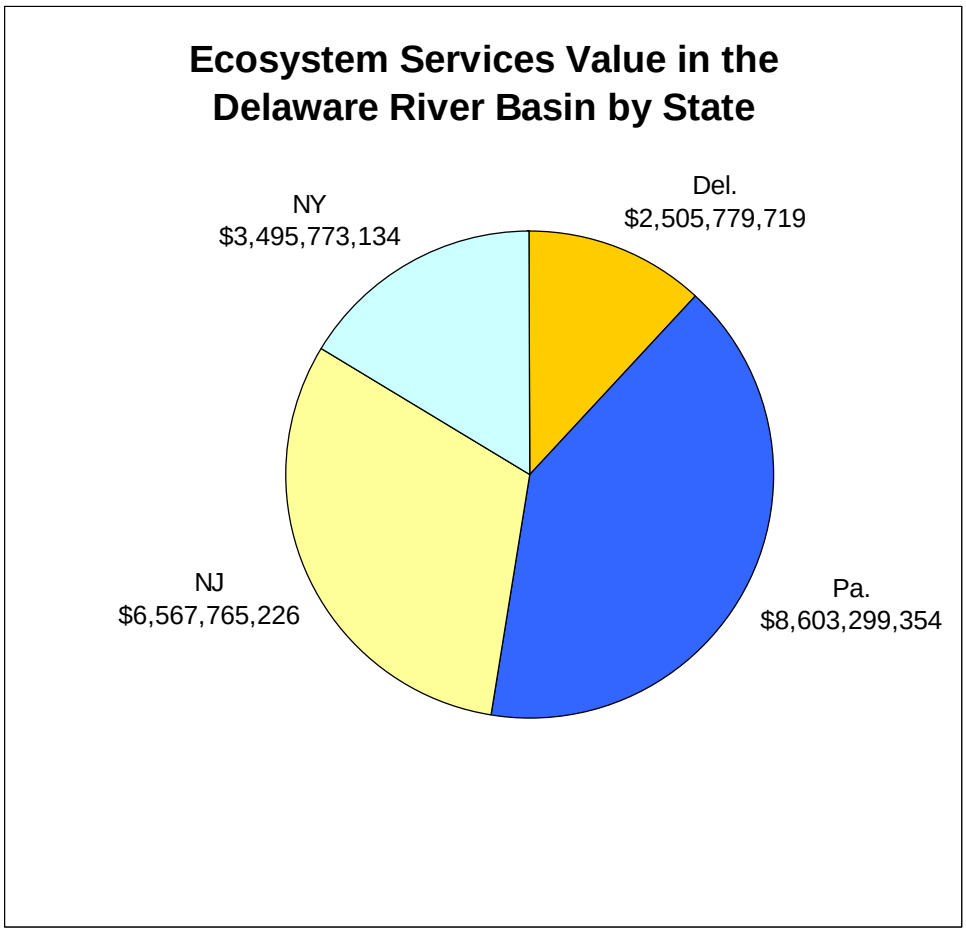


Figure 13. Ecosystem service value in the Delaware Basin by state

Table 50. Ecosystem services values in the Delaware River Basin by state

Ecosystem	Area (ac)	$/ac/yr 2010	PV 2010 $	NPV $
Delaware Basin				
Freshwater wetlands	422,838	13,621	5,759,329,048	187,178,194,067
Marine	16,588	10,006	165,982,947	5,394,445,767
Farmland	1,926,524	2,503	4,823,030,404	156,748,488,136
Forest land	4,343,190	1,978	8,591,367,360	279,219,439,184
Saltwater wetland	145,765	7,235	1,054,617,851	34,275,080,170
Urban	1,206,504	342	412,157,579	13,395,121,322
Beach/dune	900	48,644	43,758,633	1,422,155,566
Open water	92,615	1,946	180,210,703	5,856,847,857
Total	**8,154,924**		**$21,030,454,525**	**$683,489,772,069**
Delaware				
Freshwater wetlands	58,390	13,621	795,317,362	25,847,814,257
Marine	16,274	10,006	162,840,906	5,292,329,460
Farmland	254,143	3,329	846,164,877	27,500,358,509
Forest land	95,346	1,978	188,605,634	6,129,683,090
Saltwater wetland	61,617	7,235	445,802,585	14,488,584,028
Urban	123,048	342	42,034,778	1,366,130,274
Beach/dune	256	48,644	12,429,832	403,969,529
Open water	6,467	1,946	12,583,745	408,971,719
Total	**615,541**		**$2,505,779,719**	**$81,437,840,867**
New Jersey				
Freshwater wetlands	246,857	13,621	3,362,352,134	109,276,444,364
Marine	314	10,006	3,142,040	102,116,307
Farmland	505,507	2,019	1,020,866,015	33,178,145,495
Forest land	682,931	1,978	1,350,922,709	43,904,988,032
Saltwater wetland	83,563	7,235	604,583,594	19,648,966,813
Urban	321,090	342	109,688,612	3,564,879,893
Beach/dune	499	48,644	24,253,858	788,250,378
Open water	47,259	1,946	91,956,264	2,988,578,571
Total	**1,888,020**		**6,567,765,226**	**213,452,369,853**
New York				
Freshwater wetlands	34,792	13,621	473,886,107	15,401,298,475
Marine	0	10,006	0	0
Farmland	187,561	1,389	260,613,634	8,469,943,113
Forest land	1,387,514	1,978	2,744,673,732	89,201,896,298
Saltwater wetland	0	7,235	0	0
Urban	20,806	342	7,107,761	231,002,225
Beach/dune	0	48,644	0	0
Open water	4,878	1,946	9,491,900	308,486,749
Totalac	**1,635,551**		**3,495,773,134**	**113,612,626,859**
Pennsylvania				
Freshwater wetlands	82,799	13,621	1,127,773,445	36,652,636,971
Marine	0	10,006	0	0
Farmland	979,313	2,897	2,837,548,786	92,220,335,530
Forest land	2,177,399	1,978	4,307,165,285	139,982,871,763
Saltwater wetland	585	7,235	4,231,672	137,529,329
Urban	741,560	342	253,326,429	8,233,108,930
Beach/dune	145	48,644	7,074,943	229,935,659
Open freshwater	34,011	1,946	66,178,794	2,150,810,818
Total	**4,015,812**		**8,603,299,354**	**279,607,229,001**

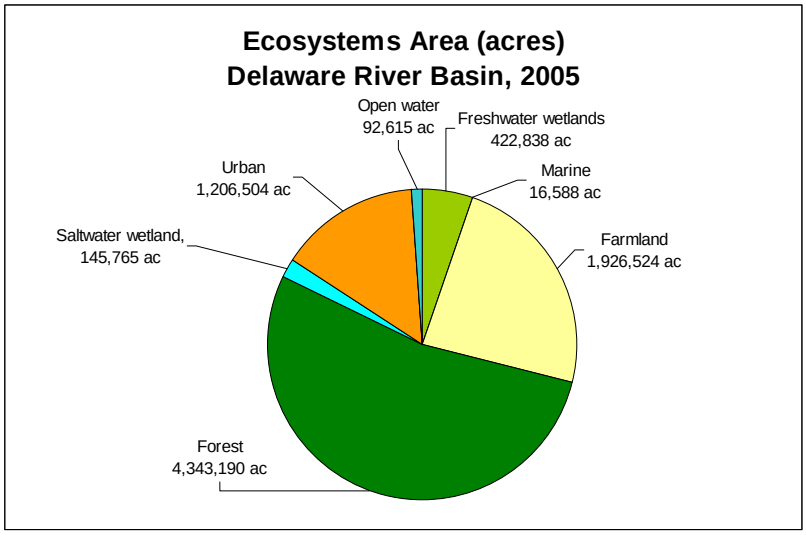


Figure 14. Ecosystem service areas within the Delaware River Basin

Table 51. Value of ecosystem goods and services in the Delaware River Basin

Natural Goods						
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**
Freshwater wetlands	422,838	234	98,943,997	270	114,191,069	3,711,209,745
Marine	16,588	1,125	18,661,829	1,298	21,537,580	699,971,336
Farmland	1,926,524	1,676	3,228,854,342	1,676	3,228,854,342	104,937,766,110
Forest land	4,343,190	238	1,033,679,112	275	1,192,966,996	38,771,427,378
Saltwater wetland	145,765	139	20,261,377	160	23,383,615	759,967,482
Urban	1,206,504	13	15,684,557	15	18,101,515	588,299,247
Beach/dune	900	0	0	0	0	0
Open water	92,615	921	85,298,217	1,063	98,442,502	3,199,381,302
Total	**8,154,924**		**4,501,383,431**		**4,697,477,618**	**152,668,022,601**
Natural Services						
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**
Freshwater wetlands	422,838	11,568	4,891,385,289	13,351	5,645,137,979	183,466,984,322
Marine	16,588	7,544	125,142,079	8,707	144,426,223	4,693,852,233
Farmland	1,926,524	717	1,381,317,758	827	1,594,176,062	51,810,722,026
Forest land	4,343,190	1,476	6,410,547,773	1,703	7,398,400,363	240,448,011,806
Saltwater wetland	145,765	6,131	893,687,073	7,076	1,031,402,464	33,520,580,080
Urban	1,206,504	283	341,440,730	327	394,056,064	12,806,822,075
Beach/dune	900	42,149	37,915,873	48,644	43,758,633	1,422,155,566
Open water	92,615	765	70,850,311	883	81,768,202	2,657,466,554
Total	**8,154,924**		**14,152,286,885**		**16,333,125,990**	**530,826,594,663**
Goods & Services						
Ecosystem	**Area (ac)**	**$/ac/yr 2004**	**$/yr 2004**	**$/ac/yr 2010**	**$/yr 2010**	**NPV $**
Freshwater wetlands	422,838	11,802	4,990,329,286	13,621	5,759,329,048	187,178,194,067
Marine	16,588	8,670	143,820,496	10,006	165,982,947	5,394,445,767
Farmland	1,926,524	2,503	4,823,030,404	2,503	4,823,030,404	156,748,488,136
Forest land	4,343,190	1,714	7,444,226,885	1,978	8,591,367,360	279,219,439,184
Saltwater wetland	145,765	6,269	913,802,685	7,235	1,054,617,851	34,275,080,170
Urban	1,206,504	296	357,125,287	342	412,157,579	13,395,121,322
Beach/dune	900	42,149	37,915,873	48,644	43,758,633	1,422,155,566
Open water	92,615	1,686	156,148,527	1,946	180,210,703	5,856,847,857
Total	**8,154,924**		**18,866,399,443**		**21,030,454,525**	**683,489,772,069**

