2014 Ohio River Pool Assessments

Belleville, Markland, McAlpine, and Olmsted

ORSANCO Biological Programs

Ohio River Valley Water Sanitation Commission
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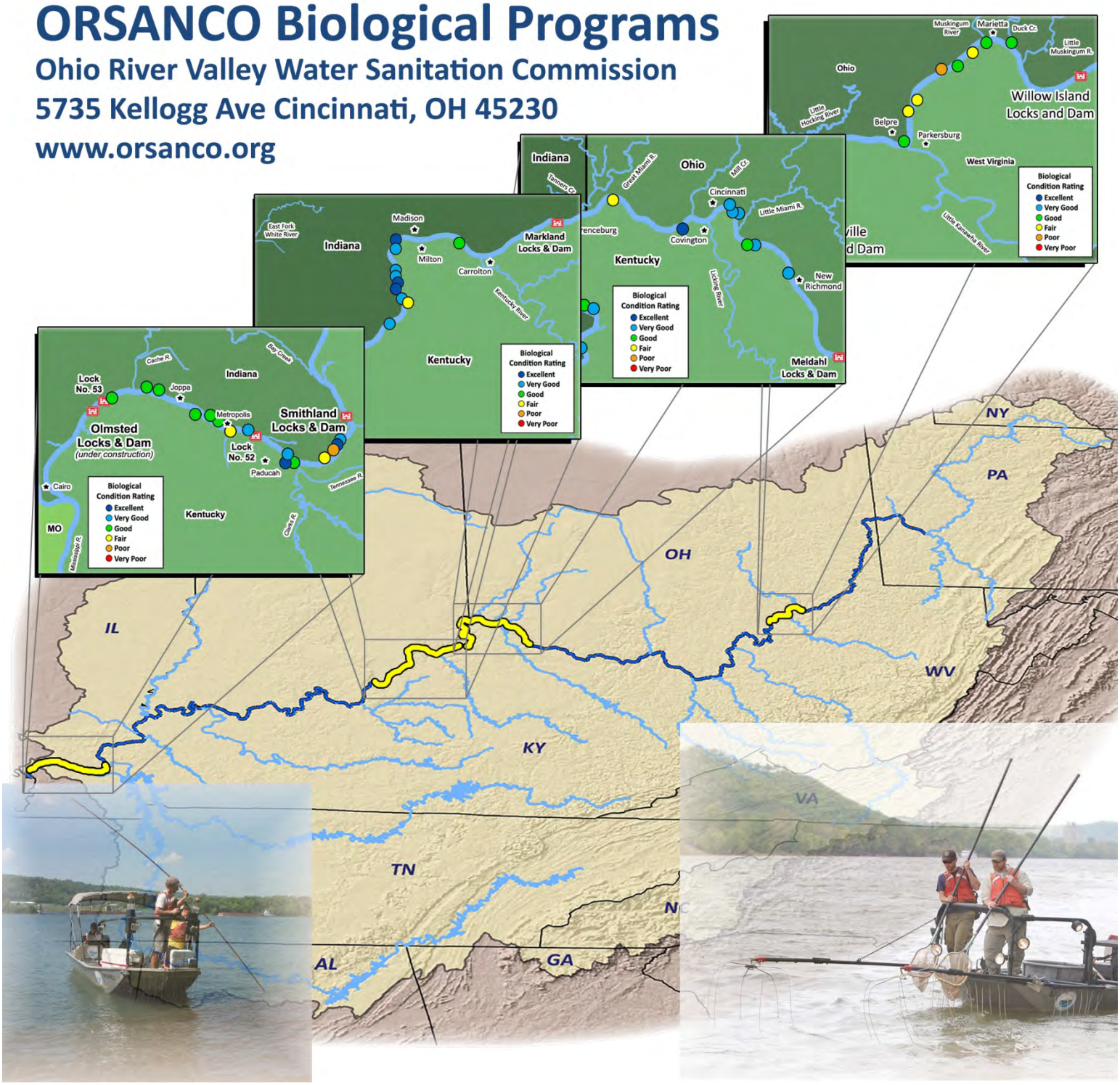

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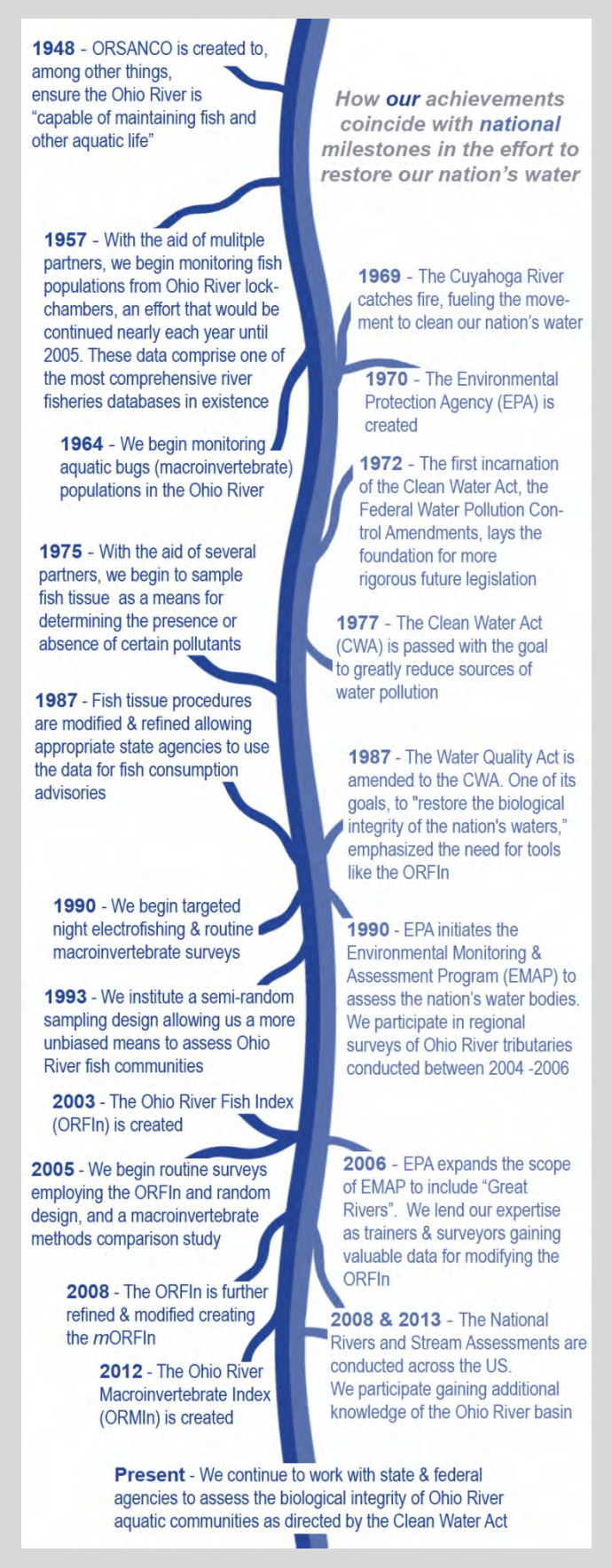
Introduction

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 findings of the 2014 surveys; the assessments of the Belleville, Markland, McAlpine, and Olmsted 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)
- ~344 fish species from Ohio River *basin* (18 exotic) = 40% of known N. American fauna (800 species)
- ~178 fish species found in the Ohio *River* (14 exotic)
- Deciduous forests continue to dominate the basin
- Major land uses: pastures, row crops, and urban development
- Basin holds ~10% of the nation (27 million people)
- 33 drinking water intakes along the main stem provide drinking water for over 5 million people
- ~600 permitted discharges to the Ohio River
- 49 power-generating facilities on the main stem
- Coal and energy products comprise 70% of the 250 million tons of cargo carried by barges each year

The OHIO…
Iroquoian for "great river"

