



A Biological Study of the Dashields 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.
- In 2008, fish population data from Dashiels pool yielded 31 species and 1 hybrid taxa, representing 10 different families. Five of these taxa were listed in PA as either endangered (silver chub), threatened (smallmouth buffalo and mooneye), or of special concern (river herring and longnose gar).
- At the species level, sauger was the most abundant individual species comprising 15.6% of the total catch.
- 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 MORFIn scores due to decreased sampling efficiency and changes in fish behavior.
- Flows were relatively variable in 2008 when sampling was conducted. Sampling occurred under 'normal' flow conditions as well as at slightly elevated flow conditions. Flows did not appear to affect electrofishing surveys.
- In 2008, 38% of the sites assessed in Dashiels pool had a quality scores <2.0 and the pool had an average quality score of only 1.7 (out of 5.0). This average score indicates the pool is in poor biological condition. Therefore the Dashiels pool will be reported to EPA as failing to meet its aquatic life-use designation.
- Recommendations include characterizing Dashiels pool as failing to support its aquatic life-use designation.
- As of 2008, 16 of the 19 pools (AUs) have been assessed which comprises 801.0 miles or 81.7% of the resource. Only two pools or 4.2% of the assessed resource has failed to meet its aquatic life-use designation.

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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. Byrd, and Smithland pools were sampled as part of ORSANCO's normal monitoring. This report presents the 2008 survey of the Dashields 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

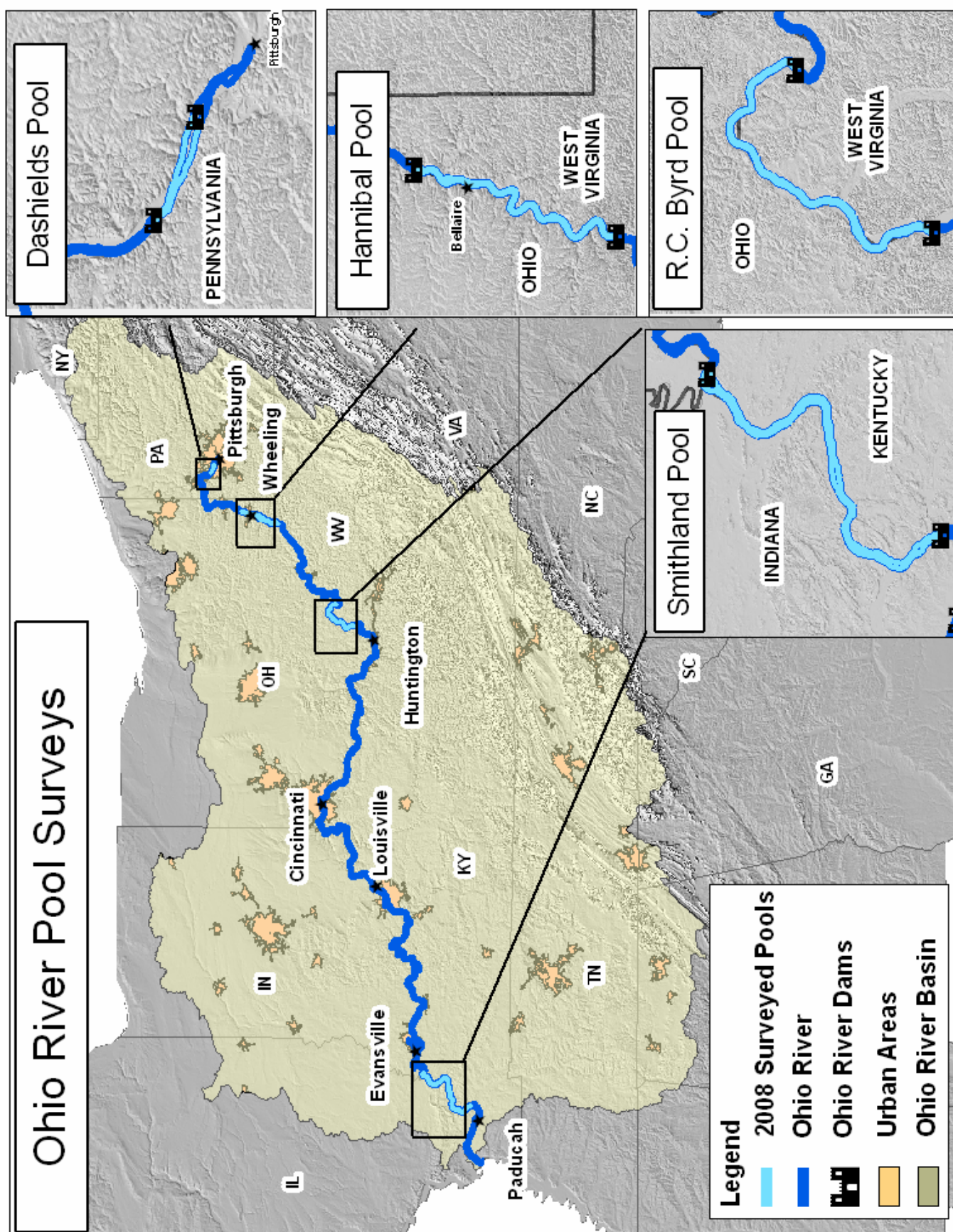


Figure 1. The Ohio River basin and the four pools selected for 2008 sampling.

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 Dashields Pool

The Dashields pool is 7.1 miles long, extending from Emsworth Locks and Dam (ORM 6.2) to Dashields Locks and Dam (ORM 13.3). The pool has a gradient drop of 0.7 feet per mile and averages 1,467 feet wide and 14 feet deep (ORSANCO 1994). The entirety of the pool lies in Pennsylvania.

2.3 Dashields Land Cover

This pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge

activity. These watersheds are primarily forested (60.7%), but also have a considerable amount of pasture lands (12.0%) and row crops (5.2%: Fig. 2).

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 Dashields pool of the Ohio River from mile marker 6.2 (Emsworth Locks and Dam) to 13.3 (Dashields Locks and Dam). The total linear extent of the target population was approximately 14.2 miles. The sample frame was generated

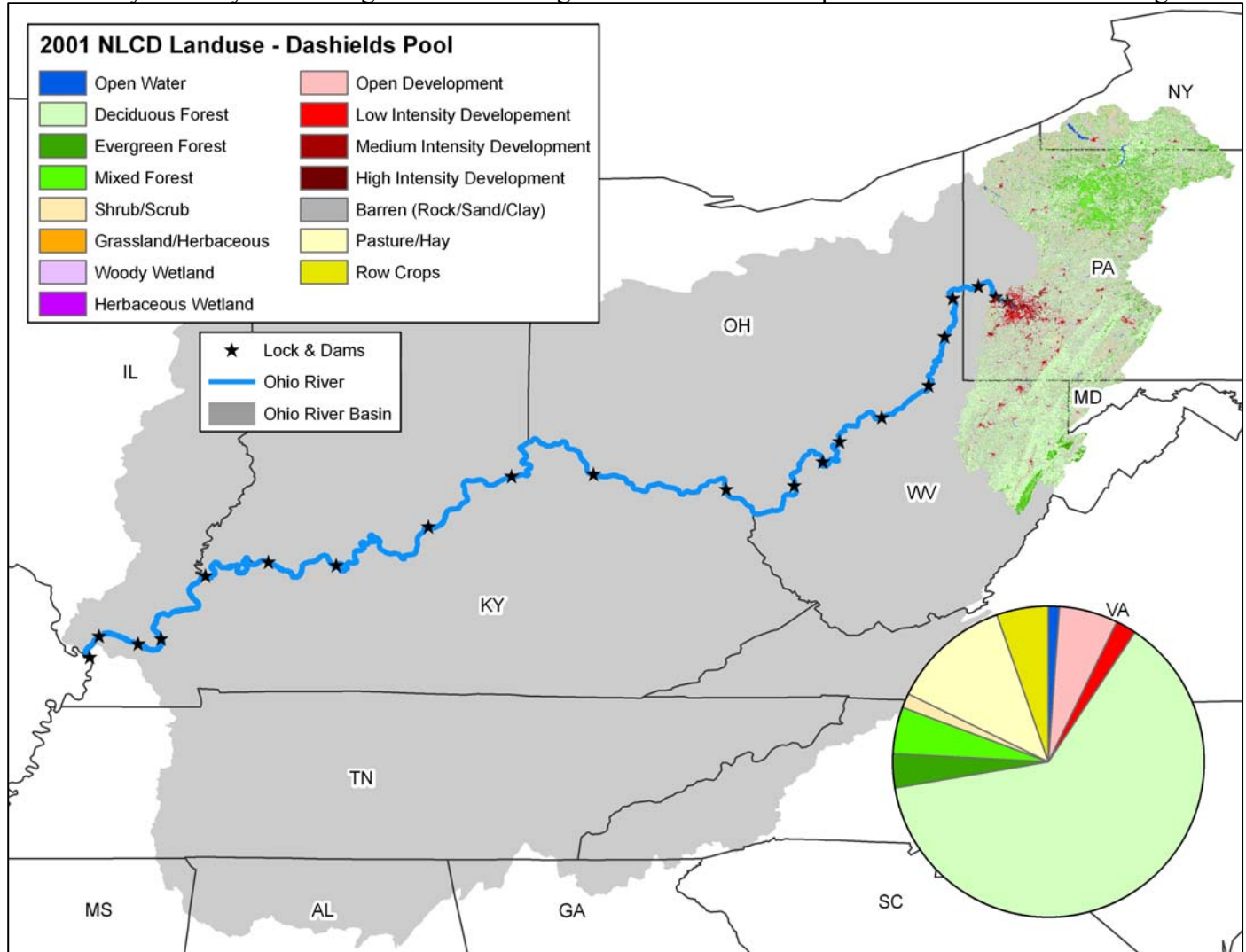


Figure 2. Land cover within the Dashields pool catchment area.

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). 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 or 5.0 GPP 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).



ORSANCO crew conducting night-time electrofishing

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 Dashields 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).

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).

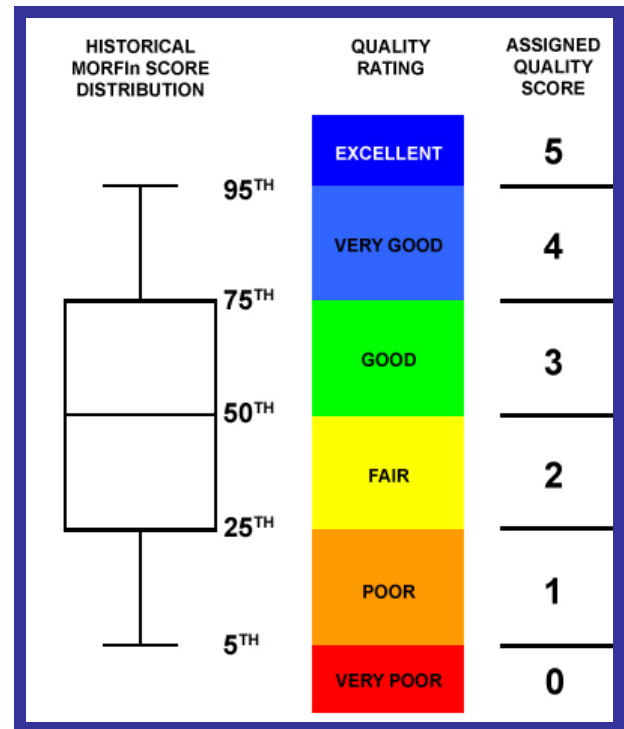


Figure 3. Approach used to assign fish quality scores for each habitat class.

