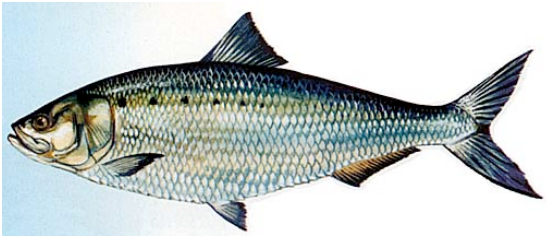
DELAWARE RIVERKEEPER NETWORK

American Shad (*Alosa Sapidissima*)

The American shad has played a critical role in both the natural resource and human history of the Delaware River – making it part of the fabric of the river and river communities and culture of our region.



In the late 1890s, the largest annual commercial catch of American shad on the Atlantic coast came from the Delaware River – an estimated 9 to 19 million pounds were harvested. In the early 1900s decline began. Then, in the 1940s and 1950s pollution levels in the Delaware River were so high that there was an oxygen dead zone for 20 miles, top to bottom, side to side, in the Philadelphia/Camden reach of the Delaware River. For these 20 miles, there were, as a result, no shad. While once the commercial shad fishery in the Delaware was among the most vibrant and profitable, by the mid-20th century, only 60 years after the largest annual commercial catch, the combination of an increasing people population and inadequate raw sewage treatment in the Philadelphia/Camden portion of the River created an ecological barrier that impeded the fish's ability to spawn and survive.

While the oxygen dead zone that once existed in the Delaware River and severely damaged the American Shad has today been removed, thanks largely to environmental regulations, such as the Clean Water Act and those issuing from the Delaware River Basin Commission; the Delaware River's American Shad population is still at historically low levels.

The Life of the American Shad

American Shad are an anadromous species – they are born in rivers, spend much of their life in the ocean, and then return to their natal river waters to spawn. Along the Atlantic Coast, each major tributary has its own discrete spawning stock of American Shad.

American shad become sexually mature at 4 to 6 years of age. Shad spawn in freshwater in the Spring. Adult shad travel at least as far up as the confluence of the West Branch and East Branch of the Delaware, in extreme northeastern Pennsylvania. When shad spawn they broadcast their eggs into the water column

allowing them to be distributed downstream and by the river's flow. As long as the eggs are not smothered by silt, sand or other substances the substrate is not a critical issue for reproduction. Fertilized eggs hatch within 2 to 17 days and then drift with the current as they mature into juveniles. Juveniles leave the nursery areas by late fall, and may remain in the estuary until they are one year, at which point they join other schools of America shad in the ocean.

American shad will remain in the ocean for 3 to 6 years before making their spring journey to their natal waters to spawn. This return migration in the Delaware begins around March/April. Temperature plays a dominant role in queuing spawning events (with 16-19°C (60.8-66.2 F) triggering the event) but water velocity and turbidity are also important factors. While many shad spawning in the Delaware River die after the event, some are repeat spawners.

The Importance of Shad to our River and Region

Shad are an important part of the food chain – feeding on some species, and being food for others. Shad eggs, larvae and juveniles in freshwater are preyed upon by American eel. Striped bass consume shad juveniles. In fact, the connection between striped bass and shad is so direct that when striped bass populations increase it may affect the overall shad populations. Shad are also a food source for weakfish, which are themselves in a depressed population state in the Delaware River system. And they are food for sharks, seals, porpoises. Because American shad arrive in early spring when other prey may be scarce, and at a time when it is nesting and breeding season for wildlife, they are seasonally important to a number if riparian fish, birds and wildlife species.

Shad are also important for transporting nutrients into the freshwater river ecosystem. After spawning many shad quickly die; their decomposition transfers nutrients and energy from the marine (e.g. ocean/estuary) system into the more interior freshwater rivers. This annual input of marine-derived biomass is an important source of energy and nutrients for freshwater ecosystems upriver.