METHODS

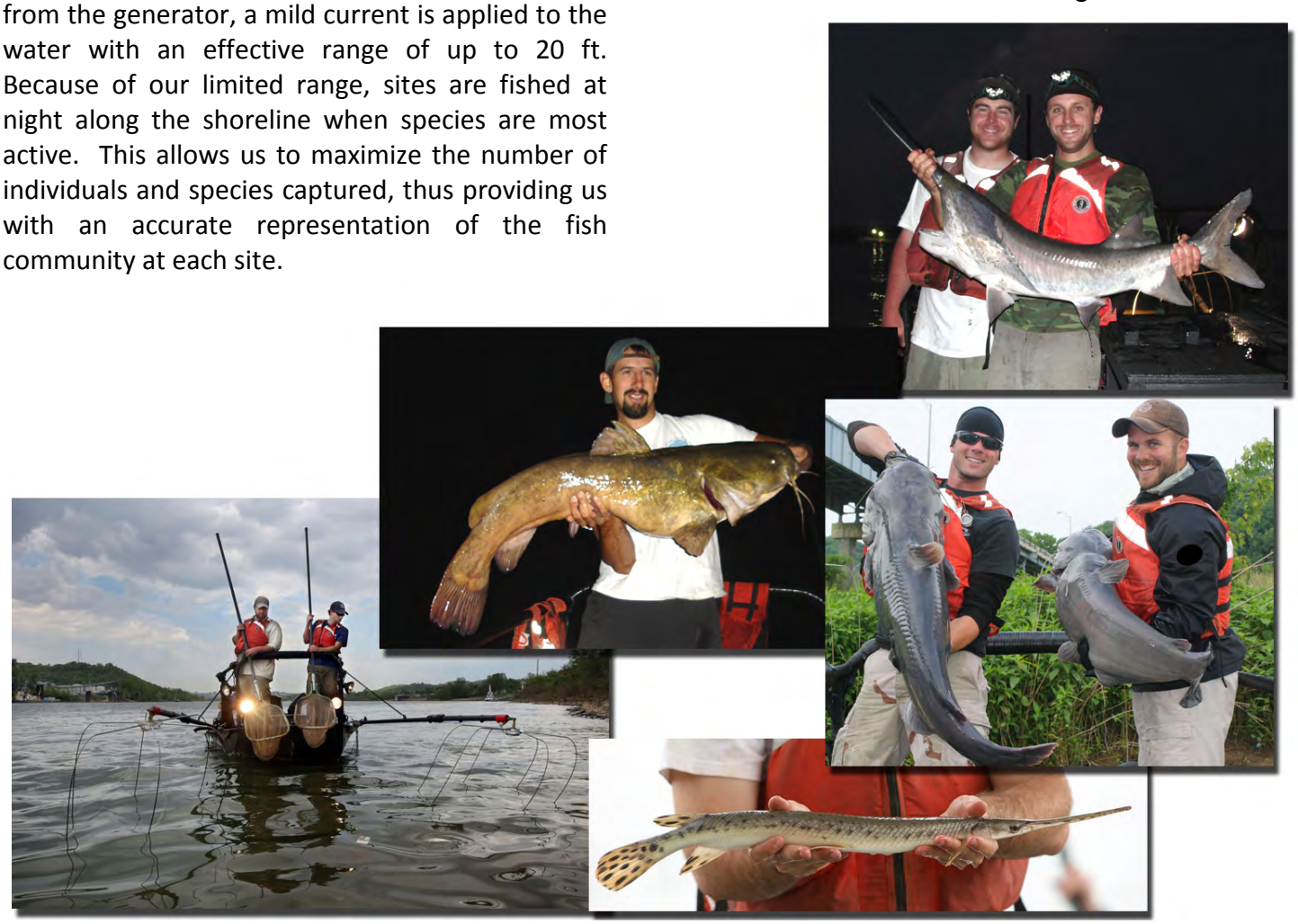
Site Selection

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

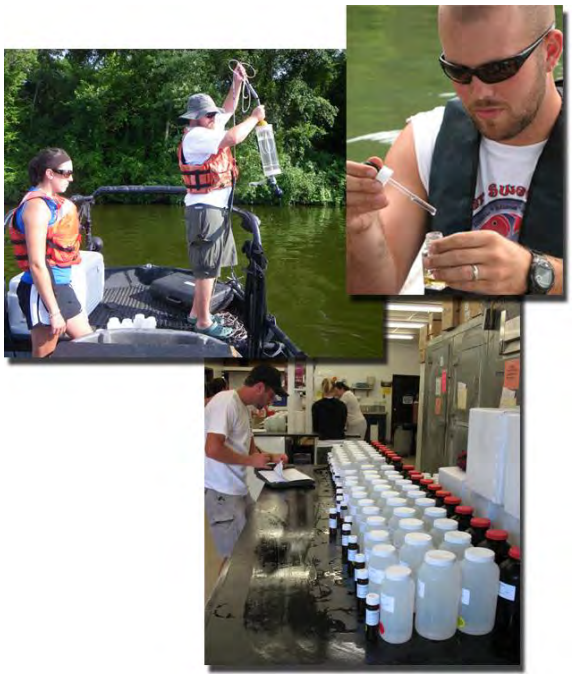
Characterizing Instream Habitat

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.

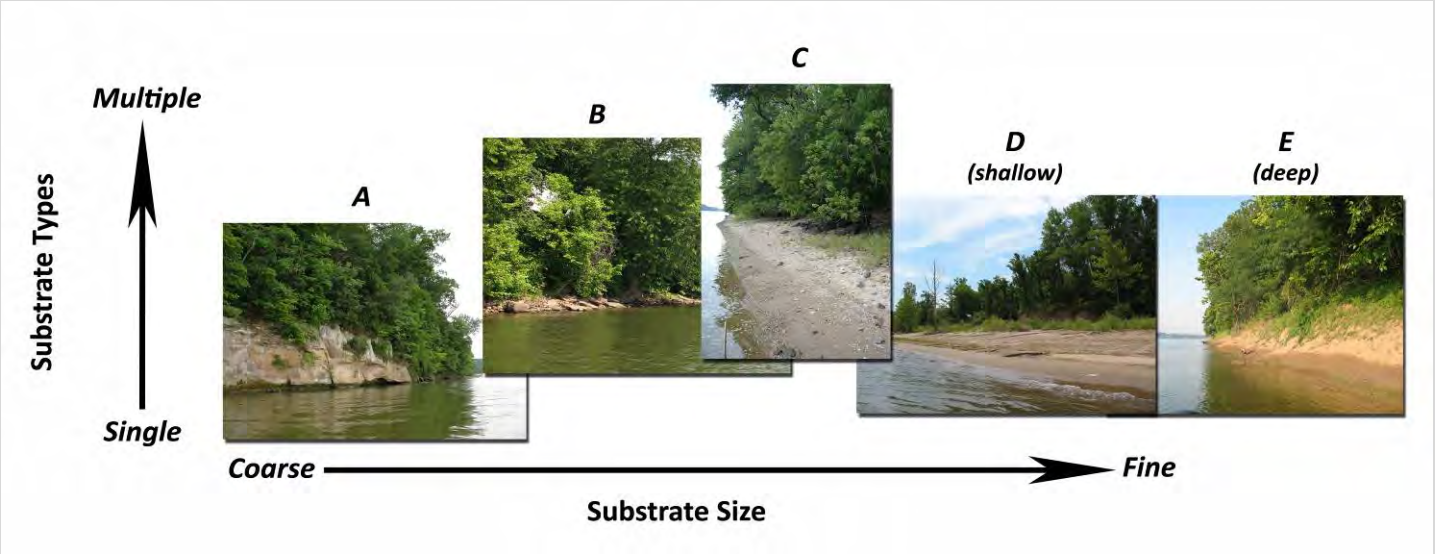
Because different fish species prefer different habitat types, it is important to classify the instream habitat at each of our sites to better understand *m*ORFIn score variability. Using the habitat survey data, we assign each site to one of five statistically derived habitat classes simply named: 'A', '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 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 sampling station to any particular site. These data are compiled to aid in the interpretation of the fish index results.



A look at our five habitat classes



Assessing Biological Condition

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

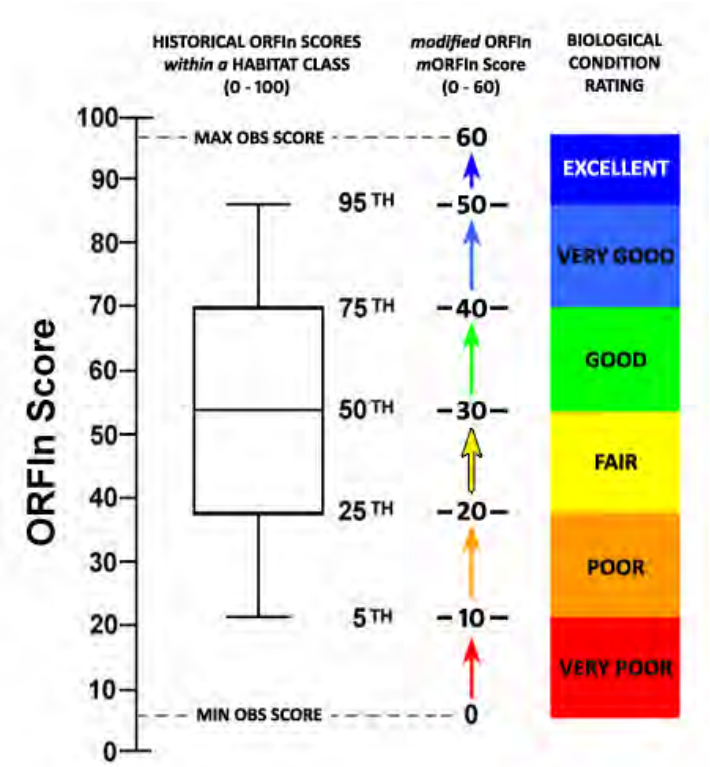
13 original ORFIn metrics used to generate *m*ORFIn scores

