2022 Ohio River Pool Assessments

Belleville and Olmsted Pools

ORSANCO Biological Programs
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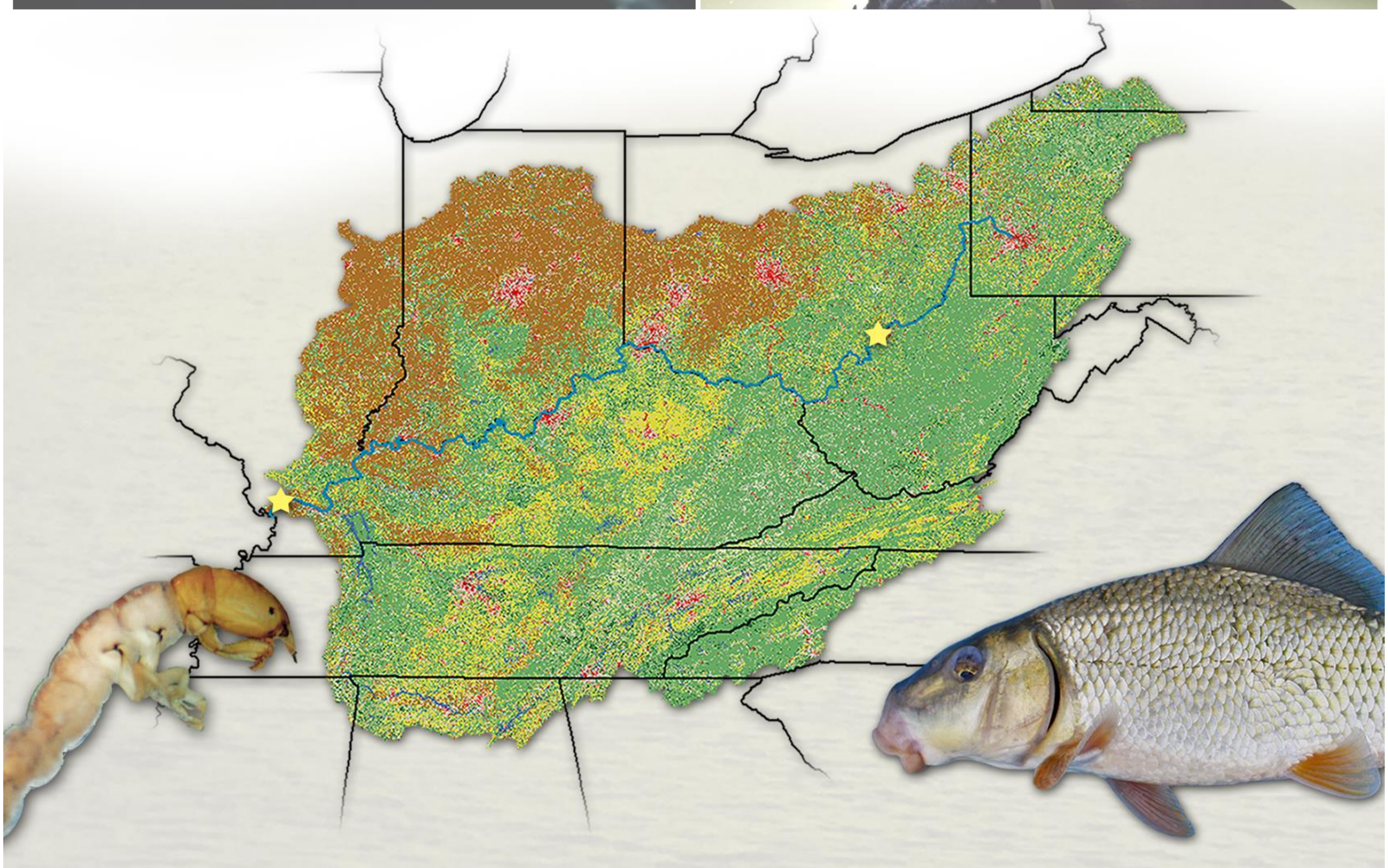

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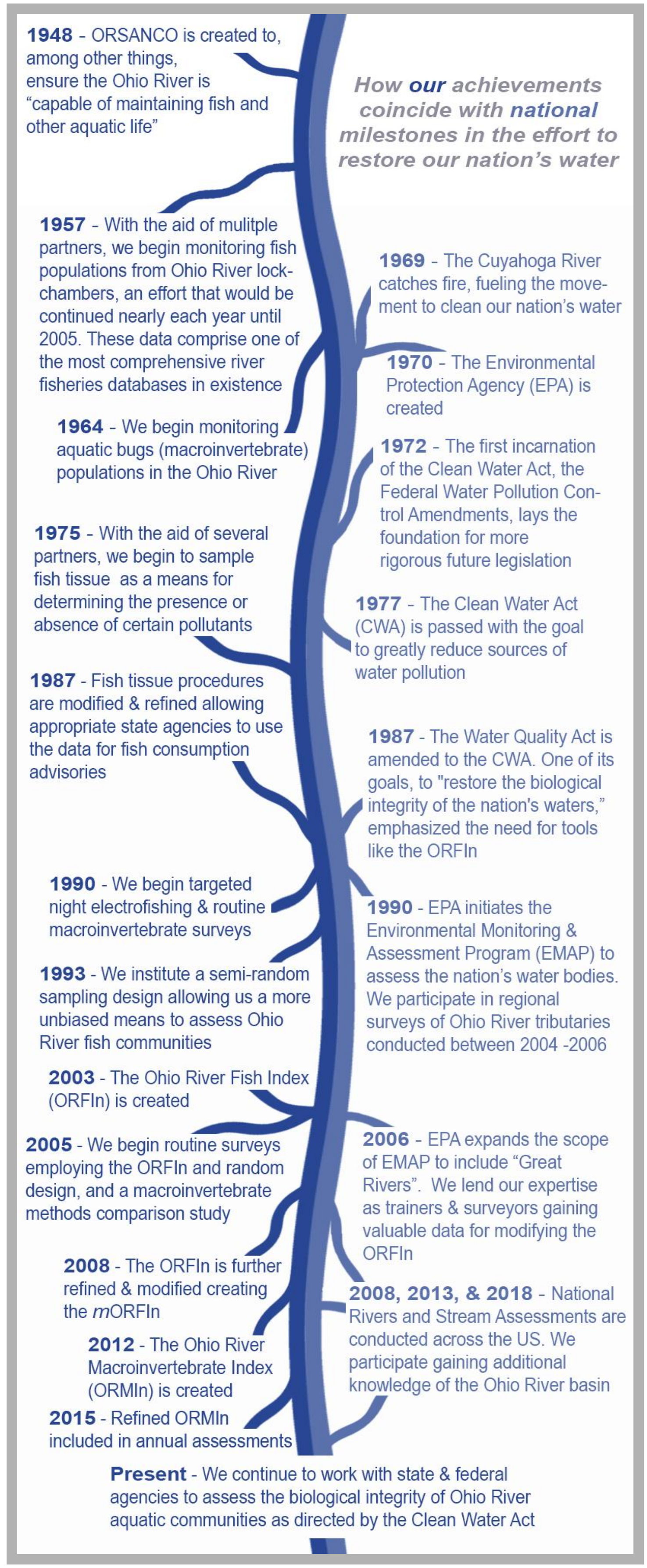
Introduction

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.