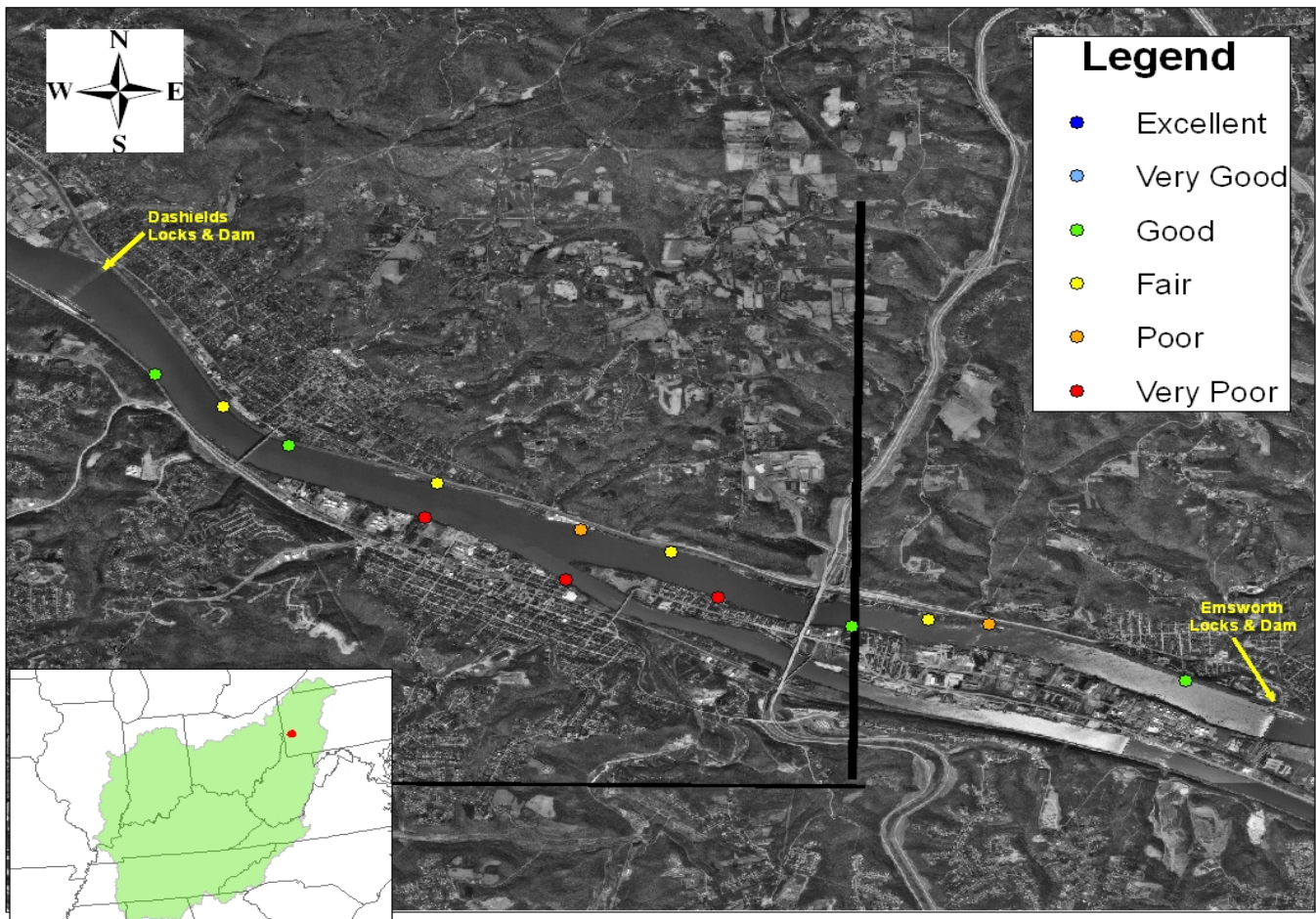


Figure 4. Locations and results of sampling at 13 sites within Dashields pool.

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 Dashields pool (Table 1). These collections produced 31 species and 1 hybrid taxa, representing 10 different families (Table 2). Five of these taxa were listed in PA as either endangered [silver chub (*Macrhybopsis storeriana*)], threatened [smallmouth buffalo (*Ictiobus bubalus*) and mooneye (*Hiodon tergisus*)],

or of special concern [river redhorse (*Moxostoma carinatum*) and longnose gar (*Lepisosteus osseus*)]. No federally listed taxa were collected from the Dashields pool. At the species level, sauger (*Sander canadensis*) was the most abundant individual species comprising 15.6% of the catch (Figure 5). The perch/darter family (Percidae), made up 30.3% of the total catch, followed by the sucker family (Catostomidae) which made up 19.9% of the catch (Figure 6).

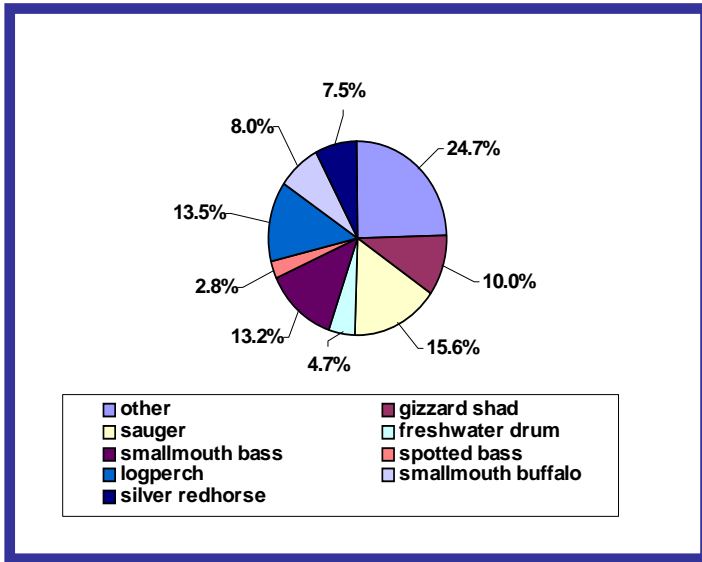


Figure 5. Species composition of fish sampled in Dashields pool.

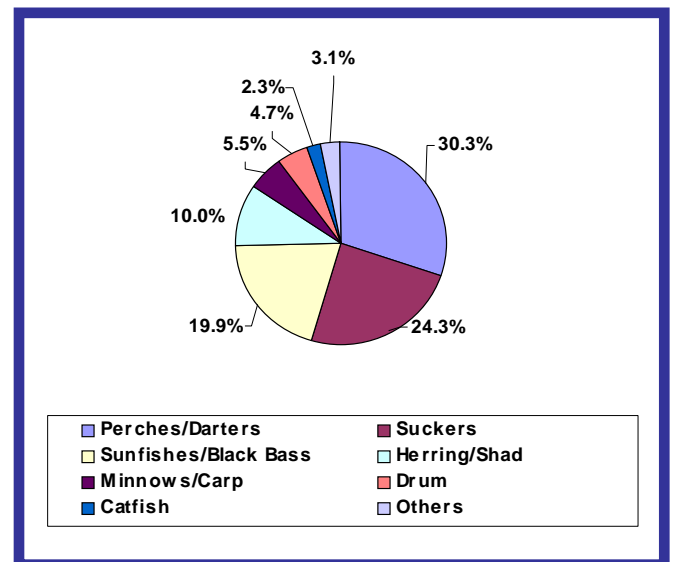


Figure 6. Sampled fish composition by family in the Dashields pool.

Table 1. Electrofishing site list for the Dashields 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	6.7	RDB	22-Jul-08	40.50807	80.09759	A	50.22	57.25	3	Good
2	7.7	RDB	23-Jul-08	40.51286	80.11073	n/a	n/a	54.43	n/a	n/a
3	8.1	RDB	23-Jul-08	40.51408	80.11657	C	43.13	31.40	1	Poor
4	8.4	RDB	23-Jul-08	40.51385	80.12987	C	43.13	48.47	2	Fair
5	8.4	LDB	06-Aug-08	40.51467	80.12245	B	46.76	62.89	3	Good
6	9.1	LDB	06-Aug-08	40.51706	80.1429	B	46.76	35.79	0	Very Poor
7	9.4	RDB	06-Aug-08	40.52192	80.14735	B	46.76	49.57	2	Fair
8	9.8	LDB	05-Aug-08	40.51889	80.15762	B	46.76	35.71	0	Very Poor
9	10.0	RDB	04-Aug-08	40.52433	80.15614	C	43.13	35.09	1	Poor
10	10.6	LDB	04-Aug-08	40.52559	80.17119	C	43.13	28.85	0	Very Poor
11	10.8	RDB	04-Aug-08	40.52741	80.16451	B	46.76	48.40	2	Fair
12	11.3	LDB	24-Jul-08	40.52922	80.18172	n/a	n/a	41.55	n/a	n/a
13	11.6	RDB	24-Jul-08	40.53339	80.18445	B	46.76	61.00	3	Good
14	12.0	RDB	24-Jul-08	40.53757	80.19077	B	46.76	51.90	2	Fair
15	12.5	LDB	24-Jul-08	40.54111	80.19733	B	46.76	61.15	3	Good

LDB = Left Descending Bank
RDB = Right Descending Bank

Table 2. Species collected in the Dashields pool during the 2008 survey. Species information are determined by and relative to the state of Pennsylvania (E = 'Endangered,' T = 'Threatened,' and SC = 'Species of Concern').

Family	Species	Latin Name	PA
Catostomidae	River Carpsucker	<i>Carpionodes carpio</i>	
Catostomidae	Quillback	<i>Carpionodes cyprinus</i>	
Catostomidae	Carpionodes Sp	<i>Carpionodes sp</i>	
Catostomidae	Northern Hog Sucker	<i>Hypentelium nigricans</i>	
Catostomidae	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	T
Catostomidae	Black Buffalo	<i>Ictiobus niger</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	Rock Bass	<i>Ambloplites rupestris</i>	
Centrarchidae	Green Sunfish	<i>Lepomis cyanellus</i>	
Centrarchidae	Bluegill	<i>Lepomis macrochirus</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	Gizzard Shad	<i>Dorosoma cepedianum</i>	
Cyprinidae	Common Carp	<i>Cyprinus carpio</i>	
Cyprinidae	Silver Chub	<i>Macrhybopsis storeriana</i>	E
Cyprinidae	Emerald Shiner	<i>Notropis atherinoides</i>	
Cyprinidae	Mimic Shiner	<i>Notropis volucellus</i>	
Hiodontidae	Mooneye	<i>Hiodon tergisus</i>	T
Ictaluridae	Channel Catfish	<i>Ictalurus punctatus</i>	
Ictaluridae	Flathead Catfish	<i>Pylodictis olivaris</i>	
Lepisosteidae	Longnose Gar	<i>Lepisosteus osseus</i>	SC
Moronidae	White Bass	<i>Morone chrysops</i>	
Percidae	Logperch	<i>Percina caprodes</i>	
Percidae	Sauger	<i>Sander canadensis</i>	
Percidae	Saugeye	<i>Sander canadensis x 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 (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 11 to 20, with an average of 15.5 species per site. The number of sucker species found at each site ranged from 2 to 7 and the number of centrarchid species varied from 1 to 5. The number of great river species did not exceed 2 species. The number of intolerant species ranged from 1 to 5 at the sampled sites. The percentage of tolerant individuals at each site did not exceed 10.0%, and the percentage of simple lithophilic spawners ranged between 23.9% and 73.6%. The percentages of non-native individuals were less than 15.0% at all sites and the percent detritivores ranged from 3.9% to 44.7%. The percent invertivorous individuals had a large range, 2.1% to 53.8% and the percent piscivores ranged from 20.8% to 60.6%. Five of the fifteen sites had a single DELT (deformities, eroded fins, lesions and tumors) anomaly. The CPUE (catch per unit effort) ranged from 35 to 163 individuals per site and had a relatively low performance with a maximum score of 13.2 (based on 100).

