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Boat Electrofishing Survey of the Fish Assemblages in the St. Clair River, Ontario

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ABSTRACT

Fisheries and Oceans Canada conducted a boat electrofishing survey in the St. Clair River Area of Concern (AOC) in 2004. Sampling replicated, in part, a 1994 Remedial Action Plan (RAP) survey by the Ontario Ministry of Natural Resources. The 2004 survey was conducted primarily to assess changes in fish assemblages and associated Indices of Biotic Integrity (IBI) since the 1994 survey and, secondarily, to examine seasonality changes in fish assemblages. Cluster analysis of annual relative abundance values demonstrated some dissimilarity in the fish assemblage between 1994 and 2004. There was no significant difference between the overall 1994 and 2004 IBI scores; however, there was noticeable variation in individual site IBI scores between the years. To examine seasonal trends in the fish assemblage, DFO sampled the St. Clair River in 2004 during June, July and October. Seasonal trends with respect to relative abundance were observed for many species, such as alewife and rainbow smelt. IBI scores calculated for each month did not differ significantly, although individual site scores demonstrated some variation over the three sampling periods.

Pêches et Océans Canada a mené une étude au moyen d'une embarcation de pêche à l'électricité dans le secteur préoccupant de la rivière Saint-Clair en 2004. L'échantillonnage répétait, en partie, une étude du plan d'assainissement de 1994 effectuée par le ministère des Richesses naturelles de l'Ontario. L'étude de 2004 visait, dans un premier temps, à évaluer les changements dans les assemblages de poissons et les indices d'intégrité biotique (IIB) connexes depuis l'étude de 1994; dans un deuxième temps, elle avait pour but d'examiner les changements de la saisonnalité dans les assemblages de poissons.
Une analyse typologique des valeurs annuelles de l'abondance relative a démontré une certaine dissemblance dans l'assemblage de poissons entre 1994 et 2004. On n'a noté aucune différence importante entre les valeurs globales de l'IIB de 1994 et de 2004; on a toutefois observé une variation notable dans les valeurs de l'IIB des sites individuels entre les années. Pour examiner les tendances saisonnières dans l'assemblage de poissons, le MPO a échantillonné la rivière Saint-Clair en 2004 durant les mois de juin, juillet et octobre. Des tendances saisonnières afférentes à l'abondance relative ont été observées pour de nombreuses espèces, telles que le gaspareau et l'éperlan. Les valeurs de l'IIB calculées pour chaque mois ne différaient pas de façon importante, quoique les valeurs des sites individuelles aient présenté une certaine variation au cours des trois périodes d'échantillonnage.

1.0. INTRODUCTION

Sampling large rivers, such as the St. Clair River, presents many logistical and technical challenges due to deep water and strong currents. The St. Clair River runs for 64 km from Lake Huron to Lake St. Clair (GLIN 2005). At its widest point, it is more than a kilometre wide and flow rates average 5710 cms. Although large rivers are more difficult to sample, they are often the most ecologically and economically important systems and are usually the water courses that receive the greatest amount of human impact and degradation (USGS 1997).

Great Lakes Areas of Concern (AOCs) are highly degraded geographic areas within the Great Lakes basin. The St. Clair River AOC extends the entire length of the river from Lake Huron to Lake St. Clair and includes the north shore of Mitchell's Bay on Lake St. Clair, the St. Clair Flats from St. John's Marsh in the west, to the southern tip of Seaway Island (Environment Canada 2004). The International Joint Commission (IJC) Water Quality Board defines an AOC as an area where there is a known impairment of a beneficial water use (MacLennan and Hyatt 1996). An impaired beneficial use is described as an impairment of an environmental feature such as public beaches, drinking water, or fish and wildlife populations that bring economic, sociological and recreational benefits to society (MacLennan and Hyatt 1996). Loss of fish and wildlife habitat was identified as an impaired beneficial use for the St. Clair River AOC, with habitat having been lost to dredging, draining, filling and bulk heading for industrial, urban, agricultural and navigational uses (Dutz 1998). Remedial Action Plans (RAPs) were developed for each AOC to identify specific problems within the AOC and to describe methods for correcting these problems (GLIN 2005).

Fisheries and Oceans Canada (DFO) conducted a boat electrofishing survey of the St. Clair River in 2004. This study replicated, in part, a 1994 RAP survey performed by the Ontario Ministry of Natural Resources (OMNR). The 1994 survey was one monitoring component of the RAP Program within the St. Clair River AOC. The 2004 DFO survey was conducted primarily to assess changes in fish assemblages and associated Indices of Biotic Integrity (IBI) since the 1994 survey and, secondarily, to examine seasonality changes in fish assemblages. The sites were sampled three times over two day periods during June, July and October. Eight sites were sampled within a 50 km reach of the St. Clair River and were distributed between the Blue Water Bridge, Sarnia and downstream to the confluence of Marshy Creek, immediately upstream of Port Lambton (Figure 1).

2.0. METHODS

2.1. ELECTROFISHING TECHNIQUES

Electrofishing was performed using a 6.35 m Model SR-20 Smith-Root electrofishing boat equipped with a Model 7.5 kW Smith-Root generator, 7.5 GPP control box, three kick plates and dual foot pedals. Sampling data recorded at each site included capture method, sampling effort, electrofishing settings and a description of the sampling equipment. Two netters retrieved stunned fishes as they appeared and all fishes were transferred from the river into a live-well within the boat. Species were identified, counted and released. Minimum and maximum lengths were recorded for all species captured. Voucher specimens were kept for lab verification at a later date.

2.2. SAMPLING OF 2004 SITES

Each sampling site (e.g. SCR04141004001) contained two separate sub-sites, an upstream site and a downstream site. These sites were denoted with 'A' for the upstream site and 'B' for downstream site (e.g. SCR04141004001A and SCR04141004001B) (Appendix 1). Each sampling site consisted of one sampling transect which was sampled twice on the same day. Sampling runs were performed travelling upstream along the OMNR 1994 transects. Upon completion of electrofishing, all fishes were processed before beginning the next sub-site. All sites were sampled between the hours of 0800 h and 1600 h to minimize the influence of diurnal effects on fish movement. Each sampling run was approximately 500 m in length and was sampled for approximately 500 s. For simplicity, each site was numbered one through eight for this report (Appendix 1).

2.3. HABITAT DATA COLLECTION

Habitat at each of the 2004 sites was described by recording air temperature, water temperature, conductivity, Secchi depth, stream width, maximum stream depth, distance from shore, maximum sampling depth, flow rate and aquatic vegetation. Habitat data were recorded upon completion of electrofishing at each transect.

2.4. ANALYZING THE DATA

2.4.1. 1994 vs. 2004

To assess changes in the fish assemblage since the 1994 OMNR survey, the 1994 data were compared to the 2004 data.

To evaluate the health of the aquatic ecosystem the OMNR calculated the Index of Biotic Integrity (IBI) for each 1994 site, using Hamilton's adaptation (MacLennan and Hyatt 1996) (Appendix 2). The OMNR used the same trophic guild classification system (Appendix 3) as Hamilton except in cases where Hamilton had not reported or classified a species, in which case they classified the species according to feeding habits as reported in Scott and Crossman (1973) and Whitehead *et al.* (1986) (MacLennan and Hyatt 1996).

IBI scores for the 2004 sites were calculated using the same adaptation. DFO used the same trophic classification as the OMNR. New species collected in 2004 and not classified by the OMNR in 1994 were classified according to Coker *et al.* (2001) (Appendix 3).

IBI scores for 1994 and 2004 data were also re-calculated using a slightly modified IBI scheme (Appendix 4) and an updated trophic guild classification scheme (Appendix 5) based on Coker *et al.* (2001). The reason for re-calculating the IBI scores was to determine what effect, if any, the above changes would have on the IBI. These new IBI scores were not used to assess the changes in aquatic ecosystem health between 1994 and 2004.

2.4.2. June, July and October 2004

The Margalef's Diversity Index (MI) (Green 1979) was calculated to compare species diversity across sites, for each month sampled.

As with the annual data, the health of the aquatic ecosystem over the seasons was assessed using Hamilton's adaptation of the IBI and the trophic classification system used by the OMNR. New species collected in 2004 were classified according to Coker *et al.* (2001) (Appendix 3). IBI scores for 2004 data were re-calculated using the modified IBI scheme and updated trophic classification scheme mentioned previously. This was done to determine possible effects the changes would have on the IBI. The new IBI scores were not used to assess changes in aquatic ecosystem health between seasons.

2.4.3. Statistical Analysis

The data for seasonal and annual sites was not normally distributed; therefore, non-parametric tests were used to test for significance. The Mann-Whitney U Test was used to analyze differences in the annual IBI scores, and the Kruskal-Wallace Test was performed on the seasonal IBI scores. These tests were performed on both versions of the IBI to determine whether the results differed.

Cluster analysis was performed on seasonal and annual relative abundance values to visually determine how similar the fish assemblages were over these periods.

3.0. RESULTS

3.1. SAMPLING EFFORT

DFO 2004 sampling efforts yielded a total catch of 2424 fishes, with 664, 740 and 1020 individuals caught in June, July and October, respectively (Table 1). The mean number of fishes captured per site was 83 in June, 92.5 in July and 127.5 in October (Table 1). The minimum number of fishes captured at one site was five (Site 2) in June, ten at Site 8 in July and 43 at Site 8 in October (Table 1, Appendix 6). The maximum number of fishes observed during June sampling was 272 (Site 4), 292 were caught at Site 3 in July, while 310 were caught at Site 1 in October (Table 1, Appendix 6).

Electrofishing sampling effort was comparable between all sites. Mean sampling effort was 32.5 minutes (June), 29.38 minutes (July) and 32.9 minutes (October) of electrofishing time per site (Table 2). Total effort expended among all sites was 259.98 minutes (June), 235.07 minutes (July) and 263.2 minutes (October) (Table 2). Catch per unit effort (CPUE) was 3.28 fishes captured per minute of sampling effort for all three sampling periods (Table 2). The mean CPUE for June sampling was 2.75, while for July it was 3.14. The mean CPUE was highest for October with 3.94 fishes captured per minute of sampling effort (Table 2). Individual site CPUEs for each month are summarized in Appendix 7 and a summary of sampling effort is found in Appendix 8.

3.2. FISH ASSEMBLAGE SAMPLING

During the 2004 DFO surveys of the St. Clair River, 36 species were caught in June, and 33 species were caught in July and October (Tables 3 and 4). Ten unique species were seen in June and four unique species were detected in July and October (Table 4). There were 18 species in common between the three sampling times and the total species richness (SR) was 36 (Table 4). Individual site SR values are in Appendix 9. Spotted sucker (*Minytrema melanops*) (scientific and common names according to Nelson *et al.* 2004, and listed in Appendix 10), a species designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2004), was detected during the July and October sampling periods (Table 3). Two specimens from the genus *Ictiobus*, also of Special Concern, were caught in the October sampling period (Table 3).

In June, the MI ranged from 1.37 (Site 6) to 9.04 (Site 4), while in July, Site 7 and Site 8 had the highest and lowest MI scores, respectively. The highest MI in October was observed at Site 7 (7.64) and the lowest at Site 3 (4.45) (Table 5).

2004 IBI – Original OMNR Method

In June, Site 2 had the lowest IBI score (10, Very Poor), while Site 1 had the highest IBI with a score of 30 (Fair to Good). In July, Site 2 had the lowest IBI score (11, Very Poor) and Site 4 had the highest (29, Fair). Site 1 had the highest IBI score in October, with a score of 26 (Fair), while Sites 5 and 6 tied for the lowest IBI, 17 (Very Poor to Poor) (Table 6, Appendix 11).

2004 IBI – Re-calculated

In June, the IBI score for Site 2 remained the same (10, Very Poor), the lowest of all the sites. Site 4 had the highest IBI score (23, Poor). Site 8 had the lowest IBI score (9, Very Poor) in July, and Sites 3 and 4 had the highest IBI score (23, Poor). In October, Site 8 had the lowest IBI score (14, Very Poor) and Site 1 had an IBI score of 23 (Poor), the highest of all the sites (Table 6, Appendix 12).

1994 IBI – Re-calculated

In August 1994, Site 8 had an IBI score of 13 (Very Poor), the lowest of all the sites, and Site 1 had the highest score, 23 (Poor) (Table 7, Appendix 13). The original IBI scores for 1994 sites are presented in Appendix 14.

3.3. STATISTICAL ANALYSIS

The IBI scores for June, July and October 2004 did not differ significantly from each other when calculated using the OMNR method ($H=0.515_{0.05,2}$;$p>0.05$), or the modified IBI scheme ($H=0.369_{0.05,2}$;$p>0.05$). Similarly, the IBI scores for 1994 and 2004 did not differ significantly from each other using either IBI method (OMNR method ($U=18_{0.05,(2)8,8}$;$p>0.05$); modified method ($U=19_{0.05(2)8,8}$;$p>0.05$)).

Cluster analysis of seasonal relative abundance values demonstrated that there was no strong seasonal trend in the fish assemblages (Figure 2). Cluster analysis of annual relative abundance values demonstrated that the fish assemblages at the sites were more similar to each other within, rather than between years (Figure 3).

3.4. HABITAT SAMPLING

In June, four of the sites had 50% or less aquatic macrophytes, while the other four had no vegetation at all. Seven sites in July had 45% or less macrophyte coverage, and Site 1 had no aquatic macrophytes at all. In October, five out of the eight sites had vegetation levels of 30% or less, two sites had vegetation over at least 70%, while one had no macrophyte growth (Appendix 15). The vast majority of vegetation observed was submergent (Appendix 15).

Many of the sites sampled contained habitats with medium flow rates, and the maximum effective sampling depth at each site was typically 2 m (Appendix 15).

