2013 Ohio River Pool Assessments

Dashields, Hannibal, R. C. Byrd, and Smithland

ORSANCO Biological Programs

Ohio River Valley Water Sanitation Commission
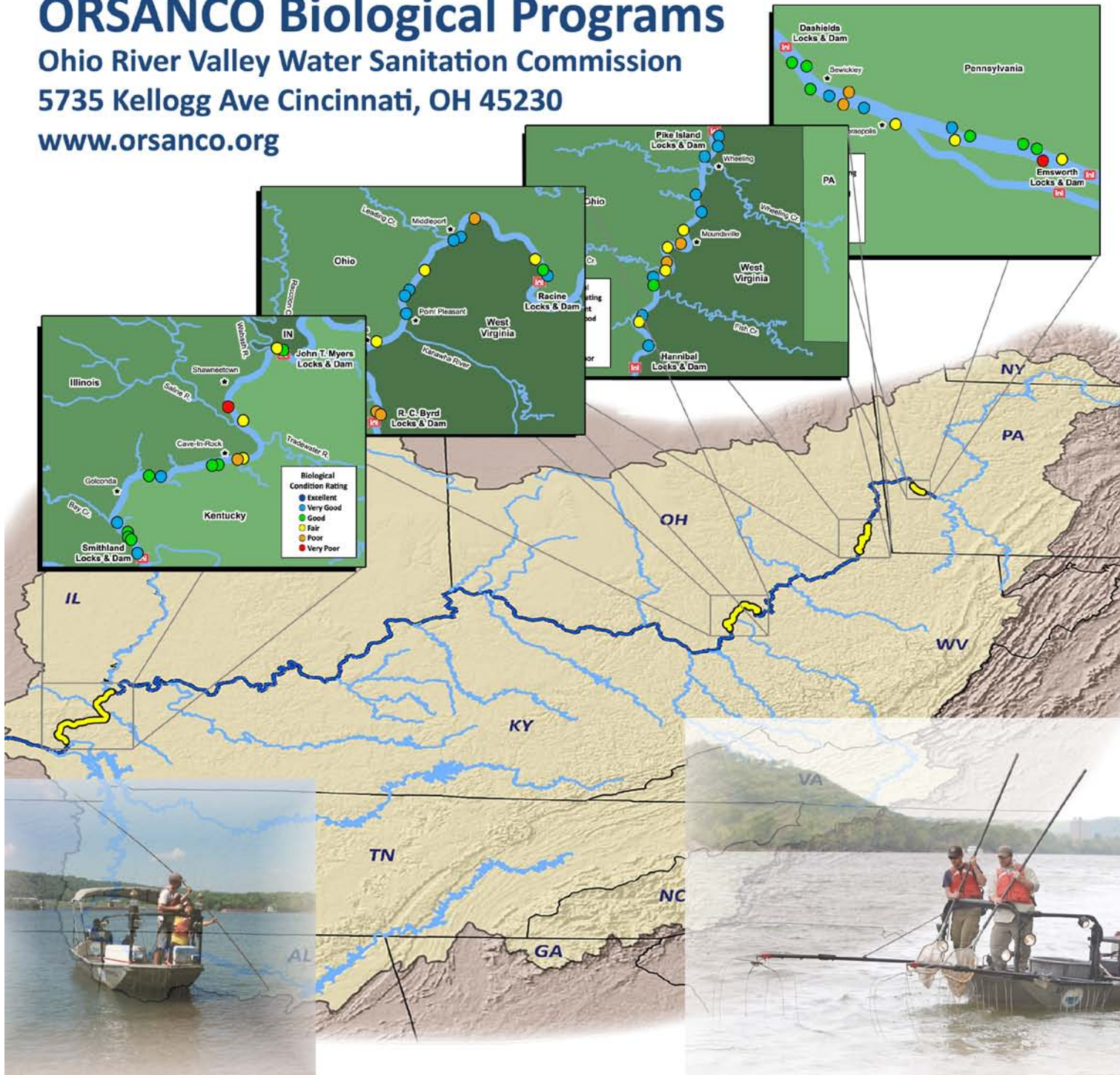**5735 Kellogg Ave Cincinnati, OH 45230**
www.orsanco.org

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Introduction

Based in Cincinnati, the Ohio River Valley Water Sanitation Commission (ORSANCO) is an interstate water pollution control agency created in 1948 by an act of Congress to monitor and improve the water quality of the Ohio River. A primary goal of ORSANCO programs is to work with state agencies to develop a set of pollution control standards for the Ohio River. Monitoring programs were established to develop and refine these standards. One of these programs, the ORSANCO biological program, uses fish studies to establish biological criteria (biocriteria) for the Ohio River. These biocriteria are ultimately used to provide insight into the overall health of the river ecosystem.

In 1993, ORSANCO developed and implemented a survey design that used electrofishing methods designed for the Ohio River. After years of collecting fish population data on the Ohio River, we developed the original Ohio River Fish Index (ORFIn) which was subsequently modified (*m*ORFIn). Each year we collect fish and environmental data from various sections of the Ohio River and use these data to calculate *m*ORFIn scores, which are numerical representations of the relative condition of Ohio River fish communities based on a suite of measurable attributes. The resulting scores allow us to assess the biological condition of each section of the river. The information included in these assessments is further used for regulatory, restorative, and protective efforts within the Ohio River basin.

How our achievements coincide with national milestones in the effort to restore our nation's water

1948 - ORSANCO is created to, among other things, ensure the Ohio River is "capable of maintaining fish and other aquatic life"

1957 - With the aid of multilple partners, we begin monitoring fish populations from Ohio River lock-chambers, an effort that would be continued nearly each year until 2005. These data comprise one of the most comprehensive river fisheries databases in existence

1969 - The Cuyahoga River catches fire, fueling the movement to clean our nation's water

1970 - The Environmental Protection Agency (EPA) is created

1975 - With the aid of several partners, we begin to sample fish tissue as a means for determining the presence or absence of certain pollutants

1972 - The first incarnation of the Clean Water Act, the Federal Water Pollution Control Amendments, lays the foundation for more rigorous future legislation

1977 - The Clean Water Act (CWA) is passed with the goal to greatly reduce sources of water pollution

1987 - Fish tissue procedures are modified & refined allowing appropriate state agencies to use the data for fish consumption advisories

1987 - The Water Quality Act is amended to the CWA. One of its goals, to "restore the biological integrity of the nation's waters," emphasized the need for tools like the ORFIn

1990 - We begin targeted night electrofishing & routine macroinvertebrate surveys

1990 - EPA initiates the Environmental Monitoring & Assessment Program (EMAP) to assess the nation's water bodies. We participate in regional surveys of Ohio River tributaries conducted between 2004 -2006

1993 - We institute a semi-random sampling design allowing us a more unbiased means to assess Ohio River fish communities

2003 - The Ohio River Fish Index (ORFIn) is created

2005 - We begin routine assessments, employing the ORFIn and random design

2006 - EPA expands the scope of EMAP to include "Great Rivers". We lend our expertise as trainers & surveyors gaining valuable data for modifying the ORFIn

2008 - The ORFIn is further refined & modified creating the *m*ORFIn

Present - We continue to work with state & federal agencies to assess the biological integrity of Ohio River fish communities as directed by the Clean Water Act
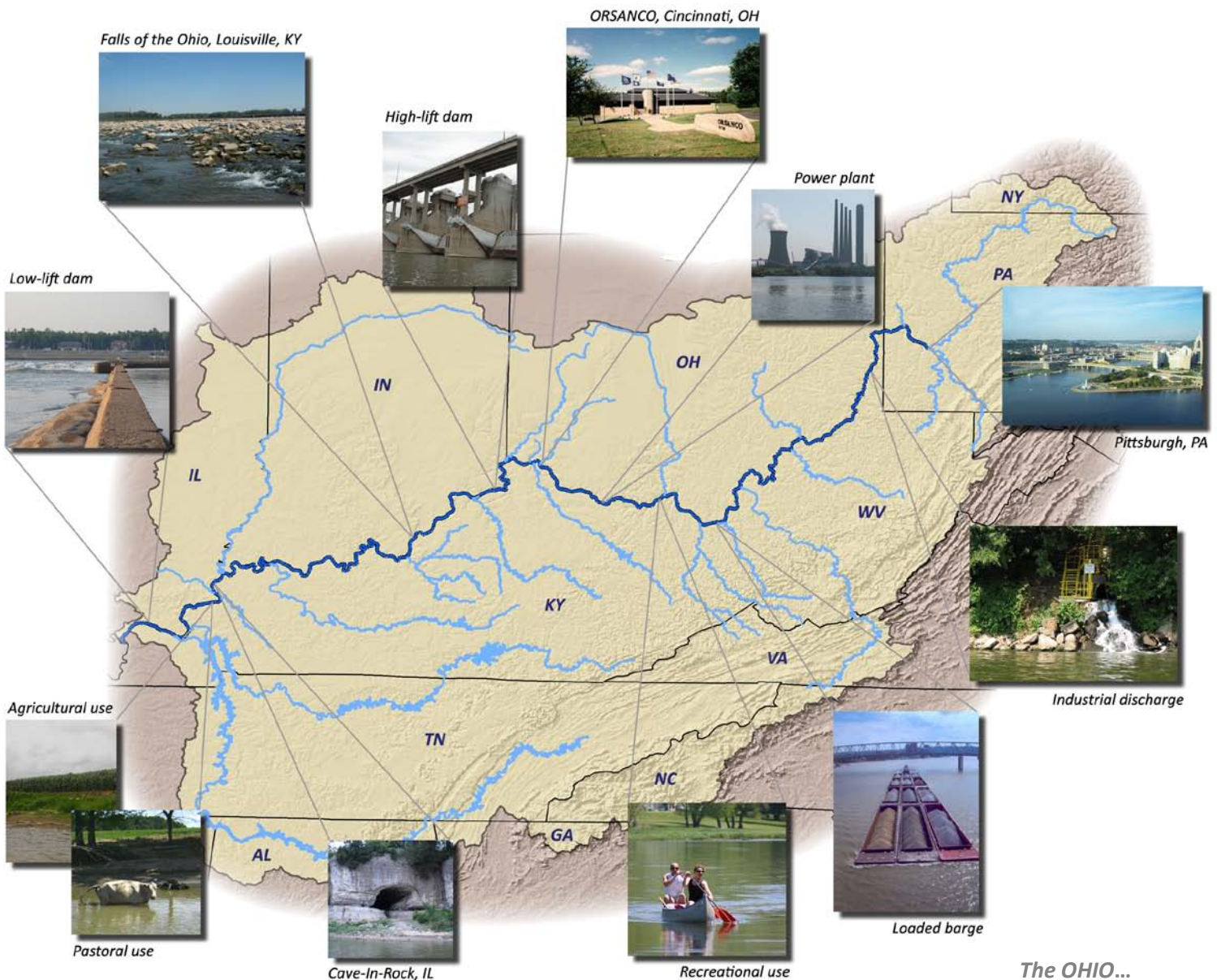
This report summarizes the findings of the 2013 surveys; the assessments of the Dashields, Hannibal, R. C. Byrd, and Smithland pools