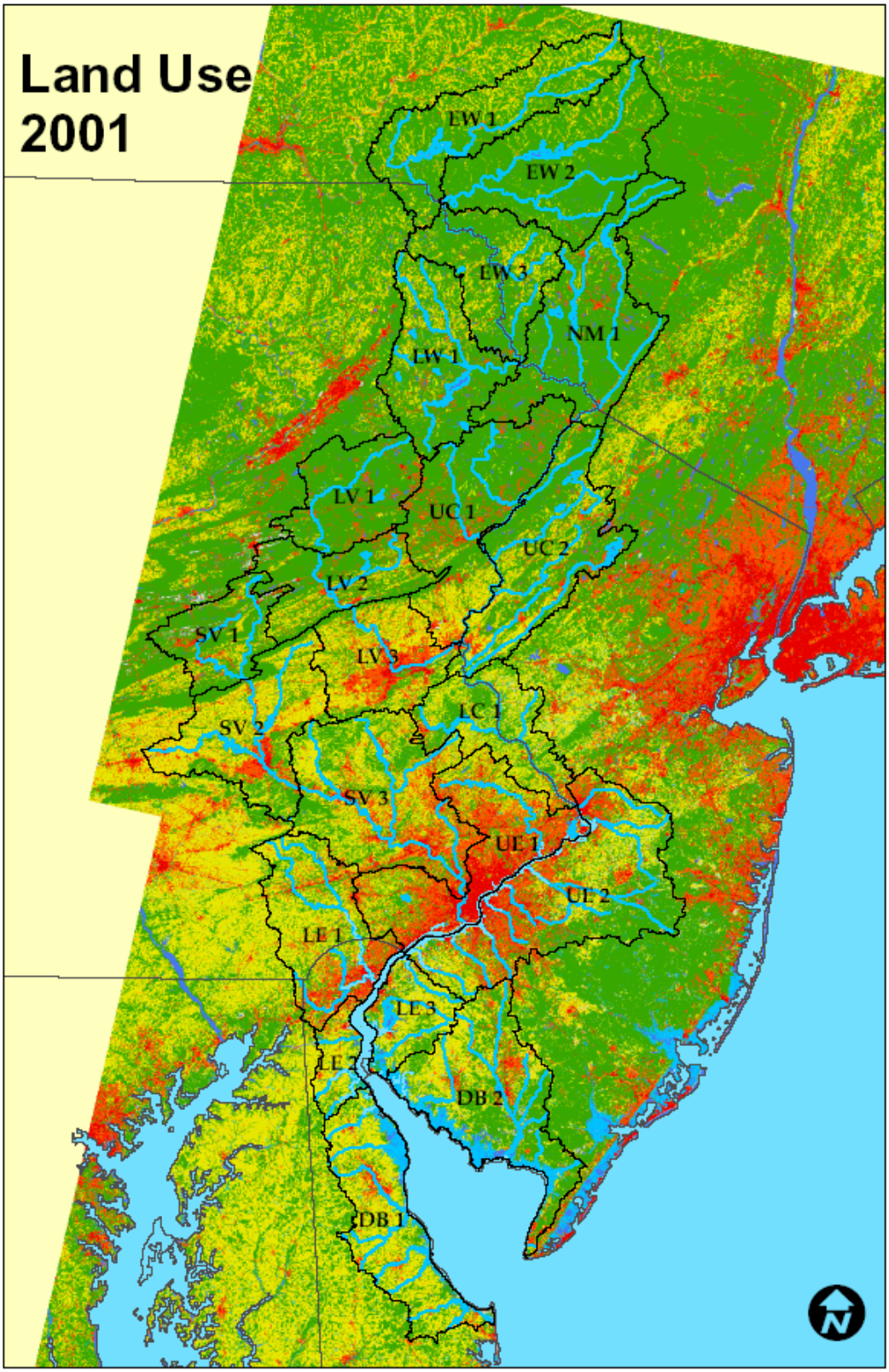


Figure 15. Land cover in the Delaware River Basin
(NOAA CSC 2001)

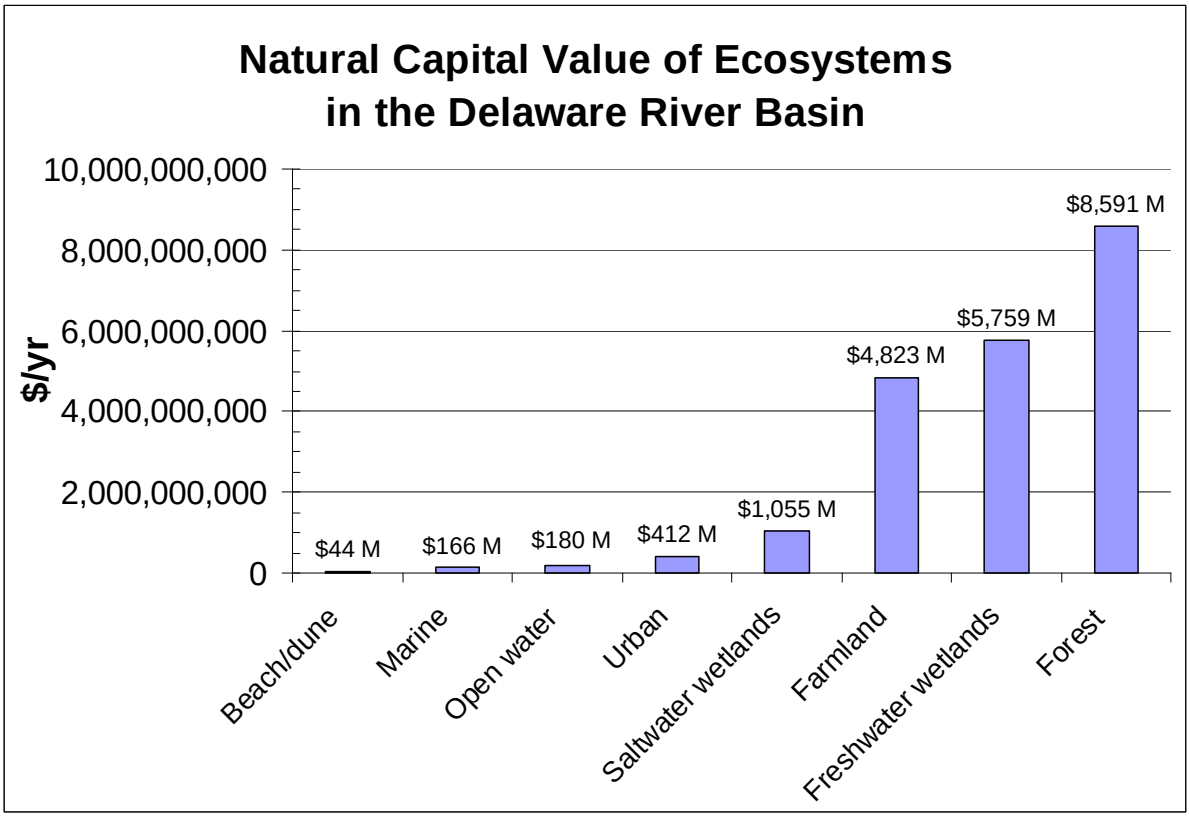


Figure 16. Ecosystem service value ($2010) of habitat within the Delaware River Basin

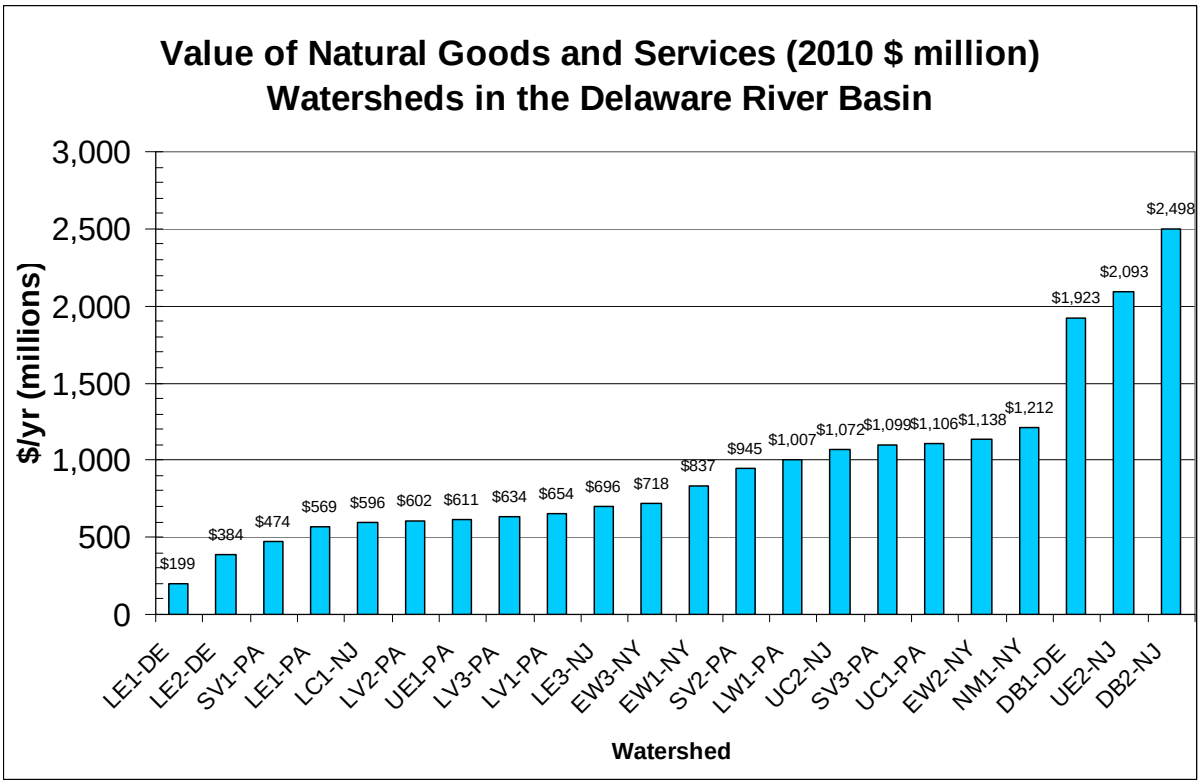


Figure 17. Ecosystem services values of watersheds within the Delaware River Basin

Table 52. Ecosystem services value of watersheds in the Delaware River Basin

Watershed	Area (sq mi)	2010 $/yr	2010 $/ac/yr
LE1 Brandywine/Christina	187	199,035,649	1,664
LE2 C&D Canal	152	384,011,292	3,941
DB1 Delaware Bay	626	1,922,732,778	4,797
Delaware	**962**	**2,505,779,719**	**4,071**
UC2 NJ Highlands	745	1,072,263,808	2,248
LC1 Del. R. above Trenton	159	208,902,978	2,053
UE2 New Jersey Coastal Plain	1,021	2,093,235,974	3,205
LE3 Salem River	254	695,858,091	4,288
DB2 Delaware Bay	782	2,497,635,761	4,991
New Jersey	**2,950**	**6,567,765,226**	**3,479**
EW1 East Branch Del. R.	666	836,579,484	1,963
EW2 West Branch Del. R.	841	1,137,547,038	2,114
EW3 Del. R. above Pt. Jervis	314	430,101,000	2,142
NM1 Neversink R.	734	1,076,794,000	2,321
New York	**2,556**	**3,495,773,134**	**2,137**
EW3 Del. R. above Pt. Jervis	210	287,647,100	2,142
NM1 Neversink R.	82	135,425,000	2,321
LW1 Lackawaxen R.	598	1,006,865,455	2,631
UC1 Pocono Mt.	779	1,106,108,992	2,219
LV1 Lehigh River above Lehighton	451	653,896,676	2,263
LV2 Lehigh River above Jim Thorpe	430	601,508,831	2,183
LV3 Lehigh River above Bethlehem	480	633,649,592	2,064
LC1 Del. R. above Trenton	295	387,587,286	2,053
SV1 Schuylkill above Reading	348	474,099,567	2,126
SV2 Schuylkill above Valley Forge	649	945,100,081	2,276
SV3 Schuylkill above Philadelphia	874	1,098,758,690	1,965
UE1 Penna Fall Line	693	611,041,618	1,377
LE1 Brandywine/Christina	401	568,524,810	2,216
Pennsylvania	**6,275**	**8,603,299,354**	**2,142**
Delaware Basin	**12,742**	**21,030,454,525**	**2,579**

Estimates of ecosystem services in the Delaware River Basin using the NJDEP/University of Vermont values coupled with market values from the USGS Census of Agriculture ($21.0 billion or $683.5 billion NPV) are conservative and in the lower end of the range. If lower per acre estimates of ecosystem services value from other studies were used instead of the NJDEP values, the total value of natural resources in the Delaware Basin would be $9.6 billion or NPV = $311 billion (Table 53). If higher per acre estimates of ecosystem services value from other studies were used, the total value of natural resources in the Delaware Basin would be $94.7 billion or NPV = $3.1 trillion (Table 54).

Estimate	PV $B	NPV $B
Low	9.6	311
NJDEP/USDA	21.0	683
High	94.7	3,100

Table 53. Low range estimate of ecosystem services in the Delaware River Basin

Ecosystem	Area (ac)	$/ac/yr	PV $	NPV $
Freshwater wetlands	422,838	6,268[5]	2,650,346,040	86,136,246,300
Marine	16,588	8,670[2]	143,820,496	4,674,166,116
Farmland	1,926,524	1,387[6]	2,672,088,886	86,842,888,779
Forest land	4,343,190	641[3]	2,783,984,500	90,479,496,255
Saltwater wetland	145,765	6,269[2]	913,802,685	29,698,587,269
Barren land	18,630	0	0	0
Urban	1,206,504	296[2]	357,125,287	11,606,571,818
Beach/dune	900	42,149[2]	37,915,873	1,232,265,862
Open water	92,615	217[5]	20,097,408	653,165,771
Total acres	**8,173,554**		**9,579,181,174**	**311,323,388,171**
sq mi	**12,771**			

Table 54. High range estimate of ecosystem services in the Delaware River Basin

Ecosystem	Area (ac)	$/ac/yr	PV $	NPV $
Freshwater wetlands	422,838	43,685[1]	18,471,660,300	600,328,959,736
Marine	16,588	8,670[2]	143,820,496	4,674,166,116
Farmland	1,926,524	9,979[4]	19,224,783,698	624,805,470,173
Forest land	4,343,190	12,033[1]	52,261,599,829	1,698,501,994,444
Saltwater wetland	145,765	28,146[1]	4,102,710,221	133,338,082,193
Barren land	18,630	0	0	0
Urban	1,206,504	296[2]	357,125,287	11,606,571,818
Beach/dune	900	42,149[2]	37,915,873	1,232,265,862
Open water	92,615	1,686[2]	156,148,527	5,074,827,144
Total acres	**8,173,554**		**94,755,764,230**	**3,079,562,337,486**
sq mi	**12,771**			

1. Cecil Co., Md. 2006. 2. NJDEP 2007. 3. Wilderness Society 2001. 4. Peconic Estuary 1995. 5. U. S. Nat'l. Wildlife Refuge 2008. 6. Mass Audubon Society 2003. 7. USDA Agric. Census 2007.

