ORSANCO

Ohio River Valley Water Sanitation Commission

Biological Programs 2004
Intensive Survey Results
Series 1
Report 2

A Biological Study of the Racine Pool of the Ohio River

Executive Summary

- In 2004, ORSANCO introduced the utilization of random probabilistic design for sampling fish communities in the Ohio River.

- The Ohio River was divided into assessment units based on the locations of navigational dams.

- Based on the random design, each assessment unit was assigned 15 sampling locations.

- Once sampled, each site is graded as passing or failing to meet it aquatic life use designation

- For an assessment unit to be considered in passing condition, more than 75% of the sites assessed must be in passing condition.

- In 2004, the sites sampled in the Racine pool failed to meet these criteria, with nearly 50% of sites failing.

- Therefore, the Racine pool would be reported as failing to meet its aquatic life use designation.

- The results from this survey are questionable due to unusually high flows that occurred during the 2004 sampling seasons.

- Recommendations include resampling the Racine Pool in 2005 and more intense analysis of the relationship between flow and assessment results.

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TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

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, but 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 suited 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 can be used to obtain water quality information and provide 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 is a collection of 13 attributes, or metrics, of the fish community that when compiled provide an accurate representation of the overall condition of the Ohio River 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 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.

An objective of this program is to apply the probability-based monitoring design to the Ohio River to assess individual pool reaches based on the fish population. In 2004, four pools in the Ohio River were surveyed: New Cumberland, Racine, Markland, and J.T. Myers. This report will focus on the fish assemblage, the performance of the ORFIn and the effectiveness of the probabilistic design in the Racine pool.

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 the 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 (Figure 2) extends from Belleville Lock and Dam (ORM 203.9) to Racine Lock and Dam (ORM 237.5), for a total length of 33.6 miles. 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 throughout its length. This pool lies in a portion of the Ohio River in which the primary land use is agriculture-based.

3.0 Methods

3.1 Survey Design

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 Lock and Dam) to 237.5 (Racine Lock and Dam). The total linear extent of the target population was approximately 67.2 miles. 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 used to select all sampling locations.

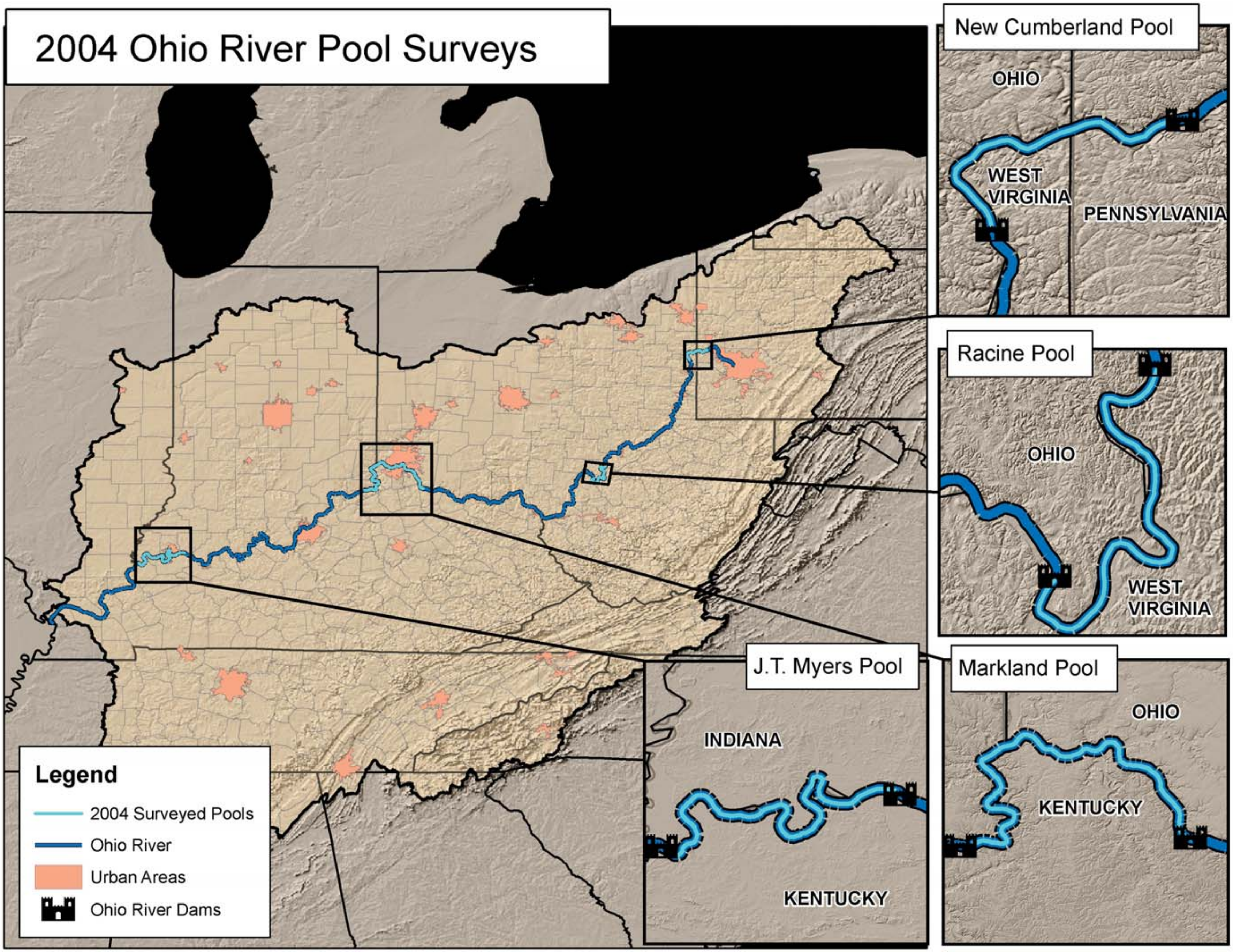


Figure 1. The Ohio River Basin and the four pools selected for 2004 sampling.

