Biological Programs 2006
Intensive Survey Results
Series 3
Report 2

A Biological Study of the Ohio River

The Montgomery Pool

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 20 assessment units based primarily on the locations of navigational dams. Using a random design, each assessment unit was assigned 15 sampling locations.

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

- In 2006, 87% of the sites assessed in Montgomery pool were in passing condition. This percentage indicates the pool is passing; however, the confidence and precision (14%) of the measurement is not at the desired level of the current protocol.

- After considering the results and additional relevant information about the pool, Montgomery was listed as passing. Since no other data indicated impairment, the Biological Water Quality Subcommittee decided that reassessing the pool is a lower priority compared to assessing other areas of the Ohio River.

- Previous analyses have indicated that increased flows may cause lower ORFIn scores due to decreased sampling efficiency and changes in fish behavior.

- Flows were moderately elevated when sampling was conducted in Montgomery pool. The effect of this on the 2006 data was uncertain.

- Recommendations include:

    - Accepting the assessment of Montgomery Pool as meeting its aquatic life use designation.
    - Resources would be better spent assessing another pool rather than reassessing a pool that appears to be passing.
    - Continuing to monitor flow and its influence on assessment results.

Table of Contents

A Biological Study of the Montgomery Pool of the Ohio River

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 (fish and macroinvertebrate studies). Another priority, water quality impacts assessment, is achieved through entire watershed intensive surveys.

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

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

An important aspect of biological monitoring is the reduction of human induced bias in the samples. The use of probability-based sample site selection was designed to reduce this bias. Within this design, sample sites are randomly selected by computer generation, eliminating the tendency to sample only in the best or worst locations. Many states already have programs in place that use this design for sampling on smaller streams, and it is also used by the U.S. Environmental Protection Agency's (USEPA) Environmental Monitoring and Assessment Program (EMAP). ORSANCO has now begun using this approach on the Ohio River for its biological monitoring. In 2006, Montgomery, Willow Island, Greenup, and Cannelton pools were sampled as part of ORSANCO's normal monitoring. This report presents the 2006 survey of the Montgomery 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 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).

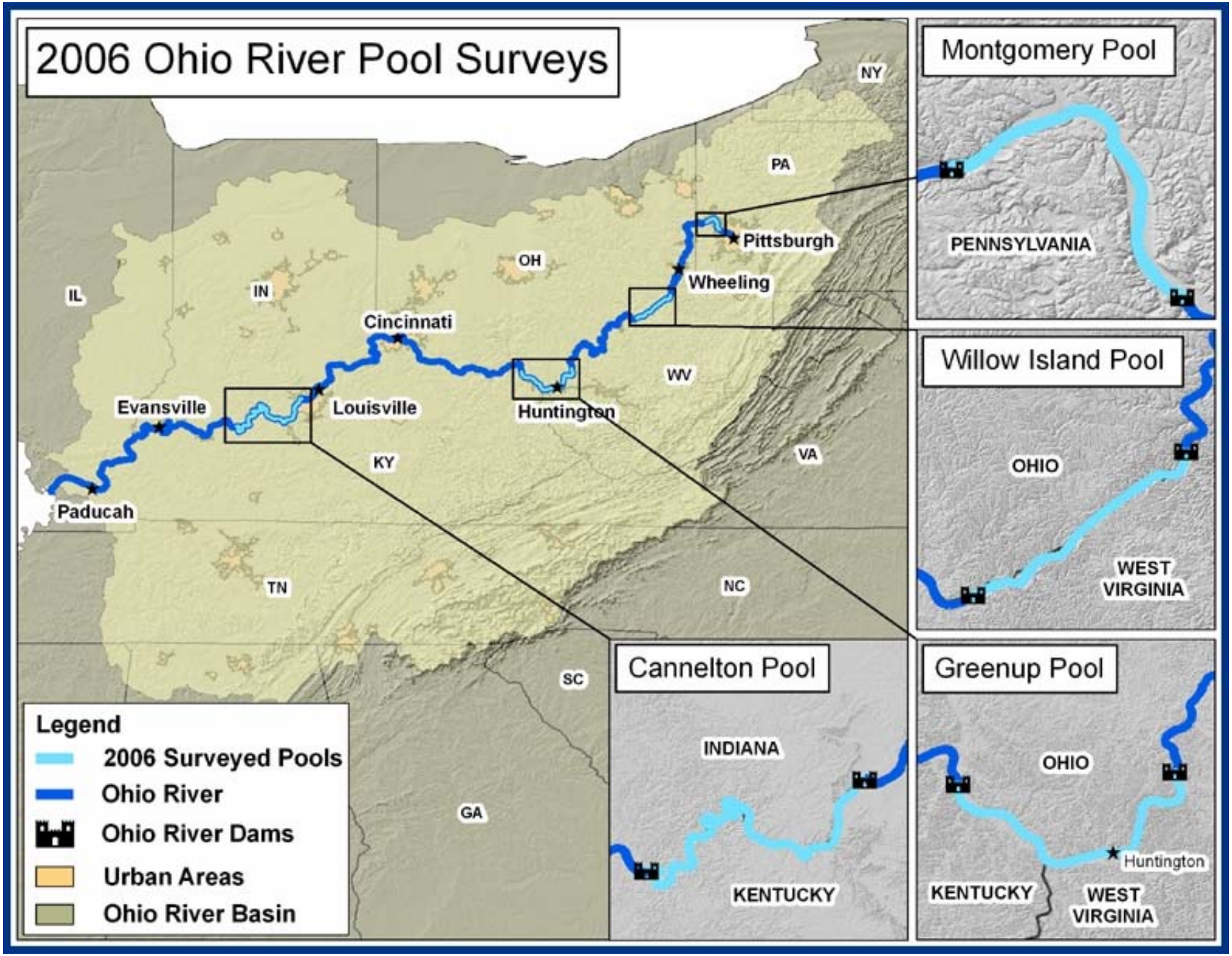


Figure 1. *The Ohio River Basin and the four pools selected for 2006 sampling.*

2.2 Montgomery Pool

The Montgomery pool is 18.5 miles long, extending from Dashields Locks and Dam (ORM 13.2) to Montgomery Locks and Dam (ORM 31.7). The pool has a gradient drop of 0.2 feet per mile, averages 1376 feet wide and 25 feet deep. The pool flows entirely within the state of Pennsylvania. This pool lies in a portion of the Ohio River heavily influenced by industry and begins just 13 miles below the city of Pittsburgh. Much of the shoreline is influenced by steel mills, rail yards and other industries. The Montgomery pool receives water from two sub-basins: the Beaver River and Raccoon Creek. These land use of these watersheds is primarily agricultural with large amounts of forest, and some urban influences.

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 Montgomery pool of the Ohio River from mile marker 13.2 (Dashields Locks and Dam) to 31.7 (Montgomery Locks and Dam). The total linear extent of the target population was approximately 37 miles. The sample frame was generated using RF3 river double lines for the Ohio River and river mile coverages provided by ORSANCO. A generalized random tessellation stratified (GRTS) survey design for a linear network with reverse hierarchical randomization (RHR) was used to select all sampling locations. This survey design provided coordinates for 15 sampling sites in each of the selected pools. The data collected from these sites were used to make an assessment of the pool (see Section 3.6 and Appendix A).

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

3.2 Index Period and Sampling Restrictions

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

3.3 Fish Collections

Standard collection techniques were employed throughout the surveys as described by Emery et al. (2003). Fish were collected using boat electrofishing techniques at night because nighttime electrofishing typically yields samples of increased diversity and richness (Sanders 1992).

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 30m or a depth of 20ft.) 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 weighed, measured, inspected for anomalies, and identified to lowest possible taxonomic level (species) before being returned to the water. Fish that could not be confidently identified in the field (e.g. minnows) were preserved in a ten percent formalin solution and identified in the laboratory.

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 three existing classes of habitat: 'A', 'B', or 'C'. By assigning each sampling site to one of three habitat categories, biologists can reduce the amount of assessment variability, or 'noise', because each habitat class has a slightly different expectation. Sites assigned to habitat class 'A' are characterized by the presence of large substrates such as cobble and boulders. Sites that fall in habitat class 'C' are dominated by sand and other small substrates, and habitat class 'B' describes sites that fall between 'A' and 'C' with a mix of large and small substrate materials.

3.5 Water Quality and Flow Condition Data

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

3.6 Pool Assessment

In 2006, 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 Montgomery pool served as one distinct assessment unit (AU) and will be reported on as such in the 305(b) report issued to EPA. The approach to assessing each AU involved sampling a statistically determined number of sites (15) and comparing observed ORFIn scores to habitat derived expectations for each site (Emery et al. 2003).

The three distinct habitat classes ('A', 'B', and 'C') each exhibit different levels of ORFIn performance. Performance expectations for each habitat class were determined based on the statistical distribution of data (ORFIn scores) gathered from 'least impacted' (reference) sites within each habitat class. The 25th percentile value for each habitat class was established as the criterion for determining whether an individual site 'passes' (meets its aquatic life use designation) or 'fails' (does not meet its aquatic life use designation, Figure 2).