5. Jobs and Wages

The Delaware River Basin is a jobs engine that supports 600,000 direct and indirect jobs with $10 billion in annual wages in the coastal, farm, ecotourism, water/wastewater, recreation, and port industries (Table 55).

Table 55. Direct and indirect jobs and wages related to the Delaware River Basin

Sector	Jobs	Wages ($ million)	Data Source
Direct Basin Related	240,621	4,900	U.S. Bureau of Labor Statistics, 2009
Indirect Basin Related	288,745	4,000	U.S. Census Bureau, 2009
Coastal	44,658	947	National Coastal Economics Program, 2009
Farm	45,865	1,880	USDA Census of Agriculture, 2007
Fishing/Hunting/Birding	44,941	1,476	U.S. Fish and Wildlife Service, 2008
Water Supply Utilities	8,750	485	UDWRA and DRBC, 2010
Wastewater Utilities	1,298	61	UDWRA and DRBC, 2010
Watershed Organizations	201	10	UDWRA and DRBC, 2010
Ski Area Jobs	1,753	$88	Penna. Ski Areas Association
Paddling-based Recreation	4,226		Outdoor Industry Association (2006
River Recreation	448	$9	U. S. Forest Service/Nat'l. Park Service, 1990
Canoe/Kayak/Rafting	225		Canoe Liveries and UDWRA, 2010
Wild Trout Fishing	350	$4	Maharaj, McGurrin, and Carpenter, 1998
Del. Water Gap Nat'l. Rec. Area	7,563	101	Stynes and Sun, 2002
Port Jobs	12,121	772	Economy League of Greater Phila., 2008
Delaware Basin Total	**> 600,000**	**>$10 billion**	

Jobs and salaries in the Delaware Basin were obtained from U. S. Bureau of Labor Statistics (2009) and U. S. Census Bureau (2009) data bases for the following scenarios (Tables 56-58):

1. Total number of jobs in each county within the Delaware Basin with jobs determined by NAICS industry code (formerly SIC code) and then grouped by census tract.
2. Direct Delaware Basin-related jobs such as water and sewer construction, living resources, maritime, tourism/recreation, ports, environmental services, and water/wastewater management determined for each NAICS code by state and county within the basin boundary.
3. Indirect jobs/wages provided by purchases of goods and services by direct jobs earners within the Delaware Basin in the interlinked regional economy. Indirect jobs were estimated by a multiplier of 2.2 applied to direct jobs and 1.8 to direct wages (Latham and Stapleford 1990), i.e., 100 direct jobs fund 120 indirect jobs and direct wages of $1,000 provide $800 indirect wages.

Within the Delaware Basin are 3,480,483 jobs earning $172.6 billion in annual wages including:

- Delaware (316,014 jobs, $16.5 billion wages)
- New Jersey (823,294 jobs, $38.1 billion wages)
- New York (69,858 jobs, $2.5 billion wages)
- Pennsylvania (2,271,317 jobs, $115.5 billion wages)

Jobs directly associated with the Delaware River Basin (such as water/sewer construction, water utilities, fishing, recreation, tourism, and ports) employ 240,621 with $4.9 billion in wages including:

- Delaware (15,737 jobs, $340 million wages)
- New Jersey (62,349 jobs, $1.3 billion wages)
- New York (32,171 jobs, $550 million wages)
- Pennsylvania (130,364 jobs, $2.8 billion wages)

Jobs indirectly related to the waters of the Delaware Basin (based on multipliers of 2.2 for jobs and 1.8 for salaries) employ 288,745 people with $4.0 billion in wages including:

- Delaware (18,884 jobs, $270 million wages)
- New Jersey (74,819 jobs, $1.0 billion in wages)
- New York (38,605 jobs, $400 million in wages)
- Pennsylvania (156,437 jobs, $2.2 billion in wages)

National Coastal Economy Report

The National Ocean Economic Program (2009) published a report that summarized the coastal economy in the United States that includes 6 industrial sectors:

- Marine Transportation
- Tourism and Recreation
- Living Marine Resources
- Marine Construction
- Ship and Boat Building
- Mineral Extraction.

According to the National Ocean Economic program (2009), the coastal counties within the Delaware Basin boundary contribute 44,658 coastal jobs with $947 million in annual wages with contributions of $1.8 billion toward the GDP. Table 59 summarizes employment, wages, and employment within the Delaware Basin obtained by multiplying the 2009 NOEP report county-wide values by the ratios of coastal county area within the basin by total coastal county area within the state which are 80% for Delaware, 5% for New Jersey and 86% for Pennsylvania. Using these ratios, 80%, 5%, and 86% of the employment and wages for coastal counties in Delaware, New Jersey, and Pennsylvania from the NOEP report are within the Delaware Basin boundary.

Table 56. Direct basin-related jobs within the Delaware River Basin by state, 2009

Sector	Industry	1997 NAICS Code	DE Jobs	DE Wages x$1,000	NJ Jobs	NJ Wages $1,000	NY Jobs	NY Wages $1,000	PA Jobs	PA Wages x$1,000
Construction	Marine Related	237120			81	4,532			923	58,999
	Water and Sewer	23711	529	21,838	2,485	109,527	551	36,387	3,138	211,691
	Construction	237990	126	5,678	318	19,547			306	16,427
Living Resources	Fish Hatcheries	112511								
	Aquaculture	112512								
	Fishing/Forestry	11411			50	2,028	21	424	67	2,485
	Finfish Fishing	114111			111	5,591				
	Shellfish Fishing	114112			28	995				
	Seafood Markets	445220	39	1,447	81	1,550			283	6,348
	Seafood Process.	31171			97	6,734				
	Comm. Fisheries		0	0	0	0			0	0
Minerals	Sand & Gravel	212321			166	8,109				
		212322	0	0	81	3,865				
	Oil & Gas	541360	16	752					39	3,802
Ship/Boat Building	Boat Bldg. Repair	336612								
	Ship Bldg. Repair	336611								
	Shipbuilding		0	0	0	0			0	0
Tourism/Recreation	Recreation	487990			52	1,184				
		611620	64	513	305	5,301			675	12,270
		532292			50	774				
	Amusement	713990	250	4,102	2,426	35,967	11,537	162,246	2,008	31,251
	Misc. Recreation				0	0	1,100	16,574	0	0
	Boat Dealers	441222	198	7,489	157	5,945				
	Restaurants	722110	3,714	173,787	26,512	415,604	17,029	264,832	59,217	974,264
		722211	6,797	4,102	14,697	190,314			31,766	422,438
		722212	265	3,876	312	4,717			1,138	18,281
		722213	942	13,509	2,388	32,495			7,628	119,695
	Hotels & Lodging	721110	650	11,673	2,323	52,310			6,965	243,253
		721191			92	1,583				
	Marinas	713930			202	6,410				
	RV Park/Camps	721211	105	3,611	339	11,894			39	494
	Scenic Tours	487210	18	393	37	748				
	Sporting Good	339920	0	0	245	5,287	702	9,972	245	3,780
	Zoos, Aquaria	712130							55	1,959
		712190			58	3,411			466	28,459
Transportation	Deep Sea Freight	483111								
	Marine Transport.	483112	954	32,378	1,823	71,222			904	43,155
	Search/Navigation	334511	39	2,856					716	61,370
	Warehousing	493110	313	13,739	2,396	95,952			8,477	336,427
		493120			361	14,120			337	14,571
	Ports		0	0	0	0			0	0
	Dredging/Disposal		0	0	0	0			0	0
Education/Research	Environ.organizations	813312	83	2,976	61	2268	103	1,221	682	23,574
	Environ. consulting	54162	205	10,745	1,193	61,107	133	7,700	1,441	895
Water/Wastewater	Water/sewage systms	2213	267	20,004	679	8,169	23	1,101	203	774
	Waste management	562	146	6,028	1,928	92,495	882	41,649	2,372	113,437
	Septic tank services	562991	17	644	215	10,381	90	4,173	274	10,145
Total			**15,737**	**342,140**	**62,349**	**1,292,136**	**32,171**	**546,279**	**130,364**	**2,760,244**

Table 57. Jobs and wages directly and indirectly related to the Delaware River Basin, 2009

State/County	(1) Total Jobs	(2) Basin Jobs	(3) Direct Jobs	(4) Indirect Jobs	(1) Total Wages $ billion	(2) Basin Wages $ billion	(3) Direct Wages $ billion	(4) Indirect Wages $ billion
Delaware	**390,900**	**316,014**	**15,737**	**18,884**	**19.5**	**16.5**	**0.34**	**0.27**
Kent	60,100	50,412			2.4	2.0		
New Castle	264,600	252,534			14.7	14.1		
Sussex	66,200	13,068			2.4	0.5		
New Jersey	**1,362,200**	**823,294**	**62,349**	**74,819**	**61.6**	**38.1**	**1.3**	**1.0**
Burlington	194,500	187,758			9.1	8.8		
Camden	196,800	169,909			8.7	7.5		
Cape May	47,500	14,545			1.4	0.4		
Cumberland	62,000	61,868			2.5	2.5		
Gloucester	99,100	89,183			3.9	3.6		
Hunterdon	47,300	23,650			2.8	1.4		
Mercer	222,900	178,320			12.4	9.9		
Monmouth	246,600	9,864			11.4	0.5		
Ocean	149,900	7,495			5.5	0.3		
Salem	21,900	21,900			1.0	1.0		
Sussex	38,200	23,302			1.4	0.9		
Warren	35,500	35,500			1.5	1.5		
New York	**341,300**	**69,858**	**32,171**	**38,605**	**12.8**	**2.5**	**0.55**	**0.4**
Broome	94,100	11,292			3.4	0.4		
Delaware	16,000	14,240			0.6	0.5		
Greene	14,300	572			0.5	19.9		
Orange	130,700	10,456			5.2	0.4		
Sullivan	26,300	25,511			0.9	0.9		
Ulster	59,900	7,787			2.2	0.3		
Pennsylvania	**2,596,260**	**2,271,317**	**130,364**	**156,437**	**126.5**	**115.5**	**2.8**	**2.2**
Berks	159,106	150,665			6.2	5.9		
Bucks	244,453	244,453			10.6	10.6		
Carbon	16,730	16,730			0.5	0.5		
Chester	231,368	212,996			13.6	12.5		
Delaware	201,208	201,208			10.1	10.1		
Lackawanna	96,604	4,830			3.2	0.2		
Lebanon	45,826	2,750			1.5	0.1		
Lehigh	166,932	166,932			7.4	7.4		
Luzerne	134,574	8,074			4.6	0.3		
Monroe	56,025	56,025			2.1	2.1		
Montgomery	453,962	453,771			27.7	27.7		
Northampton	96,536	96,536			3.8	3.8		
Philadelphia	619,396	619,396			33.3	33.3		
Pike	9,874	9,874			0.3	0.3		
Schuylkill	49,116	27,077			1.6	0.9		
Wayne	14,550	14,114			0.5	0.4		
Delaware Basin	**4,690,660**	**3,480,483**	**240,621**	**288,745**	**220.3**	**172.6**	**4.9**	**4.0**

Table 58. Direct basin-related and indirect jobs within the Delaware River Basin, 2009