4.0. DISCUSSION

4.1. HISTORICAL COMPARISON: AUGUST 1994 vs. JULY 2004

In August 1994, the OMNR collected 3720 individuals representing 39 species from eight different sites along the St. Clair River. In July 2004, DFO collected 740 individuals, representing 33 species, from the same eight sites (Tables 8 and 9). The 1994 survey had 11 species unique to that time period; whereas, the 2004 survey only had five unique species (Table 9). The average number of fishes captured per site in 1994 was 465, while in 2004 it was 92.5 (Table 10). Notable differences in the number of individuals of a species caught during each sampling period include: 2562 alewife (*Alosa pseudoharengus*) in 1994 vs. 1 in 2004; 63 rock bass (*Ambloplites rupestris*) in 1994 vs. 3 in 2004; 49 largemouth bass (*Micropterus salmoides*) in 1994 vs. 0 in 2004; 41 common shiner (*Luxilus cornutus*) in 1994 vs. 0 in 2004 (Appendix 16). This last example may be a case of misidentification as there were no common shiner caught in 2004, but striped shiner (*Luxilus chrysocephalus*) were collected. It is possible that the common shiner identified in 1994 were actually striped shiner, as the distinction between the two species at the time was fairly new.

The differences in the 1994 and 2004 results may be the result of changes in the fish assemblages or the result of differences in sampling methods. One reason for the difference in the results could be the time of day that the surveys took place. OMNR sampled in the evening from 18:00 h - 24:00 h while DFO sampled during the day between 08:00 h - 16:00 h. McInerny and Cross (1996) suggested that fishes in clear water detect and avoid electrofishing boats better during the day than at night, reducing the day CPUE. The mean CPUE for the August 1994 sampling period was 11.48 compared to 3.14 in July 2004 (Table 11). The St. Clair River is a clear river with Secchi depths, on average, of at least 2 m (Appendix 15); therefore, it is likely that the electrofishing boat was visible to fishes allowing them to avoid it. Daily patterns in fish movement can also have a major impact on CPUE. Alewife undergo diel vertical migrations, moving upward in the water column at night to pursue zooplankton (Madenjian *et al.* 2003), making them more susceptible to capture by boat electrofishing. Another reason for the differences in the total number of fishes caught and CPUE between August 1994 and July 2004 may be the total effort expended over the sampling periods. OMNR spent almost 10 more minutes, on average, per site when compared to DFO 2004 sampling. The total sampling effort for OMNR was 321 minutes; whereas, DFO spent a total of 235.07 minutes electrofishing (Table 11). However, this difference in sampling effort is not enough to explain the very large difference in CPUE for each sampling period. Differences in water temperature between the two periods may have also influenced the CPUE. Unfortunately, water temperature data for the 1994 sampling period are not available; therefore, no comparison can be made.

It is important to note that all species caught in August 1994 were caught during at least one of the three sampling periods in 2004. This indicates that there was no strong sampling bias against any particular species in 2004.

There was no significant difference between the overall 1994 and 2004 IBI scores; however, there was noticeable variation in individual site IBI scores between the years. In 1992, the eight sites sampled were designated as being 'degraded', 'intermediate' or 'unimpaired' by the Ontario Ministry of the Environment (MOE) (MacLennan and Hyatt 1996). Site 8, offshore of the Canadian National Railway (CNR) yards, was chosen to represent an unimpaired fish community as it was upstream of the major industries. However, the IBI score for Site 8 during the 1994 survey was the lowest (16, Very Poor to Poor) of all the sites. In July 2004, the IBI score decreased slightly to 14 (Very Poor), and remains the second lowest (Table 7). The fast current, deep water and a steel breakwall may have created a sampling bias at Site 8 as it cannot be sampled effectively using a boat electrofishing unit. Site 8 was not an appropriate control site, as it is one of the least effectively sampled sites and cannot readily be compared to the other sites.

Site 1 was designated in 1992 as a 'degraded' site by the MOE; however, its IBI score in 1994 was higher (23, Poor) than that of the 'unimpaired' Site 8 (Table 7, Figure 4). It is worth noting that, in 1994, alewife made up approximately 93% of the catch at Site 1, which acted to inflate the IBI score. In July 2004, the IBI score for Site 1 decreased by one. Sites 2-7 were designated as 'unimpaired' or 'intermediate'. The IBI scores for Sites 3, 4 and 7 remained the same or increased (Site 4) from 1994 to 2004 (Table 7, Figure 4). In 2004, IBIs for Sites 2, 5 and 6 decreased sharply from the 1994 survey, with Site 2 showing the most precipitous drop from 22 (Poor) to 11 (Very Poor) (Table 7, Figure 4). The fast current combined with daytime sampling in 2004 may have played a role in the decrease; however, it is unlikely these are the only contributing factors. Site 6 had the next largest decline in IBI score, from 25 (Fair) to 15 (Very Poor) (Table 7, Figure 4). In 1994, this site was described as having medium amounts of submergent vegetation and extensive amounts of emergent vegetation and a gravel/sand substrate. In 2004, there was very little vegetation and the substrate was 100% sand. The current, in 1994, was described as medium while in July 2004 it was described as slow. It is possible that sand has been deposited at the site over the intervening years, perhaps making it unsuitable for large amounts of vegetation. This lack of habitat diversity may have contributed to the drop in IBI for Site 6. However, parameters such as flow rate and percent vegetation are somewhat subjective when measured qualitatively, which should be taken into account when looking for trends over time.

4.2. INTER-SEASONAL COMPARISON: JUNE, JULY AND OCTOBER 2004

To examine the effects of seasonality on the fish assemblage, DFO sampled the St. Clair River in 2004 at three different times. Seasonal variation in species composition is dependent on the ecological requirements of individual species such as temperature range, habitat and food. When the catch data for the DFO 2004 sampling period were examined, seasonal trends in numbers caught were seen in numerous species (Appendix 6). High numbers of alewife and rainbow smelt (*Osmerus mordax*) were caught in October, likely due to water temperatures in October averaging closer to the preferred temperature of 11-15 °C for alewife (Brandt *et al.* 1980) and 7-15 °C for rainbow smelt (Scott and Crossman 1973). During June and July, it is likely that the alewife and rainbow smelt inhabited the deeper, cooler waters. October was the only month during the 2004 sampling that brook silverside (*Labidesthes sicculus*), a warmwater species (Coker *et al.* 2001), was captured; the majority of which were caught at Site 4, upstream and downstream of the Lambton Generating Station (LGS) (Appendix 17). The downstream segment (outflow of LGS) of this site had the highest temperature (17.3 °C) of any other site in October (Appendix 15), resulting in brook silverside congregating in higher densities at this location. Twenty-nine smallmouth bass (*Micropterus dolomieu*) were caught in June (the majority at Site 1), but only eight and five were caught in July and October, respectively (Appendix 6). Smallmouth bass spawn in spring, mainly during the months of May and June (Scott and Crossman 1973); therefore, it is possible that the high numbers seen in June are a result of individuals congregating to spawn. In July, 176 shorthead redhorse (*Moxostoma macrolepidotum*) were netted, while in June and October only 35 and 15, respectively, were caught (Appendix 6). Aside from the warmer water (average July water temperature was 22.09°C) that the shorthead redhorse prefers (Scott and Crossman 1973), it is unclear as to why there is such a large difference in numbers. Two individuals from the *Ictiobus* genus were captured only in October 2004. They had subterminal mouths and were not bigmouth buffalo (*Ictiobus cyprinellus*), a species of Special Concern (COSEWIC 2004). Tissue samples were taken from the *Ictiobus* specimens and sent for DNA analyses, as distinguishing between the smallmouth buffalo (*Ictiobus bubalus*) and the black buffalo (*Ictiobus niger*) (another species of Special Concern (COSEWIC 2004)) is difficult. It is not clear why *Ictiobus* were not collected in June or July. Another species of Special Concern detected during the 2004 sampling, spotted sucker, has a limited distribution in Canada and is found only in the drainages of lakes St. Clair and Erie (COSEWIC 2004). No spotted suckers were seen in June; however, five were caught in July, and 12 in October (Appendix 6). More than half the specimens caught in October were caught at Site 4, at the LGS (Appendix 6), where the water temperature was higher at the station's outflow (Appendix 15).

The CPUE values for June, July and October were comparable. June had the lowest (2.75 fish/min) and October had the highest (3.94 fish/min) (Table 2). Site 4 had the highest CPUE in the month of June (11.05) (Appendix 7) suggesting high diversity; however, 67% of the catch was comprised of one species (yellow perch (*Perca flavescens*)). Similar results were observed for Site 3 in July and Site 1 in October, where the CPUE values were high but the total catches were comprised of just a few species (Appendix 6). This supports the findings of Bayley and Austen (2002) that the CPUE cannot accurately describe fish assemblages.

The IBI scores did not differ significantly between the seasons, but individual site scores did show some variation over the seasons. The individual site IBI scores fluctuated over the three month sampling period with no discernible pattern (Table 6, Figure 5, Appendix 11). Site 1, classified as 'degraded' in 1992 by the MOE, had IBI values that were higher than many of the 'unimpaired' or 'intermediate' sites (Table 6, Figure 5, Appendix 11). Site 8, the control site, had IBI scores in June and July of 17 (Very Poor to Poor) and 14 (Very Poor), respectively. The IBI score for Site 8 did increase to 25 (Fair) in October as a result of an increase in generalist feeders, a higher species richness, and a reduction in the number of invasive species, when compared to June and July (Appendix 11).

The MI was calculated at each site for each month sampled to examine the relationship between the number of individuals caught at a site and the number of species caught per site. It is not a comprehensive index like the IBI as it only deals with one component of ecology, species diversity, but is more objective than the IBI. Conversely, the IBI deals with several other components such as trophic guild composition, individual health, abundance, as well as species diversity. In June, Site 4 had the highest MI score (9.04), and Site 6 had the lowest (1.37) (Table 5, Figure 6). Once again, Site 1, the 'degraded' site outperformed many of the 'unimpaired' or 'intermediate' sites, with an MI score of 7.63, the second highest of all the sites in June. Site 7 had the highest MI score and Site 8, the control site, had the lowest in July. In October, Sites 7 and 3 had the highest and lowest MI scores, respectively (Table 5, Figure 6).

4.3. NOTES ON THE INDEX OF BIOTIC INTEGRITY

The IBI can be a useful tool to assess ecosystem health, if applied correctly (i.e. with relevant metrics that aren't confounding or redundant (Hughes *et al.* 1998), and with standardized trophic guild classifications). The drawbacks of indices, such as the IBI, are that they cannot convey causal relationships (Hughes *et al.* 1998), and they can be difficult to interpret because of either double counting or changes in one variable that mask changes in another (EPA 2003). Hamilton's (1987) adaptation of the IBI, which used the metric 'species richness', was used to interpret the 1994 data. Hughes *et al.* (1998) suggested that a more appropriate metric would be '*native* species richness'. They did not want to confound species richness (a metric that decreases with degradation) with invasive species (a metric that often increases with disturbance) (Hughes *et al.* 1998). Depending on the number of fishes involved, trophic guild classification can have a major impact on IBI scores. In 1994, an out-of-date trophic guild classification was used in the IBI calculations. For the purpose of comparison, the same classification system was used in this study. However, IBI scores for 1994 and 2004 data were also re-calculated using a slightly modified IBI classification scheme (Appendix 4), as well as a new trophic guild classification system (Appendix 5). The new IBI classification scheme altered the 'naturally spawned salmonid and coregonid species' metric to include only *native* naturally spawned salmonid and coregonid species. The new trophic classification system was based on Coker *et al.* (2001). The re-calculated IBI scores for 1994 and 2004 data are in Tables 6 and 7, and Appendices 12 and 13, respectively.

Although there was no overall significant difference between August 1994 and July 2004 IBI scores calculated using the modified IBI scheme, the scores did drop at almost every site for both 1994 and 2004. The IBI scores for the 1994 data were lower at every site except for Site 1, where the score remained the same (Table 7). The overall IBI score for 1994 dropped from 34 (Good) to 27 (Fair). Similar results were seen for the 2004 data (June, July and October). The re-calculated IBI scores did not differ significantly from each other; however, a pattern of decreasing scores was observed. IBI scores at almost every site were lower using the new classification system (Table 6). Overall IBI scores for all sites in June, July and October decreased from 30, 28 and 32 to 22, 23 and 23, respectively (Table 6). The variation in IBI scores using the two different methods highlights the impact that the trophic guild metric can have when it is used in the IBI; therefore, it is important to use a classification system that is based on the most current information available.

The IBI classification scheme used by OMNR in 1994 incorporated a metric that counted the number of hybrids, fish(es) with lamprey scars or diseases, as well as invasive species. Only invasive species richness was used to calculate this metric, as data regarding hybrids and diseased/scarred fish were not recorded during either sampling period. Had these data been recorded and included in the IBI calculations, the IBI scores may have been affected for both periods.

Regarding metric and index scoring, Hamilton (1987) scored the metrics as 0, 1, 3 or 5; whereas, Minns *et al.* (1994) suggested that an index based on a continuous scoring system of 0.0-100.0 for the IBI and 0.0-10.0 for the metrics is more preferable. This method of scoring reduces the variance when metric values ≤ 1 are scored as different categories, and should make IBIs less variable and more easily understood (Hughes *et al.* 1998).

The IBI scores at these sites may not give a complete picture of the integrity of the aquatic ecosystem because of sampling bias. Boat electrofishing is most effective at depths of ≤ 2 m. In deeper water, benthic species may not be properly represented in the sample. Also, IBIs for individual months can be affected by seasonal migrations of various species; therefore, it may not be valid to compare IBI scores between months, but to compare them for the same season between years.

Limited time and funds make it hard to effectively sample a river as large as the St. Clair, which requires the use of different gear types and a large number of sample sites to get a comprehensive picture of the fish assemblages. In large rivers, where obtaining representative samples of the fish community can be difficult, it may be useful to use other taxa such as benthic invertebrates that are less mobile than fishes, to evaluate the health of the ecosystem. Ideally, as suggested by Karr (1981), biological monitoring programs should be based on an integrative approach involving the evaluation of more than one major taxa.

5.0. RECOMMENDATIONS

True estimates of species richness and indices, such as IBI, using boat electrofishing techniques are difficult. The use of different gear types could allow a more accurate calculation of the IBI, as well as estimating true species richness and describing fish populations (Pugh and Schramm 1998, Colvin 2002, Hughes *et al.* 2002, Mandrak *et al.* unpubl. data).