The River

The Ohio River begins at the confluence of the Monongahela and Allegheny rivers in Pittsburgh and flows 981 miles in a southwesterly direction to its confluence with the Mississippi River near Cairo, IL. The Ohio has several additional large tributaries including the: Muskingum, Scioto, Kanawha, Kentucky, Green, Wabash, Cumberland and Tennessee rivers. The Ohio River itself runs through or borders six states; Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. The river basin (>200,000 mi^2) covers an additional eight states; New York, Maryland, Virginia, North Carolina, Tennessee, Georgia, Alabama, and Mississippi. Nineteen high-lift locks and dams maintain a nine-foot minimum depth for commercial navigation throughout the river.

Facts

- Average depth 24 ft, max depth exceeding 90 ft
- Average width ½ mi, 1 mi max (Smithland Pool)
- ~344 fish species from Ohio River _basin_ (18 exotic) = 40% of known N. American species (800 species)
- ~178 fish species found in the Ohio _River_ (14 exotic)
- Deciduous forests continue to dominate the basin
- Major land uses: pastures, row crops, and urban development
- Basin holds ~10% of the nation (27 million people)
- 33 drinking water intakes provide drinking water for over 5 million people along the main stem
- ~600 permitted discharges to the Ohio River
- 49 power-generating facilities on the main stem
- Coal and energy products comprise 70% of the 250 million tons of cargo carried by barges each year

Falls of the Ohio, Louisville, KY

High-lift dam

ORSANCO, Cincinnati, OH

Power plant

Low-lift dam

Pittsburgh, PA

Industrial discharge

Agricultural use

Pastoral use

Cave-In-Rock, IL

Recreational use

Loaded barge

The OHIO…
Iroquoian for "great river"

Site Selection

A random, probability-based survey design was used to select sampling site locations within each Ohio River navigational pool. The target areas of our surveys are both shorelines of each pool from the upstream dam to the downstream dam. The survey design provides coordinates for 15 sites (500m-long) in each of the selected pools. Biological and environmental data are then collected from these 15 sites and used to assess the biological condition of the pool.

Collecting the Fish

To maintain consistency across different sampling years, fish surveys are conducted between July 1st and October 31st and when water levels are within one meter of "normal flat pool". The fish are collected by a non-lethal method called boat electrofishing using an 18ft aluminum johnboat equipped with a generator and an electrofishing unit (standard equipment used by federal and state agencies). Using the electrofishing unit to regulate the output from the generator, a mild current is applied to the water with an effective range of up to 20ft. Because of our limited range, sites are fished at night along the shoreline when species are most active. This allows us to maximize the number of individuals and species captured, thus providing us with an accurate representation of the fish community at each site.

Sampling is conducted in a downstream manner for a minimum of 1800 seconds, during which all available habitats are sampled within 100ft from shore. When the fish encounter the electric field their muscles contract and they rise to the surface. The fish are then netted and placed into a live well were they remain until the entirety of the 500m zone is sampled. Each fish is measured, inspected for anomalies, and identified to lowest possible taxonomic level (e.g. species) before being returned to the water. A few small fish (less than 4cm) that cannot be confidently identified in the field (e.g. minnows) are preserved and identified in the laboratory. All recorded fish information is reviewed and imported into a database from which fish index scores are later generated.

Characterizing Instream Habitat

Intensive habitat surveys are conducted which include measures of woody cover, depth, and prevalence of substrate types at each electrofishing site. Woody cover (submerged brush, logs, and stumps) is estimated visually. More quantitative measures of depth and substrate proportions are obtained through the use of a 20' copper pole. The pole is used to probe the bottom of the river to determine exact depth and the proportions of substrate types including: boulder, cobble, gravel, sand, fines, and hardpan (clay) that occur at each site.

Because different fish species prefer different habitat types, it is important to classify the instream habitat at each of our sites to better understand *m*ORFIn score variability. Using the habitat survey data, we assign each site to one of five statistically derived habitat classes simply named: 'A', 'B', 'C', 'D' and 'E'. The five habitat classes represent a gradient from highly coarse Class 'A' habitats with high amounts of cobble and gravel, to the predominantly sandy/fine substrates of habitat classes 'D' and 'E' (which differ by water depth, see below).

Water Quality and Hydrology

Basic measures of water quality such as water temperature, clarity, pH, DO, and conductivity are measured at each site prior to electrofishing. Water samples may also be collected at the downstream end of each 500m zone approximately 100ft from shore to determine various water quality parameters (e.g. nutrient levels and hardness). River stage is monitored using data obtained from the U.S. Army Corps of Engineers, who also provide measures of predicted daily average flow volumes and velocities from the nearest-upstream sampling station to any particular site. These data are compiled to aid in the interpretation of the fish index results.
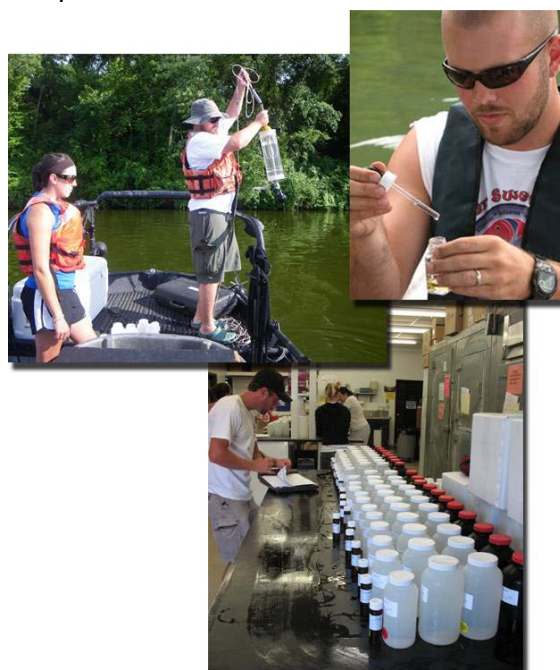
A look at our five habitat classes
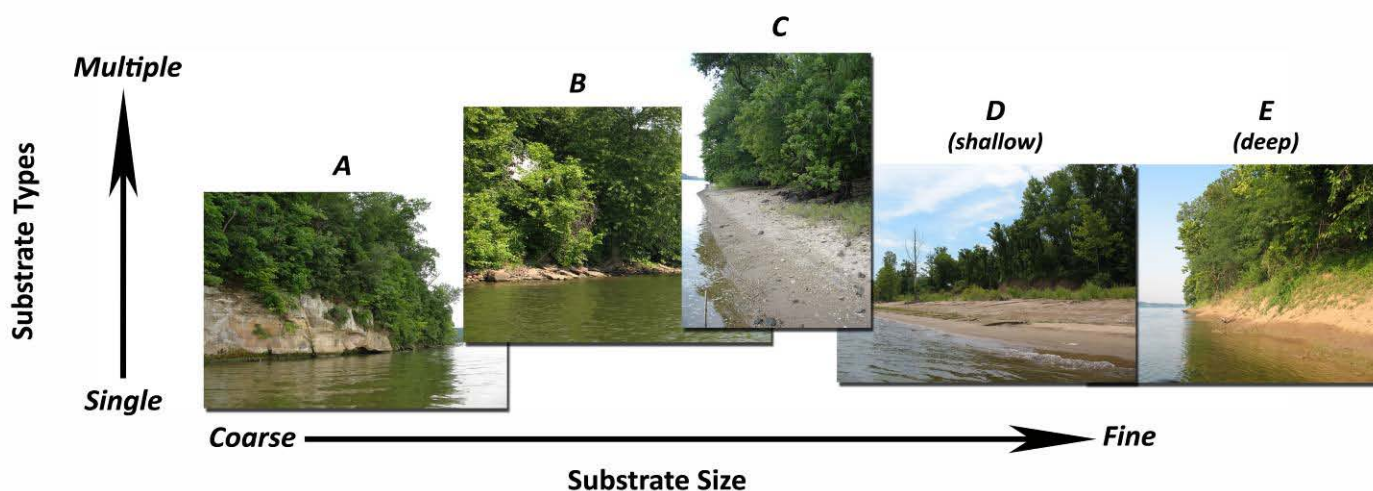
Assessing Biological Condition

The original ORFIn, created in 2003, contained 13 measures (metrics) of various aspects of the fish community including: diversity, abundance, feeding and reproductive guilds, pollution tolerance, and fish health. Individual site performance was assessed using expectations established for only three original habitat classes.

| 13 original ORFIn metrics used to generate *m*ORFIn scores	
Metric Name	**Definition**
Native Species	No. of species native to the Ohio River
Intolerant Species	No. of species intolerant to pollution and habitat degradation
Sucker Species	No. of sucker species (e.g. redhorse and buffalo)
Centrarchid Species	No. of black bass, sunfish, and crappie species
Great River Species	No. of species primarily found in large rivers
% Piscivores	% of individuals (ind) that consume other fish
% Invertivores	% of ind that consume invertebrates
% Detritivores	% of ind that consume detritus (dead plant material)
% Tolerants	% of ind tolerant to pollution and habitat degradation
% Lithophils	% of ind belonging to breeding groups that require clean substrates for spawning
% Non-natives	% of ind not native to the Ohio River, including both exotics and hybrids
No. *DELT* anomalies	No. of ind with *D*eformities, *E*rosions, *L*esions, and *T*umors present
Catch per unit effort (*CPUE*)	Total abundance of individuals (minus exotics, hybrids, and tolerants)

In 2008, we *modified* the ORFIn (*m*ORFIn) by updating the scoring system, re-evaluating our habitat classes, and accounting for variations of ORFIn scores observed across the five new habitat classes previously described. With this modified tool we assess each navigational pool based upon the biological and environmental data collected from its 15 randomly selected sites. This involves a multi-step approach (detailed below) that converts the ORFIn scores (0-100) of each individual site into a *modified* ORFIn (*m*ORFIn) score (0-60) based on the varying expectations of the five different habitat classes. The *m*ORFIn scores of the 15 sites are then averaged to provide an overall *m*ORFIn score and rating for the navigational pool. This average *m*ORFIn score is then compared to the established biocriterion of 20.0.