While Shad are important as food for other fish, reptiles (e.g. snakes and turtles), birds (such as osprey, green heron, eagles and cormorants) and mammals (such as mink), and they bring a significant source of nutrient input to the freshwater and estuarine waters of the Delaware River, they are also eaten heartily by many people. In fact, the American shad migrating up the Schuylkill to spawn are credited with saving George Washington's army from starvation during the winter of 1778 while they were at Valley Forge Park. Native Americans too depended on annual shad runs.

Shad have historically been harvested for their flesh and their roe. Recreationally the shad are fished to the delight of anglers coming from all over the region and country. While in the 19th century annual American Shad harvests reached

JUVENILE SHAD SEINING. *PHOTO CREDIT: NJ DIV. OF FISH & WILDLIFE*

over 50 million pounds, today they are in the 1 to 2 million pounds range coast wide.

From 1980 through 2007 harvesters of shad would get from $0.325 to $1.022 per pound, with an average of $0.534 per pound. In 1984, this meant that harvesters earned over $2,000,000 from their harvests; in 2006 that figure declined dramatically to just $540,000. The market price for harvested shad to the final consumer can be 3 to 10 times more than the price paid to the harvester, thus increasing the overall community economic benefit dramatically, particularly when harvests are high.

It has been reported by the Pennsylvania Fish and Boat Commission that in 1986, recreational shad fishers fishing on the Delaware River spent about $1.6 million during just a 9 week fishing season; in 2007 this would be equivalent to approximately $3 million. And in fact, study has shown that shad fishers are willing to spend twice as much as this ($3.2 million in 1986 dollars; $6 million in 2007 dollars). This is an important boost for local economies to the Delaware River with ripple effects beyond.

The American Shad are celebrated in several cities throughout the watershed during their spring spawn including Fishtown in Philadelphia, Easton, Pennsylvania and Lambertville, New Jersey bringing in people from all over the region. The annual Shad fishing tournament in Easton raised $20,000 in 2006. Lambertville's Shadfest has been an annual part of the community for 31 years (calculated in 2012), attracting 30,000 to 35,000 visitors during the two day event and providing a panoramic economic benefit for not only area restaurants and hotels, but also local non-profits, such as fire companies, that take advantage of these events as major fund-raisers.

What is the Status of the Shad Today?

According to the Atlantic States Marine Fisheries Commission (ASMFC) American Shad stocks are at an all-time low, do not appear to be recovering and, in fact, in some waterways recent declines continue. Declines are the result of a combination of overfishing, pollution and habitat loss. While in the 19th century annual American Shad harvests reached over 50 million pounds, today they are in the 1 to 2 million pounds range coast wide.

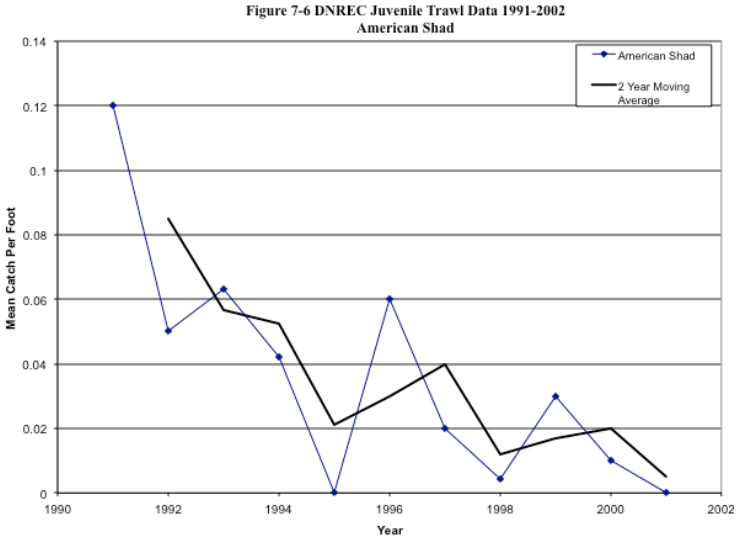
The Delaware River population, according to the ASMFC, appears to have stabilized, but is still at highly depressed levels.

