Biological Programs 2005
Intensive Survey Results
Series 2
Report 2

A Biological Study of the Racine Pool of the Ohio River

ORSANCO

OHIO RIVER VALLEY ★ AN INTERSTATE AGENCY ★ WATER SANITATION COMMISSION ★ ESTABLISHED JUNE 30, 1948

Executive Summary

- In 2004, ORSANCO began using a probabilistic (random) design for monitoring fish communities in the Ohio River.

- The Ohio River was divided into 20 assessment units based primarily on the locations of navigational dams. Using the random design, each assessment unit was assigned 15 sampling locations.

- Once sampled, each site was graded as passing or failing. For an assessment unit to meet it aquatic life use designation, more than 75% of the sites assessed must be in passing condition.

- The Racine pool sites sampled in 2004 failed to meet these criteria, with only 53% of sites passing. Therefore, the Racine pool could have been reported to EPA as failing to meet its aquatic life use designation.

- The 2004 assessment was questioned based on unusually high flows that occurred during the sampling season. The 2004 Markland report recommended re-sampling the pool in 2005 with intense analysis of flow and its correlation to assessment results.

- In 2005, 100% of the sites assessed in Racine pool were in passing condition, which was contradictory to the 2004 assessment results.

- The flow analysis identified a relationship between flow and ORFIn scores and the need for sampling thresholds and/or flow calibration. Increased flows appeared to cause lower ORFIn scores due to decreased efficiency and changes in fish behavior.

- After considering this relationship, the 2005 results were accepted over the 2004 results. Racine pool was reported as supporting its aquatic life use designation.

- Recommendations include moving to the next pool to be sampled while continuing to monitor flow and its influence on assessment results.

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1.0 Introduction

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. Until that time, water quality issues on the Ohio River had been charged to state water quality agencies. However, due to large-scale interstate implications and large pollution loads received by the Ohio River, these agencies were not sufficiently equipped to work with such a system. ORSANCO's role is to work in conjunction with state agencies to develop a set of pollution control standards exclusive to the Ohio River. The creation of these standards requires the establishment of monitoring programs that could efficiently be used on the Ohio River.

The routine ambient monitoring programs of ORSANCO are primarily directed at three monitoring and assessment priorities: spill detection (through an organics detection system), trend assessment (manual sampling system), and aquatic resource characterization (fish and macroinvertebrate studies). Another priority, water quality impacts assessment, is achieved through entire watershed intensive surveys.

In 1993, following direction from state and federal agencies, ORSANCO staff developed and implemented an intensive survey design that used electrofishing methods designed for the navigational pools of the Ohio River. This entailed extensive sampling of fish communities throughout the entire length of a particular pool. The surveys were intended to provide background information on fish populations and lay a foundation for establishing biological criteria (biocriteria) for the Ohio River. With appropriate biocriteria in place, information on the biological community provides insight into the health of the Ohio River.

After several years of collecting background data on the fish population of the Ohio River, ORSANCO developed the Ohio River Fish Index (ORFIn) (Emery et al. 2003). The ORFIn incorporates 13 attributes, or metrics, of the fish community that when compiled together provide an accurate representation of the overall condition of the Ohio River fish community. These 13 metrics take into account several different aspects of the fish population, including diversity, abundance, feeding and reproductive guilds, pollution tolerance/intolerance, and fish health.

An important aspect of biological monitoring is the reduction of human induced bias in the samples. The use of probability-based sample site selection was designed to reduce this bias. Within this design, sample sites are randomly selected by computer generation, eliminating the tendency to sample only in the best or worst locations. Many states already have programs in place that use this design for sampling on smaller streams, and it is also used by the U.S. Environmental Protection Agency's (USEPA) Environmental Monitoring and Assessment Program (EMAP). It is ORSANCO's goal to implement this approach on the Ohio River for its biological monitoring.

An objective of this program is to employ a probability-based monitoring design on the Ohio River in order to assess individual pool reaches based on the fish population. In 2005, the New Cumberland, Racine, Markland, and J.T. Myers pools were sampled as part of ORSANCO's normal monitoring. These four pools were selected because unusual river conditions (high rainfall and elevated water levels) occurred in 2004 when they were originally assessed. The higher than usual rainfall amounts and higher flows in the Ohio River in 2004 led biologists to question the accuracy of the data and the assessment results obtained in 2004. This report presents the data and assessment results obtained in 2005 and compares the 2005 results to the results from the 2004 assessment.

2.0 Study Area

2.1 Ohio River

The Ohio River (Figure 1) begins at the confluence of the Monongahela and Allegheny rivers and flows 981 miles in a southwesterly direction to the confluence with the Mississippi River. Twenty navigational dams maintain a nine-foot minimum depth for commercial navigation throughout the entire length of the river. There are over 600 permitted discharges to the Ohio River, 49 of which are power-generating facilities. The Ohio River Basin contains nearly ten percent of the nation's population, more than 25 million people, and acts as an avenue for transportation of approximately 250 million tons of cargo each year (ORSANCO 1994). The Ohio River dissects four ecoregions: the Western Allegheny Plateau, the Interior Plateau, the Interior River Lowland and the Mississippi Alluvial Plain (Omernik 1987).

2.2 Racine Pool

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) (Figure 2). The pool has a gradient drop of 0.5 feet per mile, averages 1327 feet wide and 24 feet deep. The pool is bordered by the states of Ohio and West Virginia for its entire length. This pool lies in a portion of the Ohio River watershed that is primarily influenced by agricultural land use.

A Bluegill collected by electrofishing

3.0 Methods

3.1 Survey Design and Site Location

A random, probability-based survey design was used to select sampling site locations within each Ohio River survey pool. The USEPA National Health and Environmental Effects Laboratory, Western Ecology Division provided assistance by generating the survey design for this project. The target population was the linear shorelines of the Racine pool of the Ohio River from mile marker 203.9 (Belleville Locks and Dam) to 237.5 (Racine Locks and Dam). The total linear extent of the target population was approximately 67.2miles. The sample frame was generated using RF3 river double lines for the Ohio River and river mile coverages provided by ORSANCO. A generalized random tessellation stratified (GRTS) survey design for a linear network with reverse hierarchical randomization (RHR) was utilized to select all sampling locations. This survey design provided coordinates for 15 sampling sites in each of the selected pools. The data collected from these sites were used to make an initial assessment of the pool (see Section 3.6 and Appendix A). In addition, three sites from the 2004 assessment were revisited in 2005 to assess temporal variation between the years.

Sites were to be sampled as close as possible to the location generated from the design, but in cases of restricted access or unsafe sampling conditions (i.e. barge loading/mooring area), sampling zones could be shifted (up to a maximum of 500m up or downstream). The survey design supplied additional sampling sites to be used if a site could not be placed with 500m of the original location.

3.2 Index Period and Sampling Restrictions

All sampling was conducted under the required conditions as described by Emery et al. (2003). This included sampling between July 1 and October 31 when water levels were within one meter of "normal flat pool" and Secchi depths were greater than 0.3m. These sampling restrictions were used to reduce community variability by increasing the likelihood that samples were collected during the stable, low-flow conditions usually present on the Ohio River during the summer and early fall months.