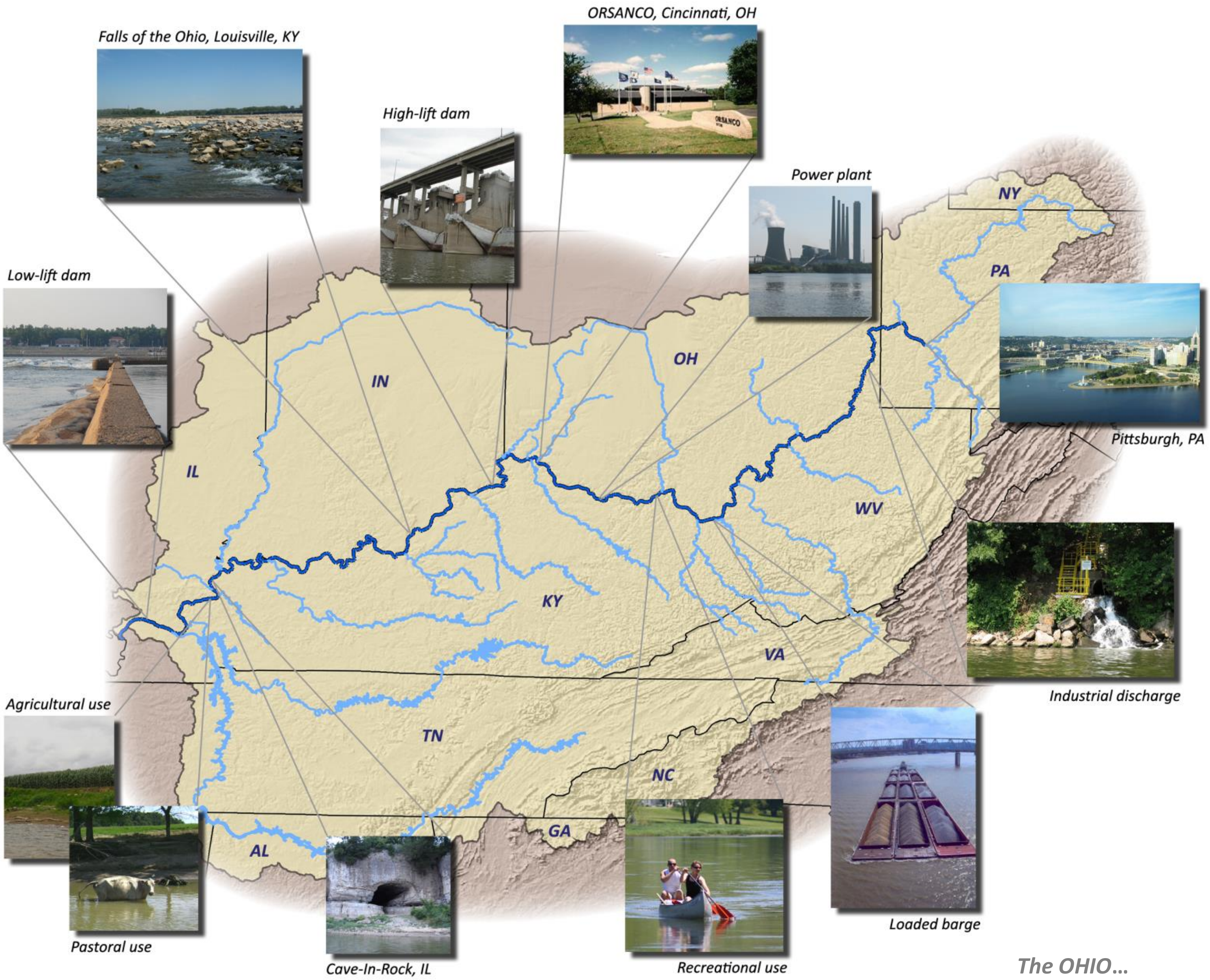
This report summarizes the 2022 Belleville and Olmsted pool assessment survey findings.

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 _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"

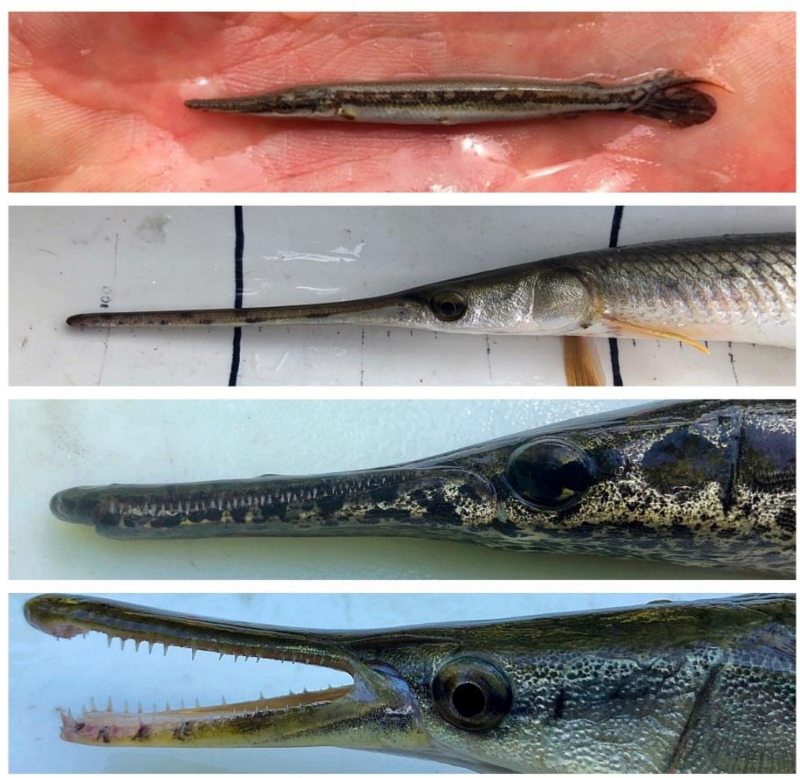
Site Selection

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 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.

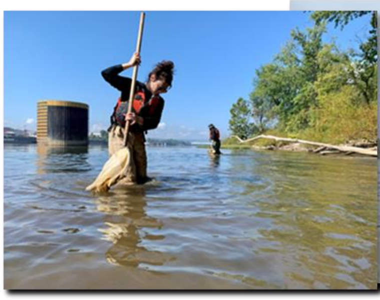


Native Ohio River fishes. Left: Members of the genus Lepomis. Bluegill, Redear Sunfish, Orangespotted Sunfish, Warmouth, Longear Sunfish. Right: Members of the genus Lepisosteus. Juvenile Shortnose Gar, Longnose Gar, Spotted Gar, Shortnose Gar.

