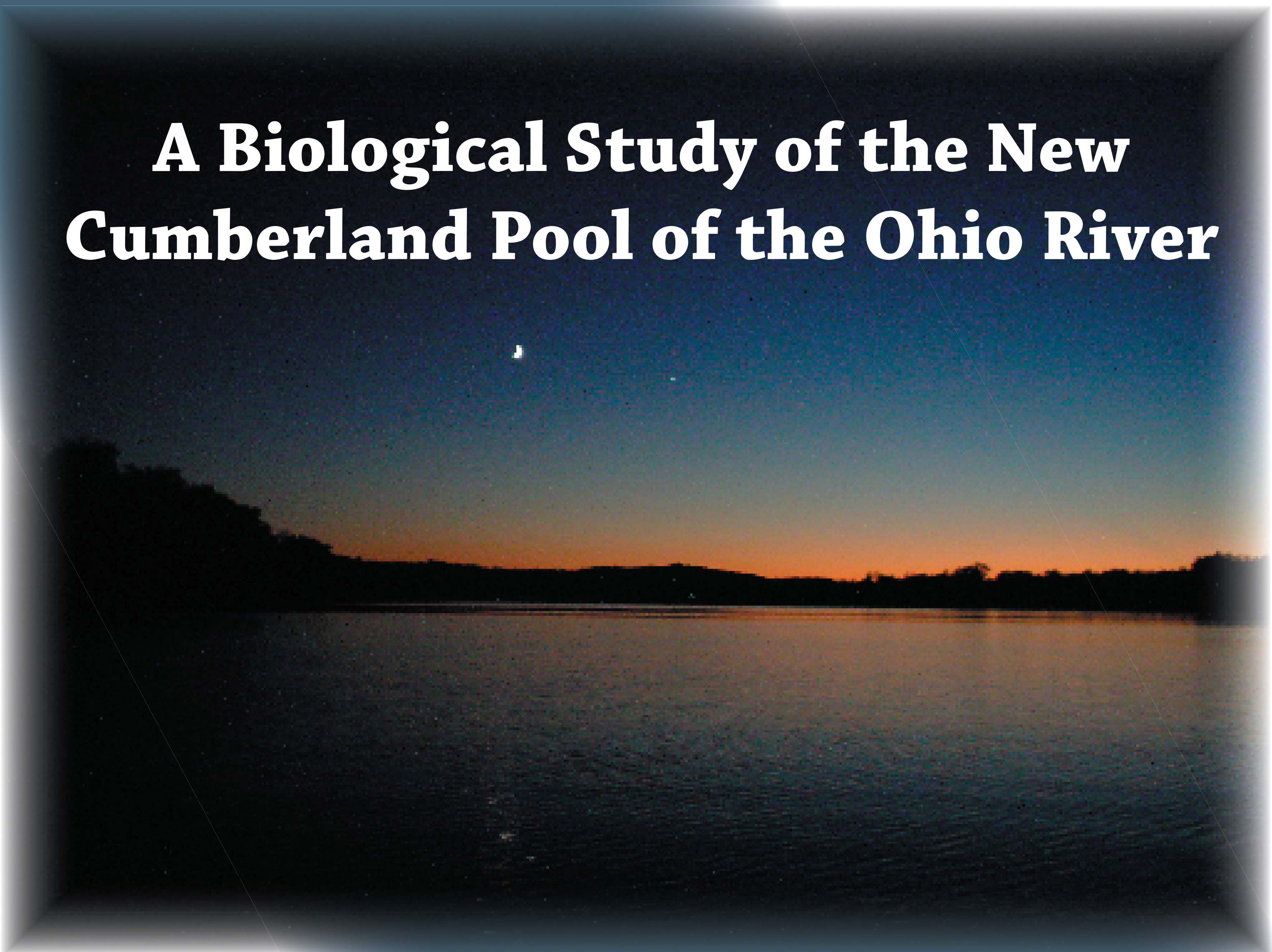
Biological Programs 2005
Intensive Survey Results
Series 2
Report 1

A Biological Study of the New Cumberland Pool of the Ohio River



ORSANCO
Ohio River Valley Water Sanitation Commission
An Interstate Agency
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 New Cumberland pool sites sampled in 2004 failed to meet these criteria, with only 27% of sites passing. Therefore, the New Cumberland 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 New Cumberland 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 New Cumberland 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. New Cumberland 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 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 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 New Cumberland Pool

The New Cumberland pool is 22.7 miles long, extending from Montgomery Locks and Dam (ORM 31.7) to New Cumberland Locks and Dam (ORM 54.4) (Figure 2). The pool has a gradient drop of 0.2 feet per mile, averages 1439 feet wide and 22 feet deep. The pool flows within the state of Pennsylvania for the upper nine miles and is bordered by Ohio and West Virginia for the remaining 13.7 miles. This pool lies in a portion of the Ohio River heavily influenced by industry and is just 31.7 miles below the city of Pittsburgh. The New Cumberland pool receives water from three major sub-basins: the Allegheny, Monongahela, and Beaver rivers, consisting of primarily forested and cropland watershed activities, but also with significant urban influences.