The five distinct habitat classes ('A', 'B', 'C', 'D', and 'E') each exhibit different levels of historical ORFIn performance (i.e. different fish communities are found at each habitat). The ORFIn score of each survey site is compared to the range of historical ORFIn scores within its particular habitat class.

Then a *m*ORFIn score between 0 and 60 is calculated for each individual site based upon how its ORFIn score relates to statistical thresholds defined within the historical ranges. A biological condition rating (i.e. 'Poor', 'Very Poor', 'Fair', 'Good', 'Very Good', and 'Excellent') is given to each site based on its *m*ORFIn score.
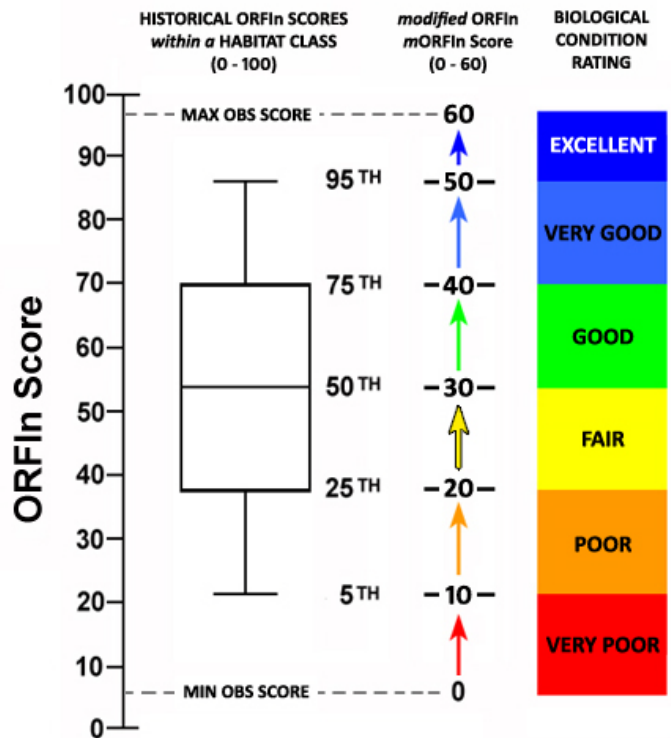
To obtain a final bio-assessment of each pool, an average *m*ORFIn score is calculated. The 25th percentile is the statistical threshold commonly used by regulatory agencies for establishing biocriteria. Using this threshold, our established biocriterion (i.e. a representation of healthy Ohio River fish communities) is set at an average *m*ORFIn score of 20.0. The pool is assessed as meeting its aquatic life-use designation (i.e. possessing intact fish communities) if its average *m*ORFIn score is greater than or equal to 20.0 (i.e. a biological rating of 'Fair', 'Good', 'Very Good', or 'Excellent'). Any pool with an average *m*ORFIn score less than 20.0 (i.e. a rating of 'Poor' or 'Very Poor') is assessed as failing to meet its aquatic life-use designation.

For more detailed information pertaining to our programs including survey design, field methods, past & present assessment results, or fish data contact one of our staff or visit: www.orsanco.org/biological-programs

2013 Pool Survey Results
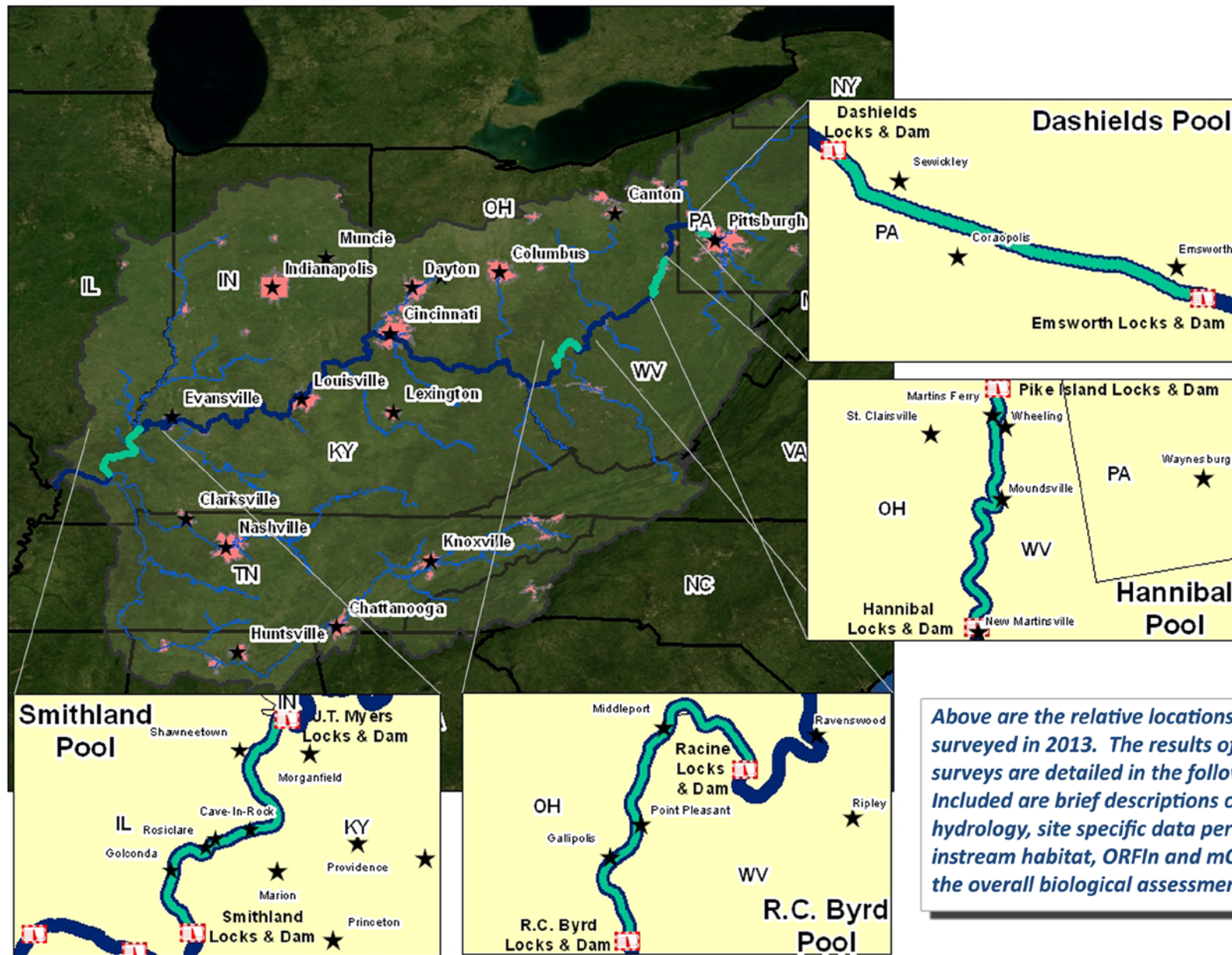
Above are the relative locations of the pools surveyed in 2013. The results of these biological surveys are detailed in the following pages. Included are brief descriptions of the land use and hydrology, site specific data pertaining to fish and instream habitat, ORFIn and mORFIn scores, and the overall biological assessment of each pool.

Dashields Pool - *2013*

The Dashields pool is 7.1 miles long, extending from Emsworth Locks and Dam (ORM 6.2) to Dashields Locks and Dam (ORM 13.3). The pool has a gradient drop of 0.7 feet per mile and averages 1,467 feet wide and 14 feet deep (ORSANCO 1994). The entirety of the pool lies in Pennsylvania. This pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. The pool receives little water from tributaries. The shorelines of this pool support a moderate degree of aquatic vegetation, and where aquatic vegetation was observed, the dominant species was invasive (Hydrilla spp.). The watershed is primarily forested (60.7%), and is also comprised of pasture lands (12.0%) and row crops (5.2%). The Ohio Park Superfund site lies on the western tip of Neville Island, which creates a 3 mile back channel on the Ohio River. The site has been reclaimed to an extent by removing and isolating pollutants.