Collecting Macroinvertebrates

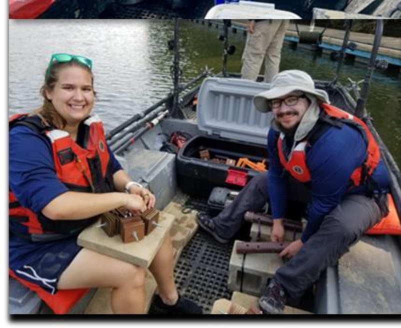
Macroinvertebrates (macros) are organisms that lack a true backbone and can be seen with the naked eye. They include aquatic insects, molluscs, arachnids, crustaceans and worms. They can range from large adult forms (e.g. crayfish), to very small larval forms of terrestrial insects (e.g. flies).

Two sampling methods are used to collect macros: Hester-Dendy (HD) samplers and multi-habitat kicks (MH). HD samplers are constructed of tempered masonite cardboard cut into 3-inch square plates and 1-inch 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

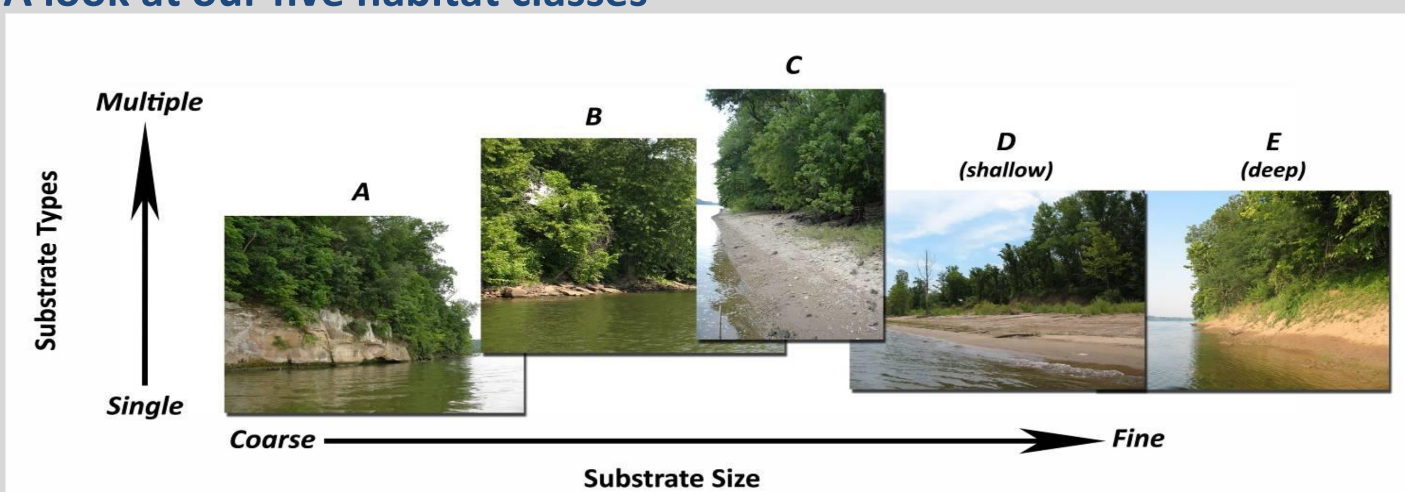
Intensive habitat surveys are conducted which include measures of woody cover, depth, prevalence of substrate types at each electrofishing site. Woody cover (e.g. submerged brush, logs, stumps) is estimated visually. More quantitative measures of depth and substrate proportions are obtained through the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



METHODS

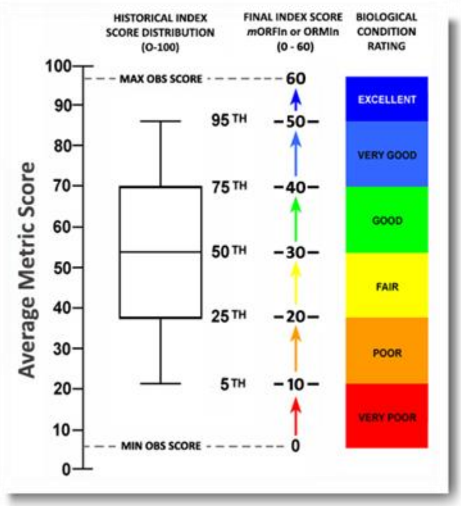
Assessing Biological Condition

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 (ORMIn 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.

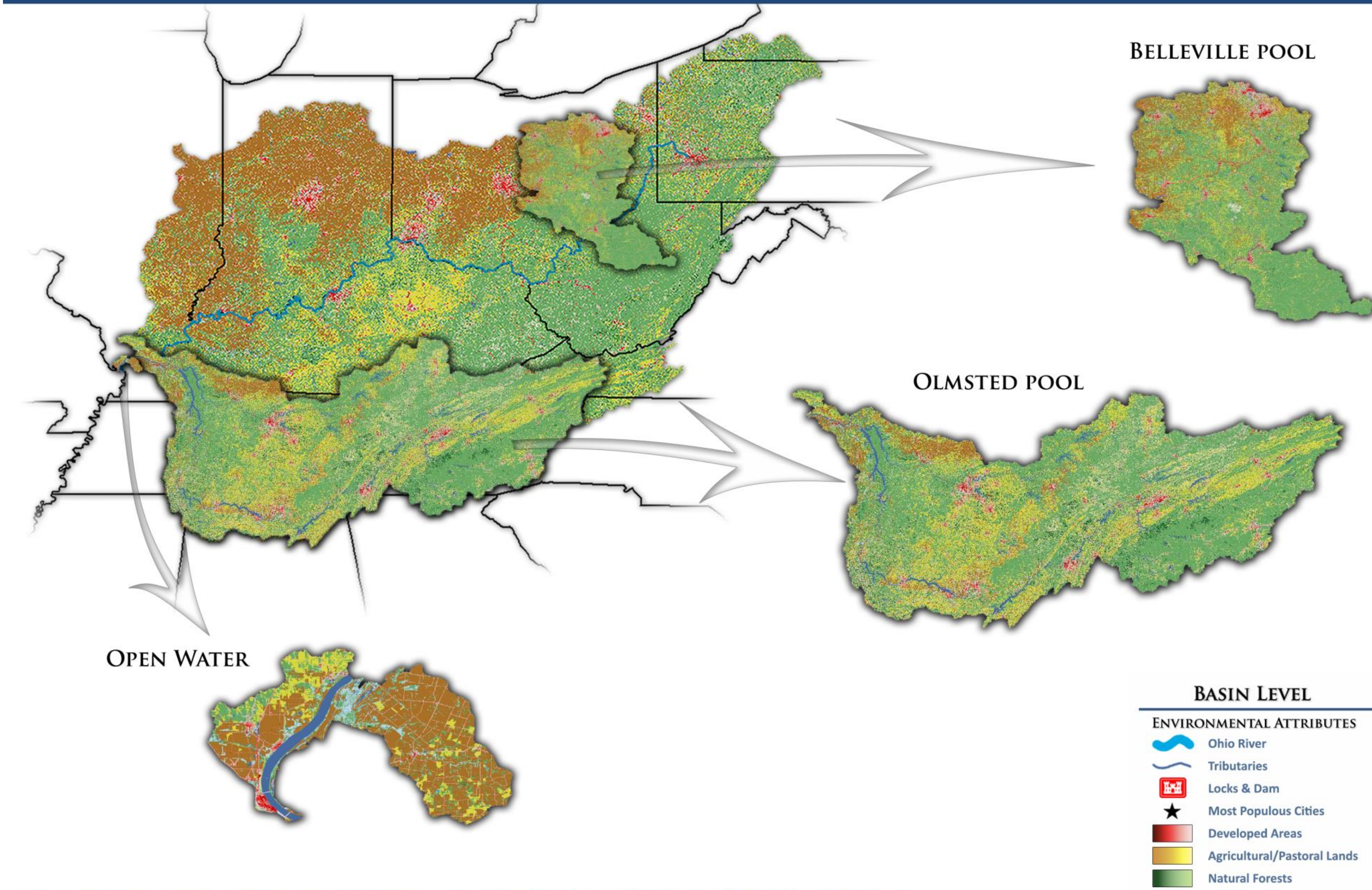
The averaged scores for both the *m*ORFIn and ORMIn are then compared to a biocriterion. The 25th percentile is the statistical threshold commonly used by regulatory agencies for establishing biocriteria. Using this threshold, our established biocriterion (i.e. a representation of healthy Ohio River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