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 New Cumberland pool of the Ohio River from mile marker 31.7 (Montgomery Locks and Dam) to 54.4 (New Cumberland Locks and Dam). The total linear extent of the target population was approximately 45.4 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. 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 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 (e.g. 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 within 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

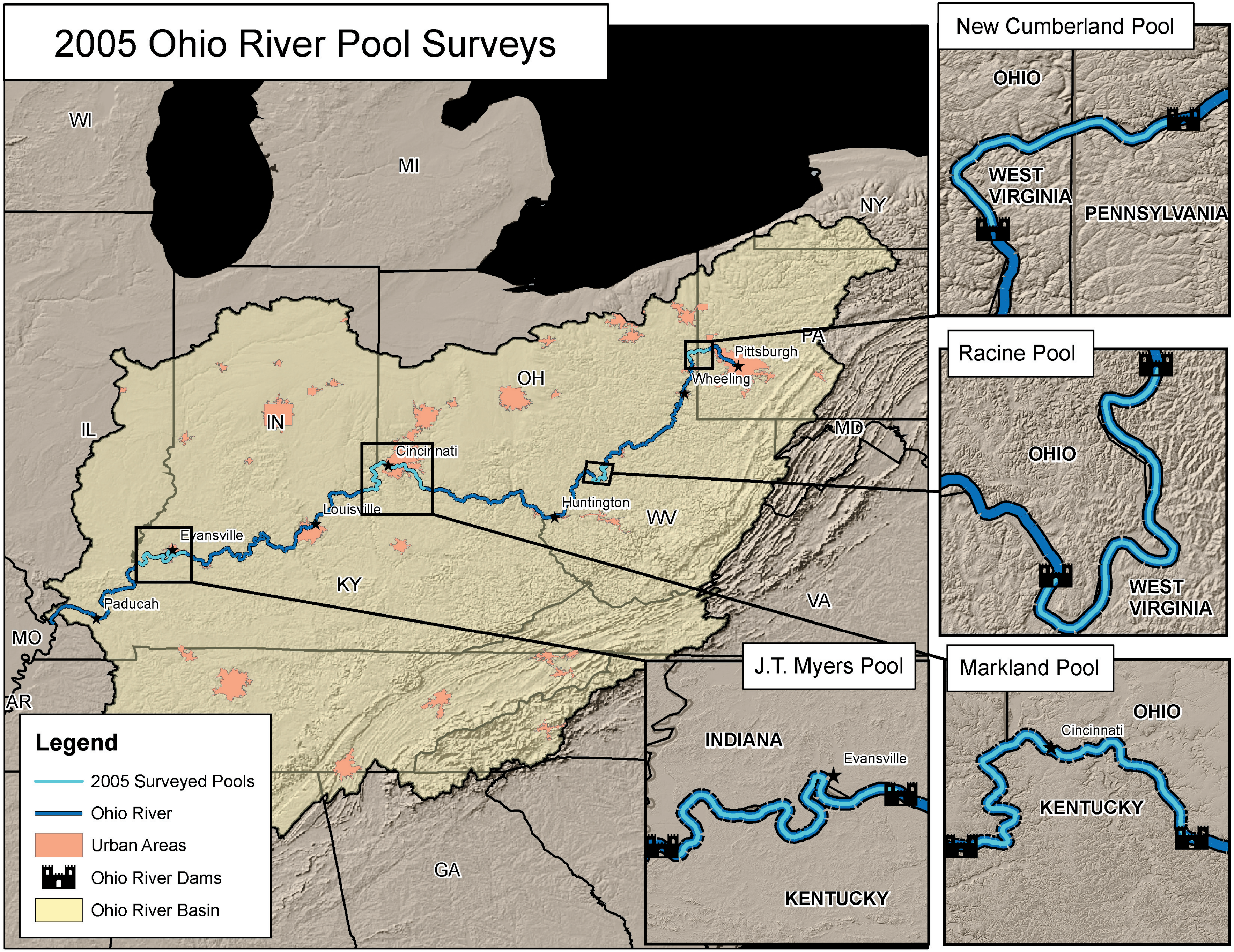

Figure 1. The Ohio River Basin and the four pools selected for 2005 sampling.

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 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 existing 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).