3.3 Fish Collections

Standard collection techniques were employed throughout the surveys as described by Emery et al. (2003). Fish were collected using boat electrofishing techniques at night because nighttime electrofishing typically yields samples of increased diversity and richness (Sanders 1992). A sampling crew consisted of a three person team working from an 18-foot aluminum johnboat. Each boat was equipped with a 5000-watt generator and a Smith-Root Type VI-A electrofishing unit. Sampling was conducted over a 500m long section of near-shore habitat (shoreline out to a maximum distance of 30m or a depth of 20ft.) and was sampled for a minimum of 2000 seconds (Gammon 1998). Time could vary depending upon the complexity of the habitat within a given zone. Stunned fish were captured with nets and placed into large, aerated tubs for processing. Each fish was weighed, measured, inspected for anomalies, and identified to lowest possible

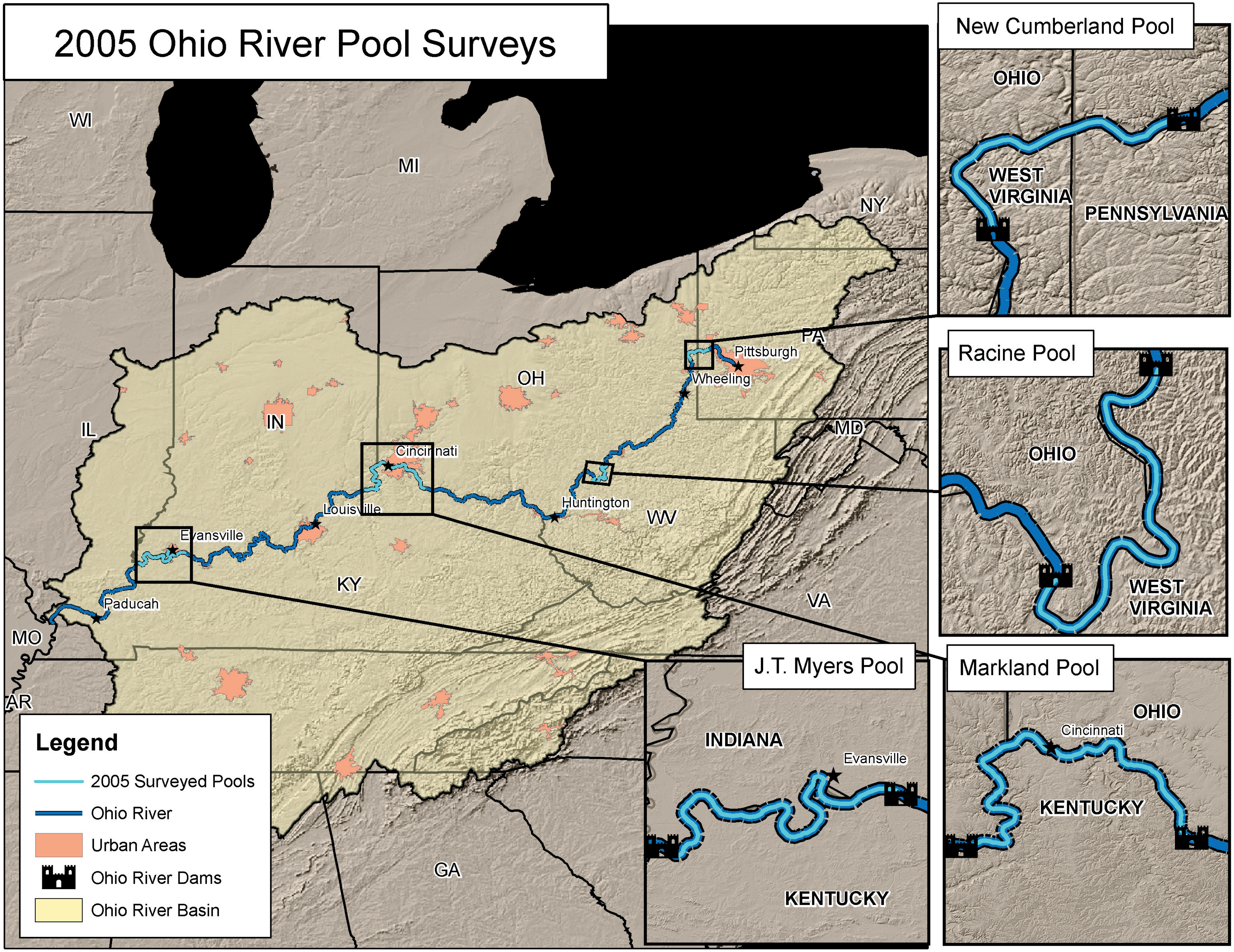

Figure 1. The Ohio River Basin and the four pools selected for 2005 sampling.

taxonomic level (species) before being returned to the water. Fish that could not be confidently identified in the field (e.g. minnows) were preserved in a ten percent formalin solution and identified in the laboratory.

3.4 Habitat Characterizations

Large rivers have distinct habitat types, including unique microhabitats (Reash 1999). Therefore, extensive habitat surveys were conducted for each electrofishing zone, including thorough substrate and depth measurements. Descriptions of the riparian corridor adjacent to the sampling zone and the presence of woody material available as fish cover were also recorded. Depth and substrate composition were measured at 66 points throughout each 500m zone. Six points along the shoreline were selected throughout the length of the zone, at 0, 100, 200, 300, 400 and 500m. From each of these points, depth was recorded at 3m intervals beginning at the shore/water interface and moving out away from the shore for 30m. Woody cover, which included submerged brush, logs and stumps, was estimated visually. Using these data, each site, or electrofishing zone, was assigned to one of three classes of habitat: ‘A’, ‘B’, or ‘C’. By assigning each sampling site to one of three habitat categories, biologists can reduce the amount of assessment variability, or ‘noise’, because each habitat class has a slightly different expectation. Sites assigned to habitat class ‘A’ are characterized by the presence of large substrates such as cobble and boulders. Sites that fall in habitat class ‘C’ are dominated by sand and other small substrates and habitat class ‘B’ describes sites that fall between ‘A’ and ‘C’ with a mix of large and small substrate materials.

3.5 Water Quality and Flow Condition Data

Basic measures of water quality were collected at each site prior to sampling. The following parameters were measured with a YSI meter: water temperature, pH, dissolved oxygen (DO), and conductivity. Secchi depth was measured using a standard Secchi disk. Flow data were obtained from the U.S. Army Corps of Engineers. These included daily average flows from the sampling station within or nearest to the sampled pool. Harmonic mean flow (HMF) values were determined by ORSANCO using 30-year means for the flow data obtained from the U.S. Army Corps of Engineers (ORSANCO 2003).

