



A Biological Study of the Robert C. Byrd Pool of the Ohio River



Executive Summary

- Since 2004, ORSANCO has been using a probabilistic (random) design for monitoring fish communities in the Ohio River and conducting biological assessments.
- The Ohio River was divided into 19 assessment units based primarily on the locations of high-lift navigational dams. Using the random design, each assessment unit was assigned 15 sampling locations.
- Once fish assemblages are sampled, each site is assessed using a site quality score (0- 5) which is generated from an Ohio River fish index (MORFIn). The expectations for the MORFIn are derived from each site's substrate composition. For an assessment unit (i.e. pool) to meet its aquatic life-use designation, the average of the quality scores for the pool must be greater than 2.0.
- Fish population data from Robert C. Byrd pool yielded 35 species and 2 hybrid taxa, representing 10 different families. One of these taxa was listed in OH as of special concern [river redhorse (*Moxostoma carinatum*)]. WV has no system for listings species.
- At the species level, gizzard shad (*Dorosoma cepedianum*) and sauger (*Sander canadensis*) were the most abundant, comprising 23.2% and 20.0% of the catch respectively.
- Previous analyses have identified a relationship between flow and MORFIn scores and the need for sampling thresholds and/or flow calibration. Increased flows appeared to cause lower ORFIn scores due to decreased sampling efficiency and changes in fish behavior.
- Flows were variable in 2008 when sampling was conducted. Sampling was conducted at very low flows as well as at moderately elevated flows. Flows did not appear to affect electrofishing surveys.
- In 2008, 93.3% of the sites assessed in Robert C. Byrd pool had site quality scores >2.0 (out of 5.0) and the pool had an average quality score of 2.7. This score indicates the pool is in fair biological condition. Therefore the R. C. Byrd pool will be reported to EPA as meeting its aquatic life-use designation.
- Recommendations include characterizing R. C. Byrd pool as supporting its aquatic life-use designation and moving to the next pool to be sampled while continuing to monitor flow and its influence on assessment results.
- As of 2008, 16 of the 19 pools (AUs) have been assessed which comprises 801.0 miles or 81.7% of the resource.

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A Biological Study of the Robert C. Byrd (R.C. Byrd) Pool of the Ohio River (2008)

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 can 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 (macroinvertebrate and fish 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 (ORFI_n,

Emery et al. 2003). The ORFI_n 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. In 2008, ORSANCO recalibrated the original ORFI_n and adjusted for more-detailed habitat classifications and a contemporary means of scoring the fish metrics (i.e. continuous in lieu of discrete scoring). A new assessment approach was also adopted for the modified ORFI_n (MORFI_n).

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). ORSANCO has now begun using this approach on the Ohio River for its biological monitoring. In 2008, the Dashields, Hannibal, Robert C. (R.C.) Byrd, and Smithland pools were sampled as part of ORSANCO's normal monitoring. This report presents the 2008 survey of the R.C. Byrd pool including the data collected and assessment results based on the fish population surveys.

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

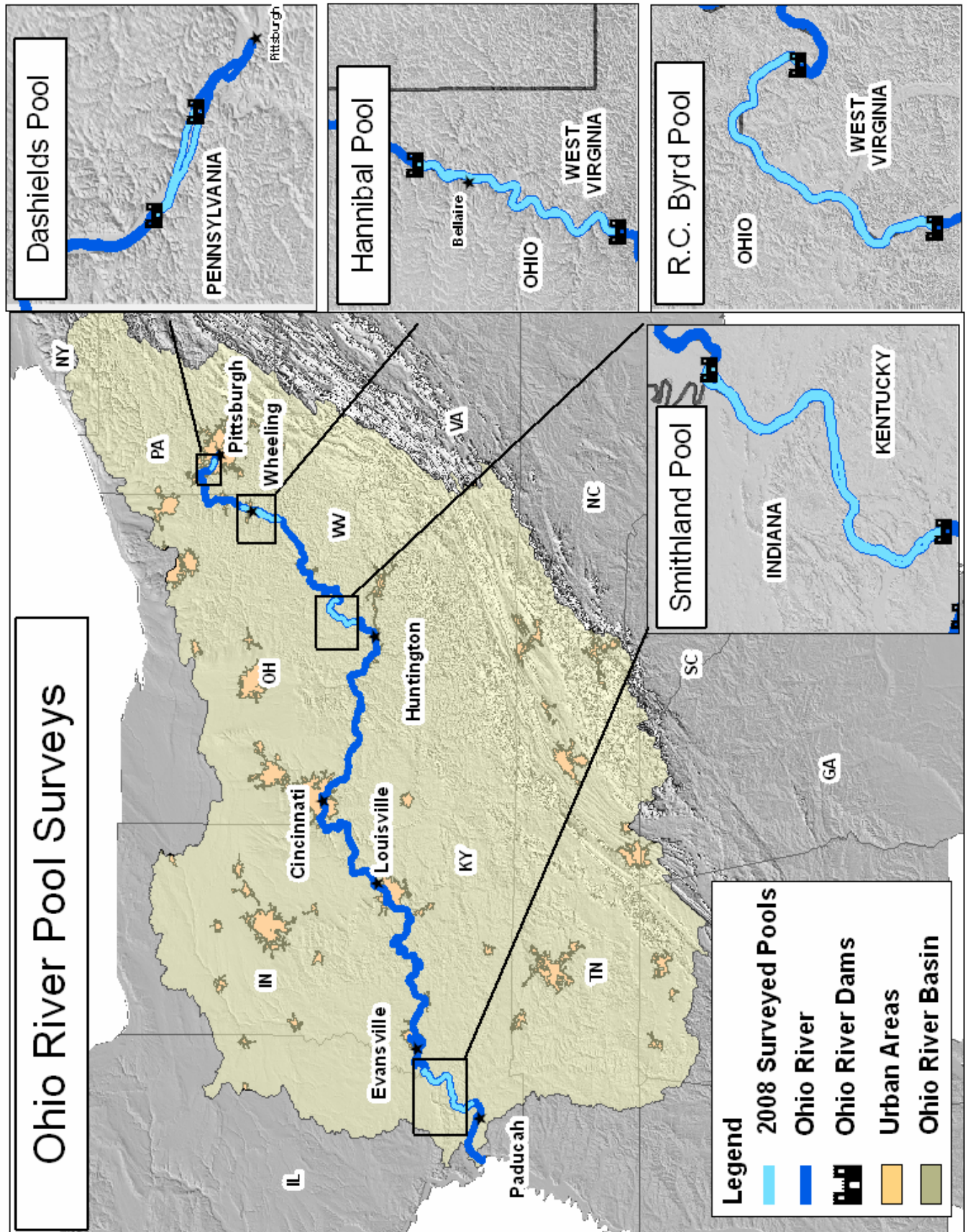


Figure 1. The Ohio River basin and the four pools selected for 2008 sampling.

population, more than 25 million people, and serves 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 R.C. Byrd Pool

The R.C. Byrd pool is 41.7 miles long, extending from the Racine Locks and Dam (ORM 237.5) to the R.C. Byrd (formerly Gallipolis) Locks and Dam (ORM 279.2) on the downstream end. The pool has a gradient drop of 0.6 feet per mile and averages 1,154 feet wide and 26 feet deep (ORSANCO

1994). The pool is bordered by the states of West Virginia and Ohio.

2.3 R.C. Byrd Pool Land Cover

This pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. The Kanawha River empties its waters into this pool at Ohio River mile-point 265.7 and has a drainage area of 12,200 square miles. Robert C. Byrd pool also receives waters from Leading Creek and Raccoon Creek with drainage areas of 151 and 684 square miles respectively. These watersheds are primarily forested (65.8%), but also have a considerable amount of pasture lands (13.2%) and row crops (7.5%; Figure 2).

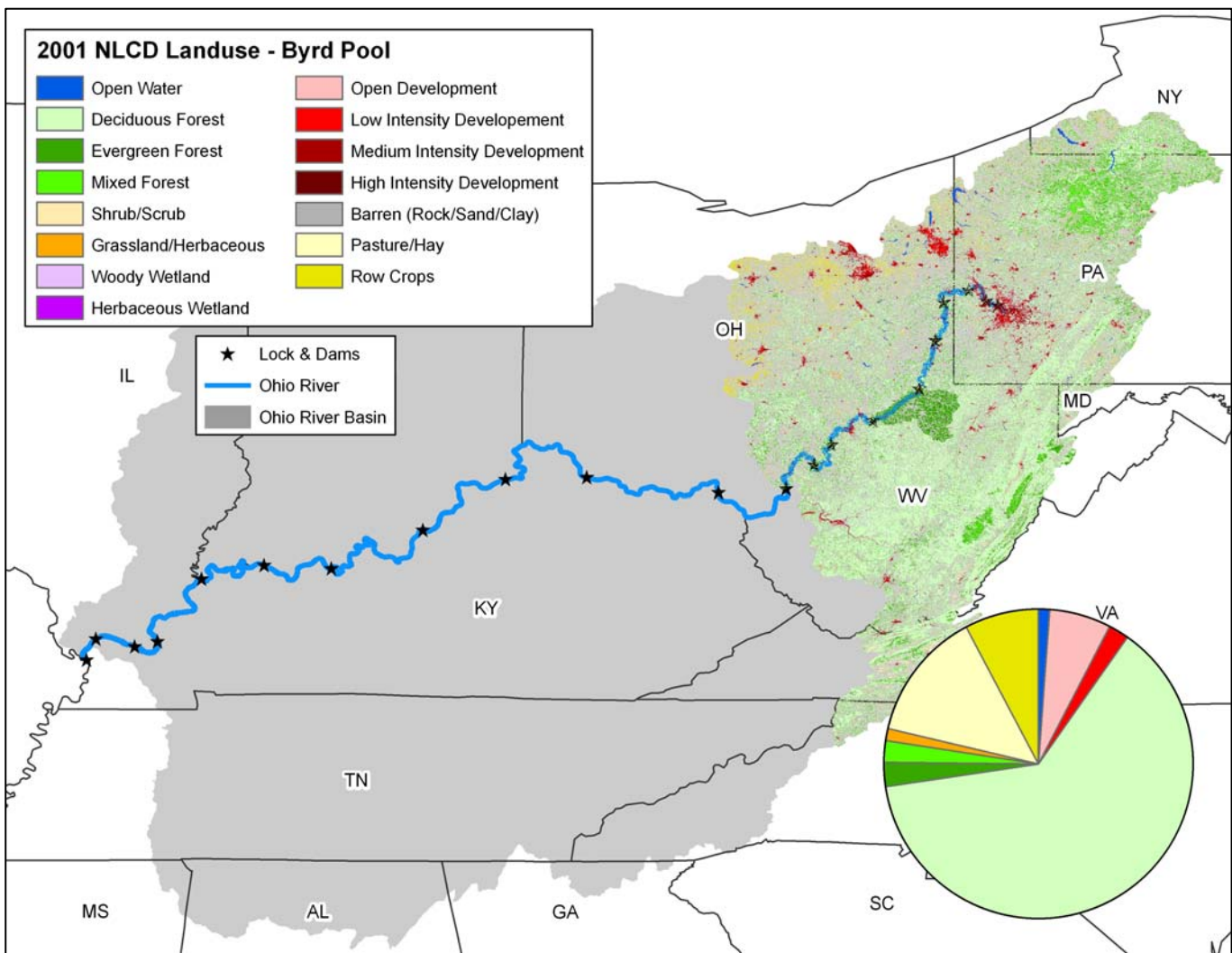


Figure 2. Land cover within the R.C. Byrd pool catchment area.

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 R.C. Byrd pool of the Ohio River from mile marker 237.5 (Racine Locks and Dam) to 279.2 (R.C. Byrd Locks and Dam). The total linear extent of the target population was approximately 83.4 miles. The sample frame was generated using RF3 river double lines for the Ohio River and river mile coverage 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).

Sites were sampled as closely 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 were shifted if possible (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 (12 in). 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).



ORSANCO crew conducting night-time electrofishing

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 100 ft or a depth of 20 ft.) and was sampled for a minimum of 1800 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 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.



Typical 500 meter electrofishing reach

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 10ft intervals beginning at the shore/water interface and moving away from the shore for 100ft. 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 five existing classes of habitat: 'A', 'B', 'C', 'D' or 'E' (Emery et al, in prep). By assigning each sampling site to one of five 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 a >81% presence of boulder, cobble, and gravel at depths <10 feet. Sites assigned to habitat class 'B' are characterized by a ≤81% and >50% presence of boulder, cobble, and gravel at depths <10 feet. Classes 'C', 'D', and 'E' each exhibit substrate compositions of boulder, cobble, and gravel that are ≤50%. Sites that fall in habitat class 'C' exhibit a lower percentage of smaller substrates (≤77%; sand, fine, and hardpan) at depths <10 feet. Class 'D' and 'E' sites similarly exhibit large amounts of sand and fine substrates (>77%), however these two classes differ with respect to depth. Habitat class 'D' sites are relatively shallow while class 'E' sites exhibit a larger percentage of >20' depths.

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. Water samples were also collected using a Kemmerer and consisted of a single-point, mid-depth grab sample at the downstream end of each 500m zone. Samples were collected

approximately 100ft from shore at each site on three separate occasions throughout the field season. Samples were kept at or below 4°C until sent off for laboratory analyses. Water quality parameters analyzed included: ammonia nitrogen, chloride, hardness, nitrate-nitrite, total Kjeldahl nitrogen (TKN), phenolics, sulfate, total suspended solids (TSS), total phosphorus, and total organic carbon (TOC).