3.2 Index Period and Sampling Frequency

All sampling was conducted between July 1 and October 31, 2004. This sampling period reduces community variability by ensuring that samples are collected during the stable, low-flow conditions usually present on the Ohio River during the summer and early fall months. Seventy-four electrofishing events were conducted on the Ohio River from July through October, 15 of which were in the Racine pool. Most sites were sampled exactly in the location generated from the design, but in a few cases sampling zones were shifted (maximum of 500m up - or downstream) due to restricted access or unsafe sampling conditions.

3.3 Fish Collections

Standard collection techniques were employed throughout the surveys as described by ORSANCO's Standard Operating Procedures (1999). Fish were collected using boat electrofishing techniques at night. Nighttime electrofishing typically yields samples of increased diversity and richness (Sanders 1992).

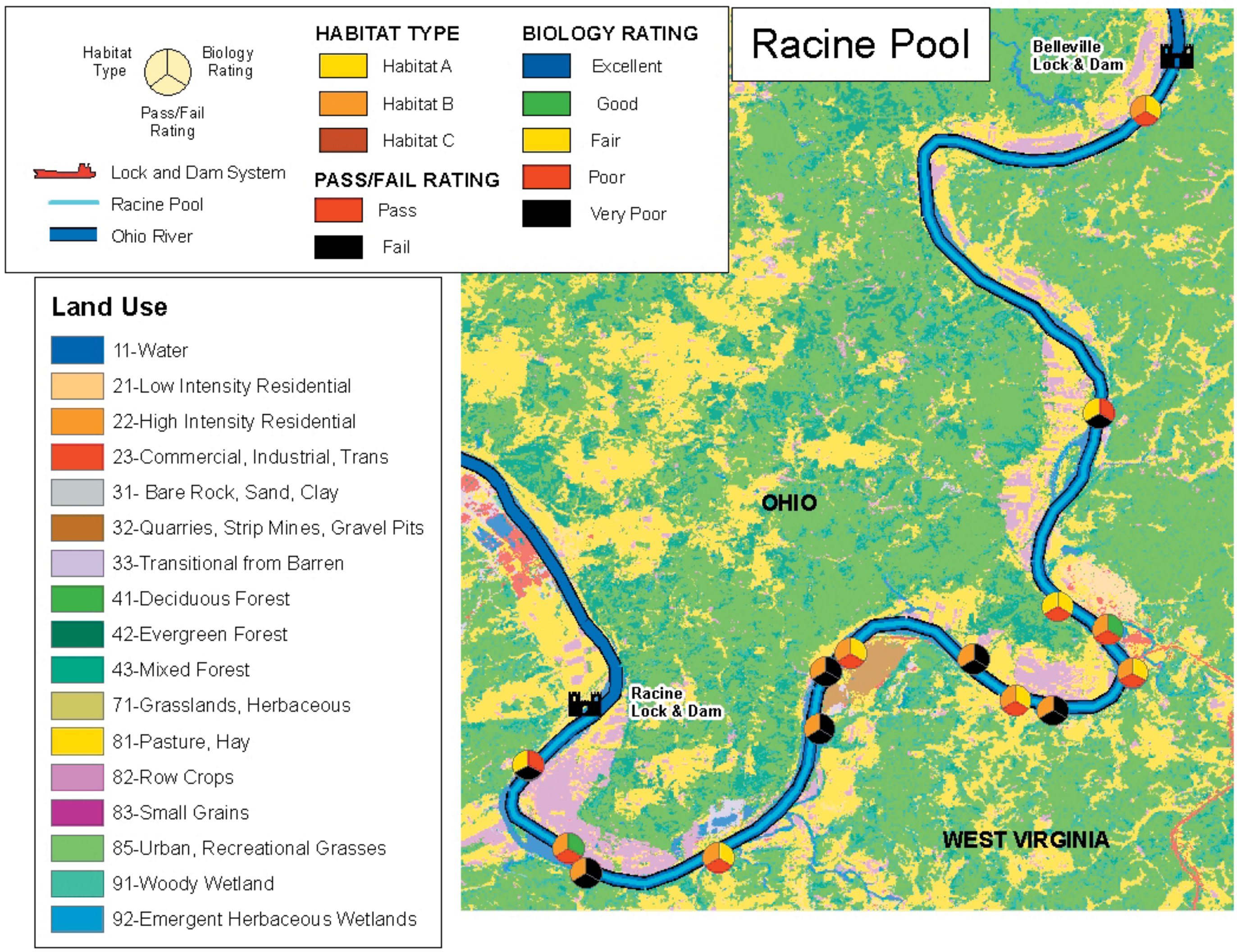
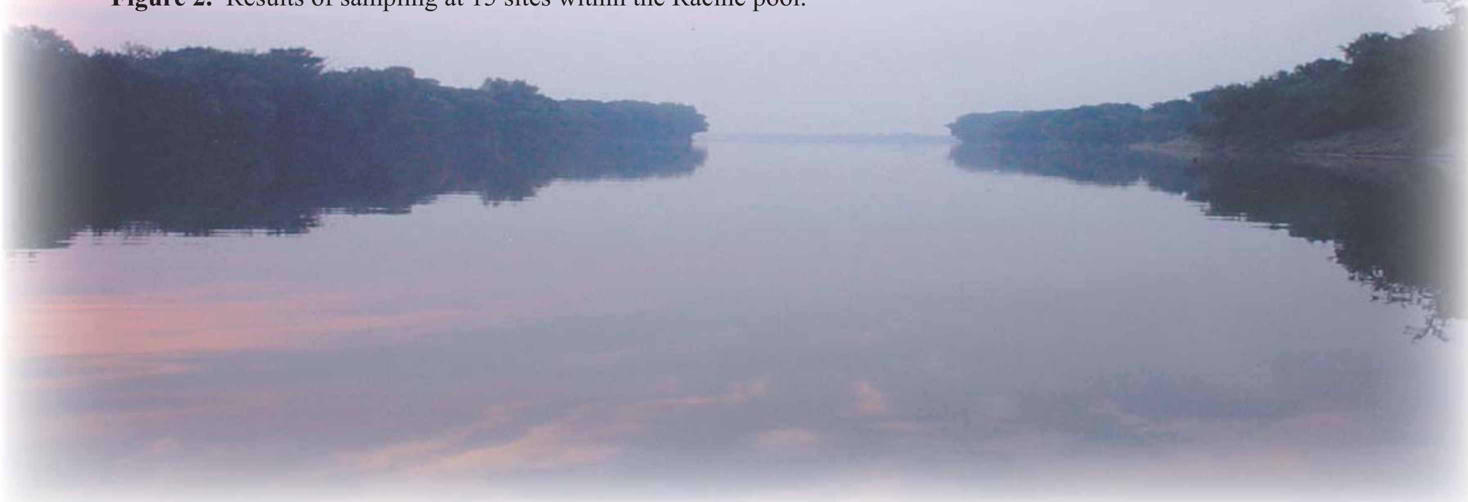