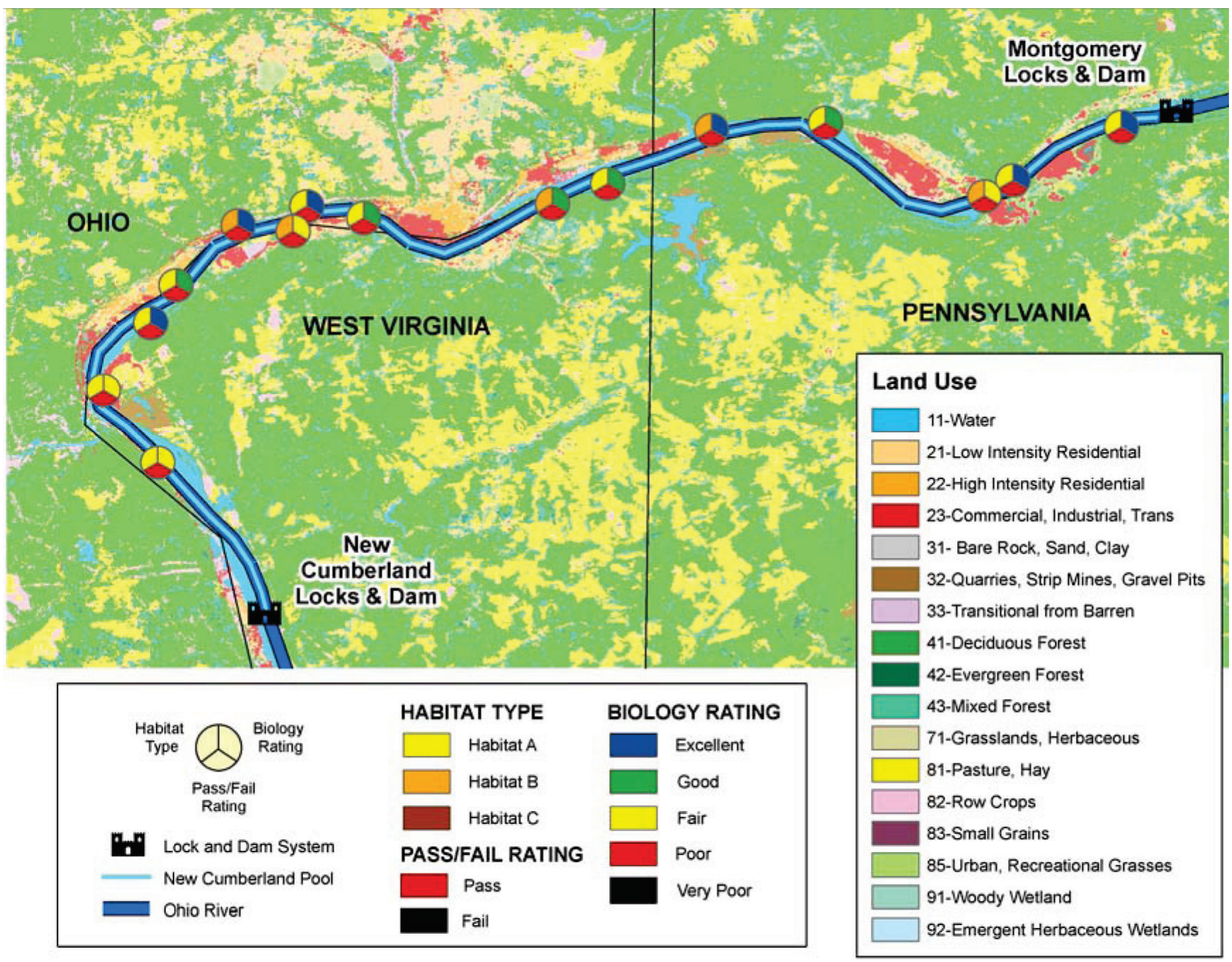

Figure 2. Results of sampling at 15 sites within the New Cumberland pool.

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 New Cumberland pool served as one distinct assessment unit (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.

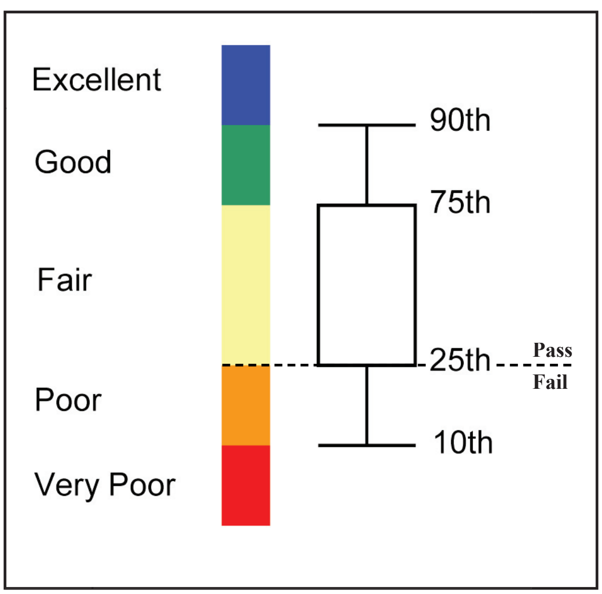

Figure 3: Illustration showing the approach used for assigning the various condition ratings.

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 New Cumberland 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 New Cumberland pool (Table 1). These collections produced 50 taxa, representing 10 different families (Table 2). Seven of these taxa are listed in PA as either threatened, endangered or of special concern. These include longnose gar (*Lepisosteus osseus*), mooneye (*Hiodon tergisus*), skipjack herring (*Alosa chrysochloris*), silver chub (*Macrobopsis storeriana*), smallmouth buffalo (*Ictiobus bubalus*), river redhorse (*Moxostoma carinatum*), and channel darter (*Percina copelandi*). Two of those seven (river redhorse and channel darter) are also given special status in OH. At the species level, the most abundant species were freshwater

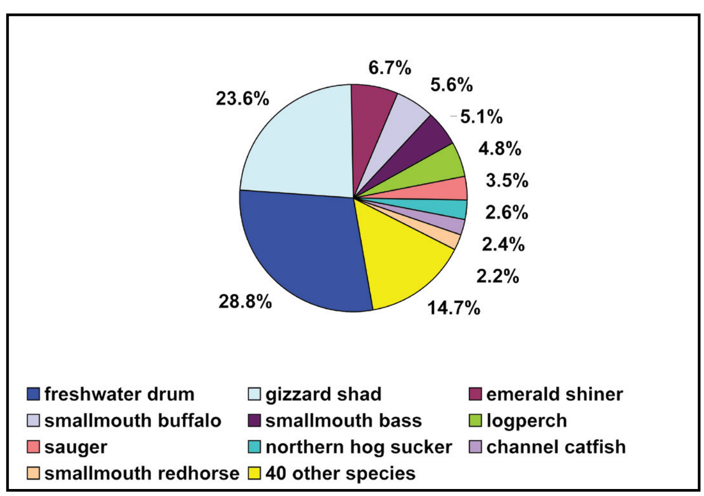

Figure 4. Species compositions of fish sampled in the New Cumberland Pool.