Future sampling of the St. Clair River should incorporate an assortment of active and passive sampling methods. Active sampling methods include boat electrofishing, boat seining (1/4" mesh) and manual seining (1/4" mesh) (N.E. Mandrak, unpubl. data). Passive sampling methods include hoopnets and trapnets with small diameter mesh (1/4") (Mandrak *et al.* unpubl. data). Trawling techniques should be considered within deep riverine habitats (>2 m deep) to seek out benthic fishes (e.g. darters and madtoms). Any further sampling of the St. Clair River should include sampling during both day and night in order to get a more accurate representation of the fish assemblage.

As well as the additional sampling recommended above, boat electrofishing using the same effort as previously undertaken, must be done to examine trends in IBIs over time, including earlier time periods.

6.0. ACKNOWLEDGEMENTS

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Table 1. Summary of DFO 2004 catch data for the St. Clair River.

Catch Data	June	July	October	Total
Total Fishes Captured	664	740	1020	**2424**
Mean Number of Fishes Captured/Site (sub-site A+B)	83	92.5	127.5	**101**
Minimum Number of Fishes Captured (among sites)	5	10	43	
Maximum Number of Fishes Captured (among sites)	272	292	310	

Table 2. Summary of DFO 2004 sampling effort on the St. Clair River.

Sampling Effort	June	July	October	Average
Mean CPUE (catch/min)	2.75	3.14	3.94	**3.28**
Mean Effort/Site (sub-site A+B) (min)	32.5	29.38	32.9	**31.59**
Total Sampling Effort (min)	259.98	235.07	263.2	**252.75**

Table 3. Species captured by DFO in 2004, St. Clair River.

Legend	Present	Absent

Scientific Name	Common Name	June	July	October
Alosa pseudoharengus	alewife		Present	Present
Ambloplites rupestris	rock bass	Present	Present	Present
Amia calva	bowfin		Present	
Aplodinotus grunniens	freshwater drum	Present	Present	Present
Carpiodes cyprinus	quillback		Present	
Catostomus commersonii	white sucker	Present	Present	Present
Coregonus sp.	whitefish sp.	Present		
Cottus bairdii	mottled sculpin	Present		
Cyprinella spiloptera	spotfin shiner		Present	
Cyprinus carpio	common carp	Present	Present	Present
Dorosoma cepedianum	gizzard shad		Present	Present
Esox lucius	northern pike			Present
Etheostoma caeruleum	rainbow darter	Present		
Gasterosteus aculeatus	threespine stickleback	Present	Present	
Hypentelium nigricans	northern hog sucker		Present	Present
Ichthyomyzon unicuspis	silver lamprey		Present	Present
Ictiobus sp.	buffalo sp.			Present
Labidesthes sicculus	brook silverside			Present
Lampetra appendix	American brook lamprey	Present		
Lepisosteus osseus	longnose gar	Present	Present	Present
Lepomis cyanellus	green sunfish	Present		
Lepomis cyanellus x L. macrochirus	green sunfish/bluegill hybrid	Present		
Lepomis gibbosus	pumpkinseed	Present		
Lepomis macrochirus	bluegill	Present		
Luxilus chrysocephalus	striped shiner		Present	Present
Lythrurus umbratilis	redfin shiner		Present	
Micropterus dolomieu	smallmouth bass	Present	Present	Present
Micropterus salmoides	largemouth bass	Present		Present
Minytrema melanops	spotted sucker		Present	Present
Morone americana	white perch		Present	Present
Morone chrysops	white bass	Present	Present	
Moxostoma anisurum	silver redhorse	Present	Present	Present
Moxostoma erythrurum	golden redhorse	Present	Present	Present
Moxostoma macrolepidotum	shorthead redhorse	Present	Present	Present
Neogobius melanostomus	round goby	Present		Present
Nocomis biguttatus	hornyhead chub	Present	Present	Present
Notemigonus crysoleucas	golden shiner	Present	Present	
Notropis atherinoides	emerald shiner	Present	Present	Present
Notropis hudsonius	spottail shiner	Present	Present	Present
Notropis volucellus	mimic shiner	Present	Present	
Oncorhynchus mykiss	rainbow trout	Present	Present	Present
Oncorhynchus tshawytscha	Chinook salmon	Present		Present
Osmerus mordax	rainbow smelt	Present	Present	Present
Perca flavescens	yellow perch	Present	Present	Present
Percina caprodes	logperch	Present	Present	Present
Pimephales notatus	bluntnose minnow	Present	Present	Present
Pimephales promelas	fathead minnow	Present		
Pomoxis nigromaculatus	black crappie			Present
Salmo trutta	brown trout	Present		Present
Sander vitreus	walleye	Present	Present	Present
Semotilus atromaculatus	creek chub	Present		
	Total Species Observed	**36**	**33**	**33**

Table 4. Summary of species collected in the St. Clair River in June, July and October by DFO, 2004.

	June	July	October
Total Richness	36	33	33
Unique Species	10	4	4
Common Species	**18**		
Total Richness	**36**		

Table 5. Margalef's Diversity Index scores for DFO 2004 data from the St. Clair River (MI = (S-1)/logN, where S is the number of species and N is the number of individuals of all species).

Site	June	July	October
1	7.63	6.93	5.22
2	2.86	3.99	5.52
3	6.52	8.92	4.45
4	9.04	8.89	7.21
5	4.47	6.14	6.62
6	1.37	4.10	5.02
7	5.00	12.56	7.64
8	5.10	2.00	5.51

Table 6. IBI scores for DFO 2004 data from the St. Clair River (IBI calculated two ways. IBI 1 uses Hamilton's adaptation of index and OMNR trophic classification system (Appendix 2, Appendix 3). IBI 2 uses a slightly modified IBI scheme and new trophic classification system based on Coker *et al.* (2001) (Appendix 4, Appendix 5)).

IBI 1									
	Sites								
Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**All Sites**
June	30 **Fair to Good**	10 **Very Poor**	25 **Fair**	23 **Poor**	15 **Very Poor**	23 **Poor**	13 **Very Poor**	17 **Very Poor to Poor**	30 **Fair to Good**
July	22 **Poor**	11 **Very Poor**	25 **Fair**	29 **Fair**	21 **Poor**	15 **Very Poor**	23 **Poor**	14 **Very Poor**	28 **Fair**
October	26 **Fair**	19 **Poor**	19 **Poor**	27 **Fair**	17 **Very Poor to Poor**	17 **Very Poor to Poor**	21 **Poor**	25 **Fair**	32 **Good**
IBI 2									
	Sites								
Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**All Sites**
June	18 **Poor**	10 **Very Poor**	20 **Poor**	23 **Poor**	14 **Very Poor**	14 **Very Poor**	12 **Very Poor**	15 **Very Poor to Poor**	22 **Poor**
July	19 **Poor**	10 **Very Poor**	23 **Poor**	23 **Poor**	18 **Poor**	10 **Very Poor**	18 **Poor**	9 **Very Poor**	23 **Poor**
October	23 **Poor**	17 **Very Poor to Poor**	17 **Very Poor to Poor**	19 **Poor**	15 **Very Poor**	15 **Very Poor**	17 **Very Poor to Poor**	14 **Very Poor**	23 **Poor**

Table 7. IBI scores for OMNR 1994 and DFO 2004 data from the St. Clair River (IBI calculated two ways. IBI 1 uses Hamilton's adaptation of index and OMNR trophic classification system (Appendix 2, Appendix 3). IBI 2 uses a slightly modified IBI scheme and new trophic classification system based on Coker *et al.* (2001) (Appendix 4, Appendix 5)).

IBI 1									
	Sites								
Sampling Year	1	2	3	4	5	6	7	8	All Sites
Aug 1994	23 Poor	22 Poor	25 Fair	28 Fair	29 Fair	25 Very Poor	23 Poor	16 Very Poor	34 Good
July 2004	22 Poor	11 Very Poor	25 Fair	29 Fair	21 Poor	15 Very Poor	23 Poor	14 Very Poor	28 Fair
IBI 2									
	Sites								
Sampling Year	1	2	3	4	5	6	7	8	All Sites
Aug 1994	23 Poor	21 Poor	21 Poor	17 Very Poor to Poor	27 Fair	21 Poor	21 Poor	13 Very Poor	27 Fair
July 2004	19 Poor	10 Very Poor	23 Poor	23 Poor	18 Poor	10 Very Poor	18 Poor	9 Very Poor	23 Poor

Table 8. Species captured during the OMNR (August 1994) survey and the DFO (July 2004) survey.

Legend	Present	Absent

Scientific Name	Common Name	OMNR	DFO
Alosa pseudoharengus	alewife	Present	Present
Ambloplites rupestris	rock bass	Present	Present
Amia calva	bowfin	Present	Present
Aplodinotus grunniens	freshwater drum	Present	Present
Carassius auratus	goldfish	Present	Absent
Carpiodes cyprinus	quillback	Present	Present
Catostomus commersonii	white sucker	Present	Present
Cyprinella spiloptera	spotfin shiner	Present	Present
Cyprinus carpio	common carp	Present	Present
Dorosoma cepedianum	gizzard shad	Present	Present
Esox lucius	northern pike	Present	Absent
Gasterosteus aculeatus	threespine stickleback	Present	Present
Hypentelium nigricans	northern hog sucker	Present	Present
Ichthyomyzon unicuspis	silver lamprey	Absent	Present
Labidesthes sicculus	brook silverside	Present	Absent
Lepisosteus osseus	longnose gar	Present	Present
Lepomis gibbosus	pumpkinseed	Present	Absent
Lepomis macrochirus	bluegill	Present	Absent
Luxilus chrysocephalus	striped shiner	Absent	Present
Luxilus cornutus	common shiner	Present	Absent
Lythrurus umbratilis	redfin shiner	Absent	Present
Micropterus dolomieu	smallmouth bass	Present	Present
Micropterus salmoides	largemouth bass	Present	Absent
Minytrema melanops	spotted sucker	Present	Present
Morone americana	white perch	Present	Present
Morone chrysops	white bass	Present	Present
Moxostoma anisurum	silver redhorse	Present	Present
Moxostoma erythrurum	golden redhorse	Absent	Present
Moxostoma macrolepidotum	shorthead redhorse	Present	Present
Neogobius melanostomus	round goby	Present	Absent
Nocomis biguttatus	hornyhead chub	Present	Present
Notemigonus crysoleucas	golden shiner	Absent	Present
Notropis atherinoides	emerald shiner	Present	Present
Notropis hudsonius	spottail shiner	Present	Present
Notropis volucellus	mimic shiner	Present	Present
Oncorhynchus mykiss	rainbow trout	Present	Present
Oncorhynchus tshawytscha	Chinook salmon	Present	Absent
Osmerus mordax	rainbow smelt	Present	Present
Perca flavescens	yellow perch	Present	Present
Percina caprodes	logperch	Present	Present
Pimephales notatus	bluntnose minnow	Present	Present
Salmo trutta	brown trout	Present	Absent
Sander vitreus	walleye	Present	Present
Semotilus atromaculatus	creek chub	Present	Absent
	Total Species Observed	**39**	**33**

Table 9. Summary of species collected by OMNR (August 1994) and DFO (July 2004) in the St. Clair River.

	OMNR	DFO
Total Richness	39	33
Unique Species	11	5
Common Species (1994, 2004)	**28**	
Total Richness (Unique + Common species)	**44**	

Table 10. Summary of OMNR (August 1994) and DFO (July 2004) catch data, St. Clair River.

Catch Data	OMNR	DFO
Total Fishes Captured	3720	740
Mean Number of Fishes Captured/Site	465	92.5
Minimum Number of Fishes Captured (among sites)	0	10
Maximum Number of Fishes Captured (among sites)	1796	292

Table 11. Summary of OMNR (August 1994) and DFO (July 2004) sampling effort, St. Clair River.

Sampling Effort	OMNR	DFO
Mean CPUE (catch/min)	11.48	3.14
Mean Effort/transect (min)	40.13	29.38
Total Sampling Effort (min)	321.00	235.07

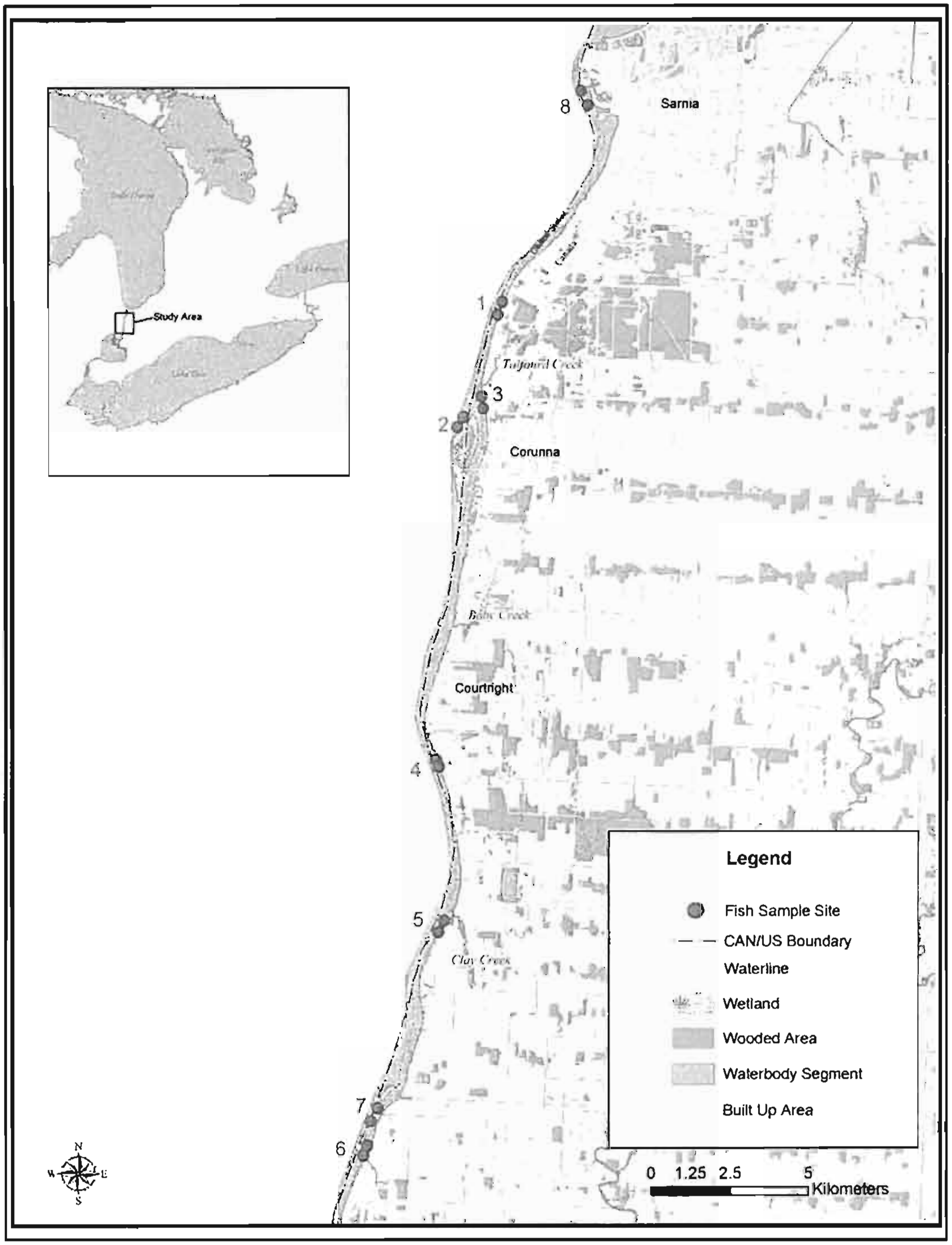

Figure 1. DFO 2004 St. Clair River sampling sites.