Secchi depth was measured using a standard Secchi disc just prior to electrofishing. The potential effects of flow on fish assemblages are unclear therefore flow was also monitored. Flow data were obtained from the U.S. Army Corps of Engineers. These included daily average flow volumes and velocities from the nearest-upstream sampling station to any particular site. There are 234 flow stations on the mainstem of the Ohio River from which data is recorded or modeled. Harmonic mean flow (HMF), the 22-year average flow, was calculated for every Julian day and flow station by ORSANCO using raw flow data obtained from the U.S. Army Corps of Engineers (ORSANCO 2003)

3.6 Pool Assessment

In 2008, 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 R.C. Byrd 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). Observed MORFIN scores were compared to habitat derived expectations for each site (Emery et al. 2003).

The five distinct habitat classes ('A', 'B', 'C', 'D', and 'E') each exhibit different levels of historical MORFIN performance. Performance expectations for each habitat class were determined based on the statistical distribution of data (MORFIN 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).

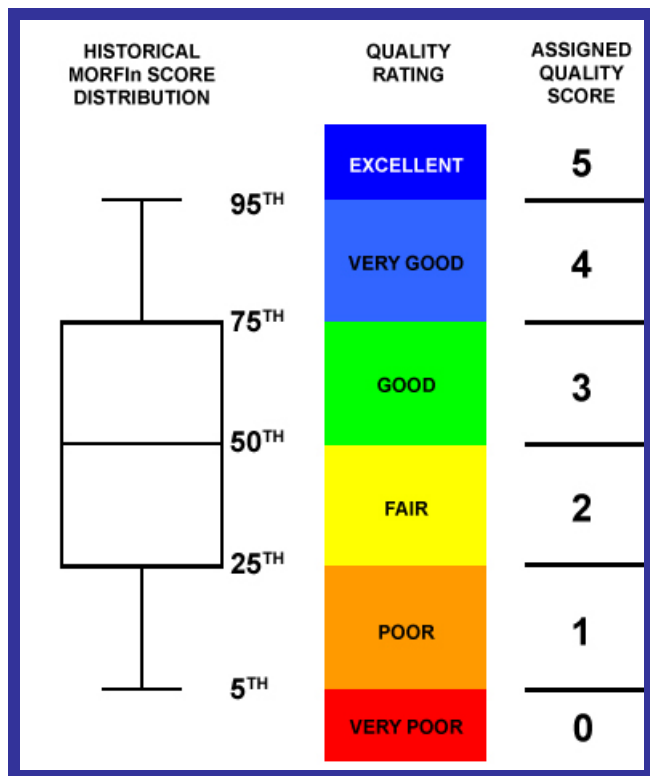


Figure 3. Approach used to assign fish quality scores for each habitat class.

Individual site scores were compared to historical MORFIn score values for a particular habitat class. Historical MORFIn values were determined by compiling fish data from the five distinct habitat classes over a fifteen year period to determine the range of scores that exists within each habitat class. A fish quality score (between 0 and 5) was assigned based on how each site scored relative to the statistical distribution of historical MORFIn scores (see Appendix A for a detailed explanation). For example, a fish quality score of 0 corresponds to the 5th percentile of the range of historical MORFIn scores specific to that habitat class (Figure 3).

Quality scores were determined to obtain a final bio-assessment and the threshold for the pool assessment was set at 25% failure. The pool passed the assessment if the average fish quality score for the pool was above the 25th percentile (≥ 2.0). If the average fish quality score for a pool was below the 25th percentile, the pool was assessed as failing. To further characterize the condition of each pool, sites were given individual condition ratings. The 95th, 75th, 50th, 25th, and 5th percentiles were used as cutoff points for the different ratings. These ratings were based on the same distribution of data from ‘least impacted’ sites used to determine expectations and consisted of Excellent, Very Good, Good, Fair, Poor, and Very Poor. Any sites that were classified as Poor or Very Poor were sites that failed to meet expectations (Figures 3 and 4).

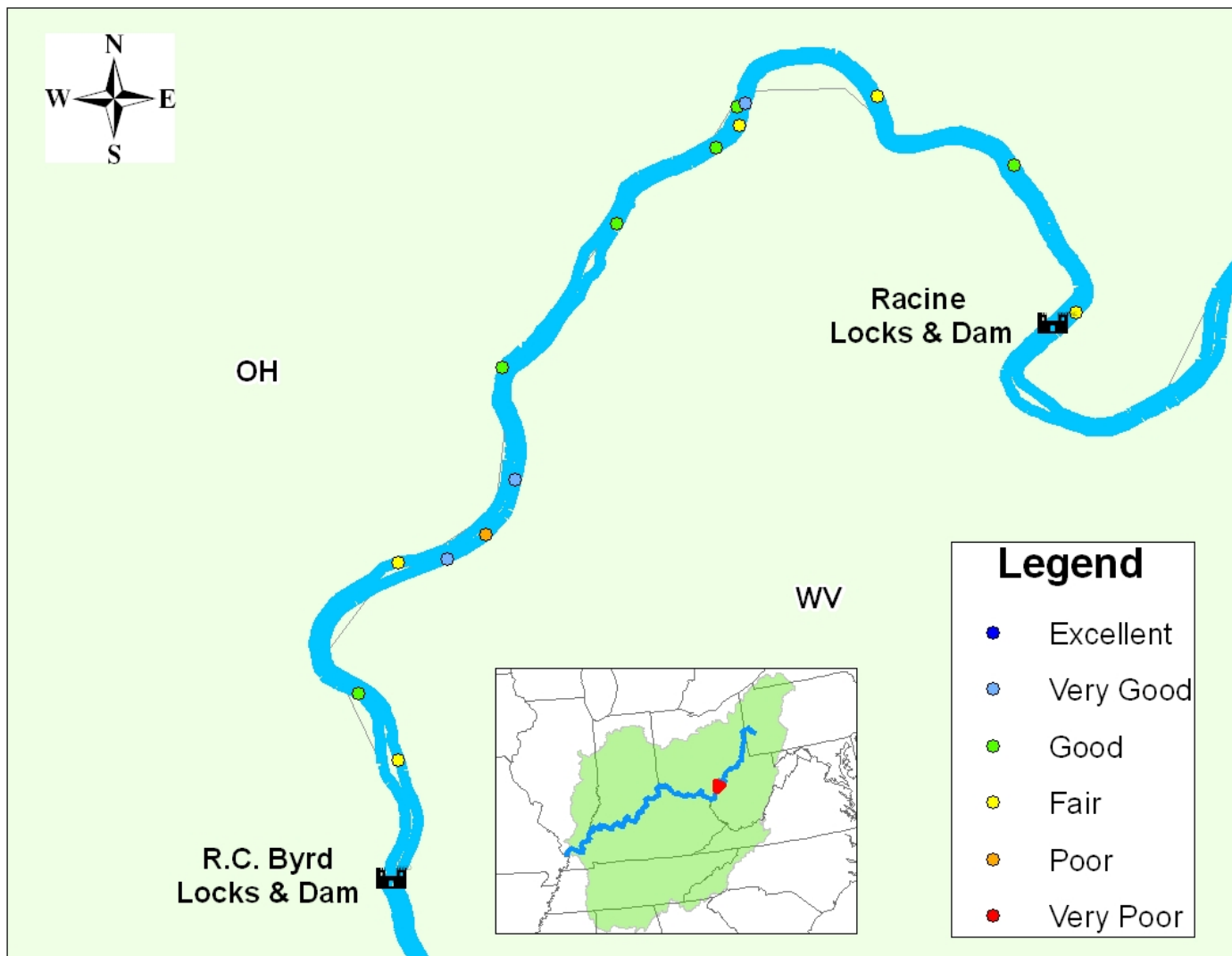


Figure 4. Locations and results of sampling at 15 sites within the R.C. Byrd pool.

4.0 Results

4.1 Fish Population

In 2008, fish population data (Appendix B) were collected from 15 randomly selected locations throughout the length of the R. C. Byrd pool (Table 1). These collections produced 35 species and 2 hybrid taxa, representing 10 different families (Table 2). One of these taxa was listed in OH as of special concern [river redhorse (*Moxostoma*

carinatum)]. WV has no system for listings species. No federally listed taxa were collected from the R. C. Byrd pool. At the species level, gizzard shad (*Dorosoma cepedianum*) and sauger (*Sander canadensis*) were the most abundant, comprising 23.2% and 20.0% of the catch respectively (Figure 5). The two dominant families were the perches and darters family (Percidae) and the shad and herring family (Clupeidae), which comprised 25.7% and 23.4% of the catch respectively (Figure 6).

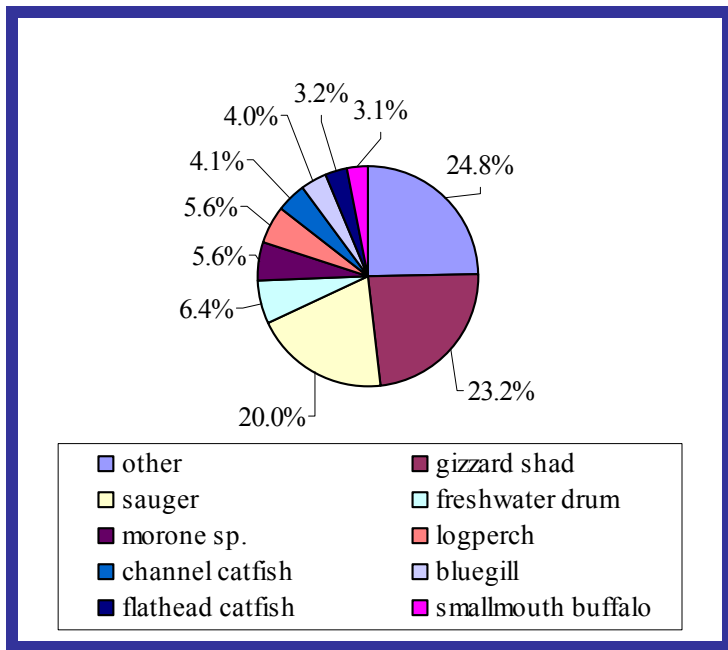


Figure 5. Species composition of fish sampled in R. C. Byrd pool.

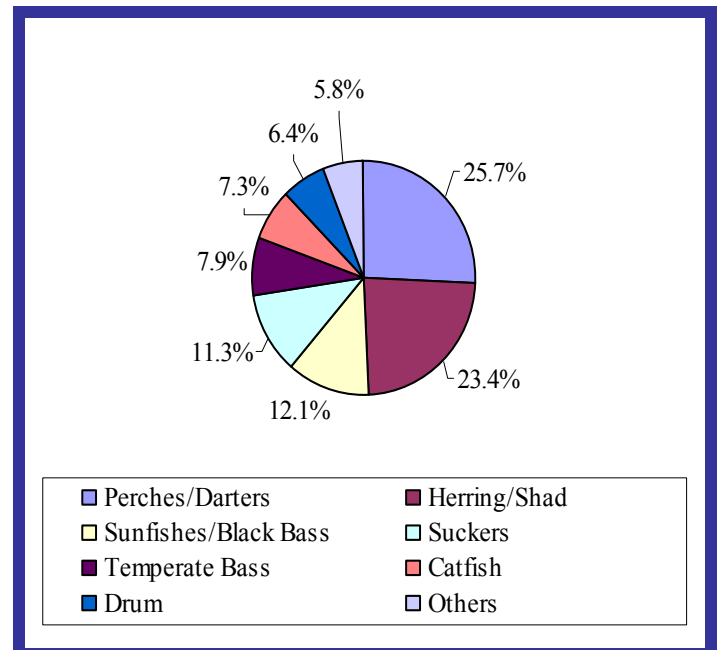


Figure 6. Sampled fish composition by family in the R. C. Byrd pool.

Table 1. Electrofishing site list for the R.C. Byrd pool including habitat designation, MORFIN scores, and quality scores.

Site #	River Mile	Bank	Date	Latitude	Longitude	Habitat Class	MORFIN Expectation	MORFIN	Quality Values	Quality Score
1	238.1	RDB	14-Jul-08	38.92115	81.90295	B	46.76	54.99	2	Fair
2	242.7	RDB	15-Jul-08	38.98266	81.92899	C	43.13	60.51	3	Good
3	247.1	RDB	15-Jul-08	39.0119	81.98634	B	46.76	54.99	2	Fair
4	251.7	LDB	06-Aug-08	39.00879	82.04135	D	41.00	61.31	4	Very Good
5	252.0	RDB	06-Aug-08	39.00743	82.04506	B	46.76	55.14	3	Good
6	252.3	LDB	06-Aug-08	38.99947	82.04401	D	41.00	46.49	2	Fair
7	253.1	LDB	06-Aug-08	38.99025	82.05365	D	41.00	50.93	3	Good
8	256.6	LDB	06-Aug-08	38.95826	82.09531	C	43.13	53.31	3	Good
9	261.5	RDB	06-Aug-08	38.89791	82.14359	B	46.76	61.89	3	Good
10	264.7	LDB	29-Jul-08	38.85093	82.13811	C	43.13	61.50	4	Very Good
11	266.5	LDB	29-Jul-08	38.82783	82.15042	B	46.76	42.07	1	Poor
12	267.2	LDB	28-Jul-08	38.81781	82.16637	C	43.13	62.82	4	Very Good
13	268.5	RDB	28-Jul-08	38.81618	82.18717	D	41.00	44.14	2	Fair
14	273.3	RDB	28-Jul-08	38.76117	82.20369	E	37.69	51.05	3	Good
15	275.8	LDB	28-Jul-08	38.73347	82.18719	D	41.00	47.73	2	Fair

LDB = Left Descending Bank
RDB = Right Descending Bank

Table 2. Species collected in the R.C. Byrd pool during the 2008 survey. Species information are determined by and relative to the state of Ohio (SC = 'Species of Concern').