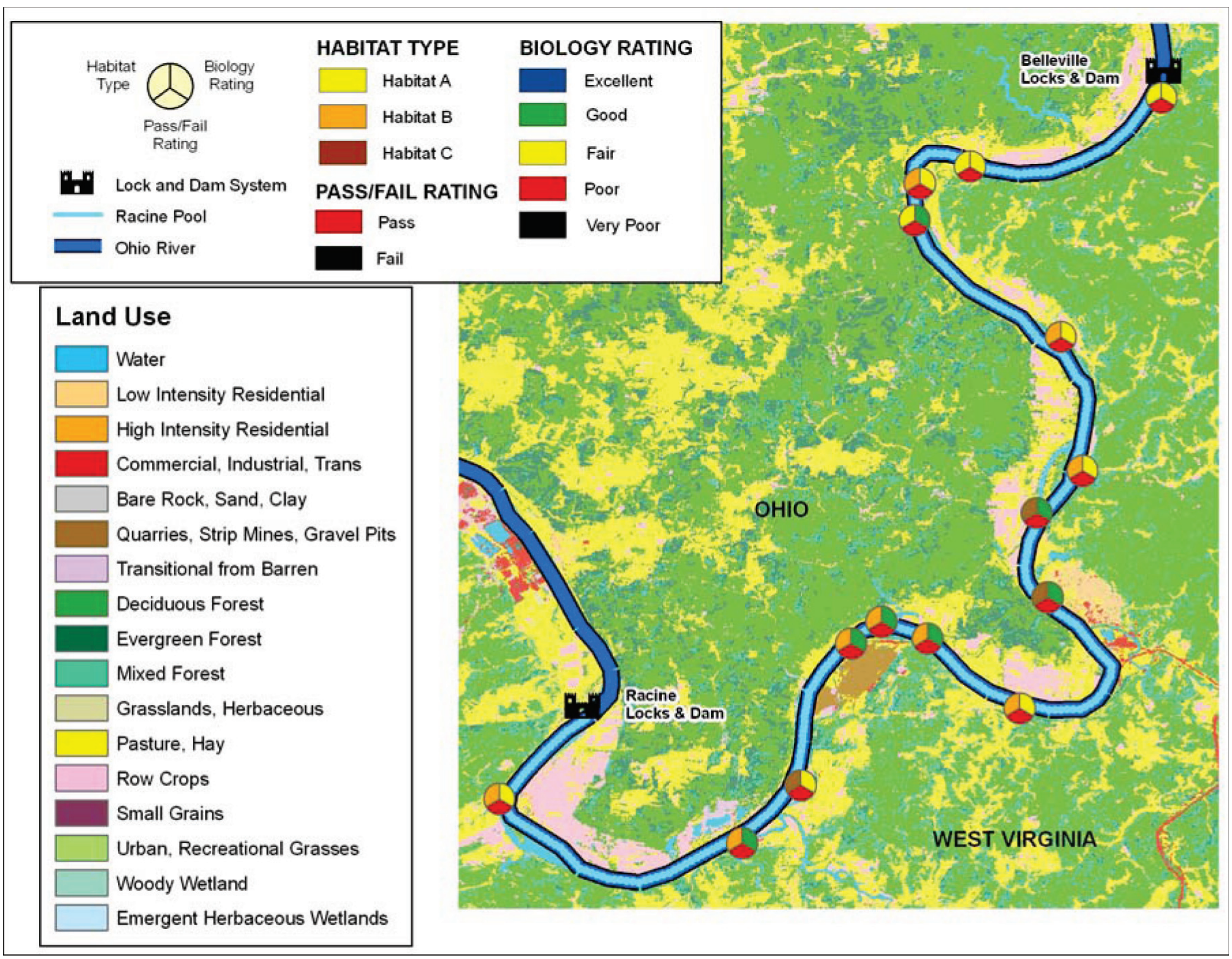

Figure 2. Results of sampling at 15 sites within the Racine pool.

3.6 Pool Assessment

In 2005, ORSANCO employed a probability-based sampling and assessment approach to provide a thorough assessment of biological condition. For the purpose of assessment, individual navigational pools served as the primary assessment units. Therefore, the Racine pool served as one distinct AU and will be reported on as such in the 305(b) report issued to EPA. The approach to assessing each AU involved sampling a statistically determined number of sites (15) and comparing observed ORFIn scores to habitat derived expectations for each site (Emery et al. 2003).

Typical 500 meter electrofishing reach.

The three distinct habitat classes ('A', 'B', and 'C') each exhibit different levels of ORFIn performance. Performance expectations for each habitat class were determined based on the statistical distribution of data (ORFIn scores) gathered from 'least impacted' (reference) sites within each habitat class. The 25th percentile value for each habitat class was established as the criterion for determining whether an individual site 'passes' (meets its aquatic life use designation) or 'fails' (does not meet its aquatic life use designation, Figure 3). Individual site scores were compared to expected values and the percentage of failing sites in the pool was then calculated. A precision estimate for the percentage of sites failing was also calculated (see Appendix A for a detailed explanation). The precision estimate was used to create a 90% confidence interval around the percentage of sites failing. The threshold for the pool assessment was set at 25% failure. If any part of the confidence interval contained 25%, the assessment required additional sampling. If the entire confidence interval was higher than 25%, the pool was assessed as failing. The pool passed the assessment if the whole confidence interval fell below 25%.

To further characterize the condition of each pool, sites were given individual condition ratings. These ratings were based on the same distribution of data from 'least impacted' sites used to determine expectations (Figure 3) and consisted of Excellent, Good, Fair, Poor and Very Poor. The 90th, 75th, 25th, and 10th percentiles were used as cutoff points for the different ratings. Any sites that were classified as Poor or Very Poor were also sites that failed to meet expectations.

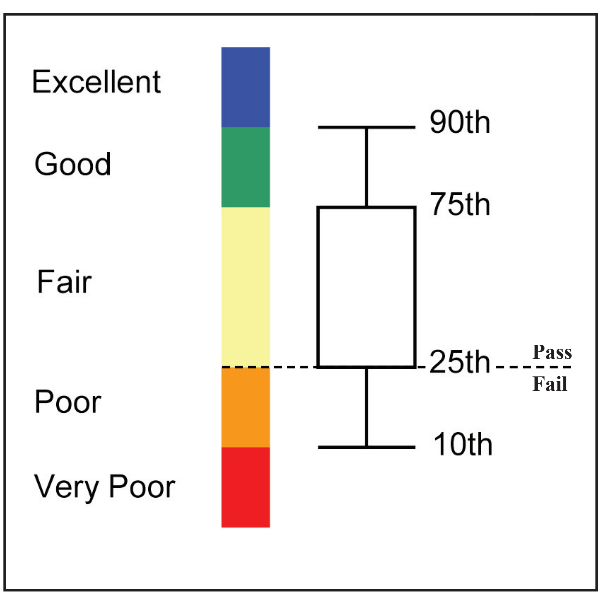

Figure 3: Illustration showing the approach used for assigning the various condition ratings.

4.0 Results

The results presented in Sections 4.1 to 4.5 are based on the 15 sites selected with the probability-based design for the 2005 assessment of the Racine pool. Three sites sampled in 2004 were resampled in 2005 and the results for these sites are included in 4.6 for a comparison of the two years.

4.1 Fish Population

In 2005, fish population data (Appendix B) were collected from 15 randomly selected locations throughout the length of the Racine pool (Table 1). These collections produced 41 taxa, representing 12 different families (Table 2). Of the species collected, only one is given special status by either of the states bordering Racine pool. The river darter (*Percina shumardi*) is listed as a threatened species in Ohio and two individuals were collected. When examining the population at the species level, gizzard shad (*Dorosoma cepedianum*) was by far the most abundant species, which comprised 73.5% of the catch. Large schools of shad were frequently encountered during sampling of the pool and most of these were small and young individuals. Emerald shiner (*Notropis atherinoides*) was the next most abundant species, at 7.3% of the total catch (Figure 4). The dominance of gizzard shad was directly reflected at the family level. The shad and herring

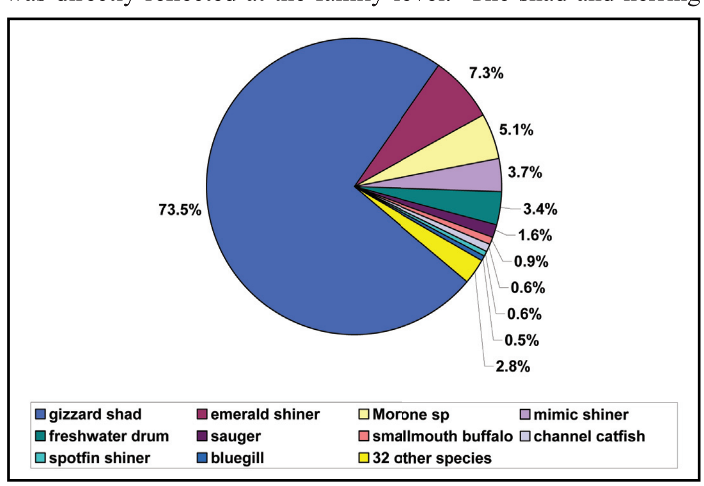

Figure 4. Species compositions of fish sampled in the Racine Pool.