Fish community composition pie chart:
- Suckers 36.6%
- other 9.8%
- Drum 6.2%
- Minnows/Carp 12.0%
- Perches 16.7%
- Sunfishes/Black Bass 18.7%

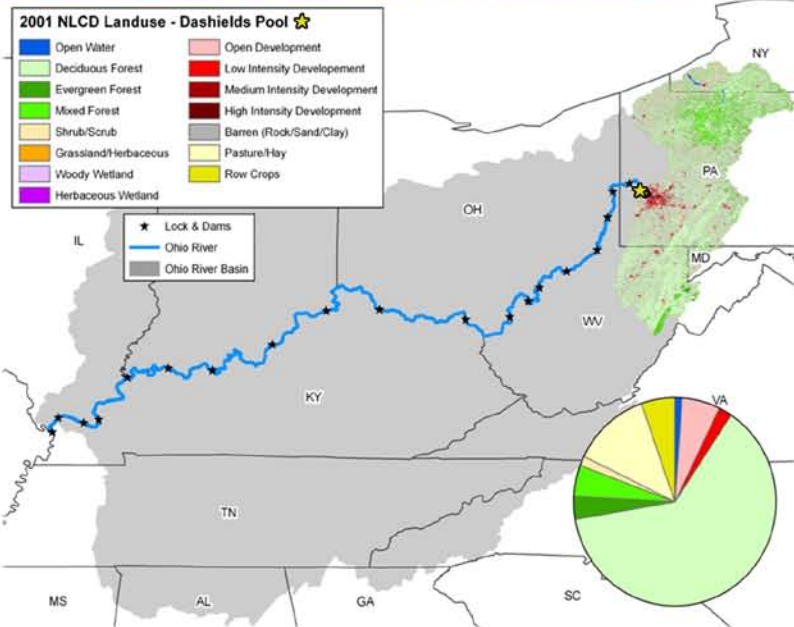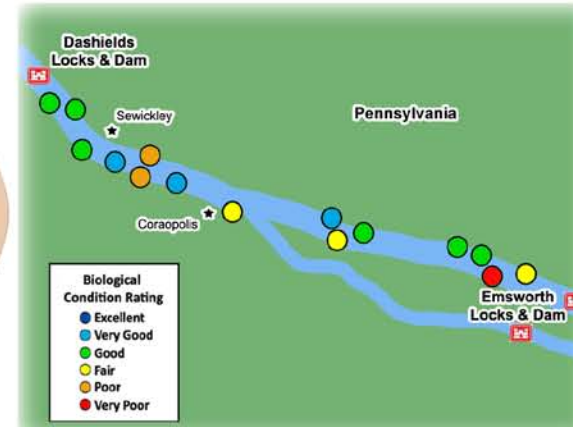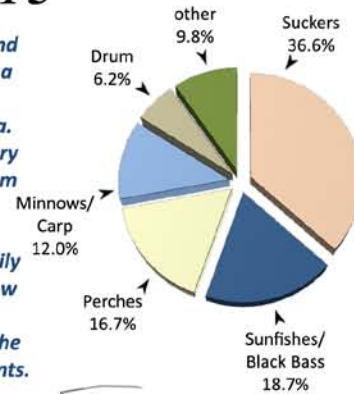The shorelines of Dashields Pool are lined with mooring cells, loading docks & other industrial infrastructure

Biological Condition Rating
- Excellent
- Very Good
- Good
- Fair
- Poor
- Very Poor

Locations of the 15 randomly chosen electrofishing sites in Dashields Pool

2001 NLCD Landuse - Dashields Pool ⭐
- Open Water
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Woody Wetland
- Herbaceous Wetland
- Open Development
- Low Intensity Developement
- Medium Intensity Development
- High Intensity Development
- Barren (Rock/Sand/Clay)
- Pasture/Hay
- Row Crops

- ★ Lock & Dams
- — Ohio River
- Ohio River Basin

Land-use types within the Dashields Pool watershed

Habitat substrate pie chart:
- other 2.0%
- Hardpan 3.5%
- Boulder 4.3%
- Cobble 16.7%
- Gravel 30.7%
- Sand 28.6%
- Fines 14.2%

streamline chub (*Erimystax dissimilis*)

sauger (*Sander canadensis*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	mORFIn Score
1	6.7	A	50.03	54.04	26.8
2	7.1	C	44.55	29.98	9.9
3	7.3	C	44.55	57.09	35.5
4	7.6	C	44.55	57.75	36.2
5	8.6	C	44.55	54.85	32.9
6	8.9	B	46.71	53.97	28.7
7	8.9	C	44.55	68.46	46.1
8	10	B	46.71	50.10	24.1
9	10.8	C	44.55	64.87	43.1
10	11.2	C	44.55	33.58	12.4
11	11.2	B	46.71	38.91	11.2
12	11.5	D	41.80	64.52	46.2
13	11.9	B	46.71	63.25	39.4
14	12.3	B	46.71	57.89	33.3
15	12.6	C	44.55	58.53	37.1
Average Pool mORFIn Score					**30.8**

Dashields Pool - Results Overview

Sampling Results
Environmental Measures
  Dominant Habitat Class: C - equal mix of coarse and fines
  Notable Measures: Above average flows and poor water clarity were observed during the sampling period
Biological Measures
  Total No. of Fish Species: 38
  Average No. of Individuals: 134
  Dominant Family (*minus herring/shad*): Suckers
  Dominant Species (*minus shad/shiners*): sauger
  Threatened and Endangered Species: mooneye & longear sunfish
  Rare Ohio River Mainstem Species: streamline chub
  Notable Catch: muskellunge & ohio lamprey
Assessment Results
  Highest scoring ORFIn metric (*minus DELTs*): Sucker Species
  Lowest scoring ORFIn metric (*minus GR Species*): % Invertivores
  Sites Above 25th percentile (i.e. mORFIn Score = 20): 12
  Sites Below 25th percentile (i.e. mORFIn Score = 20): 3
  Aquatic Life-Use Designation: Met

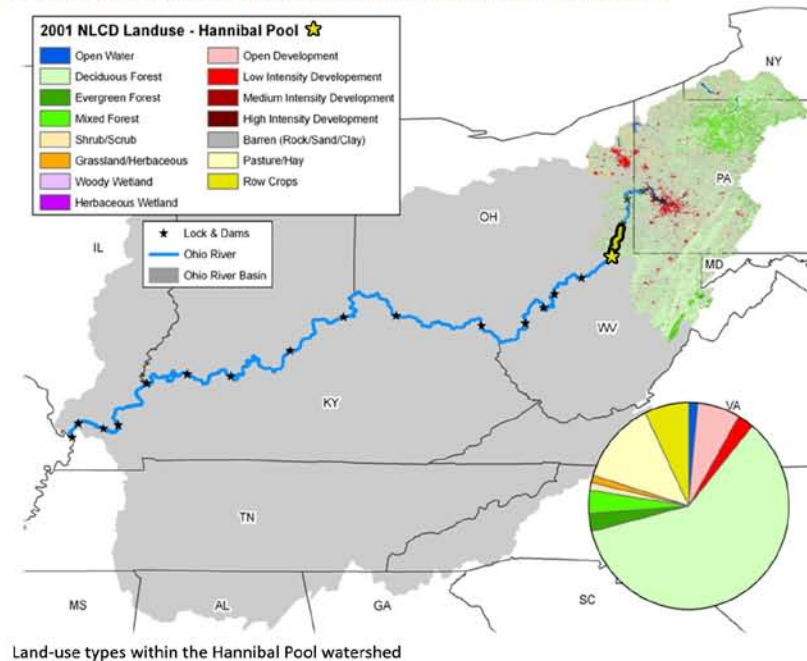**Overall Biological Condition Rating: Good**

Hannibal Pool - *2013*

The Hannibal pool is 42.2 miles long, extending from Pike Island Locks and Dam (ORM 84.2) to Hannibal Locks and Dam (ORM 126.4). The pool has a gradient drop of 0.5 feet per mile and averages 1,133 feet wide and 21 feet deep (ORSANCO 1994). The pool is bordered by the states of West Virginia and Ohio and lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. The Hannibal pool directly receives water from numerous smaller tributaries draining approx. 1,120 square miles of the larger Ohio River basin: Wheeling Creeks (OH & WV), McMahon Creek, Grave Creek, Captina Creek, Fish Creek, and Sunfish Creek. Shorelines support a large amount of aquatic vegetation, and where observed, littoral zones were dominated by invasive species (Hydrilla spp.). The combined watershed is primarily forested (64.6%) and also contains pasture lands (12.7%) and row crops (7.0%).

Pie chart (fish families):
- Sunfishes/Black Bass 44.3%
- other 7.3%
- Catfish 4.3%
- Perches 9.1%
- Minnows/Carps 16.4%
- Suckers 18.6%

Biological Condition Rating:
- Excellent
- Very Good
- Good
- Fair
- Poor
- Very Poor

Locations of the 15 randomly chosen electrofishing sites in Hannibal Pool

Some sections of Hannibal Pool shorelines are entirely bedrock as seen here near Moundsville, WV

2001 NLCD Landuse - Hannibal Pool

Legend:
- Open Water
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Woody Wetland
- Herbaceous Wetland
- Open Development
- Low Intensity Developement
- Medium Intensity Development
- High Intensity Development
- Barren (Rock/Sand/Clay)
- Pasture/Hay
- Row Crops

- Lock & Dams
- Ohio River
- Ohio River Basin

Land-use types within the Hannibal Pool watershed

Pie chart (substrate):
- Fines 32.6%
- Hardpan 0.8%
- other 1.1%
- Boulder 4.4%
- Cobble 11.7%
- Gravel 20.6%
- Sand 28.8%

bluegill (*Lepomis macrochirus*)

highfin carpsucker (*Carpiodes velifer*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	mORFIn Score
1	84.9	C	44.55	63.82	42.2
2	86.7	C	44.55	64.61	42.9
3	88.6	C	44.55	65.68	43.8
4	94.3	C	44.55	66.27	44.3
5	96.5	C	44.55	64.66	42.9
6	99.5	B	46.71	52.33	26.7
7	103.2	C	44.55	42.50	18.6
8	105.3	B	46.71	51.08	25.2
9	107.7	C	44.55	41.65	18.0
10	109.7	C	44.55	49.90	27.0
11	111.1	B	46.71	69.50	44.8
12	111.9	B	46.71	61.25	37.1
13	116.5	D	41.80	58.35	40.4
14	118.6	C	44.55	46.35	22.4
15	122.2	E	39.59	59.24	40.1
				Average Pool mORFIn Score	34.4

Hannibal Pool - Results Overview

Sampling Results

Environmental Measures
Dominant Habitat Class: C - equal mix of coarse and fines
Notable Measures: Above average flows and poor water clarity were observed during the sampling period

Biological Measures
Total No. of Fish Species: 48
Average No. of Individuals: 169
Dominant Family (*minus herring/shad*): Sunfishes/Black Bass
Dominant Species (*minus shad/shiners*): bluegill
Species of Concern (WV): highfin carpsucker
Rare Ohio River Mainstem Species: greenside darter
Notable Catch: river darter & channel darter (threatened in OH)