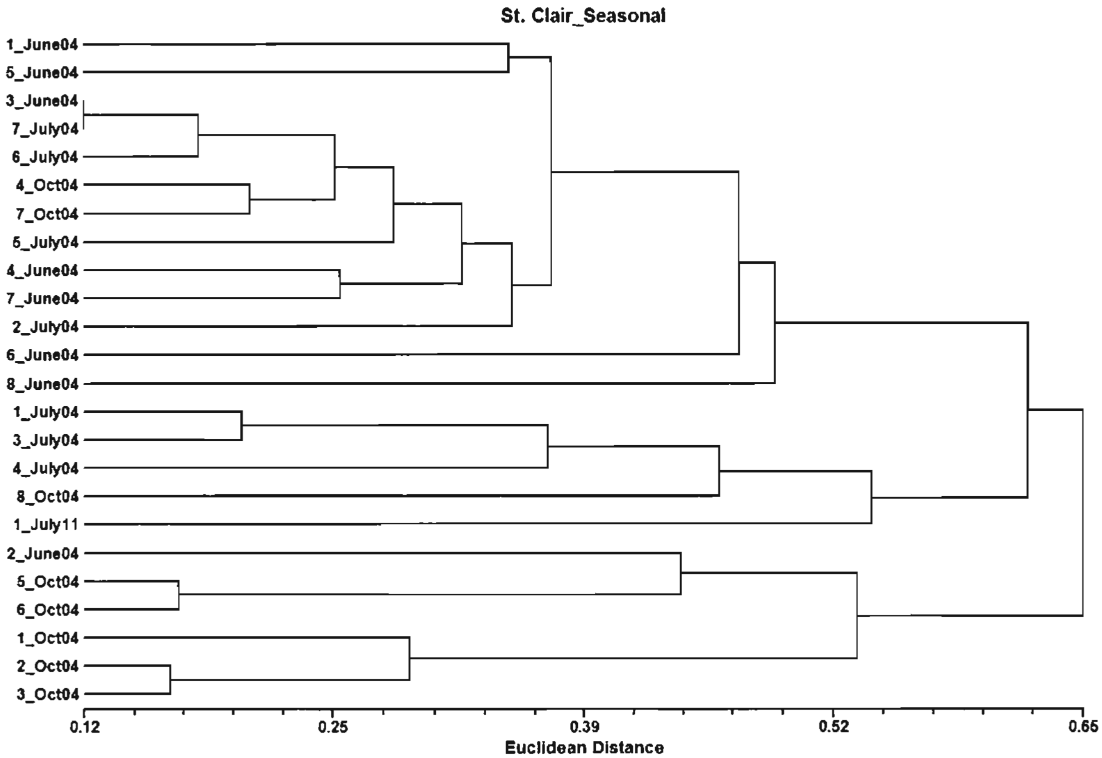

Figure 2. Cluster analysis based on seasonal relative abundance values. x_monthyy: x=site number; yy=year.

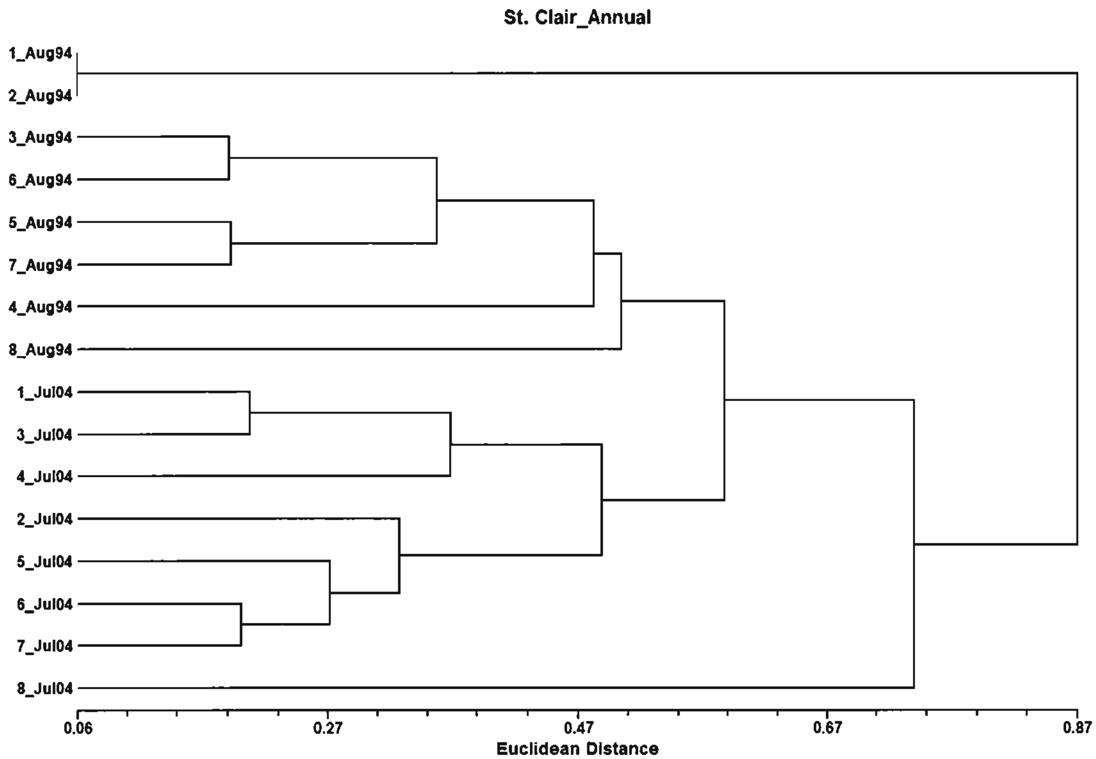

Figure 3. Cluster analysis based on annual relative abundance values. x_monthyy: x=site number; yy=year.

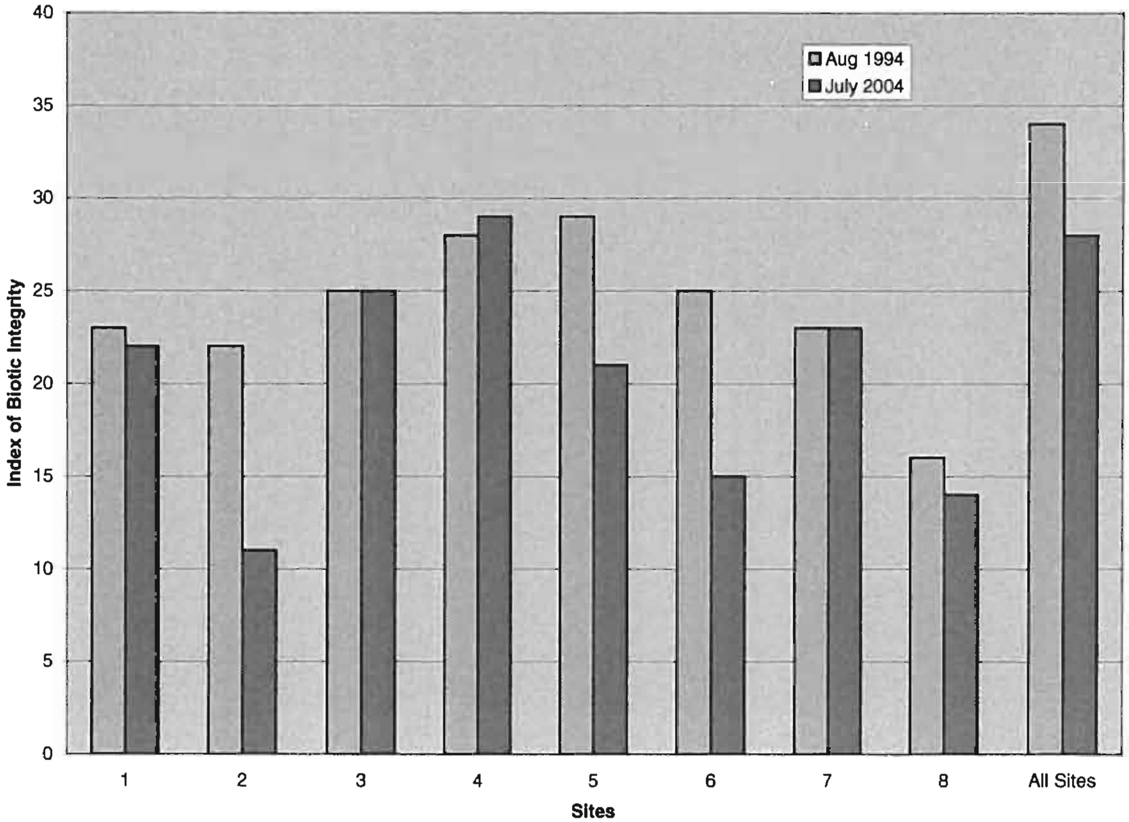

Figure 4. IBI scores for August 1994 OMNR and July 2004 DFO data, St. Clair River.

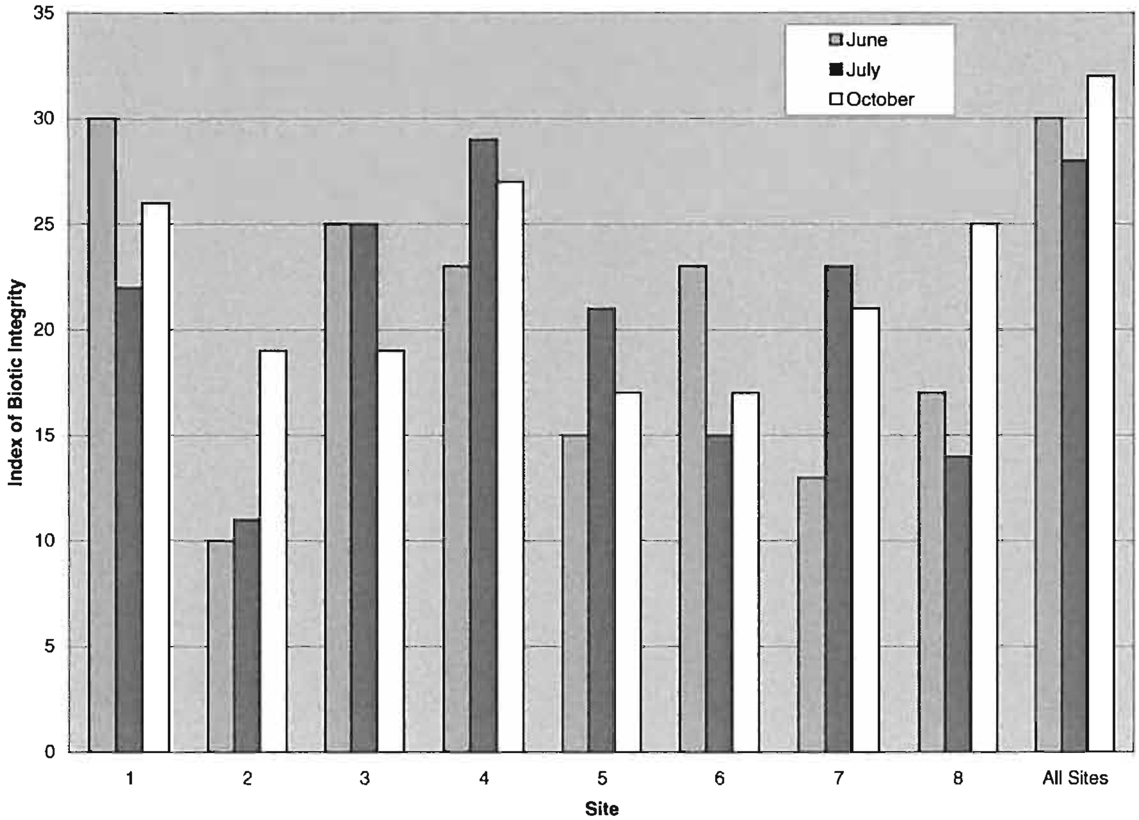

Figure 5. IBI scores for 2004 DFO data, St. Clair River.

