

# DRAMATIC CHANGES IN THE FISH AGGREGATION OF BLACK ROCK POOL OF THE SCHUYLKILL RIVER FROM 1970 TO 2007

GERRY WATERFIELD



# SUMMARY

- Between 1970 and 2007 increased competition and predation facilitated by improving water quality and other habitat improvements in the Schuylkill River resulted in a fish aggregation that was substantially changed
- The trophic structure of the fish aggregation of the Black Rock Pool expanded in both dimensions
- Four of the species that greatly predominated the aggregation in the 1970's became minor components by 2007

# SUMMARY (CON'T)

- During the decade of the 1970's a pollution-tolerant and ecologically flexible fish community, dominated by pumpkinseed, brown bullhead, redbreast sunfish and goldfish was present
- In subsequent decades (1980-2007), the improvement in water quality was largely responsible for a substantially different fish aggregation that was shaped by increased competition and predation and predominated by smallmouth bass

# BACKGROUND

- Schuylkill River Water Quality Degradation- 19<sup>th</sup> & 20<sup>th</sup> Centuries
- Improvements initiated:
  - A massive silt removal project (1947-1951)
  - Clean Water Act (1972)
  - Banning of phosphates in detergents (late-1970s-present)
- These improvements are reflected in the 37 years of fish collection data from studies in the vicinity of Cromby Generating Station (CGS) on Black Rock Pool of the Schuylkill River, PA

# CROMBY GENERATING STATION





**Study Area**

**Black  
Rock  
Dam**

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# CROMBY GENERATING STATION



# RIVER DEGRADATION “ASSAULTS”

“Not so long ago the Schuylkill was considered the country’s dirtiest river.”

Chari Towne, *A River Again: The Story of the Schuylkill River Project* (2012)

## By 1875

- Refuse from bleaching and printing, scouring and dyeing, paperworks (alkaline), gas works, ammoniacal liquor and foul lime
- Sewage waste
- Discharges from cesspools and slaughterhouses
- Silt from farming
- Wood chips, sawdust, and bark from forestry
- Deposition of coal wastes and acid mine drainage had been occurring for 60 years

## By 1882

- In Philadelphia fish were dying by the thousands
- Massive deforestation in headwaters
- Seasonal flooding and low flow periods

## By 1885

- Philadelphia could no longer use water from the Schuylkill River for water supply



# RIVER DEGRADATION “ASSAULTS”

## By 1916

- Deposits of culm in the Schuylkill River below Schuylkill Haven were reported to be 6 to 8 feet deep

## By 1945

- The total volume of coal wastes in the Schuylkill River was estimated to be 30 million cubic yards or 38 million tons

## In 1970

- Three million gallons of oil were spilled into the Schuylkill River in Douglassville, Berks County

## In 1972

- Eight million gallons of used crankcase oil and sludge were spilled into the Schuylkill River from the same facility in Douglassville as a result of flooding during Hurricane Agnes

# OIL LINE ON CHET'S GARAGE



# POST-FLOOD OIL ON TREES



# POST-FLOOD OIL ON VEGETATION



# OIL DEPOSITS IN BURIED CYLINDER SAMPLER



# 1970 OIL SPILL

## Pottstown Mercury

Vol. 40, No. 41

All Departments 323-3000  
Classified ..... 323-7000

Pottstown, Pa., (19464) Saturday Morning, November 14, 1970

34 Pages

15¢ A COPY 75¢ A WEEK

# 3 Million Gallons of Oil Spills into River

By JOSEPH E. DOUGHERTY  
*Mercury Staff Writer*

Between 2½ and 3 million gallons of thick, sludge type oil gushed into the Schuylkill River early Friday, closing water treatment plants from Pottstown to Philadelphia, and creating a slick 20 miles long.

Blamed for the massive pollution was Berks Associates, Douglassville oil reclamation firm cited on previous occasions as a polluter of the waterway.

