2015 Ohio River Pool Assessments

Montgomery, Racine, John T. Myers

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Ohio River Valley Water Sanitation Commission
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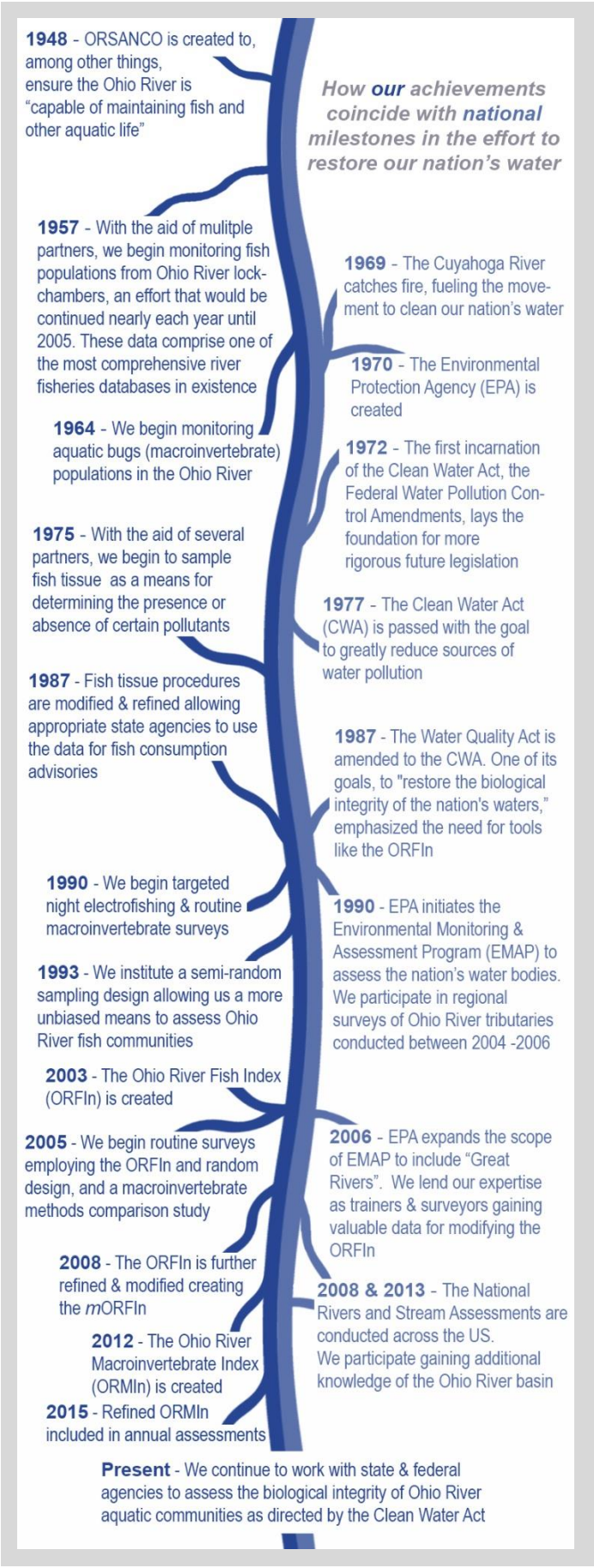
Introduction

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 and macroinvertebrate (macro) 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. Preexisting macro sampling was augmented to prescribe to this new random survey design. After years of biological collections on the Ohio River, two biological indices were developed (see figure on right for specifics). Each year we collect fish, macro, and environmental data from various sections of the Ohio River. These data are used to calculate index scores, which are numerical representations of the relative condition of Ohio River biological 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 findings of the 2015 surveys; the assessments of the Montgomery, Racine and J.T. Myers pools

The River

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

Facts

- Average depth 24 ft; max depth exceeds 90 ft
- Average width ½ mi; 1 mi max (Smithland Pool)
- ~350 fish species from Ohio River *basin* (24 exotic) = 37% of native U.S. fauna (881 species)
- ~180 fish species found in the Ohio *River* (17 exotic)
- Deciduous forests continue to dominate the basin
- Major land uses: pastures, row crops, and urban development
- Basin holds ~10% of the nation (27 million people)
- 33 drinking water intakes along the main stem provide drinking water for over 5 million people
- ~600 permitted discharges to the Ohio River
- 28 coal-fired power plants 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"