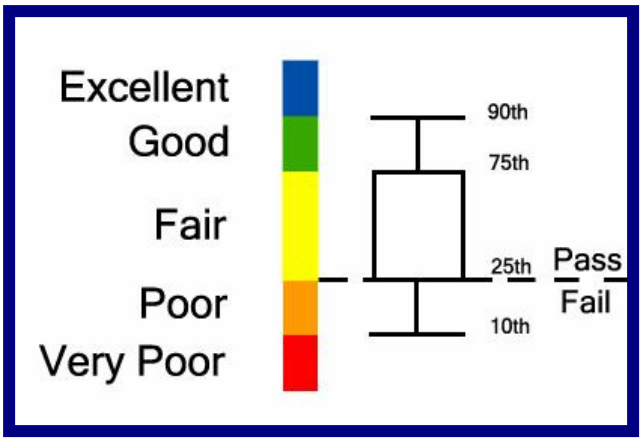


Figure 2. *Approach used to assign habitat condition ratings.*

Individual site scores were compared to expected values and the percentage of failing sites in the pool was then calculated. A precision estimate for the percentage of sites failing was also calculated (see Appendix A for a detailed explanation). The precision estimate was used to create a 90% confidence interval around the percentage of sites failing. The threshold for the pool assessment was set at 25% failure. The pool passed the assessment if the entire confidence interval fell below 25%. If the whole confidence interval was greater than 25%, the pool was assessed as failing. If the confidence interval overlapped the 25% threshold, the assessment required additional sampling to determine the result. To further characterize the condition of each pool, sites were given individual condition ratings. These ratings were based on the same distribution of data from 'least impacted' sites used to determine expectations and consisted of Excellent, Good, Fair, Poor and Very Poor. The 90^{th}, 75^{th}, 25^{th}, and 10^{th} percentiles were used as cutoff points for the different ratings. Any sites that were classified as Poor or Very Poor were also sites that failed to meet expectations (Figures 2 and 3).

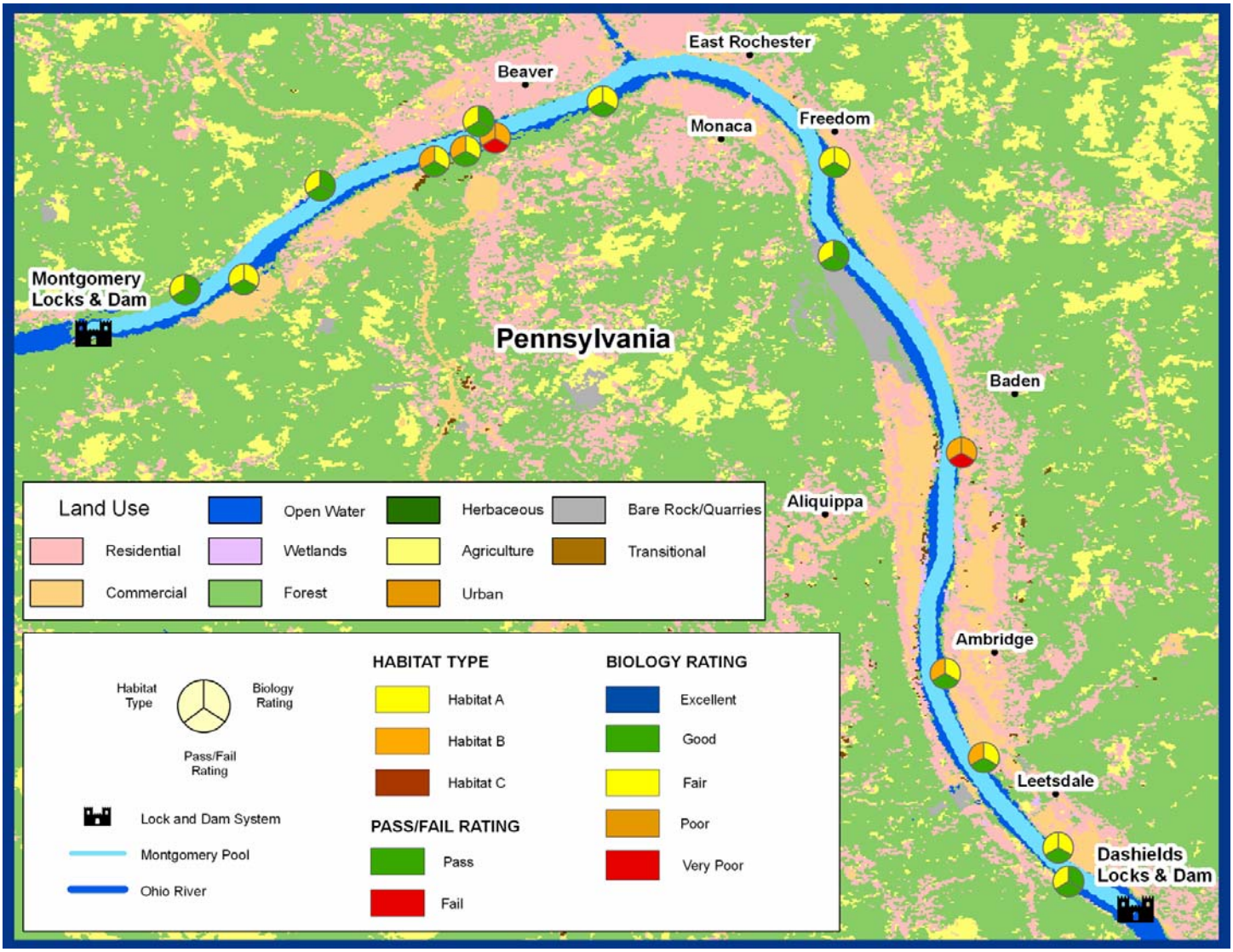


Figure 3. *Locations and results of sampling at 15 sites within the Montgomery pool.*

4.0 Results

4.1 Fish Population

In 2006, fish population data (Appendix B) were collected from 15 randomly selected locations throughout the length of the Montgomery pool (Table 1). These collections produced 41 species, representing 10 different families (Table 2). Two of those species, grass carp (*Ctenopharyngoden idella*) and common carp (*Cyprinus carpio*), were non-natives. Nine of these taxa are listed in PA as either threatened, endangered or of special concern. These include longnose gar (*Lepisosteus osseus*), mooneye (*Hiodon tergisus*), silver chub (*Macrhybopsis storeriana*), smallmouth buffalo (*Ictiobus bubalus*), river redhorse (*Moxostoma carinatum*), spotted sucker (*Minytrema melanops*), longear sunfish (*Lepomis megalotis*), warmouth (*Lepomis gulosus*) and channel darter (*Percina copelandi*). At the species level, the most abundant species were smallmouth buffalo (*I. bubalus*) and sauger (*Sander canadensis*), which comprised 12.9% and 12.8% of the catch respectively (Figure 4). The dominance of these two species was directly reflected at the family level. The sucker family (Catostomidae) dominated in abundance, making up 37.5% of the total catch, followed by the perch family (Percidae) which made up 16.5% of the catch (Figure 5).

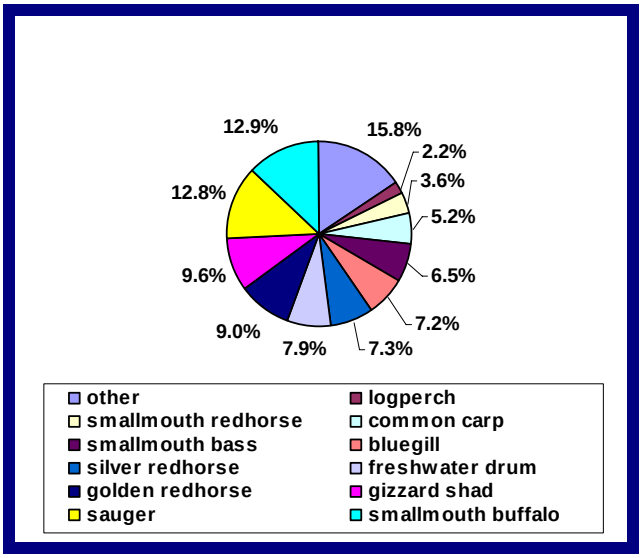


Figure 4. *Species composition of fish sampled in the Montgomery pool.*

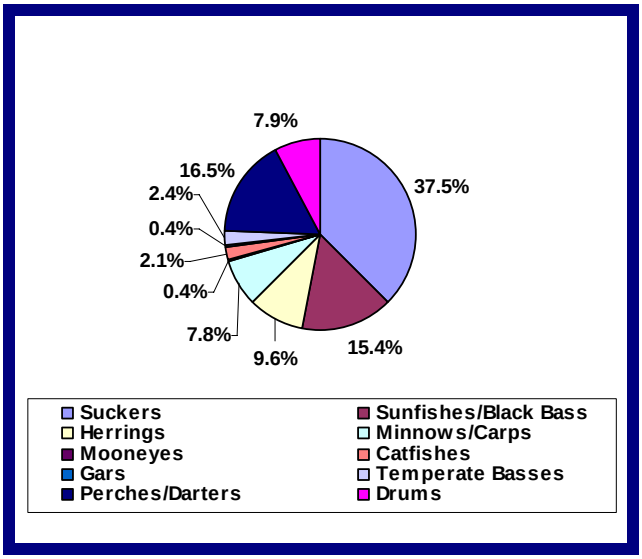


Figure 5. *Sampled fish composition by family in the Montgomery pool.*

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

Site #	River Mile	Bank	Date	Latitude	Longitude	Habitat Class	ORFIn Expectation	Observed ORFIn	Site Result	Rating
1	13.7	LDB	27-Sep-06	40.5530	80.2126	A	39	47	PASS	GOOD
2	14.1	RDB	27-Sep-06	40.5589	80.2144	A	39	45	PASS	FAIR
3	15.8	RDB	27-Sep-06	40.5747	80.2274	B	33	41	PASS	FAIR
4	16.6	RDB	26-Sep-06	40.5894	80.2342	B	33	37	PASS	FAIR
5	19.3	RDB	26-Sep-06	40.6283	80.2313	B	33	29	FAIL	POOR
6	22.0	LDB	26-Sep-06	40.6630	80.2537	A	39	47	PASS	GOOD
7	23.1	RDB	25-Sep-06	40.6794	80.2535	A	39	39	PASS	FAIR
8	26.1	LDB	7-Aug-06	40.6900	80.2941	A	39	39	PASS	FAIR
9	27.0	LDB	25-Sep-06	40.6836	80.3129	B	33	23	FAIL	POOR
10	27.1	RDB	20-Jul-06	40.6865	80.3158	A	39	49	PASS	GOOD
11	27.3	LDB	20-Jul-06	40.6813	80.3180	B	33	41	PASS	FAIR
12	27.6	LDB	19-Jul-06	40.6795	80.3235	B	33	37	PASS	FAIR
13	28.7	RDB	19-Jul-06	40.6752	80.3435	A	39	49	PASS	GOOD
14	30.1	LDB	18-Jul-06	40.6588	80.3568	A	39	43	PASS	FAIR
15	30.4	RDB	18-Jul-06	40.6570	80.3671	A	39	49	PASS	GOOD