Family	Species	Latin Name	OH
Catostomidae	River Carpsucker	<i>Carpionodes carpio</i>	
Catostomidae	Quillback	<i>Carpionodes cyprinus</i>	
Catostomidae	Northern Hog Sucker	<i>Hypentelium nigricans</i>	
Catostomidae	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	
Catostomidae	Silver Redhorse	<i>Moxostoma anisurum</i>	
Catostomidae	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	
Catostomidae	River Redhorse	<i>Moxostoma carinatum</i>	SC
Catostomidae	Golden Redhorse	<i>Moxostoma erythrurum</i>	
Centrarchidae	Green Sunfish	<i>Lepomis cyanellus</i>	
Centrarchidae	Orangespotted Sunfish	<i>Lepomis humilis</i>	
Centrarchidae	Bluegill	<i>Lepomis macrochirus</i>	
Centrarchidae	Longear Sunfish	<i>Lepomis megalotis</i>	
Centrarchidae	Smallmouth Bass	<i>Micropterus dolomieu</i>	
Centrarchidae	Spotted Bass	<i>Micropterus punctulatus</i>	
Centrarchidae	Largemouth Bass	<i>Micropterus salmoides</i>	
Centrarchidae	White Crappie	<i>Pomoxis annularis</i>	
Centrarchidae	Black Crappie	<i>Pomoxis nigromaculatus</i>	
Clupeidae	Skipjack Herring	<i>Alosa chrysochloris</i>	
Clupeidae	Gizzard Shad	<i>Dorosoma cepedianum</i>	
Cyprinidae	Spotfin Shiner	<i>Cyprinella spiloptera</i>	
Cyprinidae	Common Carp	<i>Cyprinus carpio</i>	
Cyprinidae	Silver Chub	<i>Macrhybopsis storeriana</i>	
Cyprinidae	Emerald Shiner	<i>Notropis atherinoides</i>	
Cyprinidae	Mimic Shiner	<i>Notropis volucellus</i>	
Hiodontidae	Mooneye	<i>Hiodon tergisus</i>	
Ictaluridae	Channel Catfish	<i>Ictalurus punctatus</i>	
Ictaluridae	Flathead Catfish	<i>Pylodictis olivaris</i>	
Lepisosteidae	Longnose Gar	<i>Lepisosteus osseus</i>	
Moronidae	White Bass	<i>Morone chrysops</i>	
Moronidae	Hybrid Striper	<i>Morone saxatilis</i> x <i>M. chrysops</i>	
Moronidae	Morone Sp	<i>Morone</i> sp	
Percidae	Logperch	<i>Percina caprodes</i>	
Percidae	Sauger	<i>Sander canadensis</i>	
Percidae	Saugeye	<i>Sander canadensis</i> x <i>S. vitreus</i>	
Percidae	Walleye	<i>Sander vitreus</i>	
Sciaenidae	Freshwater Drum	<i>Aplodinotus grunniens</i>	

4.2 Metric Performance

Thirteen metrics were used to calculate MORFIN scores for each electrofishing site (See Emery et al. 2003). Each site's performance and scores for the MORFIN metrics are shown in Table 3. The number of native species collected at each site ranged from 12 to 20, with an average of 15.5 species per site. The number of sucker species found at each site ranged from 2 to 5 and the number of centrarchid species varied from 1 to 7. The number of great river species ranged from 0 to 2. The number of intolerant species ranged from 0 to 4 at the sampled sites. The percentage of tolerant individuals at each site did not exceed 9.2% and the percentage of simple lithophils ranged between 24.0% and 62.9%. All sites had below 7.1% non-native individuals and the percent detritivores ranged from 1.4% to 23.2%. The percent invertivores ranged between 2.7% to 41.6%, and the percent piscivores ranged from 37.3% to 77.6%. One of the sites had two DELT (deformities, eroded fins, lesions and tumors) anomalies. The CPUE (catch per unit effort) ranged from 36 to 151 individuals and averaged 85.1 individuals per site.

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 sampling locations revealed that the bottom substrate in the R. C. Byrd pool was in nearly equal proportions of fines, sand, and gravel with a smaller percentage of cobble and boulder (Figure 7). There was some variation among the individual sites and the percentage of fines increased as river miles increased (Figure 8) within the pool. The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', 'C', 'D', or 'E'. Five sites in R. C. Byrd pool were classified as class 'B' habitats, 4 sites were class 'C' habitats, 5 sites were class 'D' habitats, and 1 site was a class 'E' habitat. There were zero 'A' habitat classes sampled in the pool (Table 1).

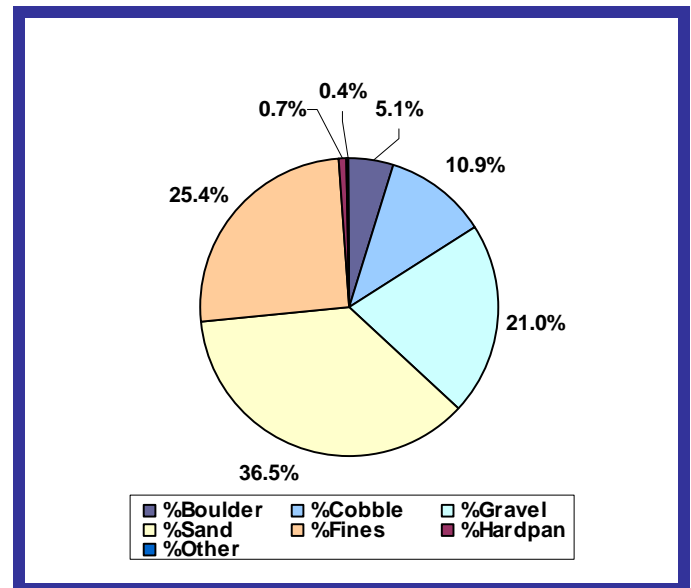


Figure 7. Substrate composition of the R.C. Byrd pool.

Woody cover was present at all 15 sites sampled and overhanging vegetation was also present at all sites. Riparian land cover was primarily natural forest with some residential and agricultural uses present. Barge activity was moderate throughout the pool, while mooring structures were present at only two of the sites sampled (see Appendix C).

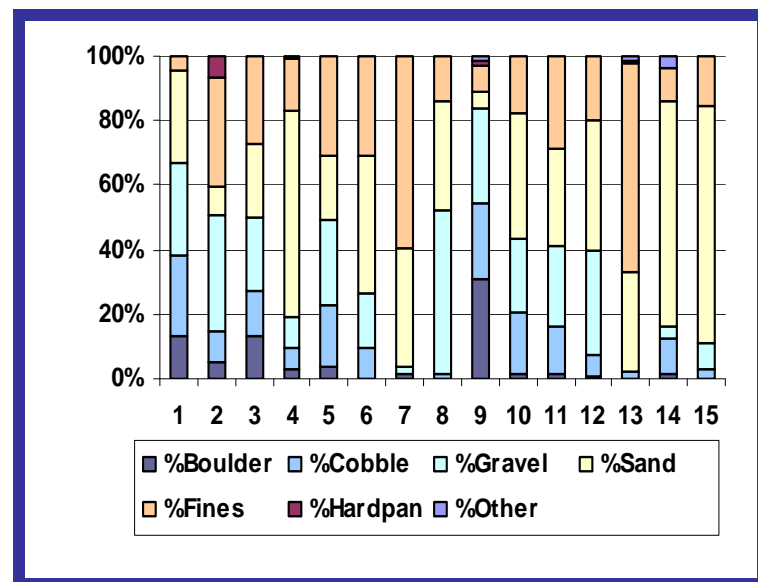


Figure 8. Substrate composition at each site sampled in the R.C. Byrd pool.

Table 3. MORFIn metrics and scores from the 2008 survey of R.C. Byrd pool.

Site #	Rmi	Bank	# Individuals	# Individuals w/o G & E	# Individuals w/o GETHEX	# Species	# Species Score	# Suckers	Suckers 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	# DELTs	DELT score	CPUE	CPUE score	Expected MORFIn	Observed MORFIn
1	238.1	R	101	83	82	14	26.4	5	66.7	4	66.7	0	0.0	3	39.8	0.0	100.0	43.4	71.6	1.2	88.8	16.9	42.3	14.5	8.4	61.4	95.8	0	100	100	8.4	46.8	55.0
2	242.7	R	81	70	70	16	41.1	3	28.3	4	66.7	0	0.0	3	40.2	0.0	100.0	62.9	100.0	0.0	100.0	1.4	96.7	14.3	8.3	77.1	100.0	0	100	81	5.4	43.1	60.5
3	247.1	R	145	33	33	15	34.0	3	28.6	3	50.0	0	0.0	3	40.5	0.0	100.0	48.5	80.9	0.0	100.0	12.1	59.0	30.3	32.7	48.5	73.3	0	100	145	15.9	46.8	55.0
4	251.7	L	72	49	49	15	34.1	4	48.2	3	50.0	2	66.7	2	22.2	0.0	100.0	44.9	74.6	0.0	100.0	2.0	94.6	10.2	2.6	77.6	100.0	0	100	72	4.1	41.0	61.3
5	252.0	R	89	75	73	19	63.3	4	48.2	4	66.7	2	66.7	4	59.4	2.7	71.7	24.0	37.0	1.3	87.6	6.7	78.2	26.7	27.4	37.3	54.0	2	50	87	6.6	46.8	55.1
6	252.3	L	64	37	36	12	12.3	2	9.5	2	33.3	1	33.3	2	22.2	2.7	71.4	37.8	61.9	2.7	75.0	5.4	82.7	2.7	0.0	70.3	100.0	0	100	63	2.7	41.0	46.5
7	253.1	L	97	65	59	19	63.3	3	28.9	5	83.3	1	33.3	4	59.5	9.2	2.2	27.7	43.7	3.1	71.5	9.2	69.2	20.0	17.4	53.8	82.6	0	100	91	7.3	41.0	50.9
8	256.6	L	119	64	64	13	19.8	3	29.1	2	33.3	1	33.3	2	22.5	0.0	100.0	37.5	61.4	0.0	100.0	1.6	96.3	21.9	20.4	43.8	65.1	0	100	119	11.9	43.1	53.3
9	261.5	R	155	154	150	20	70.9	4	48.7	7	100.0	0	0.0	3	41.5	2.6	72.5	44.8	74.6	1.9	82.0	3.2	90.3	41.6	50.3	39.0	56.8	0	100	151	17.2	46.8	61.9
10	264.7	L	65	62	62	17	49.1	4	48.9	4	66.7	1	33.3	2	23.1	0.0	100.0	46.8	78.2	0.0	100.0	6.5	79.0	32.3	36.4	53.2	81.4	0	100	65	3.3	43.1	61.5
11	266.5	L	58	56	52	16	41.9	3	29.7	3	50.0	2	66.7	3	41.8	7.1	24.3	39.3	64.7	7.1	33.8	23.2	19.9	16.1	12.2	41.1	60.4	0	100	54	1.6	46.8	42.1
12	267.2	L	103	98	97	17	49.2	2	10.4	4	66.7	2	66.7	3	41.8	1.0	89.2	58.2	98.7	1.0	90.5	6.1	80.2	28.6	31.0	54.1	82.9	0	100	102	9.4	43.1	62.8
13	268.5	R	37	32	31	13	20.2	2	10.5	4	66.7	0	0.0	0	0.0	0.0	100.0	31.3	50.3	3.1	71.1	12.5	57.7	3.1	0.0	62.5	97.4	0	100	36	0.0	41.0	44.1
14	273.3	R	52	47	47	12	13.1	2	10.8	1	16.7	2	66.7	2	23.7	0.0	100.0	51.1	86.0	0.0	100.0	14.9	49.2	12.8	7.5	57.4	88.6	0	100	52	1.4	37.7	51.1
15	278.8	R	154	54	54	15	35.0	3	30.2	4	66.7	0	0.0	1	33.3	0.0	100.0	46.8	78.2	0.0	100.0	6.5	79.0	32.3	36.4	53.2	81.4	0	100	58	2.4	41.0	47.7

R = Right Descending Bank
L = Left Descending Bank
w/o G & E = Individuals minus gizzard shad and emerald shiners
w/o GETHEX = Individuals minus gizzard shad, emerald shiners, tolerants, hybrids, and exotics
Centrarchid Species = black bass, sunfishes, crappie
Great River Species = fish expected to be predominant in great rivers
Intolerant Species = species with low pollution/disturbance tolerance
Tolerant Individuals = individuals with high pollution/disturbance tolerance
Simple Lithophils = fish that are sensitive to substrate disturbance based on reproductive needs
Detritivore = fish that feed primarily on detritus
Invertivore = fish that feed primarily on invertebrates
Piscivore = fish that feed primarily on other fish
DELT = individuals with Deformities, Eroded fins, Lesions, and/or Tumors
CPUE = Catch Per Unit Effort

4.4 Water Quality and Flow Conditions

Rain events were relatively common throughout the sampling period in 2008; therefore river levels and flows were variable. However, sampling was only conducted in R. C. Byrd pool when flows were near the harmonic mean flow (HMF). Flow conditions during sampling varied from 63% and 116% of the HMF (Figure 9).