Sector	Industry	1997 NAICS Codes	Direct Jobs	Direct Wages (x$1,000)	Indirect Jobs[1]	Indirect Wages[2] (x$1,000)
Construction	Marine Related	237120	1,004	63,531	1,205	50,825
	Water and Sewer	23711	6,703	379,443	8,044	303,554
	Construction	237990	750	41,652	900	33,322
Living Resources	Fish Hatcheries	112511	0	0	0	0
	Aquaculture	112512	0	0	0	0
	Fishing/Foresty	11411	138	4,937	166	3,950
	Finfish Fishing	114111	111	5,591	133	4,473
	Shellfish Fishing	114112	28	995	34	796
	Seafood Markets	445220	403	9,345	484	7,476
	Seafood Process.	31171	97	6,734	116	5,387
	Comm. Fisheries		0	0	0	0
Minerals	Sand & Gravel	212321	166	8,109	199	6,487
		212322	81	3,865	97	3,092
	Oil & Gas	541360	55	4,554	66	3,643
Ship/Boat Building	Boat Bldg. Repair	336612	0	0	0	0
	Shipbuilding		0	0	0	0
Tourism/Recreation	Recreation	487990	52	1,184	62	947
		611620	1,044	18,084	1,253	14,467
		532292	50	774	60	619
	Amusement	713990	16,221	233,566	19,465	186,853
	Misc. Recreation		1,100	16,574	1,320	13,259
	Boat Dealers	441222	355	13,434	426	10,747
	Restaurants	722110	106,472	1,828,487	127,766	1,462,790
		722211	53,260	616,854	63,912	493,483
		722212	1,715	26,874	2,058	21,499
		722213	10,958	165,699	13,150	132,559
	Hotels & Lodging	721110	9,938	307,236	11,926	245,789
		721191	92	1,583	110	1,266
	Marinas	713930	202	6,410	242	5,128
	RV Park/Camps	721211	483	15,999	580	12,799
	Scenic Tours	487210	55	1,141	66	913
	Sporting Good	339920	1,192	19,039	1,430	15,231
	Zoos, Aquaria	712130	55	1,959	66	1,567
		712190	524	31,870	629	25,496
Transportation	Deep Sea Freight	483111	0	0	0	0
	Marine Transport.	483112	3,681	146,755	4,417	117,404
	Search/Navigation	334511	755	64,226	906	51,381
	Warehousing	493110	11,186	446,118	13,423	356,894
		493120	698	28,691	838	22,953
	Ports		0	0	0	0
	Dredging/Disposal		0	0	0	0
Education/Research	Environ.organizations	813312	929	30,039	1,115	24,032
	Environ. consulting	54162	2,972	80,447	3,566	64,357
Water/Wastewater	Water/sewage systms	2213	1,172	30,048	1,406	24,038
	Waste management	562	5,328	253,609	6,394	202,887
	Septic tank services	562991	596	25,343	715	20,275
Total			**240,621**	**4,940,799**	**288,745**	**3,952,639**

1. Direct jobs are directly related to the Delaware Basin. 2. Indirect jobs/salaries are derived from purchases of goods and services calculated by multipliers of 2.2 for jobs and 1.8 for wages.

Table 59. Coastal employment, wages, and GDP within the Delaware River Basin (National Ocean Economic Program 2009)

Sector	Employment	Wages ($ million)	GDP ($ million)
Delaware	**12,139**	**$214**	**$392**
Marine Construction			
Living Resources	354	$8	$15
Offshore Minerals			
Tourism & Recreation	10,398	$151	$299
Marine Transportation	1,744	$53	$72
Ship and Boat Building			
New Jersey	**4,423**	**$140**	**$235**
Marine Construction			$9
Living Resources			$7
Offshore Minerals			$1
Tourism & Recreation	2,939		$110
Marine Transportation			$104
Ship and Boat Building			$4
Pennsylvania	**28,096**	**$593**	**$1,204**
Marine Construction			$4
Living Resources			$172
Offshore Minerals			$13
Tourism & Recreation	**20,093**		$538
Marine Transportation			$383
Ship and Boat Building			$68
Delaware Basin	**44,658**	**$947**	**$1,831**
Marine Construction			$12
Living Resources	354	$8	$195
Offshore Minerals			$14
Tourism & Recreation	33,430	$151	$947
Marine Transportation	1,744	$53	$560
Ship and Boat Building			$72

Farm Jobs

In 2007 there were 30,455 farms in Delaware Basin counties or 21,840 farms within the basin boundary (30,455 x 0.67 = 21,840). The USDA estimates each farm employs 2.1 full time equivalent jobs. Farming provides 45,865 jobs with $1.9 billion in wages in the Delaware Basin (Table 60).

Table 60. Farm jobs in the Delaware River Basin

County	Farmland by County[1] (ac)	Farmland in Del. Basin (ac)	Ratio Farmland County/Basin	Farms in County[1]	No. of Farms in Basin	Farm jobs in Basin (2.1 jobs/farm)
New Castle	51,913			825		
Kent	146,536			347		
Sussex	234,324			1,374		
Delaware	**432,773**	**254,143**	**59%**	**2,546**	**1,495**	**3,140**
Burlington	85,790			922		
Camden	8,760			225		
Cape May	7,976			201		
Cumberland	69,489			615		
Gloucester	46,662			669		
Hunterdon	100,027			1,623		
Mercer	21,736			311		
Monmouth	44,130			932		
Ocean	9,833			255		
Salem	96,530			759		
Sussex	65,242			1,060		
Warren	74,975			933		
New Jersey	**631,150**	**505,507**	**80%**	**8,505**	**6,812**	**14,305**
Broome	86,613			580		
Delaware	165,572			747		
Greene	44,328			286		
Orange	80,990			642		
Sullivan	50,443			323		
Ulster	75,205			501		
New York	**503,151**	**187,561**	**37%**	**3,079**	**1,148**	**2,410**
Berks	170,760			1,980		
Bucks	58,012			934		
Carbon	20,035			207		
Chester	117,145			1,733		
Delaware	1,646			79		
Lackawanna	39,756			417		
Lancaster	326,648			5,462		
Lebanon	89,566			1,193		
Lehigh	72,737			516		
Luzerne	66,577			610		
Monroe	29,165			349		
Montgomery	28,563			719		
Northampton	68,252			486		
Philadelphia	150			17		
Pike	27,569			54		
Schuylkill	81,276			966		
Wayne	92,939			603		
Pennsylvania	**1,290,796**	**979,313**	**76%**	**16,325**	**12,386**	**26,010**
Total	**2,857,870**	**1,926,524**	**67%**	**30,455**	**21,840**	**45,865**

Census of Agriculture 2007 (USDA 2009)

Fishing/Hunting/Bird and Wildlife Recreation Jobs

The 2007 NJDEP study estimates the average annual salary per ecotourism job is $32,843 using figures from the U.S. Fish and Wildlife Service (2001) report on fishing, hunting, and wildlife associated recreation. If fishing, hunting, and bird/wildlife associated recreation in the Delaware

River Basin accounts for $1.5 billion in annual economic activity ($2006), then ecotourism provides for 44,941 jobs (Table 61).

Table 61. Jobs from fishing, hunting, and wildlife recreation in the Delaware River Basin

Recreation Activity[1]	DE in Basin[2] (2006 $M)	NJ in Basin[2] (2006 $M)	NY in Basin[2] (2006 $M)	PA in Basin[2] (2006 $M)	Delaware Basin (2006 $M)
Fishing	48	301	46	181	576
Hunting	21	58	36	225	340
Wildlife/Bird-watching	65	215	78	202	560
Total	**134**	**574**	**160**	**608**	**1,476**
	DE Jobs @ $32,843	**NJ Jobs @** $32,843	**NY Jobs @** $32,843	**PA Jobs @** $32,843	**Del. Basin Jobs @** $32,843
Fishing	1,461	9,165	1,401	5,511	17,538
Hunting	639	1,766	1,096	6,851	10,352
Wildlife/Bird-watching	1,979	6,546	2,375	6,150	17,051
Total	**4,080**	**17,477**	**4,872**	**18,512**	**44,941**

1. (USFWS 2008). 2. Prorated by ratio of basin area within state to state land area: Delaware (50%), New Jersey (40%), New York (5%) and Pennsylvania (14%).

Water Utility Jobs

Over 300 public and private water utilities (including the City of New York with 5,600 employees and the City of Philadelphia with over 800 water system employees) withdraw up to 1,800 mgd of drinking water from surface water and groundwater supplies in the Delaware River Basin. According to the American Water Works Association, the average salary of a water system employee is $55,407. Therefore, water utilities in the Delaware River Basin employ at least 8,750 jobs with annual wages of $485 million (Table 62).

Wastewater Utility Jobs

Over 60 wastewater utilities discharge almost 1.2 billion gallons per day of treated wastewater to the Delaware River Basin. These wastewater utilities employ 1,298 employees who earn $61 million in annual wages (Table 63).

Table 62. Public water supply jobs in the Delaware River Basin (DRBC and UDWRA 2010)

Water Purveyor	Jobs	Salaries
Delaware	**141**	**7,812,387**
United Water Delaware	55	3,047,385
City of Wilmington	31	1,717,617
City of Dover	14	775,698
City of Newark	7	387,849
City of Milford	6	332,442
Lewes Board of Public Works	5	277,035
Tidewater Utilities	5	277,035
Dover Air Force Base	1	55,407
New Castle Mun. Services Comm.	1	55,407
Town of Smyrna	1	55,407
Harrington	1	55,407
Camden-Wyoming Water Authority	1	55,407
Town of Milton	1	55,407
Other	12	664,884
New Jersey	**823**	**45,599,961**
Delaware and Raritan Canal	123	6,815,061
NJ American Water Co.	118	6,538,026
City of Trenton	78	4,321,746
City of Camden	33	1,828,431
City of Vineland	25	1,385,175
Aqua New Jersey	31	1,717,617
Merchantville-Pennsauken Water	18	997,326
Washington Twp. MUA	14	775,698
Willingboro Twp. MUA	14	775,698
Mount Holly Water	13	720,291
City of Bridgeton	11	609,477
City of Wildwood	11	609,477
Evesham Twp. MUA	8	443,256
Millville City Water Dept.	8	443,256
Evesham MUA	7	387,849
Hackettstown MUS	7	387,849
Millville Water Dept	8	443,256
Moorestown	8	443,256
Bordentown	7	387,849
Burlington Twp.	6	332,442
Mt. Laurel	6	332,442
Glassboro	6	332,442
Collingswood	6	332,442
Mapleshade	6	332,442
West Deptford	5	277,035
Woodbury	5	277,035
Burlington City	5	277,035
Pennsgrove	5	277,035
Deptford Twp.	5	277,035
Nesqehoning Boro Auth.	5	277,035
Medford Twp.	5	277,035
NJ American Mansfield/Oxford	5	277,035
Florence Twp.	5	277,035
Salem City	5	277,035
Other	201	11,136,807

New York	**5,600**	**310,279,200**
New York City	5,600	310,279,200
Pennsylvania	**2,186**	**121,119,702**
City of Philadelphia	863	47,816,241
Aqua Pennsylvania, Inc.	307	17,009,949
Forest Park/Point Pleasant Diversion	50	2,770,350
Bethlehem	46	2,548,722
Allentown	45	2,493,315
North Wales Water Authoriity	45	2,493,315
Bucks Co. Water and Sewer Auth.	45	2,493,315
Reading Area Water Authority	43	2,382,501
Bucks Co. Water and Sewer Auth.	41	2,271,687
Penna. American Water Co.	30	1,662,210
North Penn Water	26	1,440,582
Easton	24	1,329,768
Pennsylvania-American Water Co.	22	1,218,954
Schuylkill Co. Municipal. Authority	15	831,105
Pottstown Water Authority	14	775,698
Schuylkill Co. MUA	13	720,291
Muhlenberg Twp.	12	664,884
Lehigh County	12	664,884
PA American Nazareth	12	664,884
Hazelton	12	664,884
PA American Coatesville	12	664,884
Allentown City	12	664,884
Phoenixville Mun. Waterworks	12	664,884
Northampton Boro.	10	554,070
East Stroudsburg	10	554,070
PA American Yardley	10	554,070
Phoenixville	10	554,070
Morrisville	10	554,070
PA American Home District	10	554,070
PA American Penn District	10	554,070
Falls Twp.	10	554,070
Northampton Bucks Co. Auth.	10	554,070
Warminster Twp. MUA	10	554,070
Horsham Water and Sewer Auth.	10	554,070
Newtown Artesian Water	10	554,070
Milford	7	387,849
Tamaqua MWA	7	387,849
Lehighton MWA	7	387,849
Ambler Boro	7	387,849
Brodhead Creek Reg. Auth.	7	387,849
South Whitehall Twp. Auth.	7	387,849
Emmaus Munic. Water	7	387,849
Warrington Twp.	7	387,849
Wyomissing Boro	7	387,849
Schuylkill Haven Boro.	7	387,849
PA American Water Glen Alsace	7	387,849
Palmerton Mun. Auth.	7	387,849
Quakertown Mun. Water	6	332,442
Other	263	14,572,041
Delaware Basin	**8,750**	**484,811,250**

