



2019 OHIO RIVER POOL ASSESSMENTS

R.C. BYRD AND SMITHLAND POOLS

ORSANCO Biological Programs
Ohio River Valley Water Sanitation Commission
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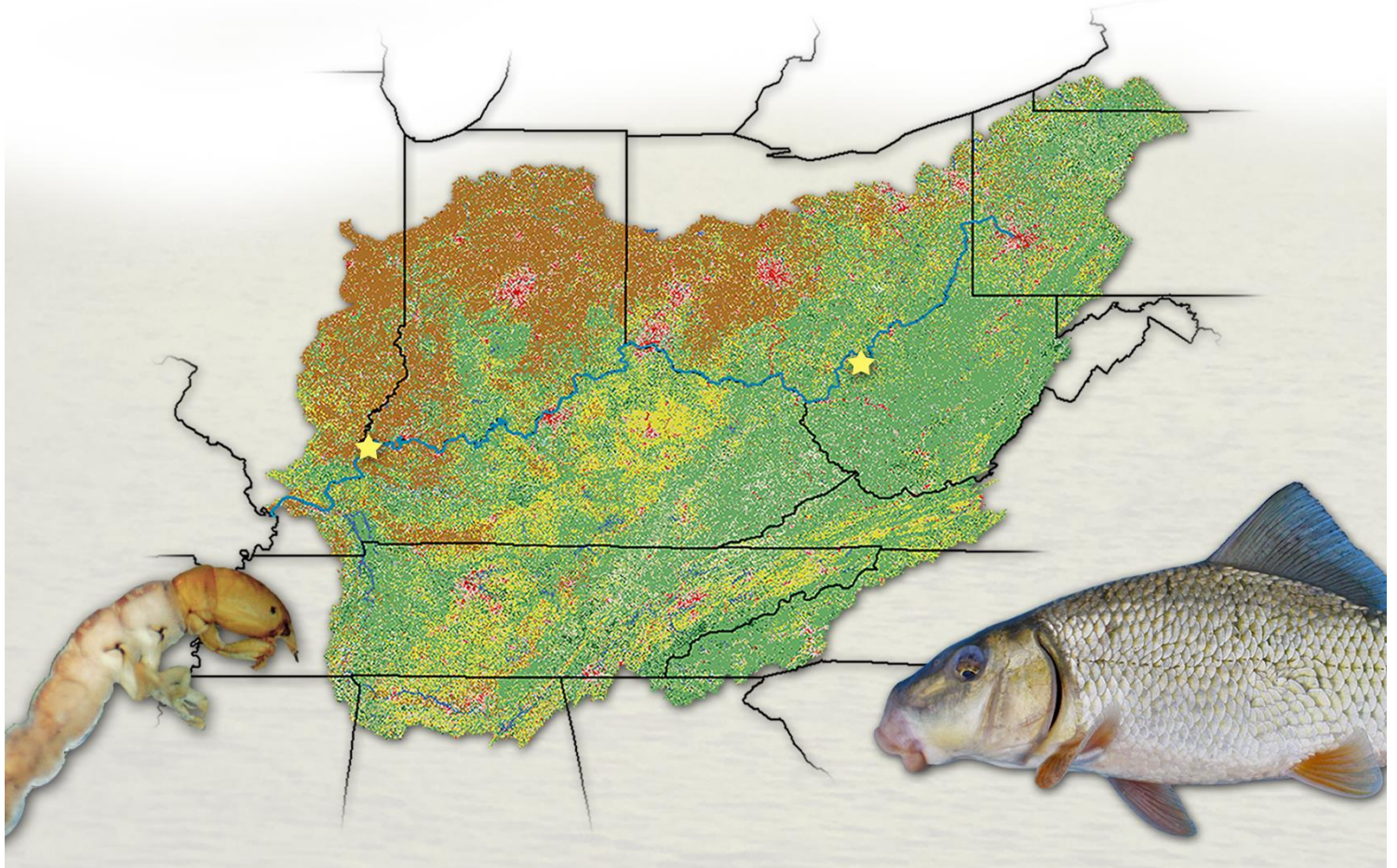


Table of Contents

Introduction	3
The River	4
Facts	4
Methods	5
Site Selection	5
Fish Collection	5
Collecting Macroinvertebrates	6
Characterizing Instream Habitat	7
Water Quality and Hydrology	7
Assessing Biological Condition	8
Survey Results	9
R.C. Byrd Pool	10
Smithland Pool	11
Conclusions	12
Pool Surveys	12
Assessment Comparisons	12
Past vs. Present Assessments	12
R.C. Byrd Pool (2008 - 2013 - 2019)	13
Smithland Pool (2008 - 2013 - 2019)	13
Macroinvertebrates	14
Acknowledgements	15
Life Below the Waterline	16
River Wide Catch Comparison Table	17



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 (ORFI_n) which was subsequently modified (*m*ORFI_n). Each year we collect fish and environmental data from various sections of the Ohio River and use these data to calculate *m*ORFI_n 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.

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

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

1957 - With the aid of multiple 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 ORFI_n

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 (ORFI_n) is created

2005 - We begin routine assessments, employing the ORFI_n 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 ORFI_n