4.3 Habitat Surveys

Intensive habitat surveys were conducted at 13 of the 15 sampling locations and revealed that the bottom substrate in the Dashields pool had a relatively even mixture of fines, sand, gravel, and cobble substrates (Figure 7) with some variation among the individual sites (Figure 8). The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', 'C', 'D', or 'E'. One site in the Dashields pool was classified as class 'A' habitat, 8 sites were class 'B' habitats, and 4 sites were class 'C' habitats. There were zero 'D' and 'E' habitat classes sampled in the pool (Table 1).

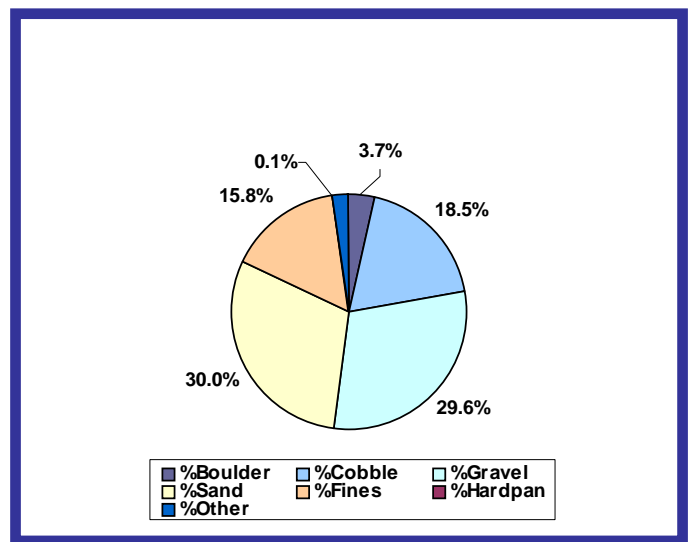


Figure 7. Substrate composition of Dashields pool.

Woody cover was present at 14 of the 15 sites sampled and overhanging vegetation was present at all but two sites. Riparian land cover was primarily natural forest with industrial and residential land-uses also present. Barge activity was heavy throughout the pool, while mooring structures were present at only two of the sites sampled (see Appendix C).

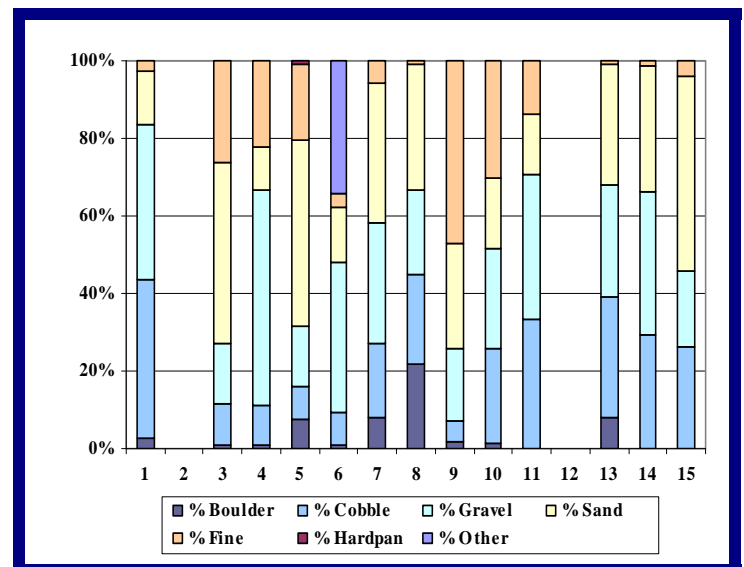


Figure 8. Substrate composition at each site sampled in the Dashields pool.

Table 3. MORFIn metrics and scores from the 2008 survey of Dashields 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	6.7	R	85	67	63	17	40.1	4	34.0	5	83.3	2	66.7	5	61.1	6.0	36.7	43.3	67.5	3.0	72.3	7.5	75.4	41.8	38.3	44.8	68.8	0	100	81	0.0	50.2	57.3
2	7.7	R	95	83	79	15	25.6	5	53.4	3	50.0	1	33.3	4	42.6	3.6	61.7	68.7	100.0	4.8	55.4	7.2	76.3	39.8	35.3	47.0	72.6	0	100	91	1.4	n/a	54.4
3	8.1	R	45	35	32	11	0.0	4	34.0	1	16.7	1	33.3	3	24.0	8.6	9.1	60.0	97.6	8.6	20.6	31.4	0.0	34.3	27.1	31.4	45.7	0	100	42	0.0	43.1	31.4
4	8.4	L	128	121	118	19	54.7	7	92.1	4	66.7	2	66.7	5	61.2	0.0	100.0	66.1	100.0	2.5	77.0	19.8	31.8	44.6	42.7	29.8	42.8	1	75	125	7.0	46.8	62.9
5	8.4	R	77	61	58	20	62.0	6	72.7	4	66.7	1	33.3	3	24.0	4.9	47.9	41.0	63.4	3.3	69.6	21.3	26.6	24.6	12.5	49.2	76.4	1	75	74	0.0	43.1	48.5
6	9.1	L	41	40	34	15	25.7	5	53.4	3	50.0	2	66.7	4	42.7	10.0	0.0	42.5	66.1	15.0	0.0	32.5	0.0	25.0	13.2	32.5	47.5	0	100	35	0.0	46.8	35.8
7	9.4	R	90	79	78	14	18.4	5	53.4	2	33.3	2	66.7	3	24.1	1.3	86.6	51.9	83.0	1.3	88.3	24.1	16.9	26.6	15.6	38.0	57.0	0	100	89	1.2	46.8	49.6
8	9.8	L	71	71	64	14	18.4	4	34.1	3	50.0	1	33.3	4	42.7	9.9	0.0	23.9	32.8	9.9	8.7	15.5	47.1	16.9	1.0	60.6	96.0	0	100	64	0.0	46.8	35.7
9	10.0	R	57	47	47	11	0.0	3	14.8	2	33.3	1	33.3	1	0.0	0.0	100.0	25.5	35.6	0.0	100.0	44.7	0.0	2.1	0.0	27.7	39.1	0	100	57	0.0	43.1	35.1
10	10.6	L	45	44	40	12	3.9	2	0.0	2	33.3	1	33.3	3	24.2	9.1	3.6	27.3	38.8	9.1	15.8	20.5	29.6	18.2	3.0	56.8	89.6	0	100	41	0.0	43.1	28.9
11	10.8	R	57	48	48	17	40.3	6	72.9	3	50.0	2	66.7	3	24.2	0.0	100.0	25.0	34.7	0.0	100.0	41.7	0.0	25.0	13.2	20.8	27.3	0	100	57	0.0	46.8	48.4
12	11.3	L	74	71	66	16	33.0	3	14.9	5	83.3	1	33.3	2	5.6	7.0	25.4	50.7	80.9	7.0	34.8	11.3	62.0	29.6	20.2	46.5	71.7	1	75	69	0.0	n/a	41.5
13	11.6	R	165	152	150	17	40.3	6	72.9	4	66.7	0	0.0	4	42.9	1.3	86.1	52.0	83.2	1.3	87.8	3.9	87.8	42.8	40.0	46.7	72.1	0	100	163	13.2	46.8	61.0
14	12.0	R	92	79	75	17	40.3	5	53.6	5	83.3	0	0.0	3	24.3	2.5	73.2	63.3	100.0	5.1	53.1	7.6	75.0	40.5	36.7	39.2	59.1	1	75	88	1.1	46.8	51.9
15	12.5	L	110	106	105	18	47.6	5	53.6	4	66.7	1	33.3	4	42.9	0.9	90.0	73.6	100.0	0.9	91.3	6.6	78.5	53.8	56.7	36.8	54.9	1	75	109	4.5	46.8	61.1

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. Sampling was conducted in Dashields pool when flows were above and below the harmonic mean flow (HMF) for the pool. Flow conditions during sampling varied between 68% and 149% 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 42 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).

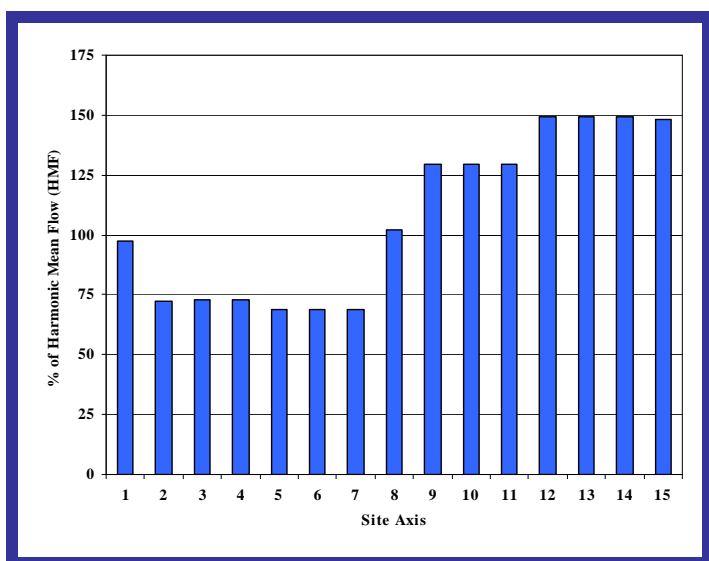


Figure 9. Relative flows (%HMF) at the time of sampling.

4.5 Assessment of Condition

MORFIn scores were calculated for each of the sites sampled from which fish and substrate data were both collected. The maximum score achieved by any site in the pool, out of a possible 100, was 62.9 and the minimum was 28.9. By comparing observed and expected MORFIn scores, ORSANCO determined if a site met its expectations (based on habitat class) or not (Table 3). Five (38%) of the 13 sites fully assessed in 2008 scored less than the minimum expected scores and were assessed as either poor or very poor (Table 1; Figure 10). The

remaining 8 sites (62%) received a fair or good quality rating and zero of the sites were assessed as being very good or excellent (Figure 10).

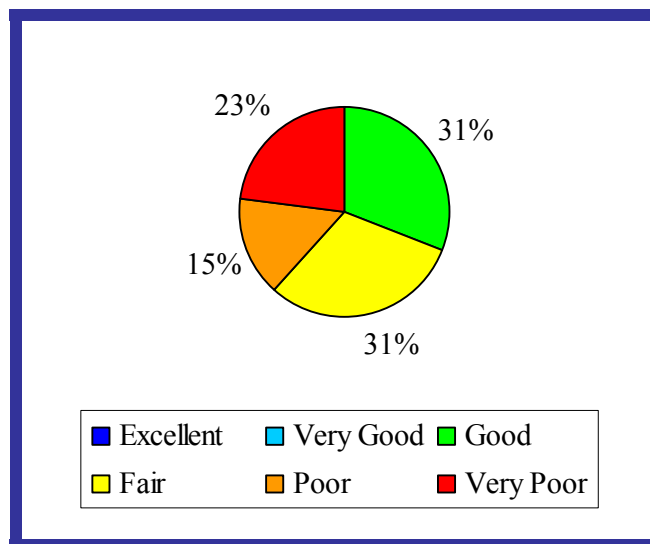


Figure 10. Condition of the Dashields pool based on MORFIn scores at 13 sites (Pass=Excellent-Fair, Fail=Poor-Very Poor).