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

River Mile	Bank	Date	Latitude	Longitude	Habitat Class	Exp ORFIn	Obs ORFIn	Site Pass/ Fail	Rating
32.5	LDB	9/6/05	40.645	80.401	A	39	55	Pass	Excellent
34.3	RDB	9/6/05	40.631	80.429	A	39	55	Pass	Excellent
34.9	RDB	9/7/05	40.627	80.436	B	33	41	Pass	Fair
37.7	RDB	9/8/05	40.646	80.477	A	39	49	Pass	Good
39.2	RDB	9/13/05	40.644	80.506	B	33	47	Pass	Excellent
40.9	LDB	9/13/05	40.630	80.533	A	39	47	Pass	Good
41.9	LDB	9/14/05	40.625	80.548	B	33	45	Pass	Good
44.8	LDB	7/20/05	40.621	80.596	A	39	49	Pass	Good
45.7	RDB	7/20/05	40.623	80.611	A	39	51	Pass	Excellent
45.8	LDB	7/19/05	40.619	80.613	B	33	39	Pass	Fair
46.6	RDB	7/19/05	40.619	80.629	B	33	49	Pass	Excellent
47.9	RDB	9/14/05	40.604	80.645	A	39	49	Pass	Good
48.6	LDB	9/14/05	40.594	80.651	A	39	53	Pass	Excellent
50.2	LDB	9/12/05	40.577	80.663	A	39	39	Pass	Fair
51.9	RDB	9/12/05	40.558	80.649	A	39	43	Pass	Fair
35.9 Revisit	LDB	9/7/05	40.623	80.457	A	39	51	Pass	Excellent
37.3 Revisit	RDB	9/8/05	40.642	80.471	B	33	37	Pass	Fair
40.2 Revisit	LDB	9/13/05	40.634	80.521	B	33	39	Pass	Fair

drum (*Aplodinotus grunniens*) and gizzard shad (*Dorosoma cepedianum*), which comprised 28.8% and 23.6% of the catch respectively (Figure 4). The dominance of these two species was directly reflected at the family level. The drum family (Sciaenidae) dominated in abundance, making up 25.6% of the total catch, followed by the shad and herring family (Clupeidae) which made up 21.0% 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 15 to 29, with an average of 22.6 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 four to eight and 13 of 15 sites scored a five for this metric. The number of centrarchid species varied from one to six and metric scores ranged from one to five. The number of great river species varied between zero and three species per site, with scores being either one or three for all sites. There were between three and eight intolerant species found at the sampled sites. All sites had less than 2.1% tolerant individuals and scored a five for the percent of tolerant individuals. The percentage of simple lithophils was between 6.2 and 36.5% and all sites scored either one or three for this metric. All sites had below six percent non-native individuals and all but one site scored five. The percent detritivores was as low as 3.9% and as high as 27.1% and scores of one, three, and five for the sites. The percent invertivores ranged from 4.3% to 37.3% with most sites scoring one for this metric. The percent piscivores ranged from 10.9% to 53.3% and metric scores ranged from one to five. No more than one DELT (deformities, eroded fins, lesions and tumors) anomaly was found at any site and all sites received a score of five for the DELT metric. The CPUE (catch per unit effort) ranged from 170 to 662 individuals per site, with scores of three and five.

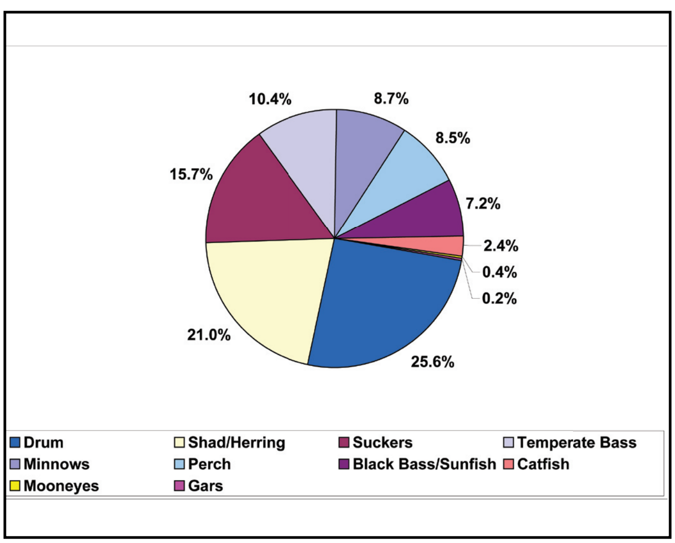

Figure 5. Fish composition by family in the New Cumberland Pool.

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 sampling locations revealed that the bottom substrate in the New Cumberland pool was almost equally composed of sand, gravel, cobble, and fines with a smaller percentage of boulders (Figure 6). However, there was some variation among the individual sites. The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', or 'C' (Table 1, Figure 7). The New Cumberland pool was dominated by class 'A' habitats, which account for two-thirds of the samples (Figures 7 and 8). The

Table 2. Species list for New Cumberland Pool in 2005.