Assessment Results
Highest scoring ORFIn metric (*minus DELTs*): % Non-natives
Lowest scoring ORFIn metric (*minus GR Species*): % Lithophils
Sites Above 25th percentile (i.e. mORFIn Score = 20): 13
Sites Below 25th percentile (i.e. mORFIn Score = 20): 2
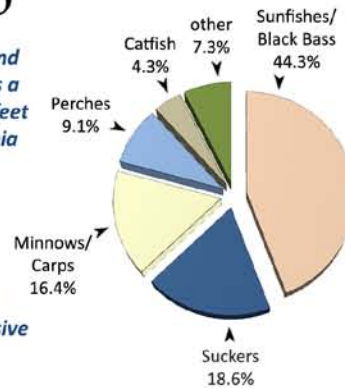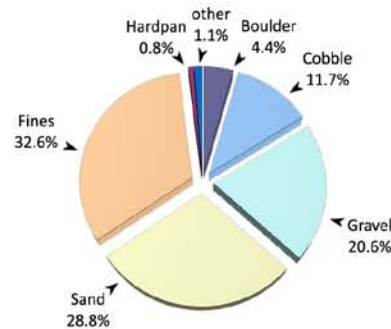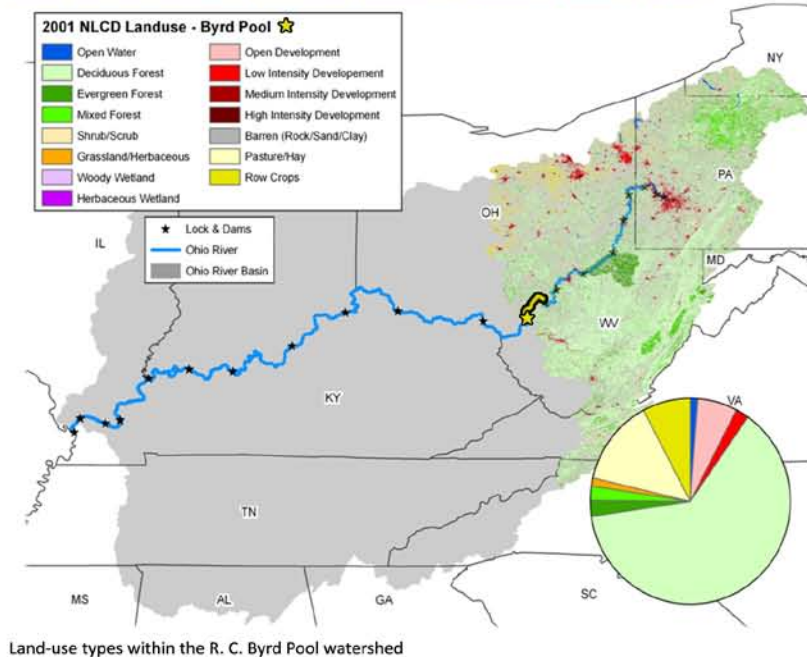Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

R. C. Byrd Pool - *2013*

The R. C. Byrd pool is 41.7 miles long, extending from the Racine Locks and Dam (ORM 237.5) to the R.C. Byrd (formerly Gallipolis) Locks and Dam (ORM 279.2) on the downstream end. The pool has a gradient drop of 0.6 feet per mile and averages 1,154 feet wide and 26 feet deep (ORSANCO 1994). The pool is bordered by the states of West Virginia and Ohio. This pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. The Kanawha River empties into this pool at Ohio River mile-point 265.7 and has a drainage area of 12,200 square miles. R. C. Byrd pool also receives water from Leading Creek and Raccoon Creek with drainage areas of 151 and 684 square miles respectively. These combined watersheds are primarily forested (65.8%), but also have a considerable amount of pasture lands (13.2%) and row crops (7.5%). Littoral zones were dominated by an invasive aquatic vegetation species (Hydrilla).

Fish families pie chart: Minnows/Carp 41.2%, other 15.3%, Catfish 7.0%, Herring/Shad 8.0%, Suckers 8.1%, Sunfishes/Black Bass 20.4%

Locations of the 15 randomly chosen electrofishing sites in R. C. Byrd Pool

Biological Condition Rating:
- Excellent
- Very Good
- Good
- Fair
- Poor
- Very Poor

The waterfront of Pomeroy, OH a small river town upstream of Middleport, OH

2001 NLCD Landuse - Byrd Pool
- Open Water
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Woody Wetland
- Herbaceous Wetland
- Open Development
- Low Intensity Development
- Medium Intensity Development
- High Intensity Development
- Barren (Rock/Sand/Clay)
- Pasture/Hay
- Row Crops
- ★ Lock & Dams
- — Ohio River
- Ohio River Basin

Land-use types within the R. C. Byrd Pool watershed

Substrate pie chart: Fines 31.4%, Hardpan 11.3%, other 0.5%, Boulder 2.3%, Cobble 7.3%, Gravel 17.6%, Sand 29.6%

river redhorse (*Moxostoma carinatum*)

white bass (*Morone chrysops*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	mORFIn Score
1	238.7	C	44.55	64.54	42.8
2	239.2	C	44.55	52.95	30.8
3	240.8	B	46.71	50.13	24.1
4	249.7	D	41.80	39.90	18.1
5	252.5	C	44.55	72.29	49.3
6	253.0	C	44.55	63.21	41.7
7	258.0	E	39.59	47.85	27.6
8	260.9	C	44.55	66.87	44.8
9	261.3	D	41.80	63.79	45.5
10	263.9	D	41.80	64.35	46.0
11	268.6	E	39.59	47.29	27.0
12	270.3	D	41.80	41.16	19.4
13	270.9	D	41.80	32.03	10.5
14	278.0	E	39.59	36.05	15.0
15	278.1	C	44.55	43.81	19.5
Average Pool mORFIn Score					**30.8**

R. C. Byrd Pool - Results Overview

Sampling Results

Environmental Measures
- Dominant Habitat Class: C - equal mix of coarse and fines
- Notable Measures: The lowest performing sites were found downstream of the confluence of the Kanawha River

Biological Measures
- Total No. of Fish Species: 33
- Average No. of Individuals: 121
- Dominant Family (*minus herring/shad*): Minnows/Carp
- Dominant Species (*minus shad/shiners*): bluegill
- Species of Concern: highfin carpsucker (WV) & river redhorse (OH)
- Rare Ohio River Mainstem Species: spottail shiner
- Notable Catch: striped bass (common in reservoirs & lower OH R.)

Assessment Results
- Highest scoring ORFIn metric (*minus DELTs*): % Tolerants
- Lowest scoring ORFIn metric (*minus GR Species*): CPUE
- Sites Above 25th percentile (i.e. mORFIn Score = 20): 10
- Sites Below 25th percentile (i.e. mORFIn Score = 20): 5
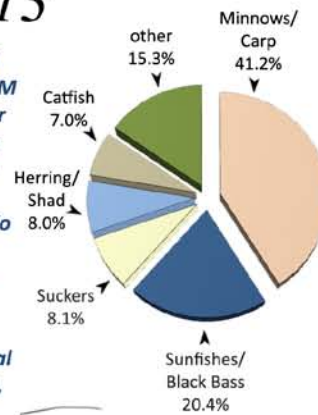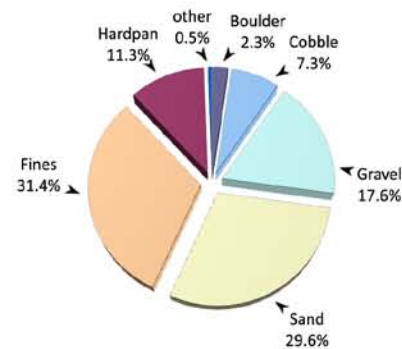- Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Smithland Pool - *2013*

The Smithland pool is 72.5 miles long, extending from J.T. Myers Locks and Dam (ORM 846.0) to Smithland Locks and Dam (ORM 918.5). The pool has a gradient drop of 0.3 feet per mile and averages 4,116 feet wide and 30 feet deep (ORSANCO 1994). The pool is bordered by the states of Kentucky, Illinois, and Indiana. Smithland pool lies in a portion of the Ohio River where the land cover consists primarily of deciduous forest (47.7%), but also has a considerable amount of row crops (25.0%) and pasture lands (13.7%). The Smithland pool receives water from the following tributaries: Wabash River at mile point 848.0 with a drainage area of 33,100 square miles, Saline River at mile point 867.3 with a drainage area of 1,170 square miles and Tradewater River at mile point 873.5 with a drainage area of 1,000 square miles. The shorelines of this pool contained very little observable aquatic vegetation within littoral zones.

Fish community composition pie chart: other 18.7%, Sunfishes/Black Bass 17.9%, Herring/Shad 17.7%, Catfish 15.9%, Suckers 15.3%, Minnows/Carp 14.4%

Locations of the 15 randomly chosen electrofishing sites in Smithland Pool

Biological Condition Rating
- Excellent
- Very Good
- Good
- Fair
- Poor
- Very Poor

Looking upstream at Smithland Pool from atop a rocky bluff in Cave-In-Rock State Park, IL

Land-use types within the Smithland Pool watershed

2001 NLCD Landuse - Smithland Pool
- Open Water
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Woody Wetland
- Herbaceous Wetland
- Open Development
- Low Intensity Developement
- Medium Intensity Development
- High Intensity Development
- Barren (Rock/Sand/Clay)
- Pasture/Hay
- Row Crops
- ★ Lock & Dams
- Ohio River
- Ohio River Basin

Substrate composition pie chart: Fines 46.4%, Hardpan 24.2%, Sand 22.2%, Cobble 3.5%, Boulder 1.8%, Gravel 1.1%, other 0.8%

goldeye (*Hiodon alosoides*)

spotted gar (*Lepisosteus platostomus*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	mORFIn Score
1	846.8	E	39.59	54.78	34.9
2	847.1	D	41.80	45.04	24.1
3	863.0	E	39.59	30.99	0.0
4	866.9	D	41.80	49.11	29.2
5	878.1	D	41.80	48.86	28.9
6	878.4	D	41.80	39.56	17.8
7	882.2	E	39.59	53.15	33.0
8	883.3	E	39.59	50.99	30.5
9	893.7	D	41.80	59.39	41.4
10	895.9	D	41.80	57.79	39.9
11	909.9	D	41.80	58.46	40.5
12	912.9	E	39.59	55.76	36.0
13	913.5	D	41.80	50.37	30.8
14	914.0	E	39.59	56.79	37.2
15	917.7	B	46.71	68.31	43.8
				Average Pool mORFIn Score	**31.2**