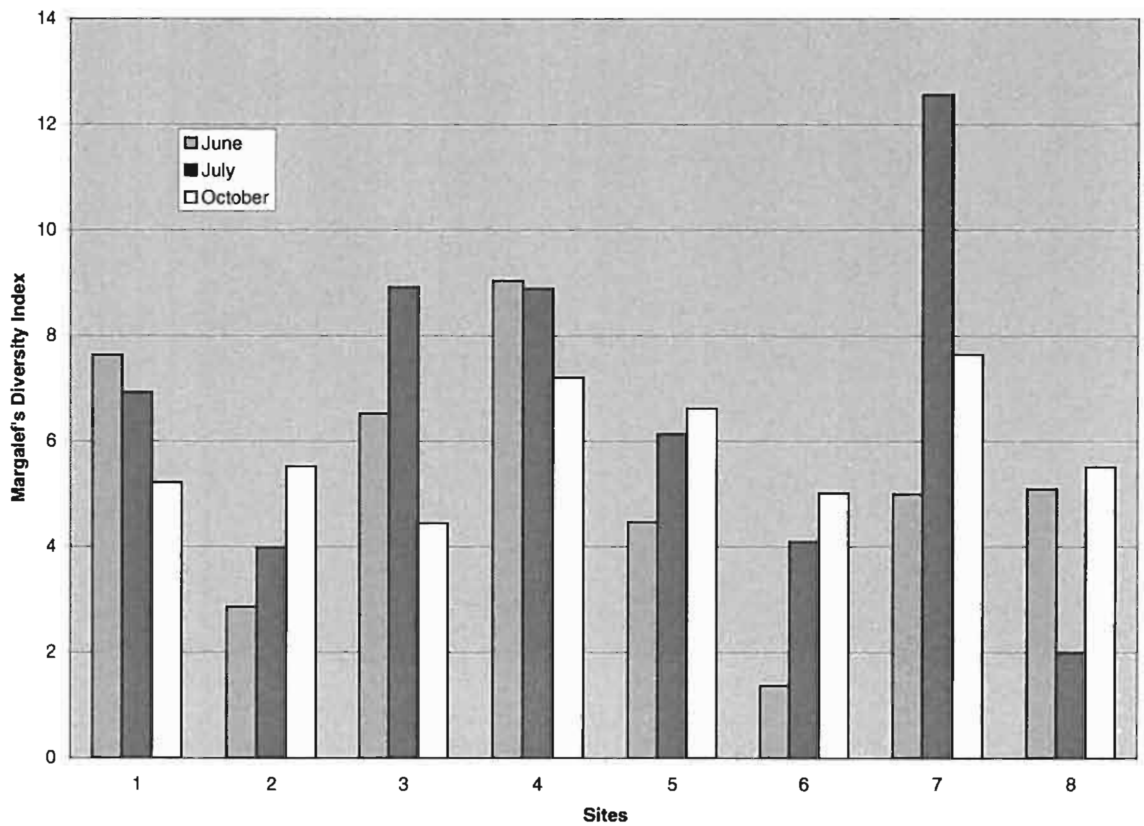

Figure 6. MI scores for DFO 2004 data, St. Clair River.

Appendix 1. Summary of DFO 2004 site descriptions, St. Clair River.

# On Map	Field Number	Date	Start Latitude	Start Longitude	Narrative Locality Description
1	SCR04COA170604001A	17/06/2004	42.92807	-82.45068	Downstream of Sarnia; East shore; adjacent to First nations
	SCR04COA170604001B	17/06/2004	42.92441	-82.45242	Downstream of chemical plants; East shore @ First nations
2	SCR04COA170604003A	17/06/2004	42.89474	-82.46523	West shore of Stag Island
	SCR04COA170604003B	17/06/2004	42.89474	-82.46523	West shore of Stag Island
3	SCR04COA170604004A	17/06/2004	42.90069	-82.45824	Upstream of Corunna; downstream of Talfourd Creek
	SCR04COA170604004B	17/06/2004	42.89725	-82.45747	East shore @ Corunna; downstream of Talfourd Creek
4	SCR04COA160604007A	16/06/2004	42.79572	-82.47360	Upstream of Lambton Generating Station
	SCR04COA160604007B	16/06/2004	42.79371	-82.47223	Downstream of Lambton Generating Station
5	SCR04COA160604008A	16/06/2004	42.74936	-82.46932	Adjacent and upstream of Clay Creek
	SCR04COA160604008B	16/06/2004	42.74598	-82.47147	Downstream of Clay Creek
6	SCR04COA160604009A	16/06/2004	42.68413	-82.49736	Downstream of Fawn Island; East shore
	SCR04COA160604009B	16/06/2004	42.68127	-82.49893	Downstream of Fawn Island; East shore
7	SCR04COA160604010A	16/06/2004	42.69503	-82.49373	East shore of Fawn Island
	SCR04COA160604010B	16/06/2004	42.69116	-82.49630	Downstream of Fawn Island; East shore
8	SCR04COA170604011A	17/06/2004	42.98932	-82.42121	Upstream Bay Point Sarnia Harbour
	SCR04COA170604011B	17/06/2004	42.98513	-82.41834	Downstream of Bay Point Sarnia Harbour
1	SCR04COA220704001A	22/07/2004	42.92807	-82.45068	Downstream of Sarnia; East shore; adjacent to First nations
	SCR04COA220704001B	22/07/2004	42.92441	-82.45242	Downstream of chemical plants; East shore @ First nations
2	SCR04COA220704003A	22/07/2004	42.89474	-82.46523	West shore of Stag Island
	SCR04COA220704003B	22/07/2004	42.89474	-82.46523	West shore of Stag Island
3	SCR04COA220704004A	22/07/2004	42.90069	-82.45824	Upstream of Corunna; downstream of Talfourd Creek
	SCR04COA220704004B	22/07/2004	42.89725	-82.45747	East shore @ Corunna; downstream of Talfourd Creek
4	SCR04COA210704007A	21/07/2004	42.79572	-82.47360	Upstream of Lambton Generating Station
	SCR04COA210704007B	21/07/2004	42.79371	-82.47223	Downstream of Lambton Generating Station
5	SCR04COA210704008A	21/07/2004	42.75238	-82.46738	Adjacent and upstream of Clay Creek
	SCR04COA210704008B	21/07/2004	42.74936	-82.46932	Downstream of Clay Creek
6	SCR04COA210704009A	21/07/2004	42.68413	-82.49736	Downstream of Fawn Island; East shore
	SCR04COA210704009B	21/07/2004	42.68127	-82.49893	Downstream of Fawn Island; East shore
7	SCR04COA210704010A	21/07/2004	42.69503	-82.49373	East shore of Fawn Island
	SCR04COA210704010B	21/07/2004	42.69116	-82.49630	Downstream of Fawn Island; East shore
8	SCR04COA220704011A	22/07/2004	42.98932	-82.42121	Upstream Bay Point Sarnia Harbour
	SCR04COA220704011B	22/07/2004	42.98513	-82.41834	Downstream of Bay Point Sarnia Harbour

Appendix 1. Continued.

# On Map	Field Number	Date	Start Latitude	Start Longitude	Narrative Locality Description
1	SCR04COA141004001A	14/10/2004	42.92807	-82.45068	Downstream of Sarnia; East shore; adjacent to First nations
	SCR04COA141004001B	14/10/2004	42.92441	-82.45242	Downstream of chemical plants; East shore @ First nations
2	SCR04COA141004003A	14/10/2004	42.89474	-82.46523	West shore of Stag Island
	SCR04COA141004003B	14/10/2004	42.89474	-82.46523	West shore of Stag Island
3	SCR04COA141004004A	14/10/2004	42.90069	-82.45824	Upstream of Corunna; downstream of Talfourd Creek
	SCR04COA141004004B	14/10/2004	42.89725	-82.45742	East shore @ Corunna; downstream of Talfourd Creek
4	SCR04COA131004007A	13/10/2004	42.79572	-82.47360	Upstream of Lambton Generating Station
	SCR04COA131004007B	13/10/2004	42.79371	-82.47223	Downstream of Lambton Generating Station
5	SCR04COA131004008A	13/10/2004	42.74936	-82.46932	Adjacent and upstream of Clay Creek
	SCR04COA131004008B	13/10/2004	42.74598	-82.47147	Downstream of Clay Creek
6	SCR04COA131004009A	13/10/2004	42.68413	-82.49736	Downstream of Fawn Island; East shore
	SCR04COA131004009B	13/10/2004	42.68127	-82.49893	Downstream of Fawn Island; East shore
7	SCR04COA131004010A	13/10/2004	42.69503	-82.49373	East shore of Fawn Island
	SCR04COA131004010B	13/10/2004	42.69116	-82.49630	Downstream of Fawn Island; East shore
8	SCR04COA141004011A	14/10/2004	42.98932	-82.42121	Upstream Bay Point Sarnia Harbour
	SCR04COA141004011B	14/10/2004	42.98513	-82.41834	Downstream of Bay Point Sarnia Harbour

Appendix 2. Hamilton's (1987) IBI classification scheme.

Section	Description	Scoring Criteria			
		0	**1**	**3**	**5**
Species Richness and Composition	Number of species collected in each sample (as a % of total collected in the entire AOC)	0	0-25%	26-50%	> 50%
	Number of percid species present in each sample area	0	1	2	≥ 3
	Number of naturally-spawned salmonid and coregonid species present in each sample area	0	1	2	≥ 3
	Subtotal:				
Trophic Composition	Proportion of individuals considered specialist/insectivores/planktivores	0	< 20%	20-40%	> 40%
	Proportion of individuals considered generalists	0	> 40%	20-40%	< 20%
	Proportion of individuals considered top piscivores	0	< 2%	2-5%	> 5%
	Subtotal:				
Fish Abundance and Health	Ratio of CPUE in the sample area to mean AOC CPUE (as %)	-	< 80%	80-120%	> 120%
	Occurrence of individuals which are hybrids, diseased, have lamprey scars or are invading species	-	> 5%	1-5%	0
	Subtotal:				
	Total:				

Rating System:

< 15 = very poor
18-23 = poor
25-29 = fair
31-34 = good
37-40 = excellent

Appendix 3. 1994 OMNR trophic guild classifications based on Hamilton (1987), Scott and Crossman (1973) and Whitehead *et al.* (1986). New species observed in 2004 (in bold) were classified according to Coker *et al.* (2001).

Generalists		Specialists		Top Carnivores	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**
bowfin	*Amia calva*	alewife*	*Alosa pseudoharengus*	longnose gar	*Lepisosteus osseus*
rainbow smelt*	*Osmerus mordax*	gizzard shad	*Dorosoma cepedianum*	Chinook salmon*	*Oncorhynchus tshawytscha*
quillback	*Carpiodes cyprinus*	emerald shiner	*Notropis atherinoides*	rainbow trout*	*Oncorhynchus mykiss*
white sucker	*Catostomus commersonii*	spottail shiner	*Notropis hudsonius*	brown trout*	*Salmo trutta*
northern hog sucker	*Hypentelium nigricans*	spotfin shiner	*Cyprinella spiloptera*	northern pike	*Esox lucius*
spotted sucker	*Minytrema melanops*	mimic shiner	*Notropis volucellus*	white bass	*Morone chrysops*
silver redhorse	*Moxostoma anisurum*	bluntnose minnow	*Pimephales notatus*	smallmouth bass	*Micropterus dolomieu*
shorthead redhorse	*Moxostoma macrolepidotum*	threespine stickleback	*Gasterosteus aculeatus*	largemouth bass	*Micropterus salmoides*
goldfish*	*Carassius auratus*	white perch*	*Morone Americana*	yellow perch	*Perca flavescens*
common carp*	*Cyprinus carpio*	rock bass	*Ambloplites rupestris*	walleye	*Sander vitreus*
hornyhead chub	*Nocomis biguttatus*	pumpkinseed	*Lepomis gibbosus*		
common shiner	*Luxilus cornutus*	bluegill	*Lepomis macrochirus*		
creek chub	*Semotilus atromaculatus*	logperch	*Percina caprodes*		
freshwater drum	*Aplodinotus grunniens*	brook silverside	*Labidesthes sicculus*		
		round goby*	*Neogobius melanostomus*		
golden redhorse	***Moxostoma erythrurum***				
golden shiner	***Notemigonus crysoleucas***	**silver lamprey**	***Ichthyomyzon unicuspis***		
fathead minnow	***Pimephales promelas***	**cisco sp.**	***Coregonus* sp.**		
striped shiner	***Luxilus chrysocephalus***	**mottled sculpin**	***Cottus bairdii***		
buffalo sp.	***Ictiobus* sp.**	**rainbow darter**	***Etheostoma caeruleum***		
redfin shiner	***Lythrurus umbratilis***	**American brook lamprey**	***Lampetra appendix***		

*invasive species

Appendix 4. Modified IBI scheme.

Section	Description	Scoring Criteria			
		0	1	3	5
Species Richness and Composition	Number of species collected in each sample (as a % of total collected in the entire AOC)	0	0-25%	26-50%	> 50%
	Number of percid species present in each sample area	0	1	2	≥ 3
	Number of native naturally-spawned salmonid and coregonid species present in each sample area	0	1	2	≥ 3
	Subtotal:				
Trophic Composition	Proportion of individuals considered specialist/insectivores/planktivores	0	< 20%	20-40%	> 40%
	Proportion of individuals considered generalists	0	> 40%	20-40%	< 20%
	Proportion of individuals considered top piscivores	0	< 2%	2-5%	> 5%
	Subtotal:				
Fish Abundance and Health	Ratio of CPUE in the sample area to mean AOC CPUE (as %)	-	< 80%	80-120%	> 120%
	Occurrence of individuals which are hybrids, diseased, have lamprey scars or are invading species	-	> 5%	1-5%	0
	Subtotal:				
	Total:				

Rating System:
< 15 = very poor
18-23 = poor
25-29 = fair
31-34 = good
37-40 = excellent

Appendix 5. 2004 trophic guild classifications based on Coker *et al.* (2001).