Family	Scientific Name	Common Name	# Caught	PA	WV	OH
Lepisosteidae	*Lepisosteus osseus*	longnose gar	11	SC		
Clupeidae	*Alosa chrysochloris*	skipjack herring	3	T		
Clupeidae	*Dorosoma cepedianum*	gizzard shad	1202			
Hiodontidae	*Hiodon tergisus*	mooneye	22	T		
Cyprinidae	*Cyprinus carpio*	common carp	25			
Cyprinidae	*Ctenopharyngodon idella*	grass carp	1			
Cyprinidae	*Carassius auratus*	goldfish	1			
Cyprinidae	*Notemigonus crysoleucas*	golden shiner	1			
Cyprinidae	*Notropis hudsonius*	spottail shiner	6			
Cyprinidae	*Cyprinella spiloptera*	spotfin shiner	21			
Cyprinidae	*Notropis atherinoides*	emerald shiner	342			
Cyprinidae	*Notropis volucellus*	mimic shiner	76			
Cyprinidae	*Macrhybopsis storeriana*	silver chub	20	E		
Cyprinidae	*Nocomis micropogon*	river chub	1			
Cyprinidae	*Campostoma anomalum*	central stoneroller	4			
Cyprinidae	*Pimephales notatus*	bluntnose minnow	2			
Cyprinidae	*Semotilus atromaculatus*	creek chub	1			
Catostomidae	*Carpiodes cyprinus*	quillback carpsucker	80			
Catostomidae	*Carpiodes carpio*	river carpsucker	46			
Catostomidae	*Carpiodes velifer*	highfin carpsucker	3			
Catostomidae	*Moxostoma breviceps*	smallmouth redhorse	110			
Catostomidae	*Moxostoma anisurum*	silver redhorse	63			
Catostomidae	*Moxostoma carinatum*	river redhorse	5	SC		SC
Catostomidae	*Moxostoma duquesnei*	black redhorse	11			
Catostomidae	*Moxostoma erythrurum*	golden redhorse	90			
Catostomidae	*Hypentelium nigricans*	northern hog sucker	132			
Catostomidae	*Ictiobus bubalus*	smallmouth buffalo	283	T		
Ictaluridae	*Ictalurus punctatus*	channel catfish	123			
Ictaluridae	*Pylodictis olivaris*	flathead catfish	15			
Moronidae	*Morone saxatilis X M. chrysops*	hybrid striper	17			
Moronidae	*Morone americana*	white perch	4			
Moronidae	*Morone chrysops*	white bass	6			
Centrarchidae	*Ambloplites rupestris*	rock bass	5			
Centrarchidae	*Lepomis cyanellus*	green sunfish	4			
Centrarchidae	*Lepomis macrochirus*	bluegill	53			
Centrarchidae	*Lepomis humilis*	orangespotted sunfish	1			
Centrarchidae	*Micropterus dolomieu*	smallmouth bass	262			
Centrarchidae	*Micropterus salmoides*	largemouth bass	8			
Centrarchidae	*Micropterus punctulatus*	spotted bass	79			
Centrarchidae	*Pomoxis nigromaculatus*	black crappie	2			
Percidae	*Etheostoma blennioides*	greenside darter	11			
Percidae	*Etheostoma caeruleum*	rainbow darter	1			
Percidae	*Etheostoma zonale*	banded darter	4			
Percidae	*Perca flavescens*	yellow perch	2			
Percidae	*Percina caprodes*	logperch	244			
Percidae	*Percina copelandi*	channel darter	9	T		T
Percidae	*Sander vitreus*	walleye	31			
Percidae	*Sander canadensis X S. vitreus*	saugeye	5			
Percidae	*Sander canadensis*	sauger	180			
Sciaenidae	*Aplodinotus grunniens*	freshwater drum	1468			
50 taxa were collected, representing 10 families						

E = Endangered

T = Threatened

SC = Special Concern

remaining third of the samples was classified as class 'B habitats. There were no class 'C habitats sampled in the pool. Woody cover was present in 14 of the 15 sites sampled, riparian land use was primarily industrial, and barge influence was present throughout the majority of the pool (additional data in Appendix C).

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 20.5 kcfs and sampling was conducted between 23% and 79% 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 60 inches.

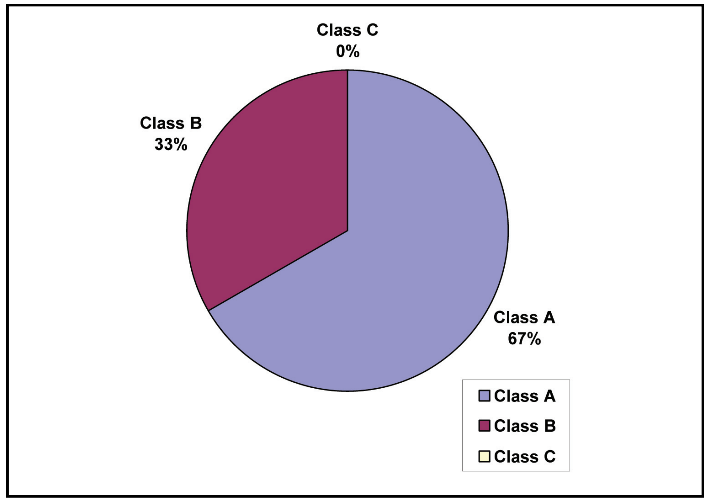

Figure 8. Habitat classification for New Cumberland Pool.

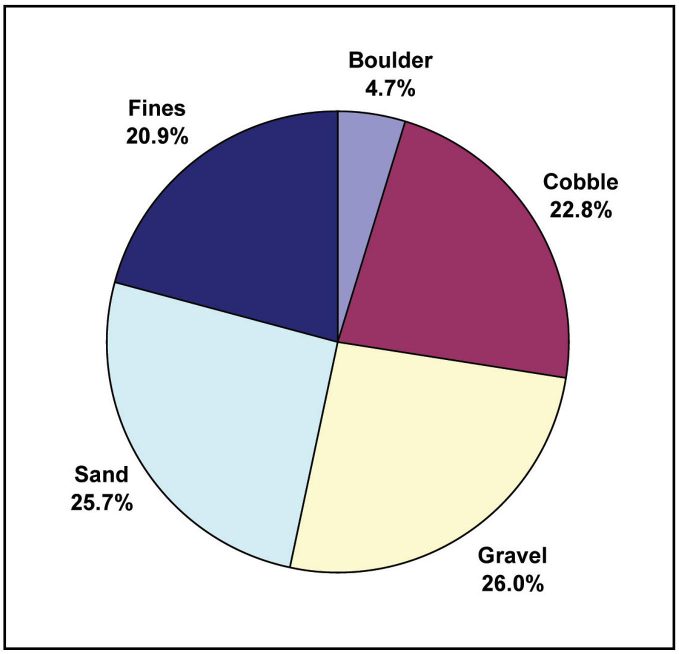

Figure 6. Average substrate composition of New Cumberland Pool sites in 2005.

