Prepared for:
Black & Veatch

Aquatic Ecology Characterization Report Detroit Edison Company Fermi 3 Project

Final Report

AECOM Environment
November 2009

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Executive Summary

The purpose of this report is to summarize the current data collected as part of the Aquatic Ecology Survey for Detroit Edison Company's (DECo) proposed Fermi 3 Nuclear Generating Station to be located near Newport (Frenchtown Charter Township) in Monroe County, Michigan. Data collected in this study are in support of DECo's Combined Operating License Application (COLA) to the Nuclear Regulatory Commission (NRC).

The Fermi site is located on the Western Basin of Lake Erie between the Swan Creek and Stony Creek watersheds. Aquatic resources associated with the site include: Lake Erie; Swan Creek; on-site waterbodies; and waters within the Detroit River International Wildlife Refuge (DRIWR). The on-site waterbodies consist of the internal canal system, quarry lakes, and the cooling tower circulating water reservoir. Waterbodies in the DRIWR portion of the site include the south lagoon, north lagoon, and a small isolated pond. In addition to the waterbodies, wetlands are associated with on-site waterbodies and low lying areas.

The purpose of the aquatic survey was to collect data over a one-year period in the vicinity of the site in order to supplement the aquatic data included in the Environmental Report of the COLA. The assessment was designed in accordance with discussions with DECo and the NRC during the project's T-1 and T-2 meetings. Current species richness and relative abundance for fishes and macroinvertebrates were determined in the waterbodies located on-site, within the DRIWR, and adjacent to the site in Lake Erie and Swan Creek. Fish species impacted by impingement and entrainment as part of the current operation of the General Service Water Pump House (GSWPH) for Fermi 2 were identified to compare current fish impingement (I) and entrainment (E) data to historical data. Impingement and entrainment rates were calculated to assist in determining potential impacts to aquatic resources associated with the proposed expansion project.

Nine representative sampling locations were chosen from a variety of aquatic habitats onsite and adjacent to the Fermi site. The locations selected for this study include two on Lake Erie immediately adjacent to the Fermi site, one in Swan Creek, three in the internal canal system, two quarry ponds, and the isolated pond. These locations were selected based on their ability to represent the aquatic resources adjacent to the site and those areas that are in proximity to the proposed new facilities and construction areas. Samples of fish communities and benthic macroinvertebrates were collected at randomly selected locations within each sample area. The study took place from July 2008 through July 2009.

Monthly samples were collected over a four to five day period using a variety of gears: dip nets and plankton nets for impingement and entrainment sampling; gill nets, seines, hoop nets, minnow traps, and electroshocking to determine fish populations in the various aquatic habitats; and dip nets for sampling benthic communities in the same aquatic habitats. Fish were collected according to current fisheries techniques as described by Murphy and Willis (1996). Upon retrieval of each sample gear, all fishes were identified to the lowest taxonomic level and enumerated. Up to 50 randomly selected individuals of each species were measured (total length) to the nearest millimeter. The total length for each fish was measured from the tip of the snout to the tip of the tail. Benthic macroinvertebrates were sampled monthly from July 2008 through June 2009 in principal habitat areas associated with each of the nine aquatic sampling locations. Principal habitats included areas with aquatic vegetation and areas consisting of soft silt and/or detrital substrates. A 12-inch D-frame dip net with 500µm mesh was pulled through one linear meter at a depth of two inches into the substrate. This method closely follows the methods outlined by the EPA field operations manual for the survey of the Nation's Lakes.

Impingement samples were collected once per month, for a 24-hour period, from August 2008 through July 2009 at the existing Fermi 2 GSWPH located on Lake Erie. No sample was collected in April 2009 due to excess debris at the intake structure. Entrainment samples were collected once per month from July 2008 through November 2008, March 2009 and July 2009, and twice per month April 2009 through June 2009. No entrainment samples were collected December 2008 through February 2009 due to icing conditions. Impingement and entrainment data were evaluated to determine the total number of individuals collected, the

life stage of each individual (entrainment only), the percent composition, and an impingement/entrainment rate for each sample.

Data were evaluated on a monthly basis to determine monthly and seasonal shifts in abundance and diversity. Based on the data presented in the interim report, it was agreed upon by DECo and the NRC, that several aspects of the sampling program be modified. These modifications consisted of changes to the impingement and entrainment sampling program and the fish and macroinvertebrate sampling program. Entrainment sampling was modified to include a two pump system that allowed for the collection of entrainment samples at multiple depths, near surface and near bottom. These changes applied to samples collected in April, May, June and July 2009. An additional entrainment sample was added in March 2009 based on historical findings that indicated whitefish had been entrained during March. One sample was added each month from April through June 2009 to collect additional data during peak recruitment season. The fish and macroinvertebrate sampling program was modified from nine to five sample locations when the South Quarry, North Quarry, Isolated Pond and Isolated Central Canal were removed from the sampling plan. Discussions with DECo and the NRC along with evaluation of the data presented in the interim report indicated that these locations are home to fairly stable fish populations, both in terms of abundance and species richness, and whose fish populations are not expected to undergo dramatic fluctuations.

Representative important species (RIS) include both state and federally listed threatened and endangered species and those with commercial and recreational value. Several fish (creek chubsucker, silver shiner, pugnose minnow, channel darter, river darter and southern redbelly dace) and mollusks (white catspaw, northern riffelshell, snuffbox, round hickorynut, salamander mussel and purple lilliput) are listed as endangered in Monroe County by the state of Michigan (MDNR). Only the northern riffelshell is federally listed (USFWS) as endangered in Monroe County. The lake sturgeon, eastern sand darter, sauger and wavy-rayed lampmussel (mollusk) are listed as threatened in Monroe County by the state of Michigan.

Commercial fish harvest in the Michigan waters of Lake Erie in 2007 consisted of 13 species of fish, weighing a total of 1,058,253 pounds with an estimated value of $398, 253. Total catch was dominated by three types of fish: the common carp, gizzard shad and buffalo. Other species harvested included channel catfish, white bass, freshwater drum, goldfish, white perch, whitefish and others, including bullheads, suckers, quillback and chub (Thomas, 2008). Important recreational species in the western basin of Lake Erie include both native and non-native species. Sport fishing harvest (non-charter) in the Michigan waters of Lake Erie in 2007 consisted of approximately 369,624 fish, which were dominated by yellow perch and walleye. Other species harvested by sport-fishermen included white perch, channel catfish, white bass, freshwater drum, largemouth bass, smallmouth bass and rainbow trout (Thomas, 2008).

Eleven impingement samples were collected during the sampling period resulting in a total of 101 fish collected. The December 2008 sample yielded the greatest number of fish (34) while the June 2009 and July 2009 samples yielded the fewest fish (1). Fish composition was dominated by gizzard shad (39%), emerald shiner (29%), white perch (10%), and bluegill (7%). Impingement rates (#/m^3) ranged from 1.9E-4 fish/m^3 in December 2008 to 4.3E-6 fish/m^3 in June 2009.[1] The average annual impingement rate for all species collected in the 11 samples from August 2008 through July 2009 was 4.6E-5 fish/m^3. Of the 15 species identified, the gizzard shad had the highest impingement rate (1.8E-5 fish/m^3). No federally or state listed threatened or endangered species were collected.

It is estimated that 3,102 fish are impinged annually at the Fermi 2 GSWPH with intake pumps at operational capacity (actual intake volumes provided by DECo were used to determine monthly operational intake). Of those, gizzard shad (1,204) and emerald shiner (889) are expected to be the most commonly impinged fish. December (1,054) and March (806) have the highest estimated impingement numbers with Fermi 2 intake pumps at operational capacity. In addition, the impingement rates calculated at Fermi 2 were used to estimate

[1] Impingement rates are expressed in scientific notation; 1.9E-4 is equivalent to $1.9x10^{-4}$

maximum impingement at the proposed Fermi 3 facility. It is estimated that 3,110 fish will be impinged annually at the Fermi 3 facility with intake pumps operating at maximum capacity (32,264 gpm). Of those, gizzard shad (1,246) and emerald shiner (916) are expected to be the most commonly impinged fish. December (1,090) and March (851) have the highest estimated impingement with Fermi 3 pumps operating at maximum capacity.

Entrainment samples were collected during 10 months from July 2008 through July 2009. A total of 1286 organisms were entrained, which included 12 identified taxa, 74 unknown eggs, and 2 unknown centrarchid larvae. The May sample yielded the greatest number of fish eggs/larvae (533) while both November and March yielded the lowest number (0). Sample composition was dominated by gizzard shad, emerald shiner, bluntnose minnow, and yellow perch. Entrainment rates (fish eggs + larvae/m^3) ranged from 4.82/m^3 in July 2009 to 0.00/m^3 in November 2008 and March 2009. The average annual entrainment rate for all species collected from July 2008 through July 2009 was 0.98/m^3. Of the 12 taxa identified in entrainment samples, the gizzard shad reflected the highest entrainment rate at 0.36/m^3 while the white perch and the brook silverside represented the lowest entrainment rates at 0.0015/m^3. No eggs or larvae of federally or state listed threatened or endangered species were collected.

It is estimated that 62,566,648 fish (3,940,823 eggs and 58,625,825 larvae) are entrained annually at the Fermi 2 GSWPH with intake pumps at operational capacity (actual intake volumes provided by DECo were used to determine monthly operational intake). Of those, 33,852,880 are expected to be entrained in July with gizzard shad (30,238,133) being the most commonly entrained fish each year with Fermi 2 intake pumps functioning at operational capacity. In addition, the entrainment rates calculated at Fermi 2 were used to estimate maximum entrainment at the proposed Fermi 3 facility. It is estimated that 54,776,573 fish (3,450,157 eggs and 51,326,416 larvae) will be entrained annually at the Fermi 3 facility with intake pumps operating at maximum capacity (32,264 gpm). Of those, the gizzard shad (25,106,899) and the emerald shiner (9,461,210) are expected to the most commonly entrained fish. July (27,896,935) has the highest estimated entrainment with Fermi 3 pumps operating at maximum capacity.

A total of 14,885 fish consisting of 52 species were captured at the nine sampling sites from July 2008 through June 2009. Of the fish collected, goldfish, gizzard shad, bluegill, and emerald shiner accounted for 61% with 48 species accounting for the remaining 39%. The greatest number of fish, 3,856, were collected at the Lake Erie – South Lagoon site (LE2-A). Goldfish, gizzard shad and emerald shiner dominated these samples. The Isolated Pond (IP-A) reflected the fewest number of total fish with only 11. The greatest number of fish were collected in August 2008, 4,649 total fish, while only 447 fish were collected in November 2008. The Lake Erie - South Lagoon (LE2-A) sample had the greatest number of fish species (38) and the Isolated Pond had the fewest number of fish species (4). No federally or state listed threatened or endangered species were collected.

Macroinvertebrate sampling produced a total of 5,049 individuals representing 19 orders from the nine sampling sites from July 2008 through June 2009. Diptera, Ephemeroptera, Amphipoda, and Tubificida accounted for 75% of individuals collected. The other 15 orders accounted for the remaining 25%. Diptera was mostly comprised of *Tanytarsus sp.* while Tubificida was mostly comprised of Naidinae and Tubificinae. Swan Creek (SC-A) sample site had the greatest number of individuals collected with 790 while the Lake Erie 1 (LE1-A) sample site had the fewest number of individuals with 260. The Isolated Pond (IP-A) sample had the greatest number of taxa captured (27) in both September 2008 and October 2008 and Lake Erie - Intake (LE1-A) had the fewest number of taxa captured (0) in the May 2008 sample.

There were no federally and/or state listed threatened or endangered species collected in this study. The most common commercially important species collected were goldfish, gizzard shad, common carp, white perch and bigmouth buffalo. Commercial species commonly found in impingement samples included gizzard shad and white perch, while the most prominent commercial species in entrainment samples were gizzard shad, bigmouth buffalo and freshwater drum. The most common recreationally important species collected were white perch, largemouth bass and yellow perch. Recreational species commonly found in impingement samples included white perch and smallmouth bass while the most prominent recreational species in entrainment samples were yellow perch and freshwater drum.

1.0 Introduction

This report summarizes data collected as a component of the Aquatic Ecology Survey for Detroit Edison Company's (DECo) proposed Fermi 3 Nuclear Generating Station to be located near Newport (Frenchtown Charter Township) in Monroe County, Michigan, Figure 1. Data collected in this study are in support of DECo's Combined Operating License Application (COLA) to the Nuclear Regulatory Commission (NRC).

The Fermi site is located on the Western Basin of Lake Erie between the Swan Creek and Stony Creek watersheds. The site consists of approximately 1,120 acres of developed and undeveloped land with approximately 650 acres of land being designated as part of the Detroit River International Wildlife Refuge (DRIWR). Aquatic resources associated with the site include: Lake Erie; Swan Creek; on-site waterbodies; and waters within the DRIWR. The on-site waterbodies consist of the internal canal system, quarry lakes, and the cooling tower circulating water reservoir. Waterbodies in the DRIWR portion of the site include the south lagoon, north lagoon, and a small isolated pond. Wetlands are also present and are associated with several of the on-site waterbodies.

The Fermi 2 Power Plant utilizes a closed-cycle condenser cooling water system with two natural draft cooling towers. Water for the operations and the cooling system is withdrawn through a shoreline intake structure located on a dredged canal near the shoreline of Lake Erie. The pumping facility consists of five general service water (GSW) pumps, each with a capacity of 7,700 gpm and two make-up water pumps, each with a capacity of 15,000 gpm. Only four (4 x 7,700 gpm) of the GSW pumps operate at any one time while the fifth pump serves as a standby pump which is used only when one of the other pumps is inoperable. Similarly, only one of the 15,000 gpm make-up water pumps is in operation at any one time resulting in a total operational withdrawal capacity of 45,800 gpm. Actual Fermi 2 intake volumes were provided by DECo for each sampling month. These operational volumes were used in estimating annual impingement and entrainment abundance at the existing Fermi 2 plant.

The Fermi 3 Power Plant proposes to utilize an intake system similar to that of Fermi 2. The Fermi 3 intake system will consist of three GSW pumps (each rated at 16,132 gpm). Similar to Fermi 2, one of these pumps will be utilized as a standby pump which operates only when one of the primary units is inoperable. Therefore, for the purpose of evaluating maximum impingement and entrainment abundance at Fermi 3, only two of the GSW pumps were considered (32,264 gpm).

The primary objective of the aquatic assessment was to collect current data over a one year period to supplement the aquatic data included in the Environmental Report of the COLA. The assessment was designed in accordance with discussions with DECo and the NRC during the projects T-1 and T-2 meetings. The final study design was ultimately reviewed by the NRC prior to sampling. The goals of the study were to:

- Determine fish species impacted by impingement and entrainment as part of the current operation of the General Service Water Pump House (GSWPH) for Fermi 2;
- Determine current species richness and relative abundance for fishes and macroinvertebrates in the waterbodies located on-site, within the DRIWR, and adjacent to the site in Lake Erie and Swan Creek;
- Compare current fish impingement (I) and entrainment (E) data to historical data to determine potential impingement and entrainment rates; and
- Identify potential impacts to aquatic resources associated with the proposed expansion project.

In order to meet the objectives of the aquatic assessment, a study was designed to take place from July 2008 through July 2009 in which nine representative sampling locations were chosen from a variety of aquatic habitats onsite and adjacent to the Fermi site. The locations selected for this study include two on Lake Erie immediately adjacent to the Fermi site, one in Swan Creek, three in an internal canal system, two quarry ponds, and the isolated pond. Table 1 provides a description of the observed aquatic habitat at each sampling location.

2.0 Materials and Methods

Nine locations were selected for aquatic resource characterization. Impingement and entrainment sampling took place at the Fermi 2 GSWPH intake facility, Figure 2. Locations were selected based upon their ability to represent the aquatic resources adjacent to the site and those areas that are in proximity to the proposed new facilities and construction areas. Fish communities and benthic macroinvertebrates were collected at randomly selected locations within each sample station. The sample stations include:

- North Canal – Including Overflow Canal (CN-A);
- Swan Creek (SC-A);
- Lake Erie - Intake (LE1-A);
- Lake Erie - South Lagoon (LE2-A);
- South Canal (CS-A);
- South Quarry (SQ-A);
- North Quarry (NQ-A);
- Isolated Pond (IP-A); and
- Isolated Central Canal (IC-A).

The Great Lakes Environmental Center (GLEC) located in Traverse City, Michigan conducted the aquatic resource sampling. GLEC has extensive experience completing I/E studies on Lake Erie and Lake Michigan, including cooperation with the Michigan Department of Natural Resources (MDNR) and the Environmental Protection Agency (EPA) to develop sampling protocols for aquatic systems in Michigan and other states in the northeast. Appendix A provides photographic documentation of sampling activities at the Fermi site.

A one year, monthly, sampling program was established to characterize species richness and diversity within each aquatic resource. The following section outlines the various sampling programs, initiated in July 2008 while modifications to the sampling program are described in section 3. Monthly samples were collected during a four to five day period using a variety of gear: dip nets and plankton nets for impingement and entrainment sampling; gill nets, seines, hoop nets, minnow traps, and electroshocking to determine fish populations in the various aquatic habitats; and D-frame dip nets for sampling benthic communities in the same aquatic habitats.

Due to site-specific environmental constraints, biological surveys were restricted to certain months of the year. Therefore, aquatic samples were collected over a one year period during those months when sampling accessibility was not limited by the icing of waterbodies or excessive aquatic vegetation. See Table 2 for a summary of all sampling events conducted at each location by date.

2.1 Impingement and Entrainment

<u>Impingement Collection</u>

Impingement samples were collected monthly over a 24-hour period (12 hour intervals) from August 2008 through July 2009 at the existing Fermi 2 GSWPH located on Lake Erie. A total of 11 samples were collected with no sampling in April due to excess debris on the screens. Samples were collected from the trash/debris sluiceway using modified sampling dip nets fitted with ¼” mesh. Prior to the initial sample collection, the traveling screens were scheduled to run for 30 minutes to wash and clear the screens of all existing debris and organisms. The screens were then left idle over the next 12 hours for the first impingement period. At 12 hours, dip nets were placed in the sluiceway and the screens were run once more for 30 minutes to ensure more than one complete revolution and complete washing of organisms and debris. Samples collected during this time were documented for the 12-hour period. This process was subsequently repeated to yield a combined sample period of 24 hours for each sampling event. Organisms collected from the screens were rinsed into dip nets and sorted by species, then total length (TL) was measured to the nearest millimeter.

Entrainment Collection

Entrainment samples were collected on the following schedule:

- Once monthly: July 2008 through November 2008, March 2009, and July 2009;
- Twice monthly: April 2009 through June 2009; and
- No samples scheduled due to icing: December 2008 through February 2009.

Entrainment samples were collected at 6-hour intervals over a 24-hour period for a total of four samples per event. To characterize diel variations, two of the samples represented day time and two represented night time collections. Samples were collected using a trash pump system located in front of the trash racks at the GSWPH. The pump system filters water through a 500µm mesh plankton net fitted within a buffer chamber. A 6-horsepower pump fitted with a 3-inch hose was lowered into the water column to a depth of approximately 12 feet (middle of the water column). The pump was run for approximately 1 to 2 hours to collect a prescribed volume of water (approximately 6, 600 gal/sampling period) per each six-hour sampling interval so that a total known volume of water was pumped during a 24-hour period. A second pump with identical specifications was added to collect samples across the entire water column during April 2009 through June 2009 samples. Fish eggs and larvae were removed from the samples collected by plankton net, counted and identified to the lowest possible taxon.

Analysis of Impingement and Entrainment Data

The impingement and entrainment data were evaluated to determine the total number of individuals collected, the species composition, and impingement/entrainment rates. The following analyses were performed in each case:

- Calculation of impingement and entrainment rates by sample, averaged by year;
- Calculation of estimated abundance at operational capacity; and
- Calculation of estimated abundance at maximum capacity.

Impingement rates were calculated for each 24 hour sample by dividing the total number of fish collected in the sample by the total volume (m^3) of water withdrawn by the facility during the sample. Table 3 details the monthly flow volumes provided by DECo for each sample month. These monthly flow volumes were used to estimate the volume withdrawn during each 24 hour sample. An average annual impingement rate was determined by dividing the total number of fish collected across the 11 samples by the total volume of water sampled. Impingement rates are provided as total number of fish collected per m^3 of water sampled. There was no sample collected in April and thus its flow volume is not utilized in the calculation of the average annual impingement rates.

Entrainment rates were calculated for each sample by dividing the total number of fish (eggs + larvae) collected during each sample by the total volume of water (m^3) pumped during sample collection by the sampling pump(s). An average annual entrainment rate was determined by dividing the total number of fish collected across the 9 monthly samples by the total volume of water sampled (m^3). Entrainment rates are provided as total number of fish per m^3 of water sampled.

Impingement/Entrainment Rate = # organisms collected/volume of water sampled (m^3)

Using the rates described above, an estimate of total impingement/entrainment abundance was calculated using two approaches: *operational capacity* and *maximum capacity*.

The estimated impingement/entrainment abundance at *operational capacity* was calculated by first recording the volume of circulating water from the operational pump usage at Fermi 2 throughout the 24-hour sample collection, Table 3. The sample impingement/entrainment rate (#/m^3) was then multiplied by the *operational* volume withdrawn by Fermi 2 each month to estimate monthly abundance at Fermi 2. The sum of the monthly abundance figures is provided as an estimate of *operational* annual impingement and entrainment at the existing Fermi 2 Power Plant.

Estimated Abundance at Operational Capacity = rate (#/m^3) x *operational* withdrawal (m^3)/month

The estimated impingement/entrainment abundance at *maximum capacity* was calculated by first determining the volume of water that could be withdrawn by Fermi 3 with intake pumps operating at *maximum capacity*. Table 4 provides maximum capacity flow volumes at Fermi 3 by month. The sample impingement/ entrainment rate (#/m^3) was then multiplied by the *maximum* capacity (34,264 gpm) at Fermi 3 each month to estimate monthly abundance. The sum of the monthly abundance figures is provided as an estimate of *maximum* annual impingement and entrainment at the proposed Fermi 3 Power Plant.

Estimated Abundance at Maximum Capacity = rate (#/m^3) x *maximum* withdrawal (m^3)/month

2.2 Fish Community

The nine representative sampling stations were sampled once per month at randomly selected locations within each station, Figure 2. Fish were collected using current fisheries techniques as described in Murphy and Willis (1996). These gears are routinely used in fisheries sampling programs throughout North America and include: gill nets; hoop nets; minnow traps; bag seines; and electroshocking. These gears were used to collect fish within the varying habitats associated with each aquatic resource. Multiple sampling gears were selected to allow for thorough sampling coverage of the different life stages of fish. Due to the diversity of aquatic habitat sampled and the amount of vegetative cover within each aquatic resource some sample gears could not be used at specific locations. Table 5 provides a summary of sample locations and the types of gears utilized for each. Electroshocking was employed at all locations except LE1-A (seines) and IP-A (minnow traps and hoop nets). Gill nets (NQ-A and SQ-A) and seines (LE1-A) were used to supplement the electrofishing effort at those specified locations.

Upon retrieval of each sample gear, all fishes were identified to the lowest practicable taxonomic level and enumerated. A maximum of 50 randomly selected individuals of each species were measured (total length) to the nearest millimeter. The total length of each fish was measured from the tip of the snout to the tip of the tail.

No samples were collected during the winter months from December 2008 through March 2009 due to environmental constraints associated with the icing of waterbodies.

2.3 Macroinvertebrate Community

Benthic macroinvertebrates were sampled monthly in principal habitat areas associated with each of the nine aquatic sampling locations. Principal habitats included areas with aquatic vegetation and areas where the benthic substrate consisted of soft silt and/or detritus materials. A 12-inch D-frame dip net with a 500µm mesh was pulled for one linear meter at a depth of two inches into the substrate. Samples were washed into a 500µm mesh sieve bucket, and subsequently rinsed into a one liter plastic jar and preserved with 95% ethanol. This method closely follows the methods outlined by the EPA Field Operations Manual (2007). Benthic invertebrates were identified to the lowest practicable taxa and data were used to evaluate species richness and aquatic biodiversity.

No samples were collected during the winter months from December 2008 through March 2009 due to environmental constraints associated with the icing of waterbodies.

2.4 Representative Important Species

As a part of the COLA application issued to the NRC, representative important species (RIS) with the potential to occur in the vicinity of the Fermi site were addressed. While no sampling locations or methods were modified to sample specifically for RIS, the study evaluated their potential occurrence. The presence or absence of the RIS species was documented through the sampling methods described throughout section 2. Representative important species (RIS) include both state and federally listed threatened and endangered species and those with commercial and/or recreational value. The following section describes the threatened and endangered aquatic species in Monroe County, Michigan as well as the state of the commercial and recreational fisheries in the Michigan waters of Lake Erie. For a complete life history of each of the representative important species discussed in this section, including spawning areas, nursery ground, food habits, feeding areas, wintering areas, and migration routes, see Appendix B.

<u>Threatened and Endangered Species</u>

Federally and state listed aquatic fish and mollusk species with the potential to occur in the western basin of Lake Erie and/or other aquatic habitats within and adjacent to the Fermi Site in Monroe County, Michigan, are provided in Table 6. Threatened and endangered species lists prepared by the USFWS (federal level) and the MDNR (state level) were reviewed in order to develop the list.

<u>Commercial Species</u>

Lake Erie supports one of the largest freshwater commercial fisheries in the world, with the majority of commercial fishing based on the Canadian border. Commercial harvest in the Michigan waters of Lake Erie in 2007 consisted of 13 species of fish, weighing a total of 1,058,253 pounds, with an estimated value of $398,253. Total catch was dominated by three types of fish accounting for about 66% of the total harvest by weight: the common carp (23%), gizzard shad (23%), and buffalo (13%). Other species harvested included channel catfish (9%), white bass (7%), freshwater drum (6%), goldfish (4%), white perch (3%), whitefish (1%), and others (3%), including bullheads, suckers, quillback and chub (Thomas, 2008).

<u>Recreational Species</u>

Lake Erie is the warmest and most biologically productive of the Great Lakes, producing more fish each year for human consumption than the other four Great Lakes combined. The Western Basin of Lake Erie is known as the "Walleye Capital of the World," producing more walleye per acre than any other lake globally. Important recreational species include both native and non-native species such as the common carp and the white perch, as well as the rainbow trout and brown trout.

Sport fishing harvest (non-charter) in the Michigan waters of Lake Erie in 2007 included approximately 369,624 fish, a number dominated by yellow perch (47%) and walleye (41%). Other species harvested by sport-fishermen included white perch (5%), channel catfish (4%), white bass (2%) and others (1%) including freshwater drum, largemouth bass, smallmouth bass, and rainbow trout. Trends in angler effort and harvest rates for walleye and yellow perch since the mid 1980's suggest that the level of angler effort is influenced by many factors in addition to harvest rates. Factors such as weather, prey fish abundance, fishing sources on other Great Lakes waters and regional economic conditions have likely contributed to the relatively low level of fishing effort since 1991.

Charter fishing harvest in the Michigan waters of Lake Erie in 2007 consisted of approximately 29,818 fish, dominated by walleye (66%) and yellow perch (33%). Together, walleye and yellow perch accounted for 99% of the charter fishing harvest. Other species harvested include the rainbow trout (Thomas, 2008).

3.0 Modifications to Survey Methodologies

The data were evaluated to determine monthly and seasonal shifts in abundance and diversity. Based on the data presented in the interim report, it was agreed upon by DECo and the NRC during February 2009 audit meetings, that several aspects of the sampling program be modified. Included in these modifications were changes to the impingement and entrainment sampling program and the fish and the macroinvertebrate sampling program.

3.1 Impingement and Entrainment

The entrainment sampling program was modified to demonstrate a more complete profile of organisms, by depth, and during peak recruitment season at the Fermi 2 intake. The following modifications were made:

<u>Change in Entrainment Sample Depth(s)</u>

In response to comments from NRC at the February 2009 audit meetings, entrainment sampling was modified to represent sample collections from near-bottom and near-surface depths. Subsequent samples were collected using a two pump system. One pump was set up to collect samples from near-bottom (at least one meter from bottom) and the other pump was positioned to collect samples from near-surface (at least one meter from surface). Each sample was collected simultaneously and combined into one composite sample for each six hour interval over the 24-hour sample period. Sampling, identification and enumeration procedures were otherwise unaltered. These changes applied to samples collected in April, May, June and July 2009.

<u>Addition of entrainment samples</u>

One additional entrainment sample was collected in March 2009 to document the presence or absence of lake whitefish in the intake area. The addition of this sample was based on historic entrainment data collected at the Fermi 2 intake structure that found an increase in lake whitefish entrainment during the month of March. Four additional entrainment samples were scheduled, one each month during peak recruitment season, April 2009 through July 2009.

<u>Modification of one Impingement Sample</u>

Due to operational constraints at the GSWPH, modifications to impingement samples were made during the September sample event. This sample was collected on a single 24 hour interval rather than the two 12 hour intervals used during the other sampling months. The screens were washed only once, for 30 minutes, at the end of the 24 hour sample period and the resulting collection represents the 24 hour sample period.

3.2 Fish and Macroinvertebrate Communities

The fish and macroinvertebrate community characterization studies were modified based on preliminary findings presented in the interim report which led to the reduction of sampling locations from nine locations to five.

The following locations remained as part of the aquatic sampling program from April 2009 through June 2009:

- North Canal (CN-A);
- Swan Creek (SC-A);
- Lake Erie - Intake (LE1-A);
- Lake Erie - South Lagoon (LE2-A); and
- South Canal (CS-A).

The following locations were removed from the aquatic sampling program and no samples were collected from April 2009 through June 2009 because these locations were isolated waterbodies and the populations were not expected to undergo dramatic fluctuations:

- South Quarry (SQ-A);
- North Quarry (NQ-A);
- Isolated Pond (IP-A); and
- Isolated Central Canal (IC-A).

4.0 Results

The following section provides the results for each of the different sampling programs completed at the Fermi site including an evaluation of species abundance, richness and composition for each of the programs, as well as impingement and entrainment rates

4.1 Impingement and Entrainment

Impingement

A total of 11 impingement samples were collected during the period from August 2008 through July 2009. Table 7 provides a summary of fish species collected in the impingement samples at the Fermi 2 GSWPH. A total of 101 fish were collected during the 11 impingement samples. The December 2008 sample yielded the greatest number of fish (34) while the June 2009 and July 2009 samples yielded the fewest fish (1). Fish composition was dominated by gizzard shad (39%), emerald shiner (29%), white perch (10%) and bluegill (7%), Figure 3. A total of 15 species of fish were represented in the samples ranging from seven in September 2008 to one in both June 2009 and July 2009. Impinged organisms ranged from 24mm to 368 mm total length. The smallest individual organism impinged was the spottail shiner with the largest being the freshwater drum. No federally or state listed threatened or endangered species were collected.

