2019 Ohio River Pool Assessments

R.C. Byrd and Smithland Pools

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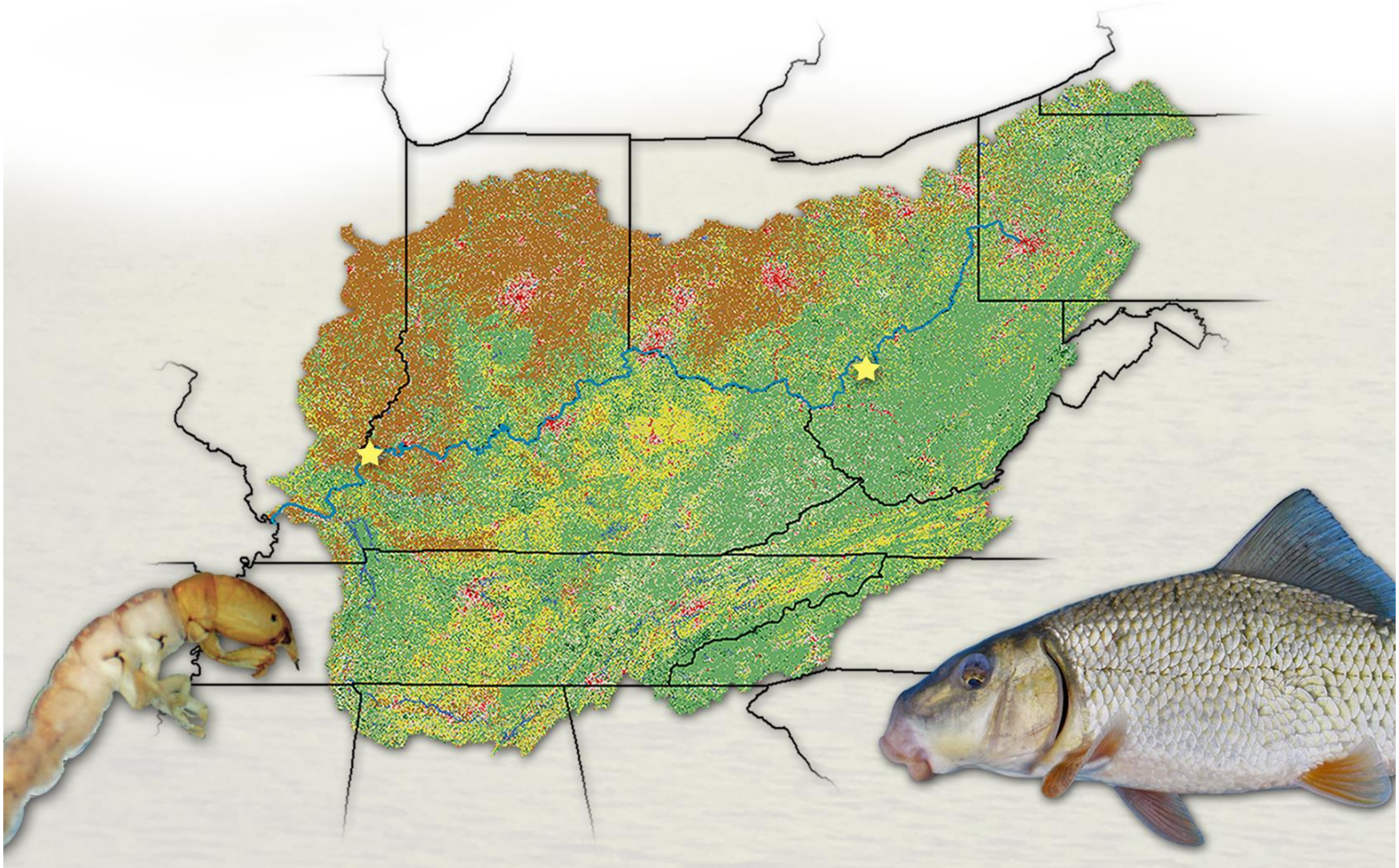