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

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

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

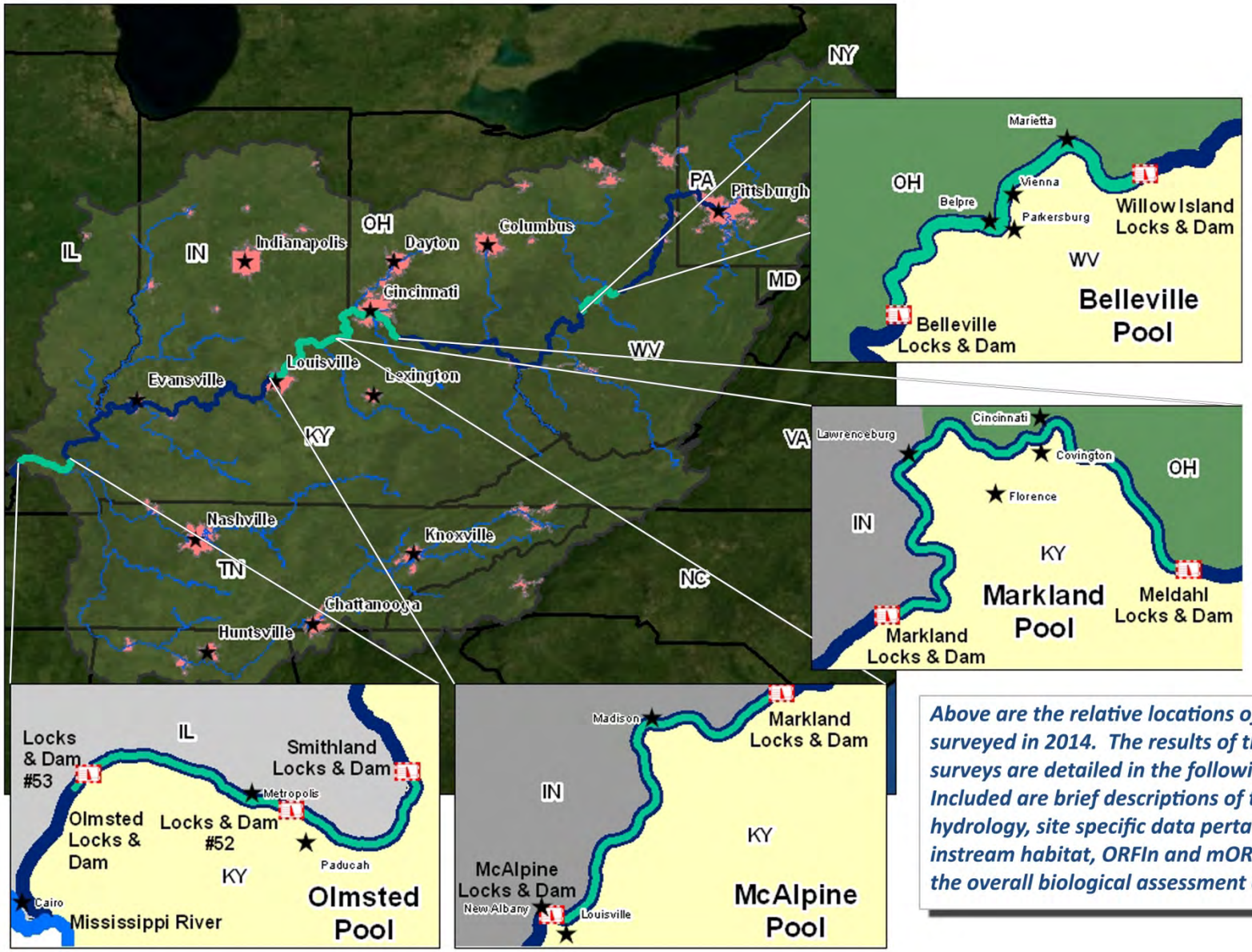
Then a *m*ORFIn score between 0 and 60 is calculated for each individual site based upon how its ORFIn score relates to statistical thresholds defined within the historical ranges. A biological condition rating (i.e. 'Poor', 'Very Poor', 'Fair', 'Good', 'Very Good', and 'Excellent') is given to each site based on its *m*ORFIn score.



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

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

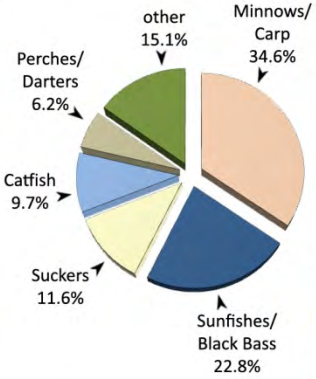
2014 Pool Survey Results

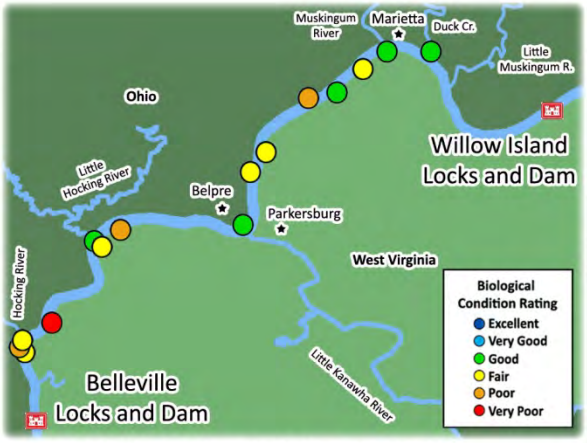


Above are the relative locations of the pools surveyed in 2014. The results of these biological surveys are detailed in the following pages. Included are brief descriptions of the land use and hydrology, site specific data pertaining to fish and instream habitat, ORFIn and mORFIn scores, and the overall biological assessment of each pool.

Belleville Pool - 2014

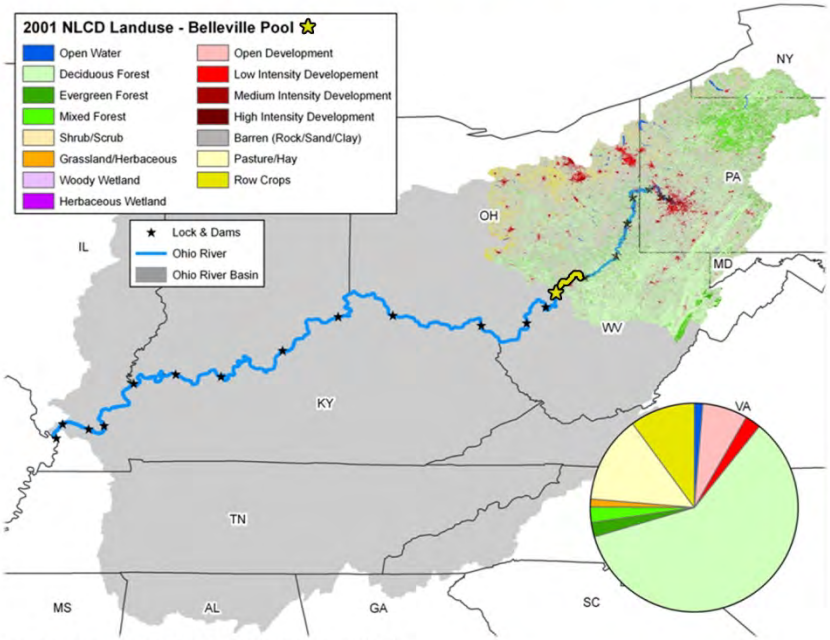
The Belleville pool is 42.2 miles long, extending from Willow Island Locks and Dam (ORM 161.7) to Belleville Locks and Dam (ORM 203.9). The pool has a gradient drop of 0.5 feet per mile and averages 1,327 feet wide and 24 feet deep (ORSANCO 1994). The pool is bordered by the states of West Virginia and Ohio and lies in a portion of the basin moderately influenced by industry and barge activity. The largest cities within in the pool are Marietta, OH (the oldest city in the state) and Parkersburg, WV. The Belleville pool receives water from three large tributaries, the Muskingum and Hocking rivers in Ohio and the Little Kanawha River in West Virginia. Combined these tributaries drain areas of over 10,000 square miles. The pool also has multiple islands scattered throughout its reach, which provide a variety of additional habitats for aquatic species.