Table 1: Electrofishing site list for the Racine Pool, including habitat designations, ORFIn scores and status.

River Mile	Bank	Date	Latitude	Longitude	Habitat Class	Expected ORFIn	Observed ORFIn	Site Pass/ Fail	Rating
205.2	LDB	07/06/05	39.099	81.741	A	39	43	Pass	Fair
208.7	LDB	07/06/05	39.079	81.797	A	39	43	Pass	Fair
210.2	LDB	07/13/05	39.074	81.811	B	33	41	Pass	Fair
210.7	RDB	07/13/05	39.066	81.813	A	39	47	Pass	Good
214.3	LDB	07/07/05	39.030	81.771	B	33	41	Pass	Fair
217.0	LDB	07/07/05	38.991	81.764	B	33	39	Pass	Fair
218.0	RDB	07/05/05	38.979	81.777	C	19.9	41	Pass	Good
219.8	LDB	07/05/05	38.955	81.774	C	19.9	41	Pass	Good
223.5	LDB	07/12/05	38.923	81.782	B	33	39	Pass	Fair
225.4	RDB	07/12/05	38.943	81.809	B	33	43	Pass	Good
226.2	RDB	07/11/05	38.948	81.822	B	33	43	Pass	Good
226.4	LDB	07/11/05	38.943	81.825	B	33	45	Pass	Good
229.8	LDB	09/08/05	38.901	81.845	C	27.7	29	Pass	Fair
231.3	LDB	09/07/05	38.884	81.862	B	33	43	Pass	Good
235.8	LDB	09/07/05	38.897	81.932	B	33	37	Pass	Fair
227.1 Revisit	LDB	09/06/05	38.938	81.834	B	33	41	Pass	Fair
227.6 Revisit	RDB	09/06/05	38.933	81.841	B	33	37	Pass	Fair
231.8 Revisit	LDB	09/07/05	38.880	81.871	B	33	41	Pass	Fair

family (Clupeidae) dominated in abundance, making up 73.1% of the total catch, followed by the minnow family which made up 12.1% of the catch (Figure 5).

4.2 Metric Performance

Thirteen metrics were used to calculate ORFIn scores for each electrofishing site (Emery et al. 2003). Each site's performance and scores for the ORFIn metrics are shown in Table 3. The number of native species collected at each site ranged from 11 to 27, with an average of 17.6 species per site. No site scored lower than three for the number of native species metric. The number of sucker species found at each site ranged from 2 to 8 and 11 of 15 sites scored a three for this metric. The number of centrarchid species varied from zero to seven and metric scores ranged from one to five. The number of great river species varied between zero and two species per site, with scores being either one or three for all sites. There were between one and four intolerant species found at the sampled sites. All sites had less than 3.8% tolerant individuals and all but two scored a five for the percent of tolerant individuals. The percentage of simple lithophils was between 2.0 and 26.7 % and most sites scored one for this metric. Most sites had below 4.0 % non-native individuals and all but two sites scored five. These two sites had over 10% non-native individuals and scored a one for the metric. The percent detritivores was as low as 1.6% and as high as 28.8%, with scores of one, three, and five for the sites. The percent invertivores ranged from 1.3% to 54.6% with most (11) sites scoring one for this metric. The percent piscivores ranged from 23.6% to 66.3% and metric scores were mostly 5 with some threes. No more than three DELT anomalies were found at any site and most sites received a score of five for the DELT metric. The CPUE (catch per unit effort) ranged from 123 to 1525 individuals per site, with mostly higher scores and only one site receiving a score of one.

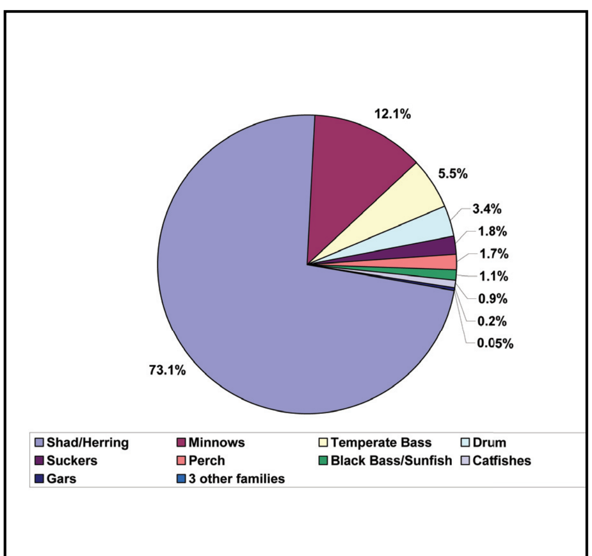

Figure 5. Fish composition by family in the Racine Pool.

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 sampling locations revealed that the bottom substrate in Racine pool was dominated by small substrate particles. Sand made up 52% of the substrate at the sites surveyed and fines contributed another 20%. However, there was some variation among the individual sites (Figure 6). The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', or 'C' (Table 1, Figure 7). All three habitat classes were present in the Racine pool; with class B being most common (Figures 7 and 8). Woody cover was present in 13 of the 15 sites sampled. Riparian land use was primarily forested and agricultural and many sites had some bank erosion occurring (additional data in Appendix C).

Table 2. Species collected from Racine pool in 2005.

Family	Scientific Name	Common Name	# Caught	WV	OH
Lepisosteidae	*Lepisosteus osseus*	longnose gar	24		
Clupeidae	*Alosa chrysochloris*	skipjack herring	1		
Clupeidae	*Dorosoma cepedianum*	gizzard shad	8048		
Hiodontidae	*Hiodon tergisus*	mooneye	1		
Cyprinidae	*Cyprinus carpio*	common carp	9		
Cyprinidae	*Luxilus chrysocephalus*	striped shiner	2		
Cyprinidae	*Cyprinella spiloptera*	spotfin shiner	63		
Cyprinidae	*Notropis atherinoides*	emerald shiner	795		
Cyprinidae	*Notropis volucellus*	mimic shiner	402		
Cyprinidae	*Macrhybopsis storeriana*	silver chub	44		
Cyprinidae	*Pimephales notatus*	bluntnose minnow	3		
Cyprinidae	*Pimephales promelas*	fathead minnow	6		
Cyprinidae	*Pimephales vigilax*	bullhead minnow	5		
Catostomidae	*Carpiodes sp*	carpiodes sp	2		
Catostomidae	*Carpiodes cyprinus*	quillback	16		
Catostomidae	*Carpiodes carpio*	river carpsucker	50		
Catostomidae	*Carpiodes velifer*	highfin carpsucker	7		
Catostomidae	*Moxostoma breviceps*	smallmouth redhorse	5		
Catostomidae	*Moxostoma anisurum*	silver redhorse	11		
Catostomidae	*Moxostoma erythrurum*	golden redhorse	11		
Catostomidae	*Ictiobus bubalus*	smallmouth buffalo	96		
Catostomidae	*Ictiobus cyprinellus*	bigmouth buffalo	1		
Catostomidae	*Minytrema melanops*	spotted sucker	1		
Ictaluridae	*Ictalurus punctatus*	channel catfish	70		
Ictaluridae	*Pylodictis olivaris*	flathead catfish	32		
Percopsidae	*Percopsis omiscomaycus*	trout-perch	3		
Atherinopsidae	*Labidesthes sicculus*	brook silverside	1		
Moronidae	*Morone sp*	morone sp	561		
Moronidae	*Morone saxatilis x M. chrysops*	hybrid striper	46		
Moronidae	*Morone chrysops*	white bass	3		
Centrarchidae	*Lepomis sp*	lepomis sp	1		
Centrarchidae	*Lepomis cyanellus*	green sunfish	6		
Centrarchidae	*Lepomis macrochirus*	bluegill	58		
Centrarchidae	*Lepomis humilis*	orangespotted sunfish	1		
Centrarchidae	*Lepomis megalotis*	longear sunfish	3		
Centrarchidae	*Lepomis microlophus*	redear sunfish	1		
Centrarchidae	*Micropterus dolomieu*	smallmouth bass	6		
Centrarchidae	*Micropterus salmoides*	largemouth bass	22		
Centrarchidae	*Micropterus punctulatus*	spotted bass	22		
Centrarchidae	*Pomoxis nigromaculatus*	black crappie	3		
Percidae	*Percina caprodes*	logperch	6		
Percidae	*Percina shumardi*	river darter	2		T
Percidae	*Sander vitreus*	walleye	4		
Percidae	*Sander canadensis x S. vitreus*	saugeye	4		
Percidae	*Sander canadensis*	sauger	173		
Sciaenidae	*Aplodinotus grunniens*	freshwater drum	375		