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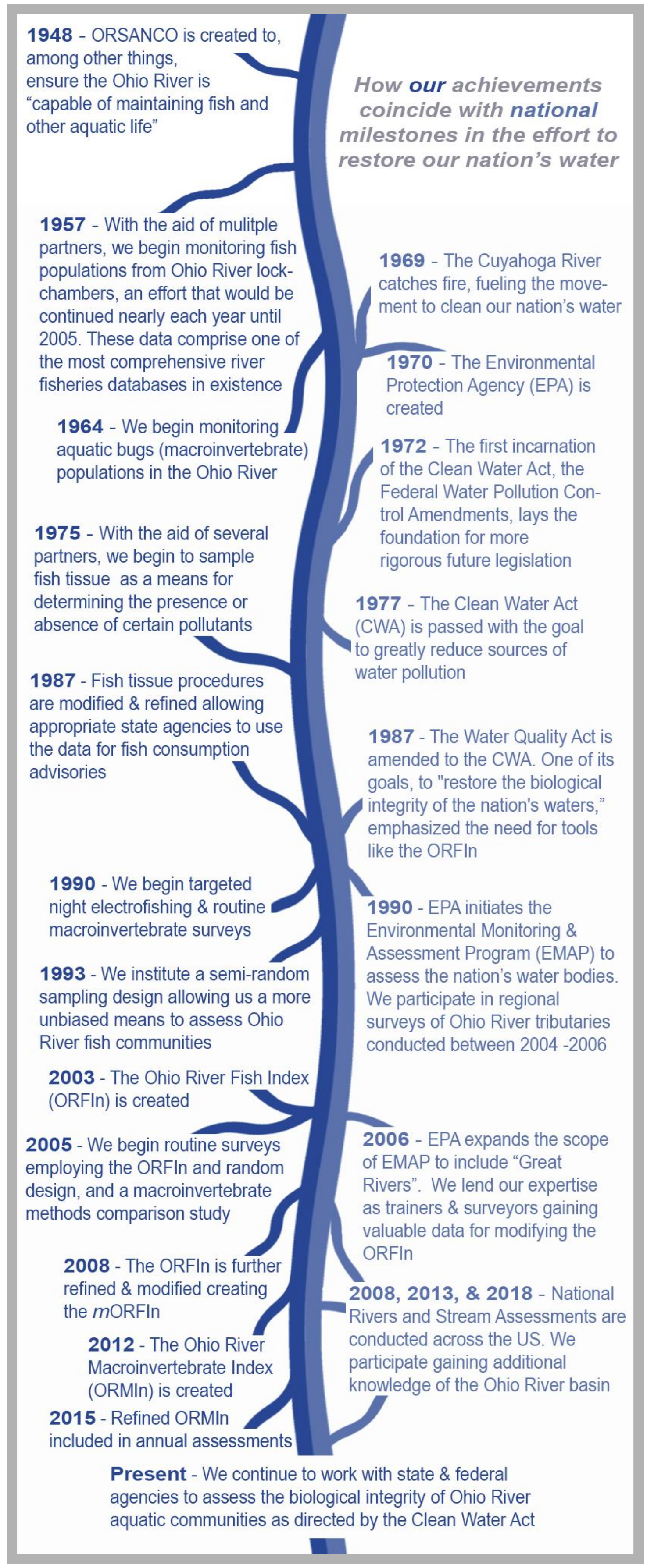
Introduction

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.