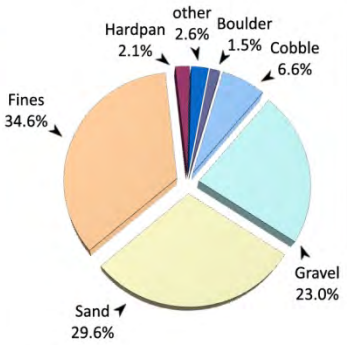


Locations of the 15 randomly chosen electrofishing sites in Belleville Pool

The mouth of the Muskingum River, the largest tributary of the Bellville Pool



Land-use types within the Belleville Pool watershed



Yellow Perch (*Perca flavescens*)

Channel Catfish (*Ictalurus punctatus*

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	*m*ORFIn Score
1	170.1	C	44.55	55.14	33.26
2	172.1	C	44.55	56.43	34.71
3	173.8	D	41.80	48.69	28.70
4	175.5	C	44.55	57.83	36.29
5	176.6	B	46.71	38.64	10.85
6	180.3	C	44.55	51.90	29.56
7	181.3	D	41.80	41.90	20.13
8	184.5	D	41.80	53.52	34.65
9	190.6	C	44.55	37.43	15.06
10	192.1	D	41.80	46.11	25.44
11	192.1	B	46.71	61.74	37.68
12	197.9	D	41.80	18.04	0.00
13	199.5	D	41.80	45.43	24.58
14	199.7	A	50.03	41.36	13.54
15	199.9	E	39.59	42.38	22.55

Average Pool *mORFIn* Score 24.5

Belleville Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D-Shallow with sands and fines

Notable Measures: rocky shorelines were still to be found, woody debris and aquatic vegetation were both very common

Biological Measures

Total No. of Fish Species: 52

Average No. of Individuals: 146

Dominant Family (*minus herring/shad*): Minnows/Carp

Dominant Species (*minus shad/shiners*): Channel Shiner

Threatened/Endangered: Ohio Lamprey (E) & Channel Darter (T)

Rare Ohio River Mainstem Species: Trout-perch

Notable Catch: Goldfish

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerant Species

Lowest scoring ORFIn metric: Great River Species

Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 11

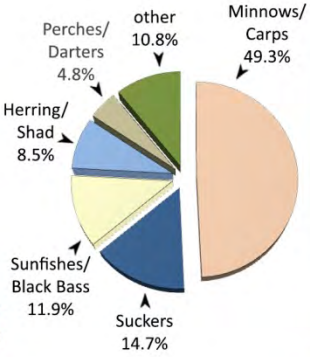
Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 4

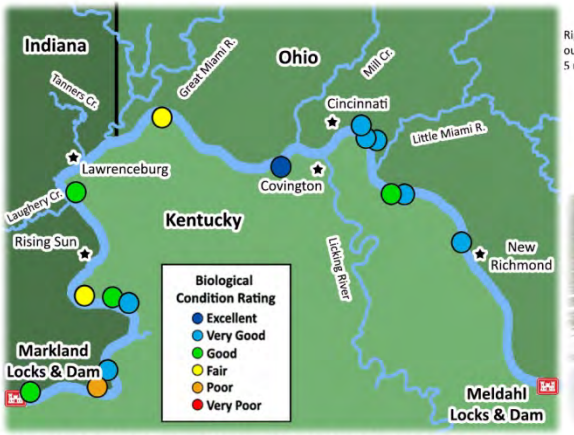
Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Fair

Markland Pool - *2014*

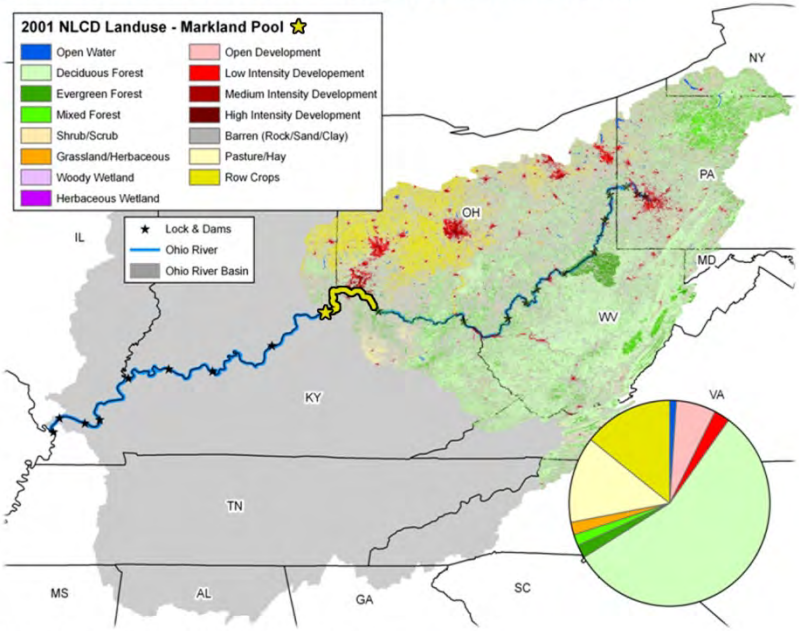
The Markland Pool is 95.3 miles long, extending from Captain Anthony Meldahl Locks and Dam (ORM 436.2) to Markland Locks and Dam (ORM 531.5). The pool has a gradient drop of 0.4 feet per mile, averages 1,594 feet wide and 31 feet deep (ORSANCO 1994), and is bordered by the states of Kentucky, Ohio, and Indiana. The pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. Markland pool receives water from three major tributaries. The Little and Great Miami rivers drain 1,750 and 5,400 square miles, respectively. The Licking River drains 3,670 square miles and empties into the Ohio River just downstream of the Little Miami River. Four smaller tributaries in the lower half of the pool also provide water, draining approximately 800 square miles collectively. The pool's watershed is primarily forested (54.7%) but also has a considerable amount of row crops (14.0%) and pasture lands (13.2%).



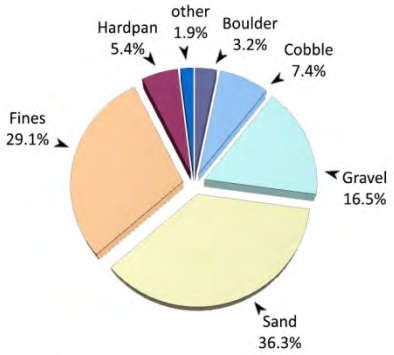


Locations of the 15 randomly chosen electrofishing sites in Markland Pool

Riprap shorelines and artificial substrate are common throughout the pool. This long-abandoned vessel resides approximately 5 miles downstream of Cincinnati, OH.



Land-use types within the Markland Pool watershed



Black Crappie (*Pomoxis nigromaculatus*)

Fantail Darter (*Etheostoma flabellare*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	*m*ORFIn Score
1	451.8	C	44.55	66.97	44.84
2	459.2	D	41.80	59.38	41.39
3	460.3	B	46.71	56.30	31.43
4	465.3	C	44.55	66.72	44.63
5	466.2	D	41.80	60.32	42.26
6	466.5	B	46.71	70.98	46.04
7	474.6	B	46.71	78.38	54.65
8	485.9	D	41.80	48.23	28.12
9	498.6	E	39.59	53.88	33.88
10	510.1	D	41.80	42.11	20.39
11	512.6	D	41.80	54.65	36.02
12	513.9	D	41.80	60.08	42.05
13	520.8	B	46.71	67.62	43.23
14	524.3	D	41.80	39.64	17.89
15	530.5	D	41.80	56.97	38.87
				Average Pool *mORFIn* Score	**37.7**

Markland Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: some degree of woody cover was observed at each of the 15 sites

Biological Measures

Total No. of Fish Species: 47

Average No. of Individuals: 214

Dominant Family (*minus herring/shad*): Minnows/carp

Dominant Species (*minus shad/shiners*): River Carpsucker

Species of Concern (KY): Black Buffalo

Rare Ohio River Mainstem Species: Central Stoneroller

Notable Catch: Fantail Darter & River Darter (threatened in OH)

Assessment Results

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

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

Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 14

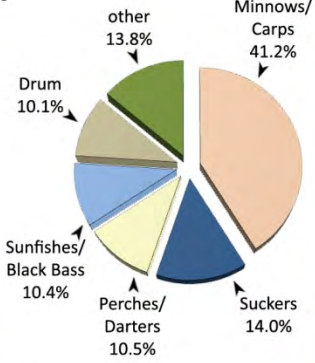
Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 1

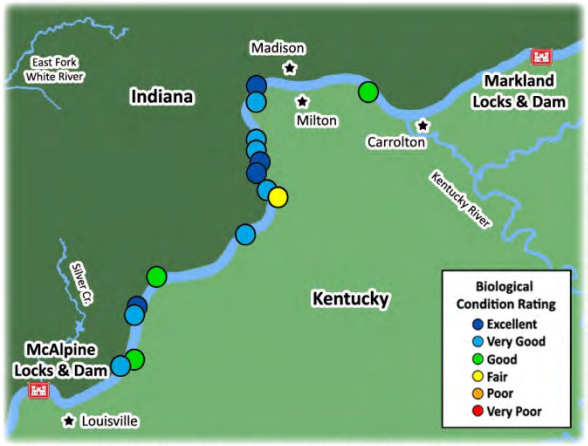
Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