METHODS

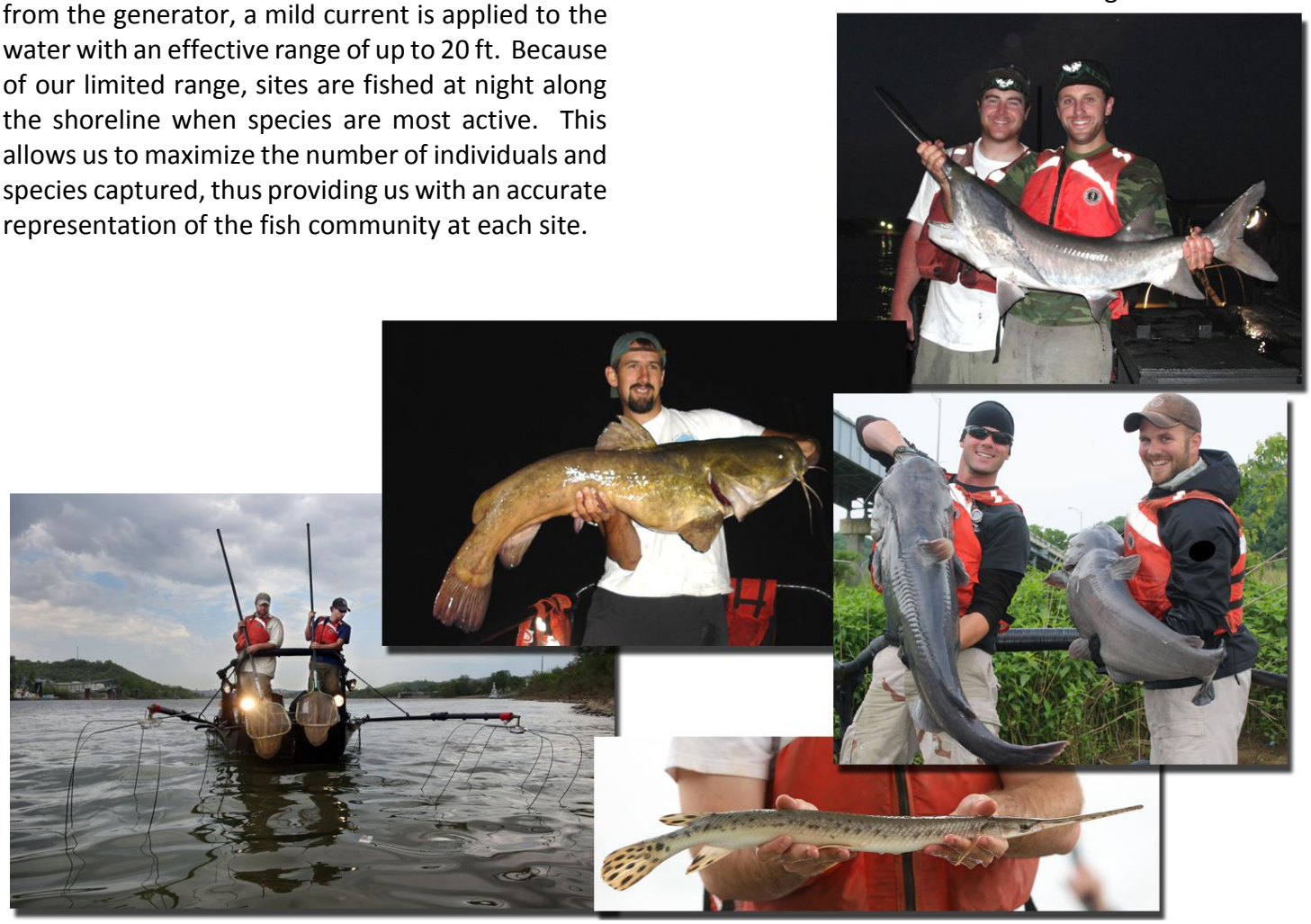
Site Selection

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

Collecting the Fish

To maintain consistency across different sampling years, fish surveys are conducted between July 1st and October 31st and when water levels are within 2 ft of "normal flat pool". The fish are collected by a non-lethal method called boat electrofishing using an 18 ft 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 20 ft. Because of our limited range, sites are fished at night along the shoreline when species are most active. This allows us to maximize the number of individuals and species captured, thus providing us with an accurate representation of the fish community at each site.

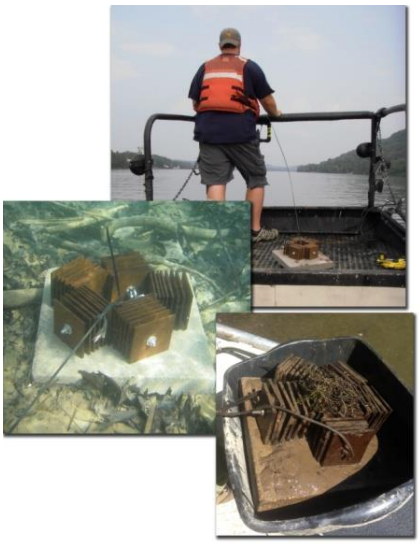
Sampling is conducted in a downstream manner for a minimum of 1800 seconds, during which all available habitats are sampled within 100ft from shore. When the fish encounter the electric field their muscles contract and they rise to the surface. The fish are then netted and placed into a live well were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



METHODS

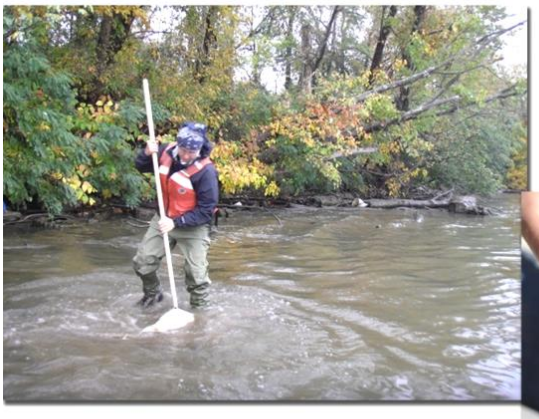
Collecting Macroinvertebrates

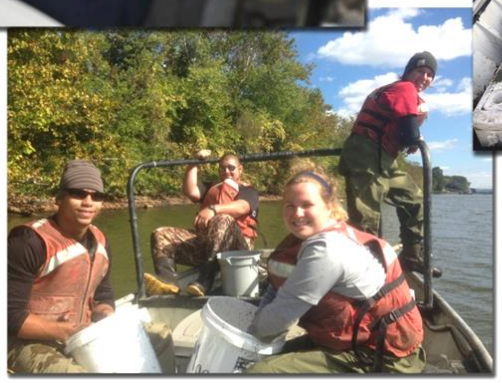
Two sampling methods are used to collect macroinvertebrates (macros); Hester-Dendy (HD) samplers and multi-habitat kicks (MH). HD samplers are constructed of tempered masonite cardboard cut into 3in square plates and 1in square spacers. Eight large plates and 12 spacers are stacked on a metal eyebolt 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.



An 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 scrapping 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 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.





Currently only HD samples are used to generate index scores. More collections are required to further refine and assess the usefulness of the MH technique relative to index development and application.

METHODS

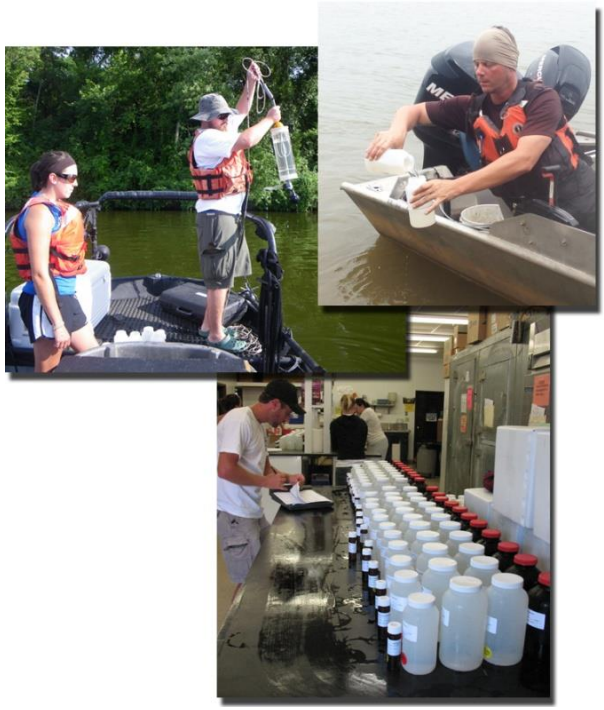
Characterizing Instream Habitat

Intensive habitat surveys are conducted which include measures of woody cover, depth, and prevalence of substrate types at each electrofishing site. Woody cover (submerged brush, logs, and stumps) is estimated visually. More quantitative measures of depth and substrate proportions are obtained through the use of a 20ft 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.