Impingement rates (#/m^3) ranged from 1.9E-4 fish/m^3 in December to 4.3E-6/m^3 in June 2009[2]. The average annual impingement rate for all species collected in the 11 samples from August 2008 through July 2009 was 4.6E-5/m^3. Of the 15 species identified, the gizzard shad had the highest impingement rate (1.8E-5/m^3) There were eight species which shared the lowest impingement rate (4.5E-7/m^3). Table 8 provides a summary of impingement rates at the Fermi Site from August 2008 through July 2009.

Table 9 provides an estimate of impingement abundance by species and month for the Fermi 2 facility with cooling water intake pumps at operational capacity (provided by DECo for each sample month). Of the estimated 3,102 fish impinged annually at operational capacity, December (1,054) and March (806) reflect the greatest estimated impingement while June (30) and July (31) reflect the lowest estimates. The estimated annual impingement ranges from 1204 for the gizzard shad to 30 for several species, including the bluntnose minnow, channel catfish, freshwater drum, green sunfish and rock bass.

Based upon Fermi 3 operations at maximum capacity (32,264 gpm) , it is estimated that 3,110 fish will be impinged annually. Of these, December represents the greatest estimate (1,090) while June represents the lowest estimate (24). The estimated annual impingement at maximum capacity for each species ranges from 1,246 for the gizzard shad to 24 for the bluntnose minnow, channel catfish, freshwater drum, green sunfish and rock bass, Table 10.

Entrainment

Thirteen entrainment samples were collected during 10 months from July 2008 through July 2009. Table 11 provides a summary of fish larvae and eggs collected in entrainment samples at the Fermi GSWPH. A total of 1286 fish (81 eggs and 1205 larvae) were entrained, consisting of 12 identified taxa, 74 unidentified eggs and 2 unidentified centrarchid larvae. A total of 1,306.79 m^3 of water was collected and filtered throughout the study. The May 2009 sample yielded the greatest number of fish (533), while both November 2008 and March 2009 yielded the lowest number (0). Sample composition was dominated by gizzard shad (37%), emerald shiner (18%), bluntnose minnow (14%) and yellow perch (13%), Figure 4.

Entrainment rates (fish eggs + larvae/m^3) ranged from 4.82/m^3 in July 2009 to 0.00/m^3 in November 2008 and March 2009. The average annual entrainment rate for all species collected from July 2008 through July 2009 was 0.98/m^3. Of the 12 taxa identified in entrainment samples, the gizzard shad reflected the highest entrainment rate at 0.36/m^3 while the white perch and the brook silverside had the lowest entrainment rates at 0.0015/m^3. Table 12 provides a summary of entrainment rates at the Fermi 2 GSWPH from July 2008 through July 2009.

Table 13 provides an estimate of entrainment abundance by species and month for the Fermi 2 facility with cooling water intake pumps at operational capacity (Provided by DECo for each sample month). Of the 62,566,648 fish (3,940,823 eggs and 58,625,825 larvae) estimated to be entrained annually, July reflects the highest estimated entrainment (33,852,880), while both November and March have an estimated entrainment of zero fish with pumps at operational capacity. The estimated annual entrainment ranges from 30,238,133 for the gizzard shad to 59,297 for the brook silverside.

With the Fermi 3 cooling water intake pumps operating at maximum capacity (32,264 gpm), it is estimated that 54,776,573 fish (3,450,157 eggs and 51,326,416 larvae) will be entrained annually, with the largest number of fish being entrained in July (27,896,935 fish) and that zero fish will be entrained in November and March. Gizzard shad is expected to reflect the greatest level of annual entrainment with 47,628,660, while unknown Centrarchid are expected to be entrained the least with 106,033 fish entrained annually. For a review of

[2] Impingement rates are expressed in scientific notation; 1.9E-4 is equivalent to 1.9×10^{-4}

monthly and annual estimated entrainment abundance with Fermi 3 intake pumps at maximum capacity, see Table 14.

4.2 Fish Community

The results of the aquatic study for fish communities are presented in Tables 15 through 26. A total of 14,885 fish comprising 52 species were captured at the nine sampling sites from July 2008 through June 2009, Table 15. Of the fish collected, goldfish (21%), gizzard shad (18%), bluegill (13%), and emerald shiner (9%) accounted for 61%, Figure 5. The other 48 species accounted for the remaining 39%. The Lake Erie – South Lagoon sample site had the greatest number of fish collected with 3,856 while the Isolated Pond had the fewest number of fish (11), Table 16. The Lake Erie - South Lagoon sample had the greatest number of fish species (38) and the Isolated Pond had the fewest number of fish species (4), Table 17.

<u>Swan Creek</u>

The Swan Creek (SC-A) station was sampled near where the north canal enters Swan Creek using electroshocking and seines. Table 18 provides a summary for all monthly samples collected on Swan Creek. A total of 1,790 fish were collected during eight sampling events from July 2008 through June 2009. The July 2008 sample yielded the greatest total number of fish (422) while November 2008 represented the smallest sample (35). Composition of fish was dominated primarily by gizzard shad (33%), followed by emerald shiner (24%), bluegill (6%), brook silverside (6%), and pumpkinseed (6%), Figure 6.

A total of 33 species of fish were represented in the samples, indicating a relatively high level of species richness for Swan Creek compared to the other sites. Monthly species richness ranged from five to 24 species with June 2009 exhibiting the highest number and November 2008 the lowest number.

<u>Lake Erie</u>

Two areas were sampled in Lake Erie, including the Lake Erie – Intake (LE1-A) area adjacent to the intake structure and the Lake Erie – South Lagoon (LE2-A). A total of 1,909 fish comprising 19 species were collected in eight sampling events at the Lake Erie – Intake location. Table 19 provides a summary for all monthly samples collected by seine at the intake structure from July 2008 through June 2009. The August 2008 sample contained the greatest total number of fish (1274) while the June 2009 sample yielded the fewest number of fish (5). Species composition was dominated by gizzard shad (45%), white perch (33%), emerald shiner (7%), and spottail shiner (6%), Figure 7.

A total of 19 species of fish were represented in the samples indicating an overall moderate level of species richness relative to the other locations. Monthly species richness ranged from a minimum of one species in November 2008 to a maximum of 12 species in July 2008.

A total of 3,856 fish comprising 38 species were collected at the Lake Erie – South Lagoon location. Table 20 provides a summary of the seven monthly events from July 2008 through June 2009 using electroshocking gear. Of the samples collected, August 2008 yielded the greatest total number of fish (1791) while the November 2008 sample represented the fewest number of fish (78). Species composition was dominated by goldfish (28%), gizzard shad (16%), and emerald shiner (14%), Figure 8.

A total of 38 species of fish were represented in the samples indicating a relatively high level of species richness for the habitat. Monthly species richness ranged from a minimum of four species in November 2008 to a maximum of 23 species in August 2008 and October 2008.

Internal Canal System

Three sampling areas were associated with the internal canal system at the Fermi site. These locations are the North Canal (CN-A), Isolated Central Canal (IC-A), and the South Canal (CS-A). The North Canal samples consisted of a total of 1,822 fish comprising 30 species in seven samples collected from July 2008 through June 2009, Table 21. The September 2008 sample contained the greatest total number of fish (574), while April 2009 exhibited the fewest (52). Species composition was dominated by bluegill (22%), followed by pumpkinseed (16%), emerald shiner (11%), and gizzard shad (10%), Figure 9.

A total of 30 species of fish were represented in the samples indicating a comparatively high level of species richness for the habitat. Monthly species richness ranged from a minimum of 11 in October 2008 to a maximum of 19 species in July 2008.

The Isolated Central Canal is an isolated component of the canal system. Although it appears to be part of the canal system there is not a hydrological link between the North Canal and the South Canal. Results from the electroshocking samples indicated that a total of 861 fish consisting of 13 species were collected in four samples collected from July 2008 through October 2008, Table 22. August 2008 yielded the greatest number of fish (316) while the July 2008 sample contained the fewest number of fish collected (118). Species composition was dominated by bluegill (58%), gizzard shad (13%), largemouth bass (11%), and white crappie (6%), Figure 10.

A total of 13 species of fish were represented in the samples indicating a moderate level of species richness compared to the other habitats sampled. Monthly species richness ranged from a minimum of seven in July 2008 to a maximum of 11 species in September 2008.

The South Canal samples consisted of a total of 2,438 fish comprising 28 species. Table 23 provides a summary of the monthly samples collected at the South Canal from July 2008 through June 2009. The October 2008 sample contained the greatest number of fish (1,707), while the fewest were collected in the June 2009 sample (51). Species composition was dominated by goldfish (63%), common carp (10%), bluegill (5%), golden shiner (5%), and pumpkinseed (5%), Figure 11.

A total of 28 species of fish were represented in the samples indicating a high level of species richness for relative to the other locations. Monthly species richness ranged from a minimum of 7 in April 2009 to a maximum of 17 species in August 2008.

Isolated Pond

The Isolated Pond is located within a large wetland forest community west of the south lagoon, and is approximately ½ acre in size. Because of its shallow depth and isolated location, hoop nets and minnow traps were utilized for the sampling effort. Results of the sampling produced a total of 11 fish representing 4 species that were collected from July 2008 to November 2008, Table 24.The samples consisted of bluegill (46%), pumpkinseed (27%), green sunfish (18%), and bluegill/green sunfish hybrid (9%), Figure 12.

A total of four species of fish were represented in the samples indicating a relatively low level of species richness for the habitat. Monthly species richness ranged from zero in September 2008 to two in July 2008, October 2008 and November 2008.

Quarry Lakes

The two quarry lakes are located on the west side of the Fermi site and are separated from one another by a thin strip of land, thus there is no hydrological connection between them. The quarries were sampled using gill nets and electroshocking gear. Five samples collected from the North Quarry produced a total of 1,066 fish representing nine species. Table 25 provides a summary for all monthly samples collected in the North Quarry from July 2008 through November 2008. The October 2008 sample contained the greatest total number of fish

(270), while July 2008 yielded the fewest number of fish (135). Species composition was dominated by bluegill/green sunfish hybrids (34%), followed by goldfish (31%), green sunfish (18%), and gizzard shad (8%), Figure 13.

A total of nine species of fish were represented in the samples indicating a comparatively low level of species richness for the habitat. Monthly species diversity ranged between six and seven species.
The South Quarry samples produced a total of 1,132 fish representing seven species. Table 26 provides a summary for all monthly samples collected from July 2008 through November 2008 using gill nets and electroshocking gear. Species composition was dominated by bluegill (71%) and gizzard shad (14%), Figure 14.

A total of seven species of fish were represented in the samples indicating a relatively low level of species richness for the quarry lakes. Monthly species richness ranged between five and six species.

4.3 Macroinvertebrate Community

The results of the aquatic study for macroinvertebrate communities are presented in Tables 27 through 38. A total of 5,049 individuals comprising 19 orders were captured at the nine sampling sites from July 2008 through June 2009, Table 27. Of the 5,049 individuals collected Diptera (24%), Ephemeroptera (24%), Amphipoda (16%) and Tubificida (11%) accounted for 75% of individuals collected. The other 15 orders accounted for the remaining 25%. Diptera was mostly comprised of *Tanytarsus sp.* (14%) while Tubificida was mostly comprised of Naidinae (46%) and Tubificinae (52%).

Swan Creek (SC-A) sample site had the greatest number of individuals collected with 790 while the Lake Erie-Intake (LE1-A) sample site had the fewest number of individuals with 260, Table 28. The Isolated Pond (IP-A) sample had the greatest number of taxa captured (27) in both September 2008 and October 2008 and Lake Erie - Intake (LE1-A) had the fewest number of taxa captured (0) in the May 2009 sample, Table 29.

<u>Swan Creek</u>

The Swan Creek (SC-A) station was sampled in the vicinity where the north canal enters Swan Creek north of the Fermi site. Sampling techniques utilized D-frame dip nets. Table 30 provides a summary for all monthly samples collected on Swan Creek. A total of 790 individuals were collected during eight sampling events from July 2008 through June 2009. The October 2008 sample yielded the greatest total number of individuals (107) while April 2009 represented the smallest sample (76).

Composition of individuals was dominated by Haplotaxida (31%), Amphipoda (23%), and Diptera (19%) among others. Haplotaxida primarily consisted of Naidinae (78%) while Amphipoda and Diptera were mostly comprised *Gammarus fasciatus* (94%) and *Cladotanytarsus sp.* (28%), respectively.

A total of 16 orders consisting of 75 taxa were represented in the samples, indicating a relatively high level of richness for Swan Creek. Monthly taxa richness ranged from 12 to 23 taxa with April 2009 exhibiting the highest number and September 2008 the lowest number of taxa captured.

<u>Lake Erie</u>

Two areas were sampled in Lake Erie, including the Lake Erie – Intake (LE1-A) area adjacent to the intake structure and the Lake Erie – South Lagoon (LE2-A). A total of 260 individuals comprising 8 orders and 32 taxa were collected in seven sampling events at the Lake Erie – Intake station. Table 31 provides a summary for all monthly samples collected using a D-frame dip net at the intake structure station from July 2008 through June 2009. The October 2008 sample contained the greatest number of individuals (100) while the May 2009 sample yielded no organisms captured followed by the November 2008 sample (8).

Sample composition was dominated by Amphipoda (61%) and Diptera (18%). *Gammarus fasciatus* (95%) made up a majority of the Order Amphipoda, while *Rheotanytarsus exiguus gr.* (21%) was the prevalent Dipteran.

A total of 32 taxa were represented in the samples indicating a relatively moderate to high level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of zero individuals captured in the May 2009 sample to a maximum of 19 taxa in the July 2008 sample.

The Lake Erie - South Lagoon station samples provided a total of 592 individuals representing 43 taxa. Table 32 provides a summary for the seven monthly samples collected from July 2008 through June 2009 using a D-frame dip net. There was no sample collected in September as a result of weather conditions. Of the samples collected, August 2008 exhibited the greatest total number of individuals (127) while the April 2009 sample comprised the fewest number of Individuals (12).

Sample composition was dominated by Ephemeroptera and Amphipoda (19%). Order Ephemeroptera was comprised entirely of *Caenis sp.,* while Amphipoda was dominated by *Gammarus fasciatus* (85%).

A total of 43 taxa were represented in the samples indicating a comparatively high level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of five taxa in November 2008 to a maximum of 17 taxa in the October 2008 and June 2009 samples.

<u>Internal Canal System</u>

Three sampling areas were associated with the internal canal system at the Fermi site. These locations are the North Canal (CN-A), Central Canal (IC-A), and the South Canal (CS-A). The North Canal samples produced a total of 763 individuals representing 15 orders and 34 taxa in seven samples collected from July 2008 through June 2009, Table 33. The October 2008 sample contained the greatest total number of individuals (131) while July 2008 exhibited the fewest (99).

Composition of samples collected from the North Canal included Ephemeroptera (28%), Diptera (24%), and Tubificida (14%) among others. Order Ephemeroptera was dominated by *Caenis sp.* (99%) while Diptera was consisting mostly of *Dicrotendipes modestus* (18%) and Tubificida was dominated by Naidinae (65%).

A total of 34 taxa were represented in the samples indicating a comparatively high level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of 14 in October 2008 to a maximum of 25 taxa in April 2009.

Results from the Isolated Central Canal collections revealed a total of 323 individuals representing 38 taxa in four samples collected from July 2008 through October 2008. Table 34 provides a summary of the monthly samples collected. October 2008 yielded the greatest number of individuals (123) while the July 2008 sample contained the fewest number of individuals collected (37).

Sample composition was dominated by Amphipoda (36%)(and Diptera (31%). Order Amphipoda was consisted mostly of *Crangonyx sp.* (57%) while Diptera was made up mostly of *Tanytarsus sp.* (24%).

A total of 25 taxa were represented in the samples indicating a comparatively moderate level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of 11 in July 2008 to a maximum of 21 taxa in August 2008.

The South Canal samples yielded a total of 768 individuals comprising 63 taxa. Table 35 provides a summary of the monthly samples collected at the South Canal from July 2008 through June 2009. The June 2009 sample contained the greatest number of individuals (142), while the fewest were collected in May 2009 (70).

The sample was dominated by Ephemeroptera (26%), Amphipoda (25%), and Diptera (20%). *Caenis sp.*(98%) was the dominant Ephemeroptera, while *Hyalella azteca* (95%) and *Paratanytarsus sp.* (17%) were dominate in the Amphipoda and Diptera, respectively.

A total of 25 taxa were represented in the samples indicating a comparatively high level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of 15 in July 2008 to a maximum of 23 taxa in September 2008.

Isolated Pond

The Isolated Pond is located within a large wetland forest community west of the south lagoon, and is approximately ½ acre in size. Results of the sampling indicated that a total of 546 individuals representing 51 taxa were collected from July 2008 through November 2008.

The samples were dominated by Diptera (44%) among others. The Diptera consisted of *Cladopelma sp.* (14%), *Tanytarsus* (14%), and *Dicrotendipes modestus* (13%) Table 36.

A total of 51 taxa were represented in the samples indicating a relatively high level of taxa richness for the habitat. Monthly taxa richness ranged from a minimum of 16 taxa in July 2008 to 27 in September 2008.

Quarry Lakes

The two quarry lakes are located on the west side of the Fermi site and are separated from one another by a manmade berm, thus there is no hydrological connection between them. The quarries were sampled using dip nets. Five samples collected from the North Quarry (NQ-A) resulted in a total of 511 individuals representing 26 taxa. Table 37 provides a summary for all monthly samples collected in the North Quarry from July 2008 through November 2008. The September 2008 sample contained the greatest total number of individuals (111), while August 2008 yielded the fewest number of individuals (98). Sample composition was dominated by *Caenis sp* (57%) and *Dasyhelea sp.* (13%) among others.

A total of 26 taxa were represented in the samples indicating a relatively low level of richness for the habitat. Monthly diversity ranged between nine and 15 taxa.

The South Quarry (SQ-A) samples resulted in a total of 496 individuals representing 27 taxa. Table 38 provides a summary for all monthly samples collected from July 2008 through November 2008 using dip nets. Sample composition was dominated by *Caenis sp* (64%) and *Dasyhelea sp.* (13%) among others.

A total of 27 taxa were represented in the samples indicating a relatively low level of taxa richness for the habitat. Monthly taxa richness ranged between seven and 13 taxa.

4.4 Representative Important Species

Threatened and Endangered Species

Based upon the review of data collected in the aquatic sampling conducted in the western basin of Lake Erie in Monroe County, MI, immediately adjacent to the Fermi site, and in additional onsite aquatic habitats, there were no occurrences of federally and/or state listed threatened and endangered aquatic species. These results indicate that the occurrence of these species in the vicinity of the Fermi site is highly unlikely and that any impacts to these species, if present, would be SMALL.

Commercial Species

In 2007, the Lake Erie commercial fishery was dominated by the harvest of common carp, gizzard shad and buffalo, followed by channel catfish, white bass, freshwater drum, goldfish, white perch and whitefish. The aquatic sampling in the western basin of Lake Erie, adjacent to the Fermi site, and in onsite aquatic habitats confirmed the presence of each of the above listed species, aside from the whitefish.

Sampling of the fish community at nine locations from July 2008 through July 2009, in both onsite aquatic habitats and in Lake Erie found goldfish (21%), gizzard shad (18%), common carp (5%), white perch (5%) and bigmouth buffalo (2%) to be the most prominent commercial species. Samples also contained very small numbers of channel catfish, white bass and freshwater drum, each representing less than 1% of all fish community samples collected at the Fermi site.

Commercial species present in impingement samples include gizzard shad (39%) and white perch (10%). Freshwater drum and channel catfish were also present in impingement samples at very low rates, representing less than 1% of all impingement samples. Entrainment samples noted the presence of gizzard shad (37%), bigmouth buffalo (4%) and freshwater drum (3%) larvae and/or eggs. White perch and channel catfish larvae and/or eggs were also present in entrainment samples at very low rates, each representing less than 1% of all entrainment samples collected at the Fermi site.

Recreational Species

The Lake Erie recreational fish harvest was dominated by yellow perch and walleye, 88% combined, with a much smaller recreational harvest of white perch, channel catfish, white bass, freshwater drum, largemouth bass, smallmouth bass and rainbow trout. The aquatic sampling program confirmed the presence of each of the above listed species, with the exception of walleye, in the western basin of Lake Erie, adjacent to the Fermi site, and/or in other onsite aquatic habitats.

Results from fish community sampling in nine aquatic habitat locations found white perch (5%), largemouth bass (3%) and yellow perch (1%) to be the most prominent recreational species. The collections also noted the presence of channel catfish, white bass, freshwater drum, smallmouth bass and rainbow trout, each representing less than 1% of all fish community samples collected at the Fermi site.

Recreational species present in impingement samples include white perch (10%) and smallmouth bass (2%). Channel catfish, freshwater drum and largemouth bass were also present in impingement samples at a very low rate, representing less than 1% of all impingement samples. Entrainment samples noted the presence of yellow perch (13%) and freshwater drum (3%) larvae. No eggs that could be identified were collected for these two species. White perch, channel catfish and largemouth bass were also noted in entrainment samples at a very low rate, each representing less than 1% of all entrainment samples.

5.0 Discussion and Conclusions

The purpose of this study was to collect data over a one year period to supplement the aquatic data included in the Environmental Report of the COLA. The goals of the study were to determine fish species currently impacted by impingement and entrainment as part of the GSWPH for Fermi 2, compare current and historical impingement and entrainment data to determine the potential for impingement and entrainment for the proposed Fermi 3 Power Plant, determine species richness and relative abundance for fish and macroinvertebrates on-site and adjacent to the site in Lake Erie and Swan Creek, and identify potential impacts to aquatic resources associated with the proposed expansion project. The following discussion section evaluates the results of this study with regard to the aforementioned objectives.

Impingement and Entrainment

A total of 101 fish were collected during the impingement study. Based on actual number of fish collected, impacts due to travelling screen operations appear minimal. Overall impingement numbers were low each month with peaks occurring in December and March and lows occurring in June and July during the summer months. The peak in November was associated with the presence of gizzard and the peak in March was associated with emerald shiner. Increased abundances of gizzard shad were expected due to the rapidly declining seasonal Lake Erie water temperatures. Increased abundance of emerald shiner in March is associated with spring movement in the western basin of Lake Erie.

These numbers indicate a low to moderate relative species richness and abundance across all samples collected at the Fermi 2 intake. This notion is confirmed through examination of the fish community at the two Lake Erie sample locations. The Lake Erie – South Lagoon site exhibited relatively high levels of species richness and abundance (a total of 3,856 fish from 38 species collected in seven monthly samples). These relatively high levels can be attributed to the abundant aquatic habitat and vegetation found in the South Lagoon. North of the South Lagoon, at the Lake Erie – Intake location, species richness and diversity (a total of 1,909 fish collected from 19 species) were almost exactly half of those found in the South Lagoon. This can be attributed to the decline in sufficient quality aquatic habitat along the shoreline north of the South Lagoon. The abundant vegetation and riparian buffer give way to the open waters of Lake Erie where fish are exposed to increased turbidity, winds and waves. Even further north, the impingement sampling took place at the Fermi 2 GSWPH. Similar to the Lake Erie – Intake location, impingement samples found relatively low species richness and abundance. This is likely due to the open water nature of the aquatic habitat in the vicinity of the intake structure.

A total of only 1,286 fish (81 eggs +1205 larvae) were collected in entrainment samples during this study which indicates that impacts to fish eggs and larvae are low. The greatest numbers of fish were collected during May and July with zero fish collected in the November and December samples. Sampling yielded relatively low levels of species richness with generally higher numbers in the spring time as compared to those found in the fall. Contributing factors include the fact that the spring season is peak recruitment season in Lake Erie. Accordingly, a second sample was collected during the months of April, May and June at multiple depths to ensure an adequate depth profile. In addition to the increased spring entrainment, there were zero fish entrained in both November and March (the months immediately before and after icing). Fish collected in entrainment samples were dominated by gizzard shad, emerald shiner, bluntnose minnow, and yellow perch. These results were expected due to the densities observed in the current fish community assessment and historical studies.

Fish & Macroinvertebrate Communities

The quantity and variety of fish species collected during this aquatic survey indicate that each of the nine aquatic communities sampled supports a diverse assemblage of fauna. Sample locations such as Swan Creek, Lake Erie-Intake Area, Lake Erie-South Lagoon, the North Canal and South Canal all have relatively high numbers of fish and species richness, which is representative of a sufficiently structured (healthy) ecosystem. All of these aquatic resources are hydrologically connected which allows for movement of fish species to and from each of these areas. Fish composition within these areas is highly diverse with no one species dominating all five locations. Gizzard shad was most prevalent at one Lake Erie site (and was second most prevalent at the other Lake Erie site) and the Swan Creek station, moderately abundant in the North and Isolated Central Canals, and was less prevalent in the South Canal and both Quarry sites. This is consistent with their habitat requirements which suggest that they are more common in open water. Other species common to all five locations included goldfish, bluegills and other sunfish species, as well as shiner species. This would be expected based upon the life histories and habitat requirements of species collected, which is indicative of a sufficiently structured (healthy) fish community with available resources. White perch were also collected at the Lake Erie, Swan Creek and North and South Canal stations.

Comparisons between the three sample stations associated with the internal canal system indicate that the fish species composition was similar between the Isolated Central Canal and North Canal sites and that both of these aquatic systems had a somewhat different composition than observed in the South Canal. For example, the North and Isolated Central Canals were generally dominated by bluegill, gizzard shad and other centrarchid species and the South Canal was dominated by goldfish, common carp and other centrarchid species. This observation is likely attributed to the isolation of the three systems.

The Isolated Central Canal, North Quarry and South Quarry had relatively high numbers of fish but a low to moderate species richness. These lower values may be attributed to the isolated nature of each system. All three systems consist of aquatic habitat such as fringing wetland vegetation and required forage organisms necessary for supporting fish populations; however, they are completely cut off from the adjacent aquatic resources that support more diverse fish assemblages. The Isolated Pond had the fewest number of fish as well as the lowest species richness. This is evident given the isolated location of the pond and the shallow water habitat that would tend to restrict the level of fish reproduction.

The two Lake Erie sample locations had comparatively different species richness and abundance. The Lake Erie-Intake location had much lower species richness and abundance levels. Even though the sampling methodologies were different, differences between the two locations are more likely attributed to differences in habitat structure associated with each location. The Intake location is located along a sand to gravel beach in the open waters of Lake Erie with little to no structure or habitat present for cover or spawning. The South Lagoon location has both sand and gravel shoreline as well as vegetated shoreline to support structure for cover and spawning. In addition, the South Lagoon location is at the confluence of the South Lagoon which has extensive aquatic vegetation that potentially supports a larger fish population, those of which can move freely from the lagoon out into the main body of the lake.

Collected macroinvertebrate samples indicate that all nine locations support a sufficiently structured benthic community typical of those expected in the aquatic habitats observed at the Fermi site. Nearly every site exhibited relatively high proportion of midges, oligochaete worms and/or amphipods. The samples associated with Swan Creek showed the greatest family diversity and were dominated by oligochaete worms while samples associated with Lake Erie were moderately to highly diverse and were dominated by amphipods, midges and mayflies. The North and South Canals included high macroinvertebrate family diversity and were dominated by oligochaetes and mayflies. The Central Canal exhibited less diversity in macroinvertbrate community structure as compared to the other two canal sites and was dominated by amphipods and oligochaetes. The Isolated Pond had moderate diversity and was dominated by multiple species of oligochaetes and midges. Benthic samples associated with the quarry lakes were the least diverse and were generally dominated by midge and mayfly families which could be explained by suitable substrates.

During the study, an inquiry arose concerning the presence or absence of the bloody-red shrimp (*Hemimysis anomala)* at the Fermi 2 site. In response, an examination of the data collected in this study indicated that no bloody-red shrimp were collected at the Fermi 2 site.

<u>Historical Impingement and Entrainment</u>

Impingement sampling at the Fermi 2 GSWPH in 1991 and 1992 found a total of 23 species impinged whereas the current data indicated only 15 species during a similar, one-year study. Of the 23 species identified in impingement samples from 1991 to 1992, gizzard shad (71%), white perch (7%) rock bass (3%) and freshwater drum (3%) were the most abundant species collected (Lawler et al 1993).. The current study also indicated high compositions of gizzard shad (39%) and white perch (10%). However, the current study had a much higher compostion of emerald shiner than the 1991-1992 study (29% vs. 3%). Also, the current study collected the round goby, an invasive species, that had not been collected during the earlier study. The 1991-1992 study found the greatest levels of impingement during the fall and winter months with the lowest levels during the summer months. The current study also noted highest impingement levels during December and March and lowest impingement numbers during June and July. Both studies generally indicated higher species richness during the winter months than the summer months. Similar to the current study, impingement sampling conducted at the Fermi 1 site from 1974 to 1975 also found that gizzard shad (46%), emerald shiner (35%), and yellow perch (5.6%) were the most abundant species collected (Detroit Edison 1976). Probable explanations for the increased abundance of this species include the slower swimming speeds of these fish related to colder temperatures, therefore the ability to escape impingement is reduced in these species during the winter months. A noticeable difference between the two historical studies conducted at the Fermi site is the relatively low number of emerald shiner collected in the 1991-1992 study while it was a dominant species not only in the 1974-1975 study, but the current study as well. It should be noted that comparisons with the Fermi 1 impingement results are somewhat problematic due to the limited data collections as a result of the intermittent operation of this peaking facility during the 1970's. This unit no longer operates.

Similar historical studies from neighboring power plants in the western basin of Lake Erie were evaluated for comparison and support the current findings. Similar to the current study, impingement studies conducted at the nearby Monroe plant from 2005 to 2006 (Golder, 2008) and the Bay Shore plant from 1976-1977 (Reutter, 1978) indicated impingement samples dominated by gizzard shad, 96% and 64% respectively. Sampling at the Davis Besse plant in 1978 (Reutter, 1979) noted samples dominated by goldfish (50%), yellow perch (24%) emerald shiner (15%) and gizzard shad (6.0%). The most noteworthy difference between the Davis Besse results and the results of the current study is the percent composition of goldfish in the historical study (50%) as no goldfish were impinged in the current study.

Entrainment sampling conducted at the Fermi 2 GSWPH from 1991-1992 noted a total of 28 taxa compared to the current study which indicated half as many during a similar one year entrainment study. Of the 28 taxa identified in entrainment sampling from 1991 to 1992, clupeids (34%), consisting of gizzard shad, alewife, and *Morone sp* (23%), consisting of white bass and white perch, dominated larvae and egg collections (Lawler et al 1993). The current study indicates a comparable composition of gizzard shad larvae and eggs, but noted very few white perch larvae. In addition, the current study indicates elevated numbers of emerald shiner, bluntnose minnow, and yellow perch, while for the 1991-1992 study cyprinids comprised 21% of the collections. The entrainment data collected in 1991 and 1992 also note the presence of lake whitefish (2% of total entrainment) during late March and April 1992. No lake whitefish were collected in the current study. The absence of whitefish in the current study is likely attributed to the lack of suitable spawning habitat within the vicinity of the Fermi site. Similar to the current study and the 1991-1992 study, an entrainment study conducted at the Fermi site from 1974-1975 found samples dominated by the family Clupeidae (53%), comprised of gizzard shad and alewife. The 1974-1975 study also collected relatively high numbers of yellow perch and freshwater drum (Detroit Edison 1976). However, as mentioned earlier, sampling was very limited in 1974-1975.