5.0 Discussion

5.1 Fish Population

In 2008, the fish population of Dashields pool did not appear to be in very good condition. The number of individuals and species was not as high as anticipated or as high as other surveyed pools. The most abundant species in the survey were sauger (*Sander canadensis*; 192 individuals), logperch (*Percina caprodes*; 166 ind.), smallmouth bass (*Micropterus dolomieu*; 163 ind.), and gizzard shad (*Dorosoma cepedianum*; 123 ind.). The only darter species (log perch) was the 2nd most abundant species. This species is 1 of 7 intolerant species found within Dashields pool. Others include: smallmouth redhorse (*Moxostoma breviceps*), river redhorse (*M. carinatum*) and mooneye (*Hiodon tergisus*). Common carp (*Cyprinus carpio*) and green sunfish (*Lepomis cyanellus*) were the only two tolerant species collected during the survey.

5.2 Metric Performance

The metric scores in Dashields pool were relatively balanced with high and low metrics. CPUE was the lowest scoring metric and did not exceed a score of 13.2 (out of 100). The number of native species metric did not perform well and indicates that the

diversity of native fish species in the pool may be subpar (Figure 13). The longitudinal position of Dashields pool on the river (i.e. nearer the Ohio River headwaters) may be responsible for the lower great river species scores. There was no known reason or explanation for the low percentages of invertivorous and intolerant individuals' scores.

Three of the highest performing metrics were % simple lithophils, % piscivores, and # DELTs. The two-most abundant species in the pool survey (sauger and logperch) were simple lithophilic spawners and two of the three most abundant species were piscivores (sauger and smallmouth bass). The number of DELT anomalies found on individuals was low suggesting the fishes in Dashields pool may not be experiencing environmental stressors severe enough to decrease their health. It should also be noted that low proportions of pollution-tolerant individuals and non-native species were collected and their metrics also performed well.

5.3 Habitat Surveys

The habitat assessments show that in Dashields pool there was a dominance of class 'B' habitats indicating that most sites had a moderate composition of coarse substrates. Class 'C' habitats were also relatively abundant indicating that there was a moderate composition of fine substrates (sand, fines, and hardpan).

5.4 Water Quality and Flow Conditions

The fluctuations in river levels could potentially have affected the survey of Dashields pool. Rain events were relatively frequent throughout the field season causing some sampling to be conducted during higher flow events. High flows can alter fish behavior and increase turbidity. Secchi depths however, indicated sufficient visibility for sampling. There were no water quality parameters that exceeded their respective criteria or provided any major insight into the assessment results for Dashields pool.

5.5 Conclusions and Assessments of Condition

Only 13 of the 15 random sites in Dashields pool could be fully assessed because substrate data

was not obtained at two of the electrofished sites. Full assessments could not be made at those two sites because a habitat class must be assigned to a site to determine the MORFIN expectation. Of the 13 fully assessed sites, five were in poor or very poor condition. Supplemental sampling occurred at four targeted sites within the pool in 2008. These specific locations were targeted as areas of potential impairment and/or interest. If these targeted sites were included in the assessment, 7 of the 17 (42%) sites would have performed less than expected and received poor or very poor ratings. This is similar to 38% of the random sites that performed less than expected. The additional targeted sampling confirms the random sampling assessment of Dashields failing to meet the expected biocriteria.

The instream habitat in the pool appeared adequate to sustain healthy fish populations due to the abundance of woody cover and heterogenous substrates. However, Dashields pool is unique because there are no major tributaries emptying into the pool. This could restrict the pool's ability to harbor a healthy fish assemblage as tributaries serve as refugia, spawning, and nursery areas for many Ohio River fishes. Additionally, Dashields pool is potentially subject to numerous negative industrial and anthropogenic influences within its relatively small size (7.1 miles).

The overall average quality score in Dashields pool was 1.7, indicating the pool is in poor biological condition. The data collected in 2008 indicated that the Dashields pool did not meet the biocriteria established by ORSANCO's Biological Water Quality Subcommittee (Appendix A) and failed to meet (support) 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 Dashields pool to other previously surveyed pools in the Ohio River.

6.2 Land Cover

Dashields lies in the upper portion 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).

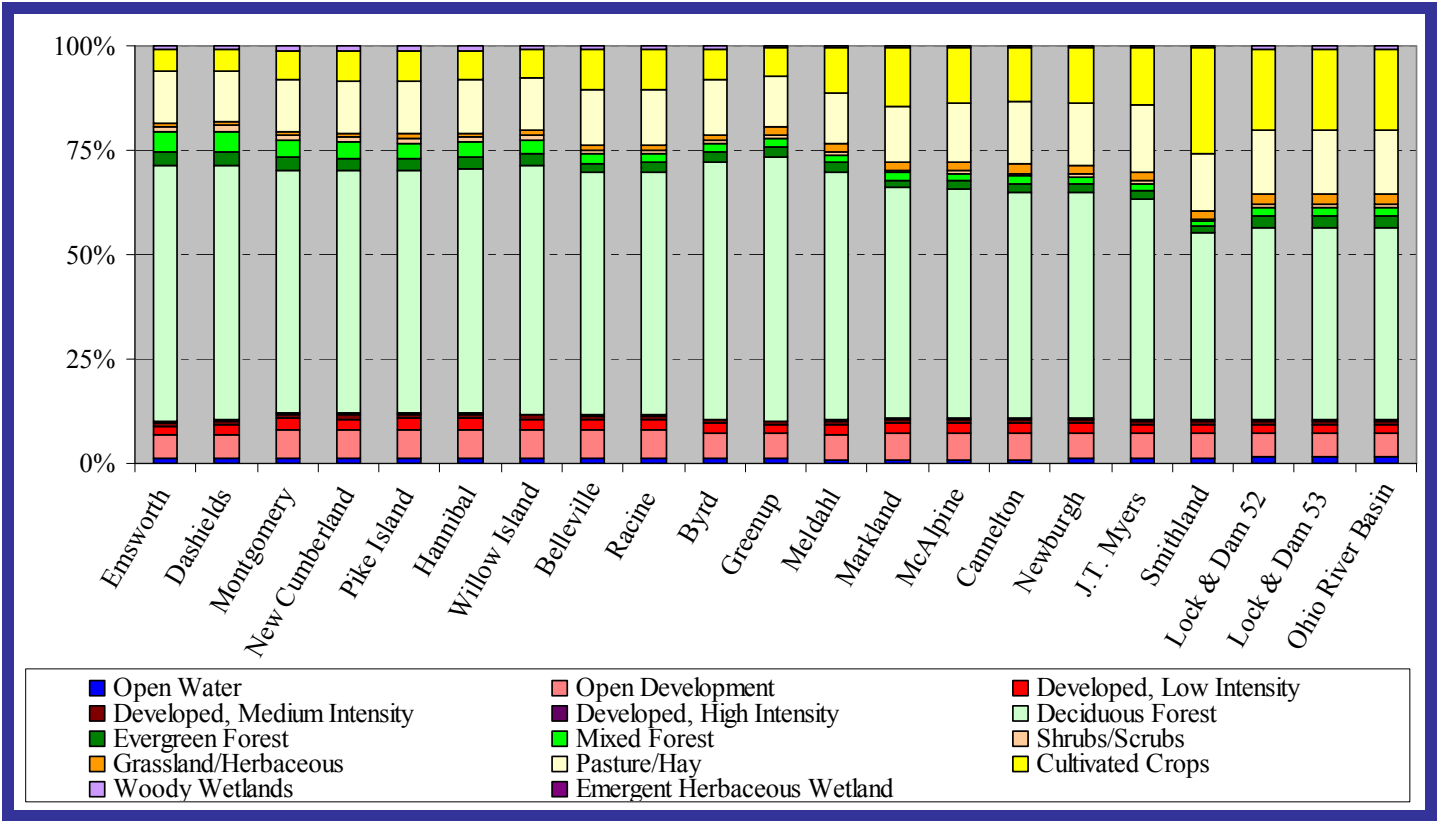


Figure 11. Cumulative land-cover within the catchment area of each pool of the Ohio River.
Cumulative

6.3 Substrate Composition

This pool had a relatively equal percentage of cobble, gravel, sand, and fines. The heterogeneous substrate composition is most

similar to its closest upstream pool (Emsworth). However, these percentages are quite different from the other pools assessed in the lower third of the river (Figure 12).

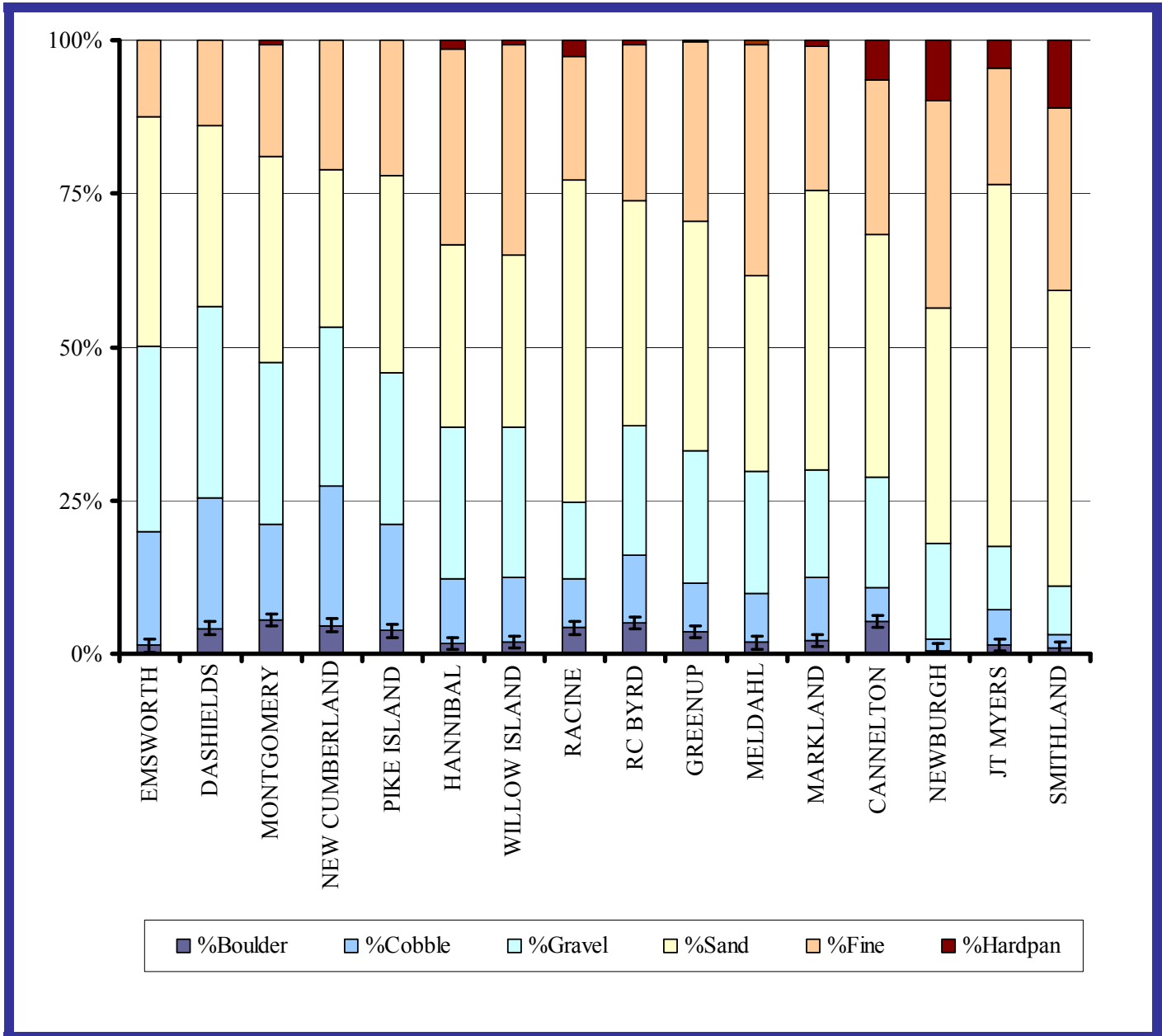


Figure 12. Substrate composition for each pool surveyed as of 2008.