Generalists		Specialists		Top Carnivores	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**	**Common Name**	**Scientific Name**
rock bass	*Ambloplites rupestris*	alewife*	*Alosa pseudoharengus*	bowfin	*Amia calva*
freshwater drum	*Aplodinotus grunniens*	cisco sp.	*Coregonus* sp.	northern pike	*Esox lucius*
quillback	*Carpiodes cyprinus*	gizzard shad	*Dorosoma cepedianum*	longnose gar	*Lepisosteus osseus*
white sucker	*Catostomus commersonii*	silver lamprey	*Ichthyomyzon unicuspis*	green sunfish	*Lepomis cyanellus*
mottled sculpin	*Cottus bairdii*	brook silverside	*Labidesthes sicculus*	smallmouth bass	*Micropterus dolomieu*
spotfin shiner	*Cyprinella spiloptera*	American brook lamprey	*Lampetra appendix*	largemouth bass	*Micropterus salmoides*
common carp*	*Cyprinus carpio*			white perch*	*Morone americana*
rainbow darter	*Etheostoma caeruleum*			white bass	*Morone chrysops*
threespine stickleback	*Gasterosteus aculeatus*			rainbow trout*	*Oncorhynchus mykiss*
northern hog sucker	*Hypentelium nigricans*			Chinook salmon*	*Oncorhynchus tshawytscha*
buffalo sp.	*Ictiobus* sp.			yellow perch	*Perca flavescens*
pumpkinseed	*Lepomis gibbosus*			black crappie	*Pomoxis nigromaculatus*
bluegill	*Lepomis macrochirus*			brown trout*	*Salmo trutta*
striped shiner	*Luxilus chrysocephalus*			walleye	*Sander vitreus*
redfin shiner	*Lythrurus umbratilis*				
spotted sucker	*Minytrema melanops*				
silver redhorse	*Moxostoma anisurum*				
golden redhorse	*Moxostoma erythrurum*				
shorthead redhorse	*Moxostoma macrolepidotum*				
round goby*	*Neogobius melanostomus*				
hornyhead chub	*Nocomis biguttatus*				
golden shiner	*Notemigonus crysoleucas*				
emerald shiner	*Notropis atherinoides*				
spottail shiner	*Notropis hudsonius*				
mimic shiner	*Notropis volucellus*				
rainbow smelt*	*Osmerus mordax*				
logperch	*Percina caprodes*				
bluntnose minnow	*Pimephales notatus*				
fathead minnow	*Pimephales promelas*				
creek chub	*Semotilus atromaculatus*				

*invasive species

Appendix 6. Summary of species caught by site by DFO in 2004, St. Clair River.

Sampling Period	June									July									October								
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Alosa pseudoharengus	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	**1**	176	26	34	4	4	1	0	0	**245**
Ambloplites rupestris	28	0	0	0	0	0	1	3	**32**	0	0	1	0	0	0	2	0	**3**	0	0	0	3	0	0	2	3	**8**
Amia calva	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Aplodinotus grunniens	0	0	4	1	0	0	0	0	**5**	1	0	3	0	4	0	4	0	**12**	1	1	4	0	2	9	3	0	**20**
Carpiodes cyprinus	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Catostomus commersonii	0	0	4	15	2	0	1	0	**22**	0	5	5	7	1	0	4	0	**22**	1	9	8	10	7	2	30	2	**69**
Coregonus sp.	0	0	0	0	0	0	0	6	**6**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Cottus bairdii	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Cyprinella spiloptera	0	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Cyprinus carpio	0	0	1	28	0	0	1	0	**30**	1	0	12	4	0	0	0	0	**17**	0	2	1	5	3	2	7	0	**20**
Dorosoma cepedianum	0	0	0	0	0	0	0	0	**0**	1	0	1	0	0	0	0	0	**2**	0	0	0	0	0	0	2	0	**2**
Esox lucius	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	**1**
Etheostoma caeruleum	0	0	0	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Gasterosteus aculeatus	2	0	0	0	0	0	0	0	**2**	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	**0**
Hypentelium nigricans	0	0	0	0	0	0	0	0	**0**	1	0	0	0	1	1	0	0	**3**	3	0	0	1	1	0	5	0	**10**
Ichthyomyzon unicuspis	0	0	0	0	0	0	0	0	**0**	1	0	0	1	0	0	0	0	**2**	0	0	0	1	0	0	1	0	**2**
Ictiobus sp.	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	1	**2**
Labidesthes sicculus	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**	1	0	0	16	1	3	1	0	**22**
Lampetra appendix	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Lepisosteus osseus	0	0	0	1	0	0	0	0	**1**	0	0	0	1	0	0	0	0	**1**	0	0	0	0	1	0	0	0	**1**
Lepomis cyanellus	2	0	1	0	0	0	0	0	**3**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
L.cyanellus x L.macrochirus hybrid	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Lepomis gibbosus	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Lepomis macrochirus	7	0	0	4	0	0	0	0	**11**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Luxilus chrysocephalus	0	0	0	0	0	0	0	0	**0**	0	3	1	0	1	0	1	0	**6**	0	0	0	3	0	1	1	0	**5**
Lythrurus umbratilis	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Micropterus dolomieu	16	0	0	1	6	0	1	5	**29**	1	0	0	1	5	0	1	0	**8**	4	0	0	0	1	0	0	0	**5**
Micropterus salmoides	0	0	0	1	0	0	0	1	**2**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	**1**
Minytrema melanops	0	0	0	0	0	0	0	0	**0**	0	0	4	0	0	0	1	0	**5**	0	0	0	7	0	0	4	1	**12**
Morone americana	0	0	0	0	0	0	0	0	**0**	0	0	1	1	0	1	0	0	**3**	0	0	0	1	0	0	0	0	**1**
Morone chrysops	0	0	0	4	0	0	0	0	**4**	3	0	2	1	0	0	0	0	**6**	0	0	0	0	0	0	0	0	**0**
Moxostoma anisurum	1	0	1	1	0	0	0	0	**3**	0	0	3	2	6	4	2	0	**17**	0	0	0	1	2	0	0	0	**3**
Moxostoma erythrurum	0	0	3	3	1	0	0	0	**7**	1	1	13	0	1	1	2	0	**19**	0	0	0	0	0	1	0	0	**1**
Moxostoma macrolepidotum	1	1	19	10	2	2	0	0	**35**	48	8	90	9	7	5	9	0	**176**	0	3	6	0	0	2	2	2	**15**

Appendix 6. Continued.

Sampling Period	June									July									October								
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Neogobius melanostomus	16	0	5	1	2	0	0	4	**28**	0	0	0	0	0	0	0	0	**0**	1	0	0	0	0	0	0	0	**1**
Nocomis biguttatus	6	0	1	0	0	0	1	0	**8**	1	1	0	2	0	0	2	0	**6**	0	1	0	2	0	0	1	0	**4**
Notemigonus crysoleucas	0	0	0	1	0	0	0	0	**1**	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Notropis atherinoides	23	0	20	2	0	0	0	0	**45**	32	0	76	48	1	11	6	7	**181**	5	2	11	19	16	28	23	17	**121**
Notropis hudsonius	1	0	8	5	0	12	0	0	**26**	0	0	2	0	0	0	5	0	**7**	1	1	0	9	0	0	18	0	**29**
Notropis volucellus	0	0	0	1	0	0	0	0	**1**	0	0	2	1	0	0	1	0	**4**	0	0	0	0	0	0	0	0	**0**
Oncorhynchus mykiss	1	0	0	0	0	0	0	9	**10**	1	0	0	0	0	0	0	2	**3**	1	0	0	0	0	0	0	1	**2**
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	**1**
Osmerus mordax	0	3	2	0	0	0	0	0	**5**	3	3	1	1	0	3	0	0	**11**	69	13	31	3	21	41	4	0	**182**
Perca flavescens	41	1	62	184	8	15	5	7	**323**	8	11	53	18	24	25	40	0	**179**	7	6	8	61	5	8	62	0	**157**
Percina caprodes	0	0	7	0	0	0	0	0	**7**	2	0	14	1	10	0	1	0	**28**	39	0	1	0	1	0	0	14	**55**
Pimephales notatus	1	0	0	2	0	0	0	0	**3**	0	0	3	3	0	0	1	0	**7**	0	0	0	20	0	0	0	0	**20**
Pimephales promelas	0	0	0	3	0	0	0	0	**3**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
Pomoxis nigromaculatus	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	**1**
Salmo trutta	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	1	0	0	0	0	0	0	0	**1**
Sander vitreus	1	0	2	1	0	0	0	0	**4**	0	0	2	3	0	0	0	0	**5**	0	1	0	0	0	0	0	0	**1**
Semotilus atromaculatus	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**

Appendix 7. CPUE values (catch/min) for 2004 DFO St. Clair River sites.

Site	June	July	October
1	3.87	3.00	7.42
2	0.22	1.44	2.87
3	4.12	9.21	3.05
4	11.05	4.84	7.30
5	0.74	2.19	2.13
6	0.85	1.85	3.46
7	0.31	2.32	4.26
8	0.85	0.30	1.02

Appendix 8. Summary of DFO 2004 sampling effort and electrofishing settings, St. Clair River (sampling performed using a 6.35 m Model SR-20 Smith-Root dual boom electrofishing boat with a 7.5 kW Smith-Root generator and 7.5 GPP control box).

# On Map	Field Number	Duration (s)	Electrofishing Settings
1	SCR04COA170604001A	1103	1000V, 8 amps, 60 Hz @ 40%
	SCR04COA170604001B	1207	1000V, 7 amps, 60 Hz @ 40%
2	SCR04COA170604003A	800	1000V, 7.5 amps, 60 Hz @ 40%
	SCR04COA170604003B	597	1000V, 7.5 amps, 60 Hz @ 40%
3	SCR04COA170604004A	1033	1000V, 7.5 amps, 60 Hz @ 40%
	SCR04COA170604004B	1004	1000V, 7.5 amps, 60 Hz @ 40%
4	SCR04COA160604007A	718	1000V, 8 amps, 60 Hz @ 40%
	SCR04COA160604007B	759	1000V, 8 amps, 60 Hz @ 40%
5	SCR04COA160604008A	896	1000V, 8 amps, 60 Hz @ 40%
	SCR04COA160604008B	896	1000V, 8 amps, 60 Hz @ 40%
6	SCR04COA160604009A	1101	1000V, 7 amps, 60 Hz @ 40%
	SCR04COA160604009B	936	1000V, 7 amps, 60 Hz @ 40%
7	SCR04COA160604010A	1031	1000V, 8 amps, 60 Hz @ 40%
	SCR04COA160604010B	901	1000V, 8 amps, 60 Hz @ 40%
8	SCR04COA170604011A	1208	1000V, 7 amps, 60 Hz @ 40%
	SCR04COA170604011B	1409	1000V, 7 amps, 60 Hz @ 40%
1	SCR04COA220704001A	1020	1000V, 5.5 amps, 30 Hz @ 55%
	SCR04COA220704001B	1079	1000V, 7 amps, 60 Hz @ 35%
2	SCR04COA220704003A	645	1000V, 7 amps, 60 Hz @ 40%
	SCR04COA220704003B	687	1000V, 6.5 amps, 60 Hz @ 40%
3	SCR04COA220704004A	843	1000V, 7 amps, 60 Hz @ 35%
	SCR04COA220704004B	1060	1000V, 7 amps, 60 Hz @ 40%
4	SCR04COA210704007A	572	1000V, 7 amps, 60 Hz @ 60%
	SCR04COA210704007B	742	1000V, 7 amps, 30 Hz @ 60%
5	SCR04COA210704008A	868	1000V, 7 amps, 30 Hz @ 60%
	SCR04COA210704008B	830	1000V, 7 amps, 30 Hz @ 60%
6	SCR04COA210704009A	826	1000V, 6.5 amps, 30 Hz @ 60%
	SCR04COA210704009B	828	1000V, 6.2 amps, 30 Hz @ 60%
7	SCR04COA210704010A	1036	1000V, 8 amps, 60 Hz @ 40%
	SCR04COA210704010B	1080	1000V, 8 amps, 60 Hz @ 40%
8	SCR04COA220704011A	994	1000V, 7 amps, 60 Hz @ 40%
	SCR04COA220704011B	994	1000V, 5.5 amps, 30 Hz @ 55%
1	SCR04COA141004001A	1161	1000V, 5.5 amps, 30 Hz @ 60%
	SCR04COA141004001B	1345	1000V, 5.5 amps, 30 Hz @ 60%
2	SCR04COA141004003A	709	1000V, 5.5 amps, 30 Hz @ 60%
	SCR04COA141004003B	709	1000V, 5.5 amps, 30 Hz @ 60%
3	SCR04COA141004004A	942	1000V, 5.7 amps, 30 Hz @ 60%
	SCR04COA141004004B	1120	1000V, 5.5 amps, 30 Hz @ 60%
4	SCR04COA131004007A	610	1000V, 5.5 amps, 30Hz @ 60%
	SCR04COA131004007B	755	1000V, 6 amps, 30 Hz @ 60%
5	SCR04COA131004008A	894	1000V, 5.5 amps, 30Hz @ 50%
	SCR04COA131004008B	938	1000V, 5.5 amps, 30 Hz @ 60%
6	SCR04COA131004009A	863	1000V, 5 amps, 30 Hz @ 60%
	SCR04COA131004009B	838	1000V, 5.5 amps, 30 Hz @ 60%
7	SCR04COA131004010A	1274	1000V, 5.5 amps, 30 Hz @ 60%
	SCR04COA131004010B	1094	1000V, 5 amps, 30 Hz @ 60%
8	SCR04COA141004011A	1109	1000V, 5.5 amps, 30 Hz @ 60%
	SCR04COA141004011B	1431	1000V, 5.5 amps, 30 Hz @ 60%

Appendix 9. Species richness per site for DFO 2004 sampling, St. Clair River.

Site	June	July	October
1	17	15	14
2	3	7	11
3	15	23	10
4	23	19	17
5	7	12	13
6	3	8	11
7	6	16	18
8	9	3	10

Appendix 10. Scientific and common names of species collected in the St. Clair River based on Nelson *et al.* (2004).