In addition to the historical entrainment studies conducted at the Fermi site, studies from other power plants on Lake Erie in the vicinity of the Fermi site were compared to the current study for reference. These findings indicate results similar to those of the current study. Gizzard shad was the most common species collected in three entrainment studies and was the second most common in the fourth. It comprised 57% in a study conducted at the Acme power plant from 1976-1977 (Reutter, 1978), 78% at the Bay Shore plant from 1976-1977 (Reutter, 1978), 52% at the Davis Besse plant in 1978 (Reutter, 1979), and 17% of eggs and 27% of larvae at the Monroe plant from 2005 to 2006 (Golder, 2008). Similar to the current study at the Fermi 2 plant, the freshwater drum and emerald shiner were common throughout the historical entrainment data.

For the purpose of discussing potential impacts associated with the Fermi 3 plant, current impingement and entrainment rates (#/m^3) from the Fermi 2 site were used to estimate potential impingement and entrainment abundance. The calculations were performed in two manners: first, using the Fermi 2 *operational* volume from 2008 through 2009; and second, using the *maximum* flow volume at the proposed Fermi 3 Power Plant. The use of the two flow volumes allowed for the development of a series of estimated abundances ranging from the likely impingement and entrainment at the Fermi 2 when at *operational* capacity to the "worst case scenario" impingement and entrainment at the proposed Fermi 3 Power Plant with intake pumps functioning at *maximum* capacity. While these numbers may be useful in estimating potential impacts at the Fermi site, they are not adequate for comparison with historical studies. For example, the 1991-1992 study concluded that an estimated 2,955,693 fish (72,367 eggs and 2,883,326 larvae) would be entrained annually whereas the current study concluded that approximately 62,566,648 fish (3,940,823 eggs and 58,625,825 larvae) would be entrained annually at operational capacity. This is partially explained by differences in estimated annual intake volumes. The historical sample reported operational intake flow at Fermi 2 to be approximately 58,000,000 m^3 (Lawler, 1993) annually while the current study found the annual operational flow volume at Fermi 2 to be approximately 70,000,000 m^3. In addition to discrepancies in estimated flow volume, reaching a definitive conclusion based upon any one year study (historic or current) should be done cautiously because any one data point in a one year study could skew the results and interpretations (e.g. – high/low entrainment during any one collection event as exampled by the high gizzard shad influx in July 2009).

Potential Impacts Associated with Proposed Fermi 3 Expansion

The current site plan for Fermi 3 indicates that three of the identified on-site waterbodies will be directly impacted. The north canal and isolated central canal will be completely filled in along with a portion of the south canal. Permanent impacts in the north canal and isolated central canal will result in the loss of all aquatic organisms and their habitats, while impacts in the south canal will result in minimal losses.

Indirect impacts associated with construction of Fermi 3 will be related to surface water runoff, sedimentation of habitats, increased turbidity, and erosion. These impacts may temporarily interfere with, but should not inhibit, the normal life processes of many of the organisms identified by this study. Most of these organisms are considered tolerant species that are common to areas where natural disturbances occur and are able to adapt to temporary fluctuations in the environment. Based on the proposed construction locations at the Fermi site it is anticipated that the overall impacts from the construction activities will result in minimal indirect impacts to aquatic communities. The Fermi site has numerous wetland areas between many of the on-site waterbodies that will provide a natural buffer and vegetative structure to reduce erosion. More importantly, DECo will implement a Soil Erosion Sediment Control Plan (SESC) and will operate under a National Pollution Discharge Elimination System Permit (NPDES). During construction, DECo will implement Best Management Practices (BMP) that may include the use of hay bales and silt fences near potentially affected waterbodies.

Potential impingement and entrainment impacts at the Fermi 3 site were addressed by utilizing rates from the Fermi 2 plant in conjunction with monthly operational and maximum flow capacity data to estimate monthly and annual impingement and entrainment. For the purpose of these calculations and characterization, *operational* capacity is defined as the monthly volume of water withdrawn by the Fermi 2 plant, as reported by DECo, and maximum capacity is defined as the *maximum* potential volume of water withdrawn by the proposed Fermi 3 Power Plant with intake pumps operating at *maximum* capacity (34,265 gpm).

It is estimated that 3,102 fish are impinged annually at the Fermi 2 site with the pumps at *operational* capacity. Of these, December (1,054) and March (806) reflect the greatest estimated impingement while June (30) and July (31) reflect the lowest estimates. The estimated impingement at *operational* capacity for each species, annually, ranges from 1,204 for the gizzard shad to 30 for several species, including the bluntnose minnow, channel catfish, freshwater drum, green sunfish and rock bass. With the Fermi 3 cooling water intake pumps operating at *maximum* capacity, it is estimated that 3,110 fish will be impinged annually. Of these, December represents the greatest estimate (1,090) while June represents the lowest estimate (24). The estimated annual impingement at *maximum* capacity for each species ranges from 1,246 for the gizzard shad to 24 for the bluntnose minnow, channel catfish, freshwater drum, green sunfish and rock bass.

With the Fermi 2 cooling water intake pumps at *operational* capacity, 62,566,648 fish (3,940,823 eggs and 58,625,825 larvae) are estimated to be entrained annually. July 2009 reflects the greatest estimate of entrainment abundance (33,852,880), while both November and March represent an estimated entrainment abundance of zero. The estimated annual entrainment ranges from 30,238,133 for gizzard shad to 59,297 for brook silverside. It is estimated that of the 54,776,573 fish (3,450,157 eggs and 51,326,416 larvae) entrained annually with Fermi 3 pumps operating at *maximum* capacity, the largest number of fish will be entrained in July (27,776,573) and that zero fish will be entrained in November and March. Estimates for Fermi 3 with pumps operating at *maximum* capacity indicate that the gizzard shad is expected to reflect the greatest level of annual entrainment with 25,106,899, while brook silverside are expected to be entrained the least with 57,861. While no entrainment data were collected December through February due to icing on Lake Erie, it is assumed that if any entrainment occurred it would be minimal because no eggs or larvae should exist during this time of year. The 1991-1192 study did not collect any eggs or larvae during this time period. Therefore, the exclusion of monthly estimates for those months is expected to have a negligible impact on annual estimates. This conclusion is reinforced with the fact that no organisms were collected in either the November or the March sample, on either side of the winter months in which no entrainment sampling was conducted.

The estimates based upon *operational* flow capacity are considered to be the most representative of the Fermi 2 Power Plant's potential impacts by impingement and entrainment. The *maximum* capacity estimates are only provided as a "worst case scenario" and should not be interpreted as representative of impacts under *normal* plant operation.

Historical data associated with the on-site waterbodies or with similar waterbodies within the general area of the Fermi 2 Power Plant are either nonexistent, very limited in scope and detail, or possibly outdated. Data presented in this study provide a baseline assessment that supports the characterization of fish and benthic communities in the on-site waterbodies and evaluates the species diversity and abundances of fish and ichthyoplankton impacted due to impingement and entrainment. These data are designed to supplement the information provided in the Environmental Report of the COLA application.

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Tables

Table 1. Summary of observed aquatic habitat at the Fermi site sampling locations, July 2008 through July 2009.

Location	Habitat Characteristics	Vegetation	Substrate
Swan Creek (SC-A)	Creek is ~3-10' deep; water is somewhat Turbid; at the mouth of Swan Creek hydrology is influenced by Lake Erie	Highly vegetated littoral zone; riparian corridor is ~ 15-20' wide	silt and muck
North Canal - Including Overflow Canal (CN-A)	Canal is hydrologically connected to Swan Creek; depth is ~7-10'. Water is moderately turbid	riparian buffer is ~10-15' wide; aquatic vegetation observed included cattails and phrag	clay-lined
Isolated Central Canal (IC-A)	Depth is ~ 7-10'; canal is hydrologically isolated from north and south canals; there are no culverts present; water is moderately turbid	Very little aquatic vegetation present	clay-lined
South Canal (CS-A)	Depth is ~ 7-10'; canal is hydrologically connected to Swan Creek	Some vegetation on steep banks (riparian buffer ~10-15')	clay-lined
Lake Erie 1 (LE1-A)	Banks are sloping into lake and consist mostly of rocks and sand; depth of LE1-A is ~ 3-5'; water is moderately turbid	No vegetation present on the banks	muck and sand
Lake Erie 2 (LE2-A)	The narrow banks are sandy and rocky; depth at LE2-A is ~1-4'; LE2-A is adjacent to the south lagoon waterway	Riparian buffer on the shore nearest to LE2-A is >25'	rocky
South Quarry (SQ-A)	50' in depth and together cover ~50 acres; neither quarry has a "shoreline". Banks are 50' rock faces; the quarries are separated with a earthen berm	No significant riparian buffer; presence of phrag around the eastern edges	unknown (assumed to be granulated rock and dirt)
North Quarry (NQ-A)	50' in depth and together cover ~50 acres; neither quarry has a "shoreline"; banks are 50' rock faces; the quarries are separated with a earthen berm	No significant riparian buffer; presence of phrag around the eastern edges	unknown (assumed to be granulated rock and dirt)
Isolated Pond (IP-A)	Pond is isolated within a wooded area; depth is ~2-6'; water is very turbid	Vegetation includes phrag and cattails	heavy muck

Table 2. Summary of biological samples collected at the Fermi site sampling locations, July 2008 through July 2009.

	2008						2009						
Location	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**
Swan Creek (SC-A)	F(7/22) B(7/22)	F(8/16) B(8/16)	F(9/10) B(9/10)	F(10/23) B(10/23)	F(11/19) B(11/19)	□	□	□	□	F(4/15) B(4/15)	F(5/5) B(5/5)	F(6/3) B(6/3)	△
North Canal (CN-A)	F(7/25) B(7/25)	F(8/16) B(8/16)	F(9/11) B(9/11)	F(10/23) B(10/23)	◊	□	□	□	□	F(4/15) B(4/15)	F(5/5) B(5/5)	F(6/3) B(6/3)	△
Isolated Central Canal (IC-A)	F(7/25) B(7/25)	F(8/16) B(8/16)	F(9/9) B(9/9)	F(10/22) B(10/22)	◊	□	□	□	□	○	○	○	△
South Canal (CS-A)	F(7/25) B(7/25)	F(8/16) B(8/16)	F(9/9) B(9/9)	F(10/23) B(10/23)	◊	□	□	□	□	F(4/14) B(4/14)	F(5/5) B(5/5)	F(6/3) B(6/3)	△
Lake Erie 1 (LE1-A)	F(7/22) B(7/22)	F(8/16) X	F(9/9) B(9/9)	F(10/21) B(10/21)	F(11/19) B(11/19)	□	□	□	□	F(4/15) B(4/15)	F(5/5) B(5/5)	F(6/3) B(6/3)	△
Lake Erie 2 (LE2-A)	F(7/22) B(7/22)	F(8/17) B(8/17)	◊	F(10/21) B(10/21)	F(11/19) B(11/19)	□	□	□	□	F(4/14) B(4/14)	F(5/5) B(5/5)	F(6/3) B(6/3)	△
South Quarry (SQ-A)	F(7/23) B(7/23)	F(8/16) B(8/16)	F(9/9) B(9/9)	F(10/22) B(10/22)	F(11/18) B(11/18)	□	□	□	□	○	○	○	△
North Quarry (NQ-A)	F(7/23) B(7/23)	F(8/16) B(8/16)	F(9/9) B(9/9)	F(10/22) B(10/22)	F(11/18) B(11/18)	□	□	□	□	○	○	○	△
Isolated Pond (IP-A)	F(7/23) B(7/23)	F(8/16) B(8/16)	F(9/9) B(9/9)	F(10/22) B(10/22)	F(11/18) B(11/18)	□	□	□	□	○	○	○	△
Entrainment	E(7/23-7/24)	E(8/27-8/28)	E(9/10-9/11)	E(10/22-10/23)	E(11/19-11/20)	□	□	□	E(3/18-3/19)	E(4/15-4/16) E(4/29-4/30)	E(5/14-5/16) E(5/27-5/28)	E(6/10-6/11) E(6/24-6/25)	E(7/7-7/8)
Impingement	△	I(8/27)	I(9/10)	I(10/22)	I(11/19)	I(12/17)	I(1/21)	I(2/18)	I(3/18)	◊	I(5/13)	I(6/10)	I(7/7)

F Fish sampling (Each F represents an individual sampling event)

E Entrainment sampling (Each E represents an individual sampling event)

B Benthic macroinvertebrate sampling (Each B represents an individual sampling event)

I Impingement sampling (Each I represents an individual sampling event)

X Benthic sampling canceled due to equipment malfunction

□ Months with no scheduled biological sampling due to anticipated winter icing

◊ No biological sampling due to weather conditions (i.e. waves, icing, vegetation, debris)

○ No biological sampling; location dropped from sampling plan

△ Months with no scheduled biological sampling

Table 3. Monthly Intake Flow Capacity at the Fermi 2 plant during impingment sampling, August 2008 through July 2009.

Month	[1]Monthly Intake Flow (m^3)	Days in Month	Average Daily Flow (m^3)
August 2008	7,291,460	31	235,208
September 2008	7,056,008	30	235,200
October 2008	5,885,937	31	189,869
November 2008	5,289,356	30	176,312
December 2008	5,597,867	31	180,576
January 2009	5,558,877	31	179,319
February 2009	5,059,581	28	180,699
March 2009	5,483,548	31	176,889
April 2009	3,132,807	30	104,427
May 2009	5,933,633	31	191,408
June 2009	7,026,103	30	234,203
July 2009	7,026,103	31	226,648
Total	**70,341,279**	365	

[1]Actual operational flow volume for Fermi 2 reported by DTE during sampling months from August 2008 through July 2009

Table 4. Estimated maximum monthly intake flow capacity at the Fermi 3 plant.

Month	[1]Maximum Monthly Intake Flow (m^3)	Days in Month	Average Maximum Daily Flow (m^3)
August	5,789,958	31	186,773
September	5,603,185	30	186,773
October	5,789,958	31	186,773
November	5,603,185	30	186,773
December	5,789,958	31	186,773
January	5,789,958	31	186,773
February	5,229,639	28	186,773
March	5,789,958	31	186,773
April	5,603,185	30	186,773
May	5,789,958	31	186,773
June	5,603,185	30	186,773
July	5,789,958	31	186,773
Annual Total	**68,172,081**	365	

[1]Based on maximium withdrawal capacity at Fermi 3 plant (34,264 gpm)

Table 5. Summary of sample locations and gear types utilized at the Fermi site, July 2008 through July 2009.

Sample Location	Gear Type	Comments
Swan Creek (SC-A)	Electroshocking and Seines	Gear selected will provide the best sampling coverage for those species occurring in the habitats associated with Swan Creek. Gears will allow for sampling of both adult and juvenile species.
Lake Erie 1 (LE1-A)	Seines	Gear was selected to evaluate those species and the size of individuals that would normally be associated with impingement.
Lake Erie 2 (LE2-A)	Electroshocking	Gear selected due to increased vegetation which limited use of most other gears.
North Canal (CN-A)	Electroshocking	Gear selected due to increased vegetation which limited use of most other gears. In addition, water depth and steep bank profile limited effectiveness of other types of gears.
Isolated Central Canal (IC-A)	Electroshocking	Gear selected due to increased vegetation which limited use of most other gears. In addition, water depth and steep bank profile limited effectiveness of other types of gears.
South Canal (CS-A)	Electroshocking	Gear selected due to increased vegetation which limited use of most other gears. In addition, water depth and steep bank profile limited effectiveness of other types of gears.
North Quarry (NQ-A)	Electroshocking and gill nets	Gears selected based on habitat areas supporting most species of fish being located around the shoreline and the depth profile limiting most other gears.
South Quarry (SQ-A)	Electroshocking and gill nets	Gears selected based on habitat areas supporting most species of fish being located around the shoreline and the depth profile limiting most other gears.
Isolated Pond (IP-A)	Hoop nets and minnow traps	Pond is very shallow and surrounded by forested vegetation which limits access by boat and does not allow for efficient sampling by gill net.

Table 6. Listed federal and state threatened and endangered fish and mollusk species in Monroe County, Michigan, 2009.

Scientific Name	Common Name	Federal Status[1]	State Status[2]
Fish			
Ammocrypta pellucida	Eastern sand darter		T
Erimyzon claviformis	Creek chubsucker		E
Etheostoma spectabile	Orangethroat darter		SC
Macrhybopsis storeriana	Silver chub		SC
Notropis photogenis	Silver shiner		E
Noturus miurus	Brindled madtom		SC
Opsopoedus emiliae	Pugnose minnow		E
Percina copelandi	Channel darter		E
Percina shumardi	River darter		E
Phoxinus erythrogaster	Southern redbelly dace		E
Sander canadensis	Sauger		T
Mollusks			
Alismidonta marginata	Elktoe		SC
Alismidonta viridis	Slippershell		T
Cyclonaias tuberculata	Purple wartyback		T
Epioblasma obliquata perobliqua	White catspaw	E	E
Epioblasma torulosa rangiana	Northern riffleshell	E	E
Epioblasma triquetra	Snuffbox		E
Lampsilis fasciola	Wavyrayed lampmussel		T
Obovaria subrotunda	Round hickorynut		E
Pleurobema sintoxia	Round pigtoe		SC
Simpsonaias ambigua	Salamander mussel		E
Toxolasma lividus	Purple lilliput		E
Villosa fabalis	Rayed bean	C	E

[1]Federally listed by United States Fish and Wildlife Service (USFWS)

[2]State listed by Michigan Department of Natural Resources (MDNR)

E-Endangered

T-Threatened

C-Species being considered for federal status

SC-Special concern

Table 7. Summary of fish species collected during impingement studies at the Fermi 2 GSWPH, August 2008 through July 2009.

				2008						2009				Total	Minimum Total	Maximum Total
Common Name	**Scientific Name**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR[1]**	**MAY**	**JUN**	**JUL**	**Number**	**Length (mm)**	**Length (mm)**
Banded Killifish	*Fundulus diaphanus*			1										1	46	46
Bluegill	*Lepomis macrochirus*					1	1	1	4					7	40	40
Bluntnose Minnow	*Pimephales notatus*		1											1	54	54
Brook Silverside	*Labidesthes sicculus*	1												1	50	50
Channel Catfish	*Ictalurus punctatus*		1											1	54	54
Emerald Shiner	*Notropis atherinoides*	1	1	1		2	3	3	18					29	26	71
Freshwater Drum	*Aplodinotus grunniens*											1		1	368	368
Gizzard Shad	*Dorosoma cepedianum*			2	5	30	2							39	79	157
Green Sunfish	*Lepomis cyanellus*		1											1	108	108
Largemouth Bass	*Micropterus salmoides*			1										1	120	120
Rock Bass	*Ambloplites rupestris*		1											1	108	108
Round Goby	*Neogobius melanostomus*	1	1				1				1			4	37	94
Smallmouth Bass	*Micropterus dolomieu*	1							1					2	75	75
Spottail Shiner	*Notropis hudsonius*										1		1	2	24	28
White Perch	*Morone americana*	2	1	1	1	1		1	3					10	44	113
	Total No. of Individuals	6	7	6	6	34	7	5	26		2	1	1	**101**		
	Total No. of Species	5	7	5	2	4	4	3	4		2	1	1	**15**		

[1]No impingement sample due to heavy debris

Table 8. Monthly and annual impingement rates[1] (#/m3) for each species collected at the Fermi 2 GSWPH, August 2008 through July 2009[2].

Common Name	AUG	SEP	2008 OCT	NOV	DEC	JAN	FEB	MAR	2009 APR[3]	MAY	JUN	JUL	Annual Average
24 hour sample volume (m^3)	*235,208*	*235,200*	*189,869*	*176,312*	*180,576*	*179,319*	*180,699*	*176,889*		*191,408*	*234,203*	*226,648*	*2,206,332*
Banded Killifish			5.3E-06										4.5E-07
Bluegill					5.5E-06	5.6E-06	5.5E-06	2.3E-05					3.2E-06
Bluntnose Minnow		4.3E-06											4.5E-07
Brook Silverside	4.3E-06												4.5E-07
Channel Catfish		4.3E-06											4.5E-07
Emerald Shiner	4.3E-06	4.3E-06	5.3E-06		1.1E-05	1.7E-05	1.7E-05	1.0E-04					1.3E-05
Freshwater Drum											4.3E-06		4.5E-07
Gizzard Shad			1.1E-05	2.8E-05	1.7E-04	1.1E-05							1.8E-05
Green Sunfish		4.3E-06											4.5E-07
Largemouth Bass			5.3E-06										4.5E-07
Rock Bass		4.3E-06											4.5E-07
Round Goby	4.3E-06	4.3E-06				5.6E-06				5.2E-06			1.8E-06
Smallmouth Bass	4.3E-06							5.7E-06					9.1E-07
Spottail Shiner										5.2E-06		4.4E-06	9.1E-07
White Perch	8.5E-06	4.3E-06	5.3E-06	5.7E-06	5.5E-06		5.5E-06	1.7E-05					4.5E-06
Total	2.6E-05	3.0E-05	3.2E-05	3.4E-05	1.9E-04	3.9E-05	2.8E-05	1.5E-04		1.0E-05	4.3E-06	4.4E-06	4.6E-05

[1]Impingement rates are expressed in scientific notation; 1.9E-4 is equivalent to 1.9x10-4

[2]Impingement Rate Calculations:

Monthly sample Impingement Rate (#/m3): Total number of fish impinged in a given 24-hour sample divided by the total volume of water withdrawn by the Fermi 2 plant during the sample

Annual Impingement Rate (#/m3): Total number of fish impinged across all 11 samples divided by the total volume of water withdrawn by the Fermi 2 plant during the samples

[3]No impingement sample due heavy debris

Table 9. Estimated monthly and annual abundance of fish species impinged at the Fermi 2 GSWPH with intake pumps at operational capacity, August 2008 through July 2009 [1].

			2008						**2009**				
Common Name	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR[2]**	**MAY**	**JUN**	**JUL**	**Annual Total[3]**
Operational Capacity (m^3)	*7,291,460*	*7,056,008*	*5,885,937*	*5,289,356*	*5,597,867*	*5,558,877*	*5,059,581*	*5,483,548*		*5,933,633*	*7,026,103*	*7,026,103*	*67,208,472*
Banded Killifish			31										31
Bluegill					31	31	28	124					214
Bluntnose Minnow		30											30
Brook Silverside	31												31
Channel Catfish		30											30
Emerald Shiner	31	30	31		62	93	84	558					889
Freshwater Drum											30		30
Gizzard Shad			62	150	930	62							1,204
Green Sunfish		30											30
Largemouth Bass			31										31
Rock Bass		30											30
Round Goby	31	30				31				31			123
Smallmouth Bass	31							31					62
Spottail Shiner										31		31	62
White Perch	62	30	31	30	31		28	93					305
Total	186	210	186	180	1054	217	140	806		62	30	31	3,102

[1]Based on actual operational flow volume reported by DTE during sampling months from August 2008 through July 2009

[2]No impingement sample due to heavy debris

[3]Annual totals do not include estimated impingement for April

Table 10. Estimated monthly and annual abundance of fish species impinged at Fermi 3 with intake pumps at maximum capacity, August 2008 through July 2009[1].

Common Name	AUG	SEP	2008 OCT	NOV	DEC	JAN	FEB	MAR	2009 APR[2]	MAY	JUN	JUL	Annual Total[3]
Maximum Capacity (m^3)	*5,789,958*	*5,603,185*	*5,789,958*	*5,603,185*	*5,789,958*	*5,789,958*	*5,229,639*	*5,789,958*		*5,789,958*	*5,603,185*	*5,789,958*	*62,568,896*
Banded Killifish			30										30
Bluegill					32	32	29	131					224
Bluntnose Minnow		24											24
Brook Silverside	25												25
Channel Catfish		24											24
Emerald Shiner	25	24	30		64	97	87	589					916
Freshwater Drum											24		24
Gizzard Shad			61	159	962	65							1,246
Green Sunfish		24											24
Largemouth Bass			30										30
Rock Bass		24											24
Round Goby	25	24				32				30			111
Smallmouth Bass	25							33					57
Spottail Shiner										30		26	56
White Perch	49	24	30	32	32		29	98					295
Total	148	167	183	191	1,090	226	145	851		60	24	26	3,110

[1]Based on maximium withdrawal capacity at Fermi 2 plant (32,264 gpm)

[2]No impingement sample due to heavy debris

[3]Annual totals do not include estimated impingement for April

Table 11. Summary of fish entrainment by species in samples collected at the Fermi 2 GSWPH, July 2008 through July 2009

			2008								2009				
Common Name	**Scientific Name**		**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR**	**APR[2]**	**MAY[2]**	**JUN[2]**	**JUL**	**Total**
		Larvae											43	12		55
Bigmouth Buffalo	*Ictiobus cyprinellus*	Eggs														0
		Larvae		1								1	160	16		178
Bluntnose Minnow	*Pimephales notatus*	Eggs											5			5
		Larvae											2			2
Brook Silverside	*Labidesthes sicculus*	Eggs														0
		Larvae	7													7
Channel Catfish	*Ictalurus punctatus*	Eggs														0
		Larvae	17	26								7	101	26	56	233
Emerald Shiner	*Notropis atherinoides*	Eggs														0
		Larvae													33	33
Freshwater Drum	*Aplodinotus grunniens*	Eggs														0
		Larvae	1										48	34	392	475
Gizzard Shad	*Dorosoma cepedianum*	Eggs											1			1
		Larvae										4	2			6
Largemouth Bass	*Micropterus salmoides*	Eggs											1			1
		Larvae	1	7	2								26	6	1	43
Round Goby	*Neogobius melanostomus*	Eggs														0
		Larvae	2													2
White Perch	*Morone americana*	Eggs														0
		Larvae										9	139	16		164
Yellow Perch	*Perca flavescens*	Eggs														0
		Larvae											5			5
Unknown Sunfish	*Lepomis sp.*	Eggs														0
		Larvae												2		2
Unknown Centrarchid		Eggs														0
		Larvae														0
Unknown		Eggs				74										74
	Total	Larvae	28	34	2	0	0				0	21	526	112	482	1205
		Eggs	0	0	0	74	0				0	0	7	0	0	81

[1]No entrainment samples due to anticipated winter icing conditions
[2]Represents month with two samples collected

Table 12. Monthly and annual entrainment rates[1] (#/m3) for each species collected at the Fermi 2 GSWPH, July 2008 through July 2009.

Common Name	JUL	AUG	SEP	OCT	NOV	DEC[2]	JAN[2]	FEB[2]	MAR	APR	MAY	JUN	JUL	Annual Average
	2008									2009				
Sample Volume (m^3)	*113.24*	*99.93*	*100.01*	*101.33*	*100.12*				*91.23*	*200.27*	*200.13*	*200.49*	*100.04*	*1306.79*
Bigmouth Buffalo											0.215	0.060		0.042
Bluntnose Minnow		0.010								0.005	0.824	0.080		0.140
Brook Silverside											0.010			0.002
Channel Catfish	0.062													0.005
Emerald Shiner	0.150	0.260								0.035	0.505	0.130	0.560	0.178
Freshwater Drum													0.330	0.025
Gizzard Shad	0.009										0.245	0.170	3.919	0.364
Largemouth Bass										0.020	0.015			0.005
Round Goby	0.009	0.070	0.020								0.130	0.030	0.010	0.033
White Perch	0.018													0.002
Yellow Perch										0.045	0.695	0.080		0.125
Sunfish sp.											0.025			0.004
Unknown Centrarchid												0.010		0.002
Unknown				0.730										0.057
Total	0.247	0.340	0.020	0.730	0.000				0.000	0.105	2.663	0.559	4.818	0.984

[1]Entrainment Rate Calculations:

Monthly Sample Entrainment Rate (#/m^3): Total number of fish (eggs + larvae) captured in a given monthly sample, Table 9, divided by the total volume of water sampled

Annual Entrainment Rate (#/m3): Total number of fish (eggs + larvae) captured across all monthly samples, Table 9, divided by the total volume of water sampled in all samples

[2]No entrainment samples due to anticipated winter icing conditions

Table 13. Estimated monthly and annual abundance of fish species entrained at the Fermi 2 GSWPH with intake pumps at operational capacity, July 2008 through July 2009 [1].

	2008									2009				
Common Name	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**Annual Total[3]**
Operational Volume (m^3)	*7,026,103*	*7,291,460*	*7,056,008*	*5,885,937*	*5,289,356*				*5,483,548*	*3,132,807*	*5,933,633*	*7,026,103*	*7,026,103*	*61,151,056*
Bigmouth Buffalo											1,274,889	420,530		1,695,419
Bluntnose Minnow		72,962								15,643	4,892,017	560,707		5,541,328
Brook Silverside											59,297			59,297
Channel Catfish	434,335													434,335
Emerald Shiner	1,054,814	1,897,015								109,500	2,994,507	911,148	3,933,115	10,900,099
Freshwater Drum													2,317,728	2,317,728
Gizzard Shad	62,048										1,452,781	1,191,501	27,531,802	30,238,133
Largemouth Bass										62,571	88,946			151,517
Round Goby	62,048	510,735	141,109								770,863	210,265	70,234	1,765,254
White Perch	124,096													124,096
Yellow Perch										140,786	4,121,154	560,707		4,822,646
Sunfish sp.											148,243			148,243
Unknown Centrarchid												70,088		70,088
Unknown				4,298,465										4,298,465
Total	1,737,340	2,480,712	141,109	4,298,465	0				0	328,500	15,802,697	3,924,946	33,852,880	62,566,648

[1]Based on actual operational flow volume reported by DTE during sampling months from August 2008 through July 2009

[2]No entrainment samples due to anticipated winter icing conditions

[3]Annual estimate does not include data from December through February

Table 14. Estimated monthly and annual abundance of fish species entrained at the Fermi 3 with intake pumps at maximum capacity, July 2008 through July 2009[1].