6.4 Species Richness

Dashiels pool had a decreased average number of native species per site (15.4) and ranked 3rd worst in comparison (Figure 13).

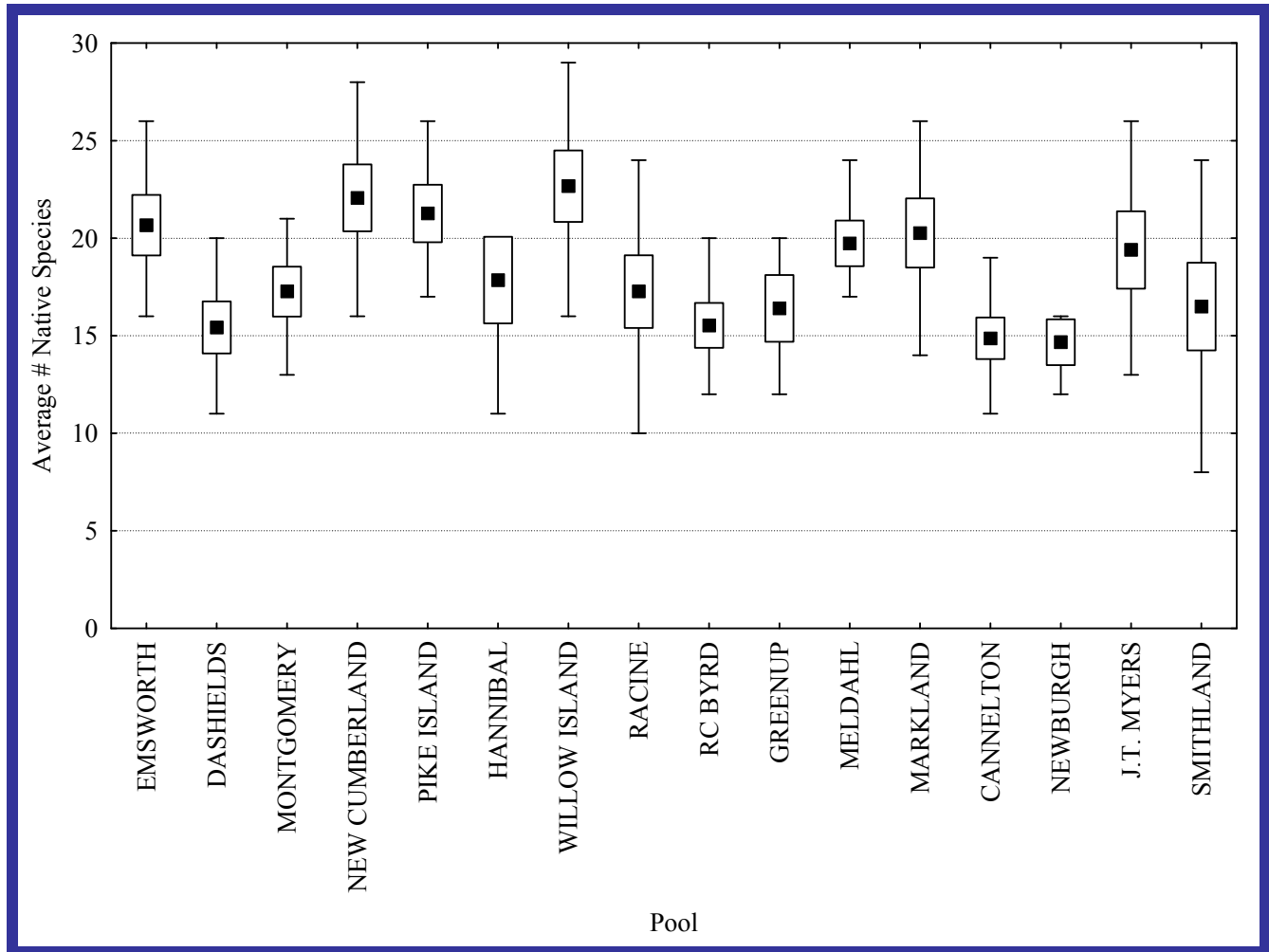


Figure 13. The average number of native species collected at each site within each pool surveyed as of 2008 (■=Average, □=90% Confidence Interval, I=Non-Outlier Range).

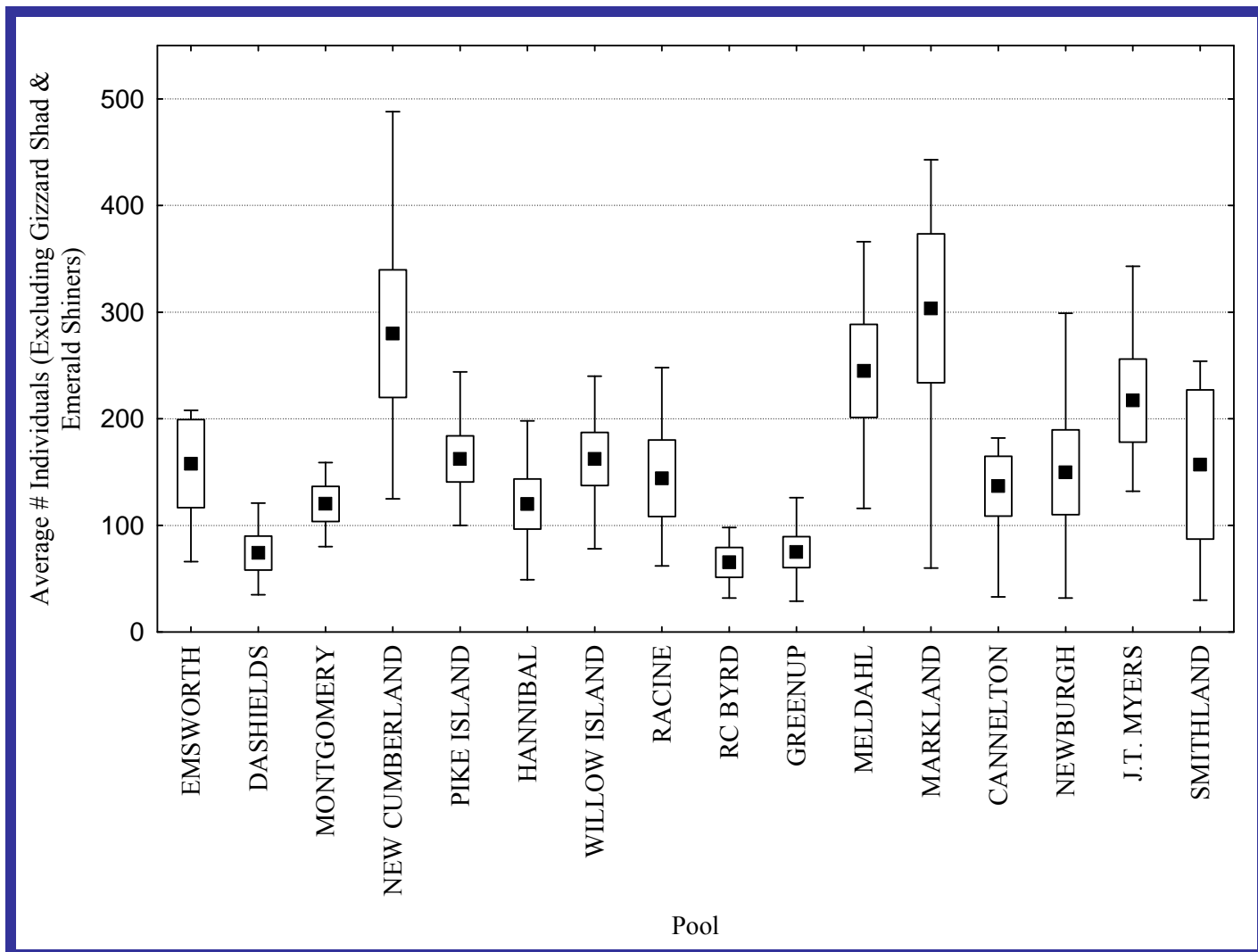


Figure 14. The average number of individuals (excluding gizzard shad & emerald shiner) collected at each site within each pool surveyed as of 2008 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).

6.5 Number of Individuals

An average of 74.1 individuals (excluding gizzard shad and emerald shiner) was collected at each site in Dashields pool which ranked 3rd worst in comparison (Figure 14). If gizzard shad and emerald shiners were included, the Dashields pool had the lowest average number of individuals per site (81.9 individuals) than any other pool assessed as of 2008.

6.6 Noteworthy Fish Observations

None of the species collected in Dashields pool were unique to the river (based on other surveyed pools). However, several species were collected from this pool that were only found in the upper portions of the Ohio River such as rock bass and walleye. There were pictures at a marina from within the pool that showed a large muskellunge and a large flathead catfish that were caught in the late spring/ early summer.

Benthic trawling occurred within Dashields pool from which Tippecanoe darters (*Etheostoma tippecanoe*) were collected from benthic trawling surveys conducted within the Dashields Pool. Trawls also yielded these darters in Hannibal pool. These are thought to be the first records of tippecanoe darters to be collected from the mainstem of the Ohio River. This species is listed in the state of Pennsylvania 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 scores that were greater than expected. Dashields pool had an average deviation of 0.8 and was the lowest of other pools surveyed as of 2008 (Figure 15). In comparison to other pools, the fish community was in poor condition.