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

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

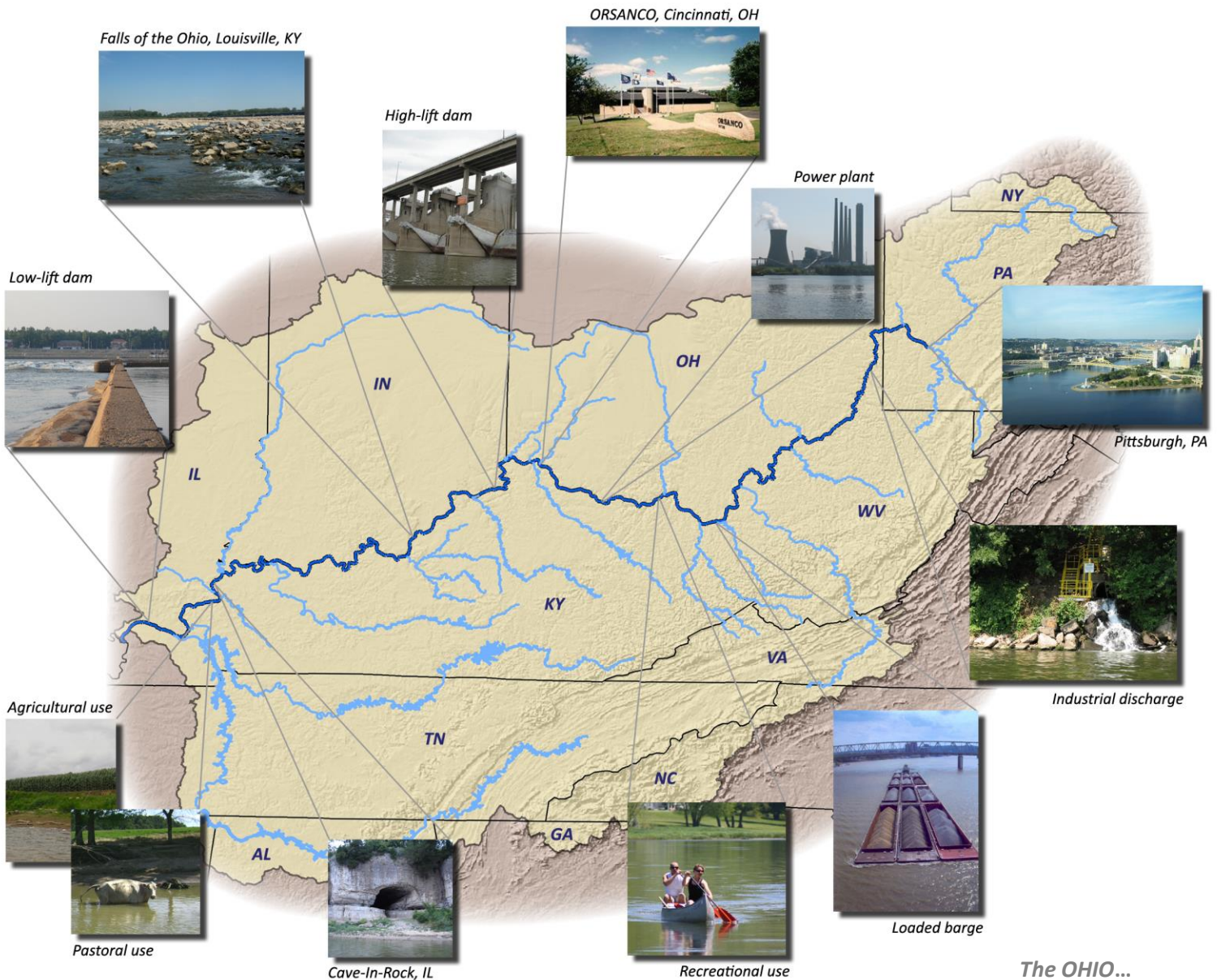
This report summarizes the 2019 R.C. Byrd and Smithland pool assessment survey findings.

The River

The Ohio River begins at the confluence of the Monongahela and Allegheny rivers in Pittsburgh, PA 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 mi²) 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 (Louisville, KY)
- ~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 ~8% of the nation (27 million people)
- 33 drinking water intakes provide drinking water for over 5 million people along the main stem
- 589 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



The OHIO...
Iroquoian for "great river"

Site Selection

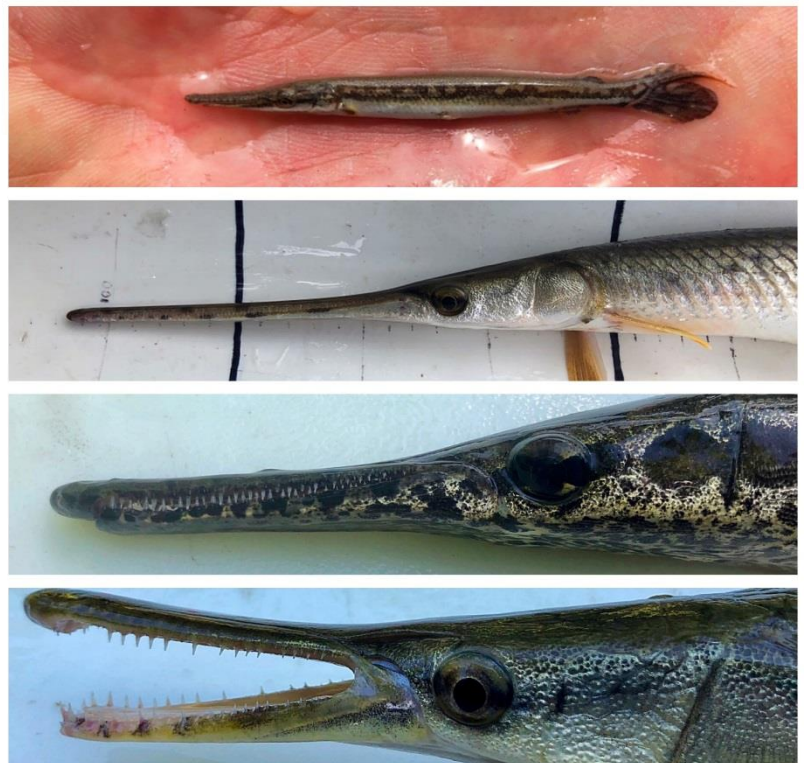
A random, probability-based survey design was used to select sampling site locations within each Ohio River navigational pool. The target areas of our surveys are both shorelines of each pool from the upstream dam to the downstream dam. The survey design provides coordinates for 15 sites (500m-long) 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.

Fish Collection

To maintain consistency across different sampling years, fish surveys are conducted between July 1st and October 31st and when water levels are within two feet of “normal flat pool”. 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 where 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 subsample of small fishes (i.e. less than 4cm) that cannot be confidently

identified in the field (e.g. minnows) are preserved and identified in the laboratory. All collected information is reviewed and imported into a database from which fish index scores are later generated.



Native Ohio River fishes. Left: Members of the genus *Lepomis*. Bluegill, Redear Sunfish, Orangespotted Sunfish, Warmouth, Longear Sunfish. Right: Members of the genus *Lepisosteus*. Juvenile Shortnose Gar, Longnose Gar, Spotted Gar, Shortnose Gar. Photos: ORSANCO

Collecting Macroinvertebrates

Macroinvertebrates (macros) are organisms that lack a true backbone and can be seen with the naked eye. They include aquatic insects, molluscs, arachnids, crustaceans and worms. They can range from large adult forms (e.g. crayfish), to very small larval forms of terrestrial insects (e.g. flies).