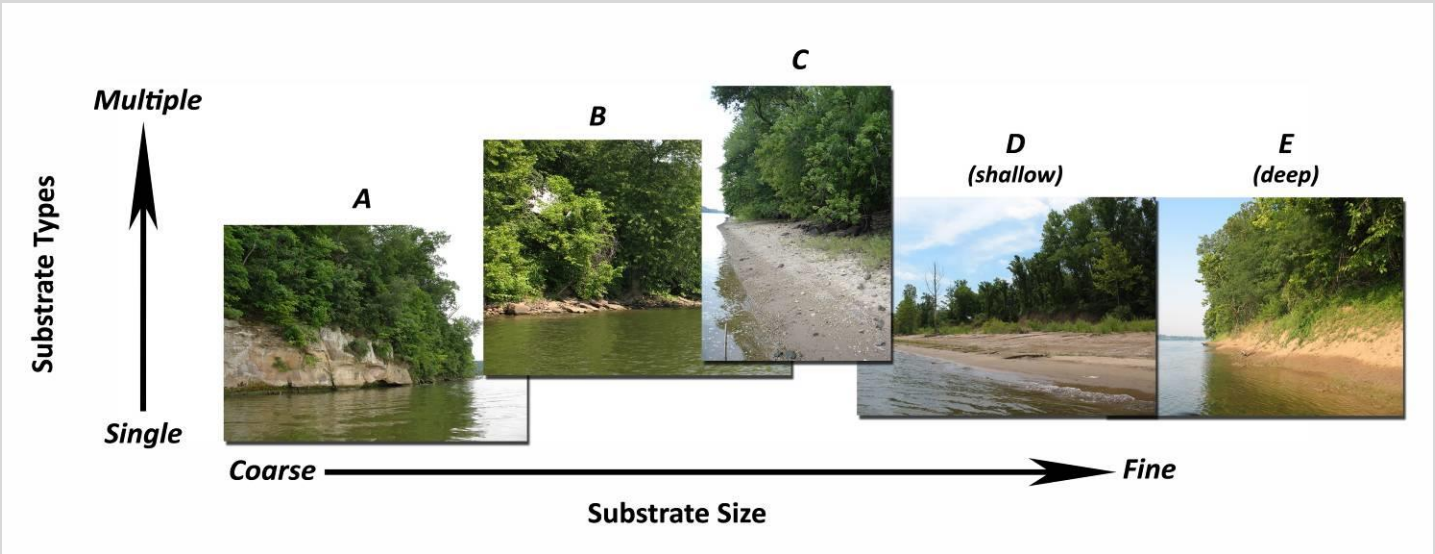
Because different fish and macro species prefer different habitat types, it is important to classify the instream habitat at each of our sites to better understand index score variability. Using the habitat survey data, we assign each site to one of five statistically derived habitat classes simply named: '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 chemistry samples may also be collected at the downstream end of each 500m zone approximately 100ft from shore to measure 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 modeled location to any particular site. These data are compiled to help interpret index results.



A look at our five habitat classes

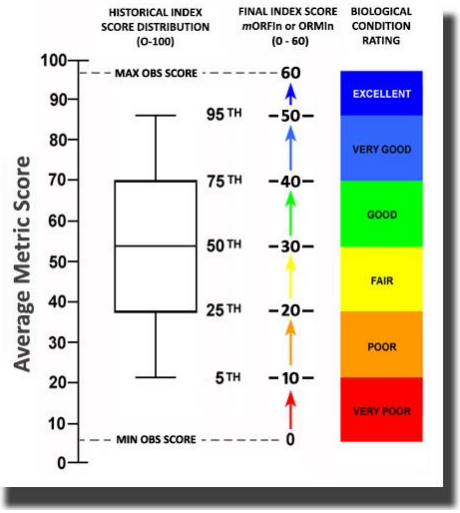


Assessing Biological Condition

ORSANCO uses two biological indices to assess the condition of the Ohio River. The modified Ohio River Fish Index (*m*ORFIn) and 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, and 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, and crappie species
Great River Species	No. of species primarily found in large rivers
% Piscivores	% of individuals (ind) that consume other fish
% Invertivores	% of ind that consume invertebrates
% Detritivores	% of ind that consume detritus (dead plant material)
% Tolerants	% of ind tolerant to pollution and habitat degradation
% Lithophils	% of ind belonging to breeding groups that require clean substrates for spawning
% Non-natives	% of ind not native to the Ohio River, including both exotics and hybrids
No. *DELT* anomalies	No. of ind with *D*eformities, *E*rosions, *L*esions, and *T*umors present
Catch per unit effort (*CPUE*)	Total abundance of individuals (minus exotics, hybrids, and tolerants)
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. Average index scores are then compared to the established biocriterion of 20.0.



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.

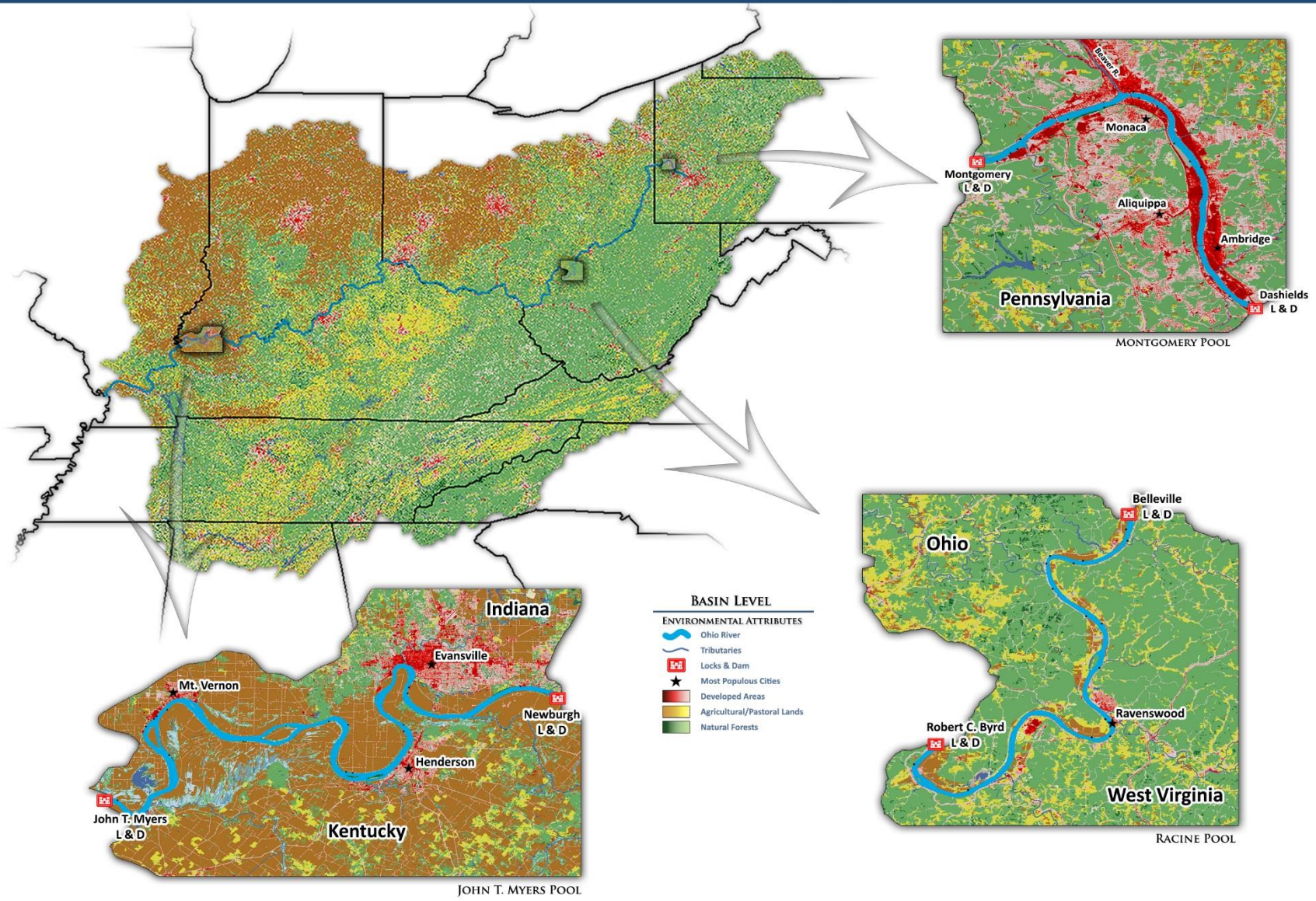
The average scores for both the *m*ORFIn and ORMIn are then compared to a biocriterion. The 25th percentile is the statistical threshold commonly used by regulatory agencies for establishing biocriteria. Using this threshold, our established biocriterion (i.e. a representation of healthy Ohio River fish 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 mORFIn and ORMIn scores are greater than or equal to 20.0 (i.e. a biological rating of '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

2015 Pool Survey Results

The results of the 2015 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.