Smithland Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: vast areas of submerged trees and stumps are common along the shorelines of Smithland pool

Biological Measures

Total No. of Fish Species: 36 (abundances were unsually even)

Average No. of Individuals: 168

Dominant Family (*minus herring/shad*): Sunfishes/Black Bass

Dominant Species (*minus shad/shiners*): channel catfish

Threatened and Endangered Species: Mississippi silverside (T)

Rare Ohio River Mainstem Species: spotted gar & threadfin shad

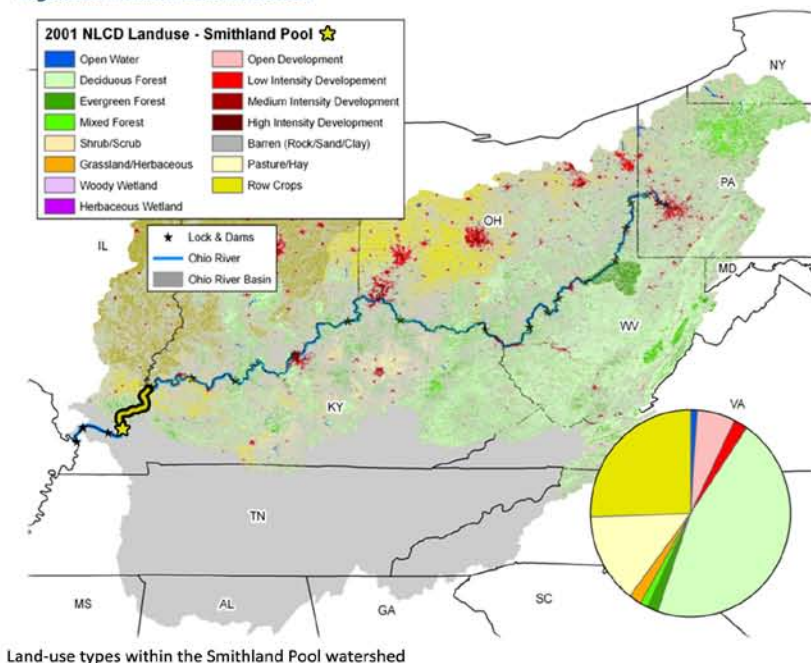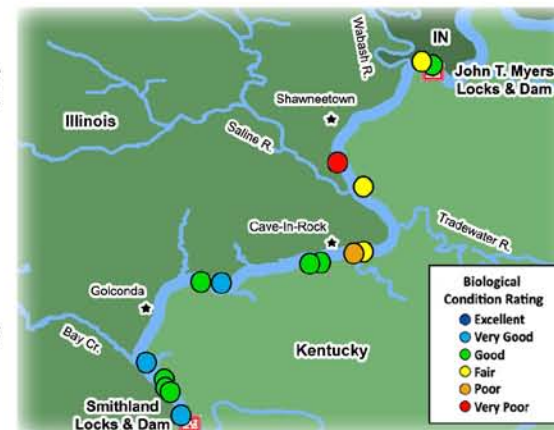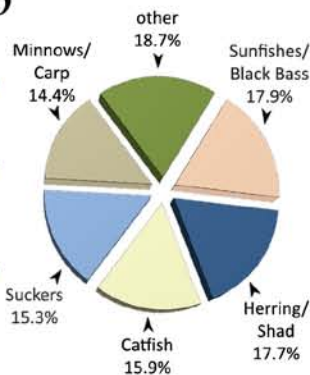Notable Observation: numerous large invasive/exotic silver carp

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerants

Lowest scoring ORFIn metric (*minus GR Species*): % Lithophils

Sites Above 25th percentile (i.e. mORFIn Score = 20): 13

Sites Below 25th percentile (i.e. mORFIn Score = 20): 2

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

Pool Surveys

The 2013 pool surveys were successfully completed between June 30th and August 15th. High rainfall was experienced throughout the sampling season. As a result, every pool experienced higher than average flows during some portion of the season. Overall, all four pools surveyed during the 2013 field season were assessed as *meeting* their aquatic life-use designations (i.e. containing healthy fish communities).

Dashields Highlights (Good)

Survey sites were distributed evenly throughout the pool with no sites selected in the back channel of Neville Island. An equal mix of coarse and fine substrates was the predominant substrate type. Suckers made up over a third of (36.6%) of the individuals caught. Numerous smallmouth bass and sauger were also encountered. Notable species caught included a juvenile muskellunge, trout-perch and streamline chub (both rare Ohio R. species), mooneye and longear sunfish (listed as threatened and endangered in PA, respectively).

Hannibal Highlights (Good)

Survey sites were evenly distributed throughout the pool, with a few occurring in close proximity to each other. Benthic composition was an equal mix of coarse and fine substrates with an abundance of submerged aquatic vegetation. Most of the vegetation observed was the invasive exotic *Hydrilla verticillata*. The Centrarchidae family (i.e. sunfishes and bass) made up the majority of the catch (44.3%). Notable catches included channel and river darters (both threatened in OH), highfin carpsucker (special concern in WV), and greenside darter (rare Ohio River species).

R. C. Byrd Highlights (Good)

Survey sites, though distributed throughout the pool, were clustered into distinct areas. Coarse and fine substrates comprised the benthic composition in nearly equal proportions. The minnows and carp family comprised the majority of individuals caught (41.2%). Notable species included striped bass (more common in reservoirs), highfin carpsucker and river redhorse (listed as species of concern in WV and OH, respectively). A few spottail shiners (rare main stem species) were also caught.

Smithland Highlights (Good)

Survey sites were spread throughout the pool though most sites fell in the middle to lower portions. Benthic composition was primarily shallow fines and hardpan. Though centrarchids were the dominant family (17.9%), the pool displayed an unusual evenness with respect to species abundance and diversity. Notable catches included Mississippi silverside (threatened in KY), spotted gar, and numerous invasive exotic silver carp.

Assessment Comparisons

Between 2005 and 2009, all 19 Ohio River navigational pools were surveyed and assessed. The first cycle revealed the majority of the river to be in 'Good' condition. The 2013 surveys were conducted as part of the second full assessment of those same 19 pools. This second cycle allows us to not only rate the relative condition of each pool, but also compare past and present survey results, Some of the species variability observed across pools (see final table, pg 15), is likely due in part to variations in natural distributions, instream habitat, and annual variations in flow/weather conditions.

River-wide Assessment Comparison

The 2013 pools (*) had relatively similar condition ratings to their neighboring pools. Reasons for the variability of ratings across the pools include, but are not limited to varying degrees of anthropogenic land uses (which can affect habitat and water quality) and proximity to tributaries (which can affect species diversity based upon the biological condition of the tributary).

○ = 1st cycle (2005-2009)
△ = 2nd cycle (2010 - Present)
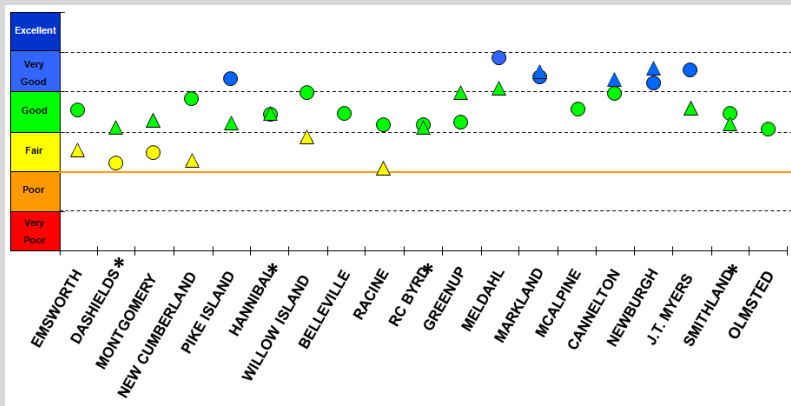
CONCLUSIONS

Past vs. Present Assessments

The focus of ORSANCO's biological assessments is to determine whether each pool 'meets' or 'fails to meet' its designated aquatic life use. To aid in interpretation, we apply six arbitrary ratings (from 'Very Poor' to 'Excellent') to the pools based on the relative condition of their fish communities. Shifts between years in these condition ratings may be due to variations in environmental factors other than water quality changes. By examining these factors (temperature, flows, etc.) and their effects on *m*ORFIn metrics, we attempt to provide plausible explanations for the differences in final condition ratings observed between years. Explanation common to the current pool assessments were the differences in the observed flows between years.

Flows were drastically higher in 2013 than during the previous round in 2008. Normally when higher flows are observed fish assemblages become less predictable and *m*ORFIn scores suffer. Therefore we would have expected the 2013 pools to exhibit depressed index scores. Instead we observed little differences in scores in all pools except Dashields (discussed below). An explanation could be that flows had been elevated in the prior months on the Ohio River long enough for fish to become acclimatized to these typically adverse conditions.

Dashields Pool (2008 vs. 2013)

Variable	2008	2013	Difference
Environmental Factors			
Avg. seasonal flow	Variable	High	Higher
Avg. conductivity (μS/cm)	366	260	-106
Avg Secchi (in)	30.5	20	-10.5
Native species score (0-100)	29.55	70.90	41.35
Total No. of species	31	43	12
Great River species score (0-100)	40.00	4.44	-35.56
No. of sites with GR species	13	2	-11
Sucker species score (0-100)	46.03	83.18	37.15
Intolerants species (0-100)	32.44	47.69	15.25
smallmouth redhorse (No. Ind)	16	153	137
river redhorse (No. Ind)	13	65	52
black redhorse (No. Ind)	0	10	10
Assessment Result			
Aquatic life-use designation	Met	Met	Same
Condition Rating	Fair	Good	Higher

Dashields pool was assessed to be in slightly higher condition in 2013 than in 2008. The metrics that influenced this difference are Native species, Sucker species, and Intolerant species, which all scored higher in 2013. Redhorse, which heavily influence these three metrics, favor areas with

consistent flows. Under normal conditions, as observed in 2008, Dashields lacks any significant tributaries or shallow gravel shoals where these conditions are typically found. This preference coupled with increased access to their preferred habitat/conditions partially explain the difference scores.