Two sampling methods are used to collect macroinvertebrates (macros): Hester-Dendy (HD) samplers and multi-habitat kicks (MH). HD samplers are constructed of tempered masonite cardboard cut into 3in square plates and 1in square spacers. Eight large plates and 12 spacers are stacked on a metal eyebolt to provide varying degrees of space for macro colonization. Five HDs are attached, in a ring, to a concrete paver. The paver is then placed on the river bottom in 10ft of water at the downstream end of each 500m sampling site and secured to the shore. Similar to the fish, macro sampling is restricted to a defined season within each year. HDs are deployed for six weeks, beginning September 1st allowing adequate time for macro colonization. After the six week colonization period, HDs are retrieved and MH kick surveys are conducted.



A MH kick is performed by actively disturbing the substrate and then sweeping a net through the resulting cloud. This technique allows the sampler to collect macros without compromising the sample with large amounts of sediment. To further exclude sediments, the net heads are “D” shaped (i.e. have flat bottoms), which also eases the scraping of woody debris and boulders. Samplers disturb/scrape 10 linear meters of substrate at each 100m interval of a site in depths 1m or shallower. At each of these intervals, every

attempt is made to sample available habitats (e.g. sand flats, woody debris, boulders, etc.) relative to the proportion of their availability. The kicks conducted at each 100m interval are then combined to represent the community present at the site.

Once the kicks are completed and the HDs have been retrieved, the samples are preserved. The HDs are disassembled in the field. The plates from the HDs and large debris from the MH samples are rinsed and drained through a 500µm sieve. The macros trapped by the sieve are then transferred to a preservative jar with 70% ethanol to be identified in a laboratory. At the lab, macros are identified to species level when possible; in all other cases the highest level of taxonomic resolution is obtained. The macro information is then reviewed and imported into a database from which index scores are generated, keeping HD and MH data separate.



METHODS

Characterizing Instream Habitat

Intensive habitat surveys are conducted which include measures of woody cover, depth, prevalence of substrate types at each electrofishing site. Woody cover (e.g. submerged brush, logs, 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 *mORFIn* 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).

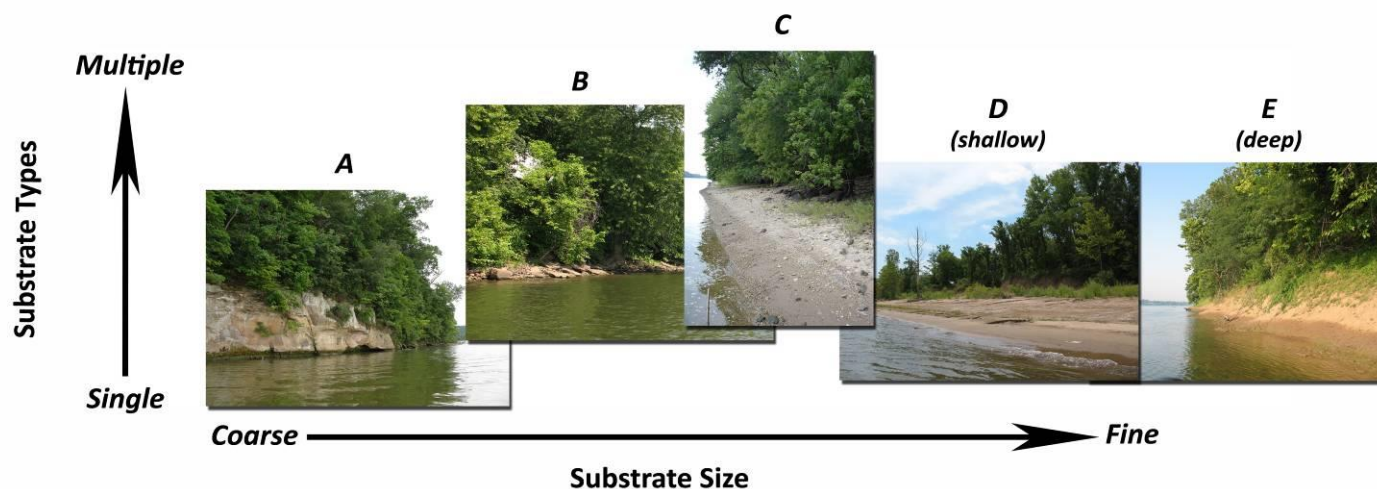


Water Quality and Hydrology

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

ORSANCO uses two biological indices to assess the condition of the Ohio River. The modified Ohio River Fish Index (*mORFI*n) and the Ohio River Macroinvertebrate Index (*ORMI*n using HD data only) were established in 2003 and 2012, respectively. Both indices include various measures (metrics) of the fish and macro communities such as: diversity, abundance, feeding and reproductive guilds, pollution tolerance, habits, health.

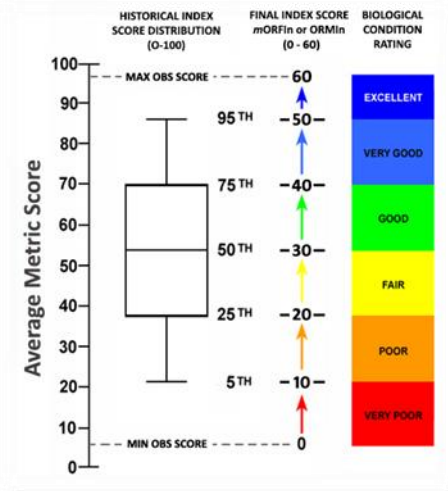
13 metrics used to generate *mORFI*n scores

Fish Metric	Definition
Native Species	Number (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, 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. <i>DELT</i> anomalies	No. of ind. with Deformities, Erosions, Lesions, Tumors present
Catch per unit effort (<i>CPUE</i>)	Total abundance of ind. (minus exotics, hybrids, tolerants)

8 metrics used to generate *ORMI*n scores

Macro Metric	Definition
No. Taxa	Number (No.) of unique taxa
EPT Taxa	No. of taxa that belong to are either the Ephemeroptera, Plecoptera, or Trichoptera orders
Predator Taxa	No. of taxa that are predators
% Collector-Gatherer Taxa	% of taxa that feed on fine particulate organic matter
% Caenids	% of individuals (ind.) that belong to the pollution tolerant <i>Caenidae</i> family of Ephemeropterans
% Odonates	% of ind. that belong to the Odonata order
% Intolerants	% of ind. intolerant to pollution and habitat degradation
% Clingers	% of ind. that cling to instream habitat

Each navigational pool is separately assessed with each index based upon the biological and environmental data collected from its 15 randomly selected sites. This involves a multi-step approach (depicted top right) that converts average metric scores (0-100) of each individual site into final index scores (0-60), based on varying expectations of the five different habitat classes. Index scores of the 15 sites are then averaged to provide an overall score and rating for the navigational pool specific to each index.