Montgomery Pool

Racine Pool

John T. Myers Pool

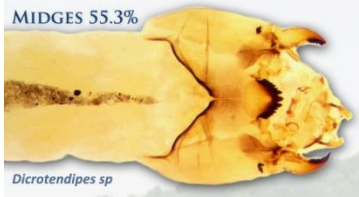
For more detailed catch, metric, and index scores visit www.orsanco.org/programs/biological-programs

Montgomery Pool (2015) - Healthy Condition

This page summarizes the 2015 fish and macroinvertebrate (macro) **surveys conducted by ORSANCO biologists in the Montgomery Pool of the Ohio River. Fish are collected via non-lethal electrofishing in the summer. Macros are collected in the fall from artificial substrate samplers placed in the water in late summer. Montgomery Pool is 18.5 miles long, extending from Dashields Locks and Dam** (ORM 13.2) **to Montgomery Locks and Dam** (ORM 31.7)**. The pool lies entirely within the state of Pennsylvania and the surrounding area is best described as an urban extension of Pittsburgh. This proximity to the largest metropolitan area on the river results in high volumes of industry, barge activity, and recreational boaters. Most of the pool's shorelines are modified, to some extent, with rocks/metal walls to curb shoreline erosion. Though aquatic vegetation is increasing, the most abundant aquatic habitat remains fallen timber** (trees and stumps)**. A major tributary to this pool, the Beaver River, is also heavily influenced by industry yet is still a valuable fishery and provides ample recreational access.**

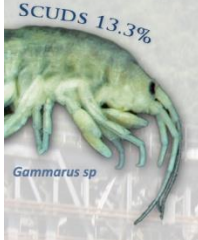
Dominant Macro Groups

Midges 55.3%



Dicrotendipes sp

Scuds 13.3%



Gammarus sp

Mussels 9.4%

Dreissena polymorpha

Caddisflies 3.3%

Cyrnellus fraternus

Snails 3.3%

Hydrobiidae sp

Boulder 5.0%

Cobble 12.0%

Gravel 19.4%

Sand 32.9%

Fines 29.8%

Hardpan 0.3%

Other 0.6%

Dominant Fish Families

Minnows 30.4%

Emerald Shiner

Suckers 27.3%

Silver Redhorse

Sunfish & Bass 14.4%

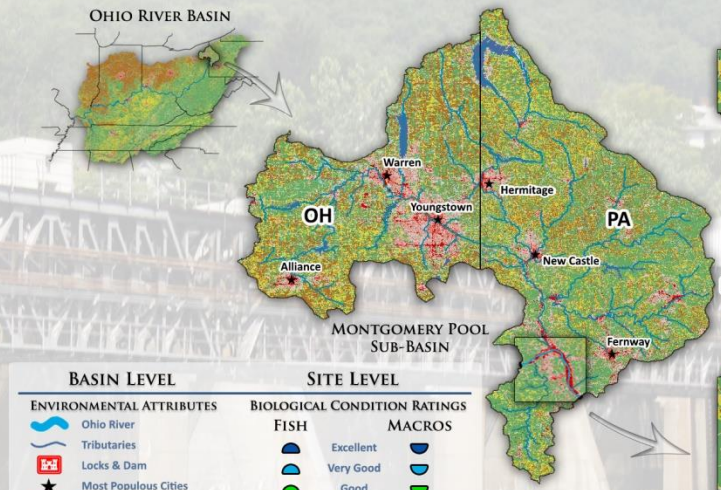
Smallmouth Bass

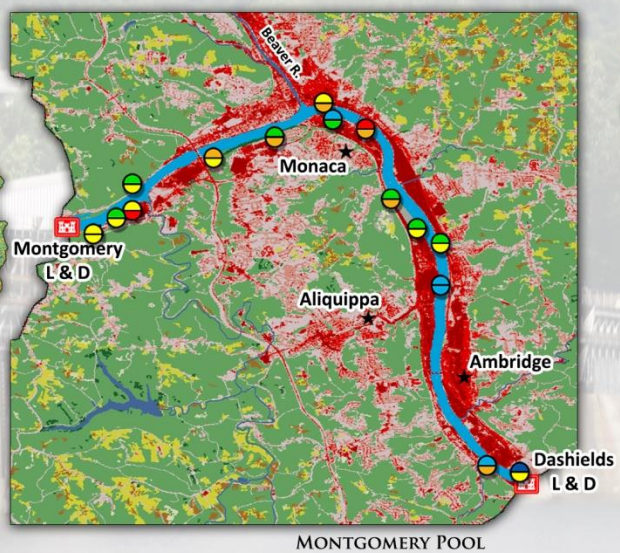
Perches 13.0%

Sauger

Trout-perch 6.1%

Trout-perch
(preserved specimen)





Montgomery Pool

Aquatic Invasives Watch

Survey Summary

Electrofishing sampling occurred as high waters were receding, after an extremely wet preceding spring. While the velocity of the water was still slightly elevated, water clarity was normal (32 inches) **and neither negatively affected sampling. Notable catches include Pennsylvania state threatened Mooneye** (*Hiodon tergisus*) **and a never before seen abundance of Trout-perch** (*Percopisis omiscomaycus*) **on the Ohio River mainstem** (137 vs 121 from the entire river since 1957 in 3400 sampling events)**. Notable macroinvertebrate collections included the dusky ancylid** (*Laevapex fuscus*) **a species of limpet commonly found in lakes, an invasive non-native predatory scud** (*Echinogammarus ischnus*)**, and an abundance of highly tolerant midge larvae** (*Dicrotendipes sp*)**. 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 in Montgomery Pool were in 'Good' condition and the macros were in 'Fair' condition. Overall, while these results indicate that Montgomery Pool harbored healthy aquatic communities, close attention will be paid to macroinvertebrates in the future for signs of chronic degradation.**

Pool Substrate Composition

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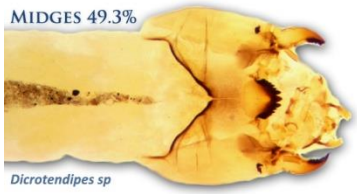
Racine Pool (2015) - Healthy Condition