2022 Pool Survey Results

The results of the 2022 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

Belleville Pool (2022) - Healthy Condition

The Belleville Pool is 42.2 miles long, extending from Willow Island Locks and Dam (ORM 161.7) to Belleville Locks and Dam (ORM 203.9). The pool has a gradient drop of 0.5 feet per mile and averages 1,327 feet wide and 24 feet deep (ORSANCO 1994). The pool is bordered by West Virginia and Ohio and lies in a portion of the Ohio River moderately influenced by industry and barge activity. The largest cities along the pool are Marietta, OH (the oldest city in the state) and Parkersburg, WV. The Belleville pool has three large tributaries, the Muskingum and Hocking Rivers in Ohio and the Little Kanawha River in West Virginia. Combined, these tributaries drain an area of over 10,000 square miles. The pool has multiple islands scattered throughout its reach, providing a variety of habitats for aquatic species. The watershed is primarily forested (55.72%), and is also comprised of pasture lands (18.28%) and row crops (11.87%).

Dominant Macro Groups

Midges 30.7%

Dicrotendipes modestus/tritomus

Snails 13.2%

Hydrobiidae sp

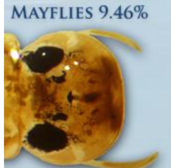
Mussels 12.5%

Dreissena polymorpha

Scuds 10.8%

Gammarus fasciatus

Mayflies 9.46%



Stenacron interpunctatum

Ohio River Basin

Belleville Pool Sub-Basin

Belleville 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			

Dominant Fish Families

Herring & Shad 46.4%

Gizzard Shad

Minnows 29.5%

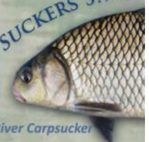
Photo by Uland Thomas

Channel Shiner

Sunfishes & Bass 6.9%

Bluegill

Suckers 5.9%



River Carpsucker

Drum 3.1%

Freshwater Drum

Aquatic Invasives Watch

- ☐ Silver Carp
- ☐ Bighead Carp
- ☑ Asiatic Clams
- ☑ Zebra Mussels
- ☑ Marine Scuds
- ☑ Hydrilla

Survey Summary

Electrofishing sampling took place over one week in early July at the begining of the index period (July-Oct). Sampling conditions were favorable marked by low flows and high Secchi readings; however water temperatures were the highest on record (avg=24.9; max=32.6 degrees C). Three species considered to be "irruptive species" comprised 75.9% of the total catch: Gizzard Shad (*Dorosoma cepedianum*, n=1,034), Channel Shiner (*Notropis wickliffi*, n=318), and Emerald Shiner (*Notropis atherinoides*, n=278). Notable catches included one Ohio species of concern (River Redhorse, *Moxostoma carinatum*, n=1) and one individual that typically inhabits small-medium rivers was captured in between the Muskingum and Little Kanawha Rivers at RMI 176.4 (Silverjaw Minnow, *Notropis buccatus*). Of the 2022 macroinvertebrate assessments, the highest species diversity was observed in the Belleville Pool, with 118 unique taxa collected. Notable macroinvertebrate collections from Belleville Pool include Alderflies (*Sialis sp.*; n=2), eight different species of Dragonflies and Damselflies (Order: *Odonata*), and 29 different EPT taxa including Winter Stoneflies (*Taeniopteryx sp.*; n=16) which are sprawler/clinger detritivores that are generally intolerant to pollution, though some species are adapted to large polluted rivers. Independent biological indices were used to apply numeric values to important components of fish and macroinvertebrate assemblages and assess their relative status. The results (see above map) show that, on average, fish populations in Belleville Pool were in 'Fair' condition and macroinvertebrate populations were in 'Good' condition.

Pool Substrate Composition

Boulder 4.1% · Cobble 4.6% · Gravel 15.2% · Sand 27.5% · Fines 43.7% · Hardpan 2.4% · Other 2.3%

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Olmsted Pool (2022) - Healthy Condition

The Olmsted Pool is 46.3 miles long, extending from Smithland Locks and Dam (ORM 918.5) to Olmsted Locks and Dam (ORM 964.8). The pool has a gradient drop of 0.3 feet per mile and averages 3,500 feet wide and 20 feet deep. The pool flows adjacent to Kentucky and Illinois and lies in a portion of the Ohio River with a large amount of barge activity. It has two major tributaries: the Cumberland and Tennessee rivers with drainage areas of 17,920 and 40,910 square miles, respectively. The pool's watershed is primarily forested (57.9%) but also has a considerable amount of pasture lands (19.3%) and row crops (5.5%).

Dominant Macro Groups

Midges 36.7%

Dicrotendipes lucifer

Caddisflies 33.4%

Cyrnellus fraternus

Mussels 10.5%

Dreissena polymorpha

Scuds 8.3%

Gammarus fasciatus

Mayflies 6.0%

Hexagenia limbata

Dominant Fish Families

Drum 42.1%

Freshwater Drum

Gars 16.2%

Longnose Gar

Temperate Basses 12.4%

Morone sp.