Related stories on page 9

and designated as one of the top ten polluters in the state.

The spillage began sometime between midnight

and 2 a.m., company officials told investigators, when an earthen dike on a huge lagoon gave way.

The lagoon was holding the sludge material remaining after auto crankcase oil was reclaimed by the firm's process.

### NO LOSS

It is material, said one state official, which the company would have been forced to dispose of anyway. It was not the end product, he added, thus the spillage represented no financial loss to the firm.

Oil in the river first was noticed by Joseph Schmansky, Pottstown water treatment plant operator, at 6:30 a.m. when he walked to the river bank to check out a kerosene type odor he smelled.

Schmansky immediately shut down pumps carrying water from the Schuylkill into the plant

and called Calvin Craft, superintendent of the treatment plant.

Craft, in turn, called water plants down-river to warn them of the floating oil. The Royersford water treatment plant was closed, and later, as the oil reached there, two plants which are part of the Philadelphia municipal water system.

### CONTINUE TO OPERATE

Phoenixville, which has intake pipes on both sides of the river, continued to operate, said Borough Manager John J. Kane, because the oil floated by on the Montgomery County side, permitting the intake of clear water through the pipe on the Chester County side.

Norristown also has two intake pipes. The regular pipe on the surface, and a submerged one for use in emergencies.

Because oil floats, the downstream borough was able to draw water from its submerged pipe.

Other water treatment plants forced to close were in Spring City, West Conshohocken, Conshohocken and Bridgeport.

Pottstown's water treatment plant suspended operations from the time of Schmansky's discovery until noon Friday when the oil began to float by on the side of the river opposite the intake pipe.

If the oil spilled at 2 a.m., and estimating two hours for it to reach the Pottstown intake pipe, Craft said the borough had been pumping oil-laden water into its system for 2½ hours.

### EXTREMELY HIGH

"The only thing that saved us," said Craft, "was that the river was extremely high from recent

(Continued on Page Two)

# Berks Oil Spill Set At 8 Million Gallons

Eight million gallons.

That's how much black greasy liquid was lifted from the oil storage lagoons of Berks Associates during the flood, federal authorities revealed Wednesday.

The U.S. Coast Guard, which set up an emergency office in Pottstown Wednesday, is calling it, "the worst inland oil spill in the history of the United States."

Eight million gallons is the

amount of liquid that falls on the entire borough of Pottstown during a half-inch rainfall.

The oil slick stretched from Douglassville to the Delaware Bay Wednesday and it's still coming. Trees, shrubs, grass and wildlife are dying along the 50-mile stretch of river and authorities say they don't know what can be done about it.

Along parts of Route 724 and in Douglassville the greasy sludge covers trees 20 feet high and gives off fumes that burn the eyes and nose.

The effects of the record spill are not news to the flood victims, but a visitor from out of town Wednesday called it "the eeriest sight I've ever seen."

## LIMIT DAMAGE

The Coast Guard said pools of the oil trapped by the flood still are seeping back into the river. Oil booms have been stretched across the mouth of the Phoenixville water plant and at Tincum Federal Wildlife Preserve on the Schuylkill in an effort to limit further damage.

The local Coast Guard office at borough hall is supposed to coordinate the battle against the oil and give advice to those damaged by it.

There may not be a lot they can do, though the Coast Guard has experience with the problem. It helped clean up the Berks Associates 3½ million gallon spill in 1970 — which until now held the national record.

Lester Shurr, president of the oil reclamation firm, said

(Continued on Page Twenty)

# 1972 OIL SPILL

## 8 Million Gallons of Oil Spilled

(Continued from Page One)

Wednesday, "We are most sorry, it is a most unfortunate occurrence.

"There was nothing we could do to prevent it. We followed the regulation of the environmental protection agency to the letter. This was an act of God by any definition. We cannot assume liability for any damage caused by the oil."