McAlpine Pool- *2014*

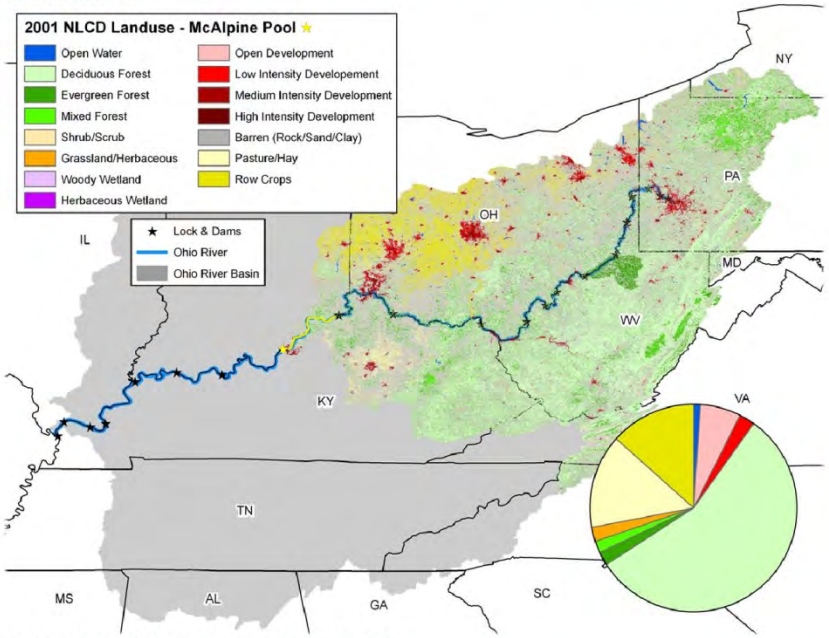
The McAlpine pool is 75.3 miles long, extending from Markland Locks and Dam (ORM 531.5) to McAlpine Locks and Dam (ORM 606.8). The pool has a gradient drop of 0.3 feet per mile and averages 2,040 feet wide and 25 feet deep. McAlpine is bordered by the states of Indiana and Kentucky, and lies in a moderately developed portion of the basin. Though the pool is heavily influenced by industry and associated barge activity, portions of rocky forested shorelines still remain. The city of Louisville, one of the largest cities on the river, is located just upstream of McAlpine Locks and Dam and the naturally occuring Falls of the Ohio (ORM 605). The majority of the pool shorelines are relatively shallow with a mix of fines and sand. The McAlpine pool receives water from one of the larger tributaries in the basin the Kentucky River (KY) which has a drainage area of nearly 7,000 square miles.



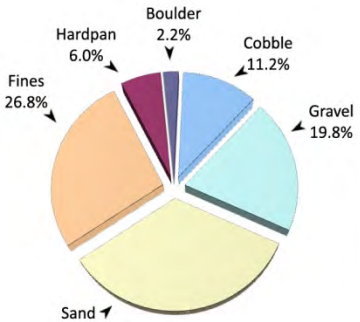


Locations of the 15 randomly chosen electrofishing sites in McAlpine Pool

Typical sandy shoreline of the McAlpine Pool. Personal watercraft docking structures are common throughout the pool.



Land-use types within the McAlpine Pool watershed



Spotted Bass (*Micropterus punctulatus*)

Rainbow Darter (*Etheostoma caeruleum*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	*m*ORFIn Score
1	549.9	D	41.80	53.69	34.86
2	561.1	A	50.03	73.43	52.66
3	562.2	D	41.80	65.76	47.36
4	567.6	C	44.55	66.86	44.74
5	568.3	C	44.55	70.86	48.07
6	569.1	D	41.80	74.72	57.30
7	570.1	D	41.80	70.82	52.67
8	572.1	C	44.55	68.86	46.41
9	572.8	D	41.80	47.98	27.80
10	577.9	C	44.55	64.69	42.95
11	587.4	C	44.55	55.90	34.12
12	591.4	C	44.55	73.77	50.69
13	591.8	C	44.55	68.40	46.03
14	596.2	D	41.80	51.91	32.67
15	597.5	D	41.80	58.88	40.92
				Average Pool *mORFIn* Score	**43.9**

McAlpine Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: C/D - mixed substrates/shallow sand flat
Notable Measures: rocky shores (B habitats) were still common

Biological Measures

Total No. of Fish Species: 54
Average No. of Individuals: 156
Dominant Family (*minus herring/shad)*: Minnows/Carp
Dominant Species (*minus gizzard shad)*: Channel Shiner
Sp. of Special Concern: Black Buffalo (KY) & River Redhorse (IN)
Rare Ohio River Mainstem Species: Warmouth
Notable Catch: Rainbow & Fantail Darters

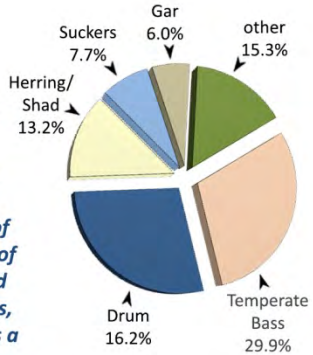
Assessment Results

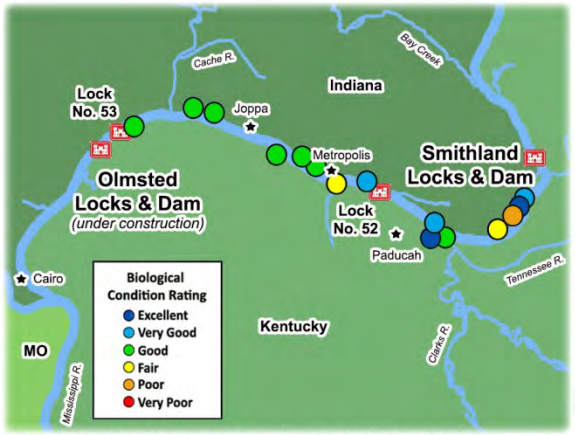
Highest scoring ORFIn metric: % Tolerant species
Lowest scoring ORFIn metric: % Piscivore species
Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 15
Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 0
Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Very Good

Olmsted Pool - *2014*

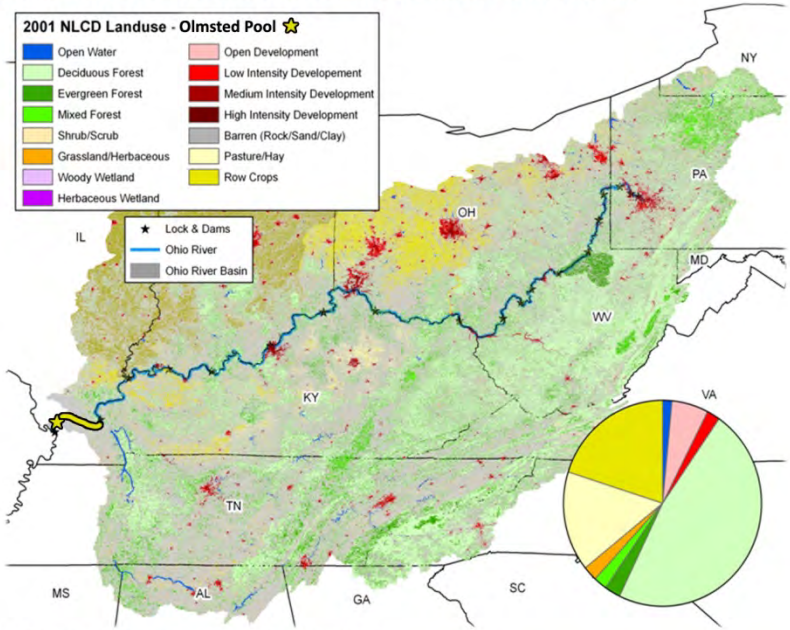
We call this 46.3 mile long section of the Ohio River, extending from Smithland Locks and Dam (ORM 918.5) to the on-going US Army Corp of Engineers Project at ORM 964.8, the Olmsted Pool. Upon completion, Olmsted Locks and Dam will hold back the waters currently retained by the last low-head dams on the Ohio River (Locks No. 52 and 53). Olmsted Pool will have a gradient drop of 0.3 feet per mile, a width of 3,500 feet, and an average depth of 20 feet (all measurements are approximate, assuming current stages are not drastically changed upon completion). This portion of the Ohio River is bordered by Kentucky and Illinois and has a large amount of barge activity. It receives water from 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 (46.1%) but also has a considerable amount of row crops (19.5%) and pasture lands (15.3%).



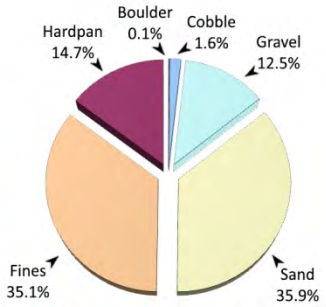


Locations of the 15 randomly chosen electrofishing sites in Olmsted Pool

Shallow sand flats and Barge loading facilities are common in Olmsted pool.