41 taxa were collected, representing 12 families. T = State threatened species.

4.4 Water Quality and Flow Conditions

Flow conditions were generally stable throughout the 2005 sampling period and river levels were at or below normal. There were very few rain events to cause increases in river flow and water levels throughout the Ohio River valley (Figures 9 and 10). No sampling was conducted when flows were above the harmonic mean for the pool. The HMF for this part of the river is 24.5 kcfs and sampling was conducted between 46% and 72% of the HMF (Figure 11). Measurements of water quality parameters did not reveal any unusual or poor water conditions present at the time of sampling (Table 4). Secchi depths at the time of sampling ranged from 36 to 72 inches.

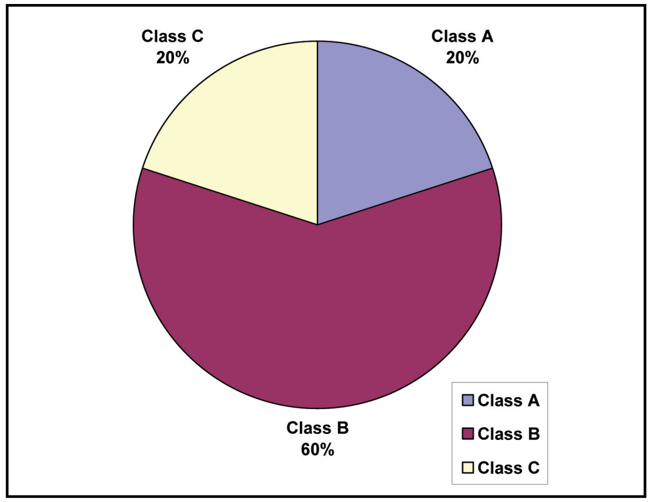

Figure 8. Habitat classification for Racine Pool.

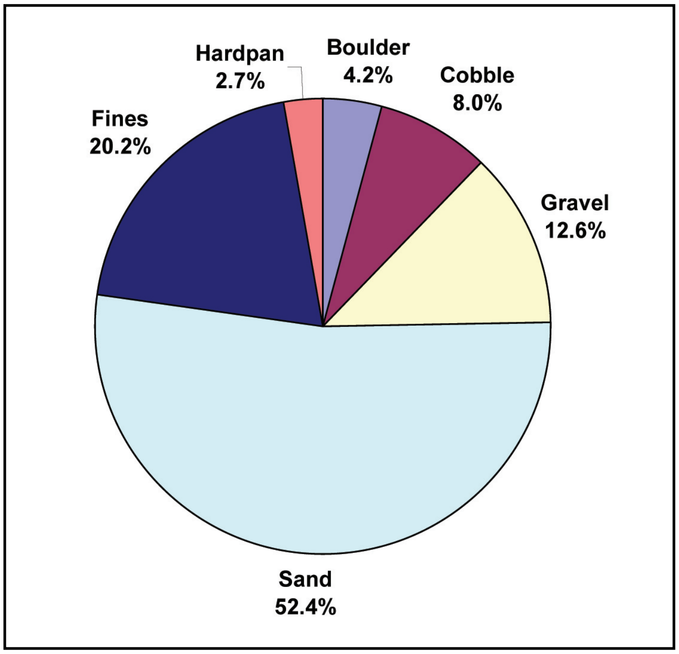

Figure 6. Average substrate composition of Racine Pool sites in 2005.

4.5 Assessment of Condition

ORFIn scores were calculated for each of the sites sampled. The maximum score achieved by any site in this pool was 47 and the minimum was 29. By comparing observed and expected ORFIn scores, ORSANCO assesses each site as either passing or failing (Table 3). All 15 sites sampled in 2005 scored higher than the minimum expected scores and received passing evaluations (Table 1, Figure 12). With 100% of the sites passing, the Racine pool was also assessed as passing. Seven sites were found to be in good condition and eight were in fair condition (Figure 13).

4.6 Revisits

The three sites that were sampled in both years scored between zero and 19 points higher in 2005 than in 2004 (Table 5, Figure 14). In 2004, one of the sites was in failing condition, but all three sites were in passing condition for 2005. The condition rating at the failing site improved from very poor to fair, while the other two remained at fair. The 2005 scores for the revisit sites were similar to scores achieved by the other sites sampled in 2005 (Table 1).

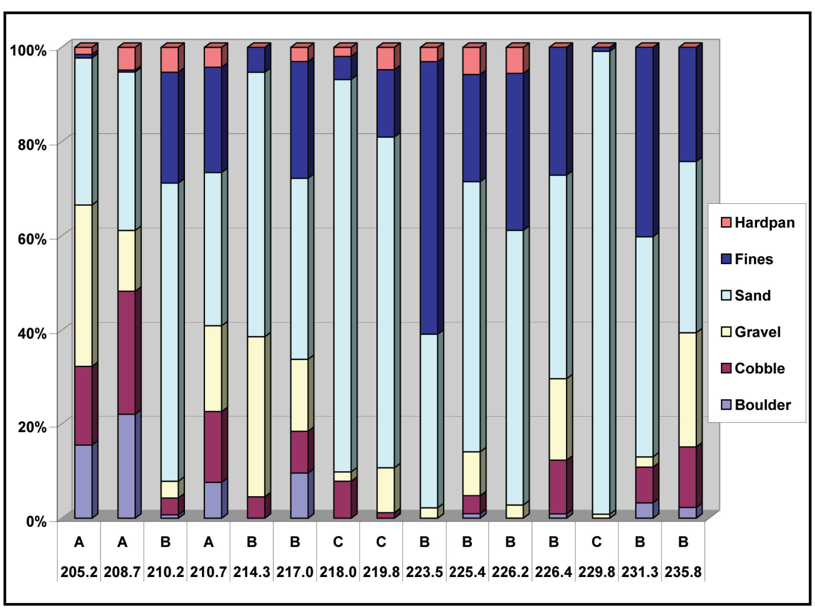

Figure 7. Substrate composition and habitat class at each of the 15 sites in Racine Pools.

5.0 Summary and Discussion of 2004 Racine Pool Results

This section provides a concise summary of the results from 2004 for comparison to 2005. These results are fully explained in the report "A Biological Study of the Racine Pool of the Ohio River (2004)" (ORSANCO 2006).