				2008						2009				
Common Name	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**Annual Total[3]**
Operational Volume (m^3)	*5,789,958*	*5,789,958*	*5,603,185*	*5,789,958*	*5,603,185*				*5,789,958*	*5,603,185*	*5,789,958*	*5,603,185*	*5,789,958*	*57,152,484*
Bigmouth Buffalo											1,244,019	335,365		1,579,384
Bluntnose Minnow		57,937								27,978	4,773,563	447,153		5,306,631
Brook Silverside											57,861			57,861
Channel Catfish	357,920													357,920
Emerald Shiner	869,234	1,506,370								195,846	2,921,999	726,624	3,241,138	9,461,210
Freshwater Drum													1,909,956	1,909,956
Gizzard Shad	51,131										1,417,603	950,200	22,687,964	25,106,899
Largemouth Bass										111,912	86,792			198,704
Round Goby	51,131	405,561	112,055								752,198	167,682	57,877	1,546,505
White Perch	102,263													102,263
Yellow Perch										251,802	4,021,365	447,153		4,720,320
Sunfish sp.											144,653			144,653
Unknown Centrarchid												55,894		55,894
Unknown				4,228,372										4,228,372
Total	1,431,679	1,969,869	112,055	4,228,372	0				0	587,538	15,420,054	3,130,071	27,896,935	54,776,573

[1]Based on maximium withdrawal capacity at Fermi 3 plant (32,264 gpm)

[2]No entrainment samples due to anticipated winter icing conditions

[3]Annual estimate does not include data from December through February

Table 15. Summary of fish species collected at all nine sample locations at the Fermi site, July 2008 through June 2009.

		2008									2009			
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Total**
Alewife	*Alosa pseudoharengus*	5	2	3										10
Banded Killifish	*Fundulus diaphanus*	2	12	2	6	3					1	1	1	28
Bigmouth Buffalo	*Ictiobus cyprinellus*	233	1	2	1						1	12	3	253
Black Bullhead	*Ameiurus melas*	6	11	9	130							1	9	166
Black Crappie	*Pomoxis nigromaculatus*				1									1
Blacknose Shiner	*Notropis heterolepis*										1			1
Bluegill	*Lepomis macrochirus*	360	664	527	329	65					4	6	19	1974
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*	45	76	63	161	78								423
Bluntnose Minnow	*Pimephales notatus*	3	59	61	165						4	22	64	378
Bowfin	*Amia calva*	4	4	14	12						5	2	4	45
Brook Silverside	*Labidesthes sicculus*	4	83	30	84	10					68	19	2	300
Brown Bullhead	*Ameiurus nebulosus*										1			1
Channel Catfish	*Ictalurus punctatus*	7	1										2	10
Common Carp	*Cyprinus carpio*	81	50	36	233	23					103	89	73	688
Common Shiner	*Luxilus cornutus*				1						2			3
Creek Chub	*Semotilus atromaculatus*												1	1
Emerald Shiner	*Notropis atherinoides*	110	28	5	99	94					442	388	128	1294
Freshwater Drum	*Aplodinotus grunniens*	11	3									7	5	26
Gizzard Shad	*Dorosoma cepedianum*	335	1584	237	443	4						10	4	2617
Golden Redhorse	*Moxostoma erythrurum*		3		1									4
Golden Shiner	*Notemigonus crysoleucas*	69	156	71	25						1	13	12	347
Goldfish	*Carassius auratus*	286	952	212	1648	39					4		22	3163
Redfin Pickerel	*Esox americanus*		5											5
Green Sunfish	*Lepomis cyanellus*	33	46	58	80	86								303
Largemouth Bass	*Micropterus salmoides*	61	127	101	48						14	34	32	417
Logperch	*Percina caprodes*		2										1	3
Longear Sunfish	*Lepomis megalotis*	6												6
Longnose Gar	*Lepisosteus osseus*	1	2									1	17	21
Western Mosquitofish	*Gambusia affinis*	1												1

Table 15 c*ontinued*. Summary of fish species collected at all nine sample locations at the Fermi site, July 2008 through June 2009.

		2008									**2009**			
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Total**
Muskellunge	*Esox masquinongy*			1							2	2		5
Northern Pike	*Esox lucius*	2	4	2	9						3		1	21
Orangespotted Sunfish	*Lepomis humilis*	1												1
Pumpkinseed	*Lepomis gibbosus*	47	187	276	81	16					2	28	44	681
Quillback	*Carpiodes cyprinus*		4			14					9	9	1	37
Rainbow Smelt	*Osmerus mordax*					4								4
Rainbow Trout	*Oncorhynchus mykiss*					1								1
Rock Bass	*Ambloplites rupestris*	3	7								9	6	13	38
Round Goby	*Neogobius melanostomus*	4	9		2								7	22
Sand Shiner	*Notropis stramineus*	62			9						1	1	11	84
Smallmouth Bass	*Micropterus dolomieu*		1									1		2
Silver Chub	*Macrhybopsis storeriana*												1	1
Spotfin Shiner	*Cyprinella spiloptera*	24	6	25	43	5						11	54	168
Spottail Shiner	*Notropis hudsonius*	65	9	5	113						14	35	8	249
Spotted Gar	*Lepisosteus oculatus*	4												4
Spotted Sucker	*Minytrema melanops*	23	3	1	2						3		2	34
Tadpole Madtom	*Noturus gyrinus*				2									2
White Bass	*Morone chrysops*	1										1	1	3
White Crappie	*Pomoxis annularis*	4	17	31	7									59
White Perch	*Morone americana*	263	471	2							1	1		738
White Sucker	*Catostomus commersoni*	7	4		1									12
Yellow Bullhead	*Ameiurus natalis*	13	11	17	13	5						2	1	62
Yellow Perch	*Perca flavescens*	9	45	34	60						3	2	15	168
Total		4203	4649	1825	3809	447					698	704	558	**14885**

[1]No scheduled sampling due to anticipated winter icing

Table 16. Total number of fish collected each month by sample location at the Fermi site, July 2008 through June 2009.

Month	Swan Creek (SC-A)	North Canal (CN-A)	Isolated Central Canal (IC-A)	South Canal (CS-A)	Lake Erie 1 (LE1-A)	Lake Erie 2 (LE2-A)	South Quarry (SQ-A)	North Quarry (NQ-A)	Isolated Pond (IP-A)	Total
July 2008	422	349	118	100	413	485	169	135	4	2195
August 2008	194	375	316	168	1274	1791	308	222	1	4649
September 2008	222	574	223	246	25	◊	297	238	0	1825
October 2008	256	279	204	1707	63	782	245	270	3	3809
November 2008	35	◊	◊	◊	17	78	113	201	3	447
December 2008	□	□	□	□	□	□	□	□	□	□
January 2009	□	□	□	□	□	□	□	□	□	□
February 2009	□	□	□	□	□	□	□	□	□	□
March 2009	□	□	□	□	□	□	□	□	□	□
April 2009	168	52	○	63	95	320	○	○	○	698
May 2009	273	63	○	103	17	248	○	○	○	704
June 2009	220	130	○	51	5	152	○	○	○	558
Total	1790	1822	861	2438	1909	3856	1132	1066	11	**14885**

□ Months with no scheduled biological sampling due to anticipated winter icing

◊ No biological sampling due to weather conditions (i.e. waves, icing, vegetation, debris)

○ No biological sampling; location dropped from sampling plan

Table 17. Species richness for monthly fish samples collected at the Fermi site, July 2008 through June 2009.

Month	Swan Creek (SC-A)	North Canal (CN-A)	Isolated Central Canal (IC-A)	South Canal (CS-A)	Lake Erie 1 (LE1-A)	Lake Erie 2 (LE2-A)	South Quarry (SQ-A)	North Quarry (NQ-A)	Isolated Pond (IP-A)
July 2008	15	19	7	9	12	19	5	7	2
August 2008	18	17	9	17	6	23	6	6	1
September 2008	16	14	11	12	4	◊	6	7	0
October 2008	11	11	9	16	5	23	6	6	2
November 2008	5	◊	◊	◊	1	4	6	7	2
December 2008	□	□	□	□	□	□	□	□	□
January 2009	□	□	□	□	□	□	□	□	□
February 2009	□	□	□	□	□	□	□	□	□
March 2009	□	□	□	□	□	□	□	□	□
April 2009	6	13	○	7	5	15	○	○	○
May 2009	15	15	○	13	5	12	○	○	○
June 2009	24	15	○	12	4	16	○	○	○
Total	33	30	13	28	19	38	7	9	4

□ Months with no scheduled biological sampling due to anticipated winter icing

◊ No biological sampling due to weather conditions (i.e. waves, icing, vegetation, debris)

○ No biological sampling; location dropped from sampling plan

Table 18. Summary of fish species collected using seine and electroshocking in Swan Creek (SC-A) at the Fermi site, July 2008 through June 2009.

		2008								2009						
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Alewife	*Alosa pseudoharengus*	5		3										8	27	37
Banded Killifish	*Fundulus diaphanus*	1											1	2	56	68
Bigmouth Buffalo	*Ictiobus cyprinellus*										1		2	3	560	685
Black Bullhead	*Ameiurus melas*				2								2	4	259	311
Bluegill	*Lepomis macrochirus*	40	29	30	5							5	4	113	24	178
Bluntnose Minnow	*Pimephales notatus*		9	6								9	17	41	39	92
Brook Silverside	*Labidesthes sicculus*	4	12	18	38	10					16	13	2	113	33	78
Channel Catfish	*Ictalurus punctatus*												1	1	489	489
Common Carp	*Cyprinus carpio*	4	1								2	15	16	38	261	687
Emerald Shiner	*Notropis atherinoides*	4	12	1	15	21					138	173	54	418	30	103
Freshwater Drum	*Aplodinotus grunniens*	5	3									2	1	11	226	613
Gizzard Shad	*Dorosoma cepedianum*	311	27	65	180	2							3	588	30	440
Golden Shiner	*Notemigonus crysoleucas*	4	18	13	2							5	6	48	35	165
Goldfish	*Carassius auratus*	19	21	14	4	1							5	64	24	319
Largemouth Bass	*Micropterus salmoides*	6	4	9								21	21	61	46	670
Logperch	*Percina caprodes*		1											1	80	80
Longnose Gar	*Lepisosteus osseus*												6	6	605	687
Muskellunge	*Esox masquinongy*											1		1	246	246
Pumpkinseed	*Lepomis gibbosus*	13	25	32								19	24	113	34	229
Quillback	*Carpiodes cyprinus*										9			9	440	499
Rainbow Trout	*Oncorhynchus mykiss*					1								1	473	473
Rock Bass	*Ambloplites rupestris*											2	8	10	53	170
Sand Shiner	*Notropis stramineus*												10	10	39	47
Silver Chub	*Macrhybopsis storeriana*												1	1	80	80
Smallmouth Bass	*Micropterus dolomieu*		1											1	55	55
Spotfin Shiner	*Cyprinella spiloptera*	2	1	20	2							5	29	59	32	93
Spottail Shiner	*Notropis hudsonius*		2	2	2						2	1		9	51	111
Spotted Sucker	*Minytrema melanops*		3	1	1								1	6	204	370
White Bass	*Morone chrysops*	1											1	2	217	360
White Crappie	*Pomoxis annularis*			1										1	98	98
White Perch	*Morone americana*		20	2										22	52	161
Yellow Bullhead	*Ameiurus natalis*											1	1	2	250	290
Yellow Perch	*Perca flavescens*	3	5	5	5							1	4	23	63	202
	Total No. of Individuals	422	194	222	256	35					168	273	220	1790		
	Total No. of Species	15	18	16	11	5					6	15	24			

[1]No scheduled sampling due to anticipated winter icing

Table 19. Summary of fish species collected using seine at the Lake Erie - Intake (LE1-A) at the Fermi site, July 2008 through June 2009.

		2008						2009								
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Alewife	*Alosa pseudoharengus*		2											2	29	32
Banded Killifish	*Fundulus diaphanus*	1												1	19	19
Bigmouth Buffalo	*Ictiobus cyprinellus*	52												52	30	65
Bluegill	*Lepomis macrochirus*	12												12	23	49
Bluntnose Minnow	*Pimephales notatus*				6									6	60	74
Channel Catfish	*Ictalurus punctatus*	7												7	26	54
Common Carp	*Cyprinus carpio*											1		1	789	789
Emerald Shiner	*Notropis atherinoides*	1		4	4	17					88	13	2	129	37	96
Gizzard Shad	*Dorosoma cepedianum*	9	831	17										857	34	125
Goldfish	*Carassius auratus*	54	4	1										59	37	205
Largemouth Bass	*Micropterus salmoides*	2												2	38	62
Longnose Gar	*Lepisosteus osseus*		2										1	3	633	711
Quillback	*Carpiodes cyprinus*											1	1	2	512	513
Rock Bass	*Ambloplites rupestris*										4			4	59	90
Sand Shiner	*Notropis stramineus*				4						1			5	47	62
Spotfin Shiner	*Cyprinella spiloptera*	12			3									15	59	68
Spottail Shiner	*Notropis hudsonius*	54	3	3	46						1	1	1	109	32	111
White Perch	*Morone americana*	205	432								1	1		639	25	134
White Sucker	*Catostomus commersoni*	4												4	55	59
	Total No. of Individuals	413	1274	25	63	17					95	17	5	1909		
	Total No. of Species	12	6	4	5	1					5	5	4			

[1]No scheduled sampling due to anticipated winter icing

Table 20. Summary of fish species collected using eletroshocking at the Lake Erie - South Lagoon (LE2-A) at the Fermi site, July 2008 through June 2009.

				2008						2009						
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**[1]	**OCT**	**NOV**	**DEC**[2]	**JAN**[2]	**FEB**[2]	**MAR**[2]	**APR**	**MAY**	**JUN**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Banded Killifish	*Fundulus diaphanus*		12		4	3					1			20	35	59
Bigmouth Buffalo	*Ictiobus cyprinellus*	181										3	1	185	35	692
Black Bullhead	*Ameiurus melas*		2		106									108	75	285
Bluegill	*Lepomis macrochirus*	1	28		2						2			33	32	127
Bluntnose Minnow	*Pimephales notatus*		16		148						4	3	42	213	22	89
Bowfin	*Amia calva*	1			2						1			4	267	719
Brook Silverside	*Labidesthes sicculus*		66		6						23	4		99	32	284
Brown Bullhead	*Ameiurus nebulosus*										1			1	284	284
Channel Catfish	*Ictalurus punctatus*												1	1	615	615
Common Carp	*Cyprinus carpio*	17	10		92						64	19	14	216	60	830
Common Shiner	*Luxilus cornutus*				1									1	56	56
Emerald Shiner	*Notropis atherinoides*		8		52	56					200	175	33	524	26	102
Freshwater Drum	*Aplodinotus grunniens*	4											1	5	413	562
Gizzard Shad	*Dorosoma cepedianum*		607		2									609	55	130
Golden Redhorse	*Moxostoma erythrurum*		3		1									4	77	84
Golden Shiner	*Notemigonus crysoleucas*	3	59		18						1			81	44	130
Goldfish	*Carassius auratus*	158	743		173						3		1	1078	28	328
Green Sunfish	*Lepomis cyanellus*				9									9	66	84
Largemouth Bass	*Micropterus salmoides*	14	68		3						5		6	96	40	448
Logperch	*Percina caprodes*		1										1	2	60	71
Longear Sunfish	*Lepomis megalotis*	6												6	34	39
Western Mosquitofish	*Gambusia affinis*	1												1	37	37
Northern Pike	*Esox lucius*	2	3		8									13	251	394
Pumpkinseed	*Lepomis gibbosus*	11	104		7									122	33	165
Quillback	*Carpiodes cyprinus*		4			14						8		26	59	550
Rock Bass	*Ambloplites rupestris*		4								4	1	5	14	49	180
Round Goby	*Neogobius melanostomus*	4	9		2								7	22	41	72
Sand Shiner	*Notropis stramineus*				5							1	1	7	43	62
Smallmouth Bass	*Micropterus dolomieu*											1		1	98	98
Spotfin Shiner	*Cyprinella spiloptera*	7	3		32	5						1	25	73	34	85
Spottail Shiner	*Notropis hudsonius*	11	3		64						10	30	7	125	26	119
Spotted Gar	*Lepisosteus oculatus*	1												1	661	661
Spotted Sucker	*Minytrema melanops*												1	1	412	412
Tadpole Madtom	*Noturus gyrinus*				2									2	77	92
White Perch	*Morone americana*	57	17								1			75	40	283
White Sucker	*Catostomus commersoni*	3	4											7	53	79
Yellow Bullhead	*Ameiurus natalis*											1		1	283	283
Yellow Perch	*Perca flavescens*	3	17		43						1		6	70	52	230
	Total No. of Individuals	485	1791		782	78					321	247	152	3856		
	Total No. of Species	19	23		23	4					15	12	16			

[1]No sample collected due to inclement weather conditions

[2]No scheduled sampling due to anticipated winter icing

Table 21. Summary of fish species collected using electroshocking in the North Canal (CN-A) at the Fermi site, July 2008 through June 2009.

		2008						2009								
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Banded Killifish	*Fundulus diaphanus*			2	2							1		5	37	60
Black Bullhead	*Ameiurus melas*												5	5	272	296
Bluegill	*Lepomis macrochirus*	73	169	139	2						2	1	10	396	27	194
Bluntnose Minnow	*Pimephales notatus*	1	22	42	8							10	5	88	30	87
Bowfin	*Amia calva*	3	3	5							2		3	16	198	682
Brook Silverside	*Labidesthes sicculus*		3	12	40						7	1		63	47	77
Channel Catfish	*Ictalurus punctatus*		1											1	422	422
Common Carp	*Cyprinus carpio*	16	12	3							3	13	18	65	96	686
Common Shiner	*Luxilus cornutus*										2			2	76	107
Emerald Shiner	*Notropis atherinoides*	105	4		28						16	8	38	199	27	172
Freshwater Drum	*Aplodinotus grunniens*	2										4	1	7	315	502
Gizzard Shad	*Dorosoma cepedianum*				177							1	1	179	72	410
Golden Shiner	*Notemigonus crysoleucas*	21	20	38	1							7	5	92	27	174
Goldfish	*Carassius auratus*	5	41	49	2						1		10	108	33	349
Redfin Pickerel	*Esox americanus*		4											4	224	245
Green Sunfish	*Lepomis cyanellus*	1												1	113	113
Largemouth Bass	*Micropterus salmoides*	13	27	32							7	1	4	84	84	467
Longnose Gar	*Lepisosteus osseus*	1											6	7	609	1090
Muskellunge	*Esox masquinongy*			1							2	1		4	174	304
Northern Pike	*Esox lucius*			1							3		1	5	59	607
Pumpkinseed	*Lepomis gibbosus*	10	42	217							2	9	18	298	29	160
Rock Bass	*Ambloplites rupestris*	3	2									3		8	52	131
Sand Shiner	*Notropis stramineus*	62												62	40	51
Spotfin Shiner	*Cyprinella spiloptera*	3	2	5	6							2		18	27	67
Spottail Shiner	*Notropis hudsonius*		1		1									2	56	72
Spotted Gar	*Lepisosteus oculatus*	3												3	603	647
Spotted Sucker	*Minytrema melanops*	23									3			26	156	370
White Crappie	*Pomoxis annularis*	1												1	254	254
White Perch	*Morone americana*		2											2	52	74
Yellow Perch	*Perca flavescens*	3	20	28	12						2	1	5	71	70	199
	Total No. of Individuals	349	375	574	279						52	63	130	1822		
	Total No. of Species	19	17	14	11						13	15	15			

[1]No sample collected due to inclement weather conditions

[2]No scheduled sampling due to anticipated winter icing

Table 22. Summary of fish species collected using electroshocking in the Isolated Central Canal (IC-A) at the Fermi site, July 2008 through October 2008.

		2008						2009								
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR[3]**	**MAY[3]**	**JUN[3]**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Bigmouth Buffalo	*Ictiobus cyprinellus*		1	2										3	641	724
Black Crappie	*Pomoxis nigromaculatus*				1									1	250	250
Bluegill	*Lepomis macrochirus*	77	200	117	104									498	30	165
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*		2	2	3									7	107	225
Bluntnose Minnow	*Pimephales notatus*	2	12	13	3									30	37	89
Common Carp	*Cyprinus carpio*	8	5	5										18	484	633
Gizzard Shad	*Dorosoma cepedianum*	3	40	15	50									108	61	332
Green Sunfish	*Lepomis cyanellus*		14	7	13									34	34	173
Largemouth Bass	*Micropterus salmoides*	24	25	28	17									94	59	467
Orangespotted Sunfish	*Lepomis humilis*	1												1	104	104
Pumpkinseed	*Lepomis gibbosus*			1										1	135	135
White Crappie	*Pomoxis annularis*	3	17	30	3									53	46	356
Yellow Bullhead	*Ameiurus natalis*			3	10									13	62	563
	Total No. of Individuals	118	316	223	204									861		
	Total No. of Species	7	9	11	9											

[1]No sample collected due to inclement weather conditions

[2]No scheduled sampling due to anticipated winter icing

[3]No sampling; location dropped from sampling plan

Table 23. Summary of fish species collected using electroshocking in the South Canal (CS-A) at the Fermi site, July 2008 through June 2009.

		2008						2009								
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Bigmouth Buffalo	*Ictiobus cyprinellus*				1							9		10	173	890
Black Bullhead	*Ameiurus melas*	6	9	9	22							1	2	49	44	344
Blacknose Shiner	*Notropis heterolepis*										1			1	61	61
Bluegill	*Lepomis macrochirus*	13	22	32	38								5	110	22	168
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*				1									1	90	90
Bowfin	*Amia calva*		1	9	10						2	2	1	25	243	640
Brook Silverside	*Labidesthes sicculus*		2								22	1		25	51	76
Common Carp	*Cyprinus carpio*	2	10	13	118						34	41	25	243	55	790
Creek Chub	*Semotilus atromaculatus*												1	1	66	66
Emerald Shiner	*Notropis atherinoides*		4									19	1	24	40	90
Freshwater Drum	*Aplodinotus grunniens*											1	2	3	427	564
Gizzard Shad	*Dorosoma cepedianum*		4	2	18							9		33	61	459
Golden Shiner	*Notemigonus crysoleucas*	41	59	20	4							1	1	126	22	127
Goldfish	*Carassius auratus*	13	27	96	1380								6	1522	45	223
Redfin Pickerel	*Esox americanus*		1											1	191	191
Green Sunfish	*Lepomis cyanellus*		4	5	6									15	52	131
Largemouth Bass	*Micropterus salmoides*	2	3	32	28						2	12	1	80	44	427
Longnose Gar	*Lepisosteus osseus*											1	4	5	648	910
Northern Pike	*Esox lucius*		1	1	1									3	273	336
Pumpkinseed	*Lepomis gibbosus*	10	16	26	74								2	128	28	171
Rock Bass	*Ambloplites rupestris*		1								1			2	51	192
Spotfin Shiner	*Cyprinella spiloptera*											3		3	50	66
Spottail Shiner	*Notropis hudsonius*										1	3		4	58	105
Spotted Sucker	*Minytrema melanops*				1									1	182	182
White Perch	*Morone americana*	1			4									5	37	118
White Sucker	*Catostomus commersoni*				1									1	138	138
Yellow Bullhead	*Ameiurus natalis*	12	1											13	40	173
Yellow Perch	*Perca flavescens*		3	1										4	142	188
	Total No. of Individuals	100	168	246	1707						63	103	51	2438		
	Total No. of Species	9	17	12	16						7	13	12			

[1]No sample collected due to inclement weather conditions

[2]No scheduled sampling due to anticipated winter icing

Table 24. Summary of fish species collected using hoop nets and minnow traps in the Isolated Pond (IP-A) at the Fermi site, July 2008 through November 2008.

		2008						2009								
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR[2]**	**MAY[2]**	**JUN[2]**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Bluegill	*Lepomis macrochirus*	1			2	2								5	39	83
Green Sunfish	*Lepomis cyanellus*		1			1								2	41	80
Pumpkinseed	*Lepomis gibbosus*	3												3	24	61
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*				1									1	60	60
	Total No. of Individuals	4	1	0	3	3								11		
	Total No. of Species	2	1	0	2	2										

[1]No scheduled sampling due to anticipated winter icing

[2]No sampling; location dropped from sampling plan

Table 25. Summary of fish species collected using gill nets and electroshocking in the North Quarry (NQ-A) at the Fermi site, July 2008 through November 2008.

Common Name	Scientific Name	2008 JUL	2008 AUG	2008 SEP	2008 OCT	2008 NOV	2008 DEC[1]	2009 JAN[1]	2009 FEB[1]	2009 MAR[1]	2009 APR[2]	2009 MAY[2]	2009 JUN[2]	Total Number	Minimum Total Length (mm)	Maximum Total Length (mm)
Bluegill	*Lepomis macrochirus*	3		1										4	56	137
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*	34	65	56	136	69								360	38	184
Common Carp	*Cyprinus carpio*	26	7	11	5	1								50	356	587
Gizzard Shad	*Dorosoma cepedianum*	5	9	66	2									82	158	428
Goldfish	*Carassius auratus*	37	114	51	88	38								328	58	418
Green Sunfish	*Lepomis cyanellus*	29	17	39	36	71								192	34	130
Pumpkinseed	*Lepomis gibbosus*					16								16	27	86
Rainbow Smelt	*Osmerus mordax*					1								1	135	135
Yellow Bullhead	*Ameiurus natalis*	1	10	14	3	5								33	97	258
	Total No. of Individuals	135	222	238	270	201								1066		
	Total No. of Species	7	6	7	6	7										

[1]No scheduled sampling due to anticipated winter icing

[2]No sampling; location dropped from sampling plan

Table 26. Summary of fish species collected using gill nets and electroshocking in the South Quarry (SQ-A) at the Fermi site, July 2008 through November 2008.

		2008					2009									
Common Name	**Scientific Name**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR[2]**	**MAY[2]**	**JUN[2]**	**Total Number**	**Minimum Total Length (mm)**	**Maximum Total Length (mm)**
Bluegill	*Lepomis macrochirus*	140	216	208	176	63								803	26	163
Bluegill/Green Sunfish Hybrid	*Lepomis sp.*	11	9	5	20	9								54	47	183
Common Carp	*Cyprinus carpio*	8	5	4	18	22								57	103	578
Gizzard Shad	*Dorosoma cepedianum*	7	66	72	14	2								161	61	363
Goldfish	*Carassius auratus*		2	1	1									4	168	184
Green Sunfish	*Lepomis cyanellus*	3	10	7	16	14								50	34	163
Rainbow Smelt	*Osmerus mordax*					3								3	114	123
	Total No. of Individuals	169	308	297	245	113								1132		
	Total No. of Species	5	6	6	6	6										

[1]No scheduled sampling due to anticipated winter icing

[2]No sampling; location dropped from sampling plan

Table 27. Summary of macroinvertebrates by order collected using a dip net at the Fermi site, July 2008 through June 2009.

Order	2008 JUL	AUG	SEP	OCT	NOV	DEC[1]	JAN[1]	FEB[1]	MAR[1]	2009 APR	MAY	JUN	Total Number	Percent Composition
Acariformes	13	1			1					3		8	26	0.51%
Amphipoda	130	59	105	282	20					23	87	110	816	16.16%
Arhynchobdellida				1									1	0.02%
Basommatophora	30	44	4	11	14					3	4	11	121	2.40%
Coleoptera	8	8	5	4						4	2	2	33	0.65%
Decapopda												1	1	0.02%
Diptera	201	209	192	160	194					125	61	91	1233	24.42%
Ephemeroptera	193	78	287	358	178					62	45	34	1235	24.46%
Haplotaxida	48	32	9	32	28					17	36	50	252	4.99%
Hemiptera	14	14	3	25	3						10	41	110	2.18%
Isopoda	4	1	12	15							41	12	85	1.68%
Lumbriculida												1	1	0.02%
Mysidacea	4	3		4							1		12	0.24%
Odonata	68	47	32	24	18						4		193	3.82%
Rhynchobdellida	6	2		2						2		15	27	0.53%
Trichoptera	7	9	12	5	1					2	1		37	0.73%
Trombidiformes	3	35	25	16	3					11	29	4	126	2.50%
Tubificida	104	105	38	77	16					37	45	111	533	10.56%
Veneroida	43	124	4	2	2					20	10	2	207	4.10%
Total No. of Individuals	876	771	728	1018	478					309	376	493	5049	100.00%

[1]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 28. Total number of macroinvertebrates collected each month by sample location at the Fermi site, July 2008 through June 2009.

Month	Swan Creek (SC-A)	North Canal (CN-A)	Isolated Central Canal (IC-A)	South Canal (CS-A)	Lake Erie 1 (LE1-A)	Lake Erie 2 (LE2-A)	South Quarry (SQ-A)	North Quarry (NQ-A)	Isolated Pond (IP-A)	Total
July 2008	99	99	37	108	98	110	103	100	122	876
August 2008	102	105	103	106	x	127	29	98	101	771
September 2008	105	112	60	115	19	◊	105	111	101	728
October 2008	107	131	123	120	100	107	129	102	99	1018
November 2008	98	◊	◊	◊	8	19	130	100	123	478
December 2008	□	□	□	□	□	□	□	□	□	□
January 2009	□	□	□	□	□	□	□	□	□	□
February 2009	□	□	□	□	□	□	□	□	□	□
March 2009	□	□	□	□	□	□	□	□	□	□
April 2009	76	103	○	107	11	12	○	○	○	309
May 2009	99	102	○	70	0	105	○	○	○	376
June 2009	104	111	○	142	24	112	○	○	○	493
Total	790	763	323	768	260	592	496	511	546	5049

□ Months with no scheduled biological sampling due to anticipated winter icing

◊ No biological sampling due to weather conditions (i.e. waves, icing, vegetation, debris)

X No biological sampling conducted to due equipment malfunction

○ No biological sampling; location dropped from sampling plan

Table 29. Total number of macroinvertebrate taxa collected each month by sample location at the Fermi site, July 2008 through June 2009.

Month	Swan Creek (SC-A)	North Canal (CN-A)	Isolated Central Canal (IC-A)	South Canal (CS-A)	Lake Erie 1 (LE1-A)	Lake Erie 2 (LE2-A)	South Quarry (SQ-A)	North Quarry (NQ-A)	Isolated Pond (IP-A)
July 2008	19	21	11	15	19	10	13	15	17
August 2008	13	20	21	19	x	15	7	13	27
September 2008	12	23	17	23	7	◊	11	9	27
October 2008	19	14	12	18	4	17	7	10	21
November 2008	18	◊	◊	◊	4	5	9	11	21
December 2008	□	□	□	□	□	□	□	□	□
January 2009	□	□	□	□	□	□	□	□	□
February 2009	□	□	□	□	□	□	□	□	□
March 2009	□	□	□	□	□	□	□	□	□
April 2009	23	25	○	16	8	8	○	○	○
May 2009	16	16	○	19	0	11	○	○	○
June 2009	19	18	○	16	11	17	○	○	○

□ Months with no scheduled biological sampling due to anticipated winter icing

◊ No biological sampling due to weather conditions (i.e. waves, icing, vegetation, debris)

X No biological sampling conducted to due equipment malfunction

○ No biological sampling; location dropped from sampling plan

Table 30. Summary of macroinvertebrate taxa collected using a dip net in Swan Creek (SC-A) at the Fermi site, July 2008 through June 2009.