LDB = Left Descending Bank
RDB = Right Descending Bank

Table 2. *Species collected in the Montgomery pool during the 2006 survey.*

Family	Species	Latin Name	PA
Lepisosteidae	longnose gar	*Lepisosteus osseus*	SC
Hiodontidae	mooneye	*Hiodon tergisus*	T
Clupeidae	gizzard shad	*Dorosoma cepedianum*	
Cyprinidae	grass carp	*Ctenopharyngoden idella*	
Cyprinidae	spotfin shiner	*Cyprinella spiloptera*	
Cyprinidae	common carp	*Cyprinus carpio*	
Cyprinidae	silver chub	*Macrhybopsis storeriana*	E
Cyprinidae	emerald shiner	*Notropis atherinoides*	
Cyprinidae	mimic shiner	*Notropis volucellus*	
Catostomidae	river carpsucker	*Carpiodes carpio*	
Catostomidae	quillback	*Carpiodes cyprinus*	
Catostomidae	highfin carpsucker	*Carpiodes velifer*	
Catostomidae	northern hog sucker	*Hypentelium nigricans*	
Catostomidae	smallmouth buffalo	*Ictiobus bubalus*	T
Catostomidae	silver redhorse	*Moxostoma anisurum*	
Catostomidae	smallmouth redhorse	*Moxostoma breviceps*	
Catostomidae	river redhorse	*Moxostoma carinatum*	SC
Catostomidae	black redhorse	*Moxostoma duquesnei*	
Catostomidae	golden redhorse	*Moxostoma erythrurum*	
Ictaluridae	channel catfish	*Ictalurus punctatus*	
Ictaluridae	flathead catfish	*Pylodictis olivaris*	
Moronidae	morone sp	*Morone sp*	
Moronidae	white bass	*Morone chrysops*	
Moronidae	hybrid striper	*Morone saxatilis x chrysops*	
Centrarchidae	rock bass	*Ambloplites rupestris*	
Centrarchidae	lepomis hybrid	*Lepomis hybrid*	
Centrarchidae	green sunfish	*Lepomis cyanellus*	
Centrarchidae	pumpkinseed	*Lepomis gibbosus*	
Centrarchidae	bluegill	*Lepomis macrochirus*	
Centrarchidae	redear sunfish	*Lepomis microlophus*	
Centrarchidae	smallmouth bass	*Micropterus dolomieu*	
Centrarchidae	spotted bass	*Micropterus punctulatus*	
Centrarchidae	largemouth bass	*Micropterus salmoides*	
Centrarchidae	black crappie	*Pomoxis nigromaculatus*	
Percidae	greenside darter	*Etheostoma blennioides*	
Percidae	rainbow darter	*Etheostoma caeruleum*	
Percidae	fantail darter	*Etheostoma flabellare*	
Percidae	banded darter	*Etheostoma zonale*	
Percidae	yellow perch	*Perca flavescens*	
Percidae	logperch	*Percina caprodes*	
Percidae	channel darter	*Percina copelandi*	T
Percidae	sauger	*Sander canadensis*	
Percidae	walleye	*Sander vitreus*	
Sciaenidae	freshwater drum	*Aplodinotus grunniens*	

SC = Special Concern T = Threatened

4.2 Metric Performance

Thirteen metrics were used to calculate ORFIn scores for each electrofishing site (Emery et al. 2003). Each site's performance and scores for the ORFIn metrics are shown in Table 3. The number of native species collected at each site ranged from 12 to 23, with an average of 17.3 species per site. Thirteen of the fifteen sites scored a 3 for the number of native species metric. The number of sucker species found at each site ranged from 4 to 7 and the sites scored either 3 or 5 for this metric. The number of centrarchid species varied from 2 to 7 and the majority of the sites scored a 3 for this metric. The number of great river species varied between 0 and 2 species per site, with scores being either 1 or 3 for all sites. There number of intolerant species ranged from 1 to 5 at the sampled sites, with scores of 1 and 3. Most of the sites had less than 4.0% tolerant individuals, although 2 possessed values greater than 9.0%. Ten of the sites scored a 5 for the percent of tolerant individuals, the remaining sites scored a 3 or lower. The percentage of simple lithophils was between 28.9% and 75.5%, and the majority of site scores for this metric were either 3 or 5. Ten of the sites had less than 4.0% non-native individuals, though a few possessed values greater than 9.0%. Eleven of the sites scored a 5 with most all of the remaining sites scoring a 1 for this metric. The percent detritivores ranged from 5.8% to 49.1% and scores were 1, 3, or 5 for the sites. The percent invertivores ranged from 14.0% to 60.4%, with most sites scoring a 3 or 5 for this metric. The percent piscivores ranged from 20.6% to 70.0% and thirteen of the fifteen sites had metric scores of 3. The number of DELT (deformities, eroded fins, lesions and tumors) anomalies ranged from 0 to 5, though nine of sites had 1 or fewer. Those nine sites scored a 5 for this metric, while the others scored 3 or lower. The CPUE (catch per unit effort) ranged from 62 to 199 individuals per site, all of which scored either 1 or 3 for the CPUE metric.

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 sampling locations revealed that the bottom substrate in the Montgomery pool was mostly composed of sand (33%) and gravel (27%), with some portions of cobble and fines with a small percentage of boulder (Figure 6).

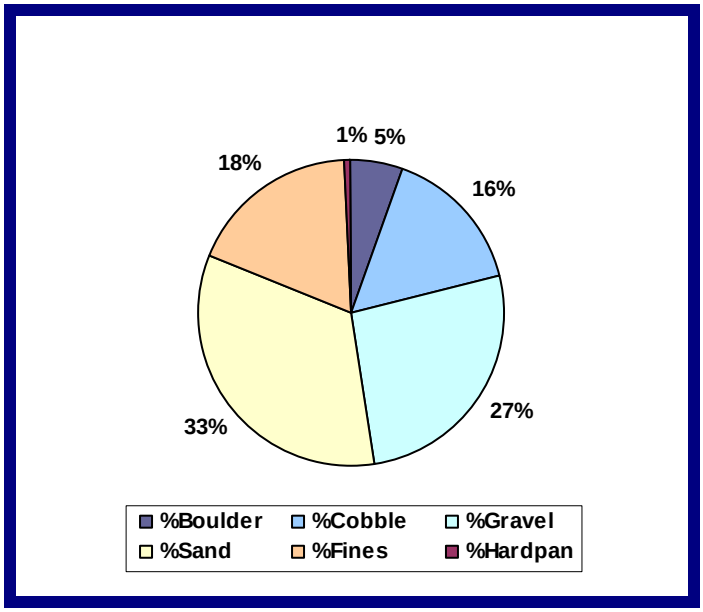


Figure 6. Substrate composition of the Montgomery pool.

However, there was some variation among the individual sites (Figure 7). The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', or 'C' (Table 1). The Montgomery pool was dominated by class 'A' habitats, which account for 60% of the samples. The remaining 40% of the samples was classified as class 'B' habitats and no class 'C' habitats sampled in the pool. Woody cover was present in 12 of the 15 sites sampled, but only 7 sites had cover at more than 10% of the area. Riparian land use was primarily industrial and forest (additional data in Appendix C).

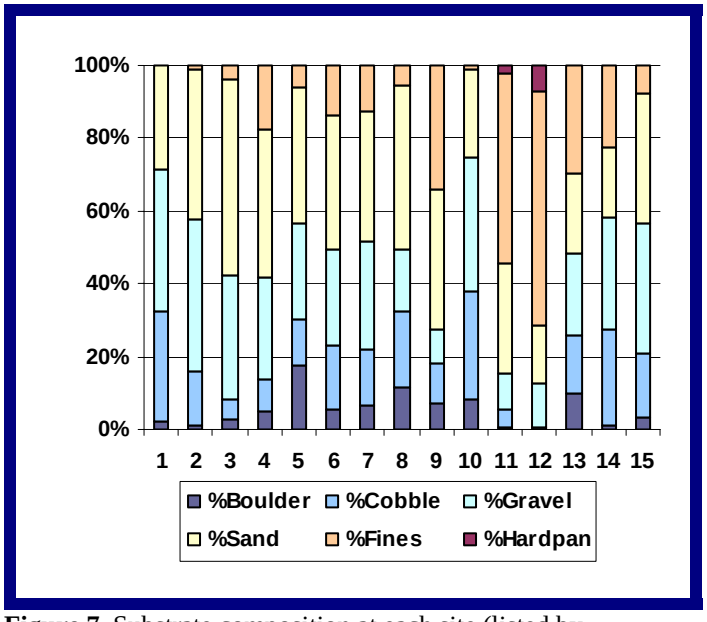


Figure 7. Substrate composition at each site (listed by number) sampled in the Montgomery pool

Table 3. ORFIN metrics and scores from the Montgomery pool 2006 survey.