### LIFTED OIL

A federal expert said the flood was a "once in 400 years event." The lagoons did not collapse this time as they did in 1970. Last week the record high waters of the Schuylkill dipped into the lagoons and lifted the oil into the current.

As the water receded, the oil coated everything in its path.

Federal authorities said Berks Associates was "very cooperative" in dealing with the disaster.

After a helicopter tour Wednesday, a Coast Guard expert called the damage "unbelievable."

The state environmental of-

ficer for Berks County, upstream in Reading, reportedly didn't realize the extent of the damage until Wednesday.

He reportedly had called the firm and then announced that only "very minor spillage" had occurred.

The estimate of eight million gallons came from an inspector of the Environmental Protection Agency, who took an inventory of the lagoons' contents only a month ago.

Ironically, Berks Associates no longer needs the lagoons, which were used to store thick, unuseable sludge left over from the process of reclaiming crankcase oil.

Since the 1970 spill the firm has been working on a process to burn the sludge and recently installed the needed equipment.

## Fish Commission Stocks Schuylkill

*19 June 72*  
The Schuylkill River has been stocked with muskellunge, a member of the pike family, for the first time in five years according to Francis Rotchford, waterways patrolman in Montgomery County.

Pennsylvania Fish Commission employees placed 15,000 muskies in the river from the Pottstown Firestone plant area east.

The stocking will open another area for local and area fishermen.

Rotchford revealed that the last time the river, in the Pottstown area, had been stocked with the fish was in 1967. The Perkiomen Creek is stocked regularly with muskie.

The muskie season opened May 6 and will run through the end of the year.

Rotchford and his deputy, Paul Hallman of Royersford reminded anglers that the state limits on muskie is two per day with a minimum size of 30 inches.

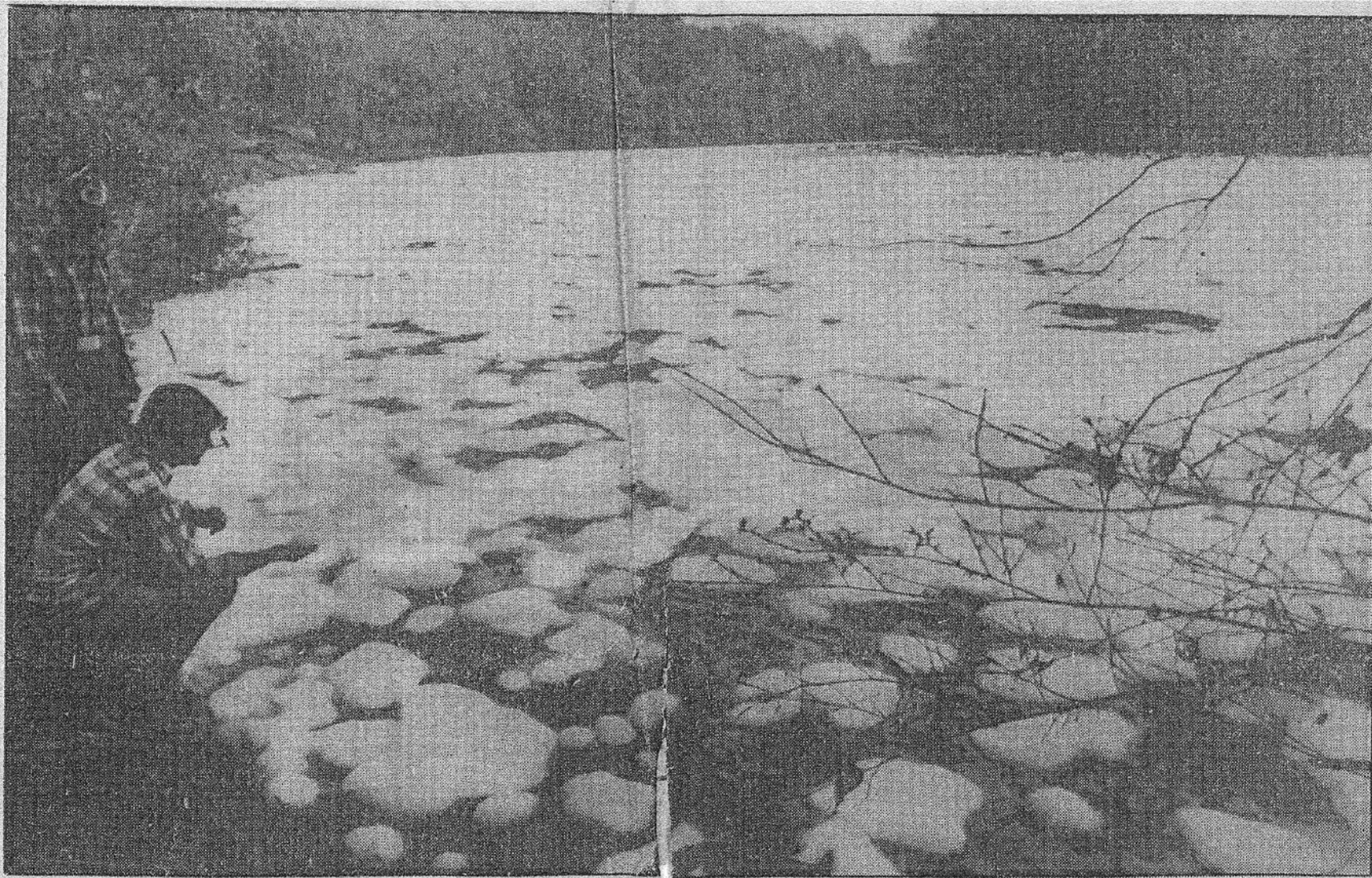
The waterway patrolmen revealed that they knew of one fisherman who caught 28 of the game fish in the Valley Forge area last year and that the largest muskie caught in the area was a 55 inch fish weighing 27 pounds.