5.1 Fish Population

In 2004, the catch was dominated by the minnow (Cyprinidae) family with mimic shiner (*Notropis volucellus*) and emerald shiner (*N. atherinoides*) being the most common species from this family. The shad and herring (Clupeidae) family was the second most dominant family, with gizzard shad (*Dorosoma cepedianum*) being the most common species overall. At many of the sites sampled, the number of fish caught was less than expected. At five of the fifteen sites the numbers were low enough to cause the sites to be low-end scored (see Emery et al. 2003), which penalizes sites for not supporting a large enough fish population.

Table 3. Performance of Racine sites for individual ORFIn metrics in 2005.

River Mile	Bank	# Individuals	# Individuals w/o gizzard shad and emerald shiners	# Individuals w/o gizzard shad, emerald shiners, and exotic, hybrid, and tolerant species	# Native Species	Native Species Score	# Sucker Species	Sucker Species Score	# Centrarchid Species	Centrarchid Species Score	# Great River Species	Great River Species Score	# Intolerant Species	Intolerant Species Score	%Tolerant Individuals	Tolerant Individuals Score	% Simple Lithophils	Simple Lithophils Score	% Non-native Individuals	Non-native Individuals Score	% Detritivores	Detritivores Score	% Invertivores	Invertivores Score	% Piscivores	Piscivores Score	# of DELTs	DELTs Score	CPUE	CPUE Score	Expected ORFIn Score	Observed ORFIn Score	Site Score Pass/Fail
205.2	LDB	1932	348	348	11	3	2	1	1	1	0	1	1	1	0.0	5	2.0	1	0.0	5	1.7	5	54.6	5	42.5	5	1	5	1932	5	39	43	Pass
208.7	LDB	647	71	71	15	3	4	3	2	1	1	1	3	3	0.0	5	9.9	1	0.0	5	7.0	5	25.4	1	56.3	5	0	5	647	5	39	43	Pass
210.2	LDB	640	62	62	13	3	2	1	1	1	0	1	1	1	0.0	5	6.5	1	0.0	5	1.6	5	53.2	5	35.5	3	0	5	640	5	33	41	Pass
210.7	RDB	1525	97	97	17	3	4	3	4	3	0	1	3	3	0.0	5	9.3	1	0.0	5	3.1	5	38.1	3	45.4	5	0	5	1525	5	39	47	Pass
214.3	LDB	370	80	76	18	3	4	3	4	3	0	1	2	1	3.8	3	13.8	1	3.8	5	10.0	5	22.5	1	52.5	5	1	5	366	5	33	41	Pass
217.0	LDB	185	95	95	17	3	3	3	4	3	1	1	2	1	0.0	5	14.7	1	0.0	5	4.2	5	17.9	1	66.3	5	3	3	185	3	33	39	Pass
218.0	RDB	1366	151	151	18	3	4	3	0	1	1	1	1	1	0.0	5	18.5	1	0.0	5	7.3	5	23.2	1	50.3	5	0	5	1366	5	20	41	Pass
219.8	LDB	870	234	233	17	3	3	3	3	3	1	1	2	1	0.0	5	9.4	1	0.4	5	2.6	5	17.1	1	32.9	3	1	5	869	5	20	41	Pass
223.5	LDB	212	94	94	17	3	4	3	1	1	1	1	1	1	0.0	5	9.6	1	0.0	5	5.3	5	9.6	1	41.5	5	0	5	212	3	33	39	Pass
225.4	RDB	1019	135	133	17	3	3	3	0	1	1	1	1	1	1.5	5	26.7	3	0.0	5	7.4	5	27.4	3	37.8	3	0	5	1017	5	33	43	Pass
226.2	RDB	933	172	166	25	5	5	3	5	3	1	1	2	1	3.5	3	23.8	3	1.2	5	12.8	3	18.6	1	40.7	5	1	5	927	5	33	43	Pass
226.4	LDB	596	112	111	18	3	3	3	3	3	2	3	2	1	0.9	5	21.4	3	0.9	5	14.3	3	20.5	1	44.6	5	0	5	595	5	33	45	Pass
229.8	LDB	254	156	132	13	3	4	3	0	1	0	1	1	1	1.3	5	10.9	1	15.4	1	28.8	1	1.3	1	32.1	3	0	5	230	3	28	29	Pass
231.3	LDB	329	248	214	27	5	8	5	7	5	0	1	4	3	2.8	5	8.1	1	11.7	1	8.5	5	13.7	1	40.3	5	2	3	295	3	33	43	Pass
235.8	LDB	126	106	103	21	5	2	1	7	5	2	3	3	3	2.8	5	12.3	1	0.0	5	25.5	1	20.8	1	23.6	3	2	3	123	1	33	37	Pass
227.1 Revisit	LDB	470	137	130	23	5	6	5	5	3	1	1	3	3	3.7	3	15.3	1	1.5	5	20.4	1	16.8	1	31.4	3	0	5	463	5	33	41	Pass
227.6 Revisit	RDB	325	222	214	20	5	4	3	3	3	0	1	2	1	1.4	5	9.9	1	2.3	5	26.1	1	9.9	1	22.1	3	1	5	317	5	33	37	Pass
231.8 Revisit	LDB	290	212	188	22	5	5	3	5	3	2	3	6	5	3.8	3	21.7	3	7.5	3	14.2	3	17.0	1	37.7	3	2	3	266	3	33	41	Pass

RDB – Right Descending Bank
LDB – Left Descending Bank
Centrarchid Species – black bass, sunfishes, crappie
Great River Species – fish expected to predominate in great rivers
Intolerant Species – species of fish with low pollution/disturbance tolerance
Tolerant Individuals – individuals with high pollution/disturbance tolerance

Simple Lithophils – reproductive grouping of fish species that are sensitive to substrate disturbance
Detritivore – feeding guild of fish species that feed primarily on detritus
Invertivore – feeding guild of fish species that feed primarily on invertebrates
Piscivore – feeding guild of fish species that feed primarily on fish
DELT – Deformities, Eroded fins, Lesions, and Tumors
CPUE – Catch Per Unit Effort

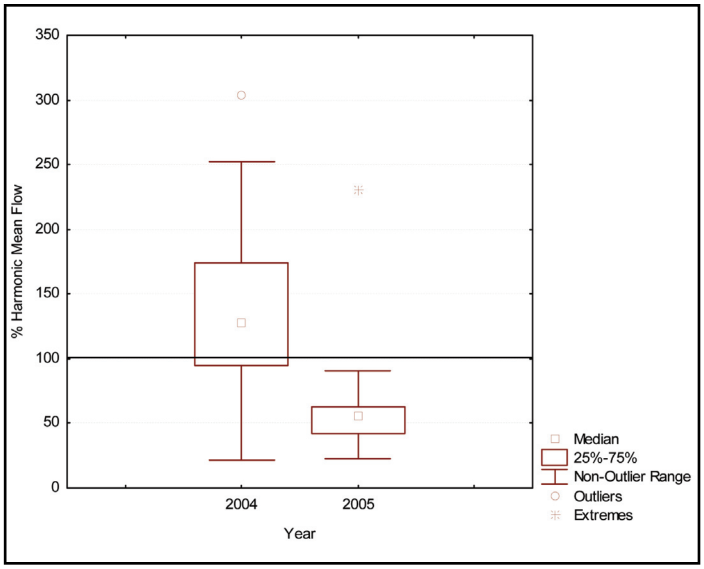

Figure 9. Daily harmonic mean flows (HMF) near sampling locations over the 2004 and 2005 sampling seasons.