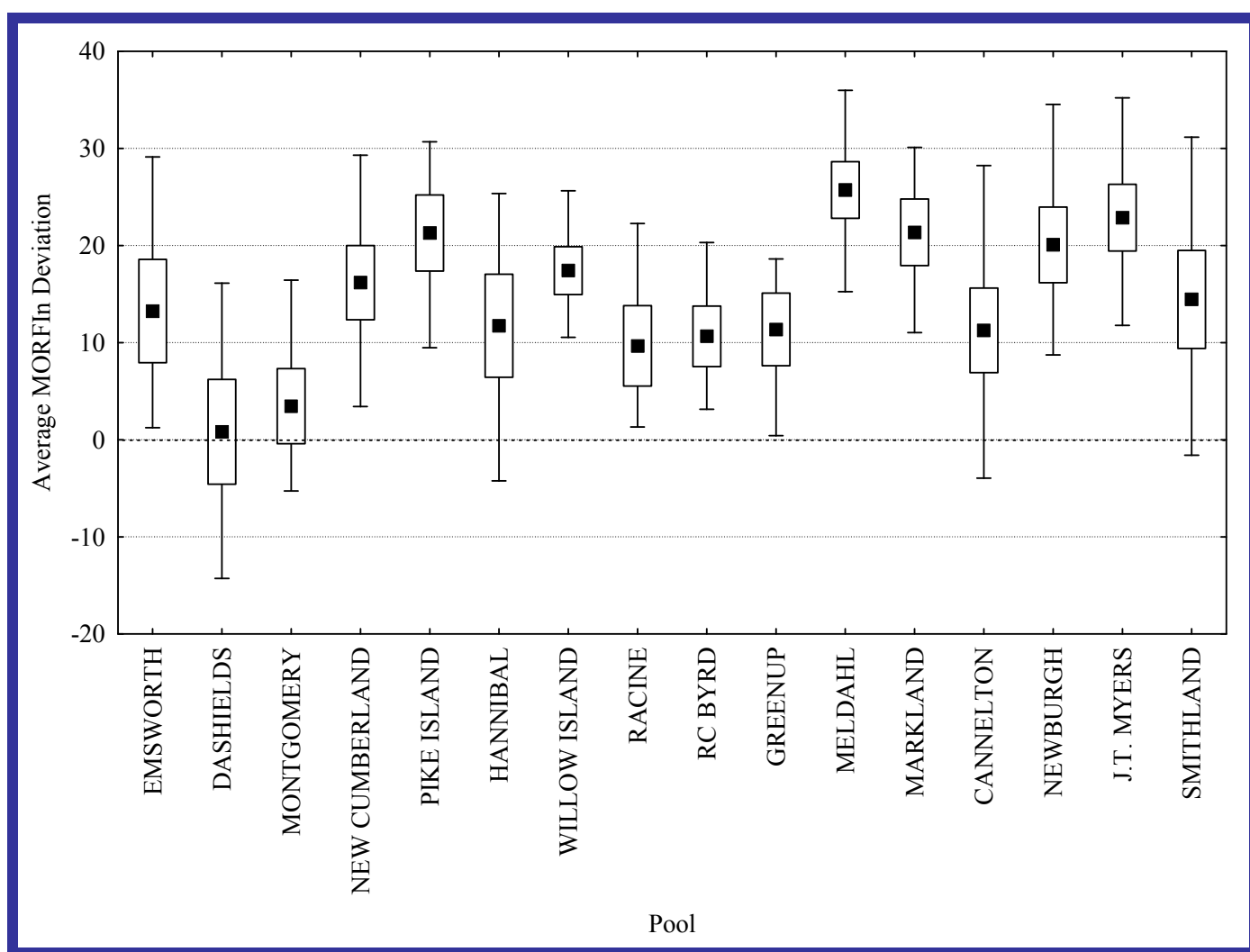


Figure 15. The average MORFIn deviation of each site within pools surveyed as of 2008 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).

6.8 Assessment of Condition

The average quality score in Dashields pool was 1.7 and it was assessed as being in poor condition. The nearest surveyed pool

downstream of Dashields was Montgomery pool in 2006 and it was also considered to be in poor condition (Figure 16).

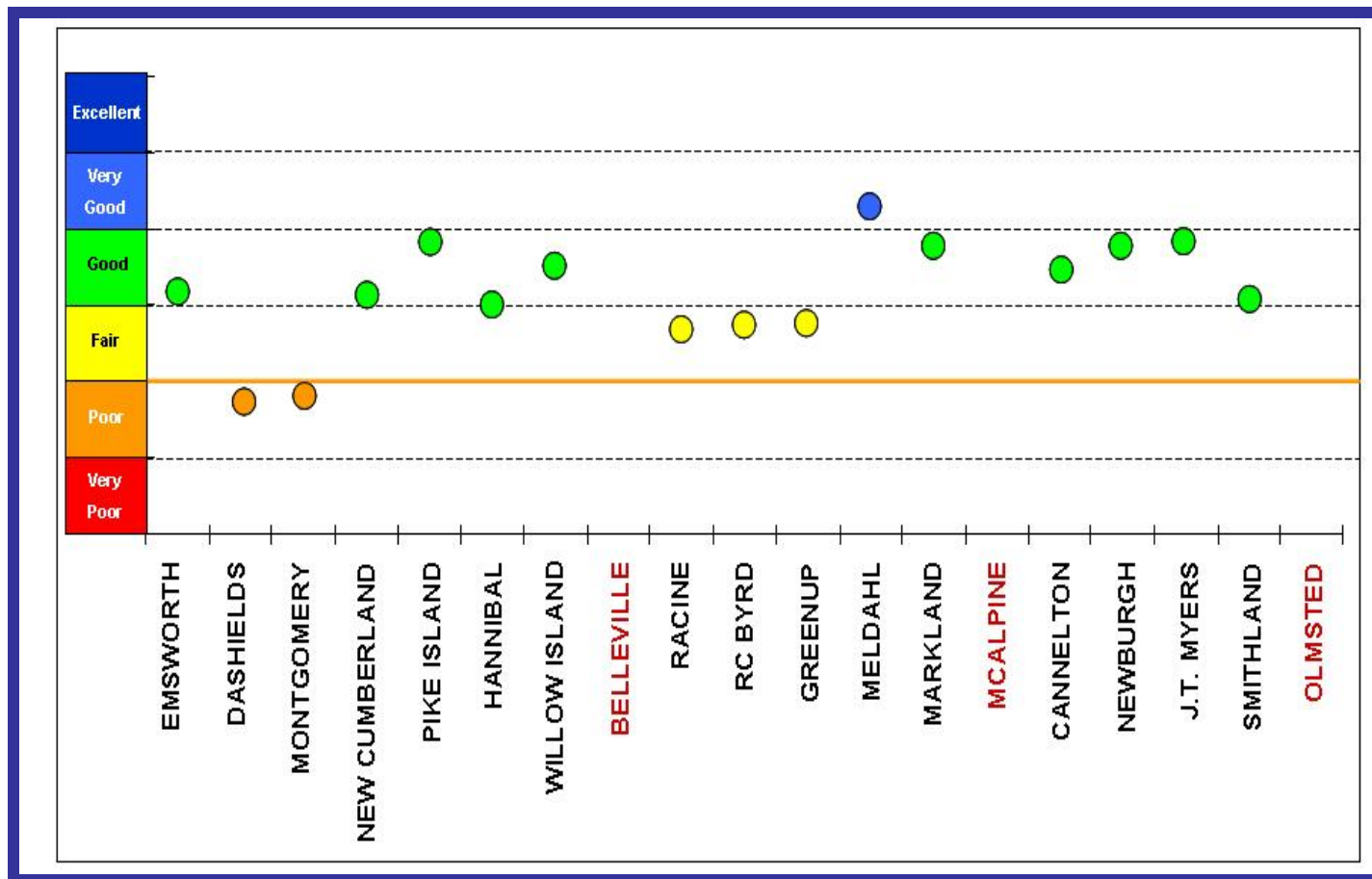


Figure 16. The average quality score for each pool surveyed as of 2008 (black text, red text = pools to be surveyed in 2009). Data points are color-coded to indicate the biological condition of a pool.

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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#	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
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	Carpionodes 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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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	

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
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

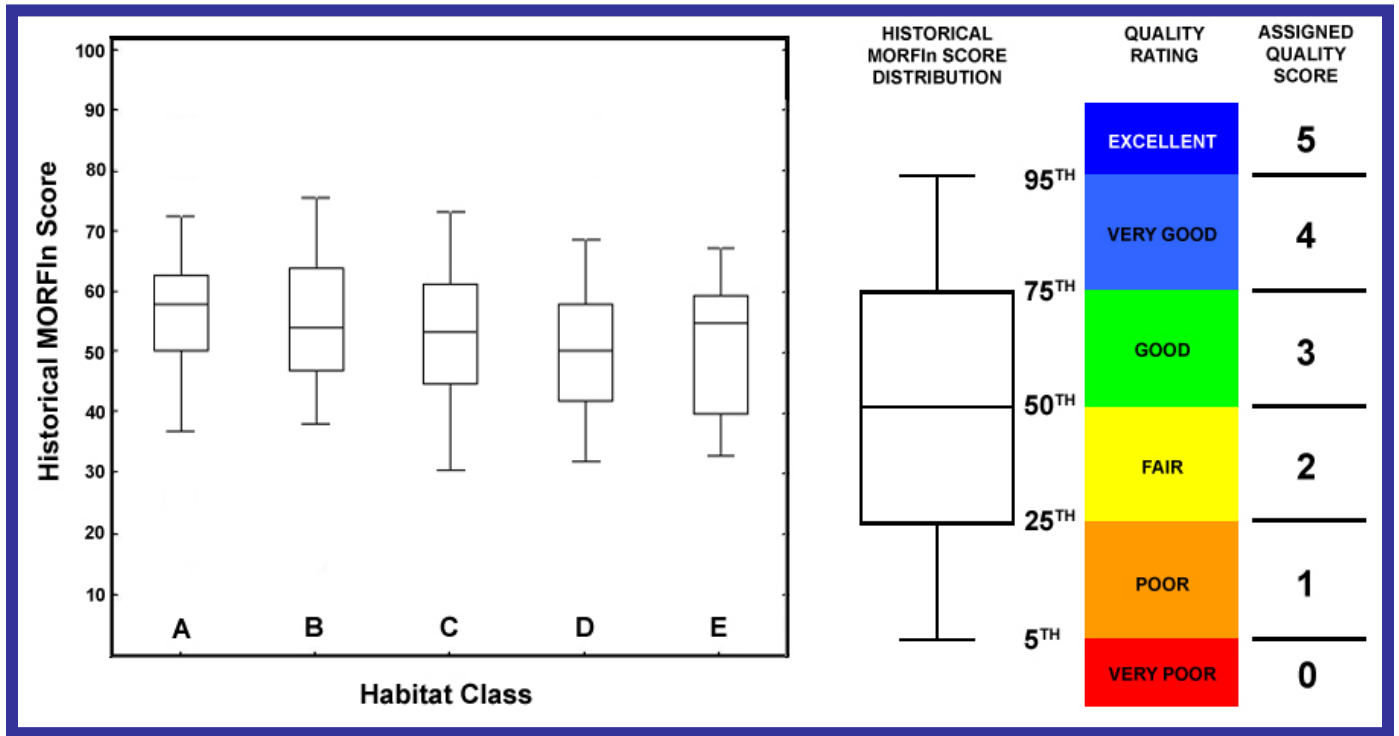
- Each individual navigational pool will serve as a separate and distinct Assessment Unit (AU), with the exception of the area below Smithland dam will also be considered one distinct AU.
 - This is based on the observation that biologically, each pool more closely resembles a lake, and not a free-flowing 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			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 Dashields pool.