Measurements of water quality parameters did not reveal any unusual or poor water conditions present at the time of fish sampling (Appendix D). Secchi depths at the time of sampling ranged from 24 to 48 inches.

The water quality parameters measured from water samples, collected three times with Kemmerers, did not reveal any parameters exceeding water quality criteria (Appendix E).

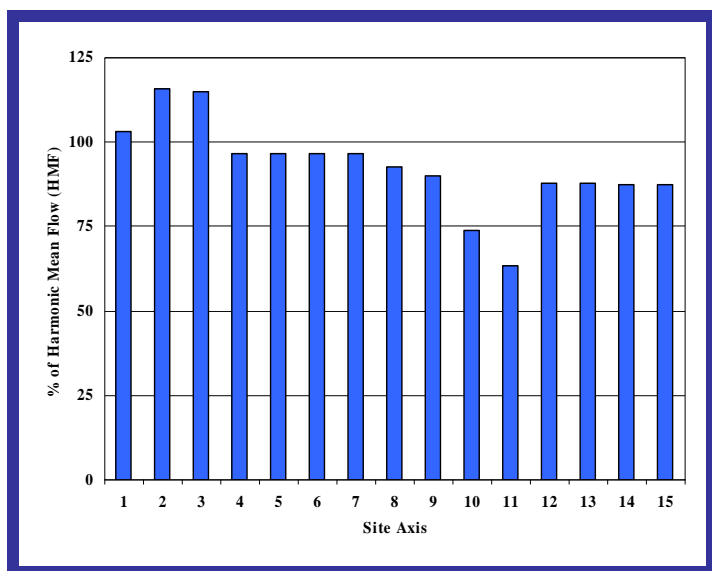


Figure 9. Relative flows (%HMF) at the time of sampling.

4.5 Assessment of Condition

MORFIn scores were calculated for each of the sites sampled. The maximum score achieved by any site in this pool out of a possible 100 was 62.8 and the minimum was 42.1. By comparing observed and expected MORFIn scores, ORSANCO determined if a site met its expectations (based on habitat class) or not (Table 3). One of the 15 sites (6.7%) assessed in 2008 scored less than the minimum expected scores and were assessed as in poor condition (Table 1; Figure 10). The remaining 14 sites

received a fair (33.3%), good (40%), or very good quality rating (20%; Figure 10).

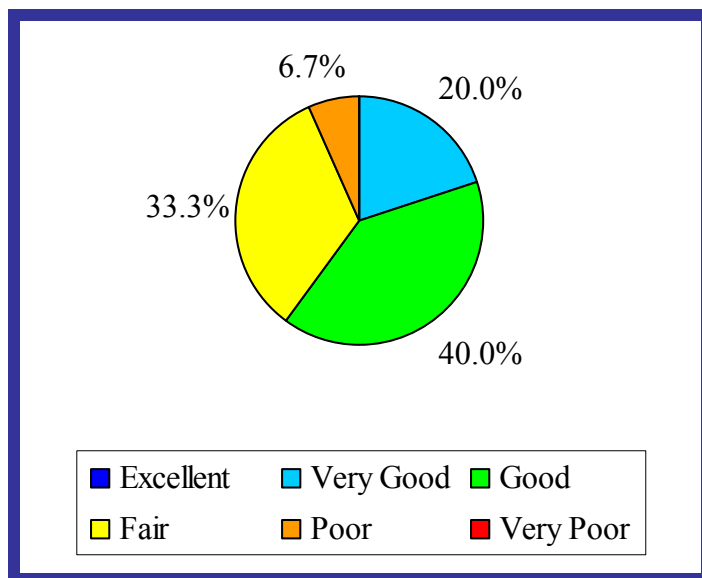


Figure 10. Condition of the R.C. Byrd pool based on MORFIn scores at 15 sites (Pass=Excellent-Fair, Fail=Poor-Very Poor).

5.0 Discussion

5.1 Fish Population

In 2008, the fish population of R.C. Byrd pool was in good condition. This was supported by the diversity and types of species collected from the pool. Multiple pollution intolerant species such as smallmouth redhorse (*Moxostoma breviceps*), river redhorse (*M. carinatum*), northern hogsucker (*Hypentelium nigricans*), mimic shiner (*Notropis volucellus*), smallmouth bass (*Micropterus dolomieu*), logperch (*Percina caprodes*), and mooneye (*Hiodon tergisus*) were collected from R.C. Byrd pool, suggesting that pollution may not be a problem in the area. Common carp (*Cyprinus carpio*) was the only non-native species collected during the survey.

The most abundant species in the survey were gizzard shad (*Dorosoma cepedianum*; 301 individuals), sauger (*Sander canadensis*; 259 ind.), freshwater drum (*Aplodinotus grunniens*; 83 ind.), temperate bass species (*Morone sp.*; 73 ind.), and logperch (*Percina caprodes*; 72 ind.).

5.2 Metric Performance

Most of the metric scores in R.C. Byrd pool were relatively high with the exception of four metrics: CPUE, % invertivores, # sucker species, and # of great river species. The longitudinal position of the pool on the river (i.e. upper third of the Ohio River) may be responsible for lower great river species scores. There was no known reason or explanation for the lower percentages of invertivorous or intolerant individuals. Gizzard shad was the dominant species collected (by abundance) and the CPUE metric does not include that species (or emerald shiners) in calculating the metric score. That is potentially the reason for the lower CPUE metric scores.

Four metrics stood out as the highest performing in R.C. Byrd pool; DELTs, the # of non-native individuals, % piscivores, and % tolerant individuals' metrics. DELT anomalies were only found at one site suggesting the majority of fishes in R.C. Byrd pool are not experiencing environmental stressors severe enough to decrease their health. Low proportions of pollution-tolerant individuals and non-native species were collected. These metrics indicate that R.C. Byrd pool is in good condition. Other metrics that performed well include: % simple lithophilic spawners, % detritivores, and # centrarchid species.

5.3 Habitat Surveys

The habitat assessments show that in R.C. Byrd pool there was a relatively balanced number of sites classified as class 'B', class 'C', and class 'D' habitats. This indicates that the majority of the benthic substrate is comprised of gravel, sand, and fines. The heterogeneous substrate compositions, supplemented with the presence of woody cover, provided adequate habitat to support the diverse populations of fishes in the pool.

5.4 Water Quality and Flow Conditions

The fluctuations in river levels are not likely to have affected the survey of R.C. Byrd pool.

Rain events were relatively frequent throughout the field season however sampling was conducted during stable flows. Secchi depths indicated sufficient visibility for sampling at all sites. There were no water quality measurements that exceeded their respective criteria or provided any major insight into the assessment results for R.C. Byrd pool.

5.5 Conclusions and Assessments of Condition

The overall average quality score in R.C. Byrd pool was 2.7, indicating the pool was in fair biological condition. Only one of the sites was assessed as being in poor condition and the assessment of R.C. Byrd pool met the criteria established by ORSANCO's Biological Water Quality Subcommittee (Appendix A). The data collected in 2008 indicated that R.C. Byrd pool met its aquatic life-use designation.

6.0 Interpool Comparisons

6.1 Purpose

As of 2008, 16 of 19 pools have been surveyed and assessed. This section was developed to compare R. C. Byrd pool to other previously surveyed pools in the Ohio River.

6.2 Land Cover

R. C. Byrd pool lies in the upper third of the Ohio River and therefore has a relatively small catchment area. Despite many industrial facilities immediately surrounding the pool, the primary land cover within the watershed is deciduous forest. Agricultural practices are secondary land uses but in lower proportions than pools in the lower third of the Ohio River (Figure 11).

6.3 Substrate Composition

This pool had a relatively equal percentage of gravel, sand, and fine substrates. The heterogeneous substrate composition is most similar to its closest downstream pool (Greenup). However, these percentages are quite different from the other pools assessed in the lower third of the river (Figure 12).

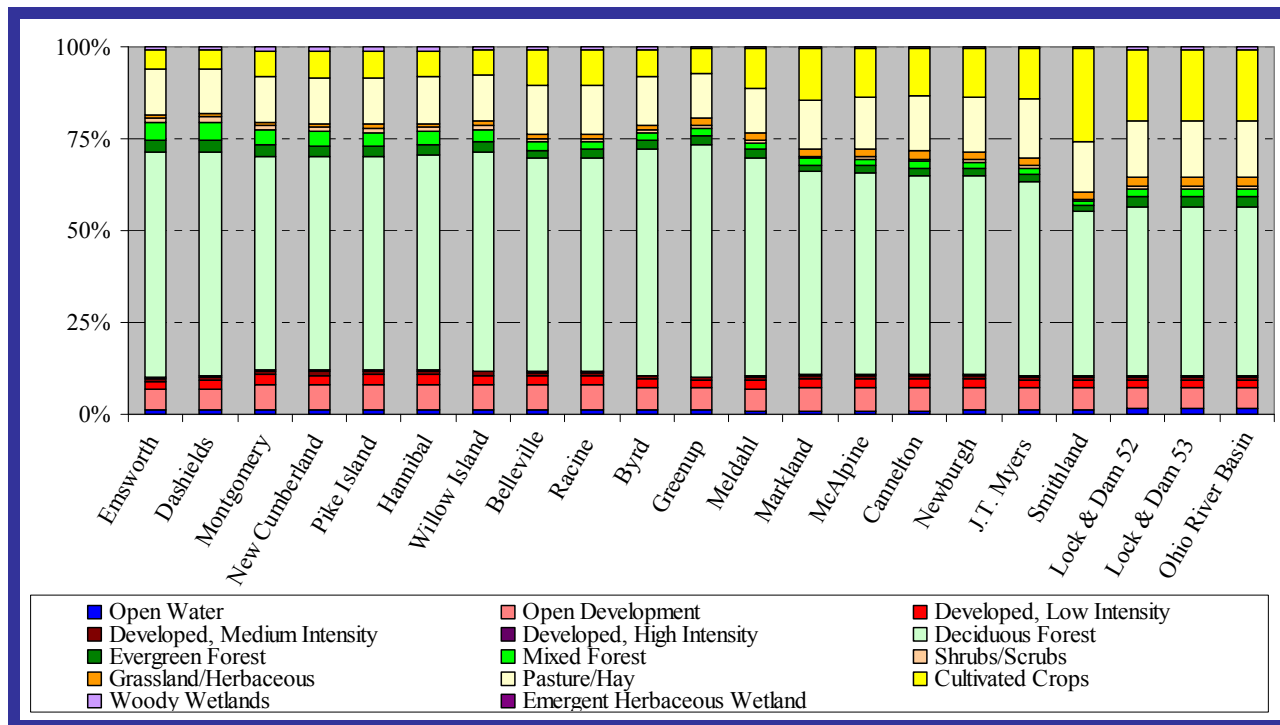


Figure 11. Cumulative land-cover within the catchment area of each pool of the Ohio River.

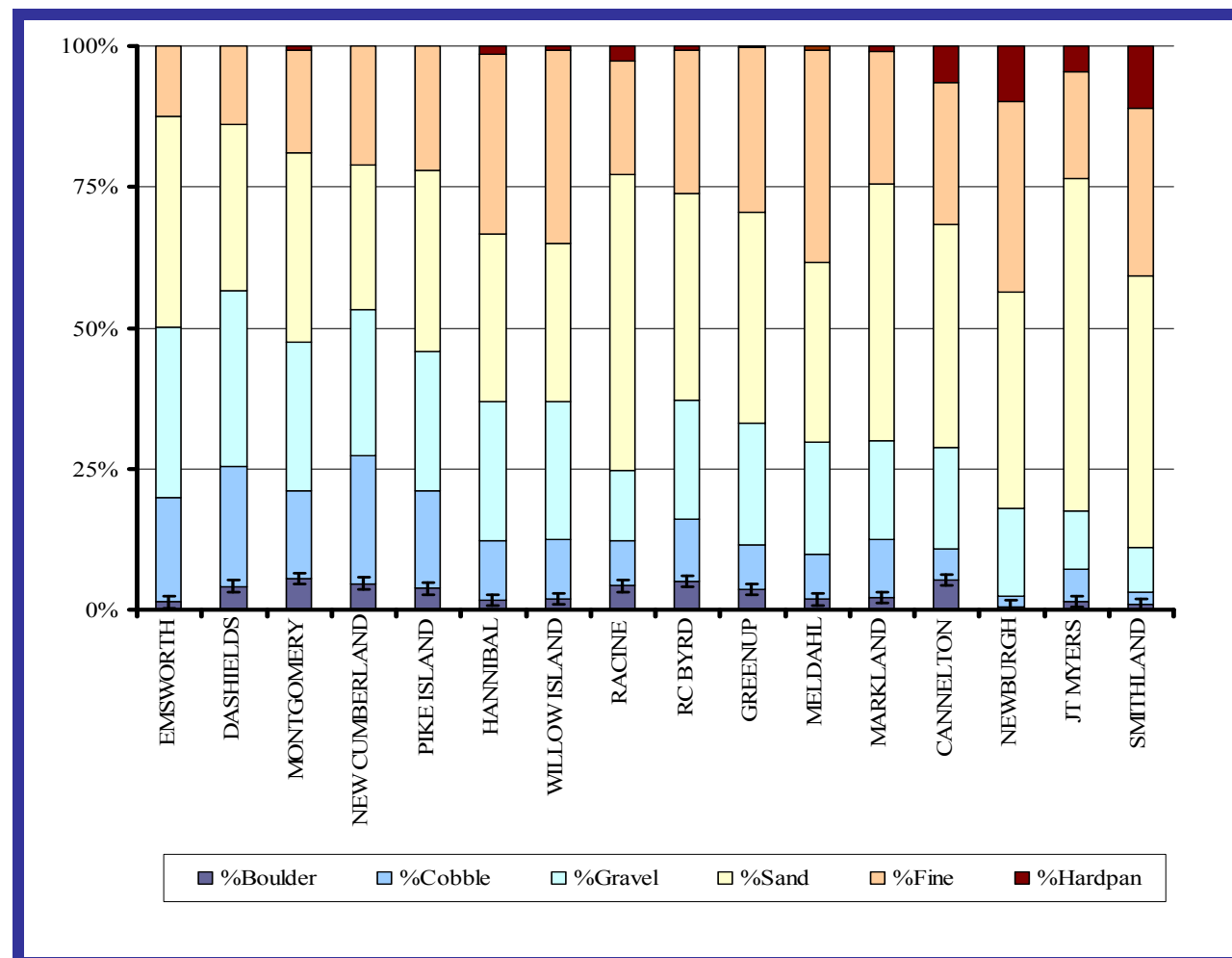


Figure 12. Substrate composition for each pool surveyed as of 2008.