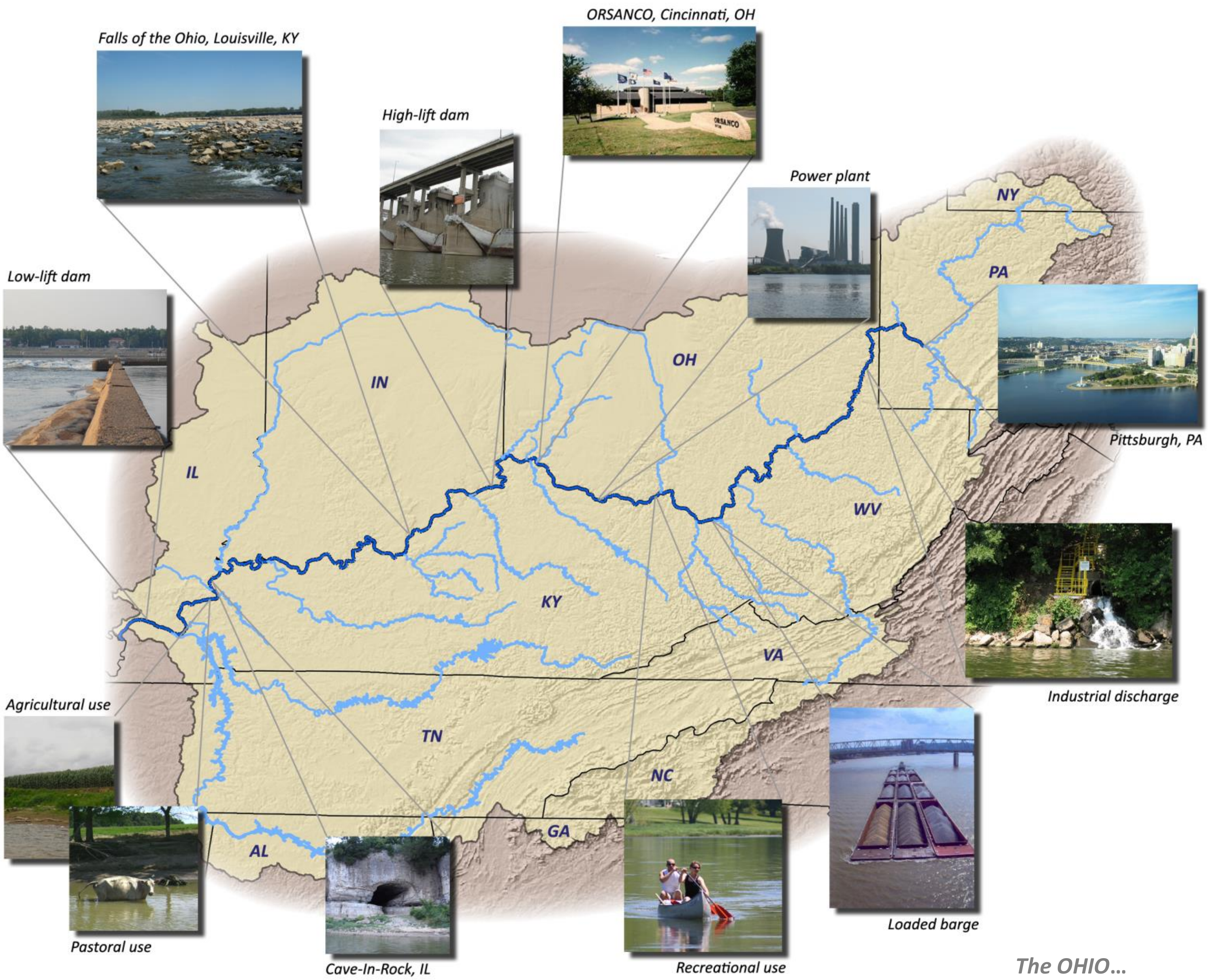
This report summarizes the 2019 R.C. Byrd and Smithland pool assessment survey findings.