Site #	River Mile	Bank	# Individuals	# Individuals w/o G & E	# Individuals w/o GETHEx	# Species	# Species Score	# Suckers	Suckers Species Score	# Centrarchid Species	Centrarchid Species Score	# Great River Species	Great River Species Score	# Intolerant Species	Intolerant Species Score	% Tolerant Individuals	Tolerant Individuals Score	% Simple Lithophils	Simple Lithophils Score	% Non-native Individuals	Non-native Individuals Score	% Detritivores	Detritivores Score	% Invertivores	Invertivores Score	% Piscivores	Piscivores Score	# DELTs	DELT Score	CPUE	CPUE Score	ORFIn Expectation	Observed ORFIn	Site Result
1	13.7	L	177	139	136	17	3	5	3	2	1	0	1	5	3	1.4	5	75.5	5	2.2	5	5.8	5	60.4	5	28.8	3	1	5	174	3	39	47	PASS
2	14.1	R	153	141	140	18	3	7	5	2	1	0	1	3	3	0.7	5	52.5	5	0.7	5	15.6	3	59.6	5	21.3	3	2	3	152	3	39	45	PASS
3	15.8	R	95	80	77	13	3	5	3	3	3	0	1	2	1	2.5	5	55.0	5	3.8	5	11.3	3	48.8	3	38.8	3	1	5	92	1	33	41	PASS
4	16.6	R	95	92	83	17	3	4	3	3	3	2	3	4	3	9.8	1	62.0	5	9.8	1	13.0	3	50.0	3	34.8	3	0	5	86	1	33	37	PASS
5	19.3	R	97	91	81	19	3	5	3	5	3	0	1	2	1	11.0	1	34.1	3	11.0	1	16.5	3	38.5	3	38.5	3	2	3	87	1	33	29	FAIL
6	22.0	L	126	102	101	15	3	6	5	3	3	2	3	3	3	1.0	5	66.7	5	1.0	5	17.6	3	56.9	5	20.6	3	2	3	125	1	39	47	PASS
7	23.1	R	139	95	91	16	3	7	5	2	1	0	1	4	3	4.2	3	42.1	3	4.2	5	24.2	1	29.5	3	41.1	5	1	5	135	1	39	39	PASS
8	26.0	L	136	112	107	17	3	5	3	4	3	1	1	4	3	3.6	3	43.8	5	4.5	3	14.3	3	37.5	3	38.4	3	1	5	131	1	39	39	PASS
9	27.0	L	64	50	48	12	3	4	3	4	3	1	1	1	1	4.0	1	54.0	1	4.0	1	12.0	1	14.0	1	70.0	1	1	5	62	1	33	23	FAIL
10	27.1	R	148	147	143	19	3	6	5	5	3	1	1	5	3	0.7	5	55.1	5	2.7	5	9.5	5	57.8	5	27.9	3	1	5	144	1	39	49	PASS
11	27.3	L	159	137	137	19	3	6	5	4	3	2	3	3	3	0.0	5	32.8	3	0.0	5	40.1	1	32.1	3	24.1	3	5	1	159	3	33	41	PASS
12	27.6	L	159	114	112	17	3	7	5	3	3	0	1	3	3	0.9	5	36.0	3	1.8	5	49.1	1	26.3	1	21.1	3	5	1	157	3	33	37	PASS
13	28.7	R	202	189	186	23	5	5	3	7	5	2	3	4	3	1.1	5	31.7	3	1.6	5	10.6	3	52.9	3	27.5	3	1	5	199	3	39	49	PASS
14	30.1	L	166	159	154	21	5	6	5	4	3	0	1	4	3	3.1	5	28.9	3	2.5	5	34.0	1	35.8	3	22.6	3	3	3	161	3	39	43	PASS
15	30.4	R	160	154	151	16	3	6	5	4	3	0	1	3	3	1.3	5	49.4	5	1.3	5	8.4	5	54.5	3	29.2	3	1	5	157	3	39	49	PASS

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

Flow conditions were unstable throughout the 2006 sampling period and river levels were frequently above normal. There were several rain events that caused increases in river flow and water levels throughout the Ohio River valley. For the Montgomery pool, all sampling was conducted in moderately high flows, but within sampling criteria. The harmonic mean flow for this part of the river is 20.5 kcfs and sampling was conducted between 119% and 210% of the HMF (Figure 8). Measurements of water quality parameters did not reveal any unusual or poor water conditions present at the time of sampling (Appendix D). Secchi depths at the time of sampling ranged from 30 to 48 inches.

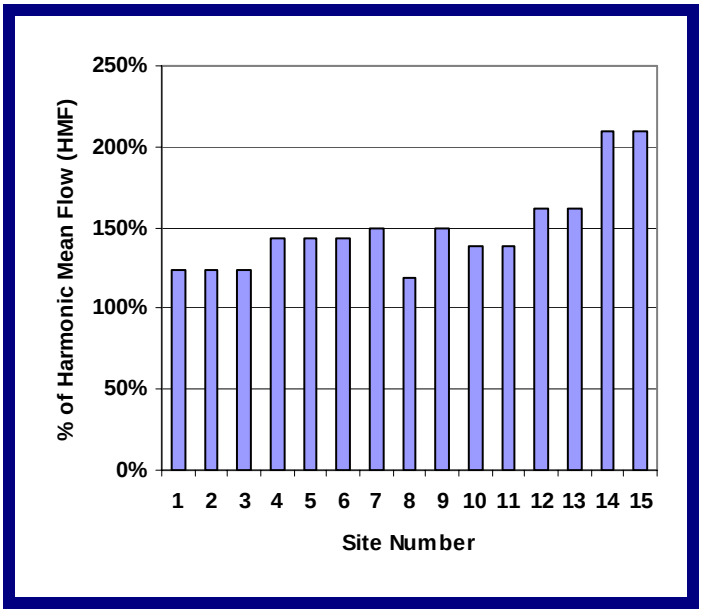


Figure 8*. Relative flows (%HMF) at the time of sampling.*

4.5 Assessment of Condition

ORFIn scores were calculated for each of the sites sampled. The maximum score achieved by any site in this pool out of a possible 65 was 49 and the minimum was 23. By comparing observed and expected ORFIn scores, ORSANCO assessed each site as either passing or failing (Table 3). All but two of the 15 sites sampled in 2006 scored higher than the minimum expected scores and received passing evaluations (Table 1). 87% of the sites were in passing condition with an estimated precision of +/- 14% (Figure 9). Five sites (33%) received a good condition rating, eight sites (54%) were found to be in fair condition and two (13%) were in poor condition (Figure 10).

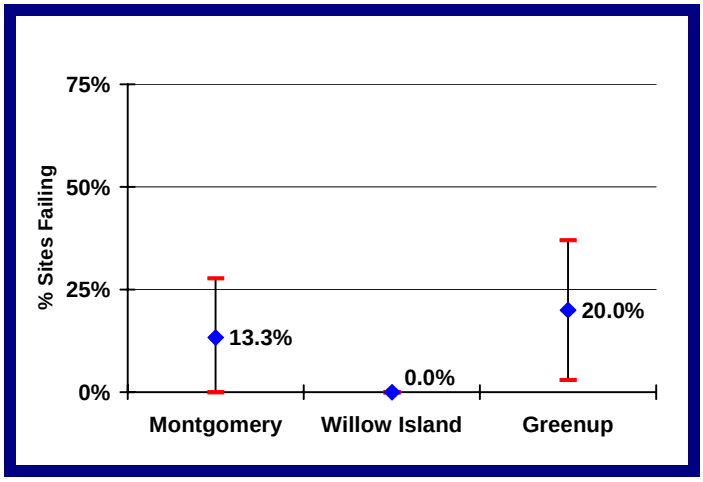


Figure 9*. 2006 pool assessment results with 90% confidence intervals.*

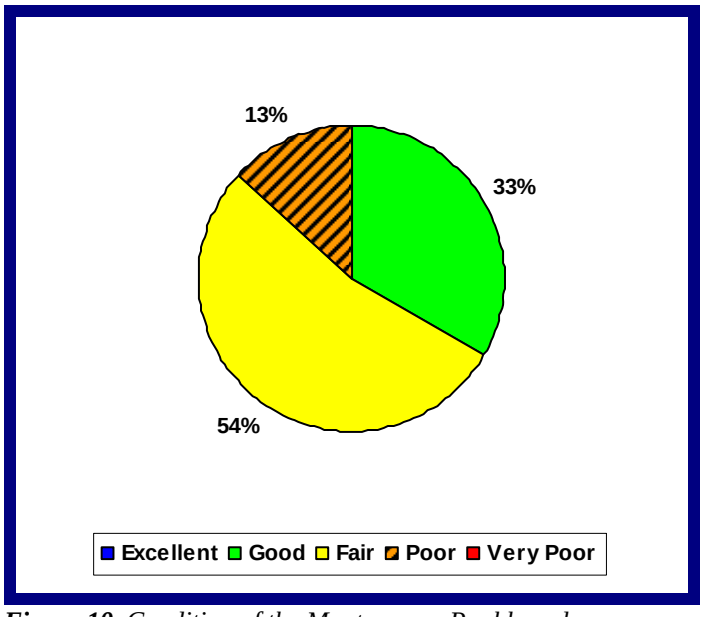


Figure 10. *Condition of the Montgomery Pool based on ORFIn scores at 15 sites (Pass=Excellent-Fair, Fail=Poor-Very Poor).*

5.0 Discussion

5.1 Fish Population

The fish population of Montgomery pool appears to be in fair to good condition. The 41 species collected indicate a diverse population. It is unexpected for smallmouth buffalo and sauger to outnumber the shad and minnows. Forage fish normally outnumber other species; their absence, as well as others, may be attributed to high flows observed during sampling.

5.2 Metric Performance

Two metrics stood out as the lowest performing metrics in Montgomery pool: the # of Great River species and CPUE metrics. For these metrics, most sites scored the minimum and none scored the maximum. Low scores for the Great River species metric are expected because the metric is designed to show community response if/when these species return to the Ohio River system. The CPUE metric was likely affected by the increased flows, which typically reduce the overall catch.

5.3 Habitat Surveys

The habitat assessments show that Montgomery pool has slightly more 'A' habitats than 'B' habitats and few, if any, class 'C' habitats. While much of the substrate is sand and gravel, there are enough larger substrates to provide good habitat for the fish population. The woody cover present at many of the sites also supplements the habitat available.