Herring & Shad 12.1%

Gizzard Shad

Suckers 8.0%

River Carpsucker

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

- [x] Silver Carp
- [x] Bighead Carp
- [x] Asiatic Clams
- [x] Zebra Mussels
- [x] Marine Scuds
- [ ] Hydrilla

Survey Summary

Electrofishing sampling occurred during normal sampling conditions with roughly half of the sites surveyed at the end of July and the other portion completed at the end of August. Notable observations over the last three asessment cycles included an increased abundance of Freshwater Drum (*Aplodinotus grunniens*, n=576) and Longnose Gar (*Lepisosteus osseus*, n=140). Declines in Sauger (*Sander canadensis*, n=10), Channel Catfish (*Ictalurus punctatus*, n=35), and Smallmouth Buffalo (*Ictiobus bubalus*, n=17) numbers were observed. Notable catches include KY threatened species Missisippi Silverside (*Menidia audens*, n=1) and KY species of concern, Black Buffalo (*Ictiobus niger*, n=9). Notable macroinvertebrate collections included 18 different EPT taxa including a high percentage of tolerant Trumpetnet/Tubemaking Caddisflies (*Cyrnellus fraternus*) and Common Net-Spinner Caddisflies (*Hydropsyche orris*). The Dragonhunter Clubtail Dragonfly (*Hagenius brevistylus*; n=4) has occurred four times in the history of ORSANCO macroinvertebrate surveys, one of these observations being in the Olmsted Pool during the 2022 surveys. This large predatory species is a sprawler and is often imperiled in areas with high zebra mussel density due to mussel colonization on their wide abdomen. Independent biological indices were used to apply numeric values to important components of fish and macroinvertebrate assemblages and assess their relative status. The results (see above map) show that, on average, fish in Olmsted Pool were in 'Fair' condition and the macroinvertebrates were in 'Very Good' condition. Overall, these results indicate that Olmsted Pool harbored healthy aquatic communities.

Pool Substrate Composition

Boulder 1.4% Cobble 1.5% Gravel 18.6% Sand 33.2% Fines 25.5% Hardpan 19.4% Other 0.4%

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CONCLUSIONS

Pool Surveys

The fish assessment portion of the 2022 pool surveys was successfully completed during the normal sampling timeframe. Fish sampling took place from July 11th-13th (Belleville), July 25th-27th and August 22nd – 25th (Olmsted), and August 19th-21st (Open Water). Electrofishing surveys took place under normal stage and flow conditions. Conditions allowed for adequate sampling of fish and macroinvertebrates during the respective index periods. The macroinvertebrate sampling for all four pools was completed between August 29th- Oct. 26th. Belleville, and Olmsted pools were assessed as *meeting* their aquatic life-use designations for both fish and macroinvertebrates (i.e. containing healthy fish and macroinvertebrate communities). Open Water remained unassessed as this unimpounded region of the river contains unique hydrology and habitats for which the biological indices are not currently calibrated.

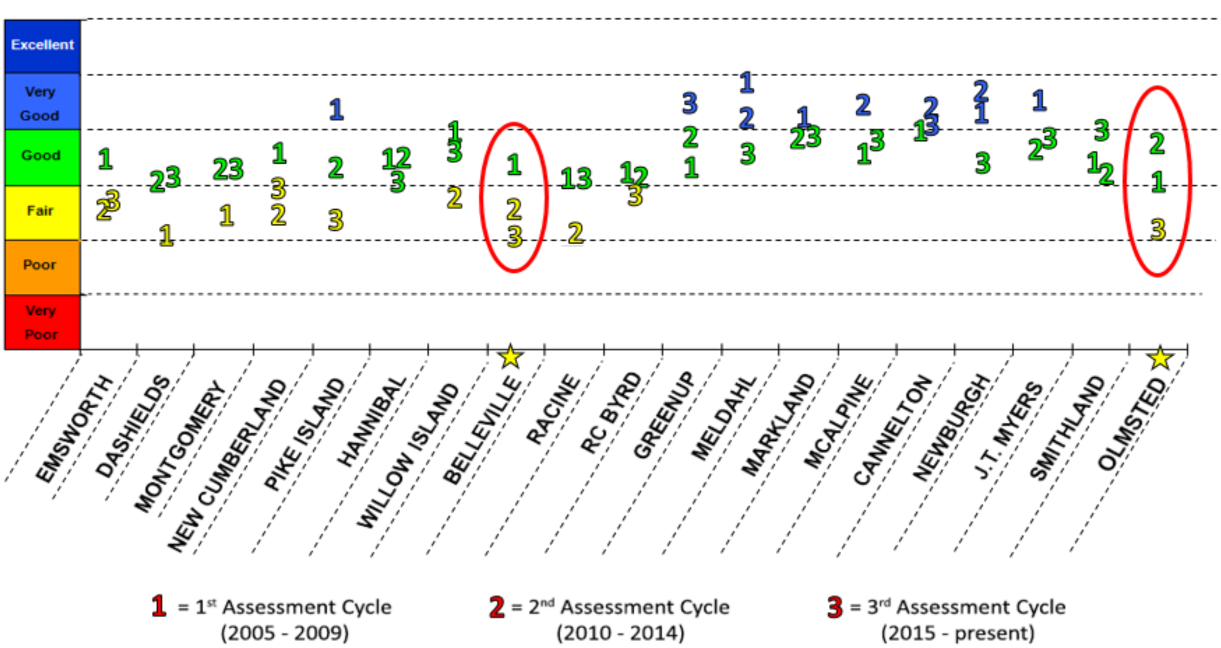
Assessment Comparisons

Between 2005 and 2022, all 19 Ohio River navigational pools were surveyed and assessed three times. All three cycles revealed the majority of the river to be in ‘Good’ condition, even though some pools changed in condition rating between surveys. The 2022 surveys concluded 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, and annual variations in flow, weather, 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.

A Sauger (*Sander canadensis*) collected from J.T. Myers Pool.



CONCLUSIONS

Belleville Pool

(Fish = FAIR, Macros = GOOD)

Variable	2009	2014	2022
Environmental Factors			
Avg. seasonal flow (cfs)	--	**Low**	**Low**
Range of Temperature (C)	23.7 - 25.5	24.9 – 25.9	27.6 – 32.6
Avg. Conductivity	579.5	284.1	450.9
Avg. Secchi Depth	34.2	23.6	32.9
Avg. Species Score	**65.3**	**52.9**	**30.8**
Species Richness	48	48	38
Avg. % Invert Score	**64.3**	**51.3**	**38.7**
Bluegill	413	391	60
Channel Shiner	795	410	318
Golden Redhorse	115	64	30
Avg. % Simple Lithophil Score	**36.6**	**24.9**	**12.4**
Sauger	133	89	21
All Redhorses	273	165	58
Avg. Great River Species Score	**31**	**6.6**	**4.4**
Mooneye	4	0	2
Silver Chub	32	1	0
Assessment Result			
Avg. mORFIn Score	**34.6**	**24.5**	**20.9**
Fish Condition Rating	**Good**	**Fair**	**Fair**