		2008					2009							Total	Percent
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Number**	**Composition**
Acariformes	*Piona sp.*	4												4	0.51%
Amphipoda	*Crangonyx sp.* (immature)										1			1	0.13%
	Crangonyx sp.												1	1	0.13%
	Gammarus fasciatus	9	8	55	33	5					14	36	12	172	21.77%
	Hyalella azteca	2		2	2	1					1		1	9	1.14%
Arhynchobdellida	*Mooreobdella sp.*				1									1	0.13%
Basommatophora	*Amnicola limosa*											1		1	0.13%
	Fossaria sp.		1								2			3	0.38%
	Physa sp.	5			1									6	0.76%
	Unknown genus (immature)	1												1	0.13%
	Gyraulus parvus				1									1	0.13%
Coleoptera	*Laccophilus sp.* (larva)	1												1	0.13%
	Dubiraphia vittata (adult)			1										1	0.13%
	Peltodytes sp. (adult)				1									1	0.13%
	Haliplus sp. (larva)												1	1	0.13%
	Berosus sp. (larva)										2			2	0.25%
	Hydroptila sp.		3		1						2			6	0.76%
Diptera	*Culicoides sp.*											1		1	0.13%
	Cricotopus trifasciatus	2												2	0.25%
	Dicrotendipes modestus	1												1	0.13%
	Endochironomus sp.	2												2	0.25%
	Parachironomus frequens	1												1	0.13%
	Paratanytarsus cf. dissimilis	1												1	0.13%
	Ablabesmyia mallochi		1											1	0.13%
	Chironomini (unknown: damaged/early)		1			1							1	3	0.38%
	Cricotopus/Orthocladius sp.		2								1			3	0.38%
	Cladotanytarsus sp.			2							3			5	0.63%
	Dicrotendipes modestus/neomodestus			1	1						3			5	0.63%
	Rheotanytarsus exiguus gr.			1										1	0.13%
	Cricotopus sp.				1									1	0.13%
	Glyptotendipes sp.				4						3			7	0.89%
	Paratanytarsus sp.				5	2					3			10	1.27%
	Tribelos atrum				2									2	0.25%
	Chironomus sp.					1								1	0.13%
	Cladotanytarsus sp.					42								42	5.32%
	Dicrotendipes sp.					2					1		3	6	0.76%
	Microchironomus sp.					1								1	0.13%
	Parakiefferiella sp.					1								1	0.13%
	Procladius sp.					7								7	0.89%
	Tanypus neopunctipennis					1								1	0.13%
	Tanytarsus sp.					2					1		1	4	0.51%
	Phaenspectra punctipes gr.										3			3	0.38%
	Parachironomus sp.											5	3	8	1.01%
	Polypedilum illinoense gr.											2		2	0.25%

Table 30 *continued*. Summary of macroinvertebrate taxa collected using a dip net in Swan Creek (SC-A) at the Fermi site, July 2008 through June 2009.

				2008							2009				
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Composition**
	Cricotopus bicinctus												1	1	0.13%
	Cricotopus sylvestris gr.												14	14	1.77%
	Dicrotendipes fumidus												4	4	0.51%
	Endochironomus subtendens												2	2	0.25%
	Polypedilum halterale gr.												1	1	0.13%
	Zavreliella marmorata												2	2	0.25%
	Unknown genus											1		1	0.13%
	Hemerodromia sp.		1											1	0.13%
	Tipula sp.										1			1	0.13%
Ephemeroptera	*Caenis sp.*	1	2	5		1					4	3	2	18	2.28%
Haplotaxida	Unknown										2			2	0.25%
	Tubificinae (unknown genus)	2	9	2	2	21					4	3	9	52	6.58%
	Naidinae (unknown genus)	46	23	7	30	7					10	29	41	193	24.43%
Hemiptera	*Trichocorixa sp.*	3												3	0.38%
	Unknown early instar	5												5	0.63%
	Palmacorixa sp.				1									1	0.13%
	Trichocorixa sp.				14								2	16	2.03%
Isopoda	*Caecidotea sp.*				4							5		9	1.14%
Mysidacea	*Mysis relicta*											1		1	0.13%
Odonata	Unknown early instar		1		2	1								4	0.51%
	Enallagma sp.			1										1	0.13%
Rhynchobdellida	*Helobdella stagnalis*	4												4	0.51%
Trichoptera	*Oecetis sp.*											1		1	0.13%
Trombidiformes	*Lebertia sp.*					1								1	0.13%
	Limnesia sp.	3	4	24							1	3	3	38	4.81%
	Tyrrellia sp.										1			1	0.13%
Veneroida	*Dreissena sp.*	6	46	4	1	1								58	7.34%
	Unknown immature										5	4		9	1.14%
	Pisidium sp.										8			8	1.01%
	Pisidium sp.											1		1	0.13%
	Musculium transversa											3		3	0.38%
	Total No. of Individuals	99	102	105	107	98					76	99	104	790	100.00%
	Total No. of Taxa	20	13	12	19	18					23	16	19		

[1]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 31. Summary of macroinvertebrate taxa collected using a dip net in Lake Erie - Intake (LE1-A) at the Fermi site, July 2008 through June 2009.

				2008							2009				
Order	**Taxa**	**JUL**	**AUG**[1]	**SEP**	**OCT**	**NOV**	**DEC**[2]	**JAN**[2]	**FEB**[2]	**MAR**[2]	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Compostion**
Acariformes	*Limnesia sp.*	6				1					2		7	16	6.15%
	Piona sp.	2												2	0.77%
Amphipoda	*Gammarus fasciatus*	46		5	96	5								152	58.46%
	Hyalella azteca			4									4	8	3.08%
Diptera	*Probezzia sp.*					1								1	0.38%
	Ablabesmyia cf. monilis	1												1	0.38%
	Cladotanytarsus sp.	7												7	2.69%
	Chironomus sp.												1	1	0.38%
	Cricotopus sp.	1												1	0.38%
	Cricotopus bicinctus	2											1	3	1.15%
	Cricotopus sylvestris gr.												2	2	0.77%
	Dicrotendipes modestus	4									1			5	1.92%
	Dicrotendipes sp.	1												1	0.38%
	Endochironomus sp.	1												1	0.38%
	Orthocladiinae (damaged pupa)										1			1	0.38%
	Parachironomus sp.										1		1	2	0.77%
	Parachironomus frequens												1	1	0.38%
	Polypedilum illinoense gr.	1		1										2	0.77%
	Polypedilum halterale gr.	2												2	0.77%
	Procladius sp.	1									1			2	0.77%
	Rheotanytarsus exiguus gr.	5		5										10	3.85%
	Tanytarsus sp.			2										2	0.77%
	Thienemanniella sp.	1												1	0.38%
	Hemerodromia sp.					1								1	0.38%
Ephemeroptera	*Caenis sp.*	4												4	1.54%
Rhynchobdellida	*Helobdella stagnalis*												1	1	0.38%
Trichoptera	*Orthotrichia sp.*				1									1	0.38%
Trombidiformes	*Atractide sp.*										2			2	0.77%
	Lebertia sp.												1	1	0.38%
Tubificida	Unknown genus	1												1	0.38%
	Naidinae (unknown genus)	11		1	2						1		4	19	7.31%
	Tubificinae (unknown genus)	1		1	1						2		1	6	2.31%
	Total No. of Individuals	98		19	100	8					11	0	24	260	100.00%
	Total No. of Taxa	19		7	4	4					8	0	11		

[1]Benthic sampling cancelled due to gear malfunction

[2]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 32. Summary of macroinvertebrate taxa collected using a dip net in Lake Erie - South Lagoon (LE2-A) at the Fermi site, July 2008 through June 2009.

		2008								2009					
Order	**Taxa**	**JUL**	**AUG**	**SEP[1]**	**OCT**	**NOV**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Composition**
Amphipoda	*Gammarus fasciatus*	3	2		44	1						18	21	89	15.03%
	Hyalella azteca										1		12	13	2.20%
	Hydroptila sp.		2		1									3	0.51%
Basommatophora	*Fossaria sp.*												8	8	1.35%
	Promenetus exacuous		2										1	3	0.51%
Diptera	*Bezzia/Palpomyia sp.*												5	5	0.84%
	Ablabesmyia peleenis										1			1	0.17%
	Cryptochironomus sp.	1										1		2	0.34%
	Cladotanytarsus sp.	1	2		7						1	10		21	3.55%
	Cladopelma sp.										2		1	3	0.51%
	Chironomus sp.												1	1	0.17%
	Cricotopus sp.				1									1	0.17%
	Cricotopus trifasciata	1			3									4	0.68%
	Cricotopus bicinctus				1									1	0.17%
	Dicrotendipes modestus												1	1	0.17%
	Omisus sp.				1									1	0.17%
	Parachironomus sp.		2											2	0.34%
	Paratanytarsus sp.		3		1									4	0.68%
	Polypedilum illinoense gr.											3		3	0.51%
	Psectrocladius sp.												1	1	0.17%
	Pseudochironomus sp.				1									1	0.17%
	Rheotanytarsus exiguus gr.	10	2											12	2.03%
	Tanytarsus sp.	5	5											10	1.69%
	Thienemanniella lobapodema		7											7	1.18%
	Hemerodromia sp.				1	1						1		3	0.51%
	Unknown pupa		1											1	0.17%
Ephemeroptera	*Caenis sp.*	80			5	15						12		112	18.92%
Haplotaxida	Unknown genus											4		4	0.68%
Hemiptera	*Trichocorixa sp.*												21	21	3.55%
	Unknown early instar												17	17	2.87%
Isopoda	*Caecidotea sp.*												2	2	0.34%
Lumbriculida	Unknown genus												1	1	0.17%
Rhynchobdellida	*Helobdella stagnalis*		2								1		11	14	2.36%
Trichoptera	*Ceratopsyche sp.*		1											1	0.17%
Trombidiformes	*Hygrobates sp.*				9									9	1.52%
	Lebertia sp.				2	1						21		24	4.05%
	Limnesia sp.		23		5	1					2	1		32	5.41%
Tubificida	Naidinae (unknown genus)	7	6		9							5	7	34	5.74%
	Tubificinae (unknown genus)	1			15							29		45	7.60%
Veneroida	*Dreissena sp.*	1	67		1									69	11.66%
	Pisidium sp.										2		1	3	0.51%
	Musculium sp.												1	1	0.17%
	Probezzia sp.										2			2	0.34%
	Total No. of Individuals	110	127		107	19					12	105	112	592	100.00%
	Total No. of Taxa	10	15		17	5					8	11	17		

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 33. Summary of macroinvertebrate taxa collected using a dip net in North Canal (CN-A) at the Fermi site, July 2008 through June 2009.

		2008								2009				
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Composition**
Acariformes	*Limnesia sp.*	1	1								1		1	4	0.52%
Amphipoda	*Crangonyx sp.*												1	1	0.13%
	Gammarus fasciatus		2	5	7							6	18	38	4.98%
	Hyalella azteca	2		6	1								2	11	1.44%
Basommatophora	*Fossaria sp.*	1												1	0.13%
	Radix auricularia		1											1	0.13%
	Physa sp.	9	2	2										13	1.70%
	Gyraulus sp.		34	1										35	4.59%
	Planorbella trivolvis		1											1	0.13%
	Unknown genus (immature)	13												13	1.70%
Coleoptera	*Dubiraphia sp. (larva)*												1	1	0.13%
Diptera	*Bezzia/Palpomyia sp.*											1		1	0.13%
	Sphaeromias sp.				1									1	0.13%
	Chironomini (unknown: damaged/early)			2							1		2	5	0.66%
	Chironomus sp.												2	2	0.26%
	Cladopelma										5	3	6	14	1.83%
	Cladotanytarsus sp.										2			2	0.26%
	Clinotanypus sp.										1			1	0.13%
	Cricotopus sylvestris gr.			1									5	6	0.79%
	Cricotopus trifasciatus	1												1	0.13%
	Cryptochironomus sp.										1	2		3	0.39%
	Dicrotendipes modestus ineomodestus			4							15	2	11	32	4.19%
	Dicrotendipes sp.		1								2			3	0.39%
	Endochironomus sp.	22		3										25	3.28%
	Endochironomus subtendens											1		1	0.13%
	Glyptotendipes sp.	4		2							1			7	0.92%
	Labrundinia neopilosella			1										1	0.13%
	Larsia sp.	1			1									2	0.26%
	Limnophyes sp.										1			1	0.13%
	Parachironomus sp.		4										2	6	0.79%
	Paratanytarsus sp.		4		4						3	1	1	13	1.70%
	Polypedilum halterale gr.										7	5		12	1.57%
	Procladius sp.											1		1	0.13%
	Pseudochironomus sp.			1							3	1		5	0.66%
	Rheotanytarsus exiguus gr.			1										1	0.13%
	Tanypodinae (unknown: damaged/early)			2										2	0.26%
	Tanypus neopunctipennis		1											1	0.13%
	Tanytarsus sp.			8							9	6		23	3.01%
	Tribelos atrum				1									1	0.13%

Table 33 *continued*. Summary of macroinvertebrate taxa collected using a dip net in North Canal (CN-A) at the Fermi site, July 2008 through June 2009.

		2008									2009			Total	Percent
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Number**	**Composition**
	Tribelos sp.										1			1	0.13%
	Zavreliella marmorata										1			1	0.13%
	unknown genus (damaged)	1												1	0.13%
	unknown genus	1												1	0.13%
	Myxosarsus sp.										1			1	0.13%
	Chrysops sp.										1			1	0.13%
	Erioptera sp.										1			1	0.13%
Ephemeroptera	*Baetis sp.*			2										2	0.26%
	Unknown early instar	1												1	0.13%
	Caenis sp.	7	2	44	92						11	27	25	208	27.26%
Haplotaxida	Unknown										1			1	0.13%
Hemiptera	*Palmacorixa sp.*		7		2									9	1.18%
	Trichocorixa sp.		2		4									6	0.79%
	Unknown early instar		3		2								1	6	0.79%
Isopoda	*Caecidotea sp.*	1		2								34	7	44	5.77%
Mysidacea	*Mysis relicta*	2												2	0.26%
Odonata	*Enallagma sp.*	3	2	6	1									12	1.57%
	Ischnura sp.				9									9	1.18%
	Unknown early instar	4	8	12	4									28	3.67%
	Leucorrhinia sp.			1										1	0.13%
Rhynchobdellida	*Helobdella fusca*				2									2	0.26%
	Helobdella stagnalis												3	3	0.39%
	Helobdella triserialis	1												1	0.13%
	Placobdella ornata	1												1	0.13%
Trichoptera	*Hydroptila sp.*		5	1										6	0.79%
	Orthotrichia sp.			3										3	0.39%
	Oecetis sp.			2							2			4	0.52%
Tubificida	Naidinae (unknown genus)	21	12								7	7	22	69	9.04%
	Tubificinae (unknown genus)	2	8								23	3	1	37	4.85%
Veneroida	*Dreissena sp.*		5											5	0.66%
	Unknown immature										2			2	0.26%
	Unknown											2		2	0.26%
	Total No. of Individuals	99	105	112	131						103	102	111	763	100.00%
	Total No. of Taxa	22	20	23	14						25	16	18		

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 34. Summary of macroinvertebrate taxa collected using a dip net in the Isolated Central Canal (IC-A) at the Fermi site, July 2008 through October 2008.

		2008						2009							
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR[3]**	**MAY[3]**	**JUN[3]**	**Total Number**	**Percent Composition**
Amphipoda	*Crangonyx sp.*				66									66	20.43%
	Hyalella azteca	15	11	8	16									50	15.48%
Basommatophora	*Physa sp.*		1											1	0.31%
Diptera	*Bezzia/Palpomyia sp.*			1										1	0.31%
	Dasyhelea sp.		2											2	0.62%
	Ablabesmyia mallochi		2	2										4	1.24%
	Chironomini (unknown:damaged/early)		6											6	1.86%
	Dicrotendipes sp.			3	5									8	2.48%
	Endochironomus sp.		5	1	7									13	4.02%
	Glyptotendipes sp.		2											2	0.62%
	Labrundinia cf. maculata			1										1	0.31%
	Labrundinia neopilosella		1											1	0.31%
	Larsia sp.	1												1	0.31%
	Parachironomus sp.				1									1	0.31%
	Paratanytarsus sp.				1									1	0.31%
	Polypedilum illinoense gr.	1												1	0.31%
	Polypedilum sp.		2	1										3	0.93%
	Psectrocladius cf. pilosus		2											2	0.62%
	Psectrocladius sp.													0	0.00%
	Pseudochironomus sp.		15	4										19	5.88%
	Tanypodinae (damaged/early)		2											2	0.62%
	Tanytarsus sp.	4	7	9	1									21	6.50%
Ephemeroptera	*Callibaetis sp.*				1									1	0.31%
	Unknown early instar			2										2	0.62%
	Caenis sp.	3		6	9									18	5.57%
Isopoda	*Caecidotea sp.*				5									5	1.55%
Mysidacea	*Mysis relicta*	2												2	0.62%
Odonata	*Argia sp.*	1		1										2	0.62%
	Enallagma sp.		1											1	0.31%
	Ischnura sp.			1										1	0.31%
	Unknown early instar	2	3	1										6	1.86%
Trichoptera	*Hydroptila sp.*		1	3										4	1.24%
	Oxyethira sp.		1	3										4	1.24%
Trombidiformes	*Lebertia sp.*		8											8	2.48%
Tubificida	Naidinae (unknown genus)	7	28	13	1									49	15.17%
	Tubificinae (unknown genus)		1		10									11	3.41%
	Unknown (damaged)	1	2											3	0.93%
	Total No. of Individuals	37	103	60	123									323	100.00%
	Total No. of Taxa	10	21	17	12										

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]Months with no scheduled biological sampling due to anticipated winter weather conditions

[3]No biological sampling; location dropped from sampling plan

Table 35. Summary of macroinvertebrate taxa collected using a dip net in the South Canal (CS-A) at the Fermi site, July 2008 through June 2009.

		2008						2009							
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Compostion**
Amphipoda	*Crangonyx sp.*											3		3	0.39%
	Gammarus fasciatus			2								2	1	5	0.65%
	Gammarus sp.	1												1	0.13%
	Hyalella azteca	50	33	17	16						6	22	37	181	23.57%
Basommatophora	*Fossaria sp.*												1	1	0.13%
	Helisoma sp.												1	1	0.13%
	Gyraulus sp.		2									3		5	0.65%
	Gyraulus parvus				6									6	0.78%
	Promenetus exacuous				1									1	0.13%
	Unknown genus (immature)			1							1			2	0.26%
	Cipangopaludina chinensis	1												1	0.13%
Coleoptera	*Peltodytes sp.*											2		2	0.26%
	Haliplus sp.			1										1	0.13%
	Peltodytes sp.				1									1	0.13%
	Unknown early instar	4	1											5	0.65%
Decapopda	Unknown (immature)												1	1	0.13%
Diptera	*Dasyhelea sp.*		1											1	0.13%
	Ablabesmyia cf. monilis		4	1										5	0.65%
	Ablabesmyia (Karelia) sp.										1			1	0.13%
	Cryptotendipes sp.												1	1	0.13%
	Cladotanytarsus sp.		1											1	0.13%
	Chironomus sp.			1	3									4	0.52%
	Cricotopus sylvestris gr.											5		5	0.65%
	Chironomini (unknown; damaged/early instar)		2	1										3	0.39%
	Cladopelma sp.			2							2		4	8	1.04%
	Corynoneura sp.											1		1	0.13%
	Dicrotendipes modestus										7	1		8	1.04%
	Dicrotendipes sp.		1	2	4						2			9	1.17%
	Endochironomus subtendens											1	2	3	0.39%
	Endochironomus sp.		4		1									5	0.65%
	Larsia sp.	1	1		1									3	0.39%
	Parachironomus sp.										3	5	3	11	1.43%
	Paratanytarsus cf. dissimilis		5	9										14	1.82%
	Paratanytarsus sp.				8						16		2	26	3.39%
	Polypedilum illinoense gr.			1							1			2	0.26%
	Polypedilum halterale gr.			1										1	0.13%
	Polypedilum sp.	1												1	0.13%
	Polypedilum flavum											1		1	0.13%
	Pseudochironomus sp.		13	3										16	2.08%

Table 35 *continued* . Summary of macroinvertebrate taxa collected using a dip net in the South Canal (CS-A) at the Fermi site, July 2008 through June 2009.

		2008									2009				
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV[1]**	**DEC[2]**	**JAN[2]**	**FEB[2]**	**MAR[2]**	**APR**	**MAY**	**JUN**	**Total Number**	**Percent Compostion**
	Tanypodinae (damaged/unknown early instar)			2										2	0.26%
	Tanytarsus sp.		2	5							10			17	2.21%
	Tribelos atrum												1	1	0.13%
	Zavreliella marmorata												1	1	0.13%
	Bezzia/Palpomyia sp.												1	1	0.13%
Ephemeroptera	*Callibaetis sp.*		2	2										4	0.52%
	Unknown early instar				1									1	0.13%
	Caenis sp.	11	23	49	57						47	3	7	197	25.65%
Hemiptera	*Pelocoris femoratus*	2												2	0.26%
	Neoplea striola	3										10		13	1.69%
Isopoda	*Caecidotea sp.*	1		7	6							2	3	19	2.47%
Mysidacea	*Mysis relicta*		2		2									4	0.52%
Odonata	*Enallagma sp.*	6	3	1										10	1.30%
	Ischnura sp.			1	1							3		5	0.65%
Odonata	Unknown early instar	24	1	4	4							1		34	4.43%
Rhynchobdellida	*Helobdella sp.* (immature)										1			1	0.13%
Trichoptera	*Orthotrichia sp.*	1												1	0.13%
	Oecetis sp.				1									1	0.13%
Trombidiformes	*Lebertia sp.*											3		3	0.39%
	Limnesia sp.										5	1		6	0.78%
	Koenikea sp.			1										1	0.13%
Tubificida	Naidinae (unknown genus)	1	5	1	6						2			15	1.95%
	Tubificinae (unknown genus)				1						2	1	76	80	10.42%
Veneroida	*Pisidium sp.*	1									1			2	0.26%
	Total No. of Individuals	108	106	115	120						107	70	142	768	100.00%
	Total No. of Taxa	16	19	23	18						16	19	16		

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]Months with no scheduled biological sampling due to anticipated winter weather conditions

Table 36. Summary of macroinvertebrate taxa collected using a dip net in the Isolated Pond (IP-A) at the Fermi site, July 2008 through November 2008.

		2008							2009					Total	Percent
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR[2]**	**MAY[2]**	**JUN[2]**	**Number**	**Compostion**
Amphipoda	*Hyalella azteca*	2	1	1		8								12	2.20%
Basommatophora	*Physa sp.*				2	14								16	2.93%
Coleoptera	*Dubiraphia sp.* (larva)	3	4	3	1									11	2.01%
Diptera	*Bezzia/Palpomyia sp.*			3										3	0.55%
	Culicoides sp.			1	4									5	0.92%
	Sphaeromias sp.			1										1	0.18%
	Unknown genus (pupa/damaged)			1										1	0.18%
	Ablabesmyia peleenis					1								1	0.18%
	Chironomini (unknown; damaged/early instar)		1											1	0.18%
	Chironomus sp.				3									3	0.55%
	Cladopelma sp.			9	17	7								33	6.04%
	Cladotanytarsus sp.				2									2	0.37%
	Clinotanypus sp.		2	10	1									13	2.38%
	Cryptochironomus sp.			7	2									9	1.65%
	Cryptotendipes sp.			2	1	7								10	1.83%
	Dicrotendipes modestus			6	1	24								31	5.68%
	Dicrotendipes sp.		1	2	5									8	1.47%
	Endochironomus sp.				1	5								6	1.10%
	Glyptotendipes sp.		1											1	0.18%
	Larsia sp.					1								1	0.18%
	Paratanytarsus sp.			3										3	0.55%
	Polypedilum flavum		2											2	0.37%
	Polypedilum halterale gr.		4	2		1								7	1.28%
	Polypedilum illinoense gr.			1										1	0.18%
	Polypedilum sp.	3	2		16									21	3.85%
	Procladius sp.		3	5										8	1.47%
	Pseudochironomus sp.			1		2								3	0.55%
	Tanypus sp.	5	1	6										12	2.20%
	Tanypus neo punctipennis			5	7	1								13	2.38%
	Tanytarsus sp.	3	16	6	3	5								33	6.04%
	Tribelos atrum	2	2											4	0.73%
	Tribelos jucundum		2	1										3	0.55%
Ephemeroptera	*Callibaetis sp.*				1									1	0.18%
	Unknown early instar	1												1	0.18%
	Caenis sp.	2	1	3	4	26								36	6.59%
Hemiptera	*Trichocorixa sp.*					2								2	0.37%
	Unknown early instar	1	2	3	2									8	1.47%
Isopoda	*Caecidotea sp.*	2	1	3										6	1.10%
Mysidacea	*Mysis relicta*		1		2									3	0.55%

Table 36 *continued*. Summary of macroinvertebrate taxa collected using a dip net in the Isolated Pond (IP-A) at the Fermi site, July 2008 through November 2008.

		2008						2009							
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR[2]**	**MAY[2]**	**JUN[2]**	**Total Number**	**Percent Compostion**
Odonata	*Argia sp.*	2	1											3	0.55%
	Enallagma sp.		3			4								7	1.28%
	Ischnura sp.					1								1	0.18%
	Unknown early instar	21	3	3		9								36	6.59%
Trichoptera	*Orthotrichia sp.*	4												4	0.73%
	Oecetis sp.		1		1									2	0.37%
	Phryganea sp.					1								1	0.18%
Tubificida	Naidinae (unknown genus)	43	5	3		1								52	9.52%
	Tubificinae (unknown genus)	1	36	10	23									70	12.82%
Veneroida	*Pisidium sp.*		1											1	0.18%
	Unknown	27	1			1								29	5.31%
	Total No. of Individuals	122	98	101	99	121								546	99.08%
	Total No. of Taxa	17	26	27	21	20									

[1]Months with no scheduled biological sampling due to anticipated winter weather conditions

[2]No biological sampling; location dropped from sampling plan

Table 37. Summary of macroinvertebrate taxa collected using a dip net in the North Quarry (NQ-A) at the Fermi site, July 2008 through November 2008.

		2008						2009							
Order	**Taxa**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC[1]**	**JAN[1]**	**FEB[1]**	**MAR[1]**	**APR[2]**	**MAY[2]**	**JUN[2]**	**Total Number**	**Percent Composition**
Diptera	*Bezzia/Palpomyia sp.*	1			1									2	0.39%
	Dasyhelea sp.	33	15	9	9	2								68	13.31%
	Probezzia sp.					5								5	0.98%
	Unknown genus (pupa/damaged)			2										2	0.39%
	Ablabesmyia mallochi		2	1										3	0.59%
	Chironomus sp.					1								1	0.20%
	Cladotanytarsus sp.	1			5	3								9	1.76%
	Cryptochironomus sp.		1			2								3	0.59%
	Orthocladiinae (unknown early instar)	1												1	0.20%
	Parachironomus sp.	1												1	0.20%
	Parakiefferiella sp.		1	3	1									5	0.98%
	Paralauterborniella nigrohalteralis		3	1	7	2								13	2.54%
	Paratanytarsus sp.		1			1								2	0.39%
	Procladius sp.	2	2	1										5	0.98%
	Stempellina sp.					1								1	0.20%
	Tanytarsus sp.	9	4	4		14								31	6.07%
Ephemeroptera	*Caenis sp.*	37	46	85	63	63								294	57.53%
	Hexagenia limbata				5									5	0.98%
	Gammarus sp.	1												1	0.20%
Odonata	*Enallagma sp.*	1	8											9	1.76%
	Unknown early instar	3	9											12	2.35%
Trichoptera	*Oxyethira sp.*	1												1	0.20%
	Oecetis sp.	1			2									3	0.59%
Tubificida	Naidinae (unknown genus)	3	2		2									7	1.37%
	Tubificinae (unknown genus)			5	7	6								18	3.52%
Veneroida	*Dreissena sp.*	5	4											9	1.76%
	Total No. of Individuals	100	98	111	102	100								511	100.00%
	Total No. of Taxa	15	13	9	10	11									

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]No biological sampling; location dropped from sampling plan

Table 38. Summary of macroinvertebrate taxa collected using a dip net in the South Quarry (SQ-A) at the Fermi site, July 2008 through November 2008.