Dominant Macro Groups

Midges 49.3%



Dicrotendipes sp

Caddisflies 17.1%

Cyrnellus fraternus

Mussels 11.1%

Dreissena polymorpha

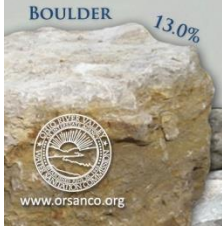
Snails 6.9%

Hydrobiidae sp

Scuds 3.9%

Gammarus sp

Boulder 13.0%



Dominant Fish Families

Minnows 70.6%

Emerald Shiner

Sunfish 11.2%

Bluegill

Suckers 5.2%

Golden Redhorse

Shad 5.0%

Gizzard Shad

Catfish 2.6%

Channel Catfish

Aquatic Invasives Watch

Survey Summary

This page summarizes the 2015 fish and macroinvertebrate (macro) surveys conducted by ORSANCO biologists in the John T. Myers Pool of the Ohio River. Fish are collected via non-lethal electrofishing in the summer. Macros are collected in the fall from artificial substrate samplers placed in the water in late summer. The Racine Pool is 33.6 miles long, extending from Belleville Locks and Dam (ORM 203.9) to Racine Locks and Dam (ORM 237.5). The pool is bordered by the states of Ohio and West Virginia, and lies in a relatively undeveloped portion of the basin, with little influence of industry. Amid the naturally forested areas, the little development that is present is mostly residential. The majority of the pool shorelines are relatively shallow with a mix of fines and sand. These shoreline conditions are conducive to the growth of aquatic vegetation, facilitated by the vast invasive *Hydrilla* beds found throughout the pool. The Racine Pool receives water from several small tributaries with drainage areas all less than 230 square miles: Shade River (OH), Shady Creek (WV), and Mill Creek (WV).

Though the pool experienced a prolonged period of high water during the spring, water velocity was only slightly elevated and water clarity was exceptional (60 inches) **at the time of fish sampling. The 2015 fish results continued the trends of decreasing pelagic predators** (White Bass - *Morone chrysops*, Sauger - *Sander canadensis*) **and increasing phytophils** (Bluegill - *Lepomis macrochirus*, Common Carp - *Cyprinus carpio*) **observed since the arrival of the invasive aquatic plant** *Hydrilla verticillata*. **Notable macroinvertebrate collections from Racine Pool included several intolerant species; the flat-headed mayfly** (*Maccaffertium vicarium*), **smoky shadowdragon** (*Neurocordulia molesta*), **and a rarely encountered stonefly** (*Acroneuria sp*). **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 Racine Pool were in 'Good' condition, even given the observed shift in species composition. Macro sampling indicates that those communities were in 'Fair' condition. Overall, these results indicate that Racine Pool harbored healthy aquatic communities.**

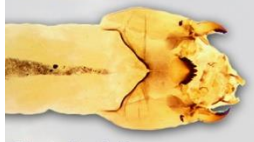
John T. Myers Pool (2015) - Healthy Condition

Dominant Macro Groups

Mussels 59.3%

Dreissena polymorpha

Midges 22.1%



Dicrotendipes lucifer

Caddisflies 3.3%

Cyrnellus fraternus

Scuds 2.3%

Apocorophium lacustre

Worms 1.2%

Naididae sp

Boulder 8.7%

Cobble 1.4%

Gravel 11.2%

Sand 38.5%

Fines 31.5%

Hardpan 4.9%

Other 3.8%

Dominant Fish Families

Shad 26.0%

Gizzard Shad

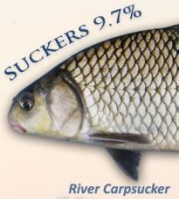
Minnows 25.4%

Spotfin Shiner

Sunfish 14.9%

Spotted Bass

Suckers 9.7%



River Carpsucker

Perches 9.4%

Sauger

John T. Myers 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 Ohio River was elevated for much of the spring and early summer, but was receding by July when sampling occurred. Residual suspended sediments slightly decreased water clarity (25 inches) **though velocities were normal and neither negatively affected sampling. Notable catches include Kentucky species of concern Black Buffalo** (*Ictiobus niger*) **and several Walleye** (*Sander vitreus*) **which are more common in the upper Ohio River. Notable macroinvertebrate collections included the midland siltsnail** (*Cincinnatia cincinnatiensis*) **an uncommon main stem species imperiled throughout parts of the basin and an abundance of invasive non-native predatory scuds** (*Apocorophium lacustre*)**. 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, both the fish and macros in John T. Myers Pool were in 'Good' condition. Overall, these results indicate that John T. Myers Pool harbored healthy aquatic communities.**

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CONCLUSIONS

Pool Surveys

The 2015 pool surveys for fish populations were successfully completed between July 20th and August 6th as the river recovered from unseasonably high early summer flows. Macro sampling was completed between September 3rd and October 15th. ORSANCO's Biological Water Quality Subcommittee recommended that all three pools surveyed during the 2015 field season should be assessed as *meeting* their aquatic life-use designations (i.e. containing healthy fish and macro communities).

Montgomery (Fish = GOOD, Macros = FAIR)

Survey sites were relatively well distributed throughout the pool with only a five mile gap in the upper section. Mixed substrates (C) made up the majority of the habitats sampled, with some coarser habitats (B) and sand flats (D) also encountered. The invasive submerged aquatic plant Hydrilla covered only small patches of 1/3 of the survey sites. Forty fish species and two hybrids were collected and were represented by a very evenly distributed community, with the most dominant species (Channel Shiner) comprising just over 14% of all individuals. The minnows and carp family overall accounted for 30% of the total catch. Silver Redhorse was the 3rd most abundant species and combined with 10 other sucker species to make up an additional 27%. An extremely notable amount of Trout-Perch was encountered as crews collected more individuals in this survey than ORSANCO has ever recorded in 3400 sampling events since 1957. Additionally, 26 state-threatened (PA) Mooneye were collected. Notable macro records include dusky ancylid (a limpet commonly found in lakes), an invasive, predatory scud, and an abundance of highly tolerant midge larvae.

Racine (Fish = GOOD, Macros = FAIR)

Most of the survey sites were located in the upper 20 miles of the pool, followed by a nine mile gap and then the final two sites. Habitat types were very evenly distributed among B, C, D, and E, with no A habitats. Very large patches of Hydrilla were observed at nearly all sites. Thirty six fish species and three hybrids were encountered with the catch being dominated by a single species, Emerald Shiner (41%). A 2nd shiner, Channel Shiner, made up an additional 25% of the catch, with no other species comprising more than 8% and the minnow and carp family accounting for over 70% of all individuals. No Ohio state-listed species were encountered (WV does not have a list). Notable macro records include the flat-headed mayfly, smoky shadowdragon, and a stonefly (rare in the Ohio River).