Not all metrics responded positively to the elevated flow conditions. Great river (GR) species decreased between the two surveys. Though in both years only two GR species were observed, they were more ubiquitous in 2008.

Hannibal Pool (2008 vs. 2013)

Variable	2008	2013	Difference
Environmental Factors			
Avg. seasonal flow	Variable	High	Higher
Avg % of Site containing SAV	5%	33%	28%
Centrarchid species score (0-100)	44.44	85.56	41.11
bluegill	36	523	487
longear sunfish	9	242	233
pumpkinseed	2	33	31
% Piscivores scores (0-100)	62.77	44.94	-17.83
sauger	317	147	-170
temperate bass	118	42	-76
% Lithophils score (0-100)	61.04	38.83	-22.22
silver redhorse	106	59	-57
Assessment Result			
Aquatic life-use designation	Met	Met	Same
Condition Rating	Good	Good	Same

Hannibal pool received a condition rating similar to the previous survey in 2008. Substantially higher amounts of *Hydrilla*, an invasive exotic aquatic plant, were observed throughout the pool in 2013. Similar to previous observations made in *Hydrilla* infested pools, we observed an assemblage shift from pelagic piscivores and suckers to one dominated by centrarchids, bluntnose minnow, and common carp.

Hydrilla (Hydrilla verticillata)
Bottom Left: Underwater view of a *Hydrilla* stand
Top Left: *Hydrilla* leaves are serrated and grow in whorls of 4 - 8 around the stem
Top Right: Shoreline view of an Ohio River pool infested with *Hydrilla*

13
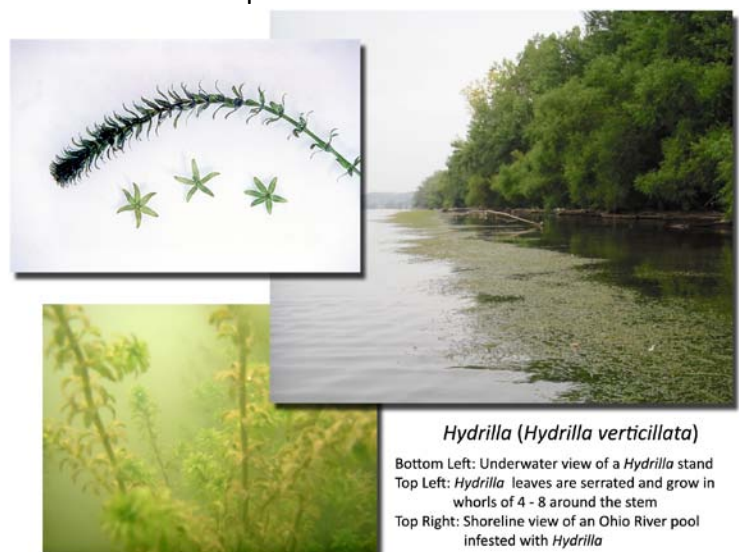
CONCLUSIONS

R. C. Byrd Pool (2008 vs. 2013)

Variable	2008	2013	Difference
Environmental Factors			
Avg. seasonal flow	Variable	High	Higher
Avg % of Site containing SAV	5%	23%	18%
Centrarchid species score (0-100)	58.89	64.44	5.56
bluegill	52	254	202
longear sunfish	9	56	47
% Piscivores scores (0-100)	81.16	32.79	-48.36
sauger	259	128	-131
temperate bass	103	86	-17
% Lithophils score (0-100)	70.10	18.27	-51.82
logperch	72	15	-57
Aquatic life-use designation	Met	Met	Same
Condition Rating	**Good**	**Good**	Same

R. C. Byrd received a condition rating similar to the previous survey in 2008. As in Hannibal, substantially higher amounts of *Hydrilla* were observed throughout the pool in 2013. Likewise the same assemblage shift from pelagic piscivores and suckers to one dominated by centrarchids, and common carp was observed. However the increase in total number of species and decrease in detritivores counteracted this negative shift.

Smithland Pool (2008 vs. 2013)

Variable	2008	2013	Difference
Environmental Factors			
Avg. seasonal flow	Variable	High	Higher
Avg. conductivity (µS/cm)	561	316	37.9
Avg Secchi (in)	30	19	40.0
Avg Great River Score (0-100)	50	62.2	12.2
% Piscivores score (0-100)	34.6	11.1	-23.5
% Lithophils score (0-100)	23.5	8.7	-14.8
% Detritivore score (0-100)	53.7	41.2	-12.5
Assessment Result			
Aquatic life-use designation	Met	Met	Same
Condition Rating	**Good**	**Good**	Same

Smithland pool was assessed to be in the same condition in 2013 as it was in the previous assessment performed in 2008. Lower numbers of piscivores, simple lithophils and detritivores were observed. Increased metric scores for great river species had a positive effect on the final condition rating. The slight differences between the Smithland assessments are likely artifacts of spatial and temporal variation that occur within a pool across a five-year timespan.

Field Notes As briefly mentioned in 'Past vs. Present Assessments', the 2013 field season experienced drastically elevated flows relative to those experienced during the previous round of sampling in 2008. This was largely due to an above average amount of rainfall (illustrated below) the basin received in late spring (left) and throughout the sampling period (right). The blue areas depict normal monthly precipitation levels, whereas greens, yellows, and reds represent areas of elevated rainfall. Areas of red and pink are above 3x the normal monthly rainfall.

MARCH

APRIL

MAY
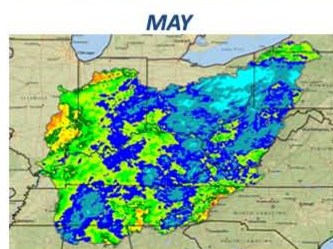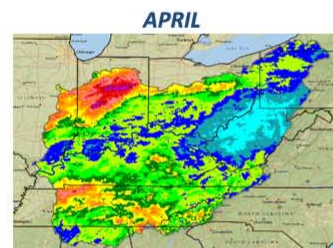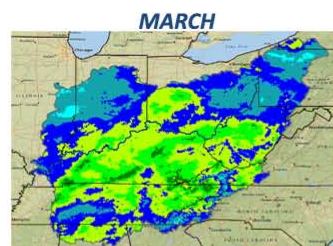
Above: Conditions experienced during summer sampling more closely resembled typical spring flow conditions
Below Left: Dashields Pool at the time of sampling
Map Key: Colored percent of normal monthly precipitation

Percent of Normal
- 5.000 - 25.00
- 25.01 - 50.00
- 50.01 - 75.00
- 75.01 - 100.0
- 100.1 - 125.0
- 125.1 - 150.0
- 150.1 - 175.0
- 175.1 - 200.0
- 200.1 - 225.0
- 225.1 - 250.0
- 250.1 - 275.0
- 275.1 - 300.0
- 300.1 - 325.0
- 325.1 - 350.0
- 350.1 - 375.0
- 375.1 - 400.0

JUNE

JULY

AUGUST

River-wide Catch Comparison (data from most recent survey year shown)

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '09	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '09	McAlpine '09	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '09
GAR	Longnose Gar	23	**19**	8	19	16	**64**	30	49	61	**25**	33	18	14	38	20	16	13	**11**	40
GAR	Spotted Gar																1	1	**2**	
GAR	Shortnose Gar													1	1		12	24	**28**	75
SHAD	Skipjack Herring		1				1		2		1		18	2	2	1	79		**2**	8
SHAD	Gizzard Shad	3417	**37**	4058	1097	5092	**43**	397	439	855	**176**	120	17703	185	394	709	10834	3039	**557**	325
SHAD	Threadfin Shad														1	7	1		**14**	3
CARP	Common Carp	48	**70**	44	19	36	**46**	40	36	43	**32**	12	9	28	12	4	7	16	**7**	51
CARP	Grass Carp																			3
CARP	Silver Carp																	12	**17**	6
CARP	Bighead Carp																			2
CARP	Goldfish																			
CARP	Carp x Goldfish	1																		
MINNOW	Cyprinidae sp.																		1	
MINNOW	Golden Shiner									1										
MINNOW	Striped Shiner			1	7					2										
MINNOW	Spottail Shiner			9	2			4			1							14		
MINNOW	Spotfin Shiner	77	**35**	35	21	62	**72**	63	159	66	**19**	65	26	1		39	39	37	**218**	12
MINNOW	Notropis sp.																			
MINNOW	Emerald Shiner	848	**46**	171	1525	892	**79**	948	637	134	**172**	1557	1837	165	61	2195	720	140	**86**	25
MINNOW	Silverband Shiner																			6
MINNOW	Sand Shiner								1											
MINNOW	Channel Shiner	492	**108**	159	685	481	**167**	532	795	178	**684**	944	689	33	30	2787	465	414	**102**	8
MINNOW	River Shiner												34	11	10	94	64	16	**8**	9
MINNOW	Shoal Chub																			
MINNOW	Silver Chub			32	2				32	2	1	12	24	338	39	79	22	2	**12**	25
MINNOW	Streamline Chub	11	**1**																	
MINNOW	River Chub											8								
MINNOW	Gravel Chub																			
MINNOW	Creek Chub																			
MINNOW	Central Stoneroller						**1**			2										
MINNOW	Mississippi Silvery																		15	1
MINNOW	Suckermouth Minnow													1						
MINNOW	Bluntnose Minnow	120	**1**	21	98	28	**98**	190	11	7		4	4		1	2	8			
MINNOW	Bullhead Minnow							2	1		**1**	25	25	8	1	36	13	14	**1**	19

River-wide Catch Comparison (data from most recent survey year shown)