Figure 2. Results of sampling at 15 sites within the Racine pool.



Two three-person crews collected samples from 18-foot aluminum johnboats. Each boat was equipped with a 5000-watt generator and a Smith-Root Type VI-A electrofishing unit. Sampling was conducted over a section of 500-meter near-shore habitat for a minimum of 2000 seconds (Gammon 1998). Time could vary depending upon the density 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 taxonomic level 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.

Typical 500 meter electrofishing reach.

3.4 Habitat Characterizations

Large rivers have distinct habitat zones, including unique microhabitats (Reash 1999). Therefore, extensive habitat surveys were conducted for each electrofishing zone. The surveys included thorough substrate and depth measurements, as well as woody cover estimates and riparian zone descriptions. Depth and substrate composition were measured at 66 points throughout each 500m zone. Six points along the shoreline were selected 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 away from the shore for 30m. Woody cover, which included submerged brush, logs, and stumps, was estimated visually. Using this data, each zone was assigned a habitat classification of "A", 'B', or 'C'. 'A' habitats tend to be deeper, with more course substrate such as cobble and gravel. 'C' habitats tend to be shallow and dominated by finer substrates such as sand. 'B' habitats tend to be a mix of several depths and substrates. This habitat information will be used by biologists to describe the influence of habitat on fish communities and to determine if trends observed in populations are habitat induced or result from other factors.

3.5 Water Quality and Flow

Basic measures of water quality were collected at each sampling site prior to sampling. The following parameters were measured with an 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.

3.6 Assessment

As described above, each electrofishing site is classified as containing 'A', 'B', or 'C' habitat characteristics. Based on this habitat designation, the longitudinal location of a given site, and the time of year (Julian day) the sample was collected, an expectation is developed for each electrofishing site in the form of a predicted ORFIn score. By comparing this expected ORFIn score to the observed ORFIn score, biologists are able to determine whether or not a given site is meeting its aquatic life use designation. Each site is then labeled as either passing or failing and given a condition rating of excellent, good, fair, poor, or very poor. Once each site has been designated as passing or failing, all sites sampled within the pool are aggregated. If upon aggregation more than 25% (within a particular confidence interval, see Appendix C) of the sites are deemed in failing condition, then the entire pool would be designated as being in failing condition, and therefore subject to further sampling.

ORSANCO crew conducting night-time electrofishing.

4.0 Results

4.1 Fish Population

In 2004, crews collected fish population data from 15 sites throughout the length of the Racine pool (Table 1). These collections produced 38 taxa representing ten families (Table 2). Among these taxa, there is one species listed as threatened in Ohio, the river darter (*Percina shumardi*) and one species listed as special concern in Ohio, the river redhorse (*Moxostoma carinatum*). The minnow family (Cyprinidae) was the most abundant within the collections made, comprising 36.1% of the total abundance captured (Figure 3). The herring and shad family (Clupidae) was the next most abundant group making up 31.1% of the total abundance (Figure 3). Specifically, abundance was dominated by the gizzard shad (*Dorosoma cepedianum*) and the mimic shiner (*Notropis volucellus*), comprising 31.1% and 19.3% respectively (Figure 4). The emerald shiner (*Notropis atherinoides*) comprised 11.3% of samples collected, followed by freshwater drum, comprising 6.1% (Figure 4). Raw fish population data for each site sampled are displayed in Appendix A.

4.2 Metric Performance

Thirteen metrics were used to produce ORFIn scores at each electrofishing site (Emery et al. 2003). Complete performance of each metric and its score are listed in Table 3. The total number of species ranged from ten to 21 per site, with an average of just over 15. The number of sucker species ranged from two to eight, averaging just over three per site. The number of centrarchid species ranged from zero to five with an average of two. The number of great river species recorded for each site ranged from zero to two, averaging one per site. The number of intolerant species ranged from zero to five, averaging 2.2 per site. The percent tolerant individuals ranged from zero to 3.7%, averaging 1.4% per site. The percent simple lithophils ranged from 4.2% to 37.5% with an average value of 18.3%. The percent non-native individuals ranged from zero to five percent and averaged 1.6%. The three feeding guild metrics of

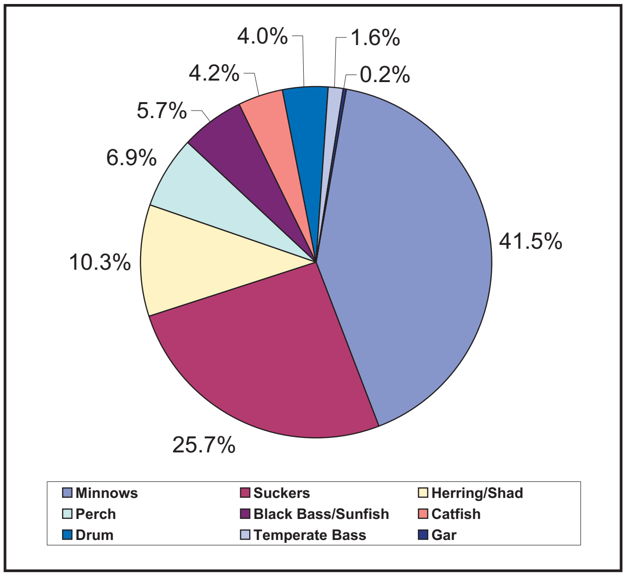


Figure 3. Fish composition by family in the Racine pool.