Land-use types within the Olmsted Pool watershed



Black Buffalo (*Ictiobus niger*)

Flathead Catfish (*Pylodictis olivaris*)

Site Performance

Site No.	River Mile	Habitat Class	ORFIn Exp	ORFIn Obs	*m*ORFIn Score
1	923.3	D	41.80	58.64	40.69
2	924.4	D	41.80	69.17	50.70
3	925.4	D	41.80	39.89	18.14
4	927.2	D	41.80	42.56	20.96
5	932	D	41.80	55.64	37.24
6	932.8	C	44.55	77.85	55.61
7	933.2	D	41.80	65.59	47.20
8	940.1	C	44.55	69.19	46.68
9	942.5	D	41.80	44.92	23.94
10	944.5	D	41.80	50.79	31.31
11	945.8	C	44.55	61.12	39.98
12	948	D	41.80	50.16	30.53
13	954.6	D	41.80	57.30	39.26
14	955.5	D	41.80	56.39	38.15
15	961.2	D	41.80	54.50	35.85
			Average Pool *mORFIn* Score		**37.1**

Olmsted Pool - Results Overview

Sampling Results

Environmental Measures

Dominant Habitat Class: D - shallow sand/fines

Notable Measures: Instream habitats and conditions are more fluid and less predictable below Locks No. 52 & 53

Biological Measures

Total No. of Fish Species: 46

Average No. of Individuals: 179

Dominant Family (*minus herring/shad*): Morone

Dominant Species (*minus shad/shiners*): Freshwater Drum

Species of Concern (KY): Black Buffalo

Rare Ohio River Species: Mississippi Silverside (Threatened)

Notable Catch: Mooneye and Yellow Bass (common in lower river)

Assessment Results

Highest scoring ORFIn metric (*minus DELTs*): % Tolerant Species

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

Sites Above 25th percentile (i.e. *m*ORFIn Score = 20): 14

Sites Below 25th percentile (i.e. *m*ORFIn Score = 20): 1

Aquatic Life-Use Designation: Met

Overall Biological Condition Rating: Good

CONCLUSIONS

Pool Surveys

The 2014 pool surveys were successfully completed between July 7th and August 18th. ORSANCO's Biological Water Quality Subcommittee recommended that all four pools surveyed during the 2014 field season should be assessed as *meeting* their aquatic life-use designations (i.e. containing healthy fish communities).

Belleville Highlights (Fair)

Some clumping of the 15 survey sites was observed in Belleville, with no sites drawn in the upper 5th of the pool (9 mi). All five habitat classes were sampled with six sand flats (D) and five mixed substrates (C) being most common. All sites were sampled under slightly higher than normal flow conditions. Large amounts of the invasive exotic submerged aquatic plant *Hydrilla verticillata* covered most sites. Six minnow species combined to comprise exactly one-third of the total catch. An additional 22% of all individuals consisted of black bass and sunfish species (primarily Bluegill), accounting for over half the total catch when combined with the minnows. A large number of Channel Catfish was also encountered. Notable species caught included the 2nd Goldfish caught by ORSANCO via electrofishing (EF) since 2000, the 5th ever (and furthest downstream) state endangered (OH) Ohio Lamprey, and a state threatened (OH) Channel Darter.

Markland Highlights (Good)

Survey sites were scattered throughout the pool, with none occurring in the upper 6th of the pool (15 mi). Sand flats (D) dominated the substrate composition. No rooted *Hydrilla* was observed throughout the pool and sites were sampled under slightly elevated flow conditions. Nine minnow species combined to comprise almost half (49%) of the total catch. One of those nine (Rosyface Shiner) is an extremely rare Ohio River inhabitant, with only one other individual recorded by ORSANCO via EF (1991) prior to 2014. Two other typically small stream species were collected (Central Stoneroller and Fantail Darter) along with one state threatened (OH) River Darter. In addition, two state species of special concern were collected, Black Buffalo (KY) and Blue Catfish (OH).

McAlpine Highlights (Very Good)

Survey sites were not very evenly distributed throughout the pool, as no sites fell in the upper 4th (18 mi) and only one fell in the upper 30 miles. Additionally, six sites were sampled within 5.2 miles. An equal number of mixed substrate types (C) and shallow sand flats (D) were sampled at 7 sites each. Twelve minnow species combined to account for 41% of the total catch with suckers being the second most dominant group at 14%. Notable species included seven primarily small-stream species including Rosyface Shiner (see Markland Highlights) and Central Stoneroller, Fantail Darter and Striped Shiner, all of which are very rare below mi 400. Three Spottail Shiners (special concern in KY), another very rare mid-lower river species, were also encountered in this survey, as were two other species of special concern: Black Buffalo (KY) and River Redhorse (IN). In addition, the 4th Yellow Bullhead ORSANCO has ever recorded via EF was collected.

Olmsted Highlights (Good)

Survey sites were spread throughout the pool and 12 of the 15 sites were shallow sand flats (D). The species composition of the pool was certainly distinct from all other pools, as temperate basses were the most dominant group (30% of the catch) followed by Freshwater Drum (16%). Another unique aspect of the community was that gar represented the 5th most common species group. Notable catches included Mississippi Silverside (threatened in KY), Black Buffalo (special concern in KY) and 25 invasive, exotic Silver Carp.

Assessment Comparisons

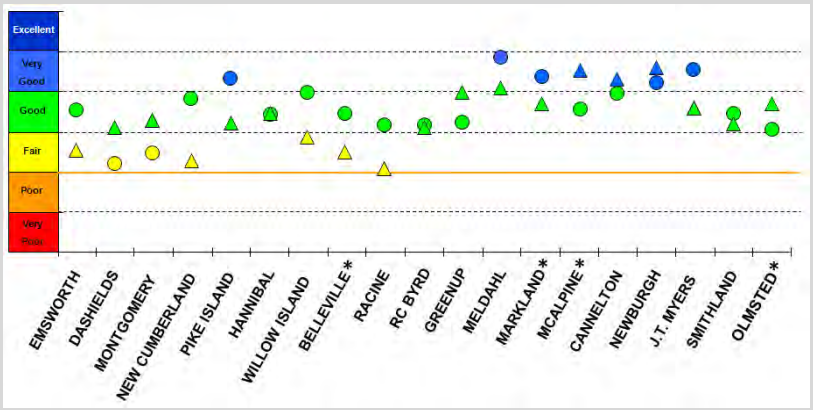
Between 2005 and 2009, all 19 Ohio River navigational pools were surveyed and assessed. The first cycle revealed the majority of the river to be in 'Good' condition. The 2014 surveys concluded the second full assessment of those same 19 pools. This second cycle allowed us to not only rate the relative condition of each pool, but also compare past and present survey results, Some of the species variability observed across pools (see final table, pg 16), is likely due in part to variations in natural distributions, instream habitat, and annual variations in flow/weather conditions.

CONCLUSIONS

River-wide Assessment Comparison

The 2014 pools (*) had relatively similar condition ratings to their neighboring pools. Reasons for the variability of ratings across the pools include, but are not limited to varying degrees of anthropogenic land uses (which can affect habitat and water quality) and proximity to tributaries (which can affect species diversity based upon the biological condition of the tributary).

○ = 1st cycle (2005 - 2009)
△ = 2nd cycle (2010 - 2014)



Past vs. Present Assessments

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

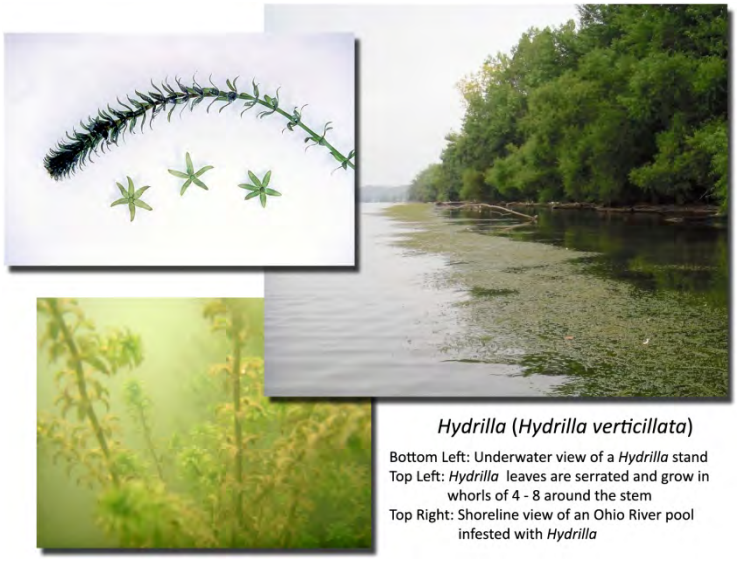
Belleville Pool (2009 vs. 2014)

Variable	2009	2014	Difference
Environmental Factors			
Avg. spring flow	Very low	High	Higher
Avg. flow day of sampling	Slightly High	Very High	Higher
No. of sites with >30% SAV	0	5	5
Avg. conductivity (µS/cm)	428	284	-144
Avg Secchi (in)	34.2	23.6	-10.6
Centrarchid species score (0-100)	74.4	56.7	-17.8
black bass (*Micropterus spp*)	160	63	-97
Great River species score (0-100)	31.1	6.7	-24.4
Silver Chub	32	1	-31
3 other species	8	0	-8
Intolerants species (0-100)	48.1	19.1	-29.1
Channel Shiner	795	410	-385
Logperch	47	5	-42
Assessment Result	34.4	24.5	-9.9
Aquatic life-use designation	Met	Met	Same
Condition Rating	**Good**	**Fair**	Lower

Belleville pool was assessed to be in slightly lower condition in 2014 than in 2009. Three metrics, each potentially affected by a separate environmental factor, were primarily responsible for the decline. The drop in the Centrarchid Species metric was driven by a decline in the number of black bass individuals which may in turn be due to the greater densities of the submerged aquatic vegetation (SAV), *Hydrilla verticillata*. While some SAV is good for bass species, the increased densities of *Hydrilla* may actually reduce available habitat and cause detrimental dissolved oxygen swings.