5.4 Water Quality and Flow Conditions

In previous surveys of other pools, higher flows were associated with lower site scores. The moderately high flows may have impacted the collections in 2006, however only 2 of the 15 sites failed. Considering this, Montgomery pool could have scored even higher under more optimal conditions, and may actually be in better condition than results indicate. The higher stage and flow conditions that were encountered are generally associated with faster velocities and higher turbidity levels, which can adversely affect capture efficiency by making boat maneuvering and fish netting more difficult. This may have been a problem in the survey of Montgomery pool, because no site achieved the maximum score for the CPUE metric.

All Secchi depths indicated ample visibility for sampling. There were no water chemistry measurements that were out of the ordinary or that provided any major insight into the assessment results for Montgomery pool.

5.5 Assessments of Condition and Conclusions

Despite conditions that can hinder sampling efficiency, most sites scored well enough to pass and only two were considered failing. Data collected in 2006 indicate that the Montgomery pool is in fair to good condition. The analysis indicates that the estimated percentage of the pool in failing condition is 13.3% (+/- 14%) (Figure 9). This estimate overlaps the threshold (25%) established to determine if a pool meets its aquatic life use designation, creating some uncertainty (Appendix A). Normally the pool would require additional sampling to confirm that it is indeed in passing condition. However, ORSANCO biologists have decided to accept the Montgomery pool as meeting its aquatic life use designation, focusing more on the estimate of 13.3% than on the range of precision. Biologists have concluded that limited resources are better spent assessing new areas of the Ohio River and are willing to accept this assessment. This decision was supported by the members of the ORSANCO Biological Water Quality Subcommittee.

The confluence of the Allegheny and Monongahela rivers in Pittsburgh forms the Ohio River.

Literature Cited

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

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

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

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

ORSANCO (Ohio River Valley Water Sanitation Commission). 2003. Pollution Control Standards for Discharges to the Ohio River. ORSANCO, Cincinnati, OH.

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

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

Riverboats at the Ohio River Tall Stacks Festival

Appendix A: Assessment Unit Criteria Details

- Each individual navigational pool will serve as a separate and distinct Assessment Unit (AU).

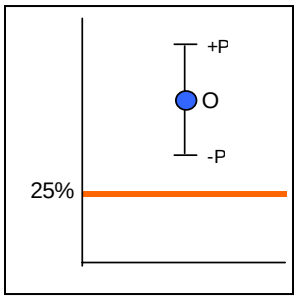
- All AUs will be sampled and assessed on a 5-year rotating basis. This is consistent with state schedules, and it allows ORSANCO (after one full rotation) in each 305(b) report, to incorporate 5 years worth of data and report on 100% of the resource. USEPA accepts 305(b) reports which use the most recent 5 years of data.

- AUs that yield >25% failure will be considered for listing as non-supporting.
  - Recognizing that even the least impacted (LI) sites in the Ohio River exhibit variability in condition, the 25th percentile of LI sites is used as the biocriteria within each habitat class.
    - Even among a random draw of LI sites, up to 25% of sites could be expected to fail, or fall below the criterion.
  - AUs with more than 25% failure rate could be listed as impaired if the BWQSC feels an "adequate assessment", as defined below, is made.

- Characteristics of "Adequate Assessments"
  - Each AU is assessed with a minimum of 15 sites, regardless of pool length.
  - 1 of 3 situations occurs after sampling 15 sites (illustrated in figure below):

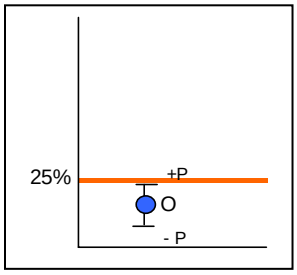
Situation 'A'

- If an observation 'O' of > 25% of the sites failing is made and O minus (-) the estimated precision (P) is >25%, the assessment is accepted as valid, the AU is listed as 'Assessed' and failing to meet the established aquatic life use. The entire AU will be properly listed on the 303(d) list.
  - If O – P > 25% then AU fails.



*Precision (P) = Z_{1-a} * 100 * Sqrt [p(1-p)/n]*

Z_{1-a} is related to the desired level of confidence
1.645 is used for 90% confidence
(use 1.96 for 95% confidence)

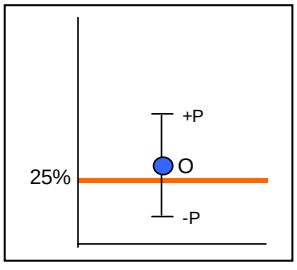


Situation 'B'

- If an observation 'O' of < 25% of the sites failing is made and O + P (precision) is <25%, the assessment is accepted as valid, the AU is listed as 'Assessed' and as meeting the established aquatic life use.
  - If O + P < 25% then AU passes.

Situation 'C'

- If after sampling 15 sites, O +/- P includes (overlaps) the criterion (25%), 1 of 2 scenarios will occur:
  - **<u>C1:</u>** if resources allow, an "Optimal Assessment" as defined below, will be conducted.
    - Additional probability sites will be sampled the next year to increase the sample size and improve precision (reducing the error bars).



- This process is repeated until one of the following occurs:
    - either Situation A or Situation B (above) is achieved.
    - precision of +/- 12 is achieved.
    - maximum of 45 samples is reached.
- At that point the AU will be considered 'Assessed', the results will be considered valid and accepted, and condition will be reported.

- **C2:** in cases where resources are limited, the BWQSC will consider other available and relevant information when deciding to accept the assessment as valid or to require more sampling.
    - Additional information to be considered in these cases include (but are not limited to):
        - additional available statistics from the current assessment
        - additional available biological & water chemistry data
        - prior performance
        - presence of known impacts
    - In these cases, ORSANCO biologists will provide a narrative justification explaining how information other than the assessment in question was used to make the assessment
    - If O + P includes 25% and multiple lines of evidence indicate that the AU is in acceptable condition, then the AU may be listed as attaining.
    - If O – P includes 25% and multiple lines of evidence indicate that the AU is in unacceptable condition, then the AU may be listed as impaired.
    - If O +/- P includes 25% and multiple lines of evidence are inconclusive, then the AU will be listed as "unassessed" and additional samples would be needed.

- Listing on the 303(d) list as
    - 4a if the determined case already has an approved TMDL is in place
    - 4b if the impairment is expected to be removed by other programs (SF, RCRA, NPDES, 319, harbor dredging)
    - 4c if the impairment is caused by something other than a pollutant
        - Habitat, natural, hydrologic, etc.
    - 5a if there is an impaired biological condition due to unknown stressor/cause.
        - Follow-up work would be needed.
            - e.g., examining WQ/Habitat/Bio interactions as a data exercise or through additional field work.
    - 5b if it is determined impairment is based on fish tissue contamination, in which case no TMDL is required.
    - 5c if a pollutant is positively identified, triggering the need for the development of a TMDL for that pollutant.

It is most likely that if any of the AUs fail, it will be listed as Category 5a.
- If follow-up work determines that a pollutant is the cause, it will be listed as Category 5c.
- If follow-up work shows impairment due to something other than a pollutant, it will be listed as Category 4c.

It will be possible to list an AU under any one of the categories shown above, although listing in any category other than 5a will require additional work, data integration, and the utmost certainty beforehand because of the resource implications of potentially triggering the need to develop a TMDL.

Appendix B. Fish survey data from the Montgomery pool.

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
1	13.7	LDB	9/27/06	banded darter	*Etheostoma zonale*	1	0.001
1	13.7	LDB	9/27/06	black crappie	*Pomoxis nigromaculatus*	1	0.179
1	13.7	LDB	9/27/06	channel catfish	*Ictalurus punctatus*	1	0.399
1	13.7	LDB	9/27/06	common carp	*Cyprinus carpio*	2	4.390
1	13.7	LDB	9/27/06	flathead catfish	*Pylodictis olivaris*	1	0.261
1	13.7	LDB	9/27/06	freshwater drum	*Aplodinotus grunniens*	5	2.337
1	13.7	LDB	9/27/06	gizzard shad	*Dorosoma cepedianum*	38	4.328
1	13.7	LDB	9/27/06	golden redhorse	*Moxostoma erythrurum*	39	8.839
1	13.7	LDB	9/27/06	hybrid striper	*Morone saxatilis x M. chrysops*	1	0.134
1	13.7	LDB	9/27/06	longnose gar	*Lepisosteus osseus*	2	0.547
1	13.7	LDB	9/27/06	mimic shiner	*Notropis volucellus*	4	0.002
1	13.7	LDB	9/27/06	river redhorse	*Moxostoma carinatum*	1	1.240
1	13.7	LDB	9/27/06	sauger	*Sander canadensis*	23	2.451
1	13.7	LDB	9/27/06	silver redhorse	*Moxostoma anisurum*	9	6.383
1	13.7	LDB	9/27/06	smallmouth bass	*Micropterus dolomieu*	9	0.753
1	13.7	LDB	9/27/06	smallmouth buffalo	*Ictiobus bubalus*	6	6.227
1	13.7	LDB	9/27/06	smallmouth redhorse	*Moxostoma breviceps*	30	4.519
1	13.7	LDB	9/27/06	walleye	*Sander vitreus*	3	2.540
1	13.7	LDB	9/27/06	white bass	*Morone chrysops*	1	0.174
2	14.1	RDB	9/27/06	bluegill	*Lepomis macrochirus*	18	1.141
2	14.1	RDB	9/27/06	channel catfish	*Ictalurus punctatus*	1	1.330
2	14.1	RDB	9/27/06	common carp	*Cyprinus carpio*	1	1.530
2	14.1	RDB	9/27/06	emerald shiner	*Notropis atherinoides*	5	0.008
2	14.1	RDB	9/27/06	freshwater drum	*Aplodinotus grunniens*	4	2.146
2	14.1	RDB	9/27/06	gizzard shad	*Dorosoma cepedianum*	7	0.769
2	14.1	RDB	9/27/06	golden redhorse	*Moxostoma erythrurum*	33	4.519
2	14.1	RDB	9/27/06	highfin carpsucker	*Carpiodes velifer*	15	1.806
2	14.1	RDB	9/27/06	longnose gar	*Lepisosteus osseus*	2	0.339
2	14.1	RDB	9/27/06	mimic shiner	*Notropis volucellus*	9	0.013
2	14.1	RDB	9/27/06	quillback	*Carpiodes cyprinus*	1	1.130
2	14.1	RDB	9/27/06	rainbow darter	*Etheostoma caeruleum*	1	0.002
2	14.1	RDB	9/27/06	river carpsucker	*Carpiodes carpio*	2	1.738
2	14.1	RDB	9/27/06	sauger	*Sander canadensis*	17	1.700
2	14.1	RDB	9/27/06	silver redhorse	*Moxostoma anisurum*	3	1.285
2	14.1	RDB	9/27/06	smallmouth bass	*Micropterus dolomieu*	10	0.901
2	14.1	RDB	9/27/06	smallmouth buffalo	*Ictiobus bubalus*	3	4.080
2	14.1	RDB	9/27/06	smallmouth redhorse	*Moxostoma breviceps*	20	3.163
2	14.1	RDB	9/27/06	white bass	*Morone chrysops*	1	0.092
3	15.8	RDB	9/27/06	bluegill	*Lepomis macrochirus*	15	0.740
3	15.8	RDB	9/27/06	channel catfish	*Ictalurus punctatus*	1	0.915
3	15.8	RDB	9/27/06	common carp	*Cyprinus carpio*	2	3.830