The muskie is usually gray-green with light vertical bars on the sides of the body and fins spotted with black. The older, larger fish tend to be more plain on the sides.

# MUSKIE STOCKING



# 1981 DETERGENT SPILL



Mercury Photo by Tom Kelly

**Robert Blye of Pottstown (left) and Gerry Waterfield of Douglassville check the snow-like detergent in the Schuylkill near the Linfield dam.**

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# RECOVERY

- The Schuylkill River Desilting Act (1945) was passed by the Pennsylvania State Legislature
- In 1949 discharge of coal wastes into the Schuylkill River was stopped
- Between 1947 and 1951 approximately 20 million cubic yards of sediments were removed
- By 1951 communities were required by the Sanitary Water Board to treat sewage before discharging it into the River
- In 1966, passage of Pennsylvania's Sewage Facilities Act placed responsibility for malfunctioning on-lot systems, overburdened treatment plants and sewer lines on municipalities
- The Clean Water Act of 1972 required upgrades to most sewage treatment plants in the US, and limited point source discharges
- Greatly declining phosphorus levels in the Schuylkill River were attributed to bans on phosphate detergents

# CGS FISH ASSEMBLAGE 1970s TRAWL

Taxon	Number	Percent
pumpkinseed	5,254	43.9
swallowtail shiner	2,069	17.2
spottail shiner	1,974	16.5
brown bullhead	1,065	8.9
redbreast sunfish	726	6.1
spotfin shiner	329	2.8
bluegill	151	1.3
goldfish	146	1.2
white sucker	68	0.6
<i>Lepomis</i> hybrid	42	0.4
white catfish	28	0.2
channel catfish	27	0.2
carp	26	0.2
banded killifish	14	0.1
golden shiner	10	0.1
white crappie	6	0.1
tessellated darter	6	0.1
green sunfish	6	0.1
black crappie	5	<0.1
yellow perch	2	<0.1
longnose dace	2	<0.1
rock bass	2	<0.1
smallmouth bass	1	<0.1
creek chubsucker	1	<0.1
yellow bullhead	1	<0.1

25 Total Species

17 Species each  
comprised less  
than 1% of  
collected fish



# REASONS FOR DISCUSSING CGS

- Large amounts of information have been collected about fish populations
- Impingement and entrainment data can be used to gain knowledge about fish populations in a source water body (all sampling methods have bias)
- The original impetus for this presentation came from an assertion from USEPA that the thermal effluent from Merrimack Generating Station in New Hampshire (among other effects) was responsible for substantial harm to the pumpkinseed population in that pool of the Merrimack River.