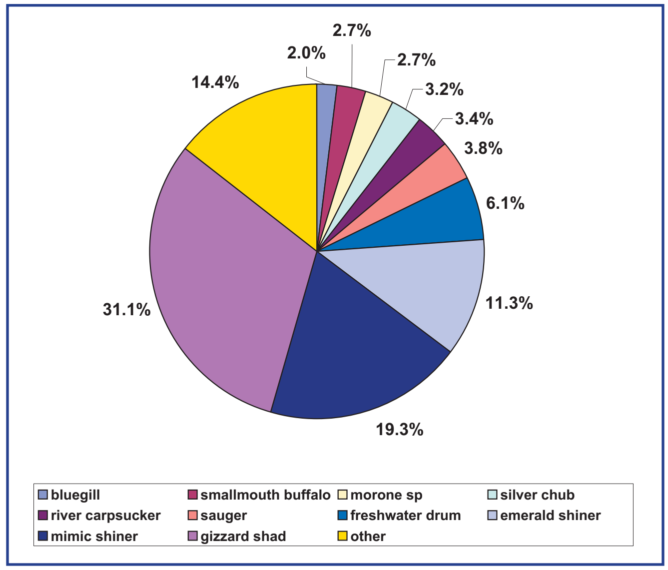


Figure 4. Species composition of fish sampled in the Racine pool.

Table 1. Electrofishing site list for the Racine pool, including habitat designation, ORFIn scores and status.

Rmi	Bank	Date	Latitude	Longitude	Habitat Type	Exp ORFIn	Obs ORFIn	Site Pass/Fail	Rating
205.9	RDB	20-Jul-04	39.092	81.750	B	33	35	PASS	Fair
215.9	LDB	20-Jul-04	39.006	81.763	A	39	37	FAIL	Poor
219.9	RDB	20-Jul-04	38.951	81.775	A	39	43	PASS	Fair
220.8	LDB	20-Jul-04	38.944	81.761	B	33	45	PASS	Good
221.7	LDB	19-Jul-04	38.932	81.754	B	33	33	PASS	Fair
223.1	LDB	19-Jul-04	38.922	81.776	B	33	17	FAIL	Very Poor
223.7	LDB	19-Jul-04	38.924	81.787	B	33	37	PASS	Fair
224.7	RDB	19-Jul-04	38.936	81.799	B	33	18	FAIL	Very Poor
227.1	LDB	26-Jul-04	38.938	81.834	B	33	41	PASS	Fair
227.6	RDB	26-Jul-04	38.933	81.841	B	33	18	FAIL	Very Poor
228.8	LDB	27-Jul-04	38.916	81.843	B	33	17	FAIL	Very Poor
231.8	LDB	27-Jul-04	38.880	81.871	B	33	35	PASS	Fair
233.9	LDB	21-Jul-04	38.876	81.909	B	33	21	FAIL	Very Poor
234.5	RDB	21-Jul-04	38.883	81.914	B	33	43	PASS	Good
236.5	LDB	21-Jul-04	38.906	81.925	A	39	35	FAIL	Poor

Rmi – River mile
RDB – Right Descending Bank
LDB – Left Descending Bank

Exp ORFIn – Expected ORFIn Score
Obs ORFIn – Observed ORFIn Score

Table 2. Species collected in the Racine pool in the 2004 survey.

Family	Latin name	Common name	OH status	WV status
Lepisosteidae	*Lepisosteus osseus*	longnose gar		
Clupeidae	*Alosa chrysochloris*	skipjack herring		
Clupeidae	*Dorosoma cepedianum*	gizzard shad		
Cyprinidae	*Cyprinus carpio*	common carp		
Cyprinidae	*Notropis hudsonius*	spottail shiner		
Cyprinidae	*Cyprinella spiloptera*	spotfin shiner		
Cyprinidae	*Notropis atherinoides*	emerald shiner		
Cyprinidae	*Notropis volucellus*	mimic shiner		
Cyprinidae	*Macrhybopsis storeriana*	silver chub		
Cyprinidae	*Campostoma anomalum*	central stoneroller		
Cyprinidae	*Pimephales notatus*	bluntnose minnow		
Catostomidae	*Carpiodes cyprinus*	quillback carpsucker		
Catostomidae	*Carpiodes carpio*	river carpsucker		
Catostomidae	*Carpiodes velifer*	highfin carpsucker		
Catostomidae	*Moxostoma breviceps*	smallmouth redhorse		
Catostomidae	*Moxostoma anisurum*	silver redhorse		
Catostomidae	*Moxostoma carinatum*	river redhorse	SC	
Catostomidae	*Moxostoma erythrurum*	golden redhorse		
Catostomidae	*Hypentelium nigricans*	northern hog sucker		
Catostomidae	*Ictiobus bubalus*	smallmouth buffalo		
Catostomidae	*Ictiobus niger*	black buffalo		
Catostomidae	*Minytrema melanops*	spotted sucker		
Ictaluridae	*Ictalurus punctatus*	channel catfish		
Ictaluridae	*Pylodictis olivaris*	flathead catfish		
Percopsidae	*Percopsis omiscomaycus*	trout-perch		
Moronidae	*Morone sp*	morone sp		
Moronidae	*Morone saxatilis*	striped bass		
Centrarchidae	*Lepomis cyanellus*	green sunfish		
Centrarchidae	*Lepomis macrochirus*	bluegill		
Centrarchidae	*Lepomis humilis*	orangespotted sunfish		
Centrarchidae	*Lepomis megalotis*	longear sunfish		
Centrarchidae	*Lepomis microlophus*	redear sunfish		
Centrarchidae	*Micropterus dolomieu*	smallmouth bass		
Centrarchidae	*Micropterus salmoides*	largemouth bass		
Centrarchidae	*Micropterus punctulatus*	spotted bass		
Percidae	*Percina caprodes*	logperch		
Percidae	*Percina shumardi*	river darter	T	
Percidae	*Sander vitreus*	walleye		
Percidae	*Sander canandensis x vitreus*	saugeye		
Percidae	*Sander canadensis*	sauger		
Sciaenidae	*Aplodinotus grunniens*	freshwater drum		