The presence of five distinct habitat classes A, B, C, D and E, coupled with the range of habitat preferences exhibited by individual fish and macro taxa required the translation of metric scores into relative index scores. By removing the effect of habitat, index scores can then be averaged within a pool to represent the overall condition of the biological community in question.

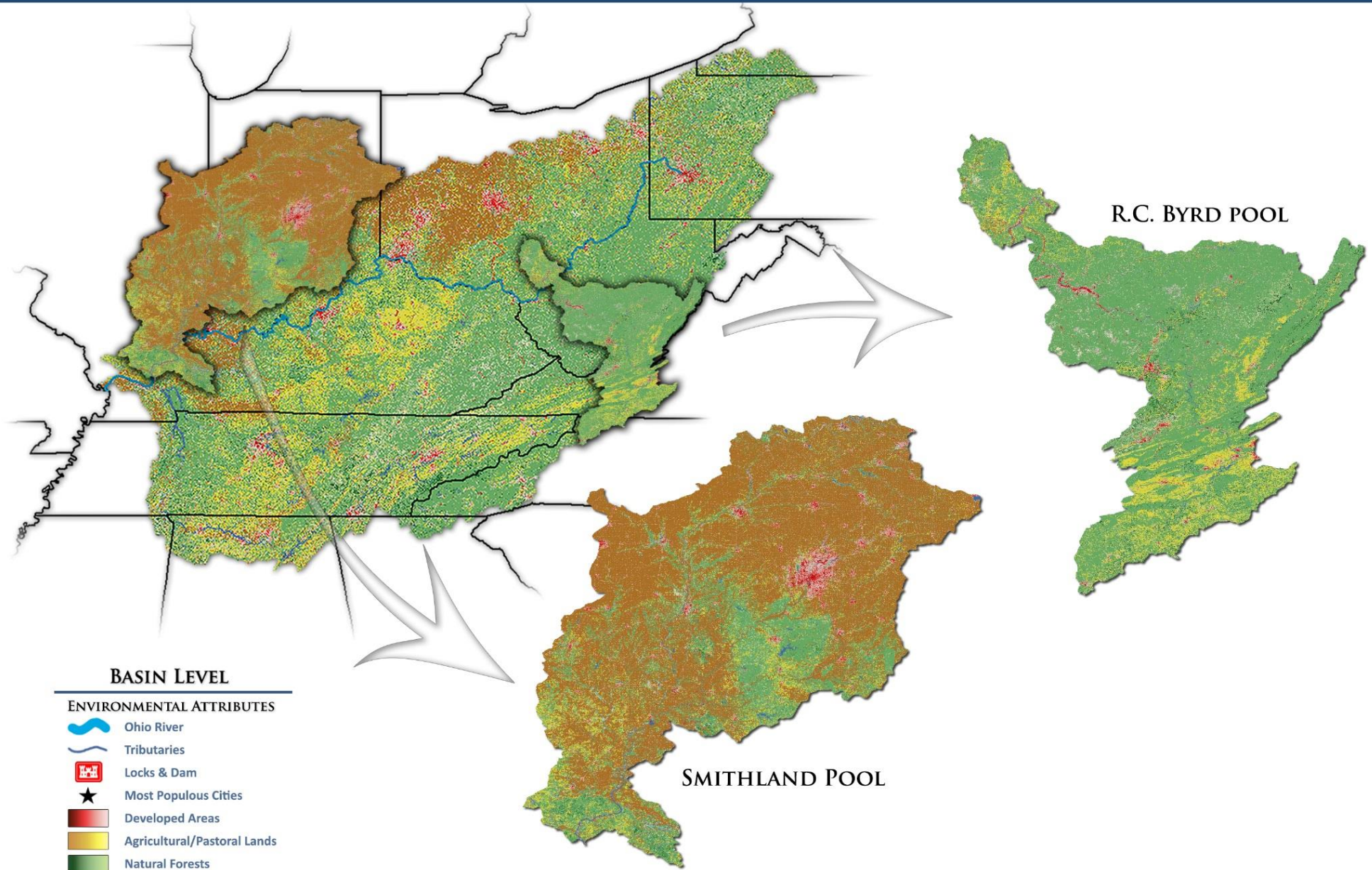
The averaged scores for both the *mORFI*n and *ORMI*n are then compared to a biocriterion. The 25th percentile is the statistical threshold commonly used by regulatory agencies for establishing biocriteria. Using this threshold, our established biocriterion (i.e. a representation of healthy Ohio River fish communities) is set at an average index score of 20.0.

A pool is assessed to be in **full support** of its aquatic life-use (ALU) designation (i.e. possessing intact biological communities) if both the *mORFI*n and *ORMI*n scores are greater than or equal to 20.0 (i.e. a biological rating “Fair”, “Good”, “Very Good”, or “Excellent”). A pool is in **partial support** of its ALU designation if only one of the indices’ scores greater than or equal to 20.0, while the other index score falls within 10.0 - 19.9 (i.e. a “Poor” rating). Any pool in which both indices score below a 20.0, or in which at least one index scores below 10.0 (i.e. a “Very Poor” rating), would be considered in **non-support** of its ALU designation.

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

2019 POOL SURVEY RESULTS

The results of the 2019 biological surveys are detailed in the following pages (relative pool locations shown below). Included are brief descriptions of the land use & hydrology, site level mORFIn & ORMIn ratings, summaries of notable catches & instream habitat, and the overall biological condition of each pool.