# SUNFISH LIKE IT HOT

- CGS began operation in 1954
- Despite the operation of CGS for over fifteen years, a great abundance of pumpkinseed was observed
- June: >50 sunfish nests observed within thermal effluent, water temperature = 97° F, single seine haul collected 74 pumpkinseed
- Revisited later in June, water temperature = 95° F, electrofishing collected 84 ripe and spent pumpkinseed, all examined nests contained eggs

# IMPINGEMENT AND ENTRAINMENT

## IMPINGEMENT

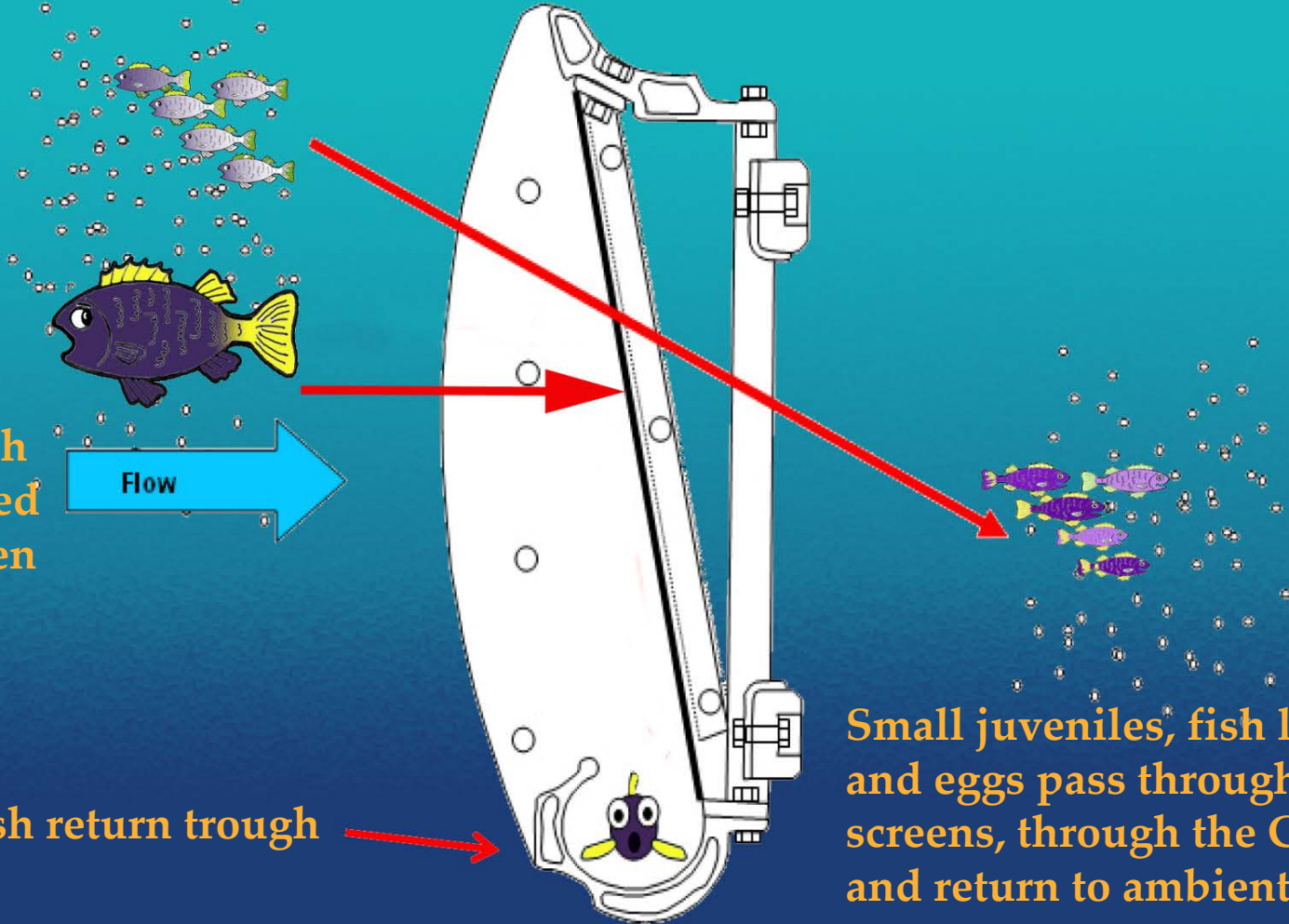
## ENTRAINMENT

Adult and juvenile fish are impinged on the screen

Flow

Fish in fish return trough

Small juveniles, fish larvae and eggs pass through screens, through the CWS and return to ambient water.



# PUMPKINSEED



Native

# BROWN BULLHEAD



Native



# REDBREAST SUNFISH



Native

# GOLDFISH



Non-Native

# BLUEGILL



Non-Native

# GREEN SUNFISH



Non-Native

# WHITE SUCKER



Native

# WHITE CATFISH



Native

# CHANNEL CATFISH



Non-Native

# FLATHEAD CATFISH



Non-Native



# FLATHEAD CATFISH MOUTH



# SMALLMOUTH BASS



Non-Native



# EDDYSTONE STATION MUMMICHOG

- Highly tolerant species
- Eddystone Generating Station Impingement