41 taxa, representing 10 Families

SC= Special Concern

T=Threatened

E=Endangered

percent detritivores, percent invertivores and percent piscivores averaged 15.1%, 42.5% and 22.9% respectively. The number of DELT Anomalies (deformities, eroded fins, lesions and tumors) ranged at each site from zero to four, averaging less than one per site. The CPUE metric (catch per unit effort) ranged from 41 to 173 individuals per site, averaging just over 114 individuals per site. Additionally, two of the 15 sites sampled were subjected to the low-end scoring mechanism built into the ORFIn that applies when a given site produces less than 50 individuals (Emery et al. 2003).

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 electrofishing site (Figure 5) revealed that fines and sand, comprising 41% and 29% respectively, dominated bottom substrate (Figure 6). Gravel and cobble substrates were also fairly common, comprising 21% and nine percent, respectively (Figure 6). Boulder and hardpan substrates were not present in the sites sampled (Figure 6). The variables mentioned were compiled within a habitat index to give each site a habitat classification of ‘A’, ‘B’, or ‘C’ (Table 1). The Racine pool was dominated by ‘B’ habitats, which account for 80% of the samples (Figure 7). The remaining 20% of the samples were made up of ‘A’ habitats (Figure 7). Woody cover was present in 14 of the 15 sites sampled and riparian land use was primarily forested and cropland (Appendix B).

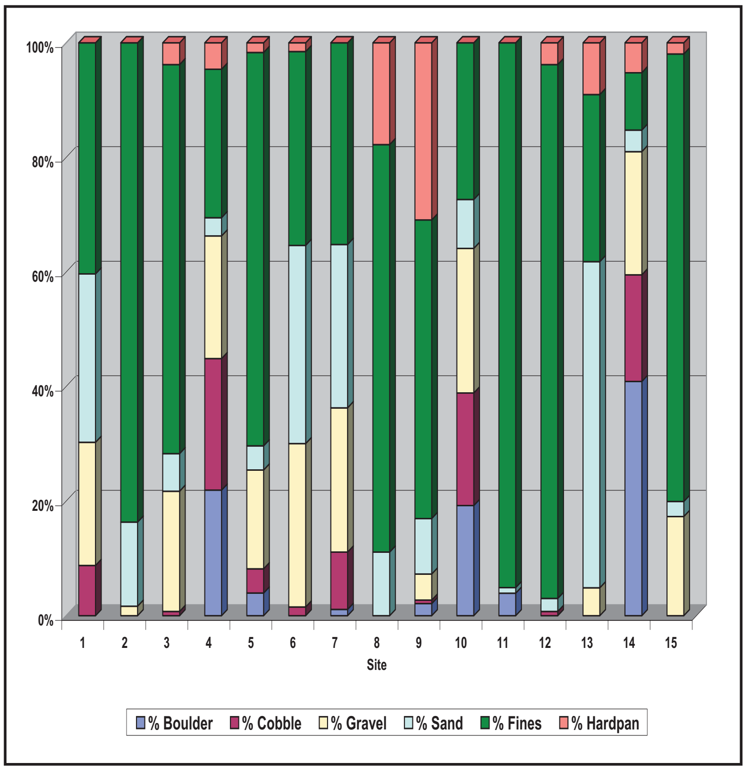


Figure 5. Sediment composition at each site.

4.4 Water Quality and Flow

The basic water quality parameters of temperature, DO, conductivity and pH were recorded at the electrofishing sites (Table 4). Additionally, secchi depth readings were collected as a measure of turbidity before each electrofishing event. Temperature ranged from 26.05◦ C to 26.8◦ C and average 26.4◦C. DO ranged from 7.25 mg/l to 8.6 mg/l with an average of 8 mg/l. Conductivity readings ranged from 465 µS/cm to 496 µS/cm and averaged 483.6 µS/cm. Readings for pH ranged from 7.25 to 7.85 and averaged 7.47. Secchi depth readings ranged from 45.7 cm to 127 cm and averaged 102.4 cm. The harmonic mean flow of the Ohio River used for this area is 24.5 kcfs based on stream-flow data analyzed by US Geological Survey (USGS). Flows for the Racine pool during the sampling season ranged from 102.02 % to 189.79 % of HMF, averaging 151.42 HMF (Figure 8).

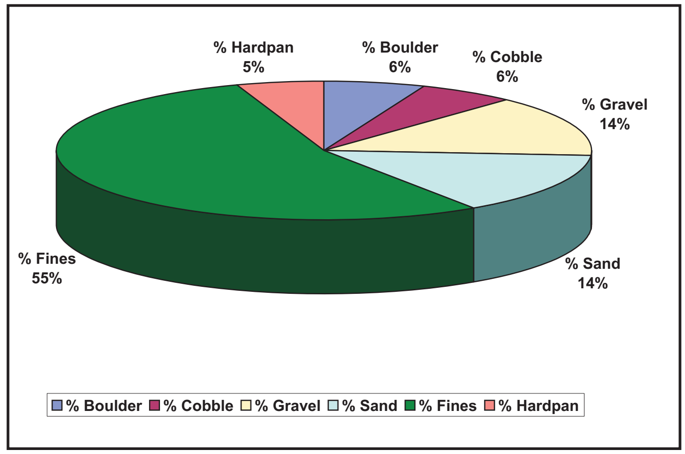


Figure 6. Substrate composition in the Racine pool.