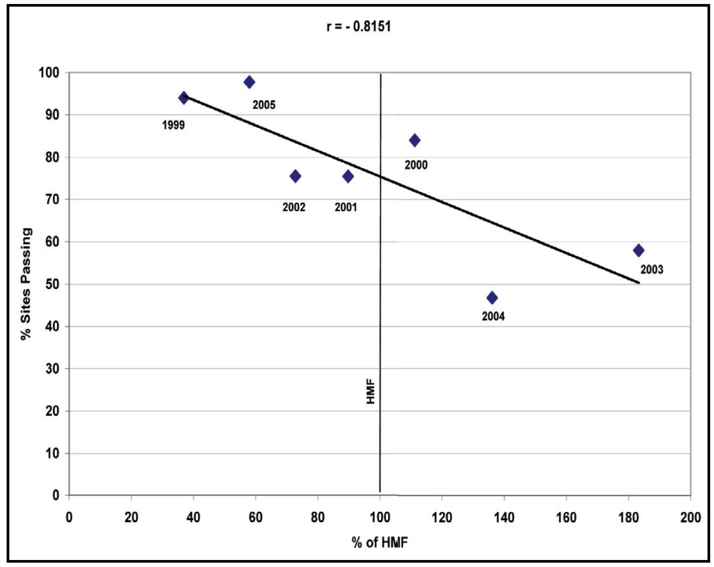

Figure 10. Correlation of harmonic mean flow (HMF) and percentage of sites passing for different years of sampling in multiple pools.

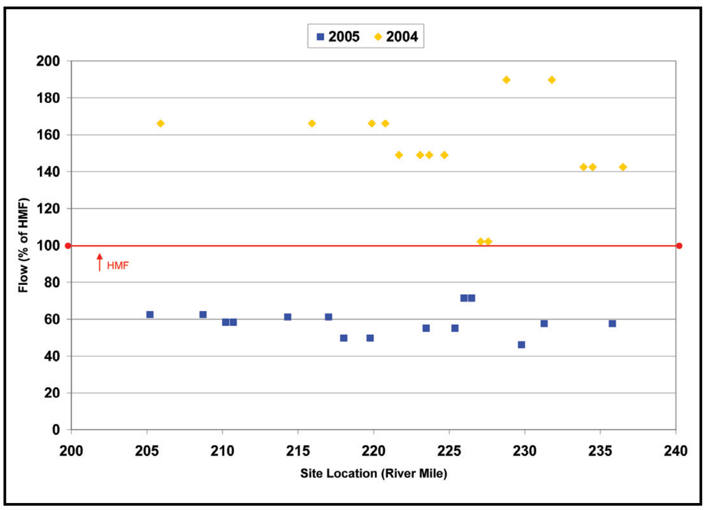

Figure 11. Flows relative to harmonic mean flow (HMF) on day of sampling for 2004 and 2005 in Racine pool.

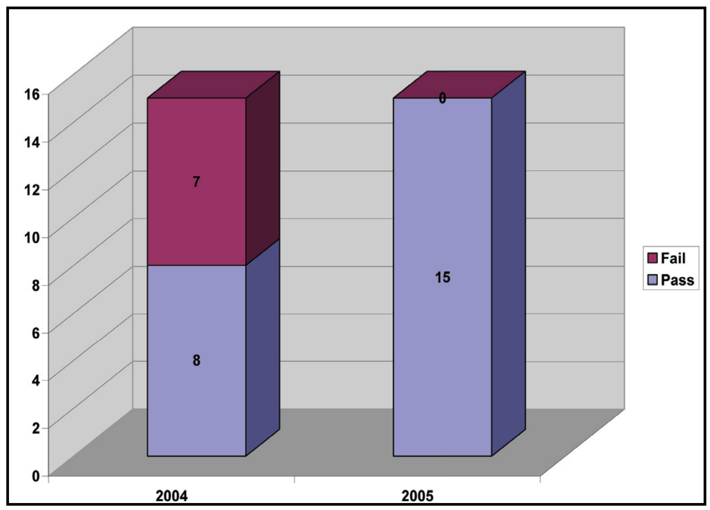

Figure 12. Comparison of site assessment results for 2004 and 2005.

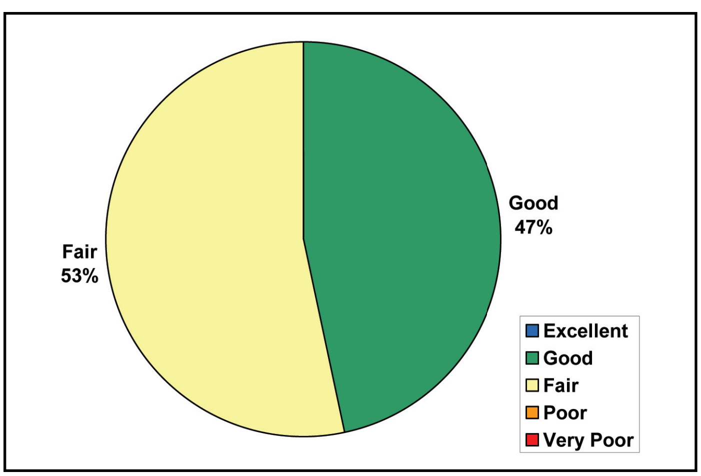

Figure 13. Condition ratings for sites in Racine Pool, based on ORFIn scores at 15 sites in 2005.

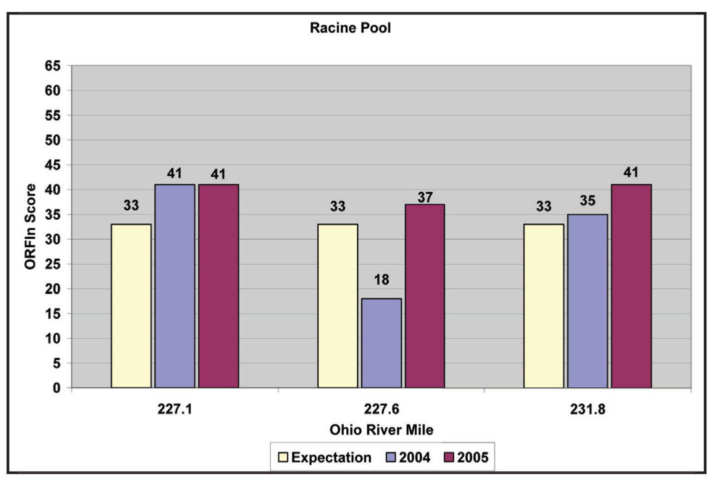

Figure 14. ORFIn scores and expectations for sites sampled in 2004 and 2005.

Table 4. Comparison of sites sampled in Racine Pool in both 2004 and 2005.

Year	RMI	Bank	Date	Latitude	Longitude	Secchi (in)	Habitat Class	Obs. ORFIn	Exp. ORFIn	Site Pass/ Fail	Rating
2004	227.1	LDB	7/26/04	38.937	81.833	36	B	41	33	Pass	Fair
2005	227.1	LDB	9/6/05	38.937	81.833	49	B	41	33	Pass	Fair
2004	227.6	RDB	7/26/04	38.932	81.840	36	B	18	33	Fail	Very Poor
2005	227.6	RDB	9/6/05	38.932	81.840	47	B	37	33	Pass	Fair
2004	231.8	LDB	7/27/04	38.879	81.871	18	B	35	33	Pass	Fair
2005	231.8	LDB	9/7/05	38.879	81.871	42	B	41	33	Pass	Fair

5.2 Metric Performance

The sites throughout the pool scored lowest on the number of great river species and CPUE metrics. The number of DELT anomalies was the highest scoring metric followed by non-native species.

5.3 Habitat Surveys

The habitat surveys showed that fines (41%) were the most common bottom substrate, followed by sand at 23%. Most (80%) of the sites were class 'B' habitats and the rest were class 'A' habitats.