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
3	15.8	RDB	9/27/06	gizzard shad	*Dorosoma cepedianum*	15	2.020
3	15.8	RDB	9/27/06	golden redhorse	*Moxostoma erythrurum*	17	1.199
3	15.8	RDB	9/27/06	highfin carpsucker	*Carpiodes velifer*	4	0.507
3	15.8	RDB	9/27/06	hybrid striper	*Morone saxatilis x M. chrysops*	1	0.212
3	15.8	RDB	9/27/06	rainbow darter	*Etheostoma caeruleum*	1	0.002
3	15.8	RDB	9/27/06	rock bass	*Ambloplites rupestris*	2	0.071
3	15.8	RDB	9/27/06	sauger	*Sander canadensis*	16	2.227
3	15.8	RDB	9/27/06	silver redhorse	*Moxostoma anisurum*	4	2.032
3	15.8	RDB	9/27/06	smallmouth bass	*Micropterus dolomieu*	8	1.231
3	15.8	RDB	9/27/06	smallmouth buffalo	*Ictiobus bubalus*	3	4.349
3	15.8	RDB	9/27/06	smallmouth redhorse	*Moxostoma breviceps*	2	0.205
3	15.8	RDB	9/27/06	walleye	*Sander vitreus*	4	0.232
4	16.6	RDB	9/26/06	bluegill	*Lepomis macrochirus*	8	0.381
4	16.6	RDB	9/26/06	channel catfish	*Ictalurus punctatus*	1	0.832
4	16.6	RDB	9/26/06	channel darter	*Percina copelandi*	1	0.001
4	16.6	RDB	9/26/06	common carp	*Cyprinus carpio*	9	14.957
4	16.6	RDB	9/26/06	emerald shiner	*Notropis atherinoides*	1	0.001
4	16.6	RDB	9/26/06	freshwater drum	*Aplodinotus grunniens*	1	0.005
4	16.6	RDB	9/26/06	gizzard shad	*Dorosoma cepedianum*	2	0.188
4	16.6	RDB	9/26/06	golden redhorse	*Moxostoma erythrurum*	17	2.664
4	16.6	RDB	9/26/06	logperch	*Percina caprodes*	2	0.015
4	16.6	RDB	9/26/06	longnose gar	*Lepisosteus osseus*	1	0.220
4	16.6	RDB	9/26/06	rainbow darter	*Etheostoma caeruleum*	1	0.001
4	16.6	RDB	9/26/06	sauger	*Sander canadensis*	19	1.458
4	16.6	RDB	9/26/06	silver chub	*Macrhybopsis storeriana*	1	0.002
4	16.6	RDB	9/26/06	silver redhorse	*Moxostoma anisurum*	13	1.378
4	16.6	RDB	9/26/06	smallmouth bass	*Micropterus dolomieu*	11	0.802
4	16.6	RDB	9/26/06	smallmouth buffalo	*Ictiobus bubalus*	3	3.670
4	16.6	RDB	9/26/06	smallmouth redhorse	*Moxostoma breviceps*	3	0.395
4	16.6	RDB	9/26/06	spotted bass	*Micropterus punctulatus*	1	0.070
5	19.3	RDB	9/26/06	black crappie	*Pomoxis nigromaculatus*	1	0.073
5	19.3	RDB	9/26/06	bluegill	*Lepomis macrochirus*	11	0.554
5	19.3	RDB	9/26/06	channel catfish	*Ictalurus punctatus*	2	1.277
5	19.3	RDB	9/26/06	common carp	*Cyprinus carpio*	10	18.450
5	19.3	RDB	9/26/06	emerald shiner	*Notropis atherinoides*	1	0.002
5	19.3	RDB	9/26/06	fantail darter	*Etheostoma flabellare*	1	0.001
5	19.3	RDB	9/26/06	flathead catfish	*Pylodictis olivaris*	1	0.224
5	19.3	RDB	9/26/06	freshwater drum	*Aplodinotus grunniens*	3	1.623
5	19.3	RDB	9/26/06	gizzard shad	*Dorosoma cepedianum*	5	0.546
5	19.3	RDB	9/26/06	golden redhorse	*Moxostoma erythrurum*	10	1.480
5	19.3	RDB	9/26/06	highfin carpsucker	*Carpiodes velifer*	1	0.135
5	19.3	RDB	9/26/06	longnose gar	*Lepisosteus osseus*	1	0.628

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
5	19.3	RDB	9/26/06	rock bass	*Ambloplites rupestris*	3	0.098
5	19.3	RDB	9/26/06	sauger	*Sander canadensis*	6	0.449
5	19.3	RDB	9/26/06	silver redhorse	*Moxostoma anisurum*	6	3.070
5	19.3	RDB	9/26/06	smallmouth bass	*Micropterus dolomieu*	19	1.986
5	19.3	RDB	9/26/06	smallmouth buffalo	*Ictiobus bubalus*	4	5.692
5	19.3	RDB	9/26/06	smallmouth redhorse	*Moxostoma breviceps*	7	0.861
5	19.3	RDB	9/26/06	spotted bass	*Micropterus punctulatus*	3	0.182
5	19.3	RDB	9/26/06	walleye	*Sander vitreus*	2	0.942
6	22.0	LDB	9/26/06	bluegill	*Lepomis macrochirus*	6	0.264
6	22.0	LDB	9/26/06	channel catfish	*Ictalurus punctatus*	4	2.621
6	22.0	LDB	9/26/06	common carp	*Cyprinus carpio*	1	1.010
6	22.0	LDB	9/26/06	emerald shiner	*Notropis atherinoides*	1	0.002
6	22.0	LDB	9/26/06	gizzard shad	*Dorosoma cepedianum*	23	2.595
6	22.0	LDB	9/26/06	golden redhorse	*Moxostoma erythrurum*	40	13.514
6	22.0	LDB	9/26/06	highfin carpsucker	*Carpiodes velifer*	8	1.196
6	22.0	LDB	9/26/06	largemouth bass	*Micropterus salmoides*	1	0.276
6	22.0	LDB	9/26/06	mooneye	*Hiodon tergisus*	1	0.256
6	22.0	LDB	9/26/06	quillback	*Carpiodes cyprinus*	1	0.121
6	22.0	LDB	9/26/06	sauger	*Sander canadensis*	15	1.990
6	22.0	LDB	9/26/06	silver chub	*Macrhybopsis storeriana*	3	0.099
6	22.0	LDB	9/26/06	silver redhorse	*Moxostoma anisurum*	5	0.668
6	22.0	LDB	9/26/06	smallmouth bass	*Micropterus dolomieu*	5	0.267
6	22.0	LDB	9/26/06	smallmouth buffalo	*Ictiobus bubalus*	8	11.620
6	22.0	LDB	9/26/06	smallmouth redhorse	*Moxostoma breviceps*	4	1.567
7	23.1	RDB	9/25/06	bluegill	*Lepomis macrochirus*	7	0.294
7	23.1	RDB	9/25/06	channel catfish	*Ictalurus punctatus*	3	2.287
7	23.1	RDB	9/25/06	common carp	*Cyprinus carpio*	4	7.524
7	23.1	RDB	9/25/06	flathead catfish	*Pylodictis olivaris*	1	0.456
7	23.1	RDB	9/25/06	freshwater drum	*Aplodinotus grunniens*	1	0.457
7	23.1	RDB	9/25/06	gizzard shad	*Dorosoma cepedianum*	44	4.687
7	23.1	RDB	9/25/06	golden redhorse	*Moxostoma erythrurum*	10	1.492
7	23.1	RDB	9/25/06	highfin carpsucker	*Carpiodes velifer*	1	0.157
7	23.1	RDB	9/25/06	logperch	*Percina caprodes*	4	0.048
7	23.1	RDB	9/25/06	northern hog sucker	*Hypentelium nigricans*	2	0.189
7	23.1	RDB	9/25/06	river carpsucker	*Carpiodes carpio*	3	0.992
7	23.1	RDB	9/25/06	sauger	*Sander canadensis*	19	2.992
7	23.1	RDB	9/25/06	silver redhorse	*Moxostoma anisurum*	1	0.120
7	23.1	RDB	9/25/06	smallmouth bass	*Micropterus dolomieu*	19	2.899
7	23.1	RDB	9/25/06	smallmouth buffalo	*Ictiobus bubalus*	15	23.700
7	23.1	RDB	9/25/06	smallmouth redhorse	*Moxostoma breviceps*	4	0.473
7	23.1	RDB	9/25/06	yellow perch	*Perca flavescens*	1	0.003
8	26.0	LDB	8/7/06	bluegill	*Lepomis macrochirus*	17	0.615