Belleville Pool was assessed to be in "Fair" condition in 2022, exhibiting decreasing *m*ORFIn score trends over the past three assessments. The 15 randomly drawn sites were distributed evenly throughout the 42.2 mile long pool, with three sites above the Muskinghum River and seven sites downstream of the Little Kanawha River. The three highest scoring sites were in the upstream segment of the pool clustered around the mouth of the Muskingum River, while the lowest performing sites were in the lower pool just upstream of the Belleville lock and dam. Water temperatures were the highest observed on record, accompanied by low flows. While the impact on assessment results is not entirely clear, we speculate that since these conditions drive fishes into deeper, colder water, it may have contributed to the depressed CPUE metric as our sampling gear is limited by water depth. The observed fish community declined in both abundance and species richness over the past three assessments, which is directly reflected in the Avg Species Score, and subsequently reflected in various other metrics shown above. Another factor possibly contributing to lower metric scores is the observed shift in substrate composition, providing less suitable habitat for fishes that are indicative of healthy aquatic ecosystems. Course substrates (boulder, cobble, & gravel) declined from an average of 41% to 29% between 2009 and 2022. Fine sediments increased by 26.3%, rendering a more homogenous habitat that can host fewer native species, and often species that are pollution tolerant. Pollution intolerant species have consistenly declined, comprising 27.8%, 23.1%, and 17.0% of the sampled fish community, respectively. The aforementioned trend was mostly driven by Smallmouth Redhorse and Channel Shiners, two species that fall into other imperiled metric calculations as well. The Simple Lithophil Score exhibited a steady decline between the three assessments, as they require course substrates to spawn and many of these species happen to be pollution intolerant. The relative abundance of simple lithophil species decreased from 29.2%, 25.0%, to 21.1% respectively, and they comprised 13.9%, 14.0%, and 4.0% of the total catch, respectively.

Olmsted Pool

(Fish = FAIR, Macros = VERY GOOD)

Variable	2009	2014	2022
Environmental Factors			
Avg. seasonal flow (cfs)	--	--	**Moderate**
Range of Temperature (C)	26.1 – 33.9	27.6 – 28.7	30.6 – 36.6
Avg. Conductivity	483.2	351	338.6
Avg. Secchi Depth	22.5	22.9	18.6
Avg. Species Score	**72.4**	**64.2**	**22.9**
Species Richness	48	40	33
Avg. Centrarchidae Score	**56.7**	**32.2**	**10.0**
Bluegill	83	41	8
Longear Sunfish	103	16	8
Avg. Great River Score	**71.1**	**55.6**	**46.7**
Number of Individuals	117	128	92
River Shiner	9	15	3
Shortnose Gar	68	101	81
Avg. % Simple Lithophil	**25.6**	**12.8**	**9.1**
Number of Individuals	156	91	24
Sauger	101	46	10
Silver Chub	25	10	2
Assessment Result			
Avg. mORFIn Score	**30.2**	**36.8**	**24.7**
Fish Condition Rating	**Good**	**Good**	**Fair**

Olmsted Pool was assessed to be in "Fair" condition in 2022, which is a lower condition rating than the previous two assessments. The 15 randomly drawn sites were fairly evenly distributed throughout the 46.3 mile long pool. Environmental factors such as flow, conductivity, and Sechhi depth did not appear to have a significant effect on assessment results. Water temperature was the highest observed on record peaking at 36.6 degrees Celcius. The average temperature was 33 degrees Celcius, which is equal to the maximum recorded temperature of 2009 and surpassing the maximum temperature of 2014 by roughly 4 degrees. Primary factors responsible for the decline of the biological condition rating over the three assessments was the overall reduction in species richness reflected in the Average Species Score (15 fewer species observed), Average Centrarchidae Score, and the Average Percent Simple Lithophil Score. The abundance and diversity of the Centrarchidae family decreased from 14.9% to 1.6% of the fish community, with a reduction from 10 to 4 species observed. The Average Percent Lithophil score was most drastically affected by fewer occurrances of Sauger and Silver Chub, and the diversity of this breeding guild has declined from 9, to 8, to 6 species, respectively. Historically and presently, the substrate of Olmsted pool has been dominated by sand and fines, meaning the community composition changes are likely attributed to other factors. The most plausible explanation for these declines is the substantial increase in water temperature. Higher temperatures drive fishes in to deeper water in search of reprieve from the heat, which affects our ability to capture them with electrofishing gear that is limited by water depth.

An invasive Silver Carp (*Hypopthalmichthys molitrix*) collected from Olmsted Pool.

Open Water

(Unnassessed)

This is the most downstream stretch of the Ohio River, it is unimpounded from Olmsted lock and Dam to the confluence of the Mississippi River. The habitat in this stretch of river and the corresponding fish and macroinvertebrate communities are vastly different from the rest of the Ohio River. The Indices of Biotic Integrity (IBI) that are used to evaluate the pools of the Ohio River are not effective here. Until more data are collected and assessments tools are refined using said data, this stretch of river cannot be assessed using the current approach that is applied throughout the rest of the river. ORSANCO biologists are collecting additional data from this stretch of the river to develop a protocol that would eventually allow for an assessment of this unique area of the basin.

Macroinvertebrates

As per ORSANCO's Biological Assessment protocol, a minimum of 15 fish samples and/or 10 macro samples are required to be collected in each pool in order to derive a viable assessment. The ten macro samples must be comprised of deep Hester-Dendy samples (HDD) or multihabitat kick samples (MH). Multihabitat kick samples will only be used when deep Hester-Dendy samples are lost, unrecoverable, or 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.

An Adult Burrowing Mayfly (*Hexagenia limbata*).

CONCLUSIONS

Belleville Pool

Macroinvertebrate collections in the Belleville Pool met the minimum number of samples in 2022. 14 HDD samplers were recovered at the end of the colonization period. The Ohio River Macroinvertebrate Index (ORMI*n*) indicates that the macroinvertebrate community in Belleville Pool is in “Good” condition, with the average ORMI*n* score of 36.61.

ORSANCO biologists processing macroinvertebrate samples

The most abundant macroinvertebrates present in the Belleville Pool were chironomids, specifically from the genus *Dicrotenipes*. Aside from chironomids, the second most abundant taxa in the collections from 2022 were from a genus named *Hydrobiidae*, more commonly known as mud snails. Zebra Mussels and Scuds made up a large percentage of catches as well. There was also a high abundance of moderately tolerant mayflies-- *Heptageniidae* commonly known as Flathead Mayflies (*Stenacron sp.*).

Dragonhunter Clubtail Dragonfly Naiad (*Hagenius brevistylus*) collected from Olmsted Pool.

The greatest species diversity was observed in the Belleville Pool, with the presence of 118 unique taxa, rendering the highest score for the Number of Taxa metric.

Seasonal biologists retrieve a Hester Dendy sampler at the end of the colonization period.