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
1	6.7	RDB	22-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	18
1	6.7	RDB	22-Jul-08	Mooneye	<i>Hiodon tergisus</i>	1
1	6.7	RDB	22-Jul-08	Common Carp	<i>Cyprinus carpio</i>	2
1	6.7	RDB	22-Jul-08	Mimic Shiner	<i>Notropis volucellus</i>	1
1	6.7	RDB	22-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
1	6.7	RDB	22-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
1	6.7	RDB	22-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
1	6.7	RDB	22-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
1	6.7	RDB	22-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3
1	6.7	RDB	22-Jul-08	White Bass	<i>Morone chrysops</i>	1
1	6.7	RDB	22-Jul-08	Rock Bass	<i>Ambloplites rupestris</i>	1
1	6.7	RDB	22-Jul-08	Green Sunfish	<i>Lepomis cyanellus</i>	2
1	6.7	RDB	22-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	2
1	6.7	RDB	22-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	24
1	6.7	RDB	22-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
1	6.7	RDB	22-Jul-08	Logperch	<i>Percina caprodes</i>	18
1	6.7	RDB	22-Jul-08	Sauger	<i>Sander canadensis</i>	3
1	6.7	RDB	22-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
2	7.7	RDB	23-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	12
2	7.7	RDB	23-Jul-08	Common Carp	<i>Cyprinus carpio</i>	3
2	7.7	RDB	23-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	5
2	7.7	RDB	23-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
2	7.7	RDB	23-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	3
2	7.7	RDB	23-Jul-08	River Redhorse	<i>Moxostoma carinatum</i>	1
2	7.7	RDB	23-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	9
2	7.7	RDB	23-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3
2	7.7	RDB	23-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
2	7.7	RDB	23-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	2
2	7.7	RDB	23-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	4
2	7.7	RDB	23-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	8
2	7.7	RDB	23-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
2	7.7	RDB	23-Jul-08	Logperch	<i>Percina caprodes</i>	10
2	7.7	RDB	23-Jul-08	Saugeye	<i>Sander canadensis</i> x <i>S. vitreus</i>	1
2	7.7	RDB	23-Jul-08	Sauger	<i>Sander canadensis</i>	27
2	7.7	RDB	23-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	3
3	8.1	RDB	23-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
3	8.1	RDB	23-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	10
3	8.1	RDB	23-Jul-08	Common Carp	<i>Cyprinus carpio</i>	3
3	8.1	RDB	23-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
3	8.1	RDB	23-Jul-08	Quillback	<i>Carpoides cyprinus</i>	1
3	8.1	RDB	23-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
3	8.1	RDB	23-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	7
3	8.1	RDB	23-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	7
3	8.1	RDB	23-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	1
3	8.1	RDB	23-Jul-08	Logperch	<i>Percina caprodes</i>	3

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
3	8.1	RDB	23-Jul-08	Sauger	<i>Sander canadensis</i>	9
3	8.1	RDB	23-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
4	8.4	RDB	23-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
4	8.4	RDB	23-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	16
4	8.4	RDB	23-Jul-08	Common Carp	<i>Cyprinus carpio</i>	2
4	8.4	RDB	23-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	3
4	8.4	RDB	23-Jul-08	Carpiodes Sp	<i>Carpiodes sp</i>	1
4	8.4	RDB	23-Jul-08	Quillback	<i>Carpiodes cyprinus</i>	2
4	8.4	RDB	23-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
4	8.4	RDB	23-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
4	8.4	RDB	23-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	2
4	8.4	RDB	23-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	8
4	8.4	RDB	23-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
4	8.4	RDB	23-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
4	8.4	RDB	23-Jul-08	White Bass	<i>Morone chrysops</i>	1
4	8.4	RDB	23-Jul-08	Green Sunfish	<i>Lepomis cyanellus</i>	1
4	8.4	RDB	23-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	3
4	8.4	RDB	23-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	5
4	8.4	RDB	23-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	8
4	8.4	RDB	23-Jul-08	Logperch	<i>Percina caprodes</i>	2
4	8.4	RDB	23-Jul-08	Walleye	<i>Sander vitreus</i>	2
4	8.4	RDB	23-Jul-08	Sauger	<i>Sander canadensis</i>	11
4	8.4	RDB	23-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
5	8.4	LDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	7
5	8.4	LDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
5	8.4	LDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	5
5	8.4	LDB	06-Aug-08	Quillback	<i>Carpiodes cyprinus</i>	5
5	8.4	LDB	06-Aug-08	River Carpsucker	<i>Carpiodes carpio</i>	3
5	8.4	LDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	3
5	8.4	LDB	06-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	21
5	8.4	LDB	06-Aug-08	River Redhorse	<i>Moxostoma carinatum</i>	8
5	8.4	LDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	6
5	8.4	LDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	16
5	8.4	LDB	06-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
5	8.4	LDB	06-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
5	8.4	LDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	2
5	8.4	LDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	7
5	8.4	LDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
5	8.4	LDB	06-Aug-08	Black Crappie	<i>Pomoxis nigromaculatus</i>	1
5	8.4	LDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	9
5	8.4	LDB	06-Aug-08	Saugeye	<i>Sander canadensis x S. vitreus</i>	3
5	8.4	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	24
5	8.4	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	3
6	9.1	LDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
6	9.1	LDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	4
6	9.1	LDB	06-Aug-08	Emerald Shiner	<i>Notropis atherinoides</i>	1

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
6	9.1	LDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
6	9.1	LDB	06-Aug-08	River Carpsucker	<i>Carpionodes carpio</i>	1
6	9.1	LDB	06-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
6	9.1	LDB	06-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
6	9.1	LDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	7
6	9.1	LDB	06-Aug-08	Black Buffalo	<i>Ictiobus niger</i>	1
6	9.1	LDB	06-Aug-08	White Bass	<i>Morone chrysops</i>	1
6	9.1	LDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	1
6	9.1	LDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	4
6	9.1	LDB	06-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
6	9.1	LDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	3
6	9.1	LDB	06-Aug-08	Saugeye	<i>Sander canadensis</i> x <i>S. vitreus</i>	2
6	9.1	LDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	5
6	9.1	LDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	3
7	9.4	RDB	06-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	9
7	9.4	RDB	06-Aug-08	Mooneye	<i>Hiodon tergisus</i>	2
7	9.4	RDB	06-Aug-08	Common Carp	<i>Cyprinus carpio</i>	1
7	9.4	RDB	06-Aug-08	Emerald Shiner	<i>Notropis atherinoides</i>	2
7	9.4	RDB	06-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	3
7	9.4	RDB	06-Aug-08	River Carpsucker	<i>Carpionodes carpio</i>	1
7	9.4	RDB	06-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	2
7	9.4	RDB	06-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
7	9.4	RDB	06-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	5
7	9.4	RDB	06-Aug-08	Black Buffalo	<i>Ictiobus niger</i>	12
7	9.4	RDB	06-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	6
7	9.4	RDB	06-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	6
7	9.4	RDB	06-Aug-08	Logperch	<i>Percina caprodes</i>	9
7	9.4	RDB	06-Aug-08	Sauger	<i>Sander canadensis</i>	24
7	9.4	RDB	06-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	7
8	9.8	LDB	05-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
8	9.8	LDB	05-Aug-08	Common Carp	<i>Cyprinus carpio</i>	7
8	9.8	LDB	05-Aug-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	2
8	9.8	LDB	05-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	6
8	9.8	LDB	05-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	2
8	9.8	LDB	05-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	4
8	9.8	LDB	05-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
8	9.8	LDB	05-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	2
8	9.8	LDB	05-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	1
8	9.8	LDB	05-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	29
8	9.8	LDB	05-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	7
8	9.8	LDB	05-Aug-08	Logperch	<i>Percina caprodes</i>	1
8	9.8	LDB	05-Aug-08	Walleye	<i>Sander vitreus</i>	1
8	9.8	LDB	05-Aug-08	Sauger	<i>Sander canadensis</i>	4
8	9.8	LDB	05-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	2
9	10.0	RDB	04-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
9	10.0	RDB	04-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	10

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
9	10.0	RDB	04-Aug-08	Mooneye	<i>Hiodon tergisus</i>	3
9	10.0	RDB	04-Aug-08	River Carpsucker	<i>Carpionodes carpio</i>	7
9	10.0	RDB	04-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	1
9	10.0	RDB	04-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	14
9	10.0	RDB	04-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
9	10.0	RDB	04-Aug-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
9	10.0	RDB	04-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	3
9	10.0	RDB	04-Aug-08	Sauger	<i>Sander canadensis</i>	8
9	10.0	RDB	04-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	8
10	10.6	LDB	04-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	4
10	10.6	LDB	04-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	1
10	10.6	LDB	04-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
10	10.6	LDB	04-Aug-08	Common Carp	<i>Cyprinus carpio</i>	4
10	10.6	LDB	04-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	3
10	10.6	LDB	04-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	5
10	10.6	LDB	04-Aug-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
10	10.6	LDB	04-Aug-08	White Bass	<i>Morone chrysops</i>	9
10	10.6	LDB	04-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	3
10	10.6	LDB	04-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	5
10	10.6	LDB	04-Aug-08	Logperch	<i>Percina caprodes</i>	2
10	10.6	LDB	04-Aug-08	Sauger	<i>Sander canadensis</i>	6
10	10.6	LDB	04-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1
11	10.8	RDB	04-Aug-08	Longnose Gar	<i>Lepisosteus osseus</i>	2
11	10.8	RDB	04-Aug-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	9
11	10.8	RDB	04-Aug-08	Mooneye	<i>Hiodon tergisus</i>	1
11	10.8	RDB	04-Aug-08	Silver Chub	<i>Macrhybopsis storeriana</i>	1
11	10.8	RDB	04-Aug-08	Quillback	<i>Carpionodes cyprinus</i>	4
11	10.8	RDB	04-Aug-08	River Carpsucker	<i>Carpionodes carpio</i>	4
11	10.8	RDB	04-Aug-08	Silver Redhorse	<i>Moxostoma anisurum</i>	4
11	10.8	RDB	04-Aug-08	River Redhorse	<i>Moxostoma carinatum</i>	2
11	10.8	RDB	04-Aug-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
11	10.8	RDB	04-Aug-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	12
11	10.8	RDB	04-Aug-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
11	10.8	RDB	04-Aug-08	White Bass	<i>Morone chrysops</i>	1
11	10.8	RDB	04-Aug-08	Bluegill	<i>Lepomis macrochirus</i>	4
11	10.8	RDB	04-Aug-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	3
11	10.8	RDB	04-Aug-08	Spotted Bass	<i>Micropterus punctulatus</i>	1
11	10.8	RDB	04-Aug-08	Sauger	<i>Sander canadensis</i>	3
11	10.8	RDB	04-Aug-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	4
12	11.3	LDB	24-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	2
12	11.3	LDB	24-Jul-08	Common Carp	<i>Cyprinus carpio</i>	5
12	11.3	LDB	24-Jul-08	Emerald Shiner	<i>Notropis atherinoides</i>	1
12	11.3	LDB	24-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	4
12	11.3	LDB	24-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	3
12	11.3	LDB	24-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	1
12	11.3	LDB	24-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
12	11.3	LDB	24-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
12	11.3	LDB	24-Jul-08	White Bass	<i>Morone chrysops</i>	3
12	11.3	LDB	24-Jul-08	Rock Bass	<i>Ambloplites rupestris</i>	2
12	11.3	LDB	24-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	1
12	11.3	LDB	24-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	7
12	11.3	LDB	24-Jul-08	Largemouth Bass	<i>Micropterus salmoides</i>	1
12	11.3	LDB	24-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	3
12	11.3	LDB	24-Jul-08	Logperch	<i>Percina caprodes</i>	12
12	11.3	LDB	24-Jul-08	Sauger	<i>Sander canadensis</i>	16
12	11.3	LDB	24-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	9
13	11.6	RDB	24-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	13
13	11.6	RDB	24-Jul-08	Common Carp	<i>Cyprinus carpio</i>	2
13	11.6	RDB	24-Jul-08	River Carpsucker	<i>Carpionodes carpio</i>	1
13	11.6	RDB	24-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	1
13	11.6	RDB	24-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	9
13	11.6	RDB	24-Jul-08	River Redhorse	<i>Moxostoma carinatum</i>	2
13	11.6	RDB	24-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	3
13	11.6	RDB	24-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3
13	11.6	RDB	24-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	1
13	11.6	RDB	24-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
13	11.6	RDB	24-Jul-08	Rock Bass	<i>Ambloplites rupestris</i>	3
13	11.6	RDB	24-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	1
13	11.6	RDB	24-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	50
13	11.6	RDB	24-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	2
13	11.6	RDB	24-Jul-08	Logperch	<i>Percina caprodes</i>	49
13	11.6	RDB	24-Jul-08	Walleye	<i>Sander vitreus</i>	2
13	11.6	RDB	24-Jul-08	Sauger	<i>Sander canadensis</i>	13
13	11.6	RDB	24-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	9
14	12.0	RDB	24-Jul-08	Longnose Gar	<i>Lepisosteus osseus</i>	1
14	12.0	RDB	24-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	13
14	12.0	RDB	24-Jul-08	Common Carp	<i>Cyprinus carpio</i>	2
14	12.0	RDB	24-Jul-08	River Carpsucker	<i>Carpionodes carpio</i>	1
14	12.0	RDB	24-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	3
14	12.0	RDB	24-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	3
14	12.0	RDB	24-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	5
14	12.0	RDB	24-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	3
14	12.0	RDB	24-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	5
14	12.0	RDB	24-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
14	12.0	RDB	24-Jul-08	Rock Bass	<i>Ambloplites rupestris</i>	1
14	12.0	RDB	24-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	2
14	12.0	RDB	24-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	3
14	12.0	RDB	24-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	4
14	12.0	RDB	24-Jul-08	White Crappie	<i>Pomoxis annularis</i>	1
14	12.0	RDB	24-Jul-08	Logperch	<i>Percina caprodes</i>	19
14	12.0	RDB	24-Jul-08	Saugeye	<i>Sander canadensis x S. vitreus</i>	2
14	12.0	RDB	24-Jul-08	Sauger	<i>Sander canadensis</i>	18