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 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 (Louisville, KY)
- ~344 fish species from Ohio River <u>*basin*</u> (18 exotic) = 40% of known N. American species (800 species)
- ~178 fish species found in the Ohio <u>*River*</u> (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"

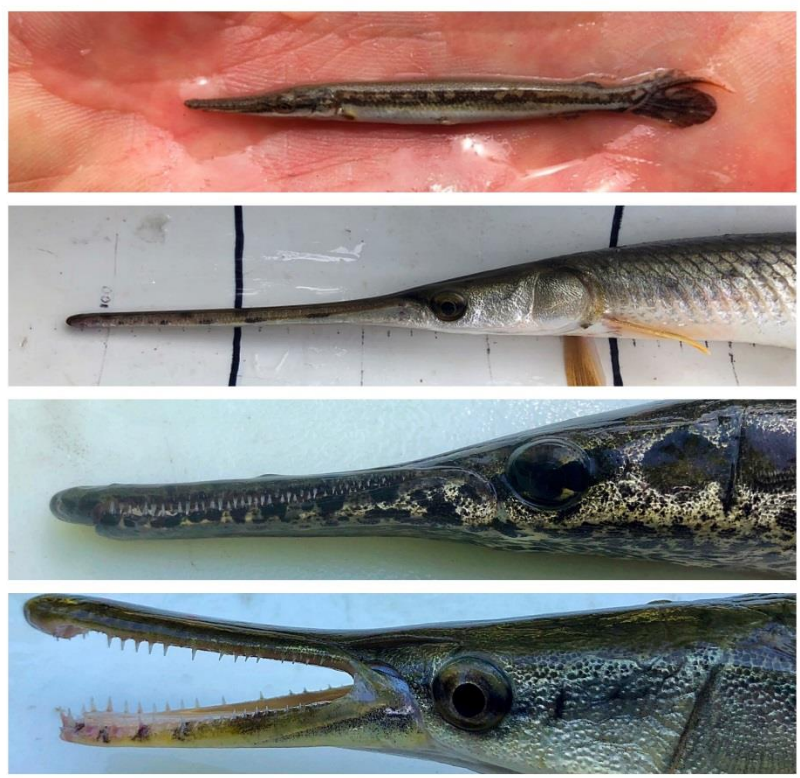
Site Selection

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 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 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.

Characterizing Instream Habitat

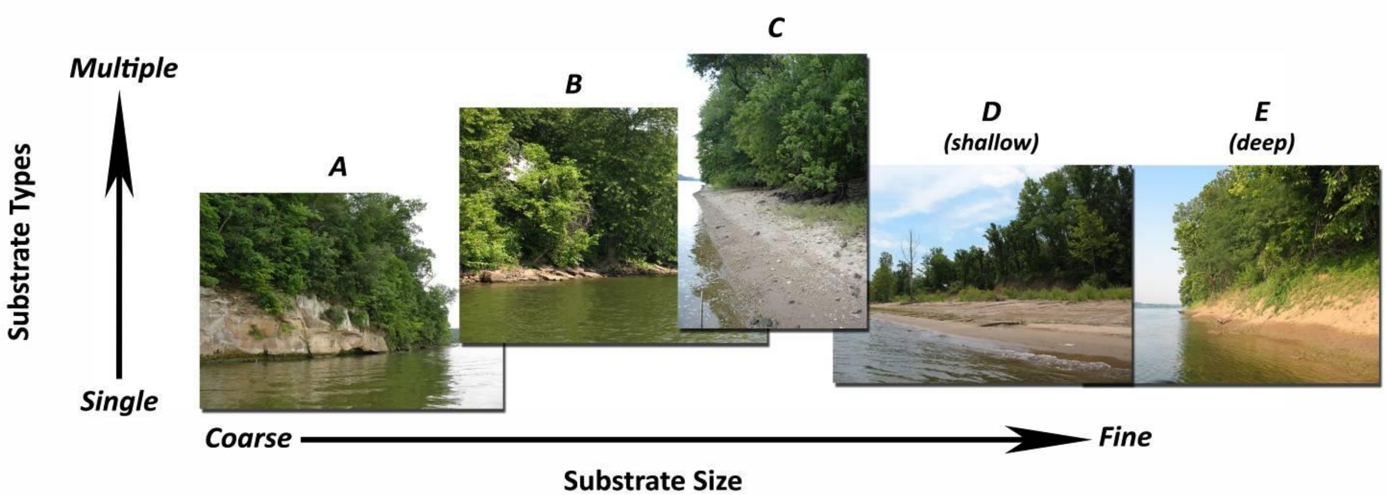
Intensive habitat surveys are conducted which include measures of woody cover, depth, prevalence of substrate types at each electrofishing site. Woody cover (e.g. submerged brush, logs, stumps) is estimated visually. More quantitative measures of depth and substrate proportions are obtained through the 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 *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

ORSANCO uses two biological indices to assess the condition of the Ohio River. The modified Ohio River Fish Index (*m*ORFIn) 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.