The more geographically-targetted Mid-Atlantic Fishery Management Council ("MAFMC") echoes that herring and shad populations are at historic lows, and landings have declined coast wide by 99 and 97 percent respectively.

A total of 19 shad spawning runs have become extinct in New Jersey along the major river systems. Pollution blocks and dams in the tributaries contributed to the decline. It is a similar story for Pennsylvania. On the Susquehanna River, shad runs on the tributaries were reduced by the construction of the canal system, which required feeder dams that restricted migration to the lower 45 miles of the river, and later four hydroelectric dams on the Susquehanna eliminated all shad runs in Pennsylvania.

And in a 2003 report commissioned by the Delaware Riverkeeper Network and funded by the Environmental Protection Agency in which Carpenter Environmental Associates reviewed data collected by PSE&G as part of a Clean Water Act permit obligation, it was revealed that American Shad in the Delaware River were/are in decline.

"DNREC juvenile trawl data from 1991 through 2001 shows a decline in the American shad population. Statistical analysis of American shad abundance data from 1991-1994 and data from 1998-2001 shows that this decline is statistically significant. American shad abundance data from 1991 through 2001 is shown on Figure 7-6."



In either instance, the American Shad population of the Delaware River is far from the healthy historic levels our River and region once enjoyed and strong action is needed to restore the population.

Biggest Threats for the American Shad

Water pollution, overfishing, bycatch and loss of habitat are among the major reasons for the Shad's decline and failure to restore even after the pollution block along the Delaware River was removed.

Sewage and stormwater runoff, industrialization, increasing erosion and sedimentation, increased nutrient enrichment resulting from agriculture, loss of riparian forests and wetland buffers as the result of development and mining and other resource extraction are among the human activities and harms that have been degrading and continuing to depress the shad populations of the Delaware River. Dams and other barriers to migration, water intakes, toxic and thermal water discharges, channelization, dredging and in river construction are also among the culprits.

Water withdrawals of large volumes of water can affect shad. Withdrawals for drinking water, irrigation, snowmaking, as well as for cooling purposes, can alter the physical characteristics of a stream or river. Changes to the width, depth, velocity, substrate or temperature of a stream or river can delay the passage of the fish past the facility and up stream. Power plants and other facilities operating along the Delaware River withdrawal billions of gallons of water each day that they use for cooling purposes. Facilities with cooling water intake structures that are using outdated technology, for example a once through system rather than a closed cycle system that reuses water, indiscriminately kill fish every day. The Salem Nuclear Generating Station alone kills over 2,000 American Shad a year.

Cooling water intakes can also involve the discharge of heated water, as can other discharges. Thermal discharges can block or impede migration, they can reduce water quality, and they can interfere with egg or larval development.

If gas drilling were to be allowed in the Delaware River watershed it would mean the loss of hundreds of billions of gallons of water to the system. Each gas well requires an average of 5 million gallons of water for fracking, at a predicted 32,000 to 64,000 wells in the upper Delaware River basin alone, that is a massive amount of water loss in the main stem and tributary streams that is of tremendous concern for the shad and all species dependent upon the Delaware River and its tributary streams.

The continuing existence of dams on tributary streams remain an impediment to the migration and spawning of the shad in the Delaware River system. Dams and other barriers can prevent the shad from being able to migrate altogether, but also their existence can impact the timely arrival of the shad for spawning.

Industrial or municipal discharges of toxic chemicals, heavy metals and organic chemicals such as insecticides, herbicides or solvents, are harmful to aquatic life and to fish. Such chemicals pass through the food chain and can have sublethal affects including changing behaviors, creating reproductive abnormalities, fin erosion, epidermal lesions, blood anemia, altered immune function and egg

mortality. Dredging can also be a source of contamination that can bioaccumulate in fish, be directly toxic to aquatic organisms, or reduce dissolved oxygen levels.

Channelization of waterways can cause bank erosion, elevated water velocities, increased drainage, reduced diversity of habitat and poor water quality. Dredging and the associated disposal of spoils along shorelines creating dredge spoil banks which can block access by the fish to sloughs, pools, vegetated areas and/or backwater swamps.