6.4 Species Richness

R.C. Byrd pool had a decreased average number of native species per site (15.5) and ranked 4th worst in comparison (Figure 13).

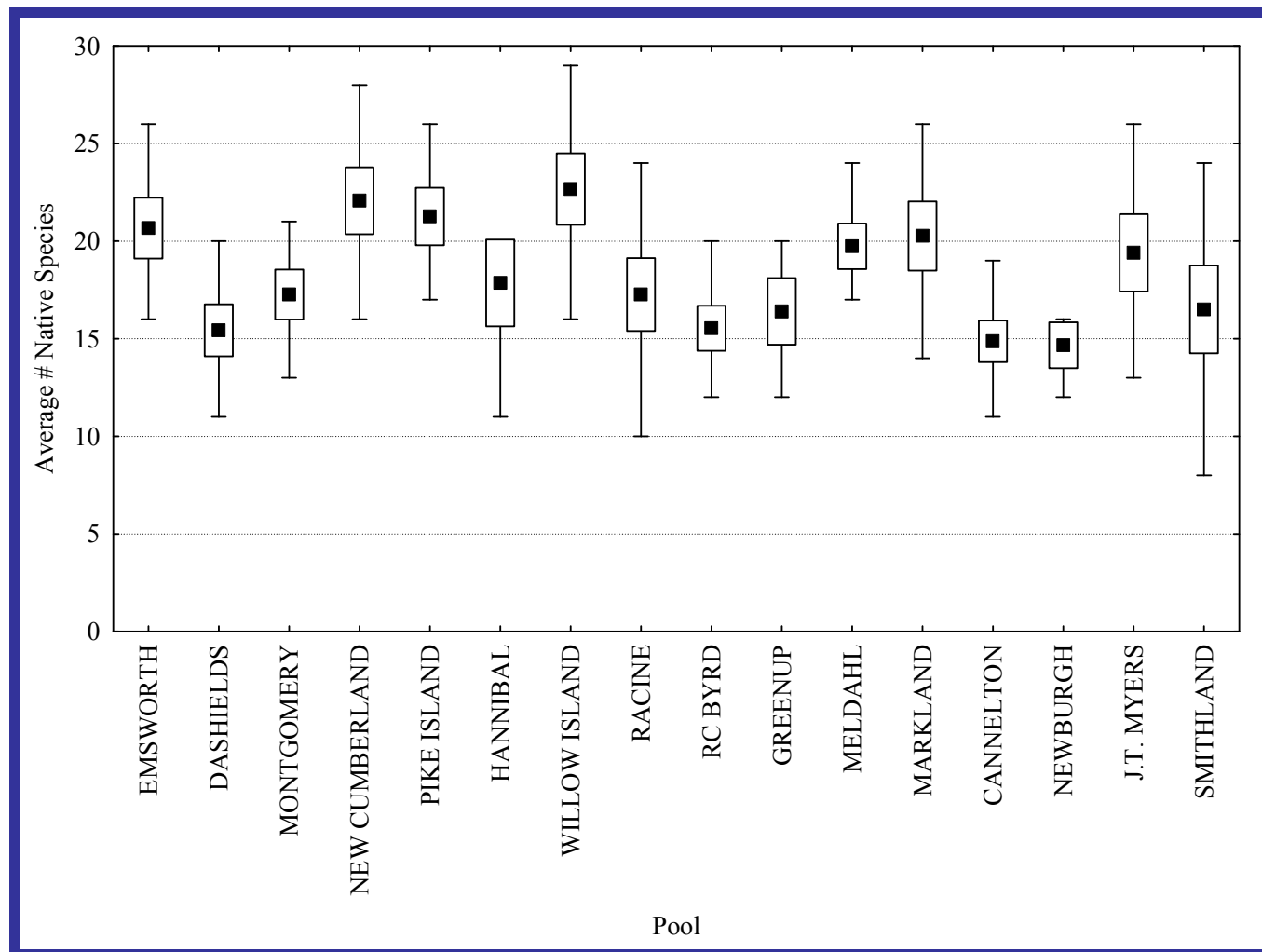


Figure 13. The average number of native species collected at each site within each pool surveyed as of 2008 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).

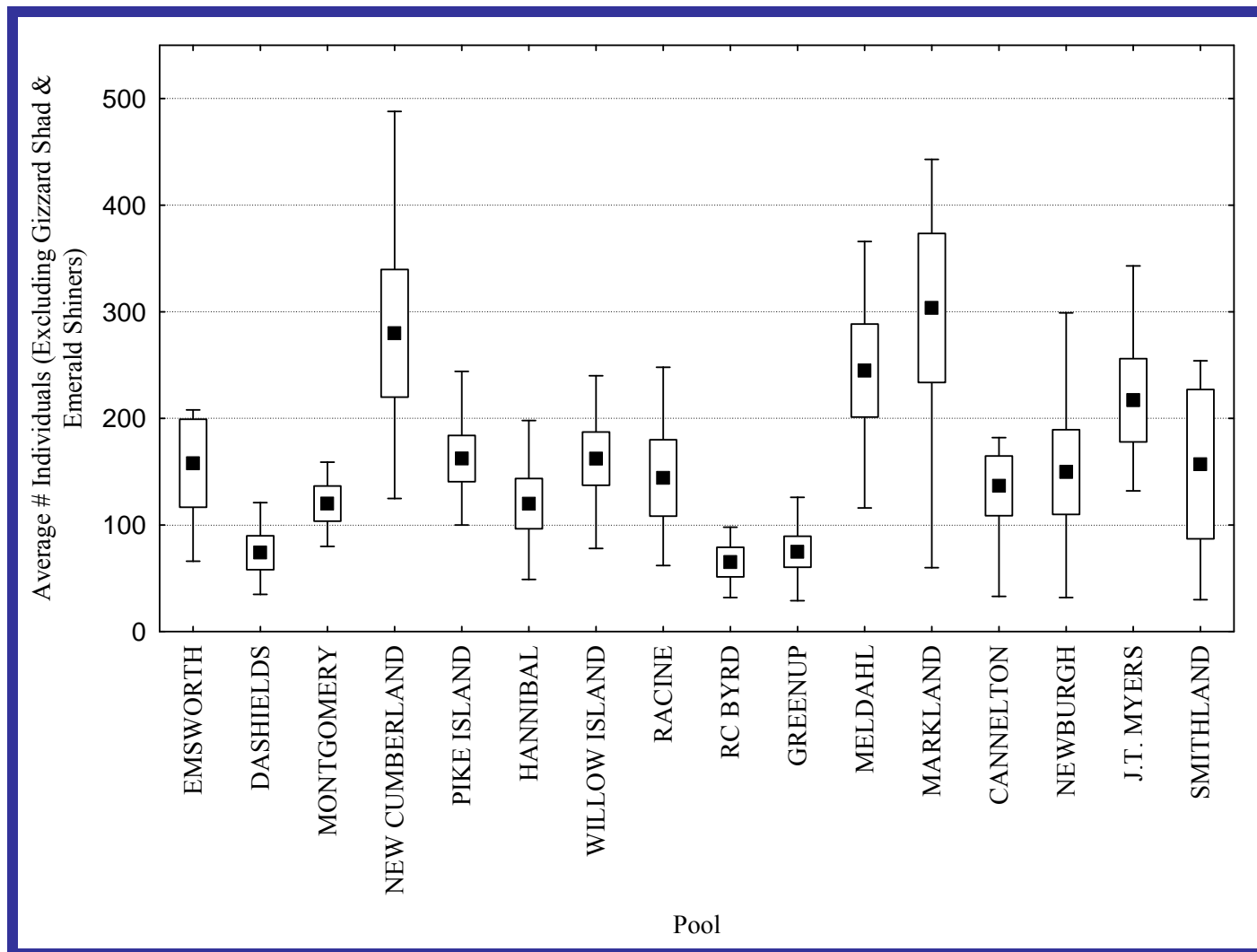


Figure 14. The average number of individuals (excluding gizzard shad & emerald shiner) collected at each site within each pool surveyed as of 2008 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).

6.5 Number of Individuals

An average of 65.3 individuals (excluding gizzard shad and emerald shiner) was collected at each site in R.C. Byrd pool which ranked lowest in comparison (Figure 14) out of all pools sampled as of 2008.

6.6 Noteworthy Fish Observations

None of the species collected in R.C. Byrd were unique to the pool (Table 4).

Benthic trawling occurred within R.C. Byrd pool from which several other darters were collected including: river darters (*Percina shumardi*), channel darters (*Percina copelandi*), slenderhead darters (*Percina phoxocephala*), dusky darters (*Percina sciera*), and johnny darters (*Etheostoma nigrum*). River darters and channel darters are listed in the state of Ohio as threatened.

6.7 MORFIn Deviation

The MORFIn deviation is a measure of how well the pool performed with regard to expected MORFIn values. Positive values indicate that

scores were greater than expected. R.C. Byrd pool had an average deviation of 10.7 and was the 4th lowest of the other pools surveyed as of 2008 (Figure 15).

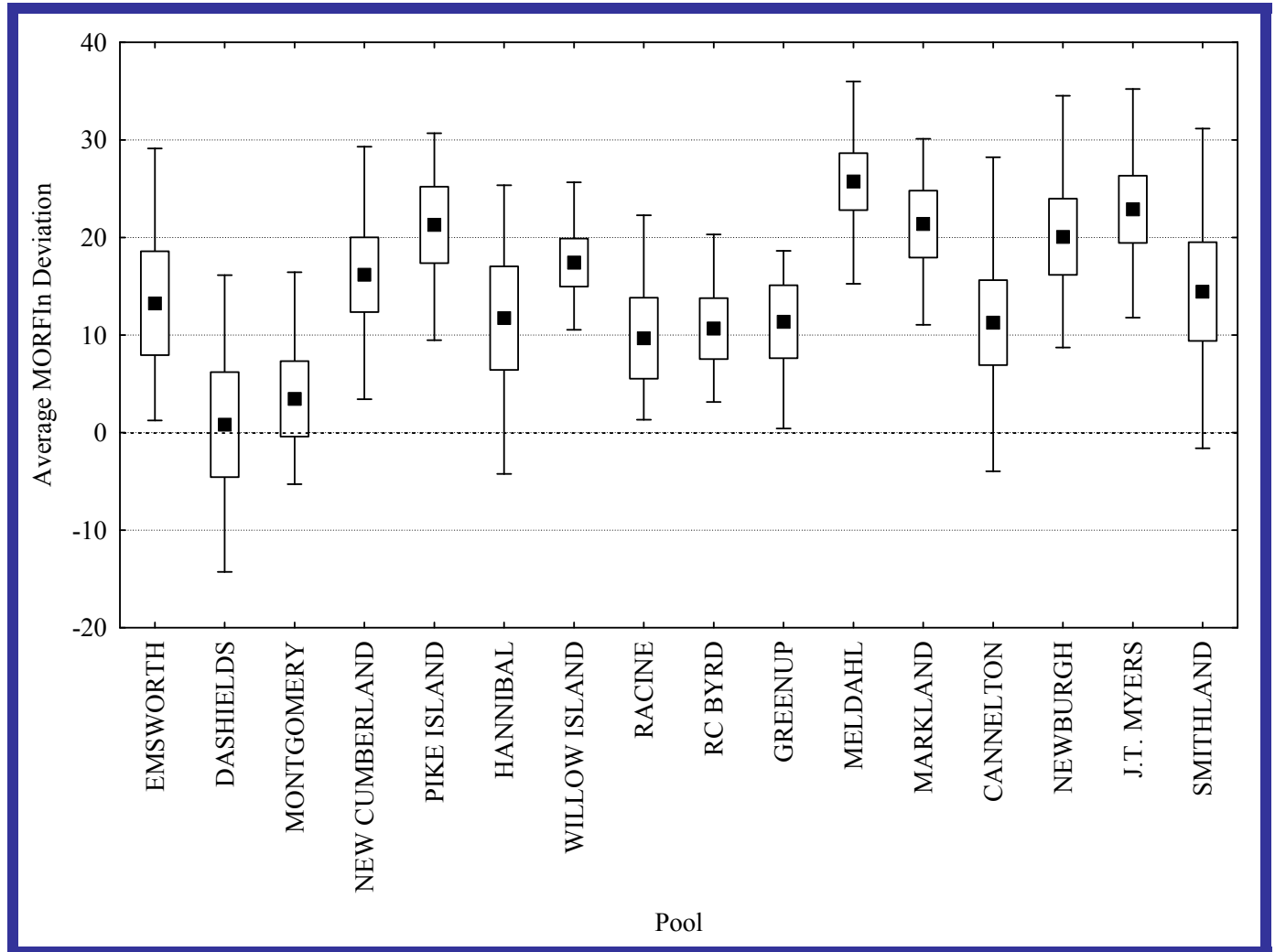


Figure 15. The average MORFIn deviation of each site within pools surveyed as of 2008 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).