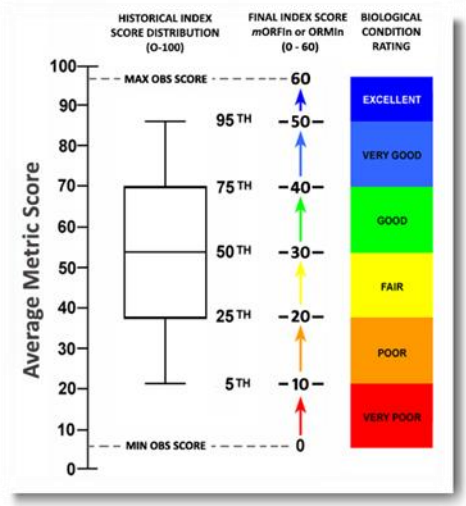
13 metrics used to generate *m*ORFIn scores

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. *DELT* anomalies	No. of ind. with *D*eformities, *E*rosions, *L*esions, *T*umors present
Catch per unit effort (*CPUE*)	Total abundance of ind. (minus exotics, hybrids, tolerants)

8 metrics used to generate ORMIn 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 *Caenidae* 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.

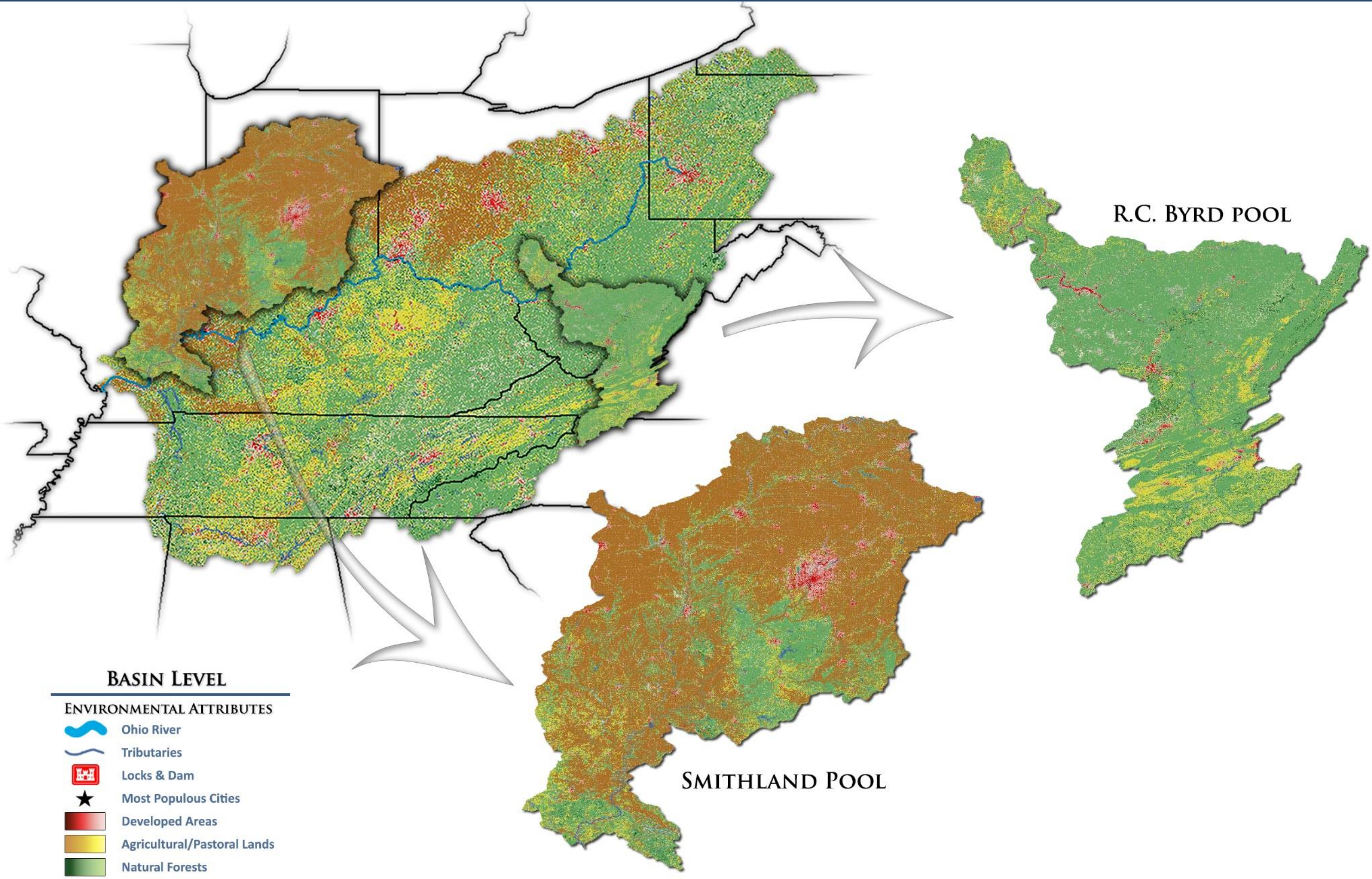
The averaged scores for both the *m*ORFIn and ORMI*n* are then compared to a biocriterion. The 25th percentile is the statistical threshold commonly used by regulatory agencies for establishing biocriteria. Using this threshold, our established biocriterion (i.e. a representation of healthy Ohio River 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 *m*ORFIn 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 notible 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