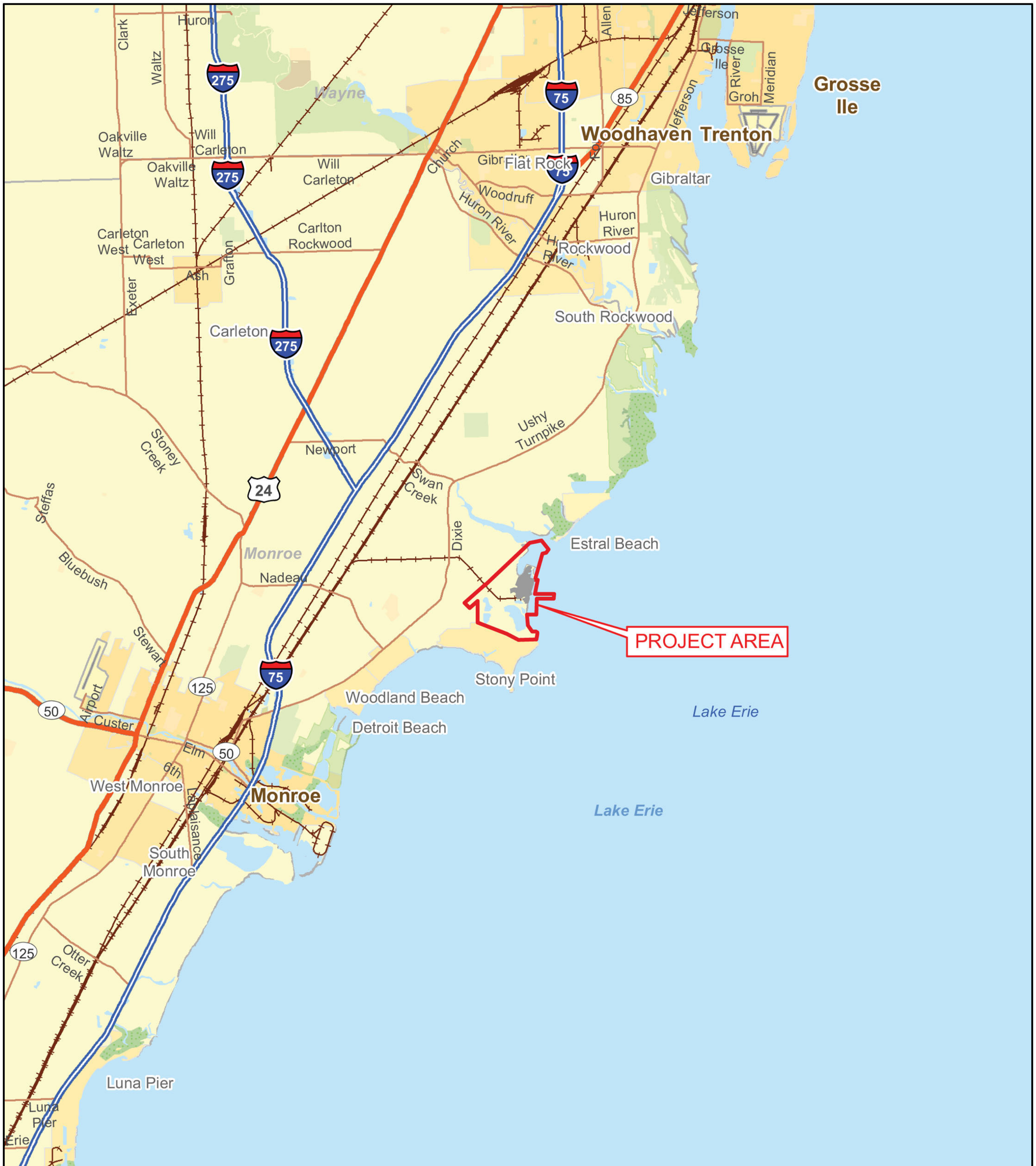
Order	Taxa	2008 JUL	AUG	SEP	OCT	NOV	DEC[1]	2009 JAN[1]	FEB[1]	MAR[1]	APR[2]	MAY[2]	JUN[2]	Total Number	Percent Composition
Diptera	*Bezzia/Palpomyia sp.*		1											1	0.20%
	Dasyhelea sp.	17	9		5	37								68	13.71%
	Probezzia sp.			1	1									2	0.40%
	Ablabesmyia mallochi	3	2											5	1.01%
	Cladotanytarsus sp.					1								1	0.20%
	Cryptochironomus sp.			2										2	0.40%
	Dicrotendipes sp.		2	1										3	0.60%
	Nilothauma sp.			1										1	0.20%
	Parakiefferiella sp.			1										1	0.20%
	Polypedilum illinoense gr.					1								1	0.20%
	Polypedilum sp.	1												1	0.20%
	Procladius sp.	3												3	0.60%
	Stempellina sp.	3												3	0.60%
	Stictochironomus sp.	2												2	0.40%
	Tanypodinae (damaged/early)													0	0.00%
	Tanypodinae (unknown early instar)	1												1	0.20%
	Tanypodinae (unknown: damaged/early)			1										1	0.20%
	Tanytarsus sp.	20	12	5		7								44	8.87%
Ephemeroptera	*Caenis sp.*	43	2	86	114	73								318	64.11%
	Hexagenia limbata	2		3	6									11	2.22%
Hemiptera	*Palmacorixa sp.*					1								1	0.20%
Odonata	*Enallagma sp.*				1									1	0.20%
	Ischnura sp.				1									1	0.20%
	Unknown early instar	1	1		1	1								4	0.81%
Tubificida	Naidinae (unknown genus)			1		1								2	0.40%
	Tubificinae (unknown genus)	4		3		8								15	3.02%
Veneroida	*Dreissena sp.*	3												3	0.60%
	Total No. of Individuals	103	29	105	129	130								496	100.00%
	Total No. of Taxa	13	7	11	7	9									

[1]No biological sampling due to weather conditions (i.e. waves, icing, heavy vegetation, debris)

[2]No biological sampling; location dropped from sampling plan

Figures

Location: J:\00940-Black & Veatch\00940-040 Aquatic Eco Stdy-Lake Erie Nuc Plant\6.0 Reference Materials\GIS



Aquatic Ecology Survey
DTE Fermi 3
Project Site Location Map

Legend

FERMI Site (Developed Areas)

Project Area

N

0 0.5 1 2

Miles

Projection: Michigan South State Plain, NAD 83
Background: ESRI Resource Center
Source: http://resources.esri.com

Black & Veatch

AECOM

FIGURE 1

Date: October 2009

Project No.: 00940-040

Location: J:\00940-Black & Veatch\00940-040 Aquatic Eco Stdy-Lake Erie Nuc Plant\6.0 Reference Materials\GIS

Aquatic Ecology Survey
DTE Fermi 3
Aquatic Sample Locations

Legend

Sample Stations

(Does not reflect actual sample location)

N

0 500 1,000 2,000

Feet

Projection: Michigan South State Plain, NAD 83
Background: ESRI Resource Center
Source: http://resources.esri.com

Black & Veatch

FIGURE 2

November 2009

Project No.: 00940-040

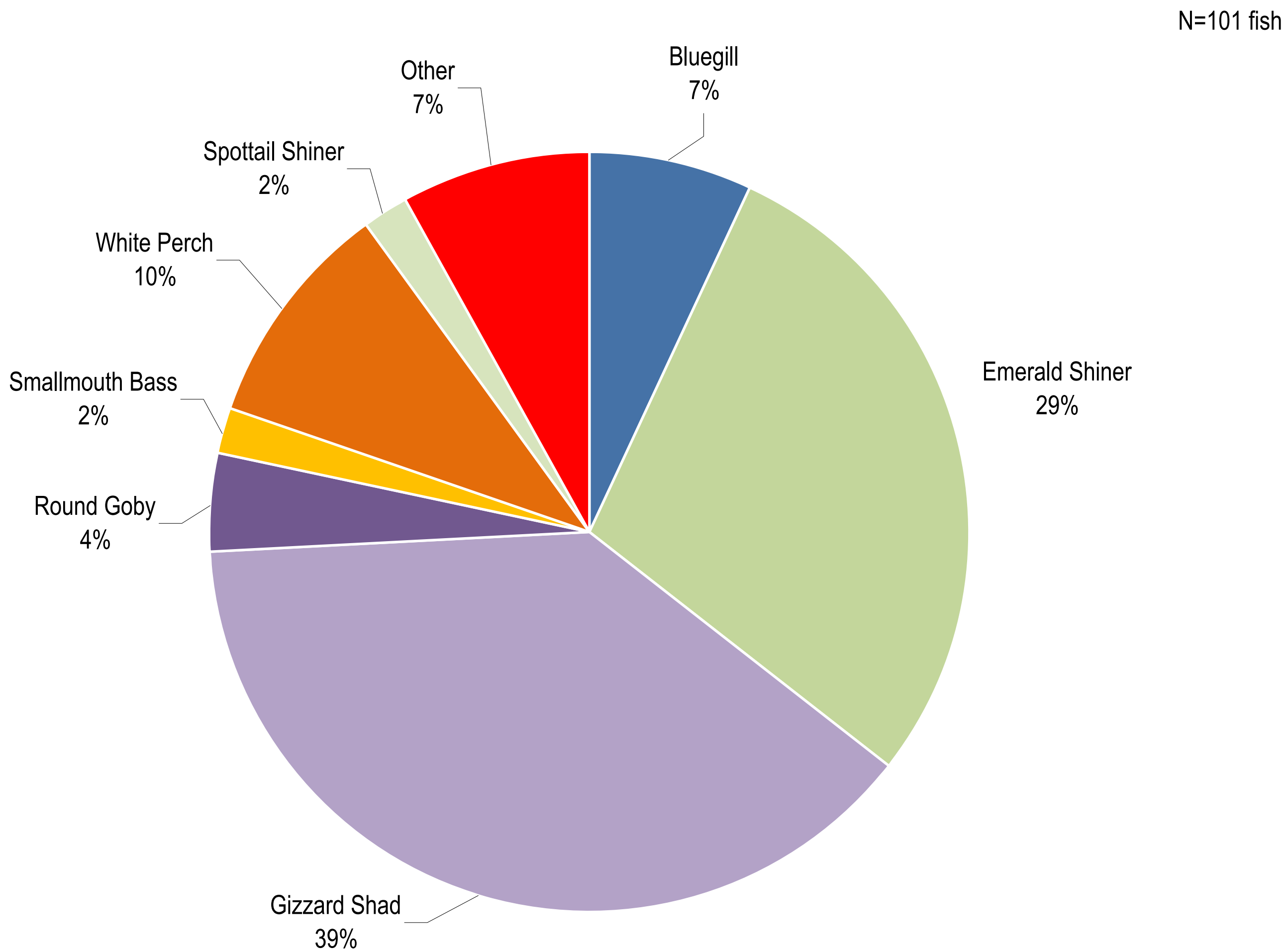


Figure 3. Composition of species comprising greater than 1% of all fish impinged at the Fermi 2 GSWPH, August 2008 through July 2009.

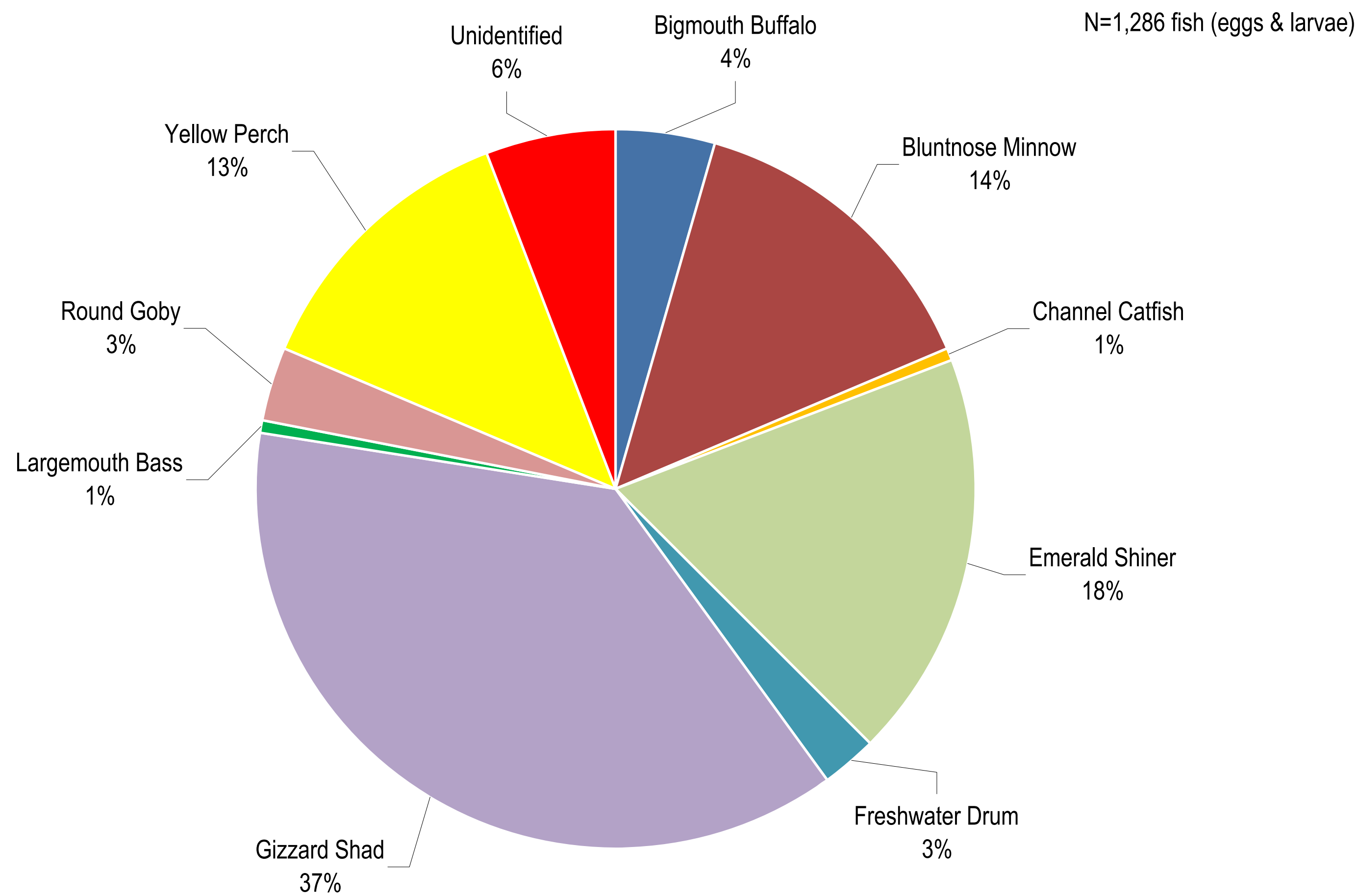


Figure 4. Composition of species comprising greater than 1% of all fish entrained at the Fermi 2 GSWPH, July 2008 through July 2009.

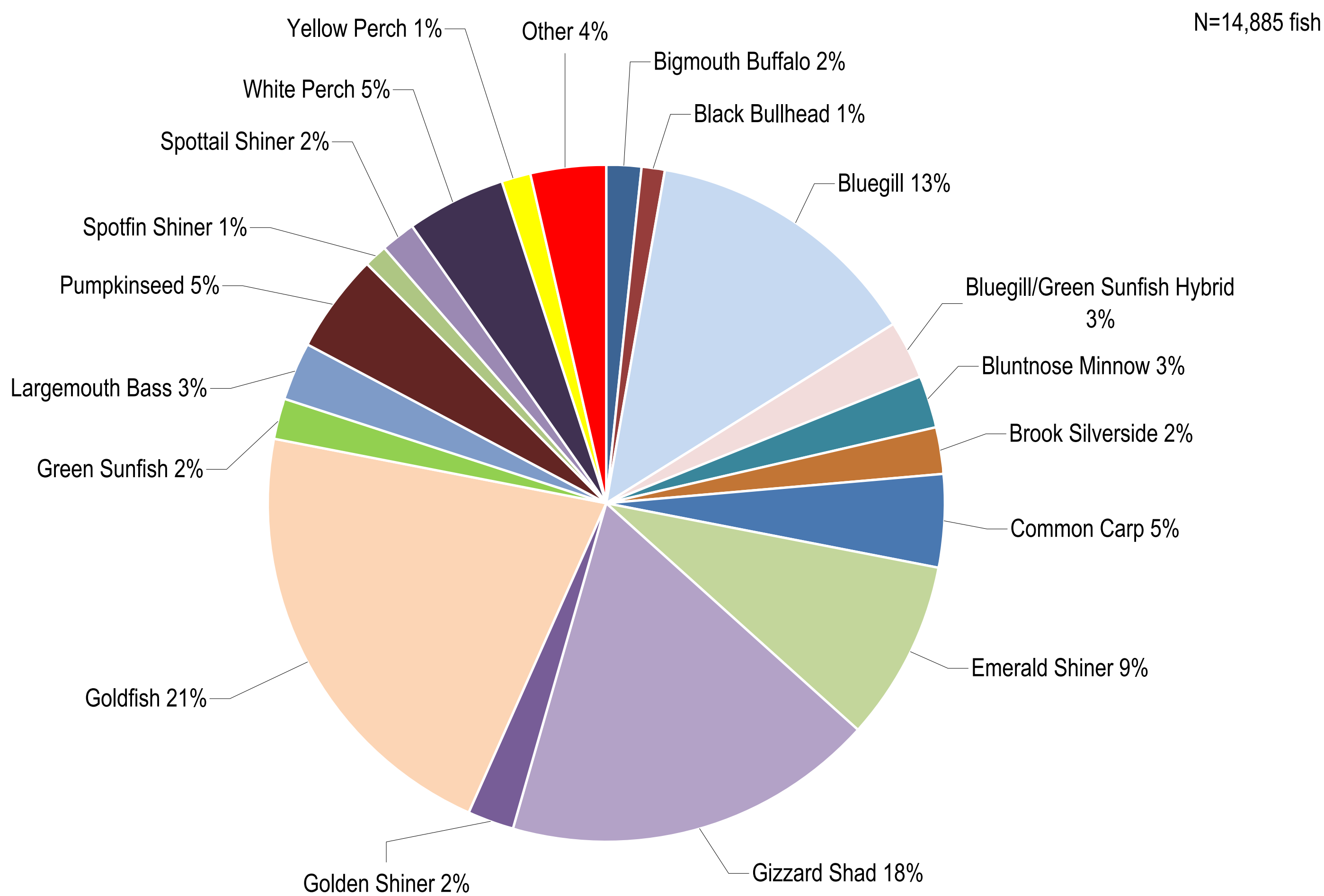


Figure 5. Composition of species comprising greater than 1% of all fish collected in nine sampling locations at the Fermi site, July 2008 through June 2009.

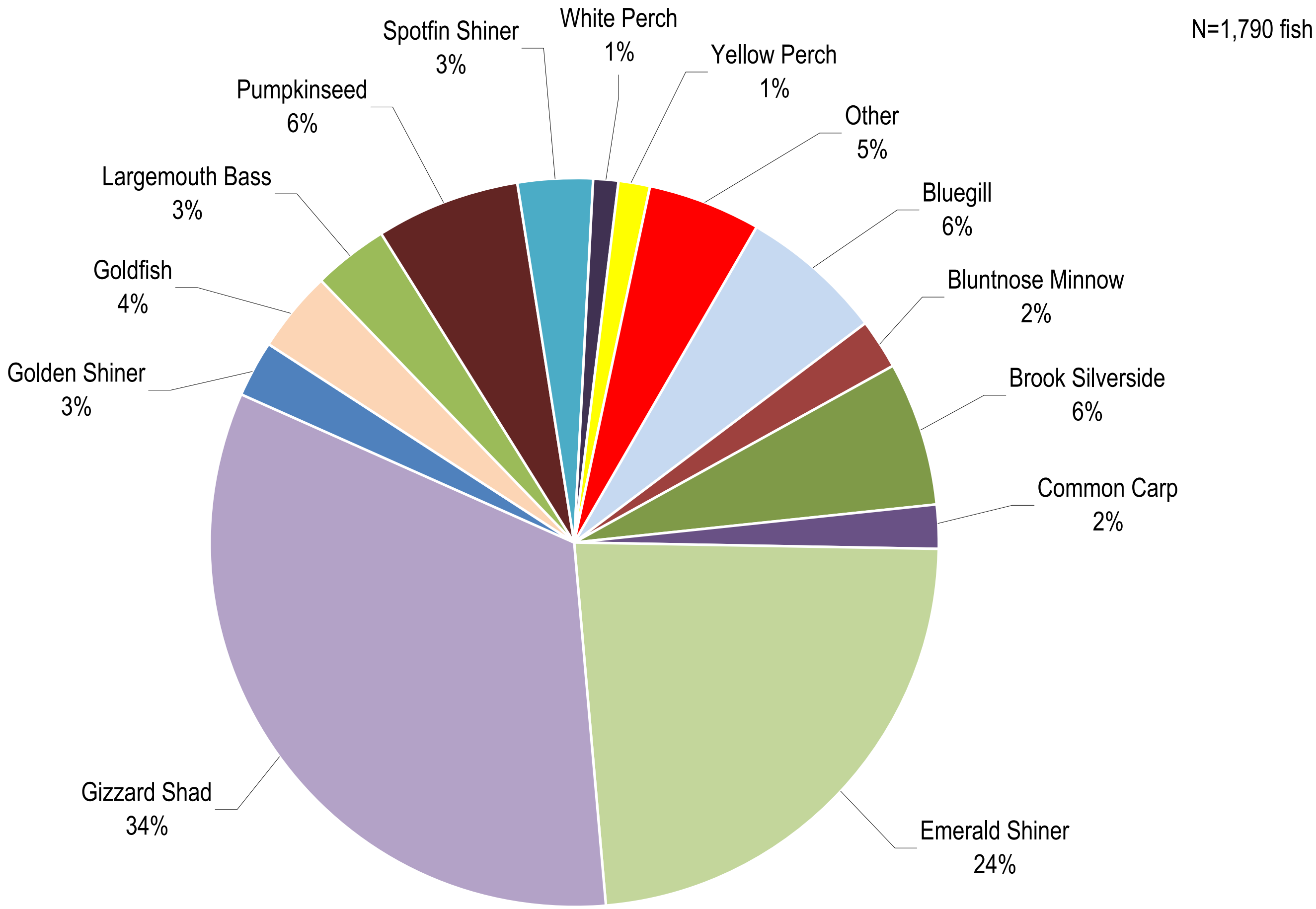


Figure 6. Composition of species comprising greater than 1% of all fish collected in samples in Swan Creek (SC-A) at the Fermi site, July 2008 through June 2009.

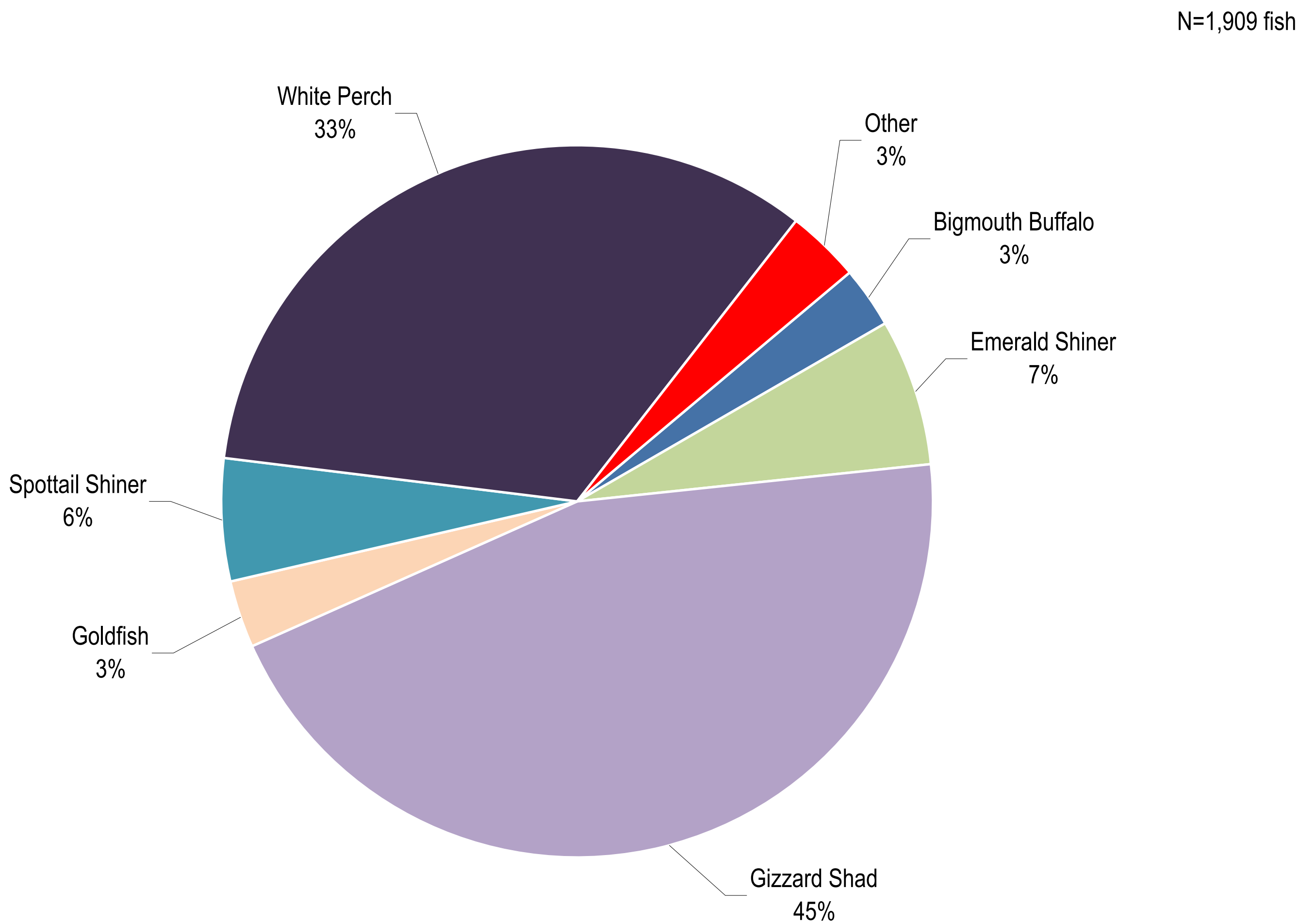


Figure 7. Composition of species comprising greater than 1% of all fish collected in samples from the Lake Erie - Intake (LE1-A) at the Fermi site, July 2008 through June 2009.

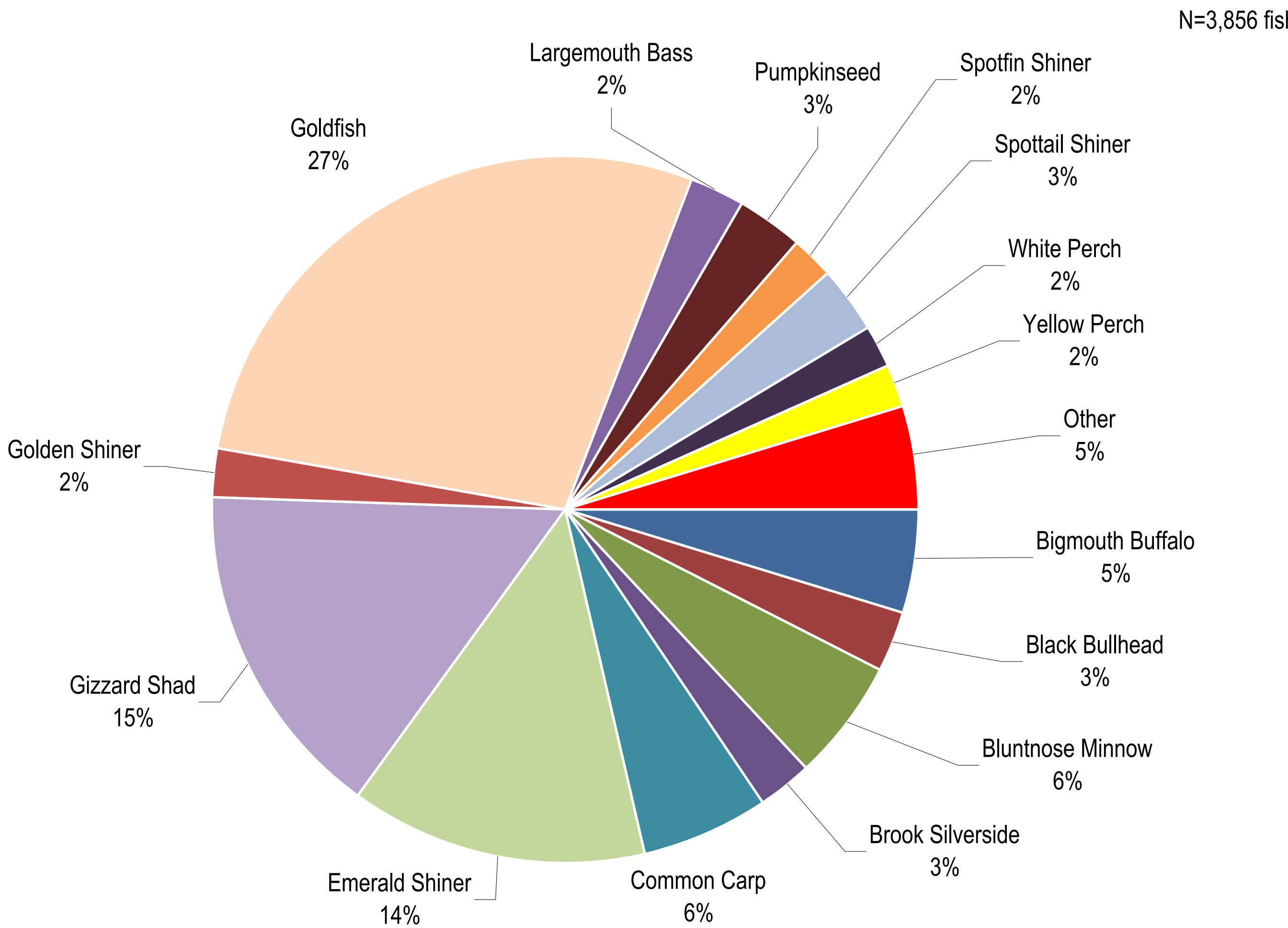


Figure 8. Composition of species comprising greater than 1% of all fish collected in samples from the Lake Erie - South Lagoon (LE2-A) at the Fermi site, July 2008 through June 2009.

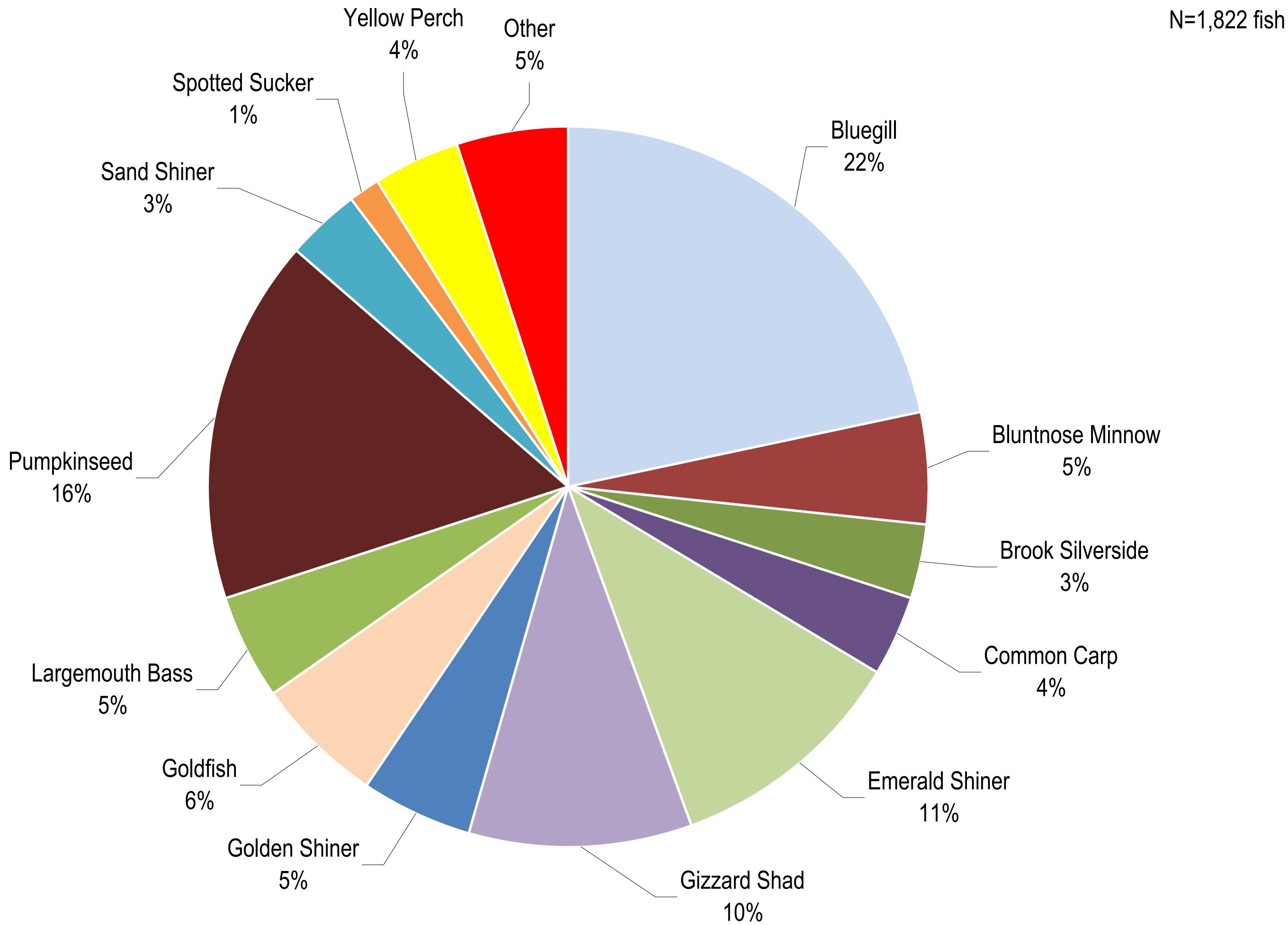


Figure 9. Composition of species comprising greater than 1% of all fish collected in samples from the North Canal (CN-A) at the Fermi site, July 2008 through June 2009.