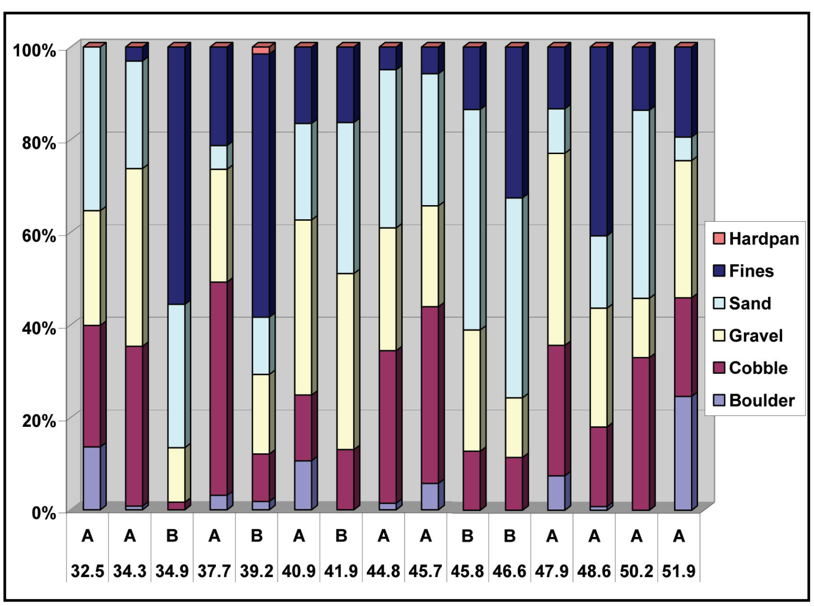

Figure 7. Substrate composition and habitat class at each of the 15 sites in New Cumberland Pools.

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 55 and the minimum was 37. 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 pool was also assessed as passing. Six sites received an excellent condition rating, five sites were found to be in good condition and four were in fair condition (Figure 13).

4.6 Revisits

The three sites that were sampled in both years scored between ten and 24 points higher in 2005 than in 2004 (Table 5, Figure 14). In 2004, two of the three sites were in failing condition. The increase in ORFIn scores put all three sites in passing condition for 2005 and the condition rating improved at each site. The 2005 scores for the revisit sites were similar to scores achieved by the other sites sampled in 2005 (Table 1).

5.0 Summary and Discussion of 2004 New Cumberland 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 New Cumberland 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. The sucker (Catostomidae) family was the second most dominant family, with golden redhorse (*Moxostoma erythrurum*) being the most

Table 3. ORFIn metrics and scores from the New Cumberland Pool 2005 study.

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
32.7	LDB	501	488	481	29	5	6	5	4	3	2	3	8	5	0.2	5	22.7	3	1.23	5	6.8	5	20.5	1	45.5	5	0	5	494	5	39	55	Pass
34.3	RDB	504	398	397	25	5	6	5	5	3	2	3	8	5	0.3	5	31.9	3	0.25	5	4.3	5	29.9	3	31.4	3	0	5	503	5	39	55	Pass
34.5	RDB	256	150	150	15	3	4	3	1	1	1	1	3	3	0.0	5	13.3	1	0.00	5	8.0	5	14.7	1	53.3	5	0	5	256	3	33	41	Pass
37.7	RDB	346	283	276	25	5	7	5	5	3	0	1	7	5	2.1	5	15.2	1	2.12	5	9.9	5	21.2	1	20.5	3	1	5	339	5	39	49	Pass
39.2	RDB	347	269	253	26	5	8	5	5	3	1	1	7	5	1.9	5	25.3	3	5.95	3	13.0	3	19.0	1	38.7	3	1	5	331	5	33	47	Pass
40.9	LDB	239	155	153	19	3	7	5	3	3	2	3	5	3	0.6	5	21.9	3	1.29	5	10.3	5	18.1	1	21.9	3	0	5	237	3	39	47	Pass
41.9	LDB	170	140	140	16	3	7	5	3	3	0	1	4	3	0.0	5	23.6	3	0.00	5	5.7	5	24.3	1	20.0	3	0	5	170	3	33	45	Pass
44.8	LDB	665	536	533	24	5	6	5	2	1	2	3	6	5	0.4	5	23.9	3	0.56	5	15.5	3	9.3	1	26.9	3	0	5	662	5	39	49	Pass
45.7	RDB	635	381	376	26	5	7	5	4	3	1	1	8	5	1.1	5	28.9	3	0.53	5	5.5	5	26.8	1	21.8	3	0	5	630	5	39	51	Pass
46.2	LDB	497	371	370	18	3	6	5	1	1	1	1	6	5	0.3	5	6.2	1	0.27	5	25.9	1	4.3	1	17.8	1	0	5	496	5	33	39	Pass
46.6	RDB	511	273	268	26	5	8	5	1	1	2	3	6	5	1.8	5	36.3	3	1.10	5	12.1	3	20.5	1	30.8	3	0	5	506	5	33	49	Pass
47.9	RDB	296	233	230	25	5	8	5	5	3	1	1	8	5	1.3	5	36.5	3	1.29	5	3.9	5	37.3	3	18.9	1	0	5	293	3	39	49	Pass
48.7	LDB	349	267	263	23	5	7	5	3	3	3	3	7	5	1.5	5	22.1	3	1.50	5	6.0	5	22.5	1	22.1	3	0	5	345	5	39	53	Pass
50.2	LDB	250	129	128	22	5	6	5	2	1	2	3	5	3	0.0	5	14.0	1	0.78	5	27.1	1	13.2	1	10.9	1	0	5	249	3	39	39	Pass
51.9	RDB	176	125	124	20	5	5	3	6	5	1	1	5	3	0.8	5	18.4	1	0.80	5	14.4	3	22.4	1	33.6	3	0	5	175	3	39	43	Pass
35.9 Revisit	LDB	351	302	293	22	5	6	5	3	3	2	3	7	5	0.3	5	18.9	1	2.98	5	3.0	5	26.5	1	23.5	3	0	5	342	5	39	51	Pass
37.3 Revisit	RDB	299	223	218	17	3	4	3	2	1	0	1	4	3	1.3	5	4.9	1	2.24	5	10.8	3	5.8	1	28.7	3	1	5	294	3	33	37	Pass
40.2 Revisit	LDB	277	117	116	18	3	7	5	3	3	0	1	4	3	0.0	5	11.1	1	0.85	5	31.6	1	15.4	1	30.8	3	0	5	276	3	33	39	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