  - 1976-1978: 17,090 Mummichog
  - 2005-2006: 1 Mummichog
- Experienced extreme competition (e.g., spottail shiner and eastern silvery minnow) and predation (e.g., white perch and striped bass)

Environmental Protection Agency (EPA). 2002. Case Study Analysis for the proposed Section 316(b) Phase II Existing Facilities Rule. Office of Water (4303). EPA-821-R-02-002, February 2002

# MUMMICHOG



# BACK TO BLACK ROCK POOL



# FISH ASSEMBLAGE 1970-1973

## TRAWL

Taxon	Number	Percent
<b>pumpkinseed</b>	<b>5,254</b>	<b>43.9</b>
<b>brown bullhead</b>	<b>1,065</b>	<b>8.9</b>
<b>redbreast sunfish</b>	<b>726</b>	<b>6.1</b>
<b>bluegill</b>	151	1.3
<b>goldfish</b>	<b>146</b>	<b>1.2</b>
<b>white sucker</b>	68	0.6
<b>white catfish</b>	28	0.2
<b>channel catfish</b>	27	0.2
<b>green sunfish</b>	6	0.1
<b>smallmouth bass</b>	1	<0.1

# FISH ASSEMBLAGE 1976

## ELECTROFISHING

Taxon	Number	Percent
<b>redbreast sunfish</b>	<b>278</b>	<b>30.3</b>
<b>pumpkinseed</b>	<b>258</b>	<b>28.2</b>
<b>goldfish</b>	<b>153</b>	<b>16.7</b>
<b>brown bullhead</b>	<b>45</b>	<b>4.9</b>
<b>green sunfish</b>	44	4.8
<b>smallmouth bass</b>	21	2.3
<b>white sucker</b>	9	1
<b>white catfish</b>	3	0.3
<b>channel catfish</b>	1	<0.1