Scientific Name	Common Name
Alosa pseudoharengus	alewife
Ambloplites rupestris	rock bass
Amia calva	bowfin
Aplodinotus grunniens	freshwater drum
Carassius auratus	goldfish
Carpiodes cyprinus	quillback
Catostomus commersonii	white sucker
Cottus bairdii	mottled sculpin
Cyprinella spiloptera	spotfin shiner
Cyprinus carpio	common carp
Dorosoma cepedianum	gizzard shad
Esox lucius	northern pike
Etheostoma caeruleum	rainbow darter
Gasterosteus aculeatus	threespine stickleback
Hypentelium nigricans	northern hog sucker
Ichthyomyzon unicuspis	silver lamprey
Labidesthes sicculus	brook silverside
Lampetra appendix	American brook lamprey
Lepisosteus osseus	longnose gar
Lepomis cyanellus	green sunfish
Lepomis gibbosus	pumpkinseed
Lepomis macrochirus	bluegill
Luxilus chrysocephalus	striped shiner
Luxilus cornutus	common shiner
Lythrurus umbratilis	redfin shiner
Micropterus dolomieu	smallmouth bass
Micropterus salmoides	largemouth bass
Minytrema melanops	spotted sucker
Morone americana	white perch
Morone chrysops	white bass
Moxostoma anisurum	silver redhorse
Moxostoma erythrurum	golden redhorse
Moxostoma macrolepidotum	shorthead redhorse
Neogobius melanostomus	round goby
Nocomis biguttatus	hornyhead chub
Notemigonus crysoleucas	golden shiner
Notropis atherinoides	emerald shiner
Notropis hudsonius	spottail shiner
Notropis volucellus	mimic shiner
Oncorhynchus mykiss	rainbow trout
Oncorhynchus tshawytscha	Chinook salmon
Osmerus mordax	rainbow smelt
Perca flavescens	yellow perch
Percina caprodes	logperch
Pimephales notatus	bluntnose minnow
Pimephales promelas	fathead minnow
Pomoxis nigromaculatus	black crappie
Salmo trutta	brown trout
Sander vitreus	walleye
Semotilus atromaculatus	creek chub

Appendix 11. IBI for eight sites in the St. Clair River sampled in June, July and October 2004. IBI calculated using Hamilton's (1987) adaptation of the index as proposed by Karr (1981).

June	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	47.22	8.33	41.67	63.89	19.44	8.33	16.67	25.00	100.00
Score	3	1	3	5	1	1	1	3	5
Number of Percid Sp.	2	1	3	2	2	1	1	1	4
Score	3	1	5	3	3	1	1	1	5
# of Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	2	0	0	0	0	0	0	3	4
Score	3	0	0	0	0	0	0	5	5
% Individuals Generalists	12.08	80.00	25.71	25.00	22.72	6.90	30.00	0	20.48
Score	5	1	3	3	3	5	3	0	3
% Individuals Specialists	47.65	0	28.57	4.41	13.63	41.38	10	37.84	23.04
Score	5	0	3	1	1	5	1	3	3
% Individuals Top Carnivores	40.27	20.00	45.71	70.59	63.63	51.72	60.00	62.16	56.47
Score	5	5	5	5	5	5	5	5	5
(Site CPUE/mean CPUE)x 100	140.72	7.82	149.82	401.82	26.80	31.05	11.31	30.84	100
Score	5	1	5	5	1	1	1	1	3
% Individuals - Invading Species	12.75	60.00	5.71	10.66	9.09	0	10.00	37.84	11.44
Score	1	1	1	1	1	5	1	1	1
Index of Biotic Integrity (IBI)	30	10	25	23	15	23	13	19	30
Rating	Fair to Good	Very Poor	Fair	Poor	Very Poor	Poor	Very Poor	Poor	Fair to Good

Appendix 11. Continued.

July	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	45.5	21.2	69.7	57.6	36.4	24.2	48.5	9.09	100
Score	**3**	**1**	**5**	**5**	**3**	**1**	**3**	**1**	**5**
Number of Percid Sp.	2	1	3	3	2	1	2	0	3
Score	**3**	**1**	**5**	**5**	**3**	**1**	**3**	**0**	**5**
# of Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	1	0	0	0	0	0	0	1	1
Score	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
% Individuals Generalists	53.30	56.25	45.21	24.53	33.87	27.45	29.27	0.00	39.32
Score	**1**	**1**	**1**	**3**	**3**	**3**	**3**	**0**	**3**
% Individuals Specialists	34.29	9.38	35.27	52.83	19.35	23.53	20.73	80.00	33.38
Score	**3**	**1**	**3**	**5**	**1**	**3**	**3**	**5**	**3**
% Individuals Top Carnivores	12.38	34.37	19.52	22.64	46.77	49.01	50.00	20.00	27.30
Score	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
(Site CPUE/mean CPUE)x 100	95.54	45.86	293.31	154.14	69.74	58.92	73.89	9.59	100
Score	**3**	**1**	**5**	**5**	**1**	**1**	**1**	**1**	**3**
% Individuals - Invading Species	4.76	9.37	5.14	5.66	0	7.84	0	20.00	4.73
Score	**3**	**1**	**1**	**1**	**5**	**1**	**5**	**1**	**3**
Index of Biotic Integrity (IBI)	**22**	**11**	**25**	**29**	**21**	**15**	**23**	**14**	**28**
Rating	**Poor**	**Very Poor**	**Fair**	**Fair**	**Poor**	**Very poor**	**Poor**	**Poor**	**Fair**

Appendix 11. Continued.

October	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	42.42	33.33	30.3	51.51	39.39	33.33	54.54	30.3	100
Score	**3**	**3**	**3**	**5**	**3**	**3**	**5**	**3**	**5**
Number of Percid Sp.	2	2	2	1	2	1	1	1	3
Score	**3**	**3**	**3**	**1**	**3**	**1**	**1**	**1**	**5**
# of Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	2	0	0	0	0	0	0	2	3
Score	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**5**
% Individuals Generalists	23.87	44.62	47.62	17.47	55.38	58.16	33.33	11.63	32.94
Score	**3**	**1**	**1**	**5**	**1**	**1**	**3**	**5**	**3**
% Individuals Specialists	71.94	44.62	44.76	45.78	33.85	33.67	28.57	81.40	50.29
Score	**5**	**5**	**5**	**5**	**3**	**3**	**3**	**5**	**5**
% Individuals Top Carnivores	4.19	10.77	7.62	36.75	10.77	8.16	38.10	6.98	16.76
Score	**3**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
(Site CPUE/mean CPUE)x 100	189.28	70.15	77.8	186.22	54.34	88.23	108.67	26.02	100
Score	**5**	**1**	**1**	**5**	**1**	**3**	**3**	**1**	**3**
% Individuals - Invading Species	80.00	63.08	62.86	7.83	43.08	44.9	6.54	4.65	44.41
Score	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
Index of Biotic Integrity (IBI)	**26**	**19**	**19**	**27**	**17**	**17**	**21**	**25**	**32**
Rating	**Fair**	**Poor**	**Poor**	**Fair**	**Very Poor to Poor**	**Very Poor to Poor**	**Poor**	**Fair**	**Good**

Appendix 12. New IBI scores for 2004 data calculated using a modified IBI scheme and an updated trophic guild classification system based on Coker *et al.* (2001).

June	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	47.22	8.33	41.67	63.89	19.44	8.33	16.67	25.00	100.00
Score	3	1	3	5	1	1	1	3	5
Number of Percid Sp.	2	1	3	2	2	1	1	1	4
Score	3	1	5	3	3	1	1	1	5
# of Native Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	0	0	0	0	0	0	0	1	1
Score	0	0	0	0	0	0	0	1	1
% Individuals Generalists	58.39	80.00	53.57	29.04	36.36	48.27	40.00	21.62	42.01
Score	1	1	1	3	3	1	3	3	1
% Individuals Specialists	0	0	0	0.37	0	0	0	0	1.05
Score	0	0	0	1	0	0	0	0	1
% Individuals Top Carnivores	41.61	20.00	46.43	70.59	63.64	51.72	60.00	62.16	56.93
Score	5	5	5	5	5	5	5	5	5
(Site CPUE/mean CPUE)x 100	140.72	7.82	149.82	401.82	26.80	31.05	11.31	30.84	100
Score	5	1	5	5	1	1	1	1	3
% Individuals - Invading Species/Hybrids	14.09	60.00	5.71	10.66	9.09	0	10.00	37.84	11.75
Score	1	1	1	1	1	5	1	1	1
Index of Biotic Integrity (IBI)	18	10	20	23	14	14	12	15	22
Rating	Poor	Very Poor	Poor	Poor	Very Poor	Very Poor	Very Poor	Very Poor to Poor	Poor

Appendix 12. Continued.

July	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	45.5	21.2	69.7	57.6	36.4	24.2	48.5	9.09	100
Score	**3**	**1**	**5**	**5**	**3**	**1**	**3**	**1**	**5**
Number of Percid Sp.	2	1	3	3	2	1	2	0	3
Score	**3**	**1**	**5**	**5**	**3**	**1**	**3**	**0**	**5**
# of Native Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	0	0	0	0	0	0	0	0	0
Score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
% Individuals Generalists	85.71	65.63	79.45	75.47	51.61	49.02	50.00	80.00	71.46
Score	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
% Individuals Specialists	1.9	0	0.68	0.94	0	0	0	0.00	0.67
Score	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**
% Individuals Top Carnivores	12.38	34.38	19.86	23.58	48.39	50.98	50.00	20.00	27.84
Score	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
(Site CPUE/mean CPUE)x 100	95.54	45.86	293.31	154.14	69.74	58.92	73.89	9.59	100
Score	**3**	**1**	**5**	**5**	**1**	**1**	**1**	**1**	**3**
% Individuals - Invading Species	4.76	9.37	5.14	5.66	0	7.84	0	30.00	4.86
Score	**3**	**1**	**1**	**1**	**5**	**1**	**5**	**1**	**3**
Index of Biotic Integrity (IBI)	**19**	**10**	**23**	**23**	**18**	**10**	**18**	**9**	**23**
Rating	**Poor**	**Very Poor**	**Poor**	**Poor**	**Poor**	**Very Poor**	**Poor**	**Very Poor**	**Poor**

Appendix 12. Continued.

October	Site								
	1	2	3	4	5	6	7	8	All Sites
# of Sp. at Each Site as % of Total Sp. #	42.42	33.33	30.3	51.51	39.39	33.33	54.54	30.3	100
Score	**3**	**3**	**3**	**5**	**3**	**3**	**5**	**3**	**5**
Number of Percid Sp.	2	2	2	1	2	1	1	1	3
Score	**3**	**3**	**3**	**1**	**3**	**1**	**1**	**1**	**5**
# of Native Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	0	0	0	0	0	0	0	0	0
Score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
% Individuals Generalists	38.71	49.23	60	50	81.54	87.75	59.52	93.02	56.57
Score	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
% Individuals Specialists	57.1	40	32.38	12.65	7.69	4.08	2.38	0.00	26.57
Score	**5**	**3**	**3**	**1**	**1**	**1**	**1**	**0**	**3**
% Individuals Top Carnivores	4.19	10.77	7.62	37.35	10.77	8.16	38.09	6.98	16.86
Score	**3**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
(Site CPUE/mean CPUE)x 100	189.28	70.15	77.8	186.22	54.34	88.23	108.67	26.02	100
Score	**5**	**1**	**1**	**5**	**1**	**3**	**3**	**1**	**3**
% Individuals - Invading Species	80.00	63.08	62.86	7.83	43.08	44.9	6.54	4.65	44.41
Score	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
Index of Biotic Integrity (IBI)	**23**	**17**	**17**	**19**	**15**	**15**	**17**	**14**	**23**
Rating	**Poor**	**Very Poor to Poor**	**Very Poor to Poor**	**Poor**	**Very Poor**	**Very Poor**	**Very Poor to Poor**	**Very Poor**	**Poor**

Appendix 13. New IBI scores for August 1994 data based on a modified IBI scheme, and an updated trophic guild classification system based on Coker *et al.* (2001).

	Site								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**All Sites**
# of Sp. at Each Site as % of Total Sp. #	41	28.2	64.1	59	56.4	53.8	38.5	30.80	100.00
Score	**3**	**3**	**5**	**5**	**5**	**5**	**3**	**3**	**5**
Number of Percid Sp.	2	2	3	2	3	3	3	1	3
Score	**3**	**3**	**5**	**3**	**5**	**5**	**5**	**1**	**5**
# of Native Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	0	0	0	0	0	0	0	0	0
Score	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
% Individuals Generalists	5.86	7.57	56.21	58.58	34.02	51.79	36.12	75.41	23.55
Score	**5**	**5**	**1**	**1**	**3**	**1**	**3**	**1**	**3**
% Individuals Specialists	93.2	88.38	25.94	7.07	55.12	30.28	59.91	13.11	69.09
Score	**5**	**5**	**3**	**1**	**5**	**3**	**5**	**1**	**5**
% Individuals Top Carnivores	0.93	4.04	17.84	34.34	10.86	17.93	3.96	11.47	7.36
Score	**1**	**3**	**5**	**5**	**5**	**5**	**3**	**5**	**5**
(Site CPUE/mean CPUE)x 100	414.4	42.6	79.6	42.6	104.90	54	48.8	13.1	100
Score	**5**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**3**
% Individuals - Invading Species	93.46	91.91	38.11	18.18	56.76	32.67	62.55	36.06	72.12
Score	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Index of Biotic Integrity (IBI)	**23**	**21**	**21**	**17**	**27**	**21**	**21**	**13**	**27**
Rating	**Poor**	**Poor**	**Poor**	**Very Poor to Poor**	**Fair**	**Poor**	**Poor**	**Very Poor**	**Fair**

Appendix 14. Original IBI scores for August 1994, from MacLennan and Hyatt (1996).