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count
14	12.0	RDB	24-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	5
15	12.5	LDB	24-Jul-08	Gizzard Shad	<i>Dorosoma cepedianum</i>	3
15	12.5	LDB	24-Jul-08	Common Carp	<i>Cyprinus carpio</i>	1
15	12.5	LDB	24-Jul-08	Emerald Shiner	<i>Notropis atherinoides</i>	1
15	12.5	LDB	24-Jul-08	Silver Chub	<i>Macrhybopsis storeriana</i>	2
15	12.5	LDB	24-Jul-08	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	2
15	12.5	LDB	24-Jul-08	Silver Redhorse	<i>Moxostoma anisurum</i>	19
15	12.5	LDB	24-Jul-08	Golden Redhorse	<i>Moxostoma erythrurum</i>	2
15	12.5	LDB	24-Jul-08	Northern Hog Sucker	<i>Hypentelium nigricans</i>	1
15	12.5	LDB	24-Jul-08	Smallmouth Buffalo	<i>Ictiobus bubalus</i>	6
15	12.5	LDB	24-Jul-08	Channel Catfish	<i>Ictalurus punctatus</i>	2
15	12.5	LDB	24-Jul-08	Flathead Catfish	<i>Pylodictis olivaris</i>	1
15	12.5	LDB	24-Jul-08	Rock Bass	<i>Ambloplites rupestris</i>	2
15	12.5	LDB	24-Jul-08	Bluegill	<i>Lepomis macrochirus</i>	2
15	12.5	LDB	24-Jul-08	Smallmouth Bass	<i>Micropterus dolomieu</i>	11
15	12.5	LDB	24-Jul-08	Spotted Bass	<i>Micropterus punctulatus</i>	2
15	12.5	LDB	24-Jul-08	Logperch	<i>Percina caprodes</i>	29
15	12.5	LDB	24-Jul-08	Walleye	<i>Sander vitreus</i>	2
15	12.5	LDB	24-Jul-08	Sauger	<i>Sander canadensis</i>	21
15	12.5	LDB	24-Jul-08	Freshwater Drum	<i>Aplodinotus grunniens</i>	1

Appendix C. Habitat survey data from 13 sites in the Dashields 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	6.7	RDB	2.9	40.7	40.0	13.6	2.9	0.0	0.0	5.4	0.0	1.6	5.0	NF,I	none	sloped
2	7.7	RDB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	1.8	7.5	NF,I	none	sloped
3	8.1	RDB	1.0	10.7	15.5	46.6	26.2	0.0	0.0	11.2	0.0	0.8	5.0	R, NF	ramp	gradual
4	8.4	LDB	1.0	10.1	55.6	11.1	22.2	0.0	0.0	9.0	0.0	0.8	0.0	R,I	boat docks, wall	steep
5	8.4	RDB	7.6	8.5	15.3	48.3	19.5	0.8	0.0	8.8	2.0	2.6	5.0	R, NF,I	boat docks, mooring cells	steep
6	9.1	LDB	0.8	8.5	38.8	14.0	3.9	0.0	34.1	9.8	0.0	0.0	0.0	R,NF	boat docks	steep
7	9.4	RDB	7.8	19.1	31.2	36.2	5.7	0.0	0.0	8.2	0.0	1.2	5.0	NF,R	barges	sloped
8	9.8	LDB	21.6	23.5	21.6	32.4	1.0	0.0	0.0	14.5	0.0	1.4	5.0	R,I	none	steep
9	10.0	RDB	2.0	5.0	19.0	27.0	47.0	0.0	0.0	6.8	2.0	2.8	5.0	NF,R	none	sloped
10	10.6	LDB	1.5	24.2	25.8	18.2	30.3	0.0	0.0	13.1	2.0	1.0	6.7	I	ramp	steep
11	10.8	RDB	0.0	33.3	37.3	15.7	13.7	0.0	0.0	14.3	2.0	1.4	5.0	NF,I	wall	gradual
12	11.3	LDB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0	2.4	5.0	NF, I	none	sloped
13	11.6	RDB	8.0	31.0	29.2	31.0	0.9	0.0	0.0	13.0	0.0	0.8	5.0	I	ramp, boat dock	steep
14	12.0	RDB	0.0	29.4	36.9	32.5	1.3	0.0	0.0	9.8	0.0	1.2	5.0	NF,I	none	steep
15	12.5	LDB	0.0	26.2	19.7	50.0	4.1	0.0	0.0	10.9	0.0	1.0	5.0	NF	mooring cells	sloped

Appendix D. Water quality parameters measured prior to fish sampling in Dashields pool.

Site #	River Mile	Bank	pH	Temp (C)	Dissolved Oxygen (mg/L)	Conductivity	Secchi (in)
1	6.7	RDB	8.08	27.09	8	364	36
2	7.7	RDB	8.38	26.99	8.29	372	30
3	8.1	RDB	7.97	26.7	7.71	368	30
4	8.4	RDB	8.34	26.79	8.09	366	30
5	8.4	LDB	6.97	25.8	9.21	368	25
6	9.1	LDB	6.97	25.8	9.44	368	25
7	9.4	RDB	6.97	25.8	9.28	368	25
8	9.8	LDB	8.56	25.36	8.89	364	30
9	10.0	RDB	7.65	26.19	9.46	343	30
11	10.6	LDB	7.65	26.9	9.08	343	30
10	10.8	RDB	7.65	26.19	9.01	343	30
12	11.3	LDB	7.95	26.53	7.89	432	24
13	11.6	RDB	7.95	26.53	7.89	432	42
14	12.0	RDB	7.95	26.53	7.89	432	30
15	12.5	LDB	7.95	26.53	7.89	432	n/a

Appendix E. Water quality parameters analyzed from Dashields 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	6.7	1	0.16	26	124	0.699	<5.00	82	0.817	4.37	0.039	14
		2	<0.03	22	96	0.806	<5.0	130	0.677	4.49	0.039	7.14
		3	0.12	42	140	1.13	<5.0	110	0.688	5.65	0.033	4.5
2	7.7	1	0.15	20	128	0.738	<5.00	84	0.549	4.86	0.043	18.4
		2	<0.03	22	104	0.817	<5.0	106	0	4.58	0.035	7.2
		3	0.1	46	140	1.11	<5.0	94	0.849	3.22	0.036	5.33
3	8.1	1	0.15	24	128	0.73	<5.00	80	0.804	4.36	0.04	16.7
		2	<0.03	20	104	0.82	<5.0	86	0.527	5.04	0.043	8.8
		3	0.12	42	128	1.09	<5.0	112	0.619	5.24	0.038	4.17
4	8.4 RDB	1	0.19	20	128	0.734	<5.00	84	0.615	4.26	0.042	22.4
		2	<0.03	20	104	0.806	<5.0	76	0.51	4.62	0.045	10.8
		3	0.13	40	136	1.04	<5.0	116	0.464	3.72	0.031	6.33
5	8.4 LDB	1	0.2	24	124	0.742	<5.00	82	0.759	4.42	0.038	16
		2	<0.03	22	96	0.812	<5.0	102	0.385	4.47	0.039	7.6
		3	0.11	44	128	1.06	<5.0	108	0.549	3.43	0.035	5.33
6	9.1	1	0.19	30	124	0.777	<5.00	84	0.586	4.23	0.056	20.7
		2	<0.03	22	100	0.803	<5.0	72	0.558	4.96	0.043	7.4
		3	0.13	44	124	1.07	<5.0	110	0.516	3.6	0.036	6.17
7	9.4	1	0.14	22	128	0.772	<5.00	86	0.659	4.09	0.046	16
		2	<0.03	20	96	0.798	<5.0	86	0.546	5.26	0.038	7.2
		3	0.11	36	156	1.06	<5.0	120	0.731	3.48	0.033	6
8	9.8	1	0.15	20	124	0.618	<5.00	84	0.612	5.48	0.05	22.2
		2	<0.03	20	104	0.766	<5.0	86	0.424	4.51	0.038	11.6
		3	0.14	38	136	0.983	<5.0	122	0.633	3.45	0.03	5.33
9	10.0	1	0.16	20	136	0.734	<5.00	108	0.593	3.79	0.036	16.6
		2	<0.03	24	100	0.68	<5.0	74	0.565	4.43	0.052	9.8
		3	0.12	38	136	1.06	<5.0	116	0.759	3.8	0.037	5.67
10	10.6	1	0.14	18	132	0.703	<5.00	96	0.551	4.42	0.032	14.2
		2	<0.03	20	100	0.75	<5.0	78	0.546	4.81	0.048	6.8
		3	0.1	40	136	1.05	<5.0	116	0.475	3.05	0.038	5
11	10.8	1	0.13	18	164	0.584	<5.00	116	0.711	4.28	0.061	24.2
		2	<0.03	22	104	0.78	<5.0	94	0.436	4.79	0.037	12.6
		3	0.1	38	140	1.09	<5.0	120	0.573	7.68	0.03	6.17
12	11.3	1	0.15	28	120	0.647	<5.00	78	0.599	4.26	0.045	22.7
		2	<0.03	22	104	0.68	<5.0	86	0.506	4.43	0.03	7.4
		3	0.09	38	144	1.06	<5.0	114	0.675	2.51	0.031	6.83
13	11.6	1	0.16	18	136	0.656	<5.00	98	0.744	4.49	0.032	15
		2	<0.03	20	104	0.698	<5.0	92	0.535	4.3	0.038	9.2
		3	0.1	40	124	1.07	<5.0	112	0.551	2.41	0.033	5.83
14	12.0	1	0.15	22	136	0.865	<5.00	118	0.75	4.49	0.058	16.6
		2	<0.03	20	100	0.685	<5.0	86	0.541	4.58	0.037	8.8
		3	0.17	42	132	1.11	<5.0	104	0.693	2.62	0.055	5.83
15	12.5	1	0.14	22	148	0.607	<5.00	122	0.665	4.94	0.037	19.6
		2	<0.03	20	104	0.697	<5.0	88	0.478	3.94	0.052	13.8
		3	0.15	38	128	1.1	<5.0	112	0.499	2.46	0.035	6.33