4.5 Assessment of Condition

The data collected from each zone was used to calculate an ORFIn score (Emery et al. 2003). The performance of each metric can be seen in Table 3. The maximum score achieved by any one site in this pool was 45 and the minimum was 17. An expected ORFIn score was generated from least impacted site data (Emery et al. 2003) for each zone based on habitat type. Observed ORFIn scores (Table 1) in the Racine pool averaged three points below what was expected. By comparing observed and expected ORFIn scores, ORSANCO assigns sites a classification of passing or failing, as well as conditional ratings (Figure 9). Of the 15 sites sampled in 2004, eight received passing evaluations (Table 1). All sites are assigned to one of the three habitat classes based on substrate composition. Sites determined to

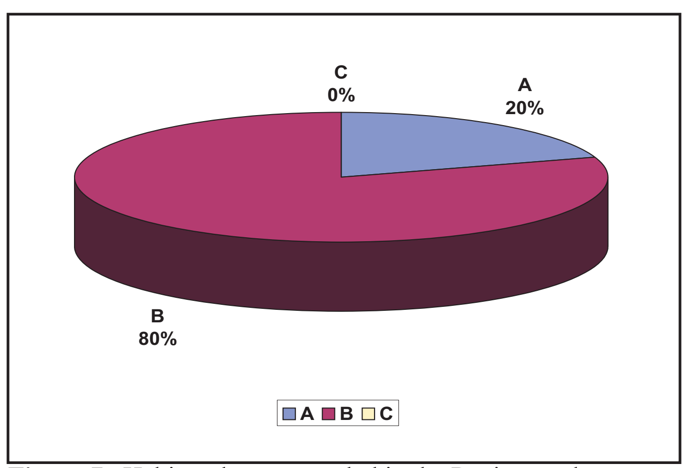


Figure 7. Habitat classes sampled in the Racine pool.

Table 3. ORFIn Metrics and Scores from the Racine Pool 2004 Survey

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	# Species	Species Score	# Suckers Species	Suckers Score	# Centrarchid Species	Centrarchid Species Score	# Great River Species	Great River Score	# Intolerant Species	Intolerant Score	% Tolerant Individuals	% Tolerant score	% Simple Lithophils	Simple Lithophil Score	% Non-native Individuals	Non-native Individuals Score	% Detritivores	Detritivore Score	% Invertivores	Invertivores Score	% Piscivores	Piscivore Score	# DELTs	DELTs Score	CPUE	CPUE score	Expected ORFIn Score	Observed ORFIn Score	Site Score Pass/Fail
205.9	RDB	91	73	73	13	3	2	1	1	1	0	1	1	1	0.00	5	5.48	1	0.00	5	1.37	5	79.45	5	12.33	1	1	5	91	1	33	35	PASS
215.9	LDB	139	125	125	13	3	2	1	1	1	1	1	4	3	0.00	5	10.40	1	0.00	5	4.00	5	72.80	5	11.20	1	0	5	139	1	39	37	FAIL
219.9	RDB	133	103	102	18	3	3	3	4	3	0	1	4	3	0.97	5	16.50	1	0.00	5	8.74	5	64.08	5	22.33	3	1	5	132	1	39	43	PASS
220.8	LDB	154	101	99	21	5	8	5	2	1	2	3	5	5	1.98	5	28.71	3	0.00	5	15.84	3	66.34	5	10.89	1	4	1	152	3	33	45	PASS
221.7	LDB	98	78	76	15	3	5	3	0	1	1	1	2	1	1.28	5	12.82	1	2.56	5	16.67	3	65.38	5	15.38	1	2	3	96	1	33	33	PASS
223.1	LDB	42	27	26	11	3	2	1	1	1	1	1	2	1	3.70	1	18.52	1	3.70	1	48.15	1	18.52	1	22.22	1	2	3	41	1	33	17	FAIL
223.7	LDB	61	59	59	17	3	3	3	1	1	2	3	2	1	0.00	5	23.73	3	0.00	5	13.56	3	47.46	3	15.25	1	1	5	61	1	33	37	PASS
224.7	RDB	69	40	38	10	3	2	1	1	1	1	1	1	1	0.00	0	37.50	1	5.00	1	2.50	1	52.50	1	25.00	1	0	5	67	1	33	18	FAIL
227.1	LDB	166	76	74	18	3	4	3	5	3	1	1	2	1	1.32	5	26.32	3	1.32	5	6.58	5	36.84	3	18.42	1	0	5	164	3	33	41	PASS
227.6	RDB	140	43	41	11	3	2	1	0	0	1	1	1	1	2.33	1	9.30	1	4.65	1	30.23	1	16.28	1	30.23	1	0	5	138	1	33	18	FAIL
228.8	LDB	173	26	26	11	3	2	1	0	0	1	1	0	0	0.00	0	19.23	1	0.00	0	23.08	1	11.54	1	19.23	1	0	5	173	3	33	17	FAIL
231.8	LDB	137	77	75	18	3	2	1	4	3	1	1	2	1	2.60	5	29.87	3	0.00	5	15.58	3	22.08	1	31.17	3	1	5	135	1	33	35	PASS
233.9	LDB	122	48	47	14	3	3	3	2	1	1	1	1	1	2.08	1	4.17	1	2.08	1	22.92	1	22.92	1	12.50	1	0	5	121	1	33	21	FAIL
234.5	RDB	126	66	64	18	3	5	3	3	3	1	1	4	3	1.52	5	22.73	3	1.52	5	4.55	5	24.24	1	59.09	5	0	5	124	1	33	43	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

Table 4: Water quality data from the Racine pool 2004 survey.