For more detailed catch, metric, and index scores visit www.orsanco.org/programs/biological-programs

R.C. BYRD POOL (2019) - HEALTHY CONDITION

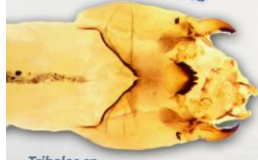
DOMINANT MACRO GROUPS

MUSSELS 46.8%



Dreissena polymorpha

MIDGES 9.06%



Tribelos sp

MIDGES 7.93%



Dicrotendipes sp

CADDISFLIES 5.92%



Cynellus fraterus

SCUDS 4.62%



Gammarus sp

BOULDER 1.1%



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COBBLE 1.7%

GRAVEL 13.5%

SAND 27.5%

FINES 32.7%

HARDPAN 20%

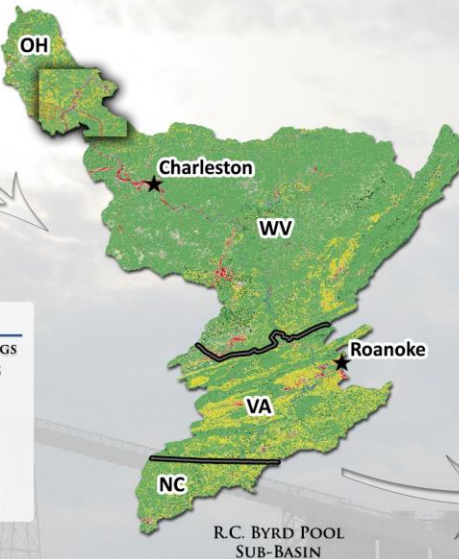
OTHER 3.6%

POOL SUBSTRATE COMPOSITION

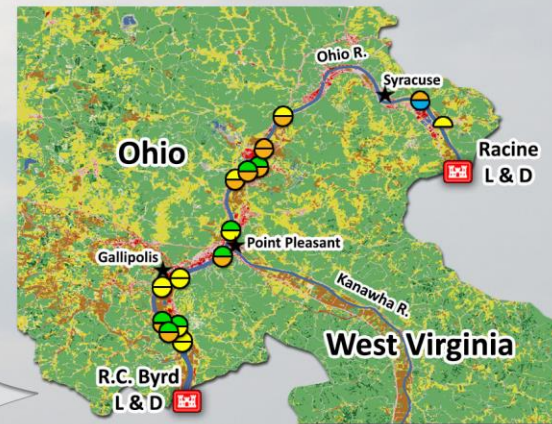
R.C. Byrd pool is 41.7 miles long, extending from Racine Locks and Dam (ORM 237.5) to R.C. Byrd (formerly Gallipolis) Locks and Dam (ORM 279.2). The pool has a gradient drop of 0.6 feet per mile and averages 1,154 feet wide and 26 feet deep (ORSANCO 1994). The pool is bordered by West Virginia and Ohio. 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 its waters 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 waters from Leading Creek and Raccoon Creek with drainage areas of 151 and 684 square miles respectively. While *Hydrilla sp.* was not observed in site-specific vegetation surveys, evidence of *Hydrilla sp.* was present throughout the pool. These combined watersheds are primarily forested, but also have a considerable amount of agricultural/pastoral land.



OHIO RIVER BASIN



R.C. BYRD POOL SUB-BASIN



R.C. BYRD POOL

BASIN LEVEL	SITE LEVEL	
ENVIRONMENTAL ATTRIBUTES	FISH	MACROS
Ohio River	Excellent	Excellent
Tributaries	Very Good	Very Good
Locks & Dam	Good	Good
Most Populous Cities	Fair	Fair
Developed Areas	Poor	Poor
Agricultural/Pastoral Lands	Very Poor	Very Poor
Natural Forests		

AQUATIC INVASIVES WATCH



Silver Chub



Bighead Carp



Asian Clams



Zebra Mussels



Marine Scuds



Hydrilla

SURVEY SUMMARY

The pool was sampled at normal conditions during the defined index period (July-Oct). Sampling commenced two weeks after stage returned to normal conditions following months of heavy rainfall patterns. Moderate flow was observed during the two weeks of fish sampling. Notable catches include two species of concern in West Virginia, the great river species Silver Chub (*Macrhybopsis storeriana*; 22 individuals collected pool-wide at 5 of 15 sites), and Black Buffalo (*Ictiobus niger*; 8 individuals collected pool-wide), which was not observed in the previous two surveys of R.C. Byrd Pool. Notable macroinvertebrate collections from R.C. Byrd Pool include large numbers of invasive mussels (*Dreissena polymorpha*) and several tolerant species (Midges-Tribelos sp. and *Dicrotendipes sp.*, Caddisflies- *Cynellus fraterus*, and Scuds-*Gammarus sp.*). Rare, intolerant species were observed in low numbers (Midges-*Stempellina sp.* and *Ablabesmyia annulata*, and Riffle Beetles- *Optioservus sp.*). Independent biological indices were used to apply numeric values to important components of fish and macro assemblages and to assess their relative status. The results (see above map) show that, on average, fish populations in R.C. Byrd Pool were in 'Fair' condition and macro communities were in 'Fair' condition. Overall, these results indicate that R.C. Byrd Pool supports its aquatic life use.

DOMINANT FISH FAMILIES

MINNOWS 60.5%



Channel Shiner

DRUM 14.2%



Freshwater Drum

SUNFISH & BASS 6.0%



Smallmouth Bass

CATFISH 4.9%



Channel Catfish

SUCKERS 4.9%



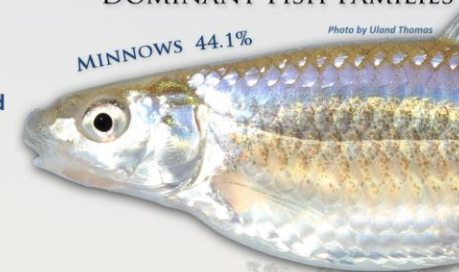
River Carpsucker

DOMINANT MACRO GROUPS

SMITHLAND POOL (2019) - HEALTHY CONDITION

DOMINANT FISH FAMILIES

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 Kentucky, Illinois, and Indiana. Smithland Pool lies in a portion of the Ohio River where the land cover consists primarily of deciduous forest, but also has a considerable amount of row crops and pasture lands. 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 contain very little observable aquatic vegetation within littoral zones.



Mississippi Silvery Minnow



Freshwater Drum



Channel Catfish



Gizzard Shad



River Carpsucker



BASIN LEVEL	SITE LEVEL
ENVIRONMENTAL ATTRIBUTES	BIOLOGICAL CONDITION RATINGS
Ohio River	FISH
Tributaries	MACROS
Locks & Dam	Excellent
Most Populous Cities	Very Good
Developed Areas	Good
Agricultural/Pastoral Lands	Fair
Natural Forests	Poor
	Very Poor

AQUATIC INVASIVES WATCH



SURVEY SUMMARY

Electrofishing sampling took place over one week in early September, which is unusually late in the index period (July-Oct). Sampling efforts were delayed due to heavy rainfall patterns throughout the spring and summer, though conditions were favorable at the time of sampling. Notable catches include the great river species Mississippi Silvery Minnow (*Hybognathus nuchalis*; 728 individuals collected) and Black Buffalo (*Ictiobus niger*; "species of concern" in KY). Independent biological indices were used to apply numeric values to important components of fish and macro assemblages and assess their relative status. The results (see above map) show that, on average, fish populations in Smithland Pool were in 'Good' condition. While macroinvertebrate collections were successfully completed, the resulting data did not meet quality control standards for application of the macroinvertebrate index (macro results are therefore not displayed). ORSANCO protocols allow for assessment of pools when only one of the two biological indices can be applied. The 2019 fish results from Smithland Pool indicate that it harbored a healthy aquatic community.