5.4 Water Quality and Flow Conditions

In 2004 multiple heavy rainfall events in the spring and summer caused both the water levels and flow volume to become elevated. These were sustained at moderately high levels throughout the sampling season and resulted in much higher flow volumes in 2004 than are normally encountered (Figure 10). Despite the higher flows and water levels, sampling was only conducted under the conditions required by Emery et al. (2003). No unusual measurements for temperature, pH, DO, and conductivity were recorded in 2004. Secchi depths ranged from 18 to 50 inches.

5.5 Assessment of Condition

In 2004, only eight sites met expectations (passed) and only two sites received a rating higher than fair. With only 47% of the sites passing, the Racine pool was assessed as failing to meet its aquatic life use designation. However, concerns were raised that the data may have been influenced by the higher than normal flows seen in 2004.

6.0 Discussion

6.1 Fish Population

The collections from Racine pool showed several important differences between 2004 and 2005. First, the 2005 survey results show more diversity and much higher abundance than the 2004 surveys. The number of individuals caught in 2005 was over six times higher than that from 2004 and three additional taxa were recorded in 2005. Second, each year's catch was dominated by different fish species and families. The 2005 samples were heavily dominated by gizzard shad. But in 2004, mimic shiners were the most common and no single species dominated the catch. The sucker family was the second most common in 2004, but only fifth in 2005. The fish population would not normally be expected to change so much within one year's time and it is unlikely that these differences reflect an actual change in the overall fish population. It seems more likely that something affected the sampling efficiency and accuracy in 2004. It is hypothesized that the lower flow conditions in 2005 were more conducive to efficient sampling and allowed for a better representation of the fish population than the conditions of 2004. It is also suspected that fish move to different locations during periods of higher flow, similar to seeking refugia in the winter (Garvey et al. 2003).

6.2 Metric Performance

The higher diversity and abundance of the 2005 catch resulted in metric scores that were higher than most 2004 metric scores. The major exception was for the percent invertivores metric, which produced lower scores in 2005. The decrease in percentage of invertivores is explained more by an increase in overall numbers in 2005 than an actual decrease in the number of invertivores. A small decrease was also seen in the percent of simple lithophils from 2004 to 2005. The most notable improvement was seen in the CPUE metric, which went from being one of the lowest scoring metrics to one of the highest. This was a direct result of the increased numbers seen in 2005. The number of DELTs remained one of the highest scoring metrics. They were joined by percent tolerant individuals as the metrics scoring a five at nearly every site. The low scoring metrics were the number of great river species and percent simple lithophils and number of intolerant species. No specific factors contributing to the lower scores in these metrics have been identified.

6.3 Habitat Surveys

The habitat assessments of both years show that most areas in Racine pool are classified as class 'B' habitats and that there are some class 'A' and 'C' habitats. In 2004 fines were the dominant substrate and in 2005 it was sand. This indicates that much of the substrate consists of small particles, which are not ideal habitat for the fish population. The 2004 habitat surveys showed a much higher percentage of fines than were seen in the 2005 assessments. The difference in the percentage may be an artifact of the probabilistic design. There is variation throughout the pool and it is likely that the sites selected in 2005 happened to have fewer fines present. Still, the habitat assessments in both years showed similar results for the substrate present in the pool, which consists predominately of small materials. These small substrate materials of Racine pool are certainly linked to the agricultural land use in the area and may limit the potential of the fish population in Racine pool.

6.4 Water Quality and Flow Conditions

There were no water quality measurements that were out of the ordinary or that provide any major insight into the assessment results for either year. The differing amounts of rainfall in each year affected the flow conditions under which the biological data were collected. Higher stage and flow conditions are generally associated with higher turbidity levels, which can hinder effective fish collection. All Secchi depths indicated sufficient visibility for sampling; however measurements were slightly lower in 2004. Sites in 2004 may have experienced lower visibility, slightly reducing the catch at some sites, but not enough to explain the differences alone. Swift flows can also adversely affect capture efficiency by making boat maneuvering and fish netting more difficult. Finally, these periods of high flow may alter the habits and locations of the fish (see Section 6.5)

6.5 Assessments of Condition and Conclusions

The assessments conducted in the Racine pool over 2004 and 2005 have provided a lot of information about the fish population and the overall biological condition of the pool. However, the information provided does not agree between the two years. In 2004, nearly 50% of the Racine pool sites were deemed as failing, therefore this assessment unit (AU) would be reported as impaired (and not supporting its designated aquatic life use). The 2005 assessment found all of the sample sites to be in passing condition and so the pool would be considered as passing (or fully supporting its aquatic life use). The sites that were revisited also showed that scores were better in 2005, highlighting the difference between the years.

It is important to understand why the 2004 and 2005 assessments are so different because each result has different implications. An AU that is considered passing or unimpaired receives no sanctions, but impaired AU's are viewed negatively and are subjected to further sampling, 303(d) listing and possible TMDL (Total Maximum Daily Load) development.

At this time an explanation for the differences in the assessments is not certain, but flow volume has been identified as one very important factor. It appears that increases in flow are associated with lower assessment scores. A better understanding of the relationship between flow and assessment scores is needed. This includes determining what flow conditions are appropriate for sampling and then calibrating the assessments for different flow levels. As this relationship is better understood, ORSANCO will be able to provide more accurate assessments of biological condition.

It is probable that the higher than normal flows seen in 2004 reduced the overall catch and biased the species that were caught. The higher flows decreased the visibility in the water, reduced boat maneuverability, and altered the movement of the fish, all of which reduced the number of fish that were seen and netted. At normal summer flow levels, fish orient to the near shore habitat, where the electrofishing is conducted. However, when flows are increased and the water is turbid, some species behave differently. It is likely that during the high flows of 2004, the fish sought refugia in different parts of the pool (e.g. deeper water, embayments, etc.) and therefore different catch rates were encountered.

The assessment was successfully conducted in the Racine pool. The primary goals of this method were to adequately assess a given AU while minimizing resource expenditure, reduce or eliminate human bias and provide statistically valid results. Although further sampling is needed to confirm our results, this design appears to have accomplished these goals.

Literature Cited

Emery, E.B., T.P. Simon, F.H. McCormick, P.L. Angermeier, J.E. Deshon, C.O. Yoder, R.E. Sanders, W.D. Pearson, G.D. Hickman, R.J. Reash, and J.A. Thomas. 2003. Development of a multimetric index for assessing the biological condition of the Ohio River. Transactions of the American Fisheries Society. 132:791-808.

Gammon, J.R. 1998. The Wabash River Ecosystem. Indiana University Press, Bloomington, IN.

Garvey, E.G., S. Welsh and K.J. Hartman. 2003. Winter Habitat Used by Fishes in Smithland Pool and Belleville Pool, Ohio River. Southern Illinois University and West Virginia University.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers. 77:179-190.

ORSANCO (Ohio River Valley Water Sanitation Commission). 1994. Ohio River Fact Book. ORSANCO, Cincinnati, OH.

ORSANCO. 2003. Pollution Control Standards for Discharges to the Ohio River. ORSANCO, Cincinnati, OH.

ORSANCO. 2006. A Biological Study of the Racine Pool of the Ohio River. ORSANCO, Cincinnati, OH.

Reash, R.J. 1999. Considerations for characterizing Midwestern large river habitats. Pages 463-473 in Simon (1999).

Sanders, R.E. 1992. Day versus night electrofishing catches from near-shore waters of the Ohio and Muskingum Rivers. Ohio Journal of science 92:51-59.

Simon T.P. 1999. Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

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