Rmi	pH	Temp (C)	Dissolved Oxygen (mg/L)	Conductivity	Secchi (cm)
205.9	7.85	26.56	7.25	495	91.44
215.9	7.85	26.56	7.25	495	91.44
219.9	7.85	26.56	7.25	495	121.92
220.8	7.85	26.56	7.25	495	121.92
221.7	7.31	26.1	8.3	470	121.92
223.1	7.31	26.2	8.3	465	91.44
223.7	7.31	26.2	8.3	465	127
224.7	7.31	26.2	8.3	465	106.68
227.1	7.55	26.4	N/A	495	91.44
227.6	7.56	26.44	N/A	496	91.44
228.8	7.3	26.05	N/A	474	68.58
231.8	7.3	26.07	N/A	474	45.72
233.9	7.25	26.85	8.6	490	121.92
234.5	7.25	26.85	8.6	490	121.92
236.5	7.25	26.85	8.6	490	121.92

be 'least impacted' are used in lieu of true reference sites to develop expectations for each habitat class. For each of the three habitat classes, condition ratings are assigned based on statistical distribution of the data as shown in Figure 9. The seven failing sites received condition ratings of either poor (two) or very poor (five), while the eight passing sites were classified as either fair (six) or good (two) (Figure 10).

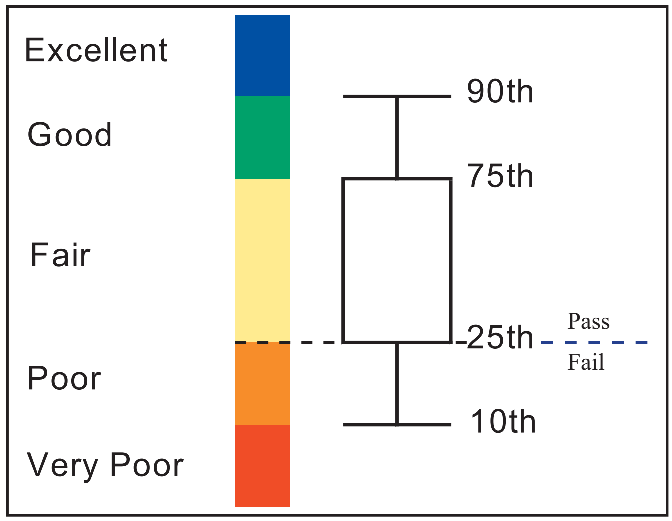


Figure 9. The approach used for assigning various condition ratings, using data from least impacted sites for each of the three habitat classes.

5.0 Discussion

5.1 Fish Population

In general, the fish population appeared healthy, as evidenced by the lack of external anomalies present. Of the 38 species collected, two are currently listed as species of concern on state threatened and endangered lists. These species, the river redhorse (*Moxostoma carinatum*) and the river darter (*Percina shumardi*), were collected in low numbers at six and four individuals respectively. Both of these species are dependant on large rivers, and we believe that they are more prevalent than our sampling indicates. The status of the species may be a function of the limitations imposed by our particular sampling methods. It is also important to note the low percentage of non-native species collected. Recent invasions of exotic species, such as the silver and bighead carp (*Hypophthalmichthys molitrix* and *H. nobilis*), which are becoming more dominant in the lower stretches of the Ohio River, were not collected in this pool.

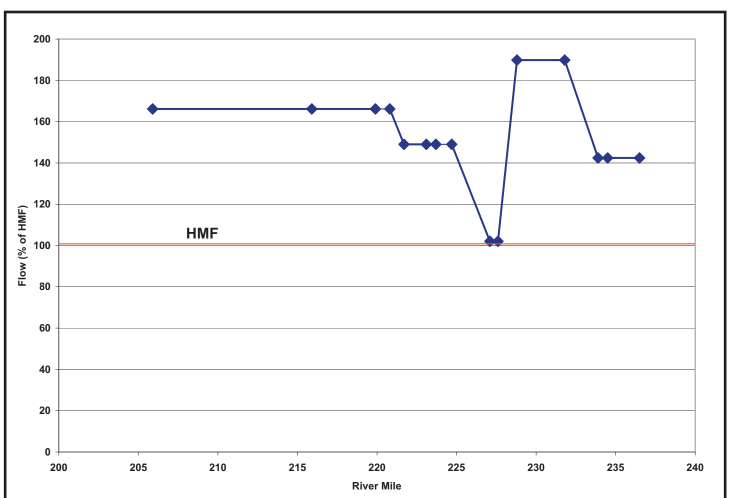


Figure 8. Daily flow for sampling events in the Racine pool.

5.2 Metric Performance

The "low-end" scoring technique (Emery et al. 2003) caused lower overall ORFIn scores at two sites. This was most notable in the number of centrarchid species metric, scoring a '0' on both occasions. Other metrics associated with low ORFIn scores include the number of great river species, scoring '1' at 13 of the 15 sites, and percent piscivores, scoring a '1' at 12 of the sites sampled. Based on the combined experience of

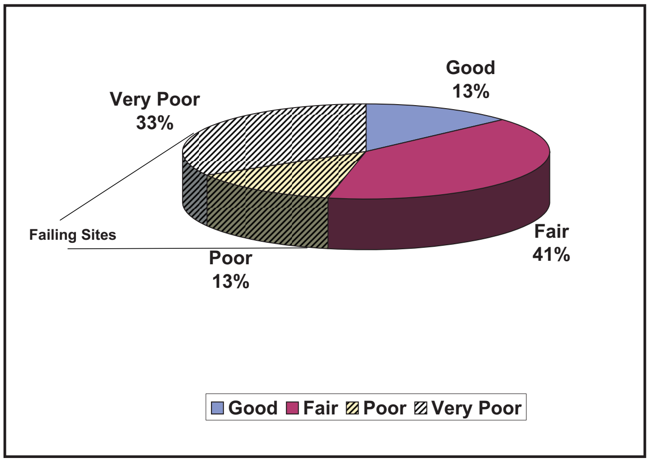


Figure 10. Condition of the Racine pool based on ORFIn scores at 15 sites.

the biologists conducting this survey and findings of Emery et al. (2003), higher species diversity was expected. It was anticipated that 15 sites concentrated within a relatively small spatial area and encompassing diverse habitat types would have produced higher abundance and diversity. Again, since this was the first application of a probability design and since unusual flow and weather conditions were encountered, it is not known which factor(s) singularly or in concert contributed to the observed conditions.