CONCLUSIONS

Pool Surveys

The fish assessment portion of the 2019 pool surveys was successfully completed later in the year than usual due to heavy rainfall patterns during spring and summer. Fish sampling took place from Aug. 5th-14th (R.C. Byrd) and Sept. 9th-12th (Smithland). While long periods of high flow events prior to sampling were observed, stage was allowed to return to normal levels prior to electrofishing commencement. Conditions allowed for adequate sampling of fish and macroinvertebrates during the index period. The macroinvertebrate assessments for both pools were completed between September 2nd and October 24th. R.C. Byrd Pool was assessed as *meeting* its aquatic life-use designation for both fish and macroinvertebrates (i.e. containing healthy fish and macroinvertebrate communities). Smithland Pool was assessed as *meeting* its aquatic life-use designation for fish, while the pool's macroinvertebrate community remained unassessed in 2019 as those data did not pass quality assurance/quality control (QA/QC) requirements. Therefore the 2019 assessment was completed using fish only.

Assessment Comparisons

Between 2005 and 2014, all 19 Ohio River navigational pools were surveyed and assessed twice. Both cycles revealed the majority of the river to be in 'Good' condition, even though some pools changed in condition rating between surveys. The 2019 surveys continued the third cycle, which enhances our ability to

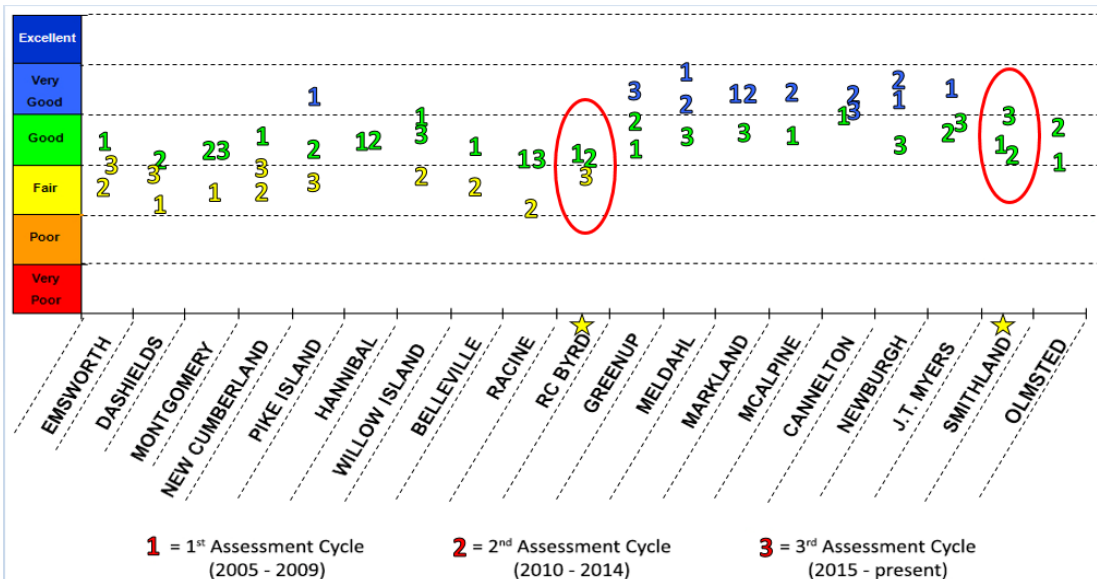
detect riverwide patterns. Some of the index and species variability observed across pools may be due in part to variations in natural distributions, instream habitat, invasive species distributions, annual variations in flow, weather conditions, and water quality.

Present vs. Past Assessments

The focus of ORSANCO's biological assessments is to determine whether each pool is in full support, partial support, or non-support of its ALU. To aid in interpretation, we assign one of six ratings (e.g. 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. By examining these factors (e.g. invasive species, flows, etc.) and their effects on *mORFIn* metrics, we attempt to provide defensible explanations for the differences in final condition ratings observed between assessments.



Muskellunge (*Esox masquinongy*) mobile aquarium Marietta, OH
Photo: ORSANCO



CONCLUSIONS

R.C. Byrd Pool

(Fish = FAIR, Macros = FAIR)

Variable	2008	2013	2019
<i>Environmental Factors</i>			
Avg. Seasonal Flow			Moderate
Avg. Conductivity	453.2	310.0	362.5
Avg. Secchi Depth	39.3	27.0	35.2
<i>Avg. % Simple Lithophil Score</i>	70.1	18.3	6.0
Sauger	259	128	42
Logperch	72	5	4
<i>Avg. % Piscivore Score</i>	81.2	32.8	11.8
Sauger	259	128	42
Largemouth Bass	25	18	1
<i>Avg. % Sucker Score</i>	31.8	45.4	21.0
Golden Redhorse	33	56	11
Silver Redhorse	11	22	4
Smallmouth Buffalo	40	32	18
<i>Avg. % Invertivore Score</i>	17.5	66.9	73.8
Channel Shiner	1	684	917
<i>Assessment Results</i>			
<i>Avg. mORFin Score</i>	31.8	30.8	26.9
Fish Condition Rating	Good	Good	Fair

R.C. Byrd pool was assessed to be in “Fair” condition in 2019. This is a condition rating lower than what was observed from the 2008 and 2013 assessments. The 15 randomly drawn sites were evenly distributed throughout the pool with 8 sites above and 7 sites below the confluence of the Kanawha River. Environmental factors such as flow, conductivity, and secchi depth were all quite comparable over the last three assessments. The primary influential factors responsible for the decline of the biological condition rating was a combination of the *Avg. % Simple Lithophil* score and the *Avg. % Piscivore* score. While there were several species that showed decline from previous assessments, these scores were most drastically affected by fewer observations of Sauger, Logperch, and Largemouth Bass. In review of the last three surveys of R.C. Byrd Pool (2008, 2013, 2019), the 2019 survey revealed the lowest number of observations of Gizzard Shad, Bluegill, White Bass, Spotted Bass, Flathead Catfish, and several species of redhorse. Overall scores were affected positively by the *Avg. % Invertivore* score, which was likely inflated by a large catch of Channel Shiners not observed in previous assessments. While *Hydrilla sp.* was not observed in site specific vegetation surveys, evidence of *Hydrilla sp.* was present throughout pool. Further investigation is necessary to confirm that *Hydrilla sp.* is a major contributing factor to the steady decline of mORFin scores in the upper Ohio River.