J.T. Myers (Fish = GOOD, Macros = GOOD)

Survey sites were not very evenly distributed throughout the pool, with three gaps of 10-15 miles each and four sites within 2 miles. Habitats sampled were primarily sand flats (D), with some mixed substrates (C) and a single deep, soft-substrate site (E). No submerged aquatic vegetation was recorded from the pool. A total of 43 fish species and two hybrids was encountered, with Gizzard Shad accounting for a quarter of the catch and the minnow and carp family making up another quarter. A large number of Sauger was encountered as the species was the 3rd most common and made up 9% of the catch. A single Western Mosquitofish (very rare in the Ohio River) was collected, becoming ORSANCO's 3rd individual ever collected from the river, and just the 2nd in electrofishing surveys. No state-listed fish (KY or IN) were encountered. Notable macro records include the midland siltsnail (an uncommon main stem species imperiled throughout parts of the basin) and an abundance of an invasive, predatory scud.

Assessment Comparisons

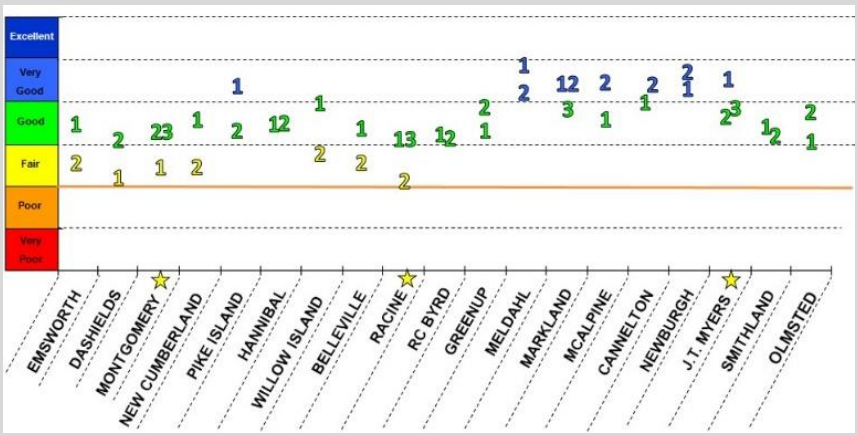
Between 2005 and 2014, all 19 Ohio River navigational pools were surveyed and assessed twice. Both cycles revealed the majority of the river to be in 'Good' condition, even though some pools changed a condition rating between surveys. The 2015 surveys continued the third cycle which enhances our ability to detect riverwide patterns. Some of the index and species variability observed across pools (see final table, pg 16) may be due in part to variations in natural distributions, instream habitat, invasive species distributions, and annual variations in flow/weather conditions as well as water quality differences.

CONCLUSIONS

River-wide Assessment Comparison

The 2015 surveys (☆) had similar condition ratings to their neighboring pools. Reasons for the variability of ratings across the pools include, but are not limited to varying degrees of anthropogenic land uses (which can affect habitat and water quality) and proximity to tributaries (which can affect species diversity based upon the biological condition of the tributary).

1 = 1st cycle (2005 - 2009)
2 = 2nd cycle (2009 - 2014)
3 = 3rd cycle (2014 - 2020)



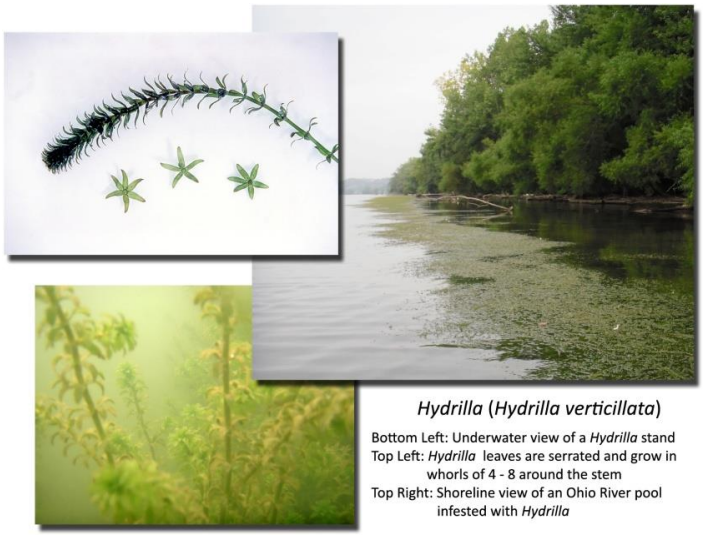
Past vs. Present Assessments

The focus of ORSANCO's biological assessments is to determine whether each pool 'meets' or 'fails to meet' its designated aquatic life use. To aid in interpretation, we apply six ratings (from 'Very Poor' to 'Excellent') to the pools based on the relative condition of their fish communities. Shifts between years in these condition ratings may be due to variations in environmental factors other than water quality changes. By examining these factors (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 years.

Montgomery Pool (2006, 2010, 2015)

Variable	2006	2010	2015
Environmental Factors			
Avg. seasonal flow (cfs)	21,606	10,867	32,130
Secchi Depth (in)	35	55	31
Conductivity (uS/cm)	260	475	267
Avg. CPUE Score (0-100)	9	41	10
Gizzard Shad	242	4159	23
Emerald Shiners	8	447	182
Avg. Non-Native Score	69	82	56
Saugeye	0	0	33
Avg. Intolerant Score	32	50	64
Channel Shiner	13	224	261
Mooneye	5	6	24
River & Black Redhorse	3	18	40
Avg. mORFIn Score (0-100)	24	33	32
Fish Condition Rating	**Fair**	**Good**	**Good**

In 2006 the pool experienced elevated flows and was determined to be in *Fair* condition. In 2010 the pool experienced normal to low flows and subsequently improved to good condition, driven by increases in six metric scores. In 2015, sampling occurred during receding high flows. Even though flows during the time of sampling more closely matched 2006 than 2010, metric and index results changed only very marginally from 2010. The large numbers of several minnow species in 2010 and 2015 relative to 2006 directly increased several metric scores (Invertivores, Intolerants, etc.), while also indirectly increasing scores of some negative proportional metrics (Tolerants and Non-Natives). The 2015 survey was also positively influenced by an unprecedented number of Trout-Perch (invertivore) and relatively large numbers of native species such as Walleye (piscivore, simple lithophil), Yellow Perch, and Mooneye (great river species). For the 2nd straight survey, the pool was determined to be in *Good* condition, almost exactly matching the same level of biological integrity as the 2010 survey.



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

CONCLUSIONS

Racine Pool (2006, 2010, 2015)

Variable	2006	2010	2015
Environmental Factors			
Avg. seasonal flow (cfs)	19,095	16,951	22,796
Secchi Depth (in)	52	38	60
Conductivity (uS/cm)	568	582	362
Sucker species Score (0-100)	42	25	46
% Piscivores Score (0-100)	60	48	20
Largemouth Bass	22	58	19
Morone sp.	561	191	8
Sauger	173	51	15
% Tolerants Score (0-100)	86	58	88
Common Carp	9	43	3
% Invertivore Score (0-100)	20	32	79
Channel Shiner	402	178	733
% Non-native Score (0-100)	80	62	80
Common Carp	9	43	3
Avg. mORFIn Score (0-100)	31	21	31
Fish Condition Rating	**Good**	**Fair**	**Good**

In 2005 Racine pool graded out in *Good* condition due in part to strong Tolerant, DELT, Non-native and CPUE scores. Condition dropped to *Fair* in 2010 as those same metrics declined sharply, possibly due in part to abnormally high water temperatures (>90°F) observed during surveys. The decreases in Tolerant and Non-native scores were influenced heavily by 5x more Common Carp in 2010 than in 2006. In 2015 biological condition rebounded to *Good* condition as the number of Common Carp and the associated metrics returned to values similar to 2005 observations. Additionally, Detritivore and Invertivore scores (both were driven directly or indirectly by the large amount of Channel Shiners) were stronger in 2015 than in previous years. It is important to note that the nearly ubiquitous presence and influence of *H. verticillata* likely contributed to increased numbers of centrarchids, detritivores and invertivores in littoral zones. Pelagic piscivores, more typical of a lotic environment, continued a pattern of decline.