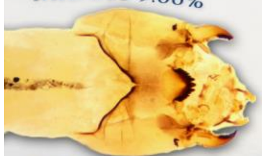
R.C. Byrd Pool (2019) - Healthy Condition

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.

Dominant Macro Groups

Mussels 46.8%

Dreissena polymorpha

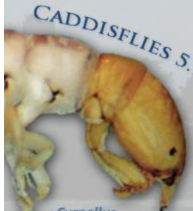


Midges 9.06%

Tribelos sp

Midges 7.93%

Dicrotendipes sp



Caddisflies 5.92%

Cyrnellus fraternus

Scuds 4.62%

Gammarus sp

Dominant Fish Families

Minnows 60.5%

Channel Shiner

Drum 14.2%

Freshwater Drum

Sunfish & Bass 6.0%

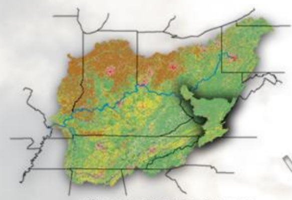
Smallmouth Bass

Catfish 4.9%

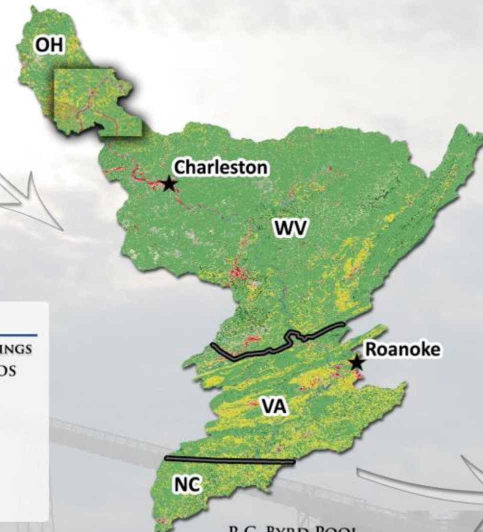
Channel Catfish

Suckers 4.9%

River Carpsucker



Ohio River Basin



R.C. Byrd Pool Sub-Basin

R.C. Byrd Pool

Basin Level		Site Level		
Environmental Attributes		Biological Condition Ratings		
		Fish		Macros
	Ohio River		Excellent	
	Tributaries		Very Good	
	Locks & Dam		Good	
★	Most Populous Cities		Fair	
	Developed Areas		Poor	
	Agricultural/Pastoral Lands		Very Poor	
	Natural Forests			