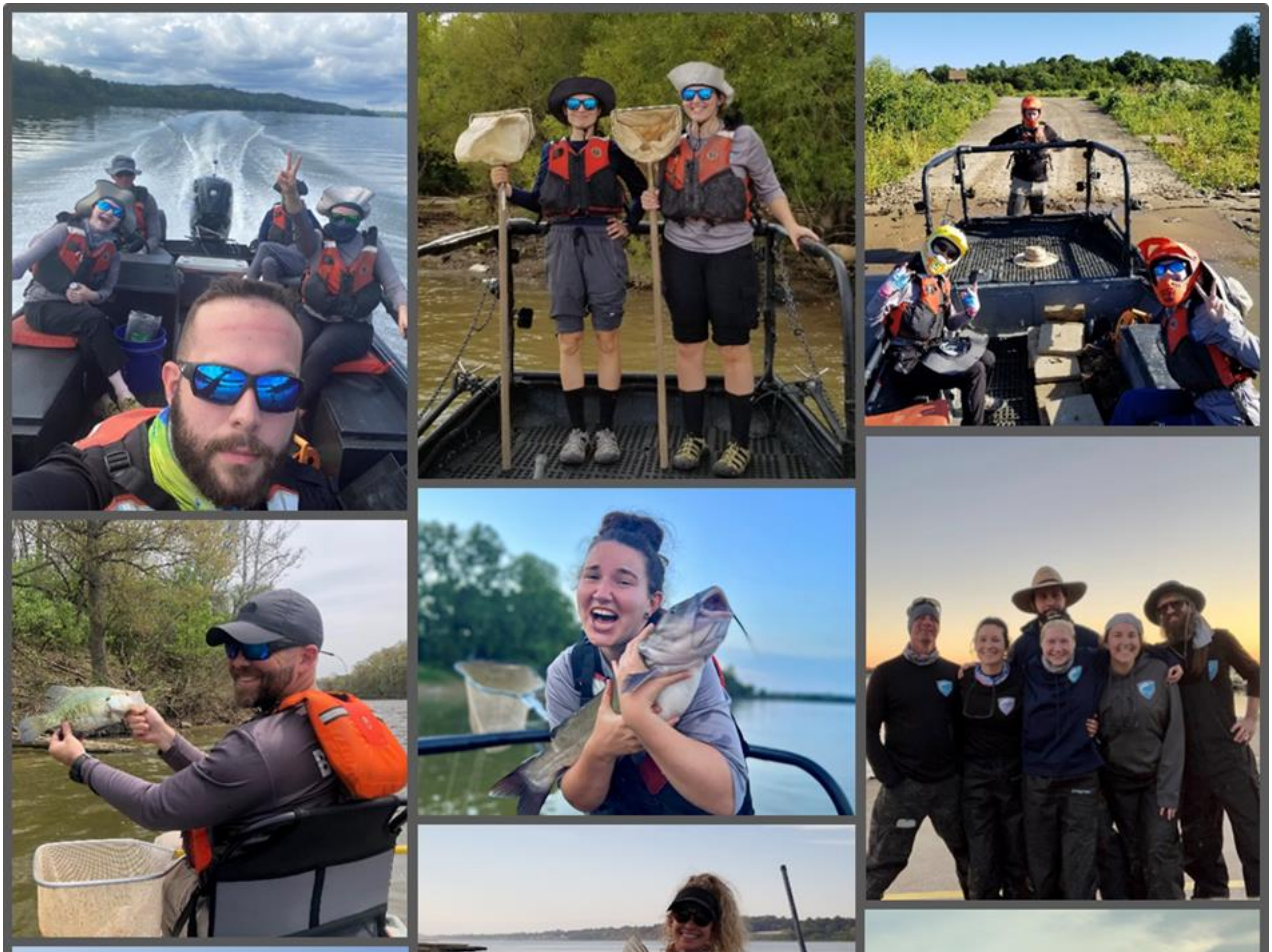
Olmsted Pool

Thirteen HDDs were retrieved from the Olmsted Pool. The 2022 assessment score of 43.37 classifies the Olmsted Pool to be in “Fair” condition for macroinvertebrates.

The most notable macroinvertebrate collection from the Olmsted Pool is the Dragonhunter Clubtail Dragonfly (*Hagenius brevistylus*). This species has been collected 4 times in the history of ORSANCO’s monitoring programs. Zebra Mussels have been observed colonizing on the wide abdomen of this species of dragonfly. This large predatory species is a sprawler and is often imperiled in areas with high abundance of Zebra Mussels. Other notable collections from the Olmsted Pool included high abundance of midges and 18 different EPT taxa including a high percentage of tolerant Trumpetnet/Tubemaking Caddisflies (*Cyrnellus fraternus*) and Common Netspinner Caddisflies (*Hydropsyche orris*). Zebra Mussels (*Dreissena polymorpha*), scuds (*Gammarus fasciatus*), and tolerant mayflies (*Hexagenia limbata*) were also observed in large numbers.

CONCLUSIONS

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
Sarah Segars (ssegars@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 '21	Montgomery '15	New Cumberland '17	Pike Island '18	Hannibal '21	Willow Island '16	Belleville '22	Racine '15	Robert C. Byrd '13	Greenup '16	Meldahl '17	Markland '21	McAlpine '21	Cannelton '16	Newburgh '17	John T. Myers '15	Smithland '13	Olmsted '22	Open Water '22
GAR	Longnose Gar	18	16	11	31	54	54	34	39	64	25	42	59	31	21	50	30	16	11	140	28
	Spotted Gar															1			2		
	Shortnose Gar												1				12	12	28	81	43
SHAD	Skipjack Herring							2			1				1	2	3	5	2	1	
	Gizzard Shad	6	11	26	83	37	24	154	1034	147	176	158	591	616	312	378	216	650	557	117	28
	Threadfin Shad																		14	48	8
CARP	Common Carp	12	25	45	75	16	11	11	12	3	32	7	13	15	3	3	4	8	7	5	15
	Grass Carp													1	1		2				1
	Silver Carp														1	3		15	17	10	7
	Bighead Carp																				1
	Goldfish																	1			
	Carp x Goldfish																				
MINNOW	Cyprinidae sp.																				
	Golden Shiner													1	1						1
	Striped Shiner				2		1						11								
	Spottail Shiner			4				11		4	1	2									
	Spotfin Shiner	76	81	68	165	61	60	295	41	127	19	52	19	8	18	73	8	112	218		
	Notropis sp.																				
	Emerald Shiner	238	748	216	357	75	376	1085	278	1208	172	221	423	133	185	407	195	102	86	4	2
	Silverband Shiner																				
	Sand Shiner					70															
	Channel Shiner	1071	1423	323	845	484	391	1173	318	733	684	2017	872	685	145	1822	426	255	102	4	
	River Shiner	1			42		1					16	69	47	94	145	47	104	8	3	1
	Shoal Chub																				
	Silver Chub	1									1	11	38	44	55	32	10	10	12	2	
	Streamline Chub	6	4			5															
	River Chub																				
	Gravel Chub																				
	Creek Chub											1									
	Central Stoneroller					2		9					1								
	Mississippi Silvery																		15	1	
	Suckermouth Minnow																				
	Bluntnose Minnow	10	47	30	224	33	61	227	6	12		2	3	4			12	9			
	Bullhead Minnow				0		3	12	2		1	17	14	11	1	11	13	24	1	4	
	Silverjaw Minnow								1												
SUCKER	Ictiobinae sp.																				