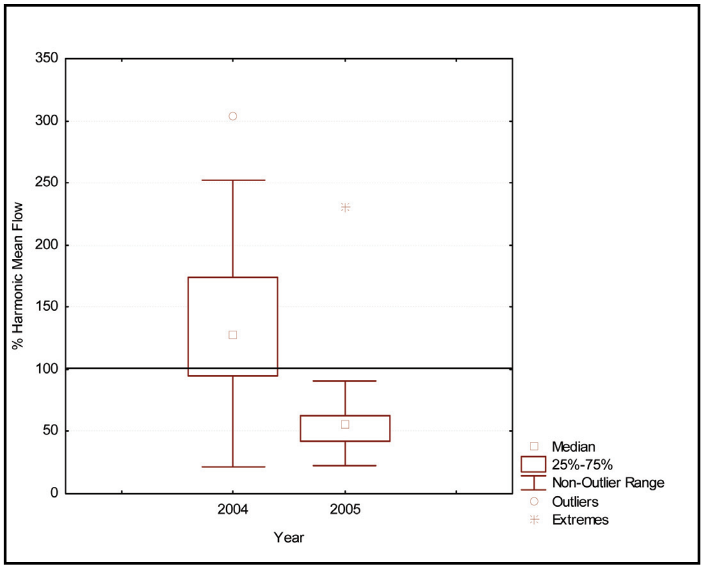

Figure 9. Daily harmonic mean flows (HMF) near sampling locations over the 2004 and 2005 sampling seasons.

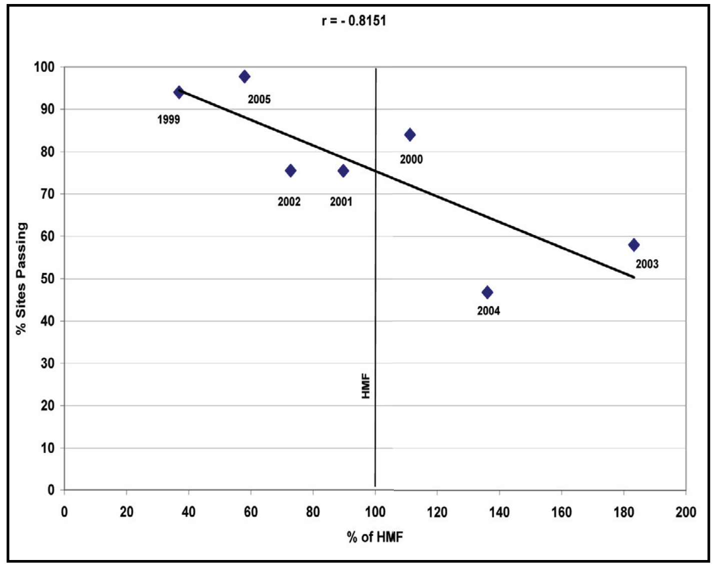

Figure 10. Correlation of harmonic mean flow (HMF) and percentage of sites passing for different years of sampling in multiple pools.

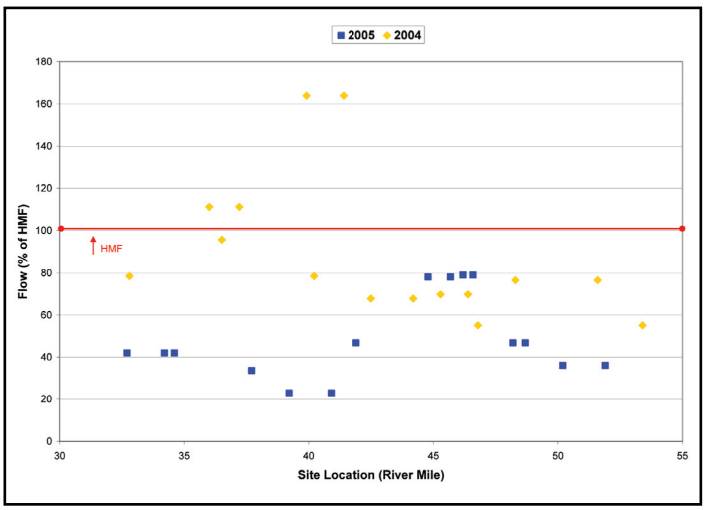

Figure 11. Flows relative to harmonic mean flow (HMF) on day of sampling for 2004 and 2005 in New Cumberland pool.

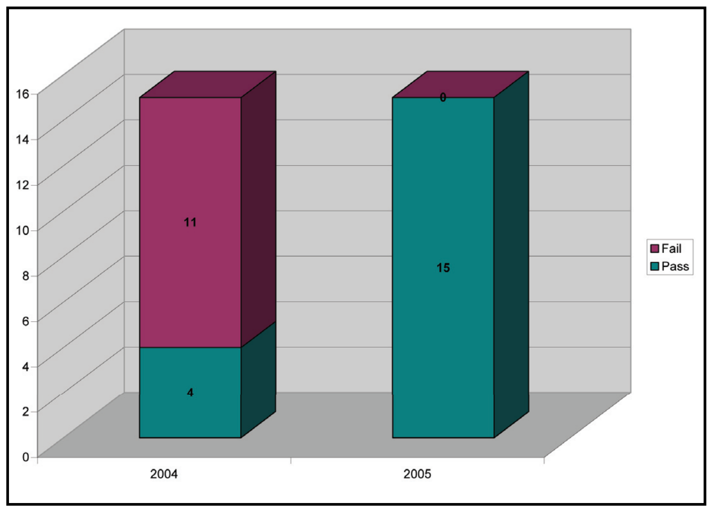

Figure 12. Comparison of site assessment results for 2004 and 2005.