Aquatic Invasives Watch

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- *Cyrnellus fraternus*, 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.

Pool Substrate Composition

Smithland Pool (2019) - Healthy Condition

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.

Dominant Macro Groups

Dominant Fish Families

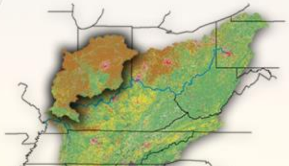
Mississippi Silvery Minnow

Freshwater Drum

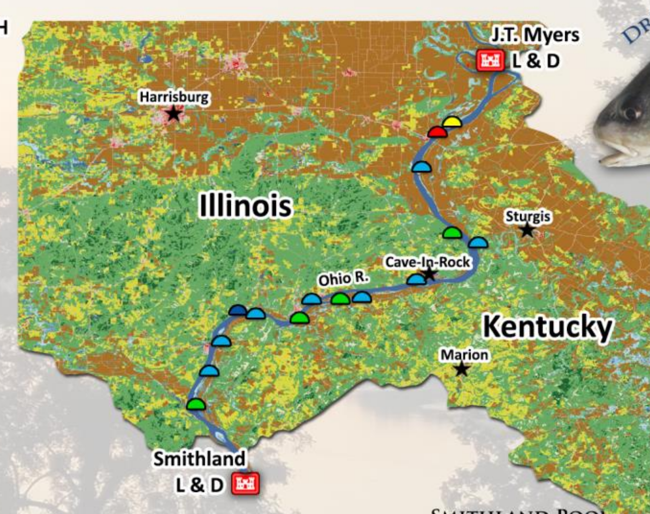
Channel Catfish

Gizzard Shad

River Carpsucker


Ohio River Basin

Smithland Pool Sub-Basin



Smithland Pool

Basin Level		Site Level		
Environmental Attributes		Biological Condition Ratings		
		Fish		Macros
	Ohio River		Excellent	
	Tributaries		Very Good	
	Locks & Dam		Good	
	Most Populous Cities		Fair	
	Developed Areas		Poor	
	Agricultural/Pastoral Lands		Very Poor	
	Natural Forests			

Aquatic Invasives Watch

Survey Summary

Electrofishing sampling took place over one week in early September, which is unusally 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.

Pool Substrate Composition

www.orsanco.org

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.