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
8	26.0	LDB	8/7/06	channel catfish	*Ictalurus punctatus*	6	1.800
8	26.0	LDB	8/7/06	common carp	*Cyprinus carpio*	4	7.150
8	26.0	LDB	8/7/06	flathead catfish	*Pylodictis olivaris*	2	4.900
8	26.0	LDB	8/7/06	freshwater drum	*Aplodinotus grunniens*	4	1.105
8	26.0	LDB	8/7/06	gizzard shad	*Dorosoma cepedianum*	24	0.785
8	26.0	LDB	8/7/06	golden redhorse	*Moxostoma erythrurum*	10	0.970
8	26.0	LDB	8/7/06	hybrid striper	*Morone saxatilis x M. chrysops*	1	0.040
8	26.0	LDB	8/7/06	largemouth bass	*Micropterus salmoides*	1	0.025
8	26.0	LDB	8/7/06	logperch	*Percina caprodes*	5	0.050
8	26.0	LDB	8/7/06	mooneye	*Hiodon tergisus*	1	0.120
8	26.0	LDB	8/7/06	quillback	*Carpiodes cyprinus*	1	0.050
8	26.0	LDB	8/7/06	sauger	*Sander canadensis*	22	3.180
8	26.0	LDB	8/7/06	silver redhorse	*Moxostoma anisurum*	1	0.840
8	26.0	LDB	8/7/06	smallmouth bass	*Micropterus dolomieu*	15	1.400
8	26.0	LDB	8/7/06	smallmouth buffalo	*Ictiobus bubalus*	11	6.200
8	26.0	LDB	8/7/06	smallmouth redhorse	*Moxostoma breviceps*	9	1.710
8	26.0	LDB	8/7/06	spotted bass	*Micropterus punctulatus*	1	0.300
8	26.0	LDB	8/7/06	walleye	*Sander vitreus*	1	0.620
9	27.0	LDB	9/25/06	bluegill	*Lepomis macrochirus*	3	0.104
9	27.0	LDB	9/25/06	common carp	*Cyprinus carpio*	2	2.130
9	27.0	LDB	9/25/06	freshwater drum	*Aplodinotus grunniens*	2	1.357
9	27.0	LDB	9/25/06	gizzard shad	*Dorosoma cepedianum*	14	1.067
9	27.0	LDB	9/25/06	golden redhorse	*Moxostoma erythrurum*	1	0.066
9	27.0	LDB	9/25/06	largemouth bass	*Micropterus salmoides*	3	0.178
9	27.0	LDB	9/25/06	quillback	*Carpiodes cyprinus*	2	0.184
9	27.0	LDB	9/25/06	river carpsucker	*Carpiodes carpio*	1	0.844
9	27.0	LDB	9/25/06	sauger	*Sander canadensis*	23	1.721
9	27.0	LDB	9/25/06	silver chub	*Macrhybopsis storeriana*	3	0.029
9	27.0	LDB	9/25/06	smallmouth bass	*Micropterus dolomieu*	8	1.305
9	27.0	LDB	9/25/06	smallmouth buffalo	*Ictiobus bubalus*	1	0.105
9	27.0	LDB	9/25/06	spotted bass	*Micropterus punctulatus*	1	0.087
10	27.1	RDB	7/20/06	bluegill	*Lepomis macrochirus*	15	0.485
10	27.1	RDB	7/20/06	channel catfish	*Ictalurus punctatus*	2	0.884
10	27.1	RDB	7/20/06	common carp	*Cyprinus carpio*	1	1.270
10	27.1	RDB	7/20/06	freshwater drum	*Aplodinotus grunniens*	3	0.720
10	27.1	RDB	7/20/06	gizzard shad	*Dorosoma cepedianum*	1	0.016
10	27.1	RDB	7/20/06	golden redhorse	*Moxostoma erythrurum*	2	1.093
10	27.1	RDB	7/20/06	greenside darter	*Etheostoma blennioides*	1	0.004
10	27.1	RDB	7/20/06	highfin carpsucker	*Carpiodes velifer*	3	0.361
10	27.1	RDB	7/20/06	logperch	*Percina caprodes*	23	0.162
10	27.1	RDB	7/20/06	mooneye	*Hiodon tergisus*	1	0.054
10	27.1	RDB	7/20/06	redear sunfish	*Lepomis microlophus*	3	0.089

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
10	27.1	RDB	7/20/06	river carpsucker	*Carpiodes carpio*	1	1.370
10	27.1	RDB	7/20/06	rock bass	*Ambloplites rupestris*	2	0.304
10	27.1	RDB	7/20/06	sauger	*Sander canadensis*	14	3.603
10	27.1	RDB	7/20/06	silver redhorse	*Moxostoma anisurum*	37	9.156
10	27.1	RDB	7/20/06	smallmouth bass	*Micropterus dolomieu*	20	1.391
10	27.1	RDB	7/20/06	smallmouth buffalo	*Ictiobus bubalus*	9	17.514
10	27.1	RDB	7/20/06	smallmouth redhorse	*Moxostoma breviceps*	4	0.296
10	27.1	RDB	7/20/06	spotted bass	*Micropterus punctulatus*	2	0.132
10	27.1	RDB	7/20/06	white bass	*Morone chrysops*	3	0.196
10	27.1	RDB	7/20/06	yellow perch	*Perca flavescens*	1	0.045
11	27.3	LDB	7/20/06	black crappie	*Pomoxis nigromaculatus*	2	0.367
11	27.3	LDB	7/20/06	bluegill	*Lepomis macrochirus*	9	0.369
11	27.3	LDB	7/20/06	channel catfish	*Ictalurus punctatus*	1	1.103
11	27.3	LDB	7/20/06	flathead catfish	*Pylodictis olivaris*	2	1.863
11	27.3	LDB	7/20/06	freshwater drum	*Aplodinotus grunniens*	1	0.040
11	27.3	LDB	7/20/06	gizzard shad	*Dorosoma cepedianum*	22	0.687
11	27.3	LDB	7/20/06	golden redhorse	*Moxostoma erythrurum*	8	1.678
11	27.3	LDB	7/20/06	highfin carpsucker	*Carpiodes velifer*	1	0.053
11	27.3	LDB	7/20/06	mooneye	*Hiodon tergisus*	1	0.053
11	27.3	LDB	7/20/06	morone sp	*Morone sp*	2	0.061
11	27.3	LDB	7/20/06	quillback	*Carpiodes cyprinus*	4	0.287
11	27.3	LDB	7/20/06	river redhorse	*Moxostoma carinatum*	2	0.083
11	27.3	LDB	7/20/06	sauger	*Sander canadensis*	9	1.412
11	27.3	LDB	7/20/06	silver chub	*Macrhybopsis storeriana*	4	0.053
11	27.3	LDB	7/20/06	silver redhorse	*Moxostoma anisurum*	21	3.934
11	27.3	LDB	7/20/06	smallmouth bass	*Micropterus dolomieu*	6	0.381
11	27.3	LDB	7/20/06	smallmouth buffalo	*Ictiobus bubalus*	50	4.348
11	27.3	LDB	7/20/06	spotted bass	*Micropterus punctulatus*	2	0.112
11	27.3	LDB	7/20/06	white bass	*Morone chrysops*	12	1.191
12	27.6	LDB	7/19/06	bluegill	*Lepomis macrochirus*	4	0.072
12	27.6	LDB	7/19/06	channel catfish	*Ictalurus punctatus*	1	0.656
12	27.6	LDB	7/19/06	common carp	*Cyprinus carpio*	1	2.820
12	27.6	LDB	7/19/06	freshwater drum	*Aplodinotus grunniens*	2	0.103
12	27.6	LDB	7/19/06	gizzard shad	*Dorosoma cepedianum*	45	1.462
12	27.6	LDB	7/19/06	golden redhorse	*Moxostoma erythrurum*	6	2.082
12	27.6	LDB	7/19/06	highfin carpsucker	*Carpiodes velifer*	4	0.209
12	27.6	LDB	7/19/06	hybrid striper	*Morone saxatilis x M. chrysops*	1	0.052
12	27.6	LDB	7/19/06	largemouth bass	*Micropterus salmoides*	2	0.775
12	27.6	LDB	7/19/06	logperch	*Percina caprodes*	1	0.007
12	27.6	LDB	7/19/06	northern hog sucker	*Hypentelium nigricans*	1	0.034
12	27.6	LDB	7/19/06	quillback	*Carpiodes cyprinus*	6	0.363
12	27.6	LDB	7/19/06	river carpsucker	*Carpiodes carpio*	1	0.670