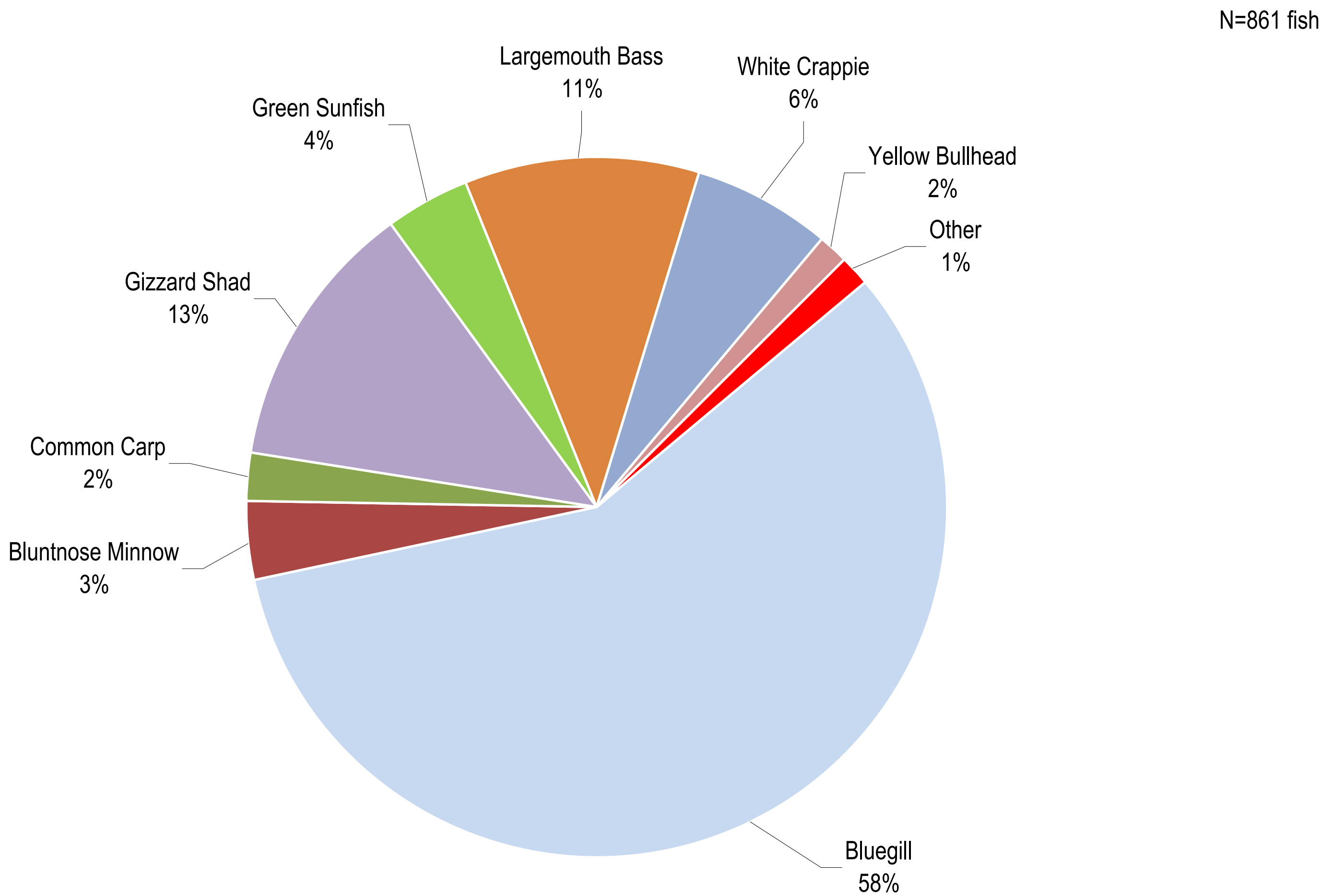


Figure 10. Composition of species comprising greater than 1% of all fish collected in samples from the Isolated Central Canal (IC-A) at the Fermi site, July 2008 through October 2008.

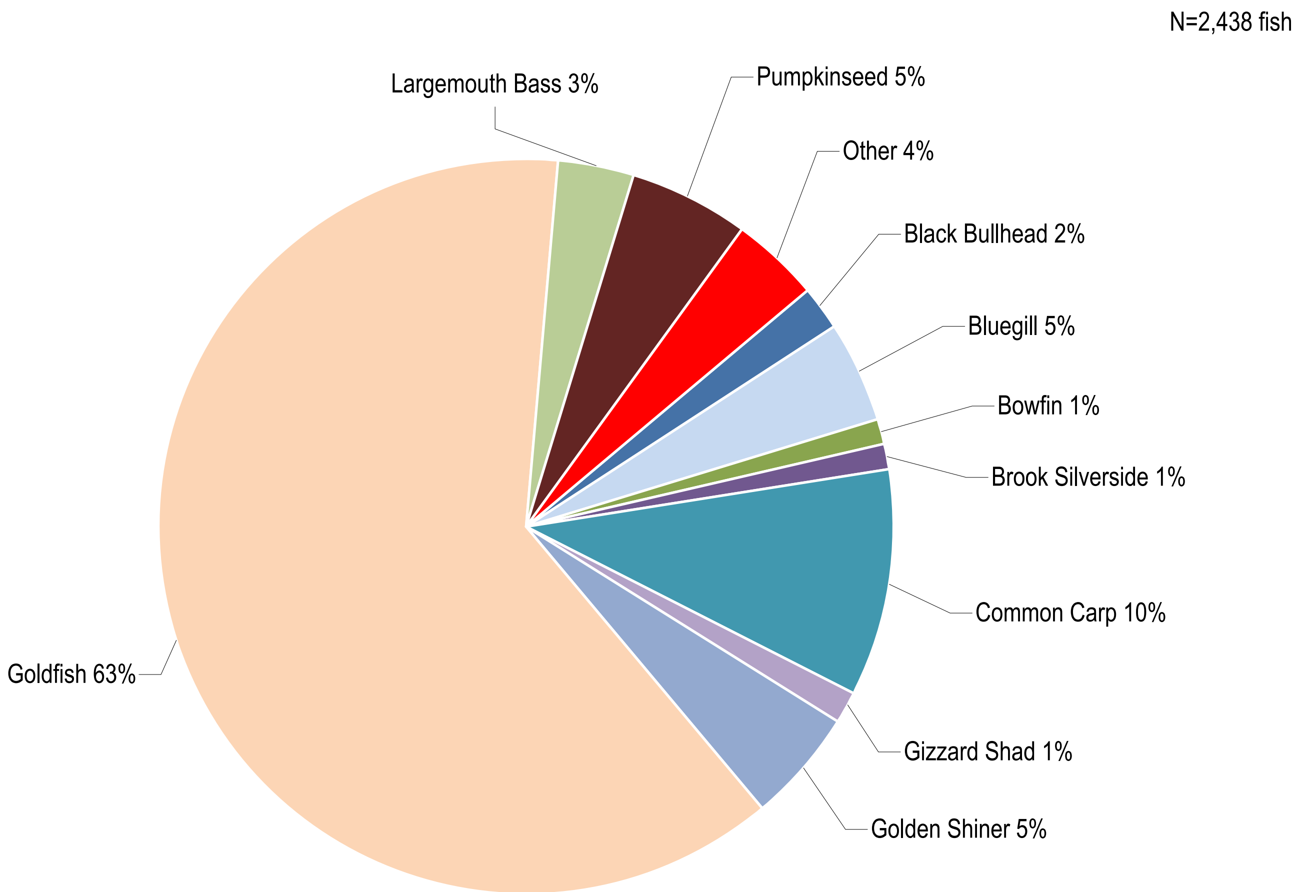


Figure 11. Composition of species comprising greater than 1% of all fish collected in samples from the South Canal (CS-A) at the Fermi site, July 2008 through June 2009.

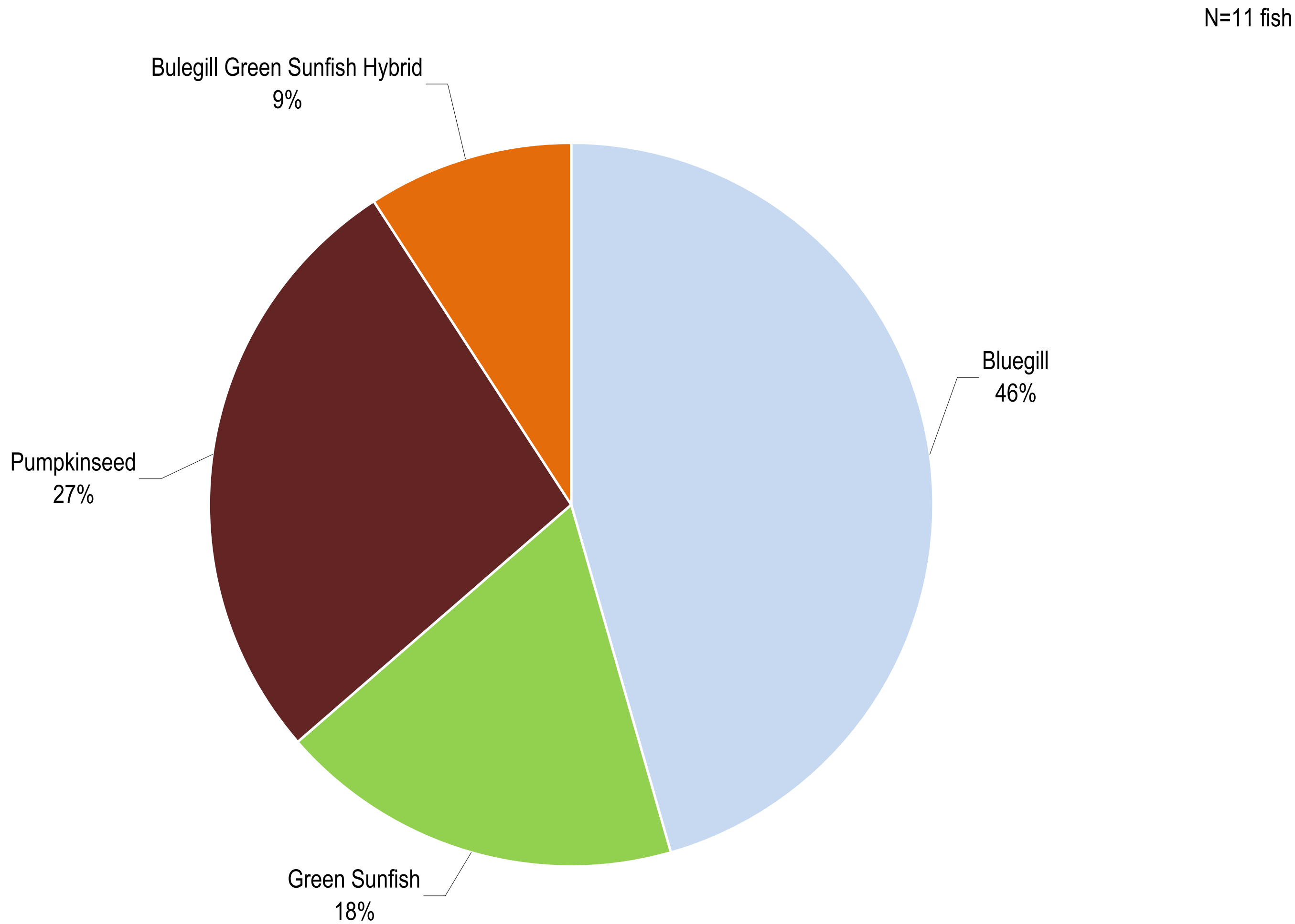


Figure 12. Composition of species comprising greater than 1% of all fish collected in samples from the Isolated Pond (IP-A) at the Fermi site, July 2008 through October 2008.

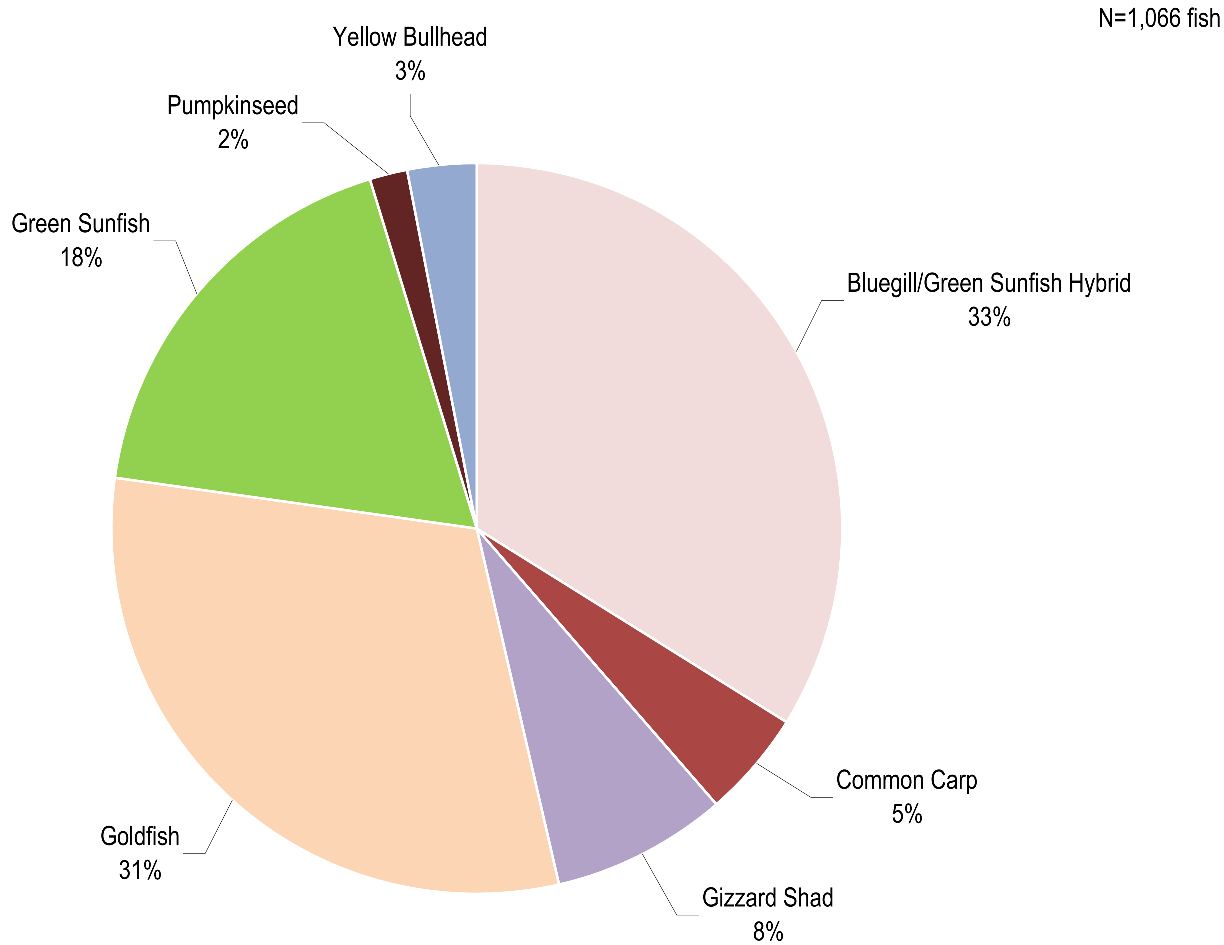


Figure 13. Composition of species comprising greater than 1% of all fish collected in samples from the North Quarry (NQ-A) at the Fermi site, July 2008 through November 2008.

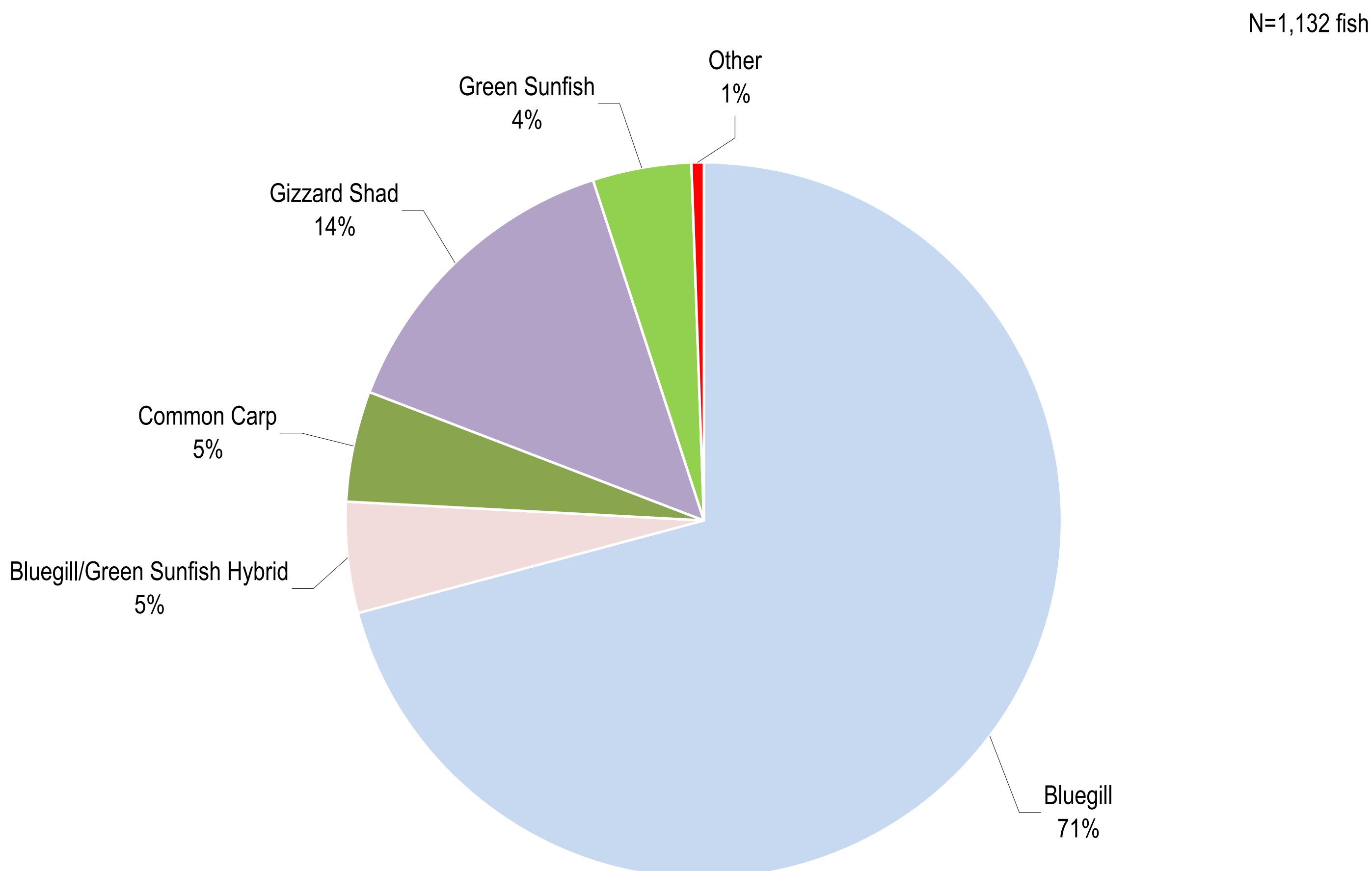


Figure 14. Composition of species comprising greater than 1% of all fish collected in samples from the South Quarry (SQ-A) at the Fermi site, July 2008 through November 2008.

Appendix A

View of northern canal facing northeast

View of Lake Erie shoreline adjacent to Fermi site facing north


View of south quarry from east bank facing west

View of north quarry facing north

View of south quarry facing west

Zodiac boat used during aquatic sampling

View of isolated pond facing east

View of Lake Erie adjacent to south lagoon, facing northeast

View of seine netting in Lake Erie, facing east

View of Fermi site from Lake Erie, facing southwest

Benthic sampling in Swan Creek

Electroshock gear/boat in Swan Creek

Samples collected from Swan Creek

View of Fermi site from Swan Creek, facing south

View of Swan Creek, facing northeast

Appendix B

Life Histories for Threatened and Endangered Species

The following species are listed as threatened or endangered in Monroe County, Michigan either by the federal government (USFWS) or by the State of Michigan (MDNR). These life histories provide available information on abundance, and any critical life-support requirements such as spawning areas, nursery grounds, food habits, and feeding areas. Supplemental life history data was gathered from NatureServe wildlife database.

Fish

Lake sturgeon-*Acipenser fulvescens*

The lake sturgeon is listed as a threatened species in Michigan, and is endangered in Ohio. Historically, it has been found in the Hudson Bay watershed, the St. Lawrence estuary, the upper and middle Mississippi River and Great Lakes basins, and scattered throughout the Tennessee, Ohio, and lower Mississippi drainages. It has become rare throughout its historic range, and population estimates are around one percent of their original numbers. Michigan populations are some of the largest, and are scattered throughout most counties bordering the Great Lakes, as well as some inland lakes and rivers.

The lake sturgeon is a benthic organism that occurs in large rivers and the shallow areas of large lakes where food is abundant. They tend to avoid aquatic vegetation and prefer deep run and pool habitats of rivers. Their habitat use varies in lakes, depending on what conditions are available.

Lake sturgeon begin spawning migrations in May when the water temperature reaches 10-12 degrees Celsius, but do not actually begin spawning until the water is between 13 and 18 degrees Celsius. Spawning habitat is defined by swift currents, clean rocky substrates, and depths of two to fifteen feet. Large females spawn only once every 3-7 years, but will lay hundreds of thousands of black, adhesive eggs. The eggs are instantly fertilized by a male, who may spawn every one or two years. The eggs hatch in five days, and the juveniles grow relatively quickly for ten years, but growth slows considerably thereafter. Males reach sexual maturity at about 15 years of age, while females do at about 25 years of age. The lake sturgeon has the greatest life expectancy of any freshwater fish, with some individuals reaching 80 years of age. The most recently documented spawning area along Michigan's Lake Erie shoreline is near Stony Point in Monroe County, however activity has diminished recently and may have ceased.

The lake sturgeon is a bottom feeder that uses its protrusible mouth to extract prey as it forages over gravel, sand, and/or mud substrates. Prey for this sturgeon includes snails, clams, crustaceans, fish, and aquatic insect larvae. The sturgeon will also prey upon eggs of other species of fish during foraging.

Lake Erie was formerly one of the most productive waters for lake sturgeon in North America. The lake sturgeon population in Michigan is estimated to be approximately 1% of its former abundance. In the 1800's, sturgeon were perceived as a pest and a nuisance because they often caused damage to fishing gear in nearshore waters. In the 1860's, the lake sturgeon population was greatly reduced in Lake Erie as a bycatch of the booming gill net fishery. In the following years, over-harvesting, limited reproduction and destruction of spawning habitats nearly eradicated the sturgeon population in the lake.

Lake sturgeon can be utilized as an indicator of ecosystem health because they are very sensitive to human disturbances such as habitat decline and pollution as illustrated by their sharp decline in the late 1800's and early 1900's. The most recently documented spawning area on the Lake Erie shoreline was near Stony Point in Monroe County, but activity has diminished and may have ceased altogether. They are not known to occur contemporarily in Swan and Stony Creeks (Goforth, 2000).

Eastern sand darter-*Ammocrypta pellucida*

The eastern sand darter may be found from the St. Lawrence River drainage, the Lake Champlain drainage in Vermont, south to West Virginia and Kentucky, and west through Ontario and Michigan. Within Michigan, this darter was found historically in the Huron, Detroit, St. Joseph, Raisin, and Rouge Rivers, as well as Lake St. Clair. However, in the last two decades it has only been recorded in the Lake St. Clair and Huron River drainages.

The preferred habitats of the eastern sand darter are streams and rivers with sandy substrates, and lakes with sandy shoals. They frequently occur in slow moving waters that deposit fine sand, often just downstream of a bend.

Spawning occurs from April through June when water temperatures are around 20-23 degrees Celsius. They deposit their eggs singly, and bury them in the sandy substrate. These darters reach sexual maturity at age one and have a life expectancy of only 2-3 years. The eastern sand darter spends a large amount of its time half-buried in the substrate, presumably to conserve energy and maintain its position on the bottom.

The eastern sand darter feeds mostly on chironomid larvae, but will also prey upon oligochaetes and cladocerans.

The eastern sand darter currently has no known populations in Monroe County (Derosier, 2004).

Creek chubsucker-*Erimyzon oblongus*

The creek chubsucker has only been listed as endangered by the state of Michigan. This species occurs throughout most of the eastern United States, but is becoming increasingly rare toward the edges of its distribution. The creek chubsucker's northern range terminates in Michigan, where it has been found in the Kalamazoo, St. Joseph, and Raisin Rivers and their tributaries. For the last two decades it has only been reported in the Kalamazoo River, located west of Monroe County.

The creek chubsucker inhabits headwaters and clear creeks with moderate currents over sand-gravel substrate, sometimes near aquatic vegetation. This holds true in Michigan, where it has been reported in moderately swift streams up to five feet deep with sand, gravel and mud bottoms.

The creek chubsucker migrates upstream to spawn in early spring. Eggs are generally scattered over substrates, but males have been observed building nests. Adults may produce up to 9,000 eggs per year. Juveniles of this species prefer to form schools in vegetated areas with less current, but migrate to deeper downstream areas as they become adults. Life expectancy of the creek chubsucker is approximately five years.

The diet of the creek chubsucker is mostly small invertebrates living on the substrate. However, the terminal mouth of the creek chubsucker suggests that it may feed less on the bottom than other species of suckers.

The habitat near the Fermi site is not an ideal habitat for the creek chubsucker. However, many populations remaining in Michigan have adapted to non-traditional habitats (Carman, 2007).

Silver shiner-*Notropis photogenis*

The silver shiner is listed as endangered by the state of Michigan. This species ranges from the Great Lakes and their tributaries, through the Ohio River basin and Tennessee drainage, to northern Alabama and Georgia. This shiner is fairly common within most of the Ohio River basin, but occurs more rarely in the Great Lakes' tributaries. Within Michigan it is locally abundant in the St. Joseph and Raisin Rivers. Historically, the silver shiner had been identified in Monroe County and the Huron River.

Preferred habitat for the silver shiner is medium to large streams with moderate to high gradients. They are often found in the deeper water pools or eddies directly below riffles. This species has been documented to prefer a variety of substrates, including gravel and boulder, pebble and cobble, and sand, mud and clay. Despite the disputes over substrate, it is agreed that silver shiners avoid areas with heavy vegetation and siltation. In Michigan, the shiner has been found to inhabit areas of strong current with wooded banks.

Reproduction of silver shiners is not well documented, due to the fact that spawning behavior has not been observed. Silver shiners are theorized to spawn around June, and may move into different habitats to do so. The juvenile shiners exhibit rapid growth, reaching sexual maturity at age two, and maximum size by age three.

Although the silver shiner primarily feeds at the surface, it will take mid-water prey as well. The majority of the silver shiner's prey are aquatic insects, with adult *Diptera* (true flies) representing the largest portion of gut samples. Silver shiners have even been documented as leaping into the air to capture low-flying insects.

The silver shiner is relatively rare in Michigan and is fairly tolerant to human impact. Populations appear to be stable (Carmen 2007). Previous impingement studies have not recorded this species, thus impingement is expected to be minimal.

Pugnose minnow-*Opsopoeodus emiliae*

The pugnose minnow is listed by both Michigan and Ohio as endangered. The pugnose minnow has been documented from the southern Great Lakes basin, through the Mississippi River valley, to the Gulf of Mexico. Although common in the southeastern portion of its range, it is becoming rare in the northern portion. Historically, the pugnose minnow was documented in Michigan tributaries and nearshore areas of Lake Erie and Lake St. Clair, however the only record in the past twenty years was in the Detroit River near Grosse Isle, located approximately 15 mile northeast of the Fermi site.

The pugnose minnow inhabits the slow, clear waters of rivers and shallow regions of lakes. It is found in greatest abundance in weedy areas over sand or organic substrate. Historically, it has also been found in turbid areas of the Huron River that lacked submergent vegetation, most likely due to remnant populations changing habitats in submarginal conditions.

The life history of the pugnose minnow is not well documented. The male selects a spawning site where the female lays adhesive eggs, usually under a flat rock. Males then guard the nest, but will make excursions away, unlike bluntnose and fathead minnows. Species growth is rapid, reaching its adult size of two inches in length within two years.

The vertically-oriented mouth of the pugnose minnow suggests adaptation for feeding near the water surface. Diet studies have shown the pugnose minnow feeds on microcrustaceans, fly larvae, and other aquatic invertebrates, as well as algae and plants (Carman, 2007).

The pugnose minnow is listed in Monroe County, MI, but has not been reported in previous impingement studies, or even recorded in the last two decades.

Channel darter-*Percina copelandi*

The channel darter is listed as endangered by the state of Michigan. Its distribution extends from the upper St. Lawrence drainages, through the Great Lakes basin, and into the Ohio River basin. The darter is found primarily in the Ohio River basin, but isolated populations occur southward to Louisiana. In Michigan, the darter's range includes the nearshore areas of Lake Erie and Lake Huron. Since 1994, it has only been recorded in the Au Sable, Pine, and St. Clair Rivers in Michigan.

The channel darter's habitat includes rivers and large creeks with moderate current over sand and gravel substrate. It has also been recorded in wave-swept areas of Lake Huron and Lake Erie with coarse-sand, fine-gravel beach and sandbar substrates. The darter is usually found in deeper water, but will move into shallow water (<1 m) at night.