Table 63. Jobs and salaries at wastewater utilities in the Delaware River Basin

NPDES ID	Facility	Location	State	Jobs	Salaries
DE0020338	Kent Co. Levy Court WWTR	Frederica	DE	15	705,000
DE0021512	Lewes City POTW	Lewes	DE	3	141,000
DE0020320	Wilmington Wastewater Plant	Wilmington	DE	90	4,230,000
Delaware				**108**	**5,076,000**
NJ0027481	Beverly City Sewer Auth. STP	Beverly	NJ	3	141,000
NJ0024678	Bordentown Sewerage Auth.	Bordentown	NJ	5	235,000
NJ0024651	Cumberland Co. Utility Auth.	Bridgeton	NJ	7	329,000
NJ0024660	Burlington City STP	Burlington	NJ	5	235,000
NJ0021709	Burlington Twp. DPW	Burlington	NJ	4	188,000
NJ0026182	Camden County MUA	Camden	NJ	80	3,760,000
NJ0021601	Carneys Point Twp. Sewer Auth	Carneys Point	NJ	3	141,000
NJ0024007	Cinnaminson Sewerage Auth.	Cinnaminson	NJ	4	188,000
NJ0023701	Florence Twp. Sewer Auth.	Florence	NJ	5	235,000
NJ0026301	Hamilton Twp. DPW WWTP	Hamilton.	NJ	16	752,000
NJ0020915	Lambertville City Sewer Auth.	Lambertville	NJ	4	188,000
NJ0024759	Ewing Lawrence Sewer Auth.	Lawrenceville	NJ	16	752,000
NJ0069167	Maple Shade Util, Authority	Maple Shade	NJ	5	235,000
NJ0026832	Medford Twp. Sewer Auth. STP	Medford	NJ	2	94,000
NJ0029467	Millville City Sewer Auth.	Millville	NJ	7	329,000
NJ0024996	Moorestown Twp. Utilities Auth	Moorestown	NJ	6	282,000
NJ0024015	Mount Holly Twp. MUA	Mount Holly	NJ	8	376,000
NJ0020184	Newton Town DPW	Newton	NJ	4	188,000
NJ0024821	Pemberton Twp. MUA STP	Pemberton	NJ	5	235,000
NJ0024023	Penns Grove Sewerage Auth.	Penns Grove	NJ	3	141,000
NJ0021598	Pennsville Twp. Sewer Auth.	Pennsville	NJ	4	188,000
NJ0024716	Phillipsburg Town STP	Phillipsburg	NJ	5	235,000
NJ0022519	Riverside Twp. DPW	Riverside	NJ	3	141,000
NJ0024856	Salem WWTP Facility	Salem	NJ	3	141,000
NJ0024686	Gloucester Co. Util. Auth. STP	Thorofare	NJ	24	1,128,000
NJ0020923	Trenton City DPW Sewer Auth.	Trenton	NJ	20	940,000
NJ0023361	Willingboro Twp. MUA	Willingboro	NJ	6	282,000
New York				**257**	**12,079,000**
NY0020265	Delhi WWTP	Delhi	NY	4	188,000
NY0030074	Liberty WWTF	Liberty	NY	4	188,000
NY0022454	Monticello STP	Monticello	NY	6	282,000
NY0029271	Sidney WWTP	Sidney	NY	6	282,000
New Jersey				**20**	**940,000**
PA0026867	Abington Twp. STP	Abington	PA	6	282,000
PA0026000	Allentown City WWTP	Allentown	PA	45	2,115,000
PA0026042	Bethlehem City STP	Bethlehem	PA	95	4,465,000
PA0021181	Bristol Borough Water/Sewer	Bristol	PA	3	141,000
PA0027103	Delaware Co. Reg. Water Auth.	Chester	PA	44	2,068,000
PA0026859	Coatesville WWTP	Coatesville	PA	6	282,000
PA0026794	Conshohocken Borough Auth.	Conshohocken	PA	4	188,000
PA0026531	Downingtown Regional WPCC	Downingtown	PA	7	329,000
PA0026549	Borough of Doylestown WWTP	Doylestown	PA	29	1,363,000
PA0027235	Easton Area Joint Auth. WWTP	Easton, PA	PA	14	658,000
PA0029441	Upper Dublin Twp. MS4 UA	Ft. Washington	PA	3	141,000
PA0051985	Horsham Twp. STP	Horsham	PA	3	141,000
PA0024058	Kennett Square Borough WWTP	Kennett Sq.	PA	3	141,000

PA0026298	Whitemarsh STP	Lafayette Hill	PA	4	188,000
PA0026182	Lansdale Borough STP	Lansdale	PA	5	235,000
PA0039004	Upper Gwynedd Towam. STP	Lansdale	PA	7	329,000
PA0026468	Morrisville Mun. Auth. Water	Morrisville	PA	10	470,000
PA0027421	Norristown Borough WWTP	Norristown	PA	10	470,000
PA0020532	Upper Montgomery Joint Sewer	Pennsburg	PA	4	188,000
PA0026689	Northeast WPCP	Philadelphia	PA	210	9,870,000
PA0026662	Philadelphia Southeast POTW	Philadelphia	PA	112	5,264,000
PA0026671	SW Water Pollution Control	Philadelphia	PA	200	9,400,000
PA0020460	Quakertown WWTP	Quakertown	PA	10	470,000
PA0026549	Reading WWTP	Reading	PA	29	1,363,000
PA0020168	East Stroudsburg Filtration Plant	Stroudsburg	PA	10	470,000
PA0029289	Stroudsburg STP	Stroudsburg	PA	10	470,000
PA0027031	Goose Creek STP	West Chester	PA	4	188,000
PA0026018	West Chester Taylor Run STP	West Chester	PA	4	188,000
PA0028584	West Goshen STP	West Chester	PA	8	376,000
PA0023256	Upper Gwynedd Twp. WWTP	West Point	PA	7	329,000
PA0025976	Upper Moreland Hatboro Sewer	Willow Grove	PA	7	329,000
Pennsylvania				**913**	**42,911,000**
Del. Basin				**1,298**	**61,006,000**

Watershed Jobs

Over 100 nonprofit watershed and environmental organizations employ at least 200 staff who earn at least 9.5 million in wages on programs to restore the watersheds in the Delaware Basin (Table 64).

Table 64. Watershed organization jobs and salaries in the Delaware River Basin

Watershed Organization	Town	State	Jobs	Salaries
Christina Conservancy, Inc.	Wilmington	DE	1	48,000
Coalition for Natural Stream Valleys	Newark	DE		0
Delaware Audubon Society	Wilmington	DE	1	48,000
Delaware Nature Society	Hockessin	DE	20	960,000
Fairfield Watershed Association	Newark	DE		0
Friends of Bombay Hook	Smyrna	DE	1	48,000
Friends of White Clay Creek State Park	Newark	DE	1	48,000
Naamans Creek Watershed Association	Arden	DE		0
Nature Conservancy of Delaware	Wilmington	DE	2	96,000
Partnership for the Delaware Estuary, Inc.	Wilmington	DE	10	480,000
Save Wetlands and Bays	Millsboro	DE		0
St. Jones River Greenway Commission	Magnolia	DE		0
St. Jones River Watershed Association	Dover	DE	1	48,000
Waterfront Watch of Wilmington	Wilmington	DE	1	48,000
White Clay Creek Watershed Mgmt. Committee	Newark	DE	1	48,000
Delaware			**39**	**1,872,000**
Cape May County Watershed Area 16	Cape May Ct. Hse.	NJ	1	48,000
Citizens United to Protect the Maurice River	Millville	NJ	1	48,000
Cooper River Watershed Association	Haddonfield	NJ		0
Crafts Creek Spring Hill Brook Watershed	Bordentown	NJ		0
Crosswicks Creek Watershed Association	Yardville	NJ	1	48,000
Crosswicks-Doctors Creeks Watershed Association	New Egypt	NJ	1	48,000
Delaware River Greenway Partnership	Burlington	NJ	1	48,000
Fairview Lake & Watershed Conservation Foundation	West Caldwell	NJ		0
Friends Hamilton-Trenton-Bordentown Marsh	Robbinsville	NJ		0

Hunterdon Land Trust Alliance	Flemington	NJ	2	96,000
Mantua/Woodbury Creeks Watershed Association	Glassboro	NJ	1	48,000
Musconetcong Watershed Association	Asbury	NJ	1	48,000
New Jersey Coalition of Lake Associations	Sparta	NJ	1	48,000
Newton Creek Watershed Association	Collingswood	NJ	1	48,000
Oldmans Creek Watershed Association.	Mullica Hill	NJ	1	48,000
Paulinskill-Pequest Watershed Association	Blairstown	NJ	1	48,000
Phillipsburg Riverview Organization	Phillipsburg	NJ	3	144,000
Pinelands Preservation Alliance	Southampton	NJ	1	48,000
Pinelands Watershed Alliance	Tuckerton	NJ	1	48,000
Pohatcong Creek Watershed Association	Phillipsburg	NJ	1	48,000
Pompeston Creek Watershed Association	Cinnaminson	NJ	1	48,000
Raccoon Creek Watershed Association, Inc.	Mullica Hill	NJ	1	48,000
Rancocas Conservancy	Vincentown	NJ	2	96,000
Salem County Watershed Task Force	Woodstown	NJ		0
South Jersey Land and Water Trust	Glassboro	NJ	2	96,000
Upper Maurice River Watershed Association	Franklinville	NJ	1	48,000
New Jersey			**26**	**1,248,000**
Neversink River Program/The Nature Conservancy	Cuddebackville	NY	3	144,000
New York			3	
Aquashicola/Pohopoco Watershed Conservancy	Kresgeville	PA	1	48,000
Berks County Conservancy	Reading	PA	5	240,000
Bertsch-Hokendauqua-Catasauqua Watershed Assoc.	Bethlehem	PA	1	48,000
Brandywine Valley Association	West Chester	PA	8	384,000
Brodhead Forest & Stream Association	Stroudsburg	PA	1	48,000
Brodhead Watershed Association	Henryville	PA	1	48,000
Bushkill Stream Conservancy	Tatamy	PA	1	48,000
Chester Creek Watershed Association	Glen Mills	PA	1	48,000
Chester-Ridley-Crum Watersheds Association	Media	PA	5	240,000
Cooks Creek Watershed Association	Springtown	PA	1	48,000
Crum Creek Watershed Partnership	Swarthmoore	PA	1	48,000
Darby Cobbs Watershed Partnership	Philadelphia	PA	1	48,000
Darby Creek Valley Association	Drexel Hill	PA	1	48,000
Delaware River Shad Fishermen's Association	Bethlehem	PA	1	48,000
Delaware Riverkeeper Network	Bristol	PA	13	624,000
French and Pickering Creeks Conservation Trust	Valley Forge	PA	7	336,000
Friends of Cherry Valley	Stroudsburg	PA	1	48,000
Friends of Cobbs Creek Park	Philadelphia	PA	1	48,000
Friends of Crum Creek	Philadelphia	PA	1	48,000
Friends of Lake Afton	Yardley	PA	1	48,000
Friends of Mingo Creek	Royersford	PA	1	48,000
Friends of Poquessing Watershed, Inc.	Philadelphia	PA	1	48,000
Friends of Tacony Creek Park	Philadelphia	PA	1	48,000
Friends of the Del. Water Gap Nat'l. Recreation Area	Bushkill	PA	1	48,000
Friends of the Manayunk Canal	Philadelphia	PA	1	48,000
Friends of the Pennypack Park	Philadelphia	PA	1	48,000
Friends of the Wissahickon	Philadelphia	PA	1	48,000
Fry's Run Watershed Association	Easton	PA		0
Greater Pottstown Watershed Alliance	Pottstown	PA		0
Green Valleys Association	Pottstown	PA	3	144,000
Hay Creek Watershed Association	Geigertown	PA	1	48,000
Lackawaxen River Conservancy	Rowland PA	PA	1	48,000
Lake Wallenpaupack Watershed Association	Paupack	PA	2	96,000
Little Schuylkill Conservation Club	Delano	PA		0
Lower Merion Conservancy	Gladwyne	PA	6	288,000