# FISH ASSEMBLAGE 1975-1976

## IMPINGEMENT

Taxon	Number	Percent
<b>brown bullhead</b>	<b>252</b>	<b>62.4</b>
<b>white sucker</b>	<b>94</b>	<b>23.3</b>
<b>green sunfish</b>	<b>18</b>	<b>4.5</b>
<b>pumpkinseed</b>	<b>17</b>	<b>4.2</b>
<b>goldfish</b>	<b>11</b>	<b>2.7</b>
<b>white catfish</b>	<b>5</b>	<b>1.2</b>
<b>redbreast sunfish</b>	<b>4</b>	<b>1.0</b>
<b>smallmouth bass</b>	<b>2</b>	<b>0.5</b>
<b>channel catfish</b>	<b>1</b>	<b>0.2</b>



# FISH ASSEMBLAGE 1989-1990

## ELECTROFISHING

Taxon	Number	Percent
<b>pumpkinseed</b>	<b>181</b>	<b>25.6</b>
<b>goldfish</b>	<b>151</b>	<b>22.0</b>
<b>redbreast sunfish</b>	<b>96</b>	<b>13.6</b>
<b>carp</b>	<b>77</b>	<b>10.9</b>
<b>brown bullhead</b>	<b>52</b>	<b>7.4</b>
<b>channel catfish</b>	<b>36</b>	<b>5.1</b>
<b>bluegill</b>	<b>35</b>	<b>5.0</b>
<b>smallmouth bass</b>	<b>20</b>	<b>2.8</b>
<b>carp x goldfish hybrid</b>	<b>18</b>	<b>2.6</b>

# FISH ASSEMBLAGE 1989-1990

## IMPINGEMENT

Taxon	Number	Percent
<b>goldfish</b>	<b>64</b>	<b>24.9</b>
<b>brown bullhead</b>	<b>20</b>	<b>7.8</b>
<b>pumpkinseed</b>	<b>15</b>	<b>5.8</b>
<b>redbreast sunfish</b>	<b>15</b>	<b>5.8</b>
<b>green sunfish</b>	<b>13</b>	<b>5.1</b>
<b>channel catfish</b>	<b>6</b>	<b>2.3</b>
<b>white sucker</b>	<b>2</b>	<b>0.8</b>
<b>carp x goldfish hybrid</b>	<b>1</b>	<b>0.4</b>
<b>smallmouth bass</b>	<b>1</b>	<b>0.4</b>

# FISH ASSEMBLAGE 1995

## ELECTROFISHING

Taxon	Number	Percent
<b>redbreast sunfish</b>	<b>361</b>	<b>24.7</b>
<b>pumpkinseed</b>	<b>346</b>	<b>23.7</b>
green sunfish	134	9.2
<b>goldfish</b>	<b>72</b>	<b>4.9</b>
smallmouth bass	30	2.1
channel catfish	23	1.6
<b>brown bullhead</b>	<b>5</b>	<b>0.3</b>
white sucker	5	0.3
white catfish	1	0.1

# FISH ASSEMBLAGE 2005-2006

## IMPINGEMENT

Taxon	Number	Percent
bluegill	388	79
channel catfish	31	6
smallmouth bass	24	5
green sunfish	20	4
<b>redbreast sunfish</b>	<b>15</b>	<b>3</b>
<b>pumpkinseed</b>	<b>5</b>	<b>1</b>
white sucker	4	1
<b>brown bullhead</b>	<b>1</b>	<b>&lt;0.5</b>
flathead catfish	1	<0.5
<b>goldfish</b>	<b>3</b>	<b>&lt;0.5</b>
white catfish	1	<0.5

# FISH ASSEMBLAGE 2007

## ELECTROFISHING

Taxon	Number	Percent
smallmouth bass	425	53.1
<b>redbreast sunfish</b>	<b>56</b>	<b>7.0</b>
channel catfish	25	3.1
flathead catfish	12	1.5
green sunfish	9	1.1
<b>pumpkinseed</b>	<b>4</b>	<b>0.5</b>
white sucker	3	0.4