J.T. Myers Pool (2005, 2010, 2015)

Variable	2005	2010	2015
Environmental Factors			
Avg. seasonal flow	36,670	49,038	56,071
Secchi Depth (in)	33	28	25
Conductivity (uS/cm	469	409	344
Great River Score (0-100)	87	49	69
Goldeye	0	3	10
Skipjack Herring	251	0	5
% Lithophils Score (0-100)	43	19	39
Sauger	555	81	225
River Shiner	105	16	104
% Invertivore Score (0-100)	32	72	57
Channel Shiner	55	414	255
% Piscivore Score (0-100)	43	25	34
Sauger	555	81	225
Spotted Bass	131	43	133
Largemouth Bass	156	2	2
Morone sp	298	21	72
Avg. mORFIn score (0-100)	45	36	38
Fish Condition Rating	**Very Good**	**Good**	**Good**

In 2005 the pool received a *Very Good* condition rating thanks to strong Great River, Tolerant, and Non-Native scores. These results were somewhat atypical due to extremely low flows and that the survey was conducted in October when most surveys are completed in July and August. The pool was sampled in 2010 under more typical flow regimes in July and dropped to *Good* condition as Tolerant, Non-Native, and CPUE scores declined due primarily to less fish overall and more Silver Carp and Common Carp. In addition, lower numbers of simple lithophils and piscivores were observed between 2005 and 2010. In 2015 sampling was conducted in early August and condition also fell within the *Good* category, although some metric scores improved overall. Flows were elevated for much of the spring and early summer and were still receding when sampling occurred. Overall metric scores did not change much from the prior survey.

Another Biological Indicator

A third five year cycle of surveys and assessments was initiated in 2014 and continued in 2015. It will be during this new cycle that ORSANCO Biological staff will incorporate an additional indicator into the annual assessment process…macroinvertebrates.

Macroinvertebrates (macros) are organisms that lack a true backbone and can be seen with the naked eye and 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).

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 Left: black-shouldered spinyleg dragonfly (*Dromogomphus spinosus*)

ORSANCO Biological staff have surveyed macro populations in the Ohio River since 1964 due to their potential importance as water quality indicators. Current sampling involves both an active and passive technique. The passive technique employs Hester-Dendy (HD) samplers. Named for the scientists that developed this simple device, an HD is constructed of compressed particle board squares layered on a threaded eye bolt. Clusters of five HDs are placed in 10' of water near each electrofishing site and are retrieved after six weeks. During this period the textured surface and spacing of the layers provides ample surface for the colonization of nearby macros.

The second technique involves actively "kicking and sweeping" for macros with a D-frame net. These kicks are performed when the HDs are retrieved, in the fall, and are stratified throughout the 500m zone to ensure a representative sample. By disturbing the substrate and sweeping through the resulting eddies, macros can be sampled from a variety of habitats (e.g. tiny cracks of rocky shorelines to vegetated mud flats), hence the name for this method; multi-habitat (MH) sampling.

A New Assessment Tool

The data from HD and MH samples are combined to generate an index score for each of the 15 randomly chosen sites in each pool. As with the fish index, macro index scores are calculated based on various measures of the macro communities. Also identical to the fish index, these scores are compared to the historical performance of sites with similar habitat types to determine final Ohio River Macroinvertebrate Index (ORMIn) scores and the 15 site scores are averaged to obtain a pool condition rating (See page 6).

The creation of the ORMIn was important because macros are responsive to localized water and sediment quality changes, whereas the *m*ORFIn has shown response to broad–scale environmental changes. Combining the knowledge gleaned from both of these aquatic communities allows for a more robust and accurate assessment of pool condition.

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

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '15	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '15	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '15	Smithland '13	Open Water '14
GAR	Longnose Gar	23	19	**11**	19	16	64	30	28	**64**	25	33	18	28	24	20	16	**16**	11	61
	Spotted Gar																1		2	
	Shortnose Gar																12	**12**	28	101
SHAD	Skipjack Herring		1				1				1		18		1	1	79	**5**	2	1
	Gizzard Shad	3417	37	**26**	1097	5092	43	397	117	**147**	176	120	17703	274	54	709	10834	**650**	557	278
	Threadfin Shad																7		14	74
CARP	Common Carp	48	70	**45**	19	36	46	40	26	**3**	32	12	9	5	4	4	7	**8**	7	2
	Grass Carp								1											1
	Silver Carp														1			**15**	17	25
	Bighead Carp																			
	Goldfish								1									**1**		
	Carp x Goldfish	1																		
MINNOW	Cyprinidae sp.																			
	Golden Shiner								1											1
	Striped Shiner				1	7									5					
	Spottail Shiner			**4**	2			4	2	**4**	1				3					
	Spotfin Shiner	77	35	**68**	21	62	72	63	58	**127**	19	65	26	10	28	39	39	**112**	218	14
	Notropis sp.																			
	Emerald Shiner	848	46	**216**	1525	892	79	948	240	**1208**	172	1557	1837	470	227	2195	720	**102**	86	20
	Silverband Shiner																			
	Sand Shiner																			
	Channel Shiner	492	108	**323**	685	481	167	532	410	**733**	684	944	689	897	609	2787	465	**255**	102	47
	River Shiner								5				34	156	30	94	64	**104**	8	15
	Shoal Chub																			
	Silver Chub				2				1		1	12	24	33	51	79	22	**10**	12	10
	Streamline Chub	11	1																	
	River Chub											8								
	Gravel Chub																			
	Creek Chub																			
	Central Stoneroller						1							1	3					
	Mississippi Silvery																		15	
	Suckermouth Minnow																			
	Bluntnose Minnow	120	1	**30**	98	28	98	190	8	**12**		4	4	4	2	2	8	**9**		2
	Bullhead Minnow							2	5		1	25	25	2	1	36	13	**24**	1	6