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
12	27.6	LDB	7/19/06	sauger	*Sander canadensis*	15	1.725
12	27.6	LDB	7/19/06	silver redhorse	*Moxostoma anisurum*	18	4.228
12	27.6	LDB	7/19/06	smallmouth bass	*Micropterus dolomieu*	4	0.654
12	27.6	LDB	7/19/06	smallmouth buffalo	*Ictiobus bubalus*	44	16.000
12	27.6	LDB	7/19/06	spotfin shiner	*Cyprinella spiloptera*	1	0.007
12	27.6	LDB	7/19/06	white bass	*Morone chrysops*	2	0.236
13	28.7	RDB	7/19/06	black crappie	*Pomoxis nigromaculatus*	1	0.039
13	28.7	RDB	7/19/06	bluegill	*Lepomis macrochirus*	54	1.173
13	28.7	RDB	7/19/06	channel catfish	*Ictalurus punctatus*	4	4.209
13	28.7	RDB	7/19/06	common carp	*Cyprinus carpio*	2	1.621
13	28.7	RDB	7/19/06	flathead catfish	*Pylodictis olivaris*	2	4.112
13	28.7	RDB	7/19/06	freshwater drum	*Aplodinotus grunniens*	7	0.996
13	28.7	RDB	7/19/06	gizzard shad	*Dorosoma cepedianum*	13	0.967
13	28.7	RDB	7/19/06	golden redhorse	*Moxostoma erythrurum*	7	2.876
13	28.7	RDB	7/19/06	largemouth bass	*Micropterus salmoides*	1	0.719
13	28.7	RDB	7/19/06	lepomis hybrid	*Lepomis hybrid*	1	0.043
13	28.7	RDB	7/19/06	logperch	*Percina caprodes*	18	0.138
13	28.7	RDB	7/19/06	mooneye	*Hiodon tergisus*	2	0.101
13	28.7	RDB	7/19/06	pumpkinseed	*Lepomis gibbosus*	2	0.053
13	28.7	RDB	7/19/06	quillback	*Carpiodes cyprinus*	2	0.173
13	28.7	RDB	7/19/06	rock bass	*Ambloplites rupestris*	1	0.027
13	28.7	RDB	7/19/06	sauger	*Sander canadensis*	13	2.450
13	28.7	RDB	7/19/06	silver chub	*Macrhybopsis storeriana*	1	0.016
13	28.7	RDB	7/19/06	silver redhorse	*Moxostoma anisurum*	13	2.999
13	28.7	RDB	7/19/06	smallmouth bass	*Micropterus dolomieu*	26	2.913
13	28.7	RDB	7/19/06	smallmouth buffalo	*Ictiobus bubalus*	16	19.625
13	28.7	RDB	7/19/06	smallmouth redhorse	*Moxostoma breviceps*	5	0.345
13	28.7	RDB	7/19/06	spotted bass	*Micropterus punctulatus*	5	0.749
13	28.7	RDB	7/19/06	walleye	*Sander vitreus*	1	0.490
13	28.7	RDB	7/19/06	white bass	*Morone chrysops*	3	0.255
13	28.7	RDB	7/19/06	yellow perch	*Perca flavescens*	2	0.045
14	30.1	LDB	7/18/06	black crappie	*Pomoxis nigromaculatus*	1	0.026
14	30.1	LDB	7/18/06	bluegill	*Lepomis macrochirus*	21	0.465
14	30.1	LDB	7/18/06	channel catfish	*Ictalurus punctatus*	6	0.235
14	30.1	LDB	7/18/06	common carp	*Cyprinus carpio*	4	5.418
14	30.1	LDB	7/18/06	flathead catfish	*Pylodictis olivaris*	2	0.797
14	30.1	LDB	7/18/06	freshwater drum	*Aplodinotus grunniens*	4	0.115
14	30.1	LDB	7/18/06	gizzard shad	*Dorosoma cepedianum*	7	0.990
14	30.1	LDB	7/18/06	golden redhorse	*Moxostoma erythrurum*	11	5.645
14	30.1	LDB	7/18/06	green sunfish	*Lepomis cyanellus*	1	0.026
14	30.1	LDB	7/18/06	greenside darter	*Etheostoma blennioides*	1	0.006
14	30.1	LDB	7/18/06	logperch	*Percina caprodes*	10	0.091
14	30.1	LDB	7/18/06	longnose gar	*Lepisosteus osseus*	4	0.832

Site #	River Mile	Bank	Date	Common Name	Latin Name	Count	Weight (kg)
14	30.1	LDB	7/18/06	morone sp	*Morone sp*	2	0.068
14	30.1	LDB	7/18/06	quillback	*Carpiodes cyprinus*	10	1.620
14	30.1	LDB	7/18/06	rainbow darter	*Etheostoma caeruleum*	1	0.002
14	30.1	LDB	7/18/06	river carpsucker	*Carpiodes carpio*	3	2.367
14	30.1	LDB	7/18/06	sauger	*Sander canadensis*	11	2.401
14	30.1	LDB	7/18/06	silver redhorse	*Moxostoma anisurum*	10	4.273
14	30.1	LDB	7/18/06	smallmouth bass	*Micropterus dolomieu*	12	1.513
14	30.1	LDB	7/18/06	smallmouth buffalo	*Ictiobus bubalus*	37	13.852
14	30.1	LDB	7/18/06	smallmouth redhorse	*Moxostoma breviceps*	3	0.219
14	30.1	LDB	7/18/06	white bass	*Morone chrysops*	5	0.755
15	30.4	RDB	7/18/06	bluegill	*Lepomis macrochirus*	28	0.637
15	30.4	RDB	7/18/06	channel catfish	*Ictalurus punctatus*	1	0.019
15	30.4	RDB	7/18/06	common carp	*Cyprinus carpio*	1	0.613
15	30.4	RDB	7/18/06	freshwater drum	*Aplodinotus grunniens*	10	1.541
15	30.4	RDB	7/18/06	gizzard shad	*Dorosoma cepedianum*	6	0.665
15	30.4	RDB	7/18/06	golden redhorse	*Moxostoma erythrurum*	16	0.788
15	30.4	RDB	7/18/06	green sunfish	*Lepomis cyanellus*	1	0.009
15	30.4	RDB	7/18/06	logperch	*Percina caprodes*	4	0.037
15	30.4	RDB	7/18/06	morone sp	*Morone sp*	2	0.105
15	30.4	RDB	7/18/06	quillback	*Carpiodes cyprinus*	3	0.210
15	30.4	RDB	7/18/06	redear sunfish	*Lepomis microlophus*	1	0.027
15	30.4	RDB	7/18/06	river carpsucker	*Carpiodes carpio*	2	1.409
15	30.4	RDB	7/18/06	sauger	*Sander canadensis*	21	4.253
15	30.4	RDB	7/18/06	silver redhorse	*Moxostoma anisurum*	16	4.783
15	30.4	RDB	7/18/06	smallmouth bass	*Micropterus dolomieu*	13	1.740
15	30.4	RDB	7/18/06	smallmouth buffalo	*Ictiobus bubalus*	7	7.708
15	30.4	RDB	7/18/06	smallmouth redhorse	*Moxostoma breviceps*	19	1.653
15	30.4	RDB	7/18/06	white bass	*Morone chrysops*	9	0.770

Appendix C. Habitat survey data from the Montgomery pool.

Site #	River Mile	Bank	% Boulder	% Cobble	% Gravel	% Sand	% Fines	% Hardpan	Depth	% Submerged Vegetation	% Woody Cover	% Overhanging Vegetation	Land Use	Human Influence	Bank Profile	Bank Erosion
1	13.7	LDB	2.0	30.6	38.9	28.5	0.0	0.0	5.2	0	0	0	I, NF, R	none	sloped	none
2	14.1	RDB	1.3	14.6	41.4	40.7	1.3	0.0	6.0	0	1	0	I, NF	moorings	steep/ sloped	very light
3	15.8	RDB	2.7	5.5	34.2	53.6	4.1	0.0	9.2	0	11	10	I, NF	none	steep/ sloped	none
4	16.6	RDB	4.8	9.0	27.7	41.0	17.5	0.0	11.6	0	1	0.4	I, NF, R	none	sloped	none
5	19.3	RDB	17.4	12.9	26.5	37.1	6.1	0.0	9.7	0	10	13	NF	none	steep	none
6	22.0	LDB	5.4	17.8	26.0	36.8	14.0	0.0	12.4	3	0	0	I, NF	none	steep	very light
7	23.1	RDB	6.3	15.5	29.9	35.6	12.6	0.0	14.3	0	6	5.4	I, R, NF	none	steep	none
8	26.0	LDB	12.0	21.0	17.0	45.0	6.0	0.0	14.5	0	1.8	0.8	NF	none	steep	none
9	27.0	LDB	7.1	10.9	9.3	38.5	34.2	0.0	7.5	0	11	0.2	NF	none	steep/ sloped	none
10	27.1	RDB	8.1	29.7	36.9	23.9	1.4	0.0	15.2	0	27	7	NF, R	ramp	steep	none
11	27.3	LDB	0.8	4.9	10.0	29.7	52.3	2.3	7.0	0	23	0	NF	none	sloped	light
12	27.6	LDB	0.0	0.6	12.1	16.1	64.2	7.0	9.5	0	17	2	NF, I	boats, docks	sloped/ gradual	light
13	28.7	RDB	10.1	15.5	22.7	21.7	29.9	0.0	12.6	0.6	13.4	2	NF, I	moorings, ramp	steep/ sloped	very light
14	30.1	LDB	1.4	26.4	30.4	19.6	22.3	0.0	15.4	0	0	0	I, NF	moorings, ramp	steep	very light
15	30.4	RDB	3.1	18.0	35.4	35.7	7.8	0.0	13.2	0	4.4	1	NF	none	steep	very light

Appendix D. Water chemistry parameters measured prior to sampling.

River Mile	pH	Temp (˚C)	Dissolved Oxygen (mg/L)	Conductivity	Secchi (in)
13.7	7.4	18.7	N/A	247	30
14.1	7.4	18.7	N/A	247	30
15.8	7.4	18.7	N/A	247	30
16.6	7.7	19.03	N/A	253	42
19.3	7.7	19.03	N/A	253	48
22.0	7.6	19.24	N/A	244	30
23.1	7.5	19.15	N/A	225	30
26.0	8.0	26.46	N/A	240	34
27.0	7.7	18.77	N/A	218	36
27.1	N/A	26.2	N/A	303	36
27.3	N/A	26.22	N/A	257	38
27.6	N/A	25.95	N/A	270	38
28.7	N/A	26.04	N/A	308	36
30.1	N/A	26.19	N/A	275	30
30.4	N/A	25.92	N/A	308	42