The Great River Species metric dropped primarily due to a decline in Silver Chub as well as three other species. There is evidence to suggest that this may be part of a steady riverwide decline observed in species of this guild over the last 5-10 years. Potential causes for these declines have yet to be identified.

Lastly, the lowered Intolerant Species score was driven by Channel Shiner and Logperch, both of which dropped from 2009 to 2014. These decreases may be due in part to reduced sampling efficiency caused by increased flow conditions on the day of sampling which resulted in lower conductivity and reduced visibility.



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

Markland Pool (2005 vs 2009 vs 2014)

Variable	2005	2009	2014
Environmental Factors			
Avg. flow day of sampling	High	Normal	High
Avg. conductivity (µS/cm	492	470	305
Avg Secchi (in)	44.2	27.2	26.9
Avg Sampling Julian Day	248	262	202
Avg Great River Score (0-100)	74.1	64.4	55.6
Mooneye	12	9	5
Silver Chub	206	372	33
Skipjack Herring	262	2	0
% Lithophils score (0-100)	44.9	72.4	30.1
Sauger	864	378	116
Logperch	63	24	14
% Detritivore score (0-100)	75.6	69.1	43.5
River Carpsucker	78	85	221
Assessment Result	43.4	43.4	37.7
Aquatic life-use designation	Met	Met	Met
Condition Rating	**Very Good**	**Very Good**	**Good**

Markland Pool is the first to be assessed on three separate occasions (2005, 2009, and 2014), giving us more insight into its fish population dynamics. Flows in 2014 were higher than in 2009 and more closely matched 2005, although other variables in 2005 (secchi and conductivity) did not match the pattern of a "high flow" year. In addition, 2009 secchi values were lower than expected for a "normal" year, confounding the issue even more.

Of the three metrics most heavily influencing index scores across the the years, only % Detritivores seemed to indicate an influence from flows, as the high number of River Carpsucker (2014) are typical of elevated flows during sampling. As observed in the Belleville survey, the decrease in Great River Species and % Lithophils relative to prior surveys support the possibility of riverwide declines in key species such as Silver Chub, Skipjack Herring, Sauger, Mooneye and Logperch.

Although the pool dropped a condition rating between the 1st two surveys and 2014, the difference observed in index scores is not drastic and may potentially be explained by natural fluctuation in index scores due to systematic population dynamics of several key species.

McAlpine (2009 vs. 2014)

Variable	2009	2014	Difference
Environmental Factors			
Avg Sampling Julian Day	253	210	-43
Native Species score (0-100)	57.1	75.3	18.2
No. of Native Species	40	47	7
Assessment Result	35.2	43.9	8.7
Aquatic life-use designation	Met	Met	Same
Condition Rating	**Good**	**Very Good**	Higher

Environmental variables (flow, water clarity, basic water quality, etc) associated with the 2009 and 2014 McAlpine surveys were remarkably similar. Despite this, the pool received a condition rating upgrade in the 2014 survey. One possible explanation for this may be due in part to the time of year each survey was conducted, with the 2014 samples collected on average more than a month earlier than in 2009. This difference may be responsible for the occurrence of seven species unique to the 2014 survey that can be classified as small stream species which helped boost several metric scores.

Another explanation for the increase in overall condition rating may be natural variation in the sampling sites selected. The most recent survey benefited from the performance of four very good sites (*m*ORFIn >50) while the 2009 survey average was greatly affected by one very bad site (*m*ORFIn = 4.5) and two bad sites (*m*ORFIn = 23). Excluding those seven sites resulted in average index scores of 39 and 40 for 2014 and 2009, respectively.

Olmsted Pool (2009 vs. 2014)

Variable	2009	2014	Difference
Environmental Factors			
Avg Sampling Julian Day	188	203	15
% Non-native Individuals (0-100)	44.7	77.9	33.2
Common Carp	49	2	-47
% Piscivores score (0-100)	36.3	61.9	25.6
Morone sp	30	733	703
% Tolerant score (0-100)	68	78.9	10.9
% Detritivore score (0-100)	42.9	63.9	21
Assessment Result	30.2	37.1	6.9
Aquatic life-use designation	Met	Met	Same
Condition Rating	**Good**	**Good**	Same

Olmsted pool was assessed as being in the same condition in both years (good). The relatively minor increase in average *m*ORFIn score for the pool can be explained by variation in a few key species. The decline in common carp in the most recent survey greatly affects three metrics (% Non-Natives, % Detritivores, and % Tolerants). The % Piscivores score increased significantly in 2014 in direct response to a drastic increase in the number of juvenile temperate bass (Morone sp). Currently, explanations for the change in the abundances of these two species between the two surveys are lacking, as measured environmental data from 2009 to 2014 was nearly identical.

Another Biological Indicator

The 2014 pool assessments concluded the second cycle of pool surveys covering five years and all 19 Ohio River navigational pools. A third five year cycle of surveys and assessments will be initiated 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 will allow for a more robust and accurate assessment of pool condition. Biological staff are currently working with state and federal agency representatives to finalize the process by which the results of both indicators will be integrated. Nevertheless, the results of both macroinvertebrate and fish surveys will be included in the ***2015 Ohio River Pool Assessments*** report which will further detail macroinvertebrate sampling methods and ORMIn specifics.

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

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '14
GAR	Longnose Gar	23	19	8	19	16	64	30	**28**	61	25	33	18	**28**	**24**	20	16	13	11	**61**
	Spotted Gar																1	1	2	
	Shortnose Gar																12	24	28	**101**
SHAD	Skipjack Herring		1				1				1		18		**1**	1	79		2	**1**
	Gizzard Shad	3417	37	4058	1097	5092	43	397	**117**	855	176	120	17703	**274**	**54**	709	10834	3039	557	**278**
	Threadfin Shad																7	1	14	**74**
CARP	Common Carp	48	70	44	19	36	46	40	**26**	43	32	12	9	**5**	**4**	4	7	16	7	**2**
	Grass Carp								**1**											**1**
	Silver Carp														**1**			12	17	**25**
	Bighead Carp																			
	Goldfish								**1**											
	Carp x Goldfish	1																		
MINNOW	Cyprinidae sp.																	1		
	Golden Shiner								**1**	1										**1**
	Striped Shiner				1	7				2					**5**					
	Spottail Shiner			9	2			4	**2**		1				**3**			14		
	Spotfin Shiner	77	35	35	21	62	72	63	**58**	66	19	65	26	**10**	**28**	39	39	37	218	**14**
	Notropis sp.																			
	Emerald Shiner	848	46	171	1525	892	79	948	**240**	134	172	1557	1837	**470**	**227**	2195	720	140	86	**20**
	Silverband Shiner																			
	Sand Shiner																			
	Channel Shiner	492	108	159	685	481	167	532	**410**	178	684	944	689	**897**	**609**	2787	465	414	102	**47**
	River Shiner								**5**				34	**156**	**30**	94	64	16	8	**15**
	Shoal Chub																			
	Silver Chub			32	2				**1**	2	1	12	24	**33**	**51**	79	22	2	12	**10**
	Streamline Chub	11	1																	
	River Chub											8								
	Gravel Chub																			
	Creek Chub																			
	Central Stoneroller						1			2				**1**	**3**					
	Mississippi Silvery																		15	
	Suckermouth Minnow																			
	Bluntnose Minnow	120	1	21	98	28	98	190	**8**	7		4	4	**4**	**2**	2	8			**2**
	Bullhead Minnow							2	**5**		1	25	25	**2**	**1**	36	13	14	1	**6**