Dredging within a waterway can harm habitat and disrupt migration. Dredging can also be responsible for direct mortality or inflicting mortality that has a more delayed affect, such as the result of underwater blasting that may be associated with the dredging.

Land use patterns can affect dissolved oxygen, sedimentation, turbidity, water temperature, pH, nutrients and flow regimes, all of which can have an affect on both the quantity and quality of habitat available to fish and aquatic life.

When fish eggs settle on the bottom substrate of a River to mature, sedimentation during this critical time of year can smother the eggs. In 2006 when the PP&L Martin Creek facility had a blowout of a basin spewing over 100,000 gallons of coal fly ash slurry into the Delaware River, a big concern for fishers was the introduction and settling of the fly ash on the river bottom where it could contaminate and smother fish eggs and other aquatic life.

Survival of eggs and larvae is often dependant upon the timing of egg deposition and other unexpected natural events. Many aquatic habitats will be affected by climate change and associated change in temperatures. Changes can include a change in the large-scale distribution patterns for fish species and changes in the thermal niche space available to them. Other affects associated with sea level rise affect fish and habitat availability as well.

Instream flows that are regulated, as well as consumptive water withdrawals, can affect habitat quality and quantity, fish passage and water availability. The Delaware River's flows are managed – while the main stem has no dams, there are three dams on the headwater tributaries which impound and divert Delaware River water for New York City drinking water use. In addition, the invasion of natural gas drilling, which requires an average 5 million gallon water withdrawals to extract gas from the ground for just one well, and which is predicted to blanket the upper Delaware with such wells, is a real concern in terms of future river flows, and pollution inputs.

Flathead catfish, an invasive species not native to the Delaware River, is an aggressive predator of the American Shad and other native species of the Delaware River. Flathead catfish, it is believed, first entered the River system via the Schuylkill River. In 1999 they were found in the Delaware River. Flathead

catfish are believed to eat a large number of American shad during the shad's spring spawning run. Anyone catching a flathead catfish is asked to report it to authorities and to not return the fish to the River waters.

What We Need to Do

The Delaware River Basin Commission needs to put in place strong, regional regulations that protect our floodplain lands and a minimum 100 to 300 foot buffer from development in order to ensure the shad have that stable bank habitat, and protection from non-natural erosion and sedimentation that riverside development brings.

We need a regional cooling water intake initiative that results in the retrofit of all cooling water intake structures so they achieve the standard of 95% reduction in fish kills. This means Delaware, New Jersey and Pennsylvania taking a proactive stance to meet this new standard in issuing permits to all cooling water intake facilities, which are renewed every 5 years. By using a closed cycle cooling technology which reuses withdrawn water repeatedly rather than requiring ongoing replenishment, facilities such as the Salem Nuclear Generating Station could reduce their fish kills by as much as 99%. Section 316b of the Clean Water Act requires facilities with cooling water intakes to use the best technology available to minimize their fish kills. This legal requirement to use proven and available technology could so significantly reduce the impact of power plants and other facilities with cooling water intake structures and offers an important opportunity for protection and restoration of shad populations in the Delaware Estuary. We also point to the inequity of establishing recreational catch limits on the shad fisheries if facilities with cooling water intake structures are allowed to continue their indiscriminate killing of shad without being required to install the best technology for minimizing those fish kills. Therefore, effectiveness in protecting and restoring the shad as well as equity would mandate that both be addressed by any management effort for the American Shad.

We need an aggressive regional strategy that also focuses on the removal of existing dams and others structures that impede fish passage. The Musconetcong River (NJ) is one bright spot where 4 dams have been removed in recent years, 7 still remain. And we need strong laws, policies and programs that prohibit construction of new dams on tributary streams or on the main stem River (as some have been proposing as of late). While new dams can include fish passage structures, they are not as effective as natural hydrologic flows at enabling full population recovery. Not to mention the negative unintended environmental and community harms that come with dams and other instream structures including increased flood damages, the false sense of security that can result in increased construction in dangerous downstream areas, erosion, water pollution, a decline in the recreation that is associated with a free flowing river. Each state needs to immediately catalogue existing dams and then create a program for targeting their safe and effective removal.