# ELECTROFISHING SUMMARY

- Pumpkinseed, redbreast sunfish, brown bullhead and goldfish were dominant in both the 1976 and 1989-1990 electrofishing samples
- These species accounted for 80.1% of the fish community as sampled by boat electrofishing in 1976, 68.6% in 1989-1990, 53.6% in 1995 and 7.5% in 2007
- Of those four fish species in 2007, only redbreast sunfish (7.0%) constituted a considerable percentage of the Black Rock Pool fish community
- Pumpkinseed (0.5%) dramatically decreased while brown bullhead and goldfish were not captured during electrofishing in 2007

# DAVIES AND JACKSON COMMUNITY ASSESSMENT CATEGORIES

PRISTINE



DEGRADED

- (1) Native taxa maintained, structural and functional integrity
- (2) Native taxa maintained with some biomass or abundance changes
- (3) Loss of some rare native taxa, sensitive taxa abundant
- (4) Replacement of some sensitive taxa, increase in more tolerant taxa, overall balanced distribution, ecosystem functions largely maintained
- (5) Sensitive taxa are diminished; unbalanced distribution, signs of physiological stress, reduced complexity
- (6) Extreme changes in structure; abnormal densities, ecosystem function lost

# DAVIES AND JACKSON COMMUNITY ASSESSMENT OF BLACK ROCK POOL

Pre-Colonial Development

Level 1

Prior to 1970's

Level 6

1970's

Level 5

2000's

(Approaching/Within) Level 4



# AQUATIC VEGETATION

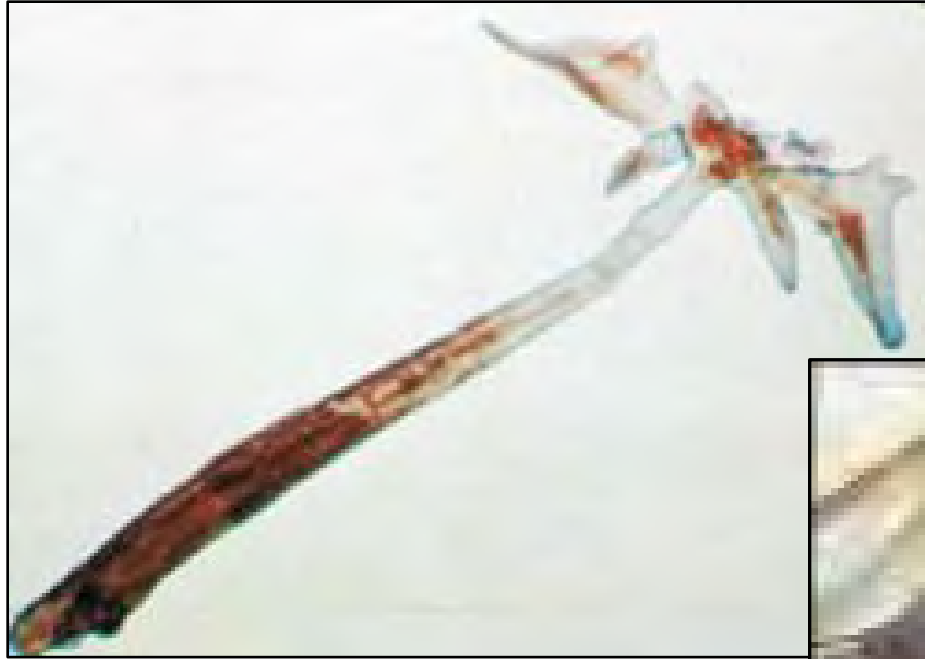


~1980

# GOLDFISH WITH PARASITE



# LERNAEA SP. (ANCHOR WORM)



# TIGER MUSKELLUNGE



Non-Native

# WALLEYE



Non-Native

# NORTHERN HOGSUCKER

Native



# SCHUYLKILL RIVER HEADWATERS, 2011

QUESTIONS?