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

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '15	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '15	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '15	Smithland '13	Open Water '14
	Silverjaw Minnow																			
SUCKER	Ictiobinae sp.																			
	Ictiobus sp.																1			
	Smallmouth Buffalo	51	84	**82**	68	58	40	50	38	**33**	32	25	44	89	31	23	10	**32**	106	32
	Bigmouth Buffalo															1		**4**	4	5
	Black Buffalo	1	4	**18**			4		7			1	1	5	4		2	**2**		10
	Carpiodes sp.					1			1					1						1
	Quillback	1	13	**6**	14	9	14	6	7	**3**	12	11	12	61	9	17	9	**7**	31	5
	River Carpsucker	8	47	**47**	23	36	33	16	33	**20**	26	55	172	221	161	363	146	**187**	263	139
	Highfin Carpsucker	5	14	**12**	5	1	5		3	**8**	1		8	4	4		2	**3**	91	3
	Northern Hog Sucker	3		**6**	2	6	6		1	**5**	2	2	1		6					
	Moxostoma sp.						3				1	3				3				
	Shorthead Redhorse																			10
	Smallmouth Redhorse	33	153	**27**	11	16	54	27	61	**11**	22	44	14	44	31	14	1			
	Silver Redhorse	75	252	**215**	70	23	59	12	31	**16**	22	19	19	19	14		1			
	River Redhorse	14	65	**23**		2	12	5		**2**	6	2			1					
	Black Redhorse	8	10	**25**		3	16													
	Golden Redhorse	56	155	**156**	216	93	273	63	64	**56**	56	34	44	26	67	2	10	**8**		1
	Spotted Sucker						4	4	8	**1**		1		1	1					
	White Sucker																			
CATFISH	Yellow Bullhead							1							1					
	Brown Bullhead																			
	Northern Madtom																			
	Blue Catfish													2				**1**	5	
	Channel Catfish	35	63	**83**	201	54	83	91	177	**52**	114	295	70	112	122	287	223	**106**	478	65
	Flathead Catfish	19	6	**8**	15	47	39	17	36	**24**	40	37	24	21	19	32	14	**20**	30	12
SUNFISH	Lepomis sp.											1		2	2					5
	Warmouth														3	1				
	Rock Bass	75	89	**22**	15	24	64	15	2			4								
	Bluegill	154	34	**88**	192	131	523	653	391	**220**	254	337	212	207	89	247	94	**65**	270	41
	Green Sunfish	3	3	**1**		3	2	1	1	**4**	4	3	2	1	1	7	3	**1**		4
	Pumpkinseed	4	4	**3**	2	2	33	25		**2**	6	2								
	Orangespotted Sunfish				2		5	20		**5**		3	2					**6**	1	
	Longear Sunfish	2	1		2	8	242	141	24	**13**	56	26	73	71	65	117	293	**137**	207	16

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

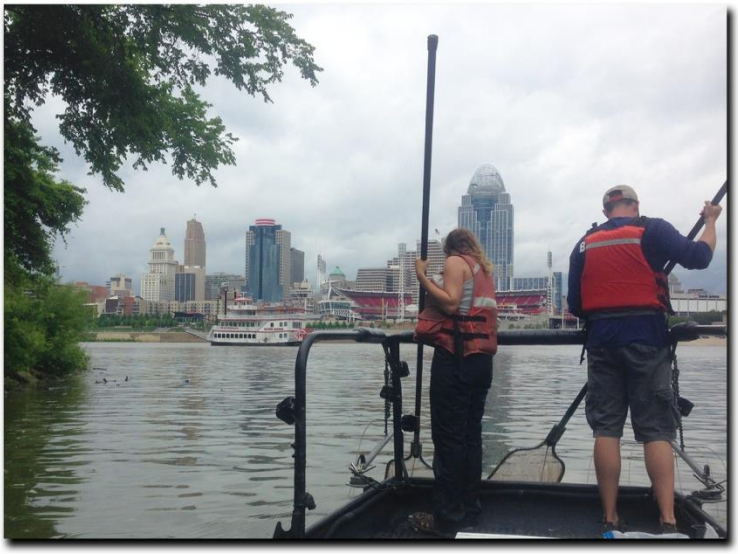
Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '15	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '15	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '15	Smithland '13	Open Water '14
SUNFISH	Redear Sunfish		1					1	7	**2**	3	1		2	1	15	3	**1**	32	
	Lepomis Hybrid					1	2		1		2	1		1					2	
	Bluegill X Longear							1												
	Bluegill X Green									**1**										
	Longear X Green											1								
TEMPERATE BASS	Morone sp.	50		**3**	22	110	12	54	79	**8**	15	55	289	11	81	54	361	**72**	86	733
	White Perch							1												
	Striped Bass								1		1						4			
	White Bass	6	65	**7**	37	2	28	13	16	**1**	71	19	1	18	18	6	60	**13**	83	34
	Yellow Bass															2			15	25
	Hybrid Striped Bass	1	5	**2**			2	7	3	**1**	2	10	3	3	1	2	22	**2**	6	10
BLACK BASS	Micropterus sp.	57	1					2			9		79	10	18		3	**14**		16
	Smallmouth Bass	167	250	**184**	155	431	270	155	27	**41**	38	47	30	19	15	27	33	**2**	2	7
	Largemouth Bass	8	3	**12**	2	8	7	50	10	**19**	18	38	21	12	10	32	72	**2**	10	6
	Spotted Bass	24	18	**6**	48	77	99	79	26	**17**	60	127	86	51	38	58	252	**133**	48	26
DARTER	Johnny Darter			**1**																
	Greenside Darter					8	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												1							
	River Darter						2							1						
	Logperch	29	15	**26**	17	40	89	17	5	**9**	5	1	2	14	9			**2**		2
PERCH	Yellow Perch			**44**	5		5	2	3											
	Walleye	20	74	**68**	2	2	10	6	13	**1**		2	2		1	1		**5**		
	Saugeye	2	11	**42**			1	44	25	**25**				22	8		11	**4**	4	6
	Sauger	39	264	**110**	29	39	147	68	89	**15**	128	91	124	116	226	138	44	**225**	23	46
MISC.	Silver Lamprey																			
	Ohio Lamprey		2						1											

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

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '15	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '15	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '15	Smithland '13	Open Water '14
MISCELLANEOUS	Goldeye														1			**10**	1	
	Mooneye	10	1	**26**	11	2	2	6			3	4	6	5	1		4	**1**		1
	Paddlefish																1			
	Northern Pike					1														
	Muskellunge		1																	
	White Crappie	2						1	4	**2**	1	7		4	1	21	2	**7**	2	1
	Black Crappie	1	4	**9**	1	1	1	5	6	**6**		4		2		7		**7**	5	
	Inland Silverside																		16	14
	Brook Silverside	14			11	10	3	2							1	5	5	**1**	1	
	Atlantic Needlefish																			
	Trout-Perch		11	**137**					2											
	Banded Killifish						5	30	1											
	Western Mosquitofish																	**1**		
	Bowfin											1								
	Freshwater Drum	55	136	**36**	201	239	47	172	82	**36**	89	329	686	146	238	520	507	**114**	328	746
	Total No. of Individuals	6071	2177	**2260**	4849	8103	2819	4070	2190	**2957**	2211	4423	22416	3207	2345	7968	14480	**2518**	3230	2680
	Total No. of Species	46	38	**42**	39	42	48	48	52	**40**	33	47	41	47	54	38	44	**47**	36	46

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

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



Our assessments would not be possible without the guidance of our committee and hard work of our seasonal interns and contractual employees. For information on our yearly internships, available to current and recently graduated students, contact Rob Tewes (*rtewes@orsanco.org*).