6.8 Assessment of Condition

The average quality score in R. C. Byrd pool was 2.7 and it was assessed as being in fair condition. The nearest surveyed pool upstream

(Racine) and downstream (Greenup) of R.C. Byrd pool were also considered to be in fair condition (Figure 16).

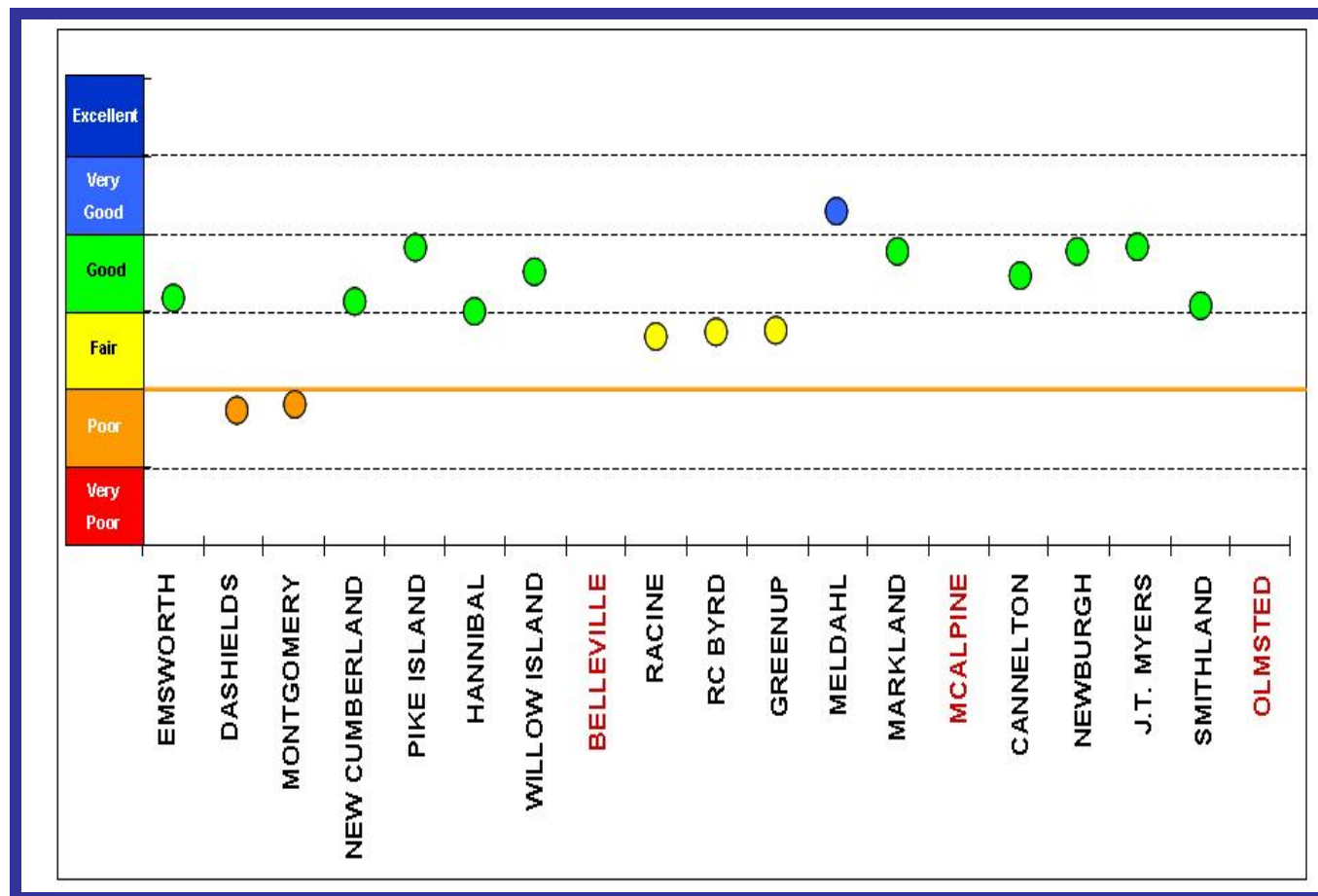


Figure 16. The average quality score for each pool surveyed as of 2008 (black text, red text = pools to be surveyed in 2009). Data points are color-coded to indicate the biological condition of a pool.

Table 4. A compiled species list containing the number of individuals collected per pool as of 2008.

#	Species	Emsworth 07	Dashields 08	Montgomery 06	New Cumberland 05	Pike Island 07	Hannibal 08	Willow Island 06	Racine 05	RC Byrd 08	Greenup 06	Meldahl 07	Markland 05	Cannelton (30) 06-07	Newburgh 07	Myers 05	Smithland 08
1	Silver Lamprey										1						1
2	Paddlefish														1		
3	Longnose Gar	13	11	10	11	43	49	46	24	27	23	22	15	48	20		16
4	Spotted Gar														1		1
5	Shortnose Gar														9	2	13
6	Skipjack Herring	8			3	6			1	2		64	145	174	70	249	1
7	Gizzard Shad	167	123	266	1202	7326	1461	216	8048	301	267	2408	1743	3527	600	444	409
8	Threadfin Shad													1	9	112	25
9	Goldeye														12		2
10	Mooneye	20	11	6	22	37	10		1	7		48	12	8	10	4	
11	Muskellunge	1															
12	Common Carp	63	36	44	25	15	15	22	9	12	9	8	20	5	4	10	17
13	Grass Carp				1										1		
14	Silver Carp														2		4
15	Bighead Carp														2		
16	Goldfish				1												
17	Golden Shiner	1			1												
18	Miss. Silvery Minnow															1	
19	Notropis Sp																1
20	Striped Shiner						2		2								
21	Spottail Shiner				6	2	1										
22	Spotfin Shiner			1	21	14		24	63	1	2	32	2	63	8	12	4
23	Emerald Shiner	82	5	8	342	197	21	728	795	16	50	637	303	1331	166	801	28
24	Mimic Shiner	35	1	13	76	162	16	306	402	1	61	7	5	195	6	43	
25	River Shiner	1										54	8	276	3	91	2
26	Silver Chub	26	26	12	20	11	19	57	44	11	33	90	171	130	126	206	46
27	River Chub				1	1											

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28	Central Stoneroller				4		3	1					1				
29	Bluntnose Minnow				2	2	4	120	3		1	1		2			1
30	Fathead Minnow								6								
31	Bullhead Minnow							4	5			23	2			8	2
32	Silverjaw Minnow						1										
33	Gravel Chub											1					
34	Creek Chub				1							3					
35	Carpiodes Sp		1			14			2			1		2			
36	Ictiobinae Sp				20												
37	Quillback	17	12	30	80	27	28	66	16	8	17	31	137	21	34	57	28
38	River Carpsucker	18	18	13	46	36	64	18	50	25	49	87	47	122	179	86	114
39	Highfin Carpsucker			37	3	10	13	1	7		4		2	1	12	3	24
40	Shorthead Redhorse																10
41	Smallmouth Redhorse	61	16	110	110	28	41	168	5	27	30	62	31	12	3	11	
42	Moxostoma Sp				58												
43	Silver Redhorse	221	93	157	63	78	105	51	11	11	12	25	19	3			1
44	River Redhorse	39	13	3	5	27	35	2		2	6	1	1		1		
45	Black Redhorse	18			11			4					1	1			
46	Golden Redhorse	7	33	227	90	66	204	277	11	33	39	120	105	4	14		3
47	Northern Hog Sucker	3	1	3	132	4	2	15		1			14	1	1		
48	Ictiobus Sp						19										
49	Smallmouth Buffalo	97	99	217	283	94	45	60	96	40	49	123	150	147	72	314	77
50	Bigmouth Buffalo								1						3	7	5
51	Black Buffalo	1	13			5	1	2			1		2	1	7	3	4
52	Spotted Sucker							1	1		5	1		1			7
53	Blue Catfish															1	7
54	Brown Bullhead										1						

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#	Species	Emsworth 07	Dashields 08	Montgomery 06	New Cumberland 05	Pike Island 07	Hannibal 08	Willow Island 06	Racine 05	RC Byrd 08	Greenup 06	Meldahl 07	Markland 05	Cannelton (30) 06-07	Newburgh 07	Myers 05	Smithland 08
55	Channel Catfish	32	17	34	123	40	62	61	70	53	58	89	247	48	11	330	291
56	Flathead Catfish	14	11	11	15	35	38	21	32	42	32	49	38	63	11	43	16
57	Trout-Perch								3								
58	Banded Killifish							1									
59	Inland Silverside																26
60	Brook Silverside								1				1	1	1	1	1
61	Morone Sp	27		6	568	419	91	17	561	73	2	152	250	625	403	253	190
62	Striped Bass						14	1						6		12	2
63	Hybrid Striper			4	17			1	46	1			40	6		11	2
64	White Perch	5			4		1	3					5				
65	White Bass	9	16	36	6	2	3	58	3	29	64	18	22	66	4	17	76
66	Yellow Bass																2
67	Rock Bass	16	9	8	5	1	2	3								1	
68	Lepomis Hybrid			1				9									
69	Lepomis Sp							16	1					1		1	
70	Green Sunfish	12	3	2	4	2	2	4	6	6	4	3	10	2	4	10	1
71	Warmouth							1				1	1			1	
72	Bluegill	379	32	216	53	46	36	232	58	52	112	207	245	103	11	31	64
73	Bluegill X Longear Sunfish																1
74	Bluegill X Green Sunfish					1								1			
75	Pumpkinseed			2			2	18									
76	Orangespotted Sunfish				1			2	1	1		1	1			2	
77	Longear Sunfish						9	23	3	9	14	35	53	39	3	11	92
78	Longear X Green Sunfish															1	
79	Redear Sunfish			4		1		1	1		1		2	16		1	20
80	Micropterus Sp																1
81	Smallmouth Bass	339	163	185	262	208	92	61	6	32	7	4	28	7	1	4	

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#	Species	Emsworth 07	Dashields 08	Montgomery 06	New Cumberland 05	Pike Island 07	Hannibal 08	Willow Island 06	Racine 05	RC Byrd 08	Greenup 06	Meldahl 07	Markland 05	Cannelton (30) 06-07	Newburgh 07	Myers 05	Smithland 08
82	Largemouth Bass	4	2	8	8	16		16	22	25	65	16	56	37	2	70	21
83	Spotted Bass	125	34	15	79	74	38	62	22	30	43	90	123	53	49	104	31
84	White Crappie	5	1							1	4		1	1	1		
85	Black Crappie	3	1	6	2	2			3	1			2	3			
86	Johnny Darter	1						2									
87	Greenside Darter	5		2	11	5							1				
88	Rainbow Darter			4	1			2					8			12	
89	Fantail Darter	3		1								1					
90	Banded Darter			1	4								1			1	
91	Yellow Perch			4	2		3										
92	Logperch	141	166	67	244	85	105	108	6	72	12	20	60	39	4	3	1
93	Dusky Darter															3	1
94	Channel Darter	16		1	9		1	3			20					1	
95	Slenderhead Darter												5			5	
96	River Darter					2		1	2		1	6	4	11		4	
97	Walleye	44	7	11	31	70	11	1	4	1	1	3	1		7		
98	Saugeye	2	8		5	4	1		4	1			17			7	2
99	Sauger	283	192	243	180	244	317	341	173	259	220	1174	664	1314	747	484	105
100	Freshwater Drum	254	58	47	1468	496	211	120	375	83	121	1000	1778	435	378	612	837
	Total # of Taxa	43	33	42	53	43	43	51	46	36	38	41	51	46	44	50	50
	Total # of Individuals	2618	1232	2076	5742	9958	3198	3378	11006	1296	1441	6718	6600	8953	3013	4501	2636