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '09	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '09	McAlpine '09	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '09
	Silverjaw Minnow																			
SUCKER	Ictiobinae sp.																			
	Ictiobus sp.															1				
	Smallmouth Buffalo	51	**84**	79	68	58	**40**	50	75	42	**32**	25	44	109	95	23	10	58	**106**	76
	Bigmouth Buffalo			1												1		6	**4**	5
	Black Buffalo	1	**4**	3			**4**		1			1	1	1	1		2	9		7
	Carpiodes sp.				1				3											1
	Quillback	1	**13**	25	14	9	**14**	6	6	4	**12**	11	12	21	12	17	9	18	**31**	15
	River Carpsucker	8	**47**	28	23	36	**33**	16	12	21	**26**	55	172	85	85	363	146	43	**263**	218
	Highfin Carpsucker	5	**14**	14	5	1	**5**		1		**1**		8		17		2		**91**	
	Northern Hog Sucker	3		7	2	6	**6**		3		**2**	2	1	1	2					
	Moxostoma sp.						**3**				**1**	3				3				
	Shorthead Redhorse																			
	Smallmouth Redhorse	33	**153**	25	11	16	**54**	27	97	35	**22**	44	14	38	59	14	1	4		
	Silver Redhorse	75	**252**	132	70	23	**59**	12	55	4	**22**	19	19	3	38		1			
	River Redhorse	14	**65**	8		2	**12**	5	1	1	**6**	2			2					
	Black Redhorse	8	**10**	9		3	**16**		2											
	Golden Redhorse	56	**155**	282	216	93	**273**	63	115	31	**56**	34	44	213	182	2	10	11		1
	Spotted Sucker						**4**	4		3	**1**									
	White Sucker			1																
CATFISH	Yellow Bullhead							1		1										
	Brown Bullhead																			
	Northern Madtom																			
	Blue Catfish																		**5**	4
	Channel Catfish	35	**63**	17	201	54	**83**	91	89	79	**114**	295	70	111	79	287	223	103	**478**	165
	Flathead Catfish	19	**6**	12	15	47	**39**	17	27	29	**40**	37	24	23	11	32	14	19	**30**	15
SUNFISH	Lepomis sp.												1							
	Warmouth														2	1	1			
	Rock Bass	75	**89**	8	15	24	**64**	15	9	3		4			2					
	Bluegill	154	**34**	58	192	131	**523**	653	413	210	**254**	337	212	205	80	247	94	47	**270**	98
	Green Sunfish	3	**3**			3	**2**	1	8	3	**4**	3	2	9	3	7	3	4		2
	Pumpkinseed	4	**4**	2	2	2	**33**	25	1		**6**	2		1						1
	Orangespotted Sunfish			2			**5**	20	1	5		3	2					2	**1**	5
	Longear Sunfish	2	**1**		2	8	**242**	141	18	7	**56**	26	73	148	56	117	293	52	**207**	110

River-wide Catch Comparison (data from most recent survey year shown)

| Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '09	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '09	McAlpine '09	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '09
SUNFISH	Redear Sunfish		1				1	1	4	1	3	1		1	1	15	3		32	
	Lepomis Hybrid				1	2					2	1							2	
	Bluegill X Longear							1												
	Bluegill X Green																			
	Longear X Green													1						
TEMPERATE BASS	Morone sp.	50		26	22	110	12	54	35	191	15	55	289	42	62	54	361	21	86	31
	White Perch							1						1						7
	Striped Bass										1						4	1		
	White Bass	6	65	37	2		28	13	41	5	71	19	1	18	24	6	60	44	83	54
	Yellow Bass														2				15	104
	Hybrid Striped Bass	1	5				2	7	3	9	2	10	3	14	6	2	22	8	6	45
BLACK BASS	Micropterus sp.	57	1					2		3	9		79				3	3		
	Smallmouth Bass	167	250	210	155	431	270	155	45	47	38	47	30	32	5	27	33	4	2	10
	Largemouth Bass	8	3	8	2	8	7	50	72	58	18	38	21	25	9	32	72	2	10	23
	Spotted Bass	24	18	5	48	77	99	79	43	20	60	127	86	102	20	58	252	41	48	36
DARTER	Johnny Darter																			
	Greenside Darter			1		8	1													
	Variegate Darter																			
	Rainbow Darter					1			1											
	Fantail Darter																			
	Bluebreast Darter																			
	Banded Darter																			
	Dusky Darter	1																		
	Channel Darter	1			1		1							1	3					
	Blackside Darter																			
	Slenderhead Darter													1	1					
	River Darter						2		2					7						
	Logperch	29	15	47	17	40	89	17	48	6	5	1	2	23	2			1		1
PERCH	Yellow Perch				5		5	2	2											
	Walleye	20	74	21	2	2	10	6	4				2	2		1				1
	Saugeye	2	11				1	44	1					13			11	3	4	16
	Sauger	39	264	92	29	39	147	68	133	51	128	91	124	368	177	138	44	81	23	127
MISC.	Silver Lamprey																			
	Ohio Lamprey		2						1											

River-wide Catch Comparison (data from most recent survey year shown)

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '09	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '09	McAlpine '09	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '09
MISCELLANEOUS	Goldeye																	3	**1**	4
	Mooneye	10	**1**	7	11	2	**2**	6	4		**3**	4	6	9	10		4	1		1
	Paddlefish															1				1
	Northern Pike				1															
	Muskellunge		**1**																	
	White Crappie	2		1				1	3	2	**1**	7		2		21	2	6	**2**	13
	Black Crappie	1	**4**	1	1	1	**1**	5	2	5		4			4	7		6	**5**	3
	Inland Silverside																		**16**	
	Brook Silverside	14		1	11	10	**3**	2								5	5		**1**	
	Atlantic Needlefish																			5
	Trout-Perch		**11**						7	1										
	Banded Killifish						**5**	30		1										
	Western Mosquitofish																			1
	Bowfin											1								
	Freshwater Drum	55	**136**	84	201	239	**47**	172	33	206	**89**	329	686	509	171	520	507	103	**328**	236
Total No. of Individuals		6071	**2177**	5753	4849	8103	**2819**	4070	3583	2435	**2211**	4423	22416	2929	1804	7968	14480	4448	**3230**	2060
Total No. of Species		46	**38**	41	39	42	**48**	48	51	42	**33**	47	41	45	40	38	44	44	**36**	52

Look for our mobile 2,200 gallon educational aquarium displays filled with fishes from local areas at festivals and events along the Ohio River

To request a "Life Below the Waterline" display at your event, contact Ryan Argo (rargo@orsanco.org) for pricing and scheduling
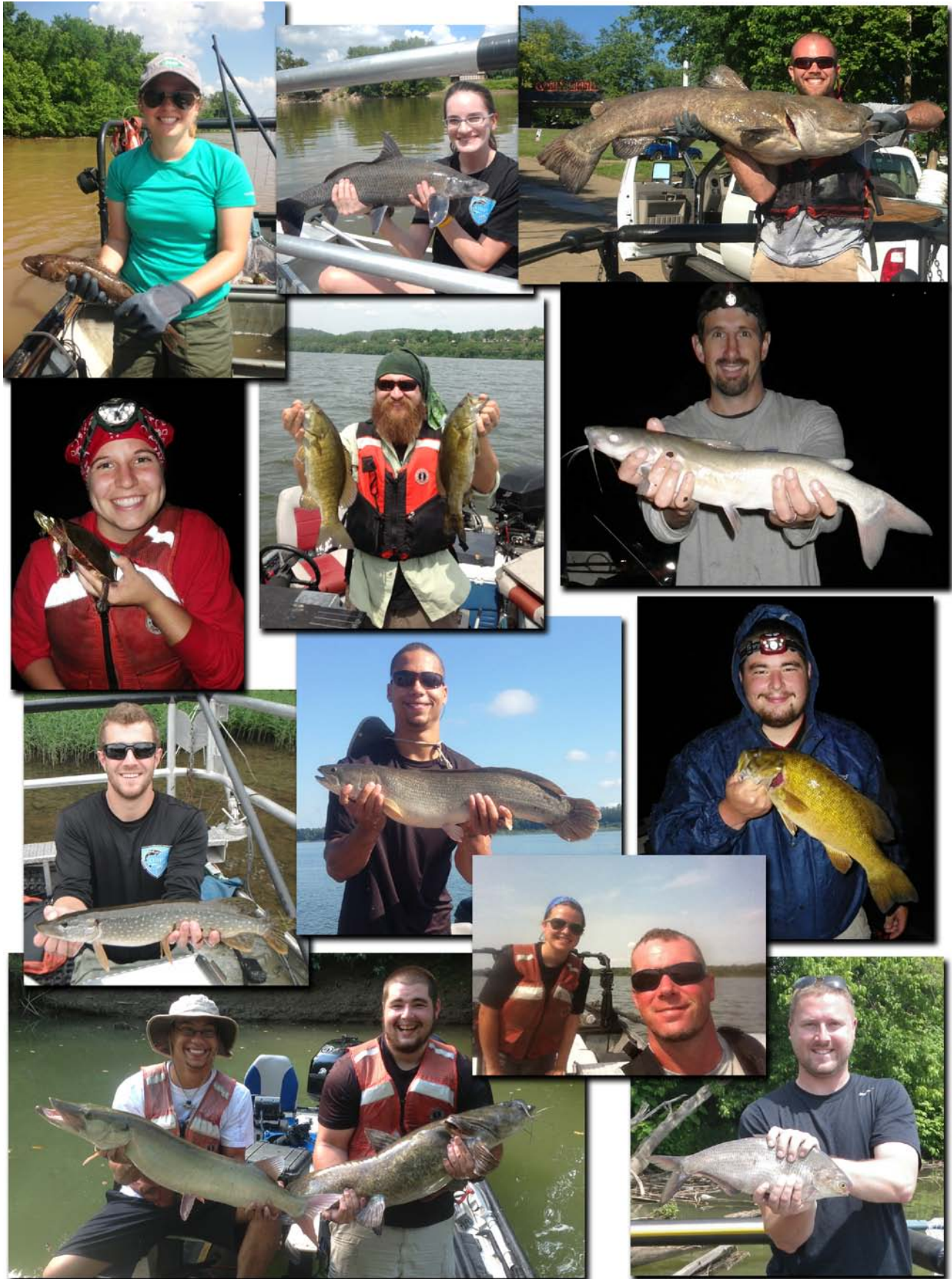
Our assessments would not be possible without the guidance of our committee and hard work of our seasonal interns and contractual employees. For information on our yearly internships, available to current and recently graduated students, contact Rob Tewes (*rtewes@orsanco.org*).