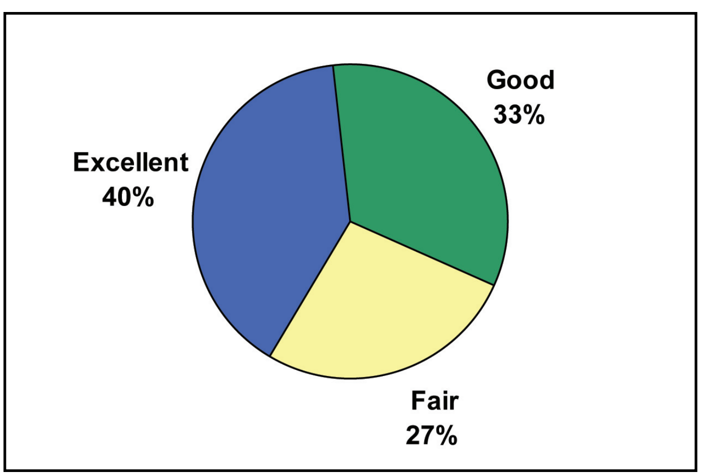

Figure 13. Condition ratings for sites in New Cumberland Pool, based on ORFIn scores at 15 sites in 2005.

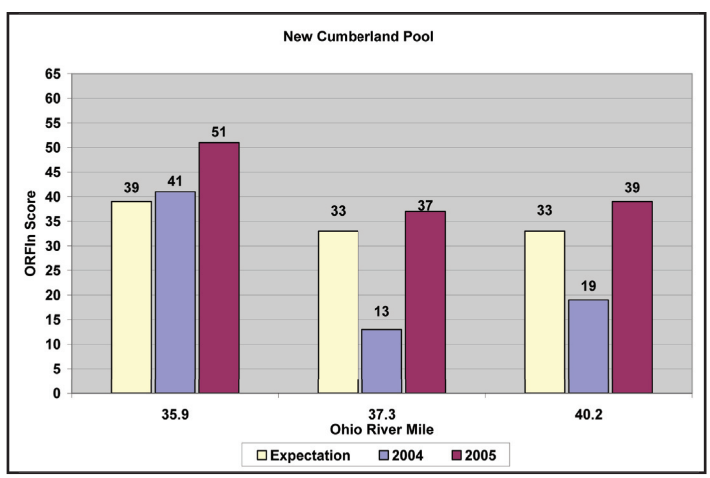

Figure 14. ORFIn scores and expectations for sites sampled in 2004 and 2005.

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

Year	RMI	Bank	Date	Latitude	Longitude	Secchi (in)	Habitat Class	Exp ORFIn	Obs ORFIn	Site Pass/ Fail	Rating
2004	35.9	LDB	8/10/04	40.623	80.457	33	A	39	41	Pass	Fair
2005	35.9	LDB	9/7/05	40.623	80.457	47	A	39	51	Pass	Excellent
2004	37.3	RDB	8/10/04	40.642	80.471	36	B	33	13	Fail	Very Poor
2005	37.3	RDB	9/8/05	40.642	80.471	48	B	33	37	Pass	Fair
2004	40.2	LDB	7/13/04	40.634	80.521	36	B	33	19	Fail	Very Poor
2005	40.2	LDB	9/13/05	40.634	80.521	43	B	33	39	Pass	Fair

common sucker and third most common species. At many of the sites sampled, the number of fish caught was less than expected. At nine of the 15 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.

5.2 Metric Performance

The sites scored lowest on the number of great river species, percent piscivores and CPUE metrics. The number of DELT anomalies was the highest scoring metric throughout the pool, followed by sucker species.

5.3 Habitat Surveys

The habitat surveys showed that fines (38%) were the most common bottom substrate, with notable percentages of gravel (23%), sand (17%), and cobble (16%). Most (73%) of the sites were class A habitats and the rest were class B 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 30 to 48 inches.

5.5 Assessment of Condition

In 2004, only four sites met expectations (passed) and no site received a rating higher than fair. With only 27% of the sites passing, the New Cumberland 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 New Cumberland pool showed several important differences between 2004 and 2005. First, the 2005 survey results show much higher diversity and abundance than was seen in the 2004 surveys. The number of individuals caught in 2005 was over three times higher than that from 2004 and 15 additional taxa were recorded in 2005. Second, each year's catch was dominated by different fish species and families. The 2005 samples were dominated by freshwater drum and gizzard shad, but in 2004 minnows such as emerald and mimic shiners were the most common. 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 generally higher than the 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. 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 and number of sucker species remained 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. 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 New Cumberland pool are classified as class 'A' habitats and that there are some 'B' habitats and few, if any, class 'C' habitats. This indicates that there is plenty of adequate habitat available to support the fish population of the New Cumberland pool. The 2004 habitat surveys showed a higher percentage of fines than were seen in the 2005 assessments. The difference in the percentage of fines is probably an artifact of the probabilistic design. There is variation throughout the pool and the sites selected in 2005 happened to have fewer fines present. Still, the habitat assessments in both years showed similar results for the percent of each habitat class present.

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 New Cumberland pool over 2004 and 2005 have provided a great deal 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 75% of the New Cumberland pool sites were deemed as failing, therefore this 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 probable 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 New Cumberland 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 the 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 (Ohio River Valley Water Sanitation Commission). 2003. Pollution Control Standards for Discharges to the Ohio River. ORSANCO, Cincinnati, OH.

ORSANCO (Ohio River Valley Water Sanitation Commission). 2006. A Biological Study of the New Cumberland 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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