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

Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '14
	Silverjaw Minnow																			
SUCKER	Ictiobinae sp.																			
	Ictiobus sp.																1			
	Smallmouth Buffalo	51	84	79	68	58	40	50	**38**	42	32	25	44	**89**	**31**	23	10	58	106	**32**
	Bigmouth Buffalo			1												1		6	4	**5**
	Black Buffalo	1	4	3			4		**7**			1	1	**5**	**4**		2	9		**10**
	Carpiodes sp.					1			**1**					**1**						**1**
	Quillback	1	13	25	14	9	14	6	**7**	4	12	11	12	**61**	**9**	17	9	18	31	**5**
	River Carpsucker	8	47	28	23	36	33	16	**33**	21	26	55	172	**221**	**161**	363	146	43	263	**139**
	Highfin Carpsucker	5	14	14	5	1	5		**3**		1		8	**4**	**4**		2		91	**3**
	Northern Hog Sucker	3		7	2	6	6		**1**		2	2	1		**6**					
	Moxostoma sp.						3				1	3				3				
	Shorthead Redhorse																			**10**
	Smallmouth Redhorse	33	153	25	11	16	54	27	**61**	35	22	44	14	**44**	**31**	14	1	4		
	Silver Redhorse	75	252	132	70	23	59	12	**31**	4	22	19	19	**19**	**14**		1			
	River Redhorse	14	65	8		2	12	5		1	6	2			**1**					
	Black Redhorse	8	10	9		3	16													
	Golden Redhorse	56	155	282	216	93	273	63	**64**	31	56	34	44	**26**	**67**	2	10	11		**1**
	Spotted Sucker						4	4	**8**	3		1		**1**	**1**					
	White Sucker			1																
CATFISH	Yellow Bullhead							1		1					**1**					
	Brown Bullhead																			
	Northern Madtom																			
	Blue Catfish													**2**					5	
	Channel Catfish	35	63	17	201	54	83	91	**177**	79	114	295	70	**112**	**122**	287	223	103	478	**65**
	Flathead Catfish	19	6	12	15	47	39	17	**36**	29	40	37	24	**21**	**19**	32	14	19	30	**12**
SUNFISH	Lepomis sp.											1		**2**	**2**					**5**
	Warmouth														**3**	1				
	Rock Bass	75	89	8	15	24	64	15	**2**	3		4								
	Bluegill	154	34	58	192	131	523	653	**391**	210	254	337	212	**207**	**89**	247	94	47	270	**41**
	Green Sunfish	3	3			3	2	1	**1**	3	4	3	2	**1**	**1**	7	3	4		**4**
	Pumpkinseed	4	4	2	2	2	33	25			6	2								
	Orangespotted Sunfish				2		5	20		5		3	2					2	1	
	Longear Sunfish	2	1		2	8	242	141	**24**	7	56	26	73	**71**	**65**	117	293	52	207	**16**

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

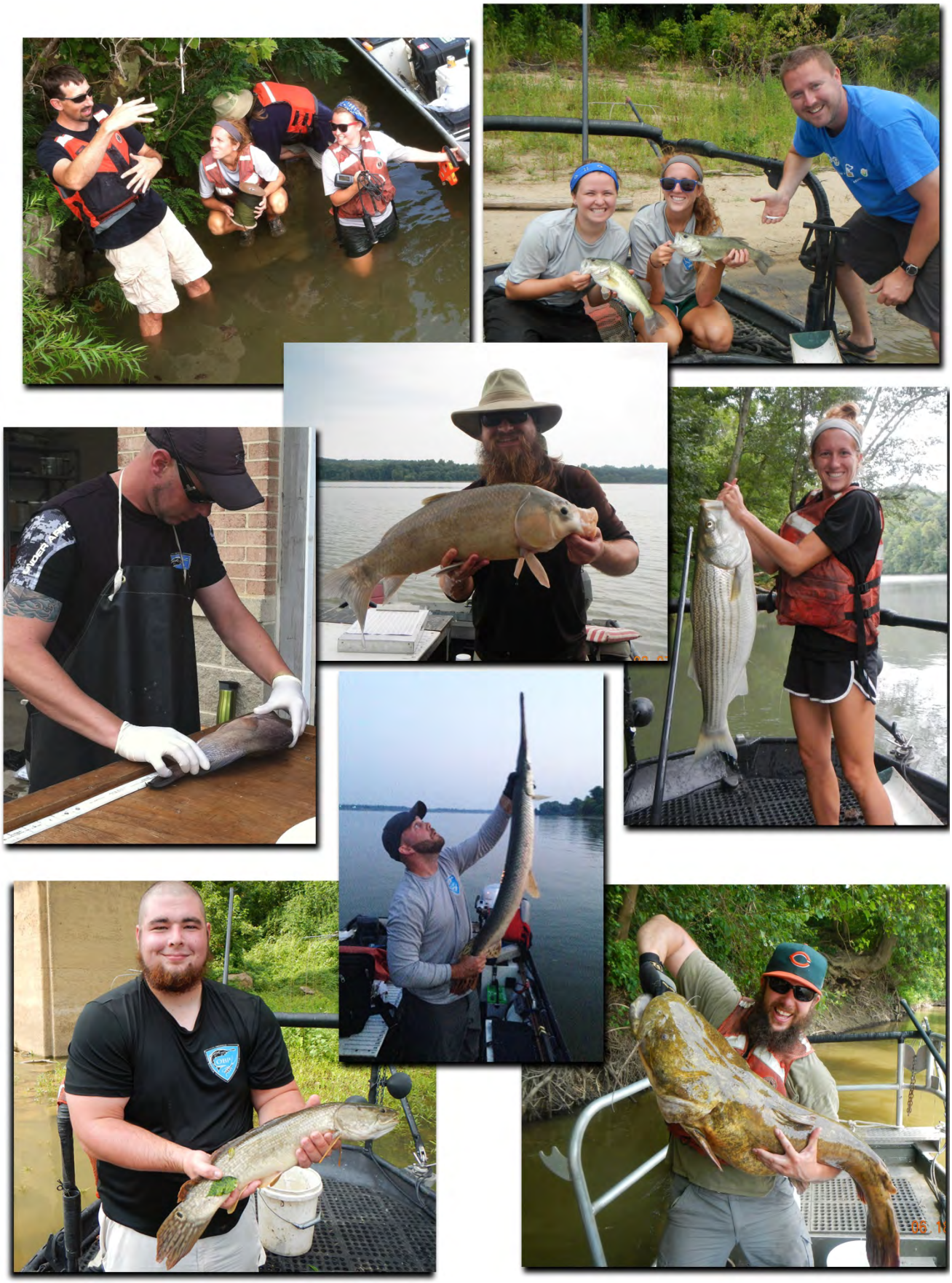
Group	Species (common name)	Emsworth '12	Dashields '13	Montgomery '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '14
SUNFISH	Redear Sunfish		1					1	**7**	1	3	1		**2**	**1**	15	3		32	
	Lepomis Hybrid					1	2		**1**		2	1		**1**					2	
	Bluegill X Longear							1												
	Bluegill X Green																			
	Longear X Green											1								
TEMPERATE BASS	Morone sp.	50		26	22	110	12	54	**79**	191	15	55	289	**11**	**81**	54	361	21	86	**733**
	White Perch							1												
	Striped Bass								**1**		1						4	1		
	White Bass	6	65		37	2	28	13	**16**	5	71	19	1	**18**	**18**	6	60	44	83	**34**
	Yellow Bass															2			15	**25**
	Hybrid Striped Bass	1	5				2	7	**3**	9	2	10	3	**3**	**1**	2	22	8	6	**10**
BLACK BASS	Micropterus sp.	57	1					2		3	9		79	**10**	**18**		3	3		**16**
	Smallmouth Bass	167	250	210	155	431	270	155	**27**	47	38	47	30	**19**	**15**	27	33	4	2	**7**
	Largemouth Bass	8	3	8	2	8	7	50	**10**	58	18	38	21	**12**	**10**	32	72	2	10	**6**
	Spotted Bass	24	18	5	48	77	99	79	**26**	20	60	127	86	**51**	**38**	58	252	41	48	**26**
DARTER	Johnny Darter																			
	Greenside Darter			1		8	1													
	Variegate Darter																			
	Rainbow Darter					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	47	17	40	89	17	**5**	6	5	1	2	**14**	**9**			1		**2**
PERCH	Yellow Perch				5		5	2	**3**											
	Walleye	20	74	21	2	2	10	6	**13**			2	2		**1**	1				
	Saugeye	2	11				1	44	**25**					**22**	**8**		11	3	4	**6**
	Sauger	39	264	92	29	39	147	68	**89**	51	128	91	124	**116**	**226**	138	44	81	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 '10	New Cumberland '11	Pike Island '12	Hannibal '13	Willow Island '11	Belleville '14	Racine '10	Robert C. Byrd '13	Greenup '11	Meldahl '12	Markland '14	McAlpine '14	Cannelton '11	Newburgh '12	John T. Myers '10	Smithland '13	Open Water '14
MISCELLANEOUS	Goldeye														**1**			3	1	
	Mooneye	10	1	7	11	2	2	6			3	4	6	**5**	**1**		4	1		**1**
	Paddlefish																1			
	Northern Pike					1														
	Muskellunge		1																	
	White Crappie	2		1				1	**4**	2	1	7		**4**	**1**	21	2	6	2	**1**
	Black Crappie	1	4	1	1	1	1	5	**6**	5		4		**2**		7		6	5	
	Inland Silverside																		16	**14**
	Brook Silverside	14		1	11	10	3	2							**1**	5	5		1	
	Atlantic Needlefish																			
	Trout-Perch		11						**2**	1										
	Banded Killifish						5	30	**1**	1										
	Western Mosquitofish																			
	Bowfin											1								
	Freshwater Drum	55	136	84	201	239	47	172	**82**	206	89	329	686	**146**	**238**	520	507	103	328	**746**
	Total No. of Individuals	6071	2177	5753	4849	8103	2819	4070	**2190**	2435	2211	4423	22416	**3207**	**2345**	7968	14480	4448	3230	**2680**
	Total No. of Species	46	38	41	39	42	48	48	**52**	42	33	47	41	**47**	**54**	38	44	44	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*).