Environmental accidents where large volumes of sediment, sands or other substances enter the River at any time, but especially during shad spawning months, need to be immediately addressed – both with immediate action to stop the occurrence but also immediate action to clean up the substance dumped or spilled so it is not allowed to continue to migrate and spread and smother shad eggs as it gets further and further carried by flows.

When pollution spills (illegal or negligent) occur in the Delaware River or tributary streams it is critical that the Natural Resource Damages Assessment process specifically consider and respond to the impacts of that spill on the Shad including their habitats. NRDA assessments must include funds to restore the shad habitats that have been damaged.

The Delaware River Basin Commission needs to aggressively pursue an initiative to identify the **highest attainable use for fish** in the Delaware Estuary and set that as the designated use. Once this new designated use is set, the DRBC needs to put in place the standards and criteria that will ensure that use is met. Such an initiative will serve all of the fish and critters that live in the Estuary, as well as all those who rely upon them.

The Delaware River Basin Commission needs to maintain the moratorium against shale gas extraction in the Delaware River Basin in order to prevent the water withdrawals, massive land disturbance, and toxic pollution inputs that all, through the total and cumulative impacts, would negatively impact already-stressed shad populations.

Decision-making for projects at the local, state and regional levels that directly impact the Delaware and other shad migration streams and rivers need to protect, restore and enhance shad habitat including spawning, nursery, rearing, production and migration areas.

Each of our watershed states needs to commit to the creation of strong and progressive habitat restoration and protection programs as mandated by the ASMFC, including compliance enforcement. In response to still declining shad numbers range-wide, despite closure of ocean fishery, the ASMFC in February of 2010 approved Amendment III to the Fisheries Management Plans. The Amendment establishes a coast wide commercial and recreational moratorium, with exceptions for sustainable systems. Sustainability will be determined through state specific management plans, and applies to systems that can demonstrate their commercial and/or recreational fishery will not diminish the potential future stock reproduction and recruitment. The Delaware River Fish and Wildlife Management Cooperative is currently developing an updated Shad Management Plan. The Amendment allows for any state or jurisdiction to keep their waters open to a catch and release recreational fishery. States or jurisdictions without an approved sustainability management plan in place by January 1, 2013 (NOTE remove this from text, but only 2 months away) will be closed (with the exception of catch and release recreational fisheries).

The Mid-Atlantic Fishery Management Council ("MAFMC") should take the lead on federal management of river herring and American shad by including robust, science-based conservation and management measures in Amendment 14 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan.

In federal waters, the incidental catch of river herring and shad remains a serious concern, and impedes recovery. The Northeast Fisheries Science Center estimates that millions of river herring and shad are caught every year by industrial mackerel and Atlantic herring trawlers operating in federal waters. The MAFMC and New England Fishery Management Council are currently developing plans to address this problem. The MAFMC must set the standard for protecting river herring and shad and ensure that Amendment 14 has robust management measures that protect river herring and shad throughout their range in federal waters, including:

- Incorporation of river herring and shad as stocks within the federal fishery management plan for Atlantic mackerel, squid and butterfish. This action would afford river herring and shad direly needed conservation and management measures in federal waters.

- An interim cap or limit in 2013 on river herring and shad catch in the mackerel fishery.

- 100 percent at-sea monitoring on all mid-water trawl fishing trips, including assigning one observer to each vessel in a pair trawl operation. This fleet of approximately 20 mid-water trawl vessels is responsible for over 70% of combined river herring and shad incidental catch.

- An accountability system to discourage the wasteful slippage, or dumping, of unsampled catch. All catch must be made available to fishery observers for systematic sampling.

- A requirement to weigh all catch.

It is critical that the implementation of these management plans in the watershed states be rigorous, comprehensive and far reaching, and it is essential that they actually be implemented and enforced. As of June 2012, Delaware and Pennsylvania MAFMC representatives were being contacted to actually set such standards as per the plan.