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Appendix A

Assessment Unit Criteria Details

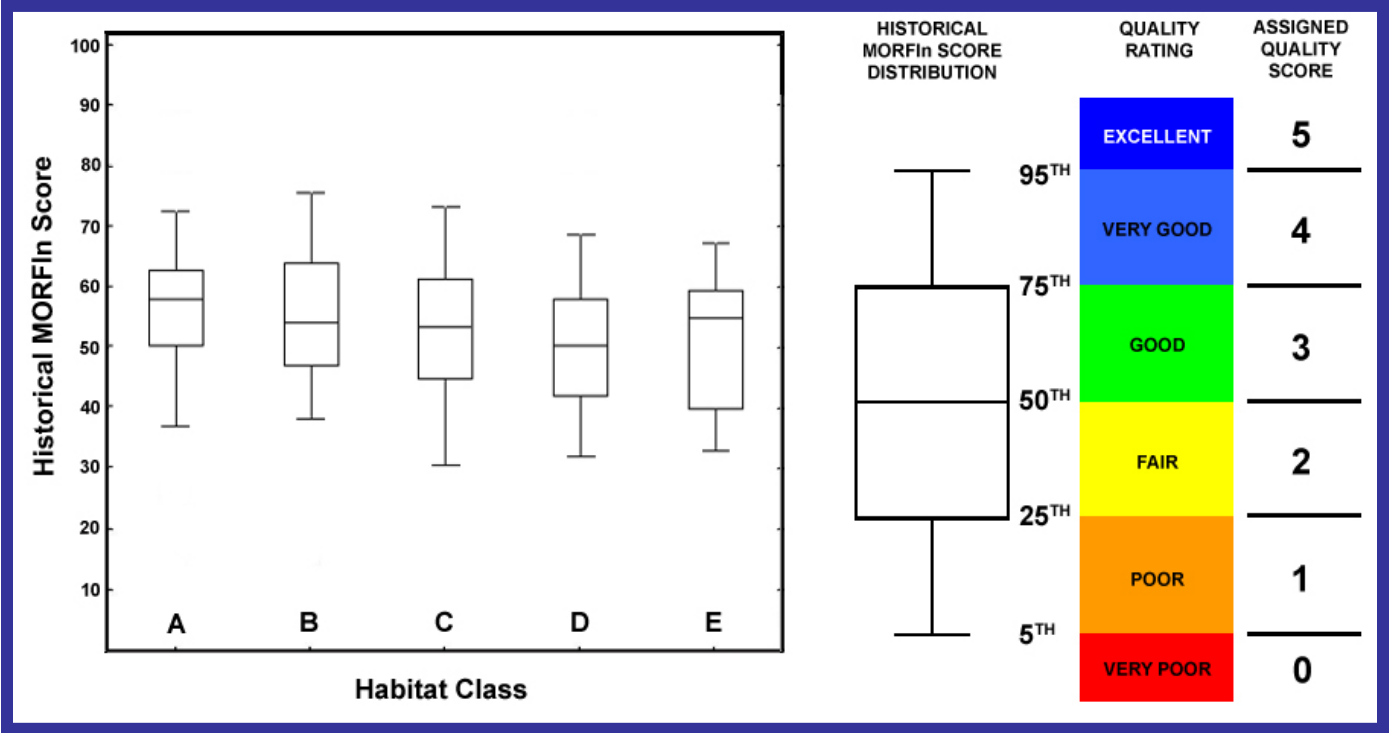
- Each individual navigational pool will serve as a separate and distinct Assessment Unit (AU), with the exception of the area below Smithland dam will also be considered one distinct AU.
 - This is based on the observation that biologically, each pool more closely resembles a lake, and not a free-flowing river. Therefore, biological condition becomes more homogeneous throughout, exhibiting little longitudinal change.
 - The dams are seen as the only real barriers that isolate individual populations. This observation is supported by research at the University of Louisville indicating little or no synchrony between pools. Each pool behaves independent of even its nearest neighbor, indicating isolated and independent populations among pools.
 - Isolated pockets, or areas, with poorly performing biotic communities have not been observed over the last ten years of sampling.
 - The BWQSC believes that a subset of randomly selected sites within each pool can accurately describe the condition of the target population (the fish population of that pool).
- All AUs will be sampled and assessed on a 5-year rotating basis. This is consistent with state schedules, and it will allow ORSANCO (after one full rotation) in each 305(b) report, to incorporate 5 years worth of data and report on 100% of the resource.
 - It is acceptable to EPA to include the most recent 5 years of data in each 305(b) report.

	Ernsworth	Deshields	Montgomery	New Cumberland	Pike Island	Hannibal	Willow Island	Belleville	Racine	R. C. Byrd	Greenup	Meldahl	Markland	McAlpine	Cannelton	Newburgh	Uniontown	Smithland	Olmsted	Sites
2005				15				15				15			11	15				60
2006			15						15						19					56
2007	15				15						15									79
2008		15				15			15				15				15			60
2009							15					15	15					15		60
SUM	15	15	15	15	15	15	15	15	15	15	15	30	15	30	15	15	15	15	15	315

- Assessment Units that yield an average quality score that is less than 2.0 will be listed as failing to meet (support) its aquatic life-use designation. The process of conducting a bioassessment and determining an AU's biological condition is outlined below:
 - Individual sites were assigned to a habitat class ('A', 'B', 'C', 'D' and 'E') based on its substrate composition. Each of these 5 habitat classes exhibits a different range of historical MORFIN scores and expectations. Therefore, the expected MORFIN score changes for each of the habitat classes. For example, if a site is characterized as habitat class 'A', then the MORFIN expectation is 50.03 whereas a habitat class 'E' site is 39.59. These MORFIN expectations for each habitat are the 25th percentiles of historical MORFIN scores for each habitat.
 - A quality score (between 0 and 5) was assigned to a site based on its score relative to the statistical distribution of historical MORFIN scores. Each quality score corresponds to the ranges between

the 5th, 25th, 50th, 75th, or 95th percentiles of historical MORFIn scores. For example, the range less than the 25th percentile receives a quality score <2.0 (see figure below).

- Those sites with MORFIn scores less than the 25th percentile are considered to be in poor or very poor condition and fail to meet its expected MORFIn score. The quality scores for individual sites are averaged within an AU (pool) to determine the AU's biological condition.



Appendix B. Fish survey data from the R.C. Byrd pool.

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
1	238.1	RDB	14-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
1	238.1	RDB	14-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	18
1	238.1	RDB	14-Jul-08	River Carpsucker	<i>Carpiodes carpio</i>	8
1	238.1	RDB	14-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	3
1	238.1	RDB	14-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
1	238.1	RDB	14-Jul-08	River Redhorse	<i>Moxostoma carinatum</i>	2
1	238.1	RDB	14-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	6
1	238.1	RDB	14-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	6
1	238.1	RDB	14-Jul-08	Hybrid Striper	<i>Morone saxatilis x M. chrysops</i>	1
1	238.1	RDB	14-Jul-08	White Bass	<i>Morone chrysops</i>	16
1	238.1	RDB	14-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	3
1	238.1	RDB	14-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	4
1	238.1	RDB	14-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
1	238.1	RDB	14-Jul-08	White Crappie	<i>Pomoxis annularis</i>	1
1	238.1	RDB	14-Jul-08	Sauger	<i>Sander canadensis</i>	27
2	242.7	RDB	15-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
2	242.7	RDB	15-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	11
2	242.7	RDB	15-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	2
2	242.7	RDB	15-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
2	242.7	RDB	15-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	1
2	242.7	RDB	15-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	3
2	242.7	RDB	15-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
2	242.7	RDB	15-Jul-08	Morone Sp	<i>Morone sp</i>	1
2	242.7	RDB	15-Jul-08	White Bass	<i>Morone chrysops</i>	6
2	242.7	RDB	15-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	5
2	242.7	RDB	15-Jul-08	Longear Sunfish	<i>Lepomis megalotis</i>	1
2	242.7	RDB	15-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	3
2	242.7	RDB	15-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
2	242.7	RDB	15-Jul-08	Logperch	<i>Percina caprodes</i>	1
2	242.7	RDB	15-Jul-08	Sauger	<i>Sander canadensis</i>	40
2	242.7	RDB	15-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	2
3	247.1	RDB	15-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
3	247.1	RDB	15-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	112
3	247.1	RDB	15-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	3
3	247.1	RDB	15-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	1
3	247.1	RDB	15-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	4
3	247.1	RDB	15-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
3	247.1	RDB	15-Jul-08	Morone Sp	<i>Morone sp</i>	1
3	247.1	RDB	15-Jul-08	White Bass	<i>Morone chrysops</i>	1
3	247.1	RDB	15-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	4
3	247.1	RDB	15-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	1
3	247.1	RDB	15-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
3	247.1	RDB	15-Jul-08	Logperch	<i>Percina caprodes</i>	2
3	247.1	RDB	15-Jul-08	Walleye	<i>Sander vitreus</i>	1
3	247.1	RDB	15-Jul-08	Sauger	<i>Sander canadensis</i>	9

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
3	247.1	RDB	15-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
4	251.7	LDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
4	251.7	LDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	23
4	251.7	LDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	2
4	251.7	LDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
4	251.7	LDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
4	251.7	LDB	06-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	1
4	251.7	LDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
4	251.7	LDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	1
4	251.7	LDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
4	251.7	LDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	16
4	251.7	LDB	06-Aug-08	Longear Sunfish	<i>Lepomis megalotis</i>	1
4	251.7	LDB	06-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	3
4	251.7	LDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
4	251.7	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	16
4	251.7	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	2
5	252.0	RDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	4
5	252.0	RDB	06-Aug-08	Skipjack Herring	<i>Alosa chrysochloris</i>	2
5	252.0	RDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	14
5	252.0	RDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
5	252.0	RDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	1
5	252.0	RDB	06-Aug-08	River Carpsucker	<i>Carpiodes carpio</i>	2
5	252.0	RDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	3
5	252.0	RDB	06-Aug-08	Northern Hog Sucker	<i>Hypentelium nigricans</i>	1
5	252.0	RDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	2
5	252.0	RDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	12
5	252.0	RDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	4
5	252.0	RDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	3
5	252.0	RDB	06-Aug-08	White Bass	<i>Morone chrysops</i>	4
5	252.0	RDB	06-Aug-08	Green Sunfish	<i>Lepomis cyanellus</i>	1
5	252.0	RDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	10
5	252.0	RDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	2
5	252.0	RDB	06-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	4
5	252.0	RDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	6
5	252.0	RDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	7
5	252.0	RDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	6
6	252.3	LDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
6	252.3	LDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	27
6	252.3	LDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
6	252.3	LDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	1
6	252.3	LDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
6	252.3	LDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	1
6	252.3	LDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
6	252.3	LDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	2
6	252.3	LDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	8
6	252.3	LDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	1

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
6	252.3	LDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
6	252.3	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	12
6	252.3	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	5
7	253.1	LDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
7	253.1	LDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	22
7	253.1	LDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	2
7	253.1	LDB	06-Aug-08	Emerald Shiner	<i>Notropis atherinoides</i>	10
7	253.1	LDB	06-Aug-08	Mimic Shiner	<i>Notropis volucellus</i>	1
7	253.1	LDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
7	253.1	LDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	2
7	253.1	LDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	6
7	253.1	LDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	4
7	253.1	LDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
7	253.1	LDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	4
7	253.1	LDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	16
7	253.1	LDB	06-Aug-08	Green Sunfish	<i>Lepomis cyanellus</i>	4
7	253.1	LDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	2
7	253.1	LDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	1
7	253.1	LDB	06-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	3
7	253.1	LDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	2
7	253.1	LDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	1
7	253.1	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	8
7	253.1	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	6
8	256.6	LDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
8	256.6	LDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	55
8	256.6	LDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
8	256.6	LDB	06-Aug-08	Quillback	<i>Carpionodes cyprinus</i>	1
8	256.6	LDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	4
8	256.6	LDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	9
8	256.6	LDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	4
8	256.6	LDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
8	256.6	LDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	13
8	256.6	LDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	2
8	256.6	LDB	06-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
8	256.6	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	10
8	256.6	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	17
9	261.5	RDB	06-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	3
9	261.5	RDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	1
9	261.5	RDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	3
9	261.5	RDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	12
9	261.5	RDB	06-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	1
9	261.5	RDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	11
9	261.5	RDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	2
9	261.5	RDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	6
9	261.5	RDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	4
9	261.5	RDB	06-Aug-08	Morone Sp	<i>Morone sp</i>	5

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
9	261.5	RDB	06-Aug-08	White Bass	<i>Morone chrysops</i>	2
9	261.5	RDB	06-Aug-08	Green Sunfish	<i>Lepomis cyanellus</i>	1
9	261.5	RDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	20
9	261.5	RDB	06-Aug-08	Orangespotted Sunfish	<i>Lepomis humilis</i>	1
9	261.5	RDB	06-Aug-08	Longear Sunfish	<i>Lepomis megalotis</i>	1
9	261.5	RDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	6
9	261.5	RDB	06-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	6
9	261.5	RDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	7
9	261.5	RDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	18
9	261.5	RDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	27
9	261.5	RDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	18
10	264.7	LDB	29-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	3
10	264.7	LDB	29-Jul-08	Emerald Shiner	<i>Notropis atherinoides</i>	3
10	264.7	LDB	29-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	2
10	264.7	LDB	29-Jul-08	Quillback	<i>Carpionodes cyprinus</i>	1
10	264.7	LDB	29-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
10	264.7	LDB	29-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
10	264.7	LDB	29-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3
10	264.7	LDB	29-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
10	264.7	LDB	29-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	6
10	264.7	LDB	29-Jul-08	Morone Sp	<i>Morone sp</i>	2
10	264.7	LDB	29-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	2
10	264.7	LDB	29-Jul-08	Longear Sunfish	<i>Lepomis megalotis</i>	1
10	264.7	LDB	29-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	1
10	264.7	LDB	29-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	9
10	264.7	LDB	29-Jul-08	Logperch	<i>Percina caprodes</i>	10
10	264.7	LDB	29-Jul-08	Sauger	<i>Sander canadensis</i>	12
10	264.7	LDB	29-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	3
11	266.5	LDB	29-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
11	266.5	LDB	29-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	1
11	266.5	LDB	29-Jul-08	Mooneye	<i>Hiodon tergisus</i>	1
11	266.5	LDB	29-Jul-08	Common Carp	<i>Cyprinus carpio</i>	4
11	266.5	LDB	29-Jul-08	Emerald Shiner	<i>Notropis atherinoides</i>	1
11	266.5	LDB	29-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	3
11	266.5	LDB	29-Jul-08	Quillback	<i>Carpionodes cyprinus</i>	1
11	266.5	LDB	29-Jul-08	River Carpsucker	<i>Carpionodes carpio</i>	1
11	266.5	LDB	29-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	7
11	266.5	LDB	29-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
11	266.5	LDB	29-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	2
11	266.5	LDB	29-Jul-08	Longear Sunfish	<i>Lepomis megalotis</i>	1
11	266.5	LDB	29-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	4
11	266.5	LDB	29-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	2
11	266.5	LDB	29-Jul-08	Logperch	<i>Percina caprodes</i>	5
11	266.5	LDB	29-Jul-08	Sauger	<i>Sander canadensis</i>	13
11	266.5	LDB	29-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	8
12	267.2	LDB	28-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	2