Smithland Pool

(Fish = Good, Macros = UNASSESSED)

Variable	2008	2013	2019
<i>Environmental Factors</i>			
Avg. Seasonal Flow			Low
Avg. Conductivity	499.6	315.9	482.8
Avg. Secchi Depth	29.7	19.0	21.6
<i>Avg. Great River Score</i>	48.7	62.2	88.9
Mississippi Silvery Minnow	0	15	728
River Shiner	2	8	57
<i>Avg. Centrarchid Score</i>	41.0	48.9	28.9
Longear Sunfish	92	207	7
Largemouth Bass	21	10	0
<i>Avg. CPUE Score</i>	37.1	41.7	43.5
Total Fish	2636	3230	3735
<i>Avg. Species Score</i>	60.4	63.6	65.4
Number of Species			
<i>Avg. DELT Score</i>	88.5	93.3	100
<i>Assessment Results</i>			
<i>Avg. mORFin Score</i>	33.6	31.2	39.2
Fish Condition Rating	Good	Good	Good

Smithland Pool was assessed to be in “Good” condition in 2019. While the condition rating has remained the same over the last three assessments, the best score was observed in 2019, less than one point shy of being upgraded to “Very Good”. The 15 randomly drawn sites were distributed throughout the pool, however there were six in the upper half and nine in the lower half of the pool. Conductivity and average Secchi depth did not appear to have a significant effect on assessment outcomes. Metric performance revealed a boom in great river species, specifically Mississippi Silvery Minnows, River Shiners, Silver Chubs, and Shortnose Gar. Habitat observations in Smithland Pool were sand dominated with fine sediment being the second most abundant substrate type. Fish health appears to be improving in Smithland Pool. *Avg. DELT* score reflects the number of deformities, erosions, lesions, and tumors observed while identifying and measuring fish at the 15 sites throughout the pool.



Shortnose Gar (*Lepisosteus platostomus*)

CONCLUSIONS

Macroinvertebrates

As per ORSANCO's Biological Assessment protocol, a required minimum of 15 fish samples and/or 10 macro samples must be collected in each pool in order to derive a viable assessment. The 10 macro samples must be comprised of deep Hester-Dendy samplers and/or multihabitat kick samples. Multihabitat kick samples will only be used when deep Hester-Dendy samples are lost, unrecoverable, or otherwise disturbed, provided the multihabitat kick samples contain at least 200 individuals. Minimum sample number criteria (15 fish and 10 macro respectively) are standardized and necessary to ensure comparability between assessments.

Macroinvertebrate collections in R.C. Byrd Pool met the minimum number of samples in 2019. A total of 14 of 15 deep Hester Dendy samplers were recovered at the end of the colonization period. A multihabitat kick sample was collected at each site.

The Ohio River Macroinvertebrate Index (ORMIn) indicates that the macro community in R.C. Byrd Pool is in "fair" condition, the average ORMIn score of the 15 probabilistic sites sampled in 2019 is 22.39. Large numbers of tolerant macro species (midges-*Tribelos sp.* and *Dicrotendipes sp.*, caddisflies-*Cyrnellus fraternus*) and invasive zebra mussels (*Dreissena polymorpha*) were observed. Notably, rare, intolerant species (midges-*Stempellina sp.* and *Ablabesmyia annulata*, and riffle beetles-*Optioservus sp.*) were observed in low numbers. Both fish and macro communities indicate that R.C. Byrd met its ALU designation for this assessment cycle.

Smithland Pool macroinvertebrate data did not meet QA/QC requirements, therefore a proper assessment could not be performed using the ORMIn. As such the pool was not assessed using macro data in 2019. However, based on the fish data and the results calculated using the *mORMIn*, the pool met its ALU designation for this assessment cycle.



Select Ohio River Macroinvertebrates

Left: non-biting midge (*Tribelos fuscicorne*), Top Middle: long-horned caddisflies (*Oecetis sp.*), Top Right: scud (*Gammarus fasciatus*)
Bottom Middle: burrowing mayfly (*Hexagenia limbata*), Bottom Right: black-shouldered spinyleg dragonfly (*Dromogomphus spinosus*)



Our assessments would not be possible without the guidance of our committee and hard work of our Seasonal Biologists. For information on seasonal employment opportunities available to recent graduates, contact Rob Tewes (rtewes@orsanco.org).

*Look for our mobile 2,200 gallon
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River-wide Catch Comparison (data from most recent survey year shown)

Group	Species (common name)	Emsworth '18	Dashields '13	Montgomery '15	New Cumberland '17	Pike Island '18	Hannibal '13	Willow Island '16	Belleville '14	Racine '15	Robert C. Byrd '19	Greenup '16	Meldahl '17	Markland '14	McAlpine '14	Cannelton '16	Newburgh '17	John T. Myers '15	Smithland '19	Open Water '14
GAR	Longnose Gar	18	19	11	31	54	64	34	28	64	19	42	59	28	24	50	30	16	30	61
	Spotted Gar															1			11	
	Shortnose Gar												1				12	12	27	101
SHAD	Skipjack Herring		1				1	2							1	2	3	5	2	1
	Gizzard Shad	6	37	26	83	37	43	154	117	147	54	158	591	274	54	378	216	650	395	278
	Threadfin Shad																		14	74
CARP	Common Carp	12	70	45	75	16	46	11	26	3	2	7	13	5	4	3	4	8	13	2
	Grass Carp								1								2			1
	Silver Carp														1	3		15	12	25
	Bighead Carp																			
	Goldfish								1		1							1		
	Carp x Goldfish																			
MINNOW	Cyprinidae sp.																			
	Golden Shiner								1											1
	Striped Shiner				2								11		5					
	Spottail Shiner			4				11	2	4		2			3					
	Spotfin Shiner	76	35	68	165	61	72	295	58	127	60	52	19	10	28	73	8	112	2	14
	Notropis sp.										1									
	Emerald Shiner	238	46	216	357	75	79	1085	240	1208	206	221	423	470	227	407	195	102	508	20
	Silverband Shiner																			
	Sand Shiner					70														
	Channel Shiner	1071	108	323	845	484	167	1173	410	733	917	2017	872	897	609	1822	426	255	261	47
	River Shiner	1			42				5			16	69	156	30	145	47	104	57	15
	Shoal Chub																			
	Silver Chub	1							1		22	11	38	33	51	32	10	10	51	10
	Streamline Chub	6	1			5														
	River Chub																			
	Gravel Chub																			
	Creek Chub											1								
	Central Stoneroller					2	1	9					1	1	3					
	Mississippi Silvery																		728	
	Suckermouth Minnow																			
	Bluntnose Minnow	10	1	30	224	33	98	227	8	12	2	2	3	4	2		12	9	1	2
	Bullhead Minnow				0			12	5		4	17	14	2	1	11	13	24	13	6
	Silverjaw Minnow																			