Maiden Creek Watershed Association	Kempton	PA		0
Martins-Jacoby Watershed Association	Martins Creek	PA	1	48,000
Mid-Atlantic Council of Watershed Associations	West Chester	PA		0
Middle Anthracite Watershed Association	Sybertsville	PA	1	48,000
Mill Creek Council, Inc.	Philadelphia	PA	1	48,000
Monocacy Creek Watershed Association, Inc.	Bethlehem	PA	1	48,000
Neshaminy Creek Watershed Association	Rushland	PA	1	48,000
North Branch Watershed Association	Doylestown	PA	1	48,000
North Pocono CARE	Thornhurst	PA	2	96,000
Palisades Region Watershed Partnership	Pipersville	PA		0
Paunacussing Watershed Association	Carversville	PA		0
Pennsylvania Organization Watersheds and Rivers	Harrisburg	PA	3	144,000
Pennypack Ecological Restoration Trust	Huntington Valley	PA	8	384,000
Pennypack Watershed Partnership	Philadelphia	PA	1	48,000
Perkiomen Watershed Conservancy	Schwenksville	PA	4	192,000
Poquessing Watershed Partnership	Philadelphia	PA		0
Red Clay Valley Association	West Chester	PA	4	192,000
Saucon Creek Watershed Association	Bethlehem	PA	1	48,000
Schuylkill Action Network	Philadelphia	PA	2	96,000
Schuylkill Canal Association	Oaks	PA	1	48,000
Schuylkill Headwaters Association	Pottsville	PA	2	96,000
Schuylkill River Greenway Association	Pottstown	PA	1	48,000
Southampton Watershed Association	Southampton	PA	1	48,000
Springton Lake/Crum Creek Conservancy	Newtown Square	PA	1	48,000
Stony Creek Watershed Committee	Norristown	PA	1	48,000
Swarthmore College's Watershed Projects	Swarthmore	PA	2	96,000
Tinicum Conservancy	Erwinna	PA	4	192,000
Tinicum Creek Watershed Association	Upper Black Eddy	PA	2	96,000
Tobyhanna/Tunkhannock Creek Watershed Association	Pocono Lake	PA	1	48,000
Tohickon Creek Watershed Association	Pipersville	PA	1	48,000
Tookany/Tacony - Frankford Watershed Partnership	Philadelphia	PA	1	48,000
Upper Perkiomen Watershed Coalition	Palm	PA	1	48,000
Water Resources Association Delaware River Basin	Exton	PA	1	48,000
White Clay Watershed Association	Landenberg	PA	1	48,000
Wildlands Conservancy	Emmaus	PA	5	240,000
Wissahickon Restoration Volunteers	Philadelphia	PA	1	48,000
Wissahickon Valley Watershed Association	Ambler	PA	1	48,000
Wissahickon Watershed Partnership	Philadelphia	PA	1	48,000
Pennsylvania			**133**	**6,384,000**
Delaware Basin			**201**	**9,504,000**

Ski Area Jobs

In the Pocono Mountains of Pennsylvania, 9 ski resorts employ 1,753 direct jobs in the Delaware Basin from aggregate annual revenues of $87,655,063 from 1,908,228 skier visits based on an average mid-week lift ticket rate of $45/day.

Paddling-based Recreation

In the Mid-Atlantic census division (NY, NJ, PA), the Outdoor Industry Association (2006) estimates that paddling-based recreation is practiced by 11% of the population and is responsible for 3,356,000 participants and 22,844 jobs. Given the Delaware Basin is the home of 18.5% of the three

state's total population of 40,800,000 people, then the prorated paddling-based recreation in the basin is responsible for 620,860 participants and 4,226 jobs.

River Recreation

Cordel et al. (1990) from the U. S. Forest Service and U.S. National Park Service estimated river recreation along the Upper Delaware River and Delaware Water Gap was responsible for 448 jobs with wages of $8.8 million in $1986.

Canoe/Kayak/Rafting

The 37 canoe and kayak liveries along the Delaware, Lehigh, and Schuylkill, and Brandywine Rivers employ 225 people to lease watercraft to approximately 225,000 visitors with earnings of $9 million per year assuming a daily rental fee of $40 per person.

Wild Trout Fishing

Along the Beaverkill, East Branch, West Branch and upper main stem of the Delaware River in New York, wild trout fishing provides for 350 jobs with $3.6 million in wages.

Delaware Water Gap National Recreation Area

Stynes and Sun (2002) estimated the Delaware Water Gap Nat'l. Recreation Area recorded 4,867,272 visits in 2001 that generated $106 million in sales, 7,563 direct/indirect jobs, and $100 million wages.

Port Jobs

The Economy League of Greater Philadelphia (2008) reported that Delaware River ports:

- Employ 4,056 workers earning $326 million in wages (Table 65).
- Indirectly support an additional two jobs each in port activity and employee spending for a total of 12,121 port jobs with $772 million wages and $2.4 billion annual economic output.
- Most of the 4,056 direct port jobs are in cargo handling and warehousing with petroleum port jobs adding up to less than 10% of employment.
- Provide good jobs, the average salary of a port employee (with benefits) is over $80,000.

Table 65. Jobs at Delaware River ports
(Economy League of Greater Philadelphia 2008)

Employment Type	Jobs
Direct	**4056**
Cargo Handling	1,911
Warehousing	987
Federal Government	553
Construction	318
State/Local Government	152
Security	99
Wholesale	36
Indirect (Industry)	**4,655**
Induced (Worker Spending)	**3,410**
Total	**12,121**

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Appendix A

Economic Value (Potential) of Marcellus Shale Natural Gas in the Delaware River Basin

The U.S. Geological Survey (Coleman et al. 2011) estimated the entire 54,000 square-mile Marcellus Shale Formation from Kentucky and Ohio to Pennsylvania and New York potentially contains a mean volume of 84 trillion cubic feet of natural gas with a range of 43 tcf (95th percentile) to 144 tcf (5th percentile). If the Delaware River Basin covers 4,700 square miles or 8.7% of the Marcellus Shale, then by proportion a mean volume of 7.3 tcf of natural gas is potentially recoverable within the basin boundary (0.087 x 84 tcf) with a range of 3.7 tcf (95th percentile) to 12.5 tcf (5th percentile). These estimates may vary as the thickness of Marcellus Shale in the Delaware Basin increases to the northeast toward the New York/Pennsylvania border ranging from 50 feet thick near Stroudsburg to more than 250 feet thick under Lackawaxen in Wayne County, Pennsylvania.

In 2010, the U.S. Energy Information Administration reported the mean natural gas wellhead price was $4.16/1000 cf, down from a peak of $7.97/1000 cf in 2008. The residential customer price of natural gas was $11.21/1000 cf, down two dollars from the 2008 peak. Table A1 lists fluctuating annual wellhead and residential consumer prices of natural gas in the U.S. from 2006 through 2010.

Table A1. Wellhead and residential prices of natural gas in the United States, 2006-2010 (EIA)

Year	Wellhead Price ($/1000 cf)	Residential Price ($/1000 cf)
2006	6.39	13.73
2007	6.25	13.08
2008	7.97	13.89
2009	3.67	12.14
2010	4.16	11.21

At the 2010 wellhead unit price (Table A2), the mean value of potentially recoverable natural gas from the Marcellus Shale Formation within the Delaware River Basin is projected to be $30.4 billion with a range of $15.4 billion (95th percentile) to $52.0 billion (5th percentile). Assuming the natural gas can be recovered within 25 years, the mean annual wellhead value of Marcellus Shale gas within the Delaware Basin is potentially $1.2 billion/year with a range of $0.6 billion/year (95th percentile) to $2.0 billion/year (5th percentile). Figures A1 and A2 project total and annual wellhead value of natural gas recoverable from the Delaware Basin based on variable prices from 2006 to 2010.

At the 2010 residential consumer unit price (Table A3), the mean value of natural gas from the Marcellus Shale Formation within the Delaware River Basin is $81.8 billion with a range of $41.5 billion (95th percentile) to $140.1 billion (5th percentile). Assuming the natural gas can be recovered within 25 years, the mean annual residential consumer value of Marcellus Shale gas within the Delaware Basin is $3.3 billion/year with a range of $1.7 billion/year (95th percentile) to $5.6 billion/year (5th percentile). Figures A3 and A4 project total and annual residential consumer value of natural gas recoverable from the Delaware Basin based on prices from 2006 to 2010.

Table A2. Wellhead value of Marcellus Shale natural gas within the Delaware River Basin

State/Basin	Area Marcellus Shale (sq mi)	Wellhead Natural Gas Price[1] ($/1000 cf)	Volume Natural Gas[2] (tcf)	Wellhead Natural Gas Value ($ billion)	Wellhead Natural Gas Value[3] ($ billion/yr)
Mean					
Pennsylvania	2,338	$4.16	3.6	$15.0	$0.6
New York	2,362	$4.16	3.7	$15.4	$0.6
Delaware Basin	4,700	$4.16	7.3	$30.4	$1.2
95th Percentile					
Pennsylvania	2,338	$4.16	1.8	$7.5	$0.3
New York	2,362	$4.16	1.9	$7.9	$0.3
Delaware Basin	4,700	$4.16	3.7	$15.4	$0.6
5th Percentile					
Pennsylvania	2,338	$4.16	6.2	$25.8	$1.0
New York	2,362	$4.16	6.3	$26.2	$1.0
Delaware Basin	4,700	$4.16	12.5	$52.0	$2.0

1. EIA 2010. 2. USGS 2011. 3. Assumes 25 year natural gas recovery period.

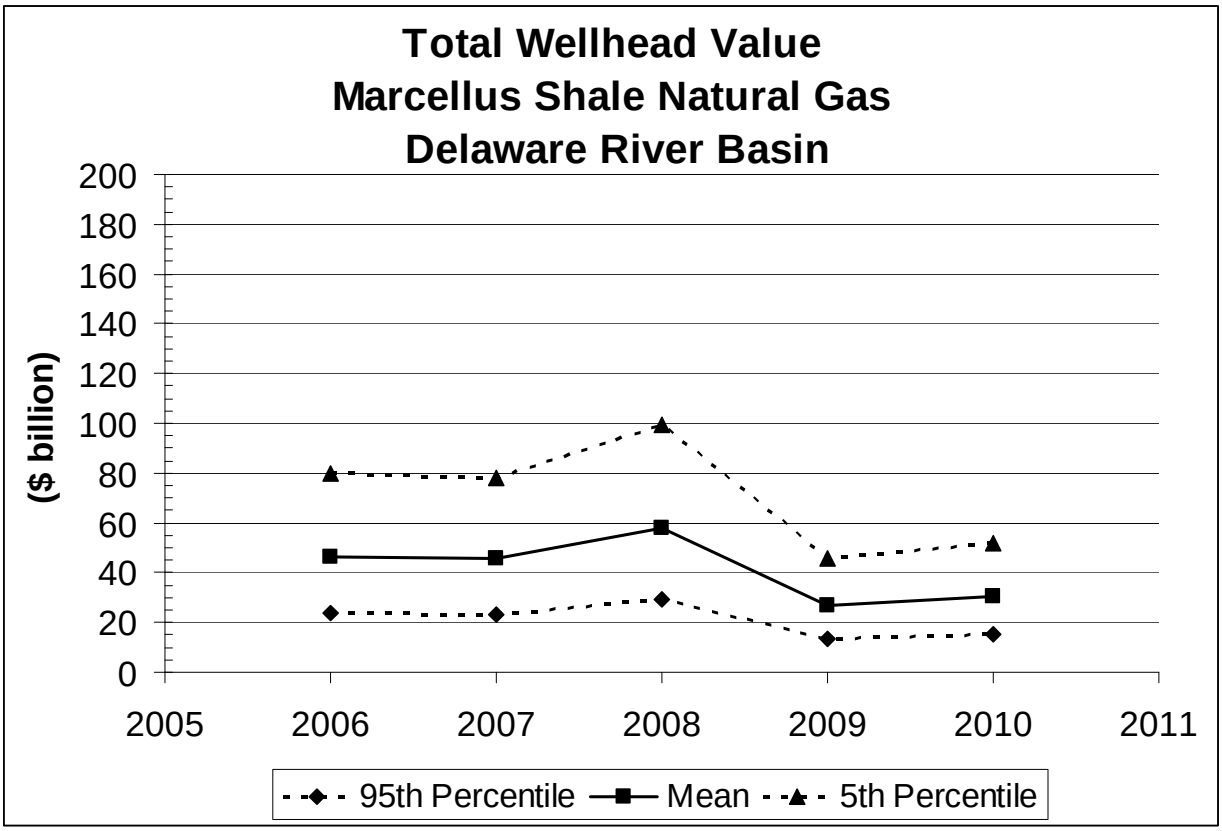


Figure A1. Total wellhead value of Marcellus shale natural gas in the Delaware River Basin Assumes mean volume of 7.3 tcf of natural gas potentially recoverable within basin boundary with a range of 3.7 tcf (95th percentile) to 12.5 tcf (5th percentile) as per Coleman et al. 2011 from the USGS. From EIA (2011), natural gas prices at wellhead ($/1000 cf): 2006 ($6.39), 2007 ($6.25), 2008 ($7.97), 2009 ($3.67), and 2010 ($4.16).