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
12	267.2	LDB	28-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	5
12	267.2	LDB	28-Jul-08	Mooneye	<i>Hiodon tergisus</i>	1
12	267.2	LDB	28-Jul-08	Common Carp	<i>Cyprinus carpio</i>	1
12	267.2	LDB	28-Jul-08	Spotfin Shiner	<i>Cyprinella spiloptera</i>	1
12	267.2	LDB	28-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	2
12	267.2	LDB	28-Jul-08	River Carpsucker	<i>Carpiodes carpio</i>	4
12	267.2	LDB	28-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	1
12	267.2	LDB	28-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
12	267.2	LDB	28-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	5
12	267.2	LDB	28-Jul-08	Morone Sp	<i>Morone sp</i>	5
12	267.2	LDB	28-Jul-08	Longear Sunfish	<i>Lepomis megalotis</i>	2
12	267.2	LDB	28-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	7
12	267.2	LDB	28-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
12	267.2	LDB	28-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	3
12	267.2	LDB	28-Jul-08	Logperch	<i>Percina caprodes</i>	24
12	267.2	LDB	28-Jul-08	Sauger	<i>Sander canadensis</i>	30
12	267.2	LDB	28-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	8
13	268.5	RDB	28-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	3
13	268.5	RDB	28-Jul-08	Emerald Shiner	<i>Notropis atherinoides</i>	2
13	268.5	RDB	28-Jul-08	Quillback	<i>Carpiodes cyprinus</i>	2
13	268.5	RDB	28-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	2
13	268.5	RDB	28-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
13	268.5	RDB	28-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	4
13	268.5	RDB	28-Jul-08	Morone Sp	<i>Morone sp</i>	1
13	268.5	RDB	28-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	1
13	268.5	RDB	28-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	2
13	268.5	RDB	28-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	3
13	268.5	RDB	28-Jul-08	Black Crappie	<i>Pomoxis nigromaculatus</i>	1
13	268.5	RDB	28-Jul-08	Saugeye	<i>Sander canadensis</i> x <i>S. vitreus</i>	1
13	268.5	RDB	28-Jul-08	Sauger	<i>Sander canadensis</i>	9
13	268.5	RDB	28-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	4
14	273.3	RDB	28-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
14	273.3	RDB	28-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	5
14	273.3	RDB	28-Jul-08	Mooneye	<i>Hiodon tergisus</i>	1
14	273.3	RDB	28-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
14	273.3	RDB	28-Jul-08	River Carpsucker	<i>Carpiodes carpio</i>	3
14	273.3	RDB	28-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	4
14	273.3	RDB	28-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	5
14	273.3	RDB	28-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	7
14	273.3	RDB	28-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	2
14	273.3	RDB	28-Jul-08	Logperch	<i>Percina caprodes</i>	3
14	273.3	RDB	28-Jul-08	Sauger	<i>Sander canadensis</i>	19
14	273.3	RDB	28-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
15	275.8	LDB	28-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
15	275.8	LDB	28-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	4
15	275.8	LDB	28-Jul-08	Quillback	<i>Carpiodes cyprinus</i>	3

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
15	275.8	LDB	28-Jul-08	River Carpsucker	<i>Carpiodes carpio</i>	7
15	275.8	LDB	28-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	2
15	275.8	LDB	28-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	4
15	275.8	LDB	28-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	2
15	275.8	LDB	28-Jul-08	Morone Sp	<i>Morone sp</i>	2
15	275.8	LDB	28-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	3
15	275.8	LDB	28-Jul-08	Longear Sunfish	<i>Lepomis megalotis</i>	2
15	275.8	LDB	28-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	3
15	275.8	LDB	28-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
15	275.8	LDB	28-Jul-08	Logperch	<i>Percina caprodes</i>	2
15	275.8	LDB	28-Jul-08	Sauger	<i>Sander canadensis</i>	20
15	275.8	LDB	28-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	2

Appendix C. Habitat survey data from the R. C. Byrd pool.

Site #	River Mile	Bank	% Boulder	% Cobble	% Gravel	% Sand	% Fine	% Hardpan	% Other	Depth	% Submerged Vegetation	% Woody Cover	% Overhanging Vegetation	Land Use	Human Influence	Bank Profile
1	238.1	RDB	13.0	25.0	28.7	28.7	4.6	0.0	0.0	12.0	1.0	0.2	12.5	NF	none	sloped
2	242.7	RDB	4.9	9.7	35.9	8.7	34.0	6.8	0.0	7.4	12.2	4.2	8.8	NF	none	steep
3	247.1	RDB	13.1	14.3	22.6	22.6	27.4	0.0	0.0	13.7	3.0	2.2	11.0	NF	none	sloped
4	251.7	LDB	3.2	6.4	9.6	63.8	16.0	1.1	0.0	10.3	8.8	0.5	8.3	NF,R	boat dock	sloped
5	252.0	RDB	4.0	18.7	26.7	20.0	30.7	0.0	0.0	13.6	15.9	0.7	3.0	NF,R	none	sloped
6	252.3	LDB	0.0	9.6	17.0	42.6	30.9	0.0	0.0	13.6	5.1	1.1	7.7	NF	mooring cells	sloped
7	253.1	LDB	1.2	0.0	2.4	36.6	59.8	0.0	0.0	11.7	10.2	0.6	8.3	NF	none	gradual
8	256.6	LDB	0.0	1.4	50.7	34.2	13.7	0.0	0.0	11.8	3.2	1.0	4.4	NF,A	none	sloped
9	261.5	RDB	31.1	23.0	29.7	5.4	8.1	1.4	1.4	13.0	5.5	1.3	5.0	NF,A	none	steep
10	264.7	LDB	1.3	19.0	22.8	39.2	17.7	0.0	0.0	13.7	17.2	2.6	10.0	NF,R	none	sloped
11	266.5	LDB	1.6	14.8	24.6	30.3	28.7	0.0	0.0	9.5	4.6	3.6	11.3	NF,A,I	mooring cells, wall	sloped
12	267.2	LDB	0.8	6.6	32.2	40.5	19.8	0.0	0.0	7.6	4.0	1.4	15.0	NF	none	sloped
13	268.5	RDB	0.0	2.4	0.0	31.0	64.3	1.2	1.2	9.0	3.0	1.0	13.3	A,R	none	gradual
14	273.3	RDB	1.8	10.7	3.6	69.6	10.7	0.0	3.6	14.6	0.0	2.4	56.0	A,NF	none	steep
15	275.8	LDB	0.0	2.8	8.3	73.6	15.3	0.0	0.0	9.4	3.2	2.4	32.0	NF,A	none	sloped

Appendix D. Water quality parameters measured prior to fish sampling in R. C. Byrd pool.

Site #	River Mile	Bank	pH	Temp (C)	Dissolved Oxygen (mg/L)	Conductivity	Secchi (in)
1	238.1	RDB	6.46	25.02	9.00	409	24
2	242.7	RDB	7.69	25.09	8.04	399	24
3	247.1	RDB	8.18	25.71	8.62	401	24
4	251.7	LDB	7.42	28.31	6.78	446	40
5	252.0	RDB	7.42	28.31	6.78	446	41
6	252.3	LDB	7.50	28.11	6.74	444	40
7	253.1	LDB	7.32	28.00	6.59	447	41
8	256.6	LDB	7.50	28.16	6.71	449	41
9	261.5	RDB	7.41	29.51	6.51	459	36
10	264.7	LDB	8.70	29.05	6.98	514	48
11	266.5	LDB	8.59	28.90	7.12	467	48
12	267.2	LDB	7.91	27.95	6.85	466	48
13	268.5	RDB	7.91	27.95	6.85	466	48
14	273.3	RDB	7.14	28.81	7.08	n/a	44
15	275.8	LDB	7.39	28.71	7.20	493	42

Appendix E. Water quality parameters analyzed from R.C. Byrd pool in 2008. Values in bold exceed water quality criteria for respective analyte.

Site #	River Mile	Round	Ammonia	Chloride	Hardness	Nitrate-Nitrite	Phenolics	Sulfate	TKN	TOC	Phosphorus	TSS
1	238.1	1	0.16	20	124	0.692	<5.0	76	0.675	7.98	0.065	31.00
		2	0.04	28	152	0.618	<5.0	84	0.624	3.84	0.018	7.00
		3	0.06	46	152	0.666	<5.0	116	0.399	3.46	0.020	3.83
2	242.7	1	0.06	22	132	0.716	<5.0	70	0.783	5.40	0.076	30.70
		2	0.04	34	132	0.615	<5.0	82	0.615	4.28	0.047	8.60
		3	0.07	46	144	0.614	<5.0	114	0.364	3.50	0.022	4.00
3	247.1	1	0.06	26	132	0.728	<5.0	66	0.736	5.75	0.090	31.30
		2	0.05	26	140	0.648	<5.0	82	0.571	3.86	0.072	7.80
		3	0.07	46	144	0.606	<5.0	126	0.352	3.67	0.036	4.33
4	251.7	1	0.05	22	132	0.701	<5.0	70	0.717	5.52	0.070	37.00
		2	0.04	30	136	0.639	<5.0	100	0.709	4.01	0.064	7.80
		3	0.04	48	168	0.597	<5.0	124	0.311	3.66	0.018	5.83
5	252.0	1	0.10	22	120	0.705	<5.0	68	0.723	5.39	0.079	26.30
		2	0.04	30	136	0.650	<5.0	84	0.624	4.38	0.032	8.20
		3	0.04	50	164	0.590	<5.0	122	0.416	3.92	0.022	5.67
6	252.3	1	0.10	22	132	0.685	<5.0	102	0.854	5.65	0.099	38.70
		2	0.04	34	140	0.609	<5.0	86	0.682	3.78	0.035	8.00
		3	<0.03	48	164	0.601	<5.0	116	0.378	3.58	0.018	6.00
7	253.1	1	0.07	24	136	0.721	<5.0	66	0.753	5.97	0.085	33.30
		2	0.04	30	136	0.610	<5.0	88	0.602	3.71	0.038	7.60
		3	<0.03	50	160	0.599	<5.0	126	0.363	3.72	0.032	5.50
8	256.6	1	0.08	20	128	0.713	<5.0	66	0.725	5.51	0.071	36.00
		2	0.04	30	132	0.631	<5.0	90	0.561	4.30	0.032	4.40
		3	<0.03	48	160	0.565	<5.0	112	0.314	3.70	0.020	7.00
9	261.5	1	0.06	20	132	0.811	<5.0	74	0.599	5.78	0.066	41.00
		2	0.04	30	136	0.640	<5.0	96	0.680	4.29	0.087	5.80
		3	<0.03	50	156	0.522	<5.0	122	0.336	3.92	0.018	9.33
10	264.7	1	0.15	14	108	0.460	<5.0	64	0.658	3.30	0.022	10.50
		2	0.04	30	144	0.652	<5.0	90	0.740	4.14	0.064	8.20
		3	<0.03	48	148	0.489	<5.0	130	0.436	4.60	0.029	12.80
11	266.5	1	0.10	18	128	0.687	<5.0	74	0.710	5.68	0.073	36.30
		2	0.03	32	132	0.452	<5.0	86	0.706	3.89	0.045	11.70
		3	0.04	42	148	0.455	<5.0	84	0.418	3.68	0.017	7.50
12	267.2	1	0.10	22	132	0.703	<5.0	72	0.687	4.94	0.075	35.00
		2	0.03	32	140	0.626	<5.0	86	0.556	3.96	0.056	7.82
		3	0.04	40	144	0.484	<5.0	116	0.388	3.79	0.022	6.67
13	268.5	1	0.10	30	136	0.763	<5.0	76	0.736	6.62	0.110	49.00
		2	0.05	30	172	0.633	<5.0	86	0.521	4.11	0.040	13.40
		3	0.04	48	140	0.470	<5.0	94	0.498	3.72	0.038	8.83
14	273.3	1	0.10	22	140	0.774	<5.0	70	0.610	6.44	0.064	28.30
		2	0.04	28	120	0.616	<5.0	82	0.582	4.80	0.017	10.80
		3	0.05	28	148	0.426	<5.0	110	0.409	3.67	0.020	6.50
15	275.8	1	0.16	26	132	0.734	<5.0	70	0.692	5.37	0.082	36.40
		2	0.04	30	132	0.626	<5.0	104	0.707	4.50	0.030	9.60
		3	0.05	38	136	0.494	<5.0	86	0.404	3.36	0.047	6.33