Flowing water is essential to channel darter spawning, which has been observed in the Cheboygan River, located north-northwest of the Fermi site, in mid-July. Males maintain a 1-meter nest station around a large rock, where the female buries herself partially to deposit her eggs. After the male fertilizes them, both parents depart the nest of adhesive eggs and provide no parental care.

Channel darters are benthic feeders whose diet is comprised of small invertebrates including mayfly and midge larvae, small crustaceans, algae, and organic debris.

The channel darter has not been recorded in Monroe County in some time, most likely due to unsuitable habitat conditions (Carman, 2007).

River darter-*Percina shumardi*

The river darter is listed as endangered by the state of Michigan. Its distribution ranges from southern Canada to the Gulf of Mexico. Historically, the river darter was found in rivers and nearshore areas of eastern Michigan, however the last report of the darter was in the Huron River in 1941, and the most recent surveys have found no records of river darters.

The river darter is found in rivers and large streams with deep, fast-flowing riffles and cobble and boulder bottoms. During nocturnal hours or when turbidity is high, the adult darters may move to shallower areas. This turbidity tolerance might explain its continued presence in the Mississippi River and its tributaries. The river darter has also been found in nearshore areas of the Great Lakes with depths approximating five meters.

The river darter tends to move upstream to spawn, toward the northern end of its range. Spawning occurs in late winter to early spring in southern areas, from April through May in the Midwest, and as late as June or July in Canada. The female darters are egg-burying spawners, expelling eggs into the substrate while partially buried. Neither males nor females provide parental care to their young. Species grow to three inches, mostly within the first year of development, and attain sexual maturity at age one. River darters are thought to live two to four years, with males having a greater life expectancy than females.

River darters tend to feed during the day upon a variety of small aquatic invertebrates. As juveniles, they primarily feed upon small zooplankton. Adult darters prey upon midge and caddisfly larvae, as well as some snail species (Carman, 2007).

Southern redbelly dace-*Phoxinus erythrogaster* (Rafinesque)

The southern redbelly dace is listed as endangered by the state of Michigan. Its total distribution ranges from the Lake Erie and Lake Michigan drainages, through the Mississippi River basin south to Alabama, Arkansas, and Oklahoma. The northern limit of this species' range is in southeastern Michigan, in the Huron and Raisin Rivers.

The southern redbelly dace generally occurs in the clear and cool permanent headwaters of river systems. It prefers clear, wooded streams intermixed with small pools. These streams are usually small, with moderate gradients and overhanging vegetation that provides ample shade. Preferred substrates include mud bottoms of pools and clean gravel of riffles.

Life history of this species has only been studied extensively in the southern portion of its range, where they spawn from April to June. Southern redbelly dace reach sexual maturity within one year at a length of about one and a half inches. The spawning fish migrate from pools to graveled riffles where they utilize nests already built by other cyprinids. Two males pressure the sides of the typically larger female who then broadcasts 700 to 1000 eggs that are immediately fertilized.

This species is generally herbivorous, feeding upon filamentous algae, diatoms, and drifting or benthic detritus. Larger fish will also feed on chironomid and mayfly larvae, as well as small invertebrates (Stagliano, 2001).

Sauger-*Sander canadensis*

The sauger is listed as a threatened species by the state of Michigan. Its native range includes the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River basins, as well as the Tennessee River in Alabama and Louisiana. The sauger has also been introduced into the Atlantic, Gulf, and southern Mississippi River drainages. This species was historically abundant in Lake Erie; however, it has only been recorded in the St. Clair River and Lake St. Clair in the past two decades.

Sauger prefer turbid areas of lakes, reservoirs, and large rivers, where the temperatures throughout the entire water column are within their preferences.

This species spawns over gravel and rubble shoals in May or June, when temperatures range from 3.9 - 6.1 degrees Celsius. Rather than building nests, the sauger broadcasts demersal, adhesive eggs over the shoals during the night. After hatching, young sauger spend up to nine days absorbing yolk while on the bottom. Males reach sexual maturity within three years, while females take four to six years. The life expectancy for the sauger is up to 13 years.

Saugers have a specialized structure in their eyes that makes them very sensitive to light. They prefer to feed at night in clearer waters or during the day in turbid areas. As juveniles, they tend to prey on zooplankton and aquatic insect larvae. Adults feed upon fish and invertebrates such as gizzard shad, emerald shiner, crappie, bass, freshwater drum, leeches, crayfish, and insects (Derosier, 2004).

Mollusks

White catspaw-*Epioblasma obliquata perobliqua*

The white catspaw mussel is state endangered and from museum specimens, it has been confirmed that it once inhabited rivers in southeastern Michigan and nearshore areas in Lake Erie. Currently, the only know viable population is in Fish Creek, Indiana. The white catspaw is a medium sized mussel, up to two inches long. The exterior shell color is tan with many fine wavy green rays. Little is known of their required habitat because this species is so rare.

This mussel prefers coarse, stable substrates, such as gravel and pebble and is typically found buried in the substrate. The exact breeding season is unknown, although other species of this genus typically release glochidia. The lifespan is estimated to exceed 15 years of age. The survival of the white catspaw mussel is currently in severe jeopardy. Changes in river hydrology and morphology can harm this riffle-dwelling species, and dredging, channelization and damming projects should be avoided (Natureserve, 2008).

Northern riffleshell-*Epioblasma torulosa rangiana*

The northern riffleshell is federally and state endangered. Currently, the northern riffelshell have only been found in the Black, St. Clair and Detroit Rivers. More specifically, it is found in the Detroit River in Wayne County, Michigan. The northern riffelshell is of moderate size with large adults reaching two inches. The shell is light green-yellow to olive green, with dark, narrow, closely-spaced rays. This mussel requires swiftly moving, well-oxygenated water. Riffle and run areas with fine to coarse gravel are the preferred habitats. It is believed that this species can reach 15 years of age. The northern riffelshell is graved from late summer to the following spring, at which time the glochidia are released. The Detroit River may still have a viable reproducing population despite human impacts and zebra mussel infestation in the river. In 1992, 110 mussels were transplanted from the Detroit River to the St. Clair River. The survival of this species depends on the protection and preservation of habitat and host fish. Siltation and run-off must be reduced to facilitate the recovery of this species (Natureserve, 2008).

Snuffbox-*Epioblasma triquetra*

The snuffbox mussel is state endangered and can be found in Otter Creek in Monroe County and the Detroit River in Wayne County. The snuffbox is about 2 inches in length and their shells are triangular and thick, yellowish on the outside, and covered with numerous, broken, dark green rays. It inhabits small and medium-sized rivers. They prefer habitats that contain sand, gravel, or cobble substrate with a swift current and individuals are often found buried deep in the sediment. Reproduction occurs in early to mid-August and the snuffbox lives between 8-10 years. The only host for the snuffbox glochidia is the log perch. This species is sensitive to river impoundment, siltation and disturbance, due to its requirement for clean, swift current and relative immobility as an adult (Natureserve, 2008).

Wavy-rayed lampmussel-*Lampsilis fasciola*

The wavy-rayed lampmussel is state threatened and is sporadically distributed in the Great Lake tributaries of Lake Michigan, Lake Erie, Lake Huron, and Lake St. Clair. This mussel has a rounded to ovate, moderately thick shell and is usually under 3.5 inches in length. The shell color ranges from yellow to yellowish green with numerous thin wavy green rays.

It occurs in small to medium sized shallow streams, in and near riffles, with good currents. The wavy-rayed lampmussel prefers sand and/or gravel substrate. Males and females are dimorphic.

The release of the larvae (glochidia) coincides with host fish appearing in the shallow riffles. As adults, they remain relatively sessile, probably not moving more than 100 meters in a lifetime. This mussel, like most mussels, is sensitive to river impoundment, siltation and channel disturbance. The wavy-rayed lampmussel is often the first to be affected by disturbances because this species prefers areas with moderate flow and high oxygen content. Pollution is also a great threat to this species well being (Natureserve, 2008).

Round hickorynut-*Obovaria subrotunda*

The round hickorynut is state endangered and can be found in the St Lawrence and Lake Erie/Lake St. Clair drainages, more specifically, in Lake St. Clair in Macomb County and in the Detroit River in Wayne County. This mussel has a near perfectly circular shell that is moderately thick and inflated. The exterior of the shell is brown, smooth, and lacks rays.

The round hickorynut inhabits medium to large rivers and along the shores of Lake Erie and Lake St. Clair, near the river mouths and prefers sand and gravel substrate in areas with moderate flow. It is a long-term breeder, holding fertilized eggs over the winter. The life span is unknown. Like most mussels, this species is sensitive to river impoundment, siltation and channel disturbance as well as pollution (Natureserve, 2008).

Mudpuppy mussel (salamander mussel)-*Simpsonaisa ambigua*

Historically, this species occurred throughout the upper Mississippi River drainage and as far south as the Cumberland River drainage of Tennessee. It is known from the Lake St. Clair, Lake Huron, and Lake Erie drainages; and from the Ohio River system, the Cumberland River system (Red River, Kentucky), and the upper Mississippi River system (Illinois, Iowa, Wisconsin, Missouri and Arkansas).

In Minnesota, it is present only in the lower St. Croix River where it is rare and localized. Its distribution in part is apparently related to the distribution of its glochidial host, the mudpuppy. In Canada, it is known from the Sydenham River and a potentially extant occurrence in the Thames River in London, Ontario.

The preferred habitat for this species is in sand or silt under large, flat stones in areas of a swift current. Its presence is presumably linked to the mudpuppy, *Necturus maculosus*. In Canada, the mudpuppy mussel is found in all types of clear, freshwater habitat, including creeks, streams, rivers and lakes; it is found on a variety of substrates (mud, silt, sand, gravel, cobble or boulder) in areas of swift current.

The host of this species is the mudpuppy. It is suspected "that *necturus* eats the adult mussel and in seeking food visits one rock after another. In satisfying its appetite it becomes infected with the mussel glochidia, nourishing them, and when they have matured serves as a transporting and distributing agent for the young mussels." Glochidia were found deeply imbedded in the external gills of the mudpuppy. There is some evidence that the glochidia are released in the fall (Natureserve, 2008).

Purple lilliput-*Toxolasma lividus*

The purple lilliput is state endangered. Spent shells have been found from sites in the Raisin River in Monroe Country. It is a small mussel, growing to a little over an inch in length. The shell is smooth, but with growth lines and is light to dark green or brown. The purple lilliput occurs in small to medium sized streams, less often in large rivers and lakes.

This species' preferred substrate is well-packed sand or gravel and occurs in water depth less that one meter. It is a long-term breeder, holding the larvae internally for about a year; however, their life span in unknown. The purple lilliput requires clean water for survival, therefore any practice that leads to siltation, pollution, or poor water quality should be avoided (Natureserve, 2008).

Mudpuppy mussel (salamander mussel)-*Simpsonaisa ambigua*

Historically, this species occurred throughout the upper Mississippi River drainage and as far south as the Cumberland River drainage of Tennessee. It is known from the Lake St. Clair, Lake Huron, and Lake Erie drainages; and from the Ohio River system, the Cumberland River system (Red River, Kentucky), and the upper Mississippi River system (Illinois, Iowa, Wisconsin, Missouri and Arkansas).

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Rayed bean-*Villosa fabalis*

The rayed bean was historically known from 106 streams, lakes, and some man-made canals in 10 states and 3 Service regions. The mussel occurred in parts of the upper (i.e., Lake Michigan drainage), lower Great Lakes system, and throughout most of the Ohio and Tennessee River systems. Historically this species was known in Canada from the Thames, Sydenham, and Detroit Rivers and western Lake Erie in southwestern Ontario, but only still extant in the Sydenham and possibly the North Thames in Ontario where a live specimen was found in 2004. A new site was recently discovered in Swan Creek (Lower Maumee drainage) in Ohio.

The rayed bean is reported to be a long-term breeder in that it holds glochidia overwinter for spring release. Gravid females have been collected during mid to late May. The glochidial fish hosts include the Tippecanoe darter.

The rayed bean is generally known from smaller headwater creeks, but records exist in larger rivers. They are usually found in or near shoal or riffle areas, and in the shallow wave-washed areas of glacial lakes, including Lake Erie. In Lake Erie, it is generally associated with islands in the western portion of the lake. Substrates typically include gravel and sand. It is oftentimes associated with vegetation (e.g., water willow, *Justicia americana*; water milfoil, *Myriophyllum* sp.) in and adjacent to riffles and shoals. Specimens are typically buried among the roots of the vegetation (Naturserve, 2008).

Purple wartyback-*Cyclonaias tuberculata*

This species is state listed as special concern. The purple wartyback has a roughly circular outline with numerous bumps covering about ¾ of the outside of the shell. The outer covering of the shell is yellow-brown or green-brown in young individuals, becoming dark brown in older individuals. The purple wartyback is found in medium to large rivers with gravel or mixed sand and gravel substrates in areas with relatively fast current. Like most freshwater mussels of the family Unionidae, this species requires a fish host to complete it's life cycle. The purple wartyback is a summer breeder and are likely to live over 25 years of age.

Threats to this species include habitat and water quality degradation from changes in water temperature and flow, the introduction of heavy metals, organic pollution such as excessive nutrients from fertilizers, pesticides and herbicides, dredging and increased sedimentation due to excessive erosion. Due to the unique life cycle of unionids, fish hosts must be present in order for reproduction to occur. The loss of habitat for these hosts can cause extirpation of unionid populations (Naturserve, 2008).

Slippershell mussel-*Alasmidonta viridis*

This species is of state special concern. The slippershell mussel is a small mussel, usually around one and a half inches long. The exterior of the shell is yellowish-brown, marked with fine green rays. The slippershell is typically found in creeks and headwaters of rivers, but has also been reported in larger rivers and in lakes. The slippershell mussel requires a fish host to complete its life cycle. The slippershell is probably a long-term (bradytictic) breeder, holding the larvae internally for about a year. These larvae (glochidae) then are released into the water and mush attach to a suitable fish host in order to survive. After development, it drops from its host and spends the remainder of its life in the substrate. The lifespan is unknown. This mussel is a filter feeder.

The slippershell mussel requires clear, clean water and substrates for survival. Therefore, any practices that lead to increased siltation and poor water quality will decrease the quality of the habitat of the slippershell. Also, since the slippershell cannot reproduce unless its fish host is present, conservation efforts should aim to maintain the composition of associated fish communities (Naturserve, 2008).

Life Histories for Commercially and Recreationally Important Species

The following species are considered important species in aquatic ecosystems within the Michigan waters of Lake Erie because they are of commercial and/or recreational value. These life histories provide detailed information on any critical life-support requirements such as spawning areas, nursery grounds, food habits, feeding areas, wintering areas, and migration routes. Supplemental life history data was gathered from NatureServe wildlife database.

Fish

Common Carp-*Cyprinus carpio*

The common carp is distributed across every continent aside from Antarctica. In North America, this species can be found in each of the 48 contiguous states and throughout much of Canada. This member of the family Cyprinidae is extremely common throughout the Great Lakes region.

These fish are known to occur in rivers, lakes, ponds, reservoirs, swamps, and low-salinity estuaries; usually in shallow water with abundant vegetation and little or no current. The common carp generally does not inhabit first-order, cold streams or deep lakes with little or no littoral zone. Optimal river habitat for the carp is characterized by warm water (above 20 degrees C during the growing season, June through August), a low gradient, shallow-vegetated marshland available for spawning, pools and off-channel areas, adequate cover (brush, logs, etc.) and fertile conditions. Optimal lake habitat has warm water, aquatic/inundated vegetation for spawning, deeper waters for overwintering and fertile conditions.

Adult carps are omnivorous, relying largely on invertebrates, detritus, fish eggs and plant material as food sources. Fry feed mainly on zooplankton such as cladocerns and copepods but will consume phytoplankton if zooplankton densities are low.

Spawning occurs in spring and summer, usually in shallows and flooded areas with adequate aquatic or inundated vegetation.

Gizzard shad-*Dorosoma cepedianum*

The gizzard shad is in the Family Clupeidae, the herring family. It is distributed through the mid to eastern region of the United States and the middle and south of Canada around the Great Lakes. As an adult, the gizzard shad will reach 9 to 14 inches in length and be up to two pounds. This fish can thrive in a wide variety of habitats including large rivers, reservoirs, lakes, swamps, bays, sloughs, and similar quiet open waters. Young and juveniles live in the more clear and shallow waters versus adult gizzard shad that stay in deeper waters, near the bottom.

These fish spawn at night during the spring and summer in shallow waters over rocky substrate. The eggs are scattered and adhere to objects on the bottom substrate until hatching 2 to 4 days later. The juveniles obtain sexual maturity in 2 to 3 years and have a lifespan of approximately 4 to 6 years.

Juvenile gizzard shad are planktivores, eating protozoans, small crustaceans, Chlorophyta, and Chrysophyta. Adults are primarily bottom filter-feeding detritivores, acquiring food from aufwuch assemblages in littoral areas (Natureserve, 2009).

Gizzard shad are often used by anglers as a bait fish.

Bigmouth buffalo-*Ictiobus cyprinellus*

The bigmouth buffalo is fairly common throughout North America from the Mississippi River basin stretching from Louisiana to Ohio, to southern Michigan, Wisconsin, Minnesota, North Dakota, Montana, the lower Great Lakes basin, the Hudson Bay basin (Nelson River drainage) and Saskatchewan.

This species preferred habitat is found in the main channels, pools, and backwaters of small to large sluggish rivers; oxbows, bayous, reservoirs, and lakes. The bigmouth buffalo is tolerant of low oxygen levels and high temperatures. These fish prefer to spawn after spring floods, doing so in flooded marshes and river bottoms, or in tributary streams. Eggs sink and adhere to vegetation or other objects (Natureserve, 2009).

Both juvenile and adult members of this species rely mainly on planktonic and bottom dwelling invertebrates as a food source.

Channel catfish-*Ictalurus punctatus*

Channel catfish occur mostly in the central drainages of North America, from southern Canada to northern Mexico, historically. It has been widely distributed throughout the United States as well as other countries.

This species prefers clean, well-oxygenated water of rivers and streams, but will occur in ponds and lakes as well. They occur from clear, rapid flowing waters over firm bottoms, to turbid slow moving water over mud substrates.

Channel catfish have been known to migrate hundreds of miles throughout their lifetime. They generally spawn between April and July when temperatures are about 27 degrees Celsius. Females lay up to 20,000 eggs in a nest on holes dug in sandy substrates. Males then guard and fan over the nest during the 3-8 day incubation period. Larval development lasts about two weeks, and schools of larvae may persist for weeks after leaving the nest. Sexual maturity is reached anywhere from 2-8 years, and adults may reach over 130 cm and live up to 16 years.

Juvenile channel catfish eat mainly small invertebrates and insects, and prey increasingly on crayfish and fishes as they grow. Adults are mainly piscivorous, but will feed upon insects, small mammals, and vegetation (Natureserve, 2009).

The channel catfish size make it a highly sought after sport fish. They also have significant commercial value to fisherman in Lake St. Clair and Lake Erie.

White bass-*Morone chrysops*

The white bass is a freshwater member of the sea bass family. It is distributed across the United States and eastern Canada, specifically in Lake Michigan, Lake Huron, Lake Ontario, and Lake Erie. This fish prefers open water habitat in lakes and some large rivers.

White bass spawn in spring with each female releasing between 242,000 and 933,000 eggs in shallower water, which sink and adhere to the bottom substrate. Soon after spawning, the parents abandon the eggs and move to deeper waters. The eggs hatch approximately 4.5 days later and the young fish remain in shallow water for a period of time before migrating to deeper areas. White bass usually do not live past 7 years of age. They are carnivores, eating microscopic crustaceans, insect larvae, and other fish.

It can be easily caught and is an excellent eating fishing causing it to be a highly sought after game fish.

Freshwater drum-*Aplodinotus grunniens*

This species of drum is widely distributed throughout North and Central America. It ranges from the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River Basins, Gulf Coast drainages, south through eastern Mexico and down to Guatemala.

Freshwater drum occur in a variety of habitats, but seem to prefer large, silty lakes and large rivers. They generally occur over mud bottoms in open water.

Spawning usually occurs in the spring or summer when water temperatures reach 19-22 degrees Celsius. They are generally pelagic spawners, utilizing open water far from shore, where their fertilized eggs float on the surface 1-2 days before hatching. Juvenile males generally reach sexual maturity in 2-4 years, while females take 4-6 years. Maximum life expectancy for this drum is ten years, with a growth potential of 95 cm.

Juvenile drum tend to feed upon minute crustaceans and insect larvae. Adults are mostly benthic foragers, and prey items include insect larvae, crustaceans, fishes, and bivalves (Natureserve, 2009).

Freshwater drums are harvested commercially in Lake Erie. This species is not a recreationally significant fish as anglers opinions of the species is mixed on the suitability for consumption.

Goldfish-*Carassius auratus*

Native to Eurasia, the goldfish has been introduced throughout most of the contiguous U.S. and in parts of Canada. These fish prefer still water with abundant vegetation; lakes, reservoirs, ponds, rivers and quiet streams provide suitable habitat. They have no preference for clear or turbid water.

This species usually spawns in spring and summer, preferring to do so in shallow water so that eggs can be scattered in order to stick to objects. Eggs hatch in 2-14 days, depending on temperature and individuals reach sexual maturity sometime between 9 months and 4 years of age (Natureserve, 2009).

Both adult and juvenile goldfish are classified as herbivores/invertivores. They rely mainly on aquatic insects, mollusks, crustaceans, worms and vegetation for food.

White perch-*Morone americana*

These fish belong to the family of temperate basses, a group of food and sport fish. White perch are native to the east coast but can be found in the Great Lakes area and are considered an exotic species. On the Atlantic coast they can be found in brackish waters, but have adapted to inland, freshwater lakes and tributaries. White perch prefer clear water and have no preference for substrate type.

They spawn in the spring by randomly releasing their eggs in the shallow waters of the Great Lake tributaries. Eggs sink and stick to the bottom until hatching 4 days later. After hatching the young feed on microplankton and as they grow larger feed upon aquatic insects, invertebrates, other fishes, and the eggs of other fish species (Natureserve, 2009).

Though generally regarded as undesirable as a game fish in the Great Lakes, in the Eastern United States it is considered an excellent sport fish.

Lake whitefish-*Coregonus clupeaformis*

During the late 19th and early 20th centuries, large numbers of lake whitefish entered the Detroit River each year to spawn. Whitefish prefer rock, honeycomb limestone, gravel or sand for optimal spawning conditions. Reports indicate that the lower Detroit River was a prolific spawning area prior to the construction of the Livingstone Shipping Channel. The timing of this construction coincides with the degradation of whitefish populations in the river and western Lake Erie. The primary sources of food for the lake whitefish in the Western Lake Erie Basin are two small, bottom-dwelling organisms called *Diporeia* and chironomids. Lake whitefish have a narrow temperature tolerance, requiring cold, well oxygenated bottom waters throughout the summer in order to survive. They require relatively silt-free river or lake spawning areas for successful reproduction.

Lake whitefish are recognized as an indicator of ecosystem health and are an integral component of the Great Lakes food web. Recently, populations of lake whitefish were once again discovered in the Detroit River, but further studies are necessary to ascertain their presence in other tributaries of western Lake Erie.

Little information exists regarding whitefish life history, habitat requirements, and ecological niche in Lake Erie and its tributaries including the Detroit River. The Detroit River-Western Lake Erie Basin Indicator Project, sponsored by the EPA has identified a need for the collection of life history data for the lake whitefish and incorporated this need into ongoing monitoring and restoration studies on Lake Erie and the Detroit River (Natureserve, 2009).

Quillback-*Carpiodes cyprinus*

The quillback belongs to the family Catostomidae or the sucker family. It has a wide distribution, including the Great Lakes-St. Lawrence River, Hudson Bay, and Mississippi River basins from Quebec to Alberta and south to Louisiana, west to Wyoming; Atlantic Slope drainages from the Delaware River, New York, to the Altamaha River, South Carolina, Gulf Slope drainages from the Apalachicola River, Florida and Georgia, to the Pearl River, Louisiana.

These fish are suited for both riverine and lacustrine habitats including pools, backwaters, and main channels, clear to turbid waters of creeks, rivers, and lakes. They may migrate up small streams and creeks during the spring and summer in order to find suitable spawning habitat. Both adults and juveniles can be classified as herbivores and invertivores, relying mainly on debris in bottom ooze, insect larvae and plant material for food (Natureserve, 2009).

Yellow perch-*Perca flavescens*

The yellow perch belongs to the family Percidae or the perch family. It can be found in almost all 50 states as well as most of Canada. More specifically, the yellow perch is one of the most common fishes to Michigan waters, commonly found in Lake Erie, and is assumed to occur throughout the Detroit River, Swan Creek, and Stony Creek as well. They travel in schools, generally preferring the clear shallower waters of lakes or weedy backwaters of creeks and rivers. Yellow perch usually grow 6 to 10 inches in length and weigh between 6 and 16 ounces.

This species spawns in the spring in shallower waters over submerged beds of aquatic vegetation or over sand, gravel, or rubble. Eggs hatch in 10 to 20 days with males reaching sexual maturity at 2-3 years and females at 3-4 years. Their maximum lifespan is 10 years. Larvae and young yellow perch primarily feed upon zooplankton and as adults feed among plants, invertebrates, and other fishes.

Primary food sources for the yellow perch include mayfly larvae, caddisfly larvae, amphipods, chironomids, and zooplankton. This species feeds actively year round, leading the yellow perch to be recreationally targeted not only in warmer months, but also by ice fisherman in the winter. These large bodied, large-finned panfish have the distinction of being the most frequently caught game fish in Michigan.

In the late 1980's and early 1990's, after a 40 year absence due to pollution and eutrophication, large benthic invertebrates including mayfly larvae, caddisfly larvae, and amphipods recolonized western Lake Erie. When burrowing mayflies began to recolonize the lake as water quality improved, the yellow perch population began to rebound as well. Of high value economically, the yellow perch is also an indicator of water quality and ecological conditions on Lake Erie. Yellow perch are also beneficial because they feed on the round goby, a non-native, invasive species (Natureserve, 2009).

Walleye-*Sander vitreus*

Walleye are the largest member of the perch family. They can be found in all the Great Lakes as well as across the central-east United States and up into Canada. It ranges in length from 13 to 25 inches and weighs 1 to 5 pounds. Walleye can be found in a variety of large bodies of freshwater including lakes, pools, backwaters, rivers and flooded marshes. They prefer deep waters and avoid bright light.

This species spawns in late spring or early summer in turbulent rocky areas in rivers, coarse gravel shoals in lakes or flooded marshes. Eggs are dispersed, then abandoned and will hatch approximately 26 days later. It has been documented that adults may migrate up to 160 km between spawning habitat and non-spawning habitat. Male juvenile walleye will reach sexual maturity in 2 to 4 years and females 3-8 years. Young walleye up to 6 weeks of age mainly eat copepods, cladocera, and small fishes while adults feed upon fishes and larger invertebrates (Natureserve, 2009).

This popular game fish can be caught year round in the Great Lakes and it sought for its excitement to catch and its favorable taste.

Largemouth bass-*Micropterus salmoides*

The largemouth bass is widely distributed throughout North America, from the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River basins, as well as the Atlantic drainages from North Carolina to Florida, to northern Mexico. This popular gamefish has been introduced widely throughout the United States and the rest of the world, where it is sometimes considered to have had adverse ecological impacts.

This bass will inhabit clear waters of lakes, ponds, reservoirs, and swamps. Largemouths may also be found in the pools or backwater areas of creeks and rivers. They are usually associated with muddy bottoms and aquatic vegetation as well.

Largemouth bass spawn in spring and summer when the water temperature reaches at least 15 degrees Celsius. Males become aggressive and territorial as they dig nests in shallow water. After the female deposits eggs in the nest, the male guards and fans the eggs, which hatch within five days. The hatchlings will reach sexual maturity in 2-5 years, and may attain sizes of nearly 100cm with a life expectancy up to 23 years.

This species feeds mainly upon zooplankton as fry. As the juvenile grows it begins to prey upon insects, crustaceans, and fish fry. Adults are mainly piscivorous, but will feed upon crawfish and frogs as well. Largemouth bass have also been shown to be cannibalistic and do not feed while spawning (Natureserve, 2009).

The largemouth bass is a major sport fish in the Great Lakes. It's excellent fighting ability and good taste makes it a valuable resource for recreational fishing.

Smallmouth bass- *Micropterus dolomieu*

The smallmouth bass is widely distributed throughout North America, from the St. Lawrence-Great Lakes, Hudson Bay (Red River) and Mississippi River basins from southern Quebec to North Dakota and south to northern Alabama and eastern Oklahoma. This gamefish has been widely introduced throughout U.S., southern Canada, and in other countries.

This species prefers large clear lakes (especially in north) and clear midorder streams and rivers with many large pools, abundant cover (rocks, shelves, logs, etc.), and cool (20-27 C) summer temperatures. While individuals living in lacustrine habitats prefer shallow waters, adults are known to seek shelter of pools or deep water during the day.

Smallmouth bass spawn in shallow water in lakes or quiet areas of streams. In some situations, lake populations may move a short distance up a stream to spawn. Eggs are laid in nests made by the male, usually on a gravel or sand bottom at depth of about 1 m (less than 4 m) near protective cover.

This bass relies mainly on crustaceans and aquatic insects as a food source (e.g., chironomid larvae and pupae) until they are about 5 cm in length, when they start feeding heavily on other fishes. Crayfish, amphibians, and insects often become dominant foods of local populations or seasonally. Adults rely almost entirely on other fishes as prey as long as their availability is adequate (Natureserve, 2009).

The smallmouth bass is a popular sport fish in the Great Lakes area.

Rainbow trout-*Oncorhynchus mykiss*

The rainbow trout is widely distributed throughout North America, from streams along the Pacific coast to the Great Lakes region. It can be found in almost every state in the lower 48 and throughout most of Canada.

This fish is capable of surviving in a wide range of habitats, typically preferring areas where dissolved oxygen concentration is at least 7 ppm. Anadromous populations occur in coastal rivers whereas some resident populations now inhabit small headwater streams, large rivers, lakes, and reservoirs. These fish often inhabit cool clear lakes and cool swift streams with silt-free substrate and deep low velocity pools for wintering habitats.

Rainbow trout usually spawn in the spring and summer months, depending upon water temperature. Lake populations will usually move to streams for spawning where eggs are laid in a gravel depression made by the female. With a normal life-span of 5-6 years, a single anadromous rainbow trout might migrate hundreds of miles from the coast into the headwaters of a stream.

In lakes, these fish feed mostly on bottom-dwelling invertebrates and other small organisms such as aquatic insects, amphipods, insects, worms, fish eggs and, occasionally, small fish and plankton. In streams, they tend to feed primarily on drift organisms. Rainbow trout might occasionally ingest aquatic vegetation (likely in effort to consume attached invertebrates).

Rainbow trout are an important game fish throughout North America (Natureserve, 2009).