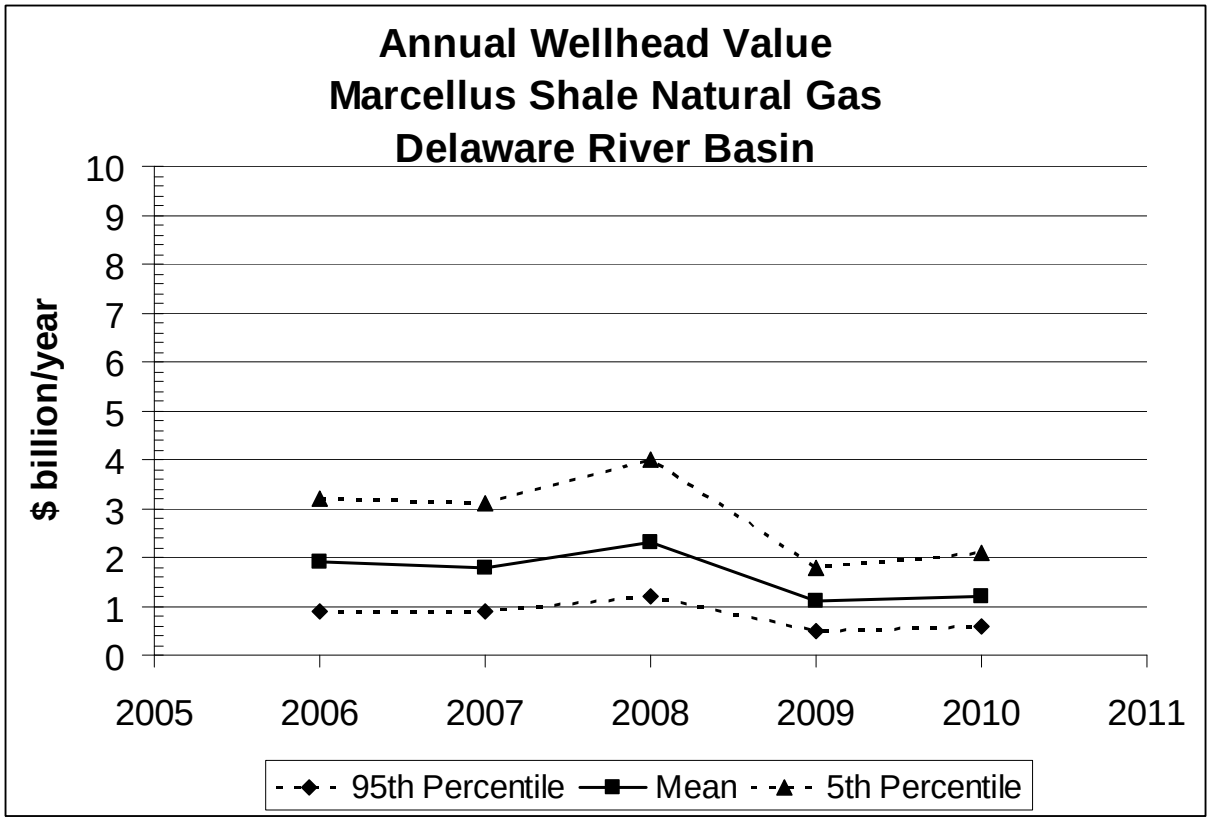


Figure A2. Total wellhead value of Marcellus shale natural gas in the Delaware River Basin Assumes mean volume of 7.3 tcf of natural gas potentially recoverable within basin boundary with a range of 3.7 tcf (95th percentile) to 12.5 tcf (5th percentile) as per Coleman et al. 2011 from the USGS. From EIA (2011), natural gas prices at wellhead ($/1000 cf): 2006 ($6.39), 2007 ($6.25), 2008 ($7.97), 2009 ($3.67), and 2010 ($4.16). Assumes 25 year natural gas recovery period.

Table A3. Residential value of Marcellus Shale natural gas within the Delaware River Basin

State/Basin	Area Marcellus Shale (sq mi)	Residential Natural Gas Price[1] ($/1000 cf)	Volume Natural Gas[2] (tcf)	Residential Natural Gas Value ($ billion)	Residential Natural Gas Value[3] ($ billion/yr)
Mean					
Pennsylvania	2,338	$11.21	3.6	$40.4	$1.6
New York	2,362	$11.21	3.7	$41.5	$1.7
Delaware Basin	4,700	$11.21	7.3	$81.8	$3.3
95th Percentile					
Pennsylvania	2,338	$11.21	1.8	$20.2	$0.8
New York	2,362	$11.21	1.9	$21.3	$0.9
Delaware Basin	4,700	$11.21	3.7	$41.5	$1.7
5th Percentile					
Pennsylvania	2,338	$11.21	6.2	$69.5	$2.8
New York	2,362	$11.21	6.3	$70.6	$2.8
Delaware Basin	4,700	$11.21	12.5	$140.1	$5.6

1. EIA 2010. 2. USGS 2011. 3. Assumes 25 year natural gas recovery period.

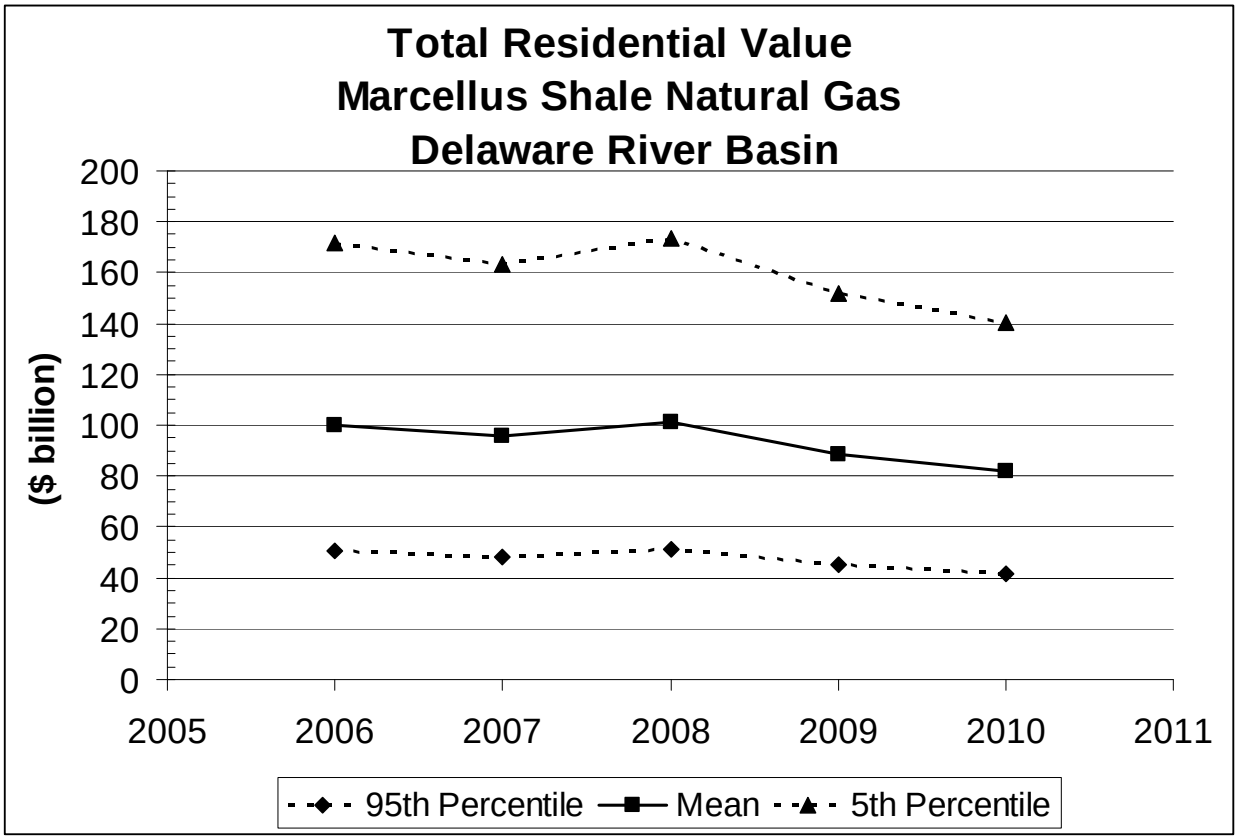


Figure A3. Total residential value of Marcellus shale natural gas in the Delaware River Basin Assumes mean volume of 7.3 tcf of natural gas potentially recoverable within basin boundary with a range of 3.7 tcf (95th percentile) to 12.5 tcf (5th percentile) from Coleman et al. 2011 (USGS). From EIA (2011), natural gas sold to residential consumers ($/1000 cf): 2006 ($13.73), 2007 ($13.08), 2008 ($13.89), 2009 ($12.14), and 2010 ($11.21).

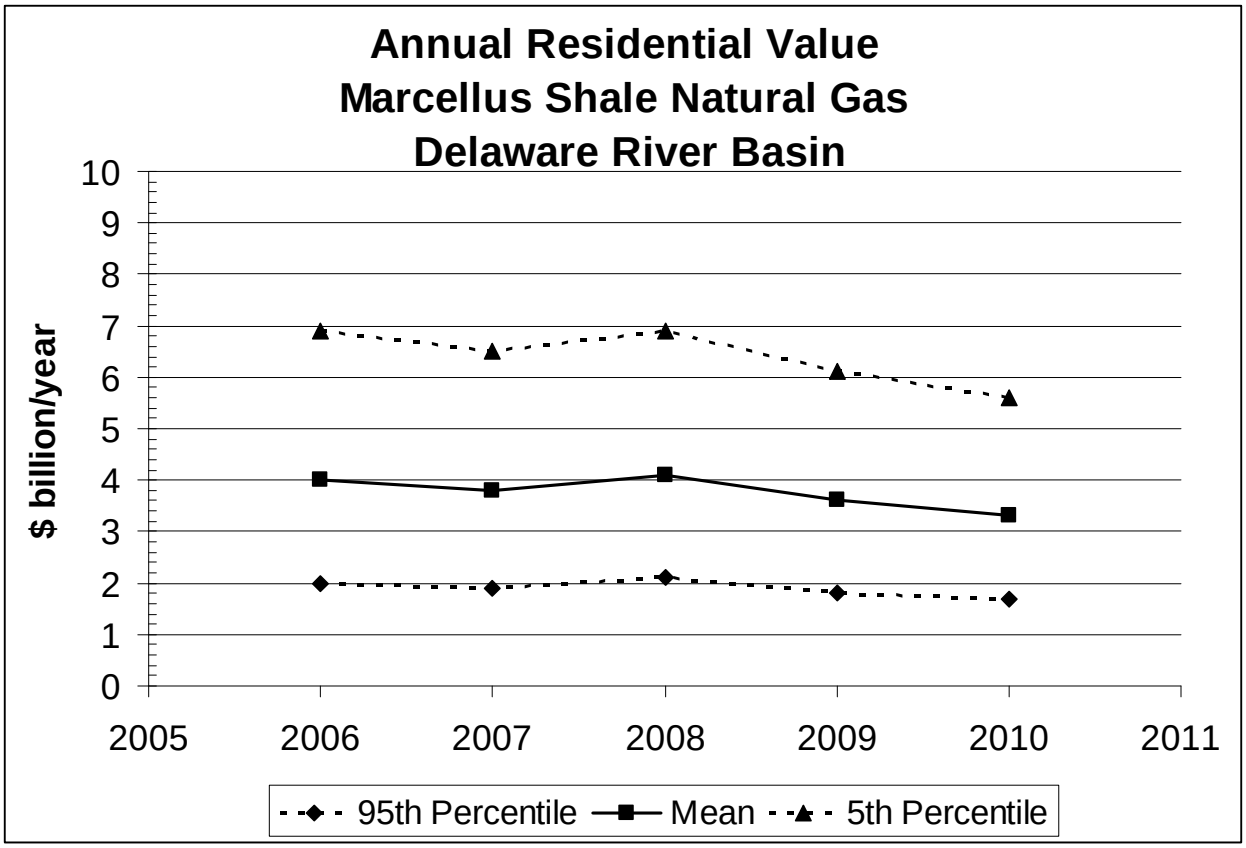


Figure A4. Annual residential value of Marcellus shale natural gas in the Delaware River Basin Assumes mean volume of 7.3 tcf of natural gas potentially recoverable within basin boundary with a range of 3.7 tcf (95th percentile) to 12.5 tcf (5th percentile) from Coleman et al. 2011 (USGS). From EIA (2011), natural gas sold to residential consumers ($/1000 cf): 2006 ($13.73), 2007 ($13.08), 2008 ($13.89), 2009 ($12.14), and 2010 ($11.21). Assumes 25 year natural gas recovery period.