5.3 Habitat

Three distinct habitat classes, 'A', 'B', and 'C', have been identified on the Ohio River. 'A' habitats are generally deeper and dominated by more course substrates. Additionally, 'A' habitats generally score higher than 'B' or 'C'. Generally speaking, 'A' and 'B' habitats tend to support a more diverse and abundant fish population (unpublished data). In the Racine pool, 'B' habitats were dominant, with 'A' habitats the only other type present. No 'C' habitat types were sampled. It would be expected that a pool dominated by more coarse substrates would produce more diverse fish populations and higher ORFIn scores. This leads researchers to believe that poor metric performance, and subsequently, poor ORFIn performance is not a function of poor habitat.

5.4 Water Quality and Flow

Parameters measured at each electrofishing site provided no explanation for the low ORFIn scores generated from the data at these sites. Values for temperature, DO, conductivity, and pH all fell into a range that would be considered normal or background for this section of the river. In addition, other monitoring activities conducted by ORSANCO provided no data that could account for low ORFIn scores being attributed to water quality. Flow values, in contrast, were elevated during the entire time period when sampling occurred. In some cases, flows reached values nearly twice that of the harmonic mean flow. Higher flows can cause several problems during sampling, including reducing capture efficiency, which could potentially reduce metric and index performance.

5.5 Assessment and Conclusions

The probabilistic design was implemented on the Ohio River to biologically assess a navigational pool. Hence, each navigational pool will serve as a distinct assessment unit (AU) and will be reported on individually in the 305(b) report to EPA.

The criteria for reporting on the condition of an AU are based on the performance of the ORFIn in relation to the habitat at the 15 sites sampled in each unit. Each site, based upon its habitat classification, will have an "expected" ORFIn score generated. This score reflects how a particular site should perform. The observed score for each site within the AU is then compared to the expected score, with each site assigned as passing or failing. The sites are then aggregated and the AU is viewed as a percentage of sites passing and failing. If an AU is assessed and exhibits greater than 25%, + or – the estimated precision (see Appendix C), of the sites as failing, then the assessment is accepted as valid, and the AU would be reported as failing to meet the established aquatic life use designation. If the estimated precision was not achieved, then the AU would be considered unassessed and further sampling would be needed. Less than 25% failing sites (+/- estimated precision) would indicate that the AU meets the aquatic life use designation.

In the Racine pool, nearly 50% of the sites sampled were deemed as failing, causing the pool to be reported as impaired and not supporting its designated aquatic life use criteria. Designating the AU as impaired leads to implications that would cause it to be included in the 305(b) report on stream condition required by the Clean Water Act (CWA). Reporting this stream segment as impaired would also require that it be placed on the list of impaired

streams as directed by Section 303(d) of the CWA. This list has several categories for classifying streams based on the type of stressor involved and whether a specific stressor or pollutant can be identified as the source of the impairment. Based on the 2004 data, it is likely that the Racine pool AU would be placed on the 303(d) list in category 5a, which states that an impaired biological condition has been detected, but due to an unknown stressor or cause. Listing the AU in category 5a would require additional sampling efforts (e.g. intense chemical and/or physical habitat measurements) to identify the cause. If this follow-up work identifies the source of impairment as a pollutant, then the AU would be reclassified as category 5c, which would require the development of a Total Maximum Daily Load (TMDL) for that stressor. If it is determined that impairment is caused by something other than a pollutant (e.g. habitat, natural, hydrologic), then the AU would be reclassified as category 4c, again requiring additional sampling to allow for a more precise determination of cause without TMDL development.

An explanation for the high proportion of failing sites remains unclear. By design, the probability-based method eliminates human bias in the selection of sample sites. Sampling locations avoided in the past due to elevated human activity were sampled in this design. The Racine pool was designated as "fully supporting" the aquatic life use based on water quality. This assessment was determined using water quality data from bimonthly and dissolved metals sampling sites. Parameters such as DO, ammonia, and various dissolved metals have criteria that must be met to provide protection of warm water aquatic life. No violations of the aquatic life criteria for dissolved metals or bimonthly parameters were observed. This indicates that other factors may be influencing fish populations and therefore affecting ORFIn scores.

As described above, water quality results did not indicate impairment during 2004, nor were any significant differences in parameters observed during this time period that could have led to a drastic change in the fish community. This suggests that based on ORSANCO's monitoring, water quality conditions did not affect the fish community in 2004. Explanations for low ORFIn scores other than water quality may include elevated flows and river stage that occurred during the 2004 sampling season. Higher stage and flow conditions are generally associated with higher turbidity levels, which can hinder effective fish collection. Swift flows can also affect capture efficiency by making both boat operation and netting more difficult. Additionally, many species normally common in the mainstem seek refugia during these periods of high flow. Future sampling and more intense analysis of flow data may offer better explanations of the lower observed scores.

The probabilistic assessment design 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

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.

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 (Ohio River Valley Water Sanitation Commission) 1999. Boat Electrofishing Standard Operating Procedure. ORSANCO, Cincinnati, OH.

Reash, R.J. 1999. Considerations for characterizing Midwestern large river habitats. Pages 463-473 *in* Simon (1999). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL

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.