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

Group	Species (common name)	Emsworth '18	Dashields '21	Montgomery '15	New Cumberland '17	Pike Island '18	Hannibal '21	Willow Island '16	Belleville '22	Racine '15	Robert C. Byrd '13	Greenup '16	Meldahl '17	Markland '21	McAlpine '21	Cannelton '16	Newburgh '17	John T. Myers '15	Smithland '13	Olmsted '22	Open Water '22
	Ictiobus sp.																1				
	Smallmouth Buffalo	22	43	82	37	42	14	26	7	33	32	19	45	24	9	17	11	32	106	17	22
	Bigmouth Buffalo											1			1		1	4	4	1	1
	Black Buffalo	5	20	18	13	13	1	3	1			3	14	21	9	2		2		9	19
	Carpiodes sp.						2									1					
	Quillback	2	11	6	13	3	10	9	5	3	12	3	28	41	10	3	3	7	31		
	River Carpsucker	4	43	47	15	5	8	18	58	20	26	38	151	181	92	19	48	187	263	81	29
	Highfin Carpsucker		1	12			3		4	8	1	6	6	8	1			3	91	1	
	Northern Hog Sucker	7	8	6	16	4	1	8		5	2	1		1	5						
	Moxostoma sp.				22						1										
	Shorthead Redhorse																				1
	Smallmouth Redhorse	48	216	27	3	27	62	41	19	11	22	38	114	46	17	40	13				
	Silver Redhorse	131	189	215	122	26	118	42	8	16	22	39	31	26	7	5	2				
	River Redhorse	12	10	23	6	5		1	1	2	6	25	4	6	1	4					
	Black Redhorse	5		25	27	4		6													
	Golden Redhorse	34	177	156	442	116	439	219	30	56	56	124	112	65	31	17	25	8			
	Spotted Sucker							13		1		2	1	1							
	White Sucker						2														
CATFISH	Yellow Bullhead																				
	Brown Bullhead																				
	Northern Madtom																				
	Blue Catfish															4		1	5	3	2
	Channel Catfish	9	16	83	59	45	59	35	49	52	114	61	98	107	58	46	68	106	478	35	11
	Flathead Catfish	8	7	8	9	10	12	22	17	24	40	29	26	39	24	10	19	20	30	13	3
SUNFISH	Lepomis sp.																				
	Warmouth													1							
	Rock Bass	31	28	22	238	35	14	11	2												
	Bluegill	20	105	88	215	138	129	540	60	220	254	205	73	490	154	65	32	65	270	8	4
	Green Sunfish	3	2	1	3	2	3	1	1	4	4	2	2	9	6	2	2	1			1
	Pumpkinseed		1	3	54	6	1	14	5	2	6										
	Orangespotted Sunfish		1				17	197		5		5	13	76		2	2	6	1		2
	Longear Sunfish				1	20	173	18	4	13	56	15	17	134	88	31	32	137	207	8	5
SUNFISH	Redear Sunfish							2	3	2	3	4	2	13	3	20	8	1	32		
	Lepomis Hybrid				3	1					2				1				2		
	Bluegill X Longear																				
	Bluegill X Green									1											

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

Group	Species (common name)	Emsworth '18	Dashields '21	Montgomery '15	New Cumberland '17	Pike Island '18	Hannibal '21	Willow Island '16	Belleville '22	Racine '15	Robert C. Byrd '13	Greenup '16	Meldahl '17	Markland '21	McAlpine '21	Cannelton '16	Newburgh '17	John T. Myers '15	Smithland '13	Olmsted '22	Open Water '22
	Longear X Green																				
TEMPERATE BASS	Morone sp.			3		1		49	32	8	15	35	25	140	36	28	37	72	86	138	2
	White Perch																2				
	Striped Bass										1		3				4				
	White Bass	3	10	7	3		27	4	10	1	71	16	59	95	41	20	43	13	83	11	5
	Yellow Bass															1			15	2	5
	Hybrid Striped Bass			2			6		1	1	2	6	16	13	7	13	6	2	6	19	
BLACK BASS	Micropterus sp.	2			4	3		5			9		21	2		12	3	14			
	Smallmouth Bass	229	177	184	241	169	58	198	31	41	38	24	55	65	20	13	11	2	2	5	
	Largemouth Bass	3		12	16	17		20	15	19	18	18	6	19	20	4		2	10		
	Spotted Bass	7	17	6	28	25	18	46	32	17	60	59	46	120	74	48	50	133	48		1
DARTER	Johnny Darter			1																	
	Greenside Darter					1								1							
	Variegate Darter																				
	Rainbow Darter		1	2				1						1							
	Fantail Darter																				
	Bluebreast Darter																				
	Banded Darter																				
	Dusky Darter																				
	Channel Darter				1			1				1									
	Blackside Darter																				
	Slenderhead Darter																				
	River Darter																				
	Logperch	59	91	26	15	35	85	73	7	9	5	16	4	14	1	2		2		1	
PERCH	Yellow Perch	1		44	15	9	1	7						1							
	Walleye	26	19	68	29	9	5	1	1	1			1		12		7	5			
	Saugeye		16	42	1	1	12		1	25			14	78	152	2	23	4	4	7	
	Sauger	13	85	110	110	31	76	73	21	15	128	194	58	58	8	94	52	225	23	10	2
MISC.	Silver Lamprey	1	1									1									1
	Ohio Lamprey																				
MISCELLANEOUS	Goldeye																	10	1		2
	Mooneye	2		26	11	3		2	2		3	2		2	12	5	4	1		1	
	Paddlefish													1			1				
	Northern Pike	1																			
	Muskellunge	4																			
	White Crappie				2			1	1	2	1	6	2	3	1	3	3	7	2		1

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

Group	Species (common name)	Emsworth '18	Dashields '21	Montgomery '15	New Cumberland '17	Pike Island '18	Hannibal '21	Willow Island '16	Belleville '22	Racine '15	Robert C. Byrd '13	Greenup '16	Meldahl '17	Markland '21	McAlpine '21	Cannelton '16	Newburgh '17	John T. Myers '15	Smithland '13	Olmsted '22	Open Water '22
	Black Crappie	1		9	8		1	4		6		6	10	1	2		2	7	5	1	2
	Inland Silverside																		16	1	
	Brook Silverside		1		4			1									2	1	1		
	Atlantic Needlefish																				
	Trout-Perch	9	22	137	21	14	3		1												
	Banded Killifish				10	1	16	14													
	Western Mosquitofish																	1			
	Bowfin																				
	Freshwater Drum	17	20	36	34	8	44	16	70	36	89	116	158	151	86	47	157	114	328	576	53
Total No. of Individuals		**2158**	**3693**	**2260**	**3675**	**1666**	**2402**	**4755**	**2230**	**2957**	**2211**	**3666**	**3329**	**3650**	**1827**	**3507**	**1652**	**2518**	**3230**	**1368**	**309**
Total No. of Species		**41**	**37**	**42**	**48**	**43**	**42**	**49**	**40**	**40**	**41**	**45**	**45**	**49**	**45**	**43**	**45**	**47**	**43**	**35**	**33**