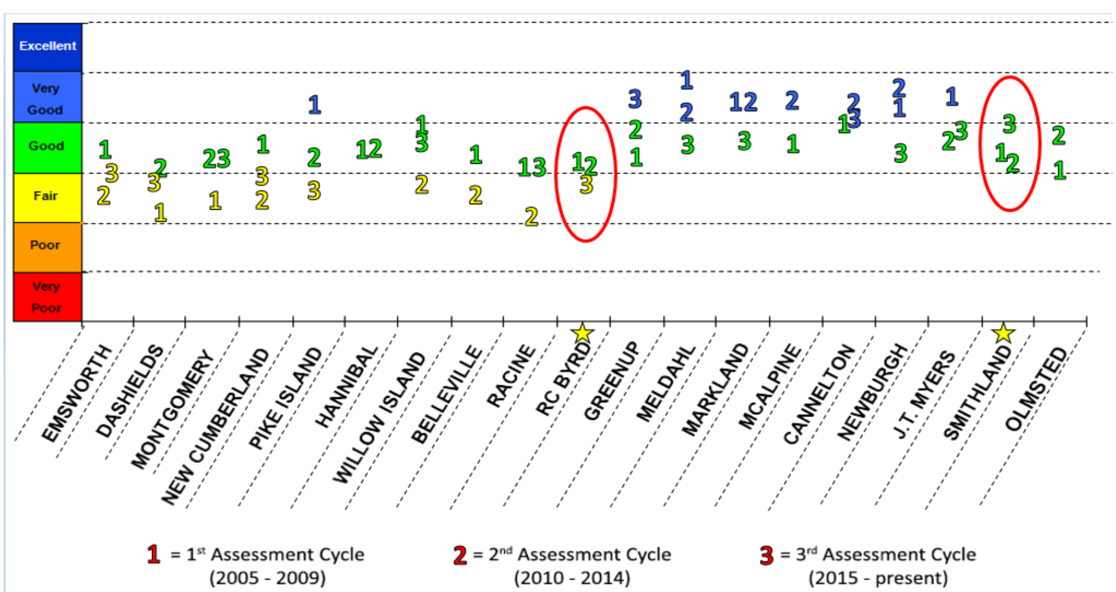
Assessment Comparisons

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 *m*ORFIn 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
Environmental Factors			
Avg. Seasonal Flow			**Moderate**
Avg. Conductivity	**453.2**	**310.0**	**362.5**
Avg. Secchi Depth	**39.3**	**27.0**	**35.2**
Avg. % Simple Lithophil Score	**70.1**	**18.3**	**6.0**
Sauger	259	128	42
Logperch	72	5	4
Avg. % Piscivore Score	**81.2**	**32.8**	**11.8**
Sauger	259	128	42
Largemouth Bass	25	18	1
Avg. % Sucker Score	**31.8**	**45.4**	**21.0**
Golden Redhorse	33	56	11
Silver Redhorse	11	22	4
Smallmouth Buffalo	40	32	18
Avg. % Invertivore Score	**17.5**	**66.9**	**73.8**
Channel Shiner	1	684	917
Assessment Results			
Avg. mORFIn Score	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 mORFI*n* scores in the upper Ohio River.

Smithland Pool

*(Fish = Good, Macros = **UNASSESSED**)*

Variable	2008	2013	2019
Environmental Factors			
Avg. Seasonal Flow			**Low**
Avg. Conductivity	**499.6**	**315.9**	**482.8**
Avg. Secchi Depth	**29.7**	**19.0**	**21.6**
Avg. Great River Score	**48.7**	**62.2**	**88.9**
Mississippi Silvery Minnow	0	15	728
River Shiner	2	8	57
Avg. Centrarchid Score	**41.0**	**48.9**	**28.9**
Longear Sunfish	92	207	7
Largemouth Bass	21	10	0
Avg. CPUE Score	**37.1**	**41.7**	**43.5**
Total Fish	2636	3230	3735
Avg. Species Score	**60.4**	**63.6**	**65.4**
Number of Species			
Avg. DELT Score	**88.5**	**93.3**	**100**
Assessment Results			
Avg. mORFIn Score	**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 (ORMI*n*) indicates that the macro community in R.C. Byrd Pool is in "fair" condition, the average ORMI*n* 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 communites 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 ORMI*n*. As such the pool was not assessed using macro data in 2019. However, based on the fish data and the results calculated using the *m*ORFI*n*, 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 educational aquarium displays at festivals and events along the Ohio River filled with fishes from local areas.

To request a "Life Below the Waterline" display at your event, contact Rob Tewes (rtewes@orsanco.org) for pricing and scheduling

Life Below the Waterline

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.																			
	Ictiobus sp.																1			
	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)

	Yellow Bass															1			12	25
	Hybrid Striped Bass		5	2			2		3	1	**17**	6	16	3	1	13	6	2	9	10
BLACK BASS	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
	Spotted Bass	**7**	18	6	28	**25**	99	46	26	17	**16**	59	46	51	38	48	50	133	15	26
DARTER	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)