Appendix B

Employment Codes by Industry, 2009

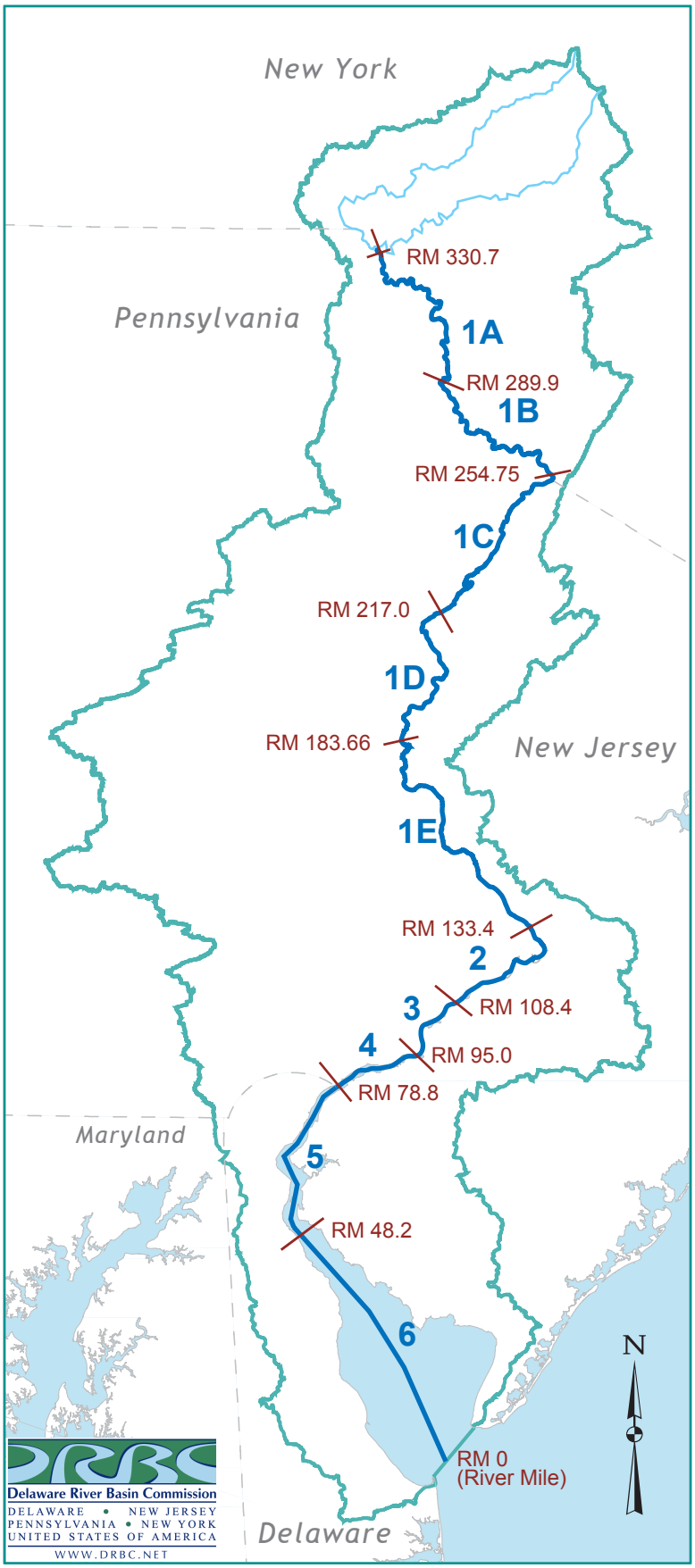
(U. S. Bureau of Labor Statistics)

Industry			NAICS Code
Agriculture, Forestry, Fishing and Hunting			11
	Crop Production		111
	Animal Production		112
		Aquaculture	1125
	Forestry and Logging		113
	Fishing, Hunting and Trapping		114
		Fishing	1141
	Support Activities for Agriculture and Forestry		115
Mining, Quarrying, and Oil and Gas Extraction			21
	Oil and Gas Extraction		211
	Mining (except Oil and Gas)		212
		Nonmetallic Mineral Mining and Quarrying	2123
	Support Activities for Mining		213
Utilities			22
	Utilities		221
		Electric Power Generation, Transmission and Distribution	2211
		Natural Gas Distribution	2212
		Water, Sewage and Other Systems	2213
Construction			23
	Construction of Buildings		236
		Residential Building Construction	2361
		Nonresidential Building Construction	2362
	Heavy and Civil Engineering Construction		237
		Land Subdivision	2372
		Highway, Street, and Bridge Construction	2373
		Other Heavy and Civil Engineering Construction	2379
	Specialty Trade Contractors		238
Manufacturing			31
	Food Manufacturing		311
		Seafood Product Preparation and Packaging	3117
	Beverage and Tobacco Product Manufacturing		312
	Textile Mills		313
	Textile Product Mills		314
	Apparel Manufacturing		315
		Apparel Knitting Mills	3151
	Leather and Allied Product Manufacturing		316
	Wood Product Manufacturing		321
	Paper Manufacturing		322
	Petroleum and Coal Products Manufacturing		324
	Chemical Manufacturing		325
		Basic Chemical Manufacturing	3251
		Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	3252
		Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	3253
		Pharmaceutical and Medicine Manufacturing	3254
		Paint, Coating, and Adhesive Manufacturing	3255
		Soap, Cleaning Compound, and Toilet Preparation Manufacturing	3256
		Other Chemical Product and Preparation Manufacturing	3259
	Plastics and Rubber Products Manufacturing		326

	Nonmetallic Mineral Product Manufacturing		327
		Cement and Concrete Product Manufacturing	3273
		Lime and Gypsum Product Manufacturing	3274
		Other Nonmetallic Mineral Product Manufacturing	3279
	Primary Metal Manufacturing		331
	Fabricated Metal Product Manufacturing		332
	Machinery Manufacturing		333
	Computer and Electronic Product Manufacturing		334
		Computer and Peripheral Equipment Manufacturing	3341
		Communications Equipment Manufacturing	3342
		Audio and Video Equipment Manufacturing	3343
		Semiconductor and Other Electronic Component Manufacturing	3344
		Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	3345
		Manufacturing and Reproducing Magnetic and Optical Media	3346
	Electrical Equipment, Appliance, and Component Manufacturing		335
	Transportation Equipment Manufacturing		336
		Motor Vehicle Manufacturing	3361
		Motor Vehicle Body and Trailer Manufacturing	3362
		Motor Vehicle Parts Manufacturing	3363
		Aerospace Product and Parts Manufacturing	3364
		Railroad Rolling Stock Manufacturing	3365
		Ship and Boat Building	3366
		Other Transportation Equipment Manufacturing	3369
	Furniture and Related Product Manufacturing		337
	Miscellaneous Manufacturing		339
Wholesale Trade			42
	Merchant Wholesalers, Durable Goods		423
	Merchant Wholesalers, Nondurable Goods		
	Wholesale Electronic Markets and Agents and Brokers		425
Retail Trade			44
	Motor Vehicle and Parts Dealers		441
	Furniture and Home Furnishings Stores		442
	Electronics and Appliance Stores		443
		Electronics and Appliance Stores	4431
	Building Material and Garden Equipment and Supplies Dealers		444
	Food and Beverage Stores		445
	Health and Personal Care Stores		446
	Gasoline Stations		447
	Clothing and Clothing Accessories Stores		448
	Sporting Goods, Hobby, Book, and Music Stores		451
	General Merchandise Stores		452
	Miscellaneous Store Retailers		453
	Nonstore Retailers		454
Transportation and Warehousing			48
	Air Transportation		481
		Scheduled Air Transportation	4811
		Nonscheduled Air Transportation	4812
	Rail Transportation		482
		Rail Transportation	4821
	Water Transportation		483
		Deep Sea, Coastal, and Great Lakes Water Transportation	4831
		Inland Water Transportation	4832
			4883
	Truck Transportation		484
		General Freight Trucking	4841

		Specialized Freight Trucking	4842
	Transit and Ground Passenger Transportation		485
		Urban Transit Systems	4851
		Interurban and Rural Bus Transportation	4852
		Taxi and Limousine Service	4853
		School and Employee Bus Transportation	4854
		Charter Bus Industry	4855
		Other Transit and Ground Passenger Transportation	4859
	Pipeline Transportation		486
		Pipeline Transportation of Crude Oil	4861
Information			51
	Publishing Industries (except Internet)		511
	Motion Picture and Sound Recording Industries		512
	Broadcasting (except Internet)		515
	Telecommunications		517
	Data Processing, Hosting, and Related Services		518
	Other Information Services		519
Finance and Insurance			52
	Monetary Authorities-Central Bank		521
	Credit Intermediation and Related Activities		522
	Securities, Commodity Contracts, and Other Financial Investments and Related Activities		523
	Insurance Carriers and Related Activities		524
	Funds, Trusts, and Other Financial Vehicles		525
Real Estate and Rental and Leasing			53
	Real Estate		531
	Rental and Leasing Services		532
	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)		533
Professional, Scientific, and Technical Services			54
	Professional, Scientific, and Technical Services		541
		Management, Scientific, and Technical Consulting Services	5416
		Scientific Research and Development Services	5417
Management of Companies and Enterprises			55
	Management of Companies and Enterprises		551
Administrative and Support and Waste Management and Remediation Services			56
	Administrative and Support Services		561
		Travel Arrangement and Reservation Services	5615
	Waste Management and Remediation Services		562
Educational Services			61
	Educational Services		611
		Colleges, Universities, and Professional Schools	6113
		Technical and Trade Schools	6115
		Educational Support Services	6117
Health Care and Social Assistance			62
	Ambulatory Health Care Services		621
	Hospitals		622
	Nursing and Residential Care Facilities		623
	Social Assistance		624
Arts, Entertainment, and Recreation			71
	Performing Arts, Spectator Sports, and Related Industries		711
	Museums, Historical Sites, and Similar Institutions		712
	Amusement, Gambling, and Recreation Industries		713
		Other Amusement and Recreation Industries	7139
Accommodation and Food Services			72
	Accommodation		721
		Traveler Accommodation	7211

		RV (Recreational Vehicle) Parks and Recreational Camps	7212
		Rooming and Boarding Houses	7213
	Food Services and Drinking Places		722
Other Services (except Public Administration)			81
	Repair and Maintenance		811
	Personal and Laundry Services		812
	Religious, Grantmaking, Civic, Professional, and Similar Organizations		813
		Social Advocacy Organizations	8133
		Business, Professional, Labor, Political, and Similar Organizations	8139
	Private Households		814
Public Administration			92
	Executive, Legislative, and Other General Government Support		921
	Justice, Public Order, and Safety Activities		922
	Administration of Human Resource Programs		923
	Administration of Environmental Quality Programs		924
	Administration of Housing Programs, Urban Planning, Community Development		925
	Administration of Economic Programs		926
	Space Research and Technology		927
	National Security and International Affairs		928

Attachment 6

Delaware River Main Stem Interstate Zones