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

SUCKER	Ictiobinae sp.																1			
	Ictiobus sp.																			
	Smallmouth Buffalo	22	84	82	37	42	40	26	38	33	18	19	45	89	31	17	11	32	66	32
	Bigmouth Buffalo											1					1	4	2	5
	Black Buffalo	5	4	18	13	13	4	3	7		8	3	14	5	4	2		2	5	10
	Carpiodes sp.								1					1		1				1
	Quillback	2	13	6	13	3	14	9	7	3		3	28	61	9	3	3	7	23	5
	River Carpsucker	4	47	47	15	5	33	18	33	20	38	38	151	221	161	19	48	187	73	139
	Highfin Carpsucker		14	12			5		3	8	1	6	6	4	4			3		3
	Northern Hog Sucker	7		6	16	4	6	8	1	5	1	1			6					
	Moxostoma sp.				22		3													
	Shorthead Redhorse																		9	10
	Smallmouth Redhorse	48	153	27	3	27	54	41	61	11	17	38	114	44	31	40	13			
	Silver Redhorse	131	252	215	122	26	59	42	31	16	4	39	31	19	14	5	2			
	River Redhorse	12	65	23	6	5	12	1		2		25	4		1	4				
	Black Redhorse	5	10	25	27	4	16	6												
	Golden Redhorse	34	155	156	442	116	273	219	64	56	11	124	112	26	67	17	25	8	4	1
	Spotted Sucker						4	13	8	1		2	1	1	1					
	White Sucker																			
CATFISH	Yellow Bullhead														1					
	Brown Bullhead																			
	Northern Madtom																			
	Blue Catfish													2		4		1	3	
	Channel Catfish	9	63	83	59	45	83	35	177	52	73	61	98	112	122	46	68	106	423	65
	Flathead Catfish	8	6	8	9	10	39	22	36	24	25	29	26	21	19	10	19	20	11	12
SUNFISH	Lepomis sp.													2	2					5
	Warmouth														3					
	Rock Bass	31	89	22	238	35	64	11	2											
	Bluegill	20	34	88	215	138	523	540	391	220	35	205	73	207	89	65	32	65	45	41
	Green Sunfish	3	3	1	3	2	2	1	1	4	10	2	2	1	1	2	2	1	2	4
	Pumpkinseed		4	3	54	6	33	14		2										
	Orangespotted Sunfish						5	197		5		5	13			2	2	6	2	
	Longear Sunfish		1		1	20	242	18	24	13	6	15	17	71	65	31	32	137	7	16
SUNFISH	Redear Sunfish		1					2	7	2		4	2	2	1	20	8	1	5	
	Lepomis Hybrid				3	1	2		1					1						
	Bluegill X Longear																			
	Bluegill X Green									1										
	Longear X Green																			
TEMPERATE BASS	Morone sp.			3		1	12	49	79	8	35	35	25	11	81	28	37	72	15	733
	White Perch																2			
	Striped Bass								1				3				4			
	White Bass	3	65	7	3		28	4	16	1	13	16	59	18	18	20	43	13	125	34

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

BLACK BASS	Yellow Bass															1			12	25
	Hybrid Striped Bass		5	2			2		3	1	17	6	16	3	1	13	6	2	9	10
	Micropterus sp.	2	1		4	3		5			1		21	10	18	12	3	14		16
	Smallmouth Bass	229	250	184	241	169	270	198	27	41	50	24	55	19	15	13	11	2	1	7
	Largemouth Bass	3	3	12	16	17	7	20	10	19	1	18	6	12	10	4		2		6
DARTER	Spotted Bass	7	18	6	28	25	99	46	26	17	16	59	46	51	38	48	50	133	15	26
	Johnny Darter			1																
	Greenside Darter					1	1													
	Variegate Darter																			
	Rainbow Darter			2				1							1					
	Fantail Darter													1	1					
	Bluebreast Darter																			
	Banded Darter																			
	Dusky Darter																		1	
	Channel Darter				1		1	1	1			1								
	Blackside Darter																			
	Slenderhead Darter																			
	River Darter						2							1						
	Logperch	59	15	26	15	35	89	73	5	9	4	16	4	14	9	2		2	3	2
PERCH	Yellow Perch	1		44	15	9	5	7	3		1									
	Walleye	26	74	68	29	9	10	1	13	1			1		1		7	5		
	Saugeye		11	42	1	1	1		25	25	5		14	22	8	2	23	4	33	6
	Sauger	13	264	110	110	31	147	73	89	15	42	194	58	116	226	94	52	225	38	46
MISC.	Silver Lamprey	1										1								
	Ohio Lamprey		2						1											
MISCELLANEOUS	Goldeye														1			10	5	
	Mooneye	2	1	26	11	3	2	2			2	2		5	1	5	4	1		1
	Paddlefish																1			
	Northern Pike	1																		
	Muskellunge	4	1																	
	White Crappie				2			1	4	2		6	2	4	1	3	3	7	1	1
	Black Crappie	1	4	9	8		1	4	6	6	2	6	10	2			2	7	1	
	Inland Silverside																			14
	Brook Silverside				4		3	1			1				1		2	1	1	
	Atlantic Needlefish																			
	Trout-Perch	9	11	137	21	14			2											
	Banded Killifish				10	1	5	14	1											
	Western Mosquitofish																	1		
	Bowfin																			
	Freshwater Drum	17	136	36	34	8	47	16	82	36	285	116	158	146	238	47	157	114	656	746
Total No. of Individuals		2158	2177	2260	6071	1666	2819	4755	2190	2957	2211	3666	3329	3205	2344	3507	1652	2518	3230	2680
Total No. of Species		41	43	42	40	43	50	49	52	40	41	45	45	46	53	43	45	47	43	46

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