	Site								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**All Sites**
# of Sp. at Each Site as % of Total Sp. #	41	28.2	64.1	59	56.4	53.8	38.5	30.80	100.00
Score	**3**	**3**	**5**	**5**	**5**	**5**	**3**	**3**	**5**
Number of Percid Sp.	2	2	3	2	3	3	3	1	3
Score	**3**	**3**	**5**	**3**	**5**	**5**	**5**	**1**	**5**
# of Naturally-Spawned Salmonid/Coregonid Spp. at Each Site	0	1	0	2	0	0	0	1	3
Score	**0**	**1**	**0**	**3**	**0**	**0**	**0**	**1**	**5**
% Individuals Generalists	4.8	5.6	20.5	14.1	8	23.1	9.3	65.6	9.8
Score	**5**	**5**	**3**	**5**	**5**	**3**	**5**	**1**	**5**
% Individuals Specialists	94.2	90.4	64.6	52	81.6	60.2	86.8	24.6	83.3
Score	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**3**	**5**
% Individuals Top Carnivores	0.9	4	14.9	33.8	10.5	16.7	4	9.8	6.9
Score	**1**	**3**	**5**	**5**	**5**	**5**	**3**	**5**	**5**
(Site CPUE/mean CPUE)x 100	414.4	42.6	79.6	42.6	104.90	54	48.8	13.1	100
Score	**5**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**3**
% Individuals - Invading Species	93.4	91.9	38.1	18.2	56.8	32.7	62.6	32.8	72
Score	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Index of Biotic Integrity (IBI)	**23**	**22**	**25**	**28**	**29**	**25**	**23**	**16**	**34**
Rating	**Poor**	**Poor**	**Fair**	**Fair**	**Fair**	**Fair**	**Poor**	**Very Poor to Poor**	**Good**

Appendix 15. Summary of DFO 2004 habitat data, St. Clair River.

# On Map	Field Number	Air Temp (C°)	Water Temp (C°)	Secchi Depth (m)	Conductivity (µS)	Stream Width (m)	Max Stream Depth (m)	Distance From Shore (m)	Max Samp Depth (m)	Flow Rate	Aquatic Veg Type1	(%)	Aquatic Veg Type2	(%)
1	SCR04COA170604001A	23.5	14.7	N/A	227	500	10	2	2.5	Medium	None	100		
	SCR04COA170604001B	22.5	15.9	N/A	227	500	9	2	2.5	Medium	None	100		
2	SCR04COA170604003A	18.7	15.5	N/A	212	500	9	50	2	Medium	Submergent	30	None	70
	SCR04COA170604003B	18.7	15.2	N/A	223	500	8	50	2	Medium	Submergent	50	None	50
3	SCR04COA170604004A	24.1	17.5	N/A	233	500	9	10	2	Slow/Medium	Submergent	50	None	50
	SCR04COA170604004B	21.9	16.8	N/A	233	500	9	10		Medium	Submergent	50	None	50
4	SCR04COA160604007A	18	18	N/A	210	500	7	10	2	Medium	Myriophylum	40	None	60
	SCR04COA160604007B	22.1	18.2	N/A	217	500	7	10	2	Medium	Myriophylum	50	None	50
5	SCR04COA160604008A	26.1	16.9	N/A	220	500	8	30	2	Medium	Submergent	20	None	80
	SCR04COA160604008B	26.1	16.9	N/A	220	500	8	30	2	Medium	Emergent	50	None	50
6	SCR04COA160604009A	23.8	16.8	N/A	222	500	8	50	2	Medium	None	100		
	SCR04COA160604009B	25.3	17	N/A	204	500	8	50	2	Medium	None	100		
7	SCR04COA160604010A	21.5	16	N/A	212	500	8	10	2	Medium	None	100		
	SCR04COA160604010B	21.8	16	N/A	212	500	8	30	3	N/A	N/A	N/A		
8	SCR04COA170604011A	N/A	N/A	N/A	N/A	400	10	2	2	Medium	None	100		
	SCR04COA170604011B	21.8	15.2	N/A	220	350	9	10	2	N/A	None	100		
1	SCR04COA220704001A	26.1	21.5	>3	224	700	12	2	2	Medium	None	100		
	SCR04COA220704001B	23.9	20.3	>3	221	700	12	2	2	Fast	None	100		
2	SCR04COA220704003A	21.5	19.8	>3	223	700	10	80	2	Fast	Submergent	40	None	60
	SCR04COA220704003B	22.4	19.8	>3	225	700	10	70	2	Medium	Submergent	40	None	60
3	SCR04COA220704004A	23.7	20.5	>3	223	800	10	20	2	Slow	Submergent	50	None	50
	SCR04COA220704004B	22	21.9	>3	230	800	10	10	1.33	Slow	Submergent	40	None	60
4	SCR04COA210704007A	25.8	29.2	N/A	236	600	15	20	2	Medium	Submergent	30	None	70
	SCR04COA210704007B	25.5	25	N/A	232	600	15	20	2	Medium	Emergent	40	None	60
5	SCR04COA210704008A	25.2	21.9	N/A	224	750	10	100	2	N/A	None	80	Submergent	20
	SCR04COA210704008B	27.6	22.6	N/A	214	600	12	100	2	N/A	Submergent	30	None	70
6	SCR04COA210704009A	26.2	22.2	>3	220	600	12	75	2	Slow	Submergent	30	None	70
	SCR04COA210704009B	26.4	21.7	>3	223	600	12	75	2	Slow	None	100		
7	SCR04COA210704010A	29.8	N/A	>3	N/A	250	15	10	2	Slow	Submergent	60	None	40
	SCR04COA210704010B	26.9	22.4	>3	212	600	16	150	2	Medium	Submergent	30	None	70

Appendix 15. Continued.

# On Map	Field Number	Air Temp (C°)	Water Temp (C°)	Secchi Depth (m)	Conductivity (µS)	Stream Width (m)	Max Stream Depth (m)	Distance From Shore (m)	Max Samp Depth (m)	Flow Rate	Aquatic Veg Type1	(%)	Aquatic Veg Type2	(%)
8	SCR04COA220704011A	27.1	21.2	>3	214	600	12	2	2	Medium	None	100		
	SCR04COA220704011B	26.8	21.8	>3	218	700	12	20	2	Medium	Submergent	30	None	70
1	SCR04COA141004001A	N/A	14.6	N/A	207	400	15	2	2	Medium	Submergent	5	None	95
	SCR04COA141004001B	12.3	14.2	N/A	207	N/A	N/A	N/A	N/A	N/A	Submergent	5	None	95
2	SCR04COA141004003A	N/A	14.1	>2	203	400	15	150	2	Medium	Submergent	20	None	80
	SCR04COA141004003B	11.9	14	>2	203	400	12	120	2	Medium	Submergent	40	None	60
3	SCR04COA141004004A	11.9	14.5	>2	210	450	15	30	2	Medium	Submergent	30	None	70
	SCR04COA141004004B	N/A	16.6	>2	218	400	15	30	2	Slow	Submergent	10	None	90
4	SCR04COA131004007A	17	15.5	2.2	201	400	15	30	2.5	Medium	Submergent	70	None	30
	SCR04COA131004007B	11	17.3	2.3	210	400	15	20	2	Medium	Submergent	70	None	30
5	SCR04COA131004008A	N/A	15.9	2.3	157	400	15	100	2	Medium	Submergent	30	None	70
	SCR04COA131004008B	18	16	>1.2	198	400	15	50	2	Slow	Submergent	20	None	80
6	SCR04COA131004009A	20	16.2	>2	195	400	15	60	2	Medium	Submergent	30	None	70
	SCR04COA131004009B	20	18	>2.3	190	400	15	30	2	Slow	Submergent	30	None	70
7	SCR04COA131004010A	19	15.4	>2	198	400	15	5	2	Slow	Submergent	100		
	SCR04COA131004010B	21	15.9	2.4	197	400	15	150	2	N/A	Submergent	50	None	50
8	SCR04COA141004011A	N/A	N/A	>2	N/A	300	15	2	2	Medium	None	100		
	SCR04COA141004011B	12.5	13.9	>2	204	400	15	2	2	Medium	None	100		

Appendix 16. Summary of species caught by site during OMNR (August 1994) and DFO (July 2004) sampling, St. Clair River.

	OMNR 1994									DFO 2004								
Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Alosa pseudoharengus	1796	175	96	14	268	70	136	7	**2562**	0	0	1	0	0	0	0	0	**1**
Ambloplites rupestris	14	1	23	5	6	7	3	4	**63**	0	0	1	0	0	0	2	0	**3**
Amia calva	0	0	0	0	1	1	0	1	**3**	0	0	0	0	1	0	0	0	**1**
Aplodinotus grunniens	4	1	6	0	13	1	0	0	**25**	1	0	3	0	4	0	4	0	**12**
Carassius auratus	0	0	0	0	2	0	0	0	**2**	0	0	0	0	0	0	0	0	**0**
Carpiodes cyprinus	0	0	0	0	1	0	0	0	**1**	0	0	1	0	0	0	0	0	**1**
Catostomus commersonii	9	3	2	2	14	8	2	0	**40**	0	5	5	7	1	0	4	0	**22**
Cyprinella spiloptera	0	0	4	0	0	0	0	0	**4**	0	0	0	1	0	0	0	0	**1**
Cyprinus carpio	3	3	21	13	4	9	6	1	**60**	1	0	12	4	0	0	0	0	**17**
Dorosoma cepedianum	0	0	0	0	1	5	0	1	**7**	1	0	1	0	0	0	0	0	**2**
Esox lucius	1	0	0	3	2	0	1	0	**7**	0	0	0	0	0	0	0	0	**0**
Gasterosteus aculeatus	1	0	0	0	0	0	0	2	**3**	0	0	0	0	0	0	0	1	**1**
Hypentelium nigricans	2	0	0	0	0	0	1	0	**3**	1	0	0	0	1	1	0	0	**3**
Ichthyomyzon unicuspis	0	0	0	0	0	0	0	0	**0**	1	0	0	1	0	0	0	0	**2**
Labidesthes sicculus	0	0	0	0	0	1	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Lepisosteus osseus	0	0	0	3	0	0	0	0	**3**	0	0	0	1	0	0	0	0	**1**
Lepomis gibbosus	0	0	1	1	0	0	0	0	**2**	0	0	0	0	0	0	0	0	**0**
Lepomis macrochirus	0	0	7	2	0	0	0	0	**9**	0	0	0	0	0	0	0	0	**0**
Luxilus chrysocephalus	0	0	0	0	0	0	0	0	**0**	0	3	1	0	1	0	1	0	**6**
Luxilus comutus	0	0	3	2	2	32	1	1	**41**	0	0	0	0	0	0	0	0	**0**
Lythrurus umbratilis	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	**1**
Micropterus dolomieu	4	0	15	0	0	0	2	0	**21**	1	0	0	1	5	0	1	0	**8**
Micropterus salmoides	0	0	1	37	5	6	0	0	**49**	0	0	0	0	0	0	0	0	**0**
Minytrema melanops	0	0	1	0	0	2	5	0	**8**	0	0	4	0	0	0	1	0	**5**
Morone americana	0	0	11	1	1	2	0	0	**15**	0	0	1	1	0	1	0	0	**3**
Morone chrysops	0	0	3	0	0	0	0	0	**3**	3	0	2	1	0	0	0	0	**6**
Moxostoma anisurum	4	0	1	3	0	2	0	0	**10**	0	0	3	2	6	4	2	0	**17**
Moxostoma erythrurum	0	0	0	0	0	0	0	0	**0**	1	1	13	0	1	1	2	0	**19**
Moxostoma macrolepidotum	71	3	13	2	1	2	4	11	**107**	48	8	90	9	7	5	9	0	**176**
Neogobius melanostomus	1	0	10	6	2	1	0	0	**20**	0	0	0	0	0	0	0	0	**0**
Nocomis biguttatus	0	0	0	2	0	0	0	0	**2**	1	1	0	2	0	0	2	0	**6**
Notemigonus crysoleucas	0	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	0	0	**1**
Notropis atherinoides	3	0	50	3	44	29	54	1	**184**	32	0	76	48	1	11	6	7	**181**
Notropis hudsonius	1	0	7	38	30	26	3	0	**105**	0	0	2	0	0	0	5	0	**7**
Notropis volucellus	0	0	0	2	18	0	0	0	**20**	0	0	2	1	0	0	1	0	**4**
Oncorhynchus mykiss	0	0	0	1	0	0	0	0	**1**	1	0	0	0	0	0	0	2	**3**
Oncorhynchus tshawytscha	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	**0**
Osmerus mordax	0	1	3	0	0	0	0	11	**15**	3	3	1	1	0	3	0	0	**11**
Perca flavescens	8	1	35	22	39	32	4	0	**141**	8	11	53	18	24	25	40	0	**179**
Percina caprodes	0	0	1	8	14	1	1	0	**25**	2	0	14	1	10	0	1	0	**28**
Pimephales notatus	0	3	29	15	5	8	0	0	**60**	0	0	3	3	0	0	1	0	**7**
Salmo trutta	0	3	0	0	0	0	0	1	**4**	0	0	0	0	0	0	0	0	**0**
Sander vitreus	5	4	1	0	5	4	2	5	**26**	0	0	2	3	0	0	0	0	**5**
Semotilus atromaculatus	0	0	4	0	0	0	0	0	**4**	0	0	0	0	0	0	0	0	**0**

Appendix 17. Species catch summary at each sub-site, October 2004, St. Clair River.

Species List	%Composition	Total	1a	1b	2a	2b	3a	3b
Alosa pseudoharengus	24.01960784	245	53	123	26	0	25	9
Ambloplites rupestris	0.784313725	8	0	0	0	0	0	0
Amia calva	0	0	0	0	0	0	0	0
Aplodinotus grunniens	1.960784314	20	0	1	0	1	1	3
Carpiodes cyprinus	0	0	0	0	0	0	0	0
Catostomus commersonii	6.764705882	69	1	0	0	9	1	7
Coregonus sp.	0	0	0	0	0	0	0	0
Cottus bairdii	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	0	0	0	0	0	0	0
Cyprinus carpio	1.960784314	20	0	0	1	1	1	0
Dorosoma cepedianum	0.196078431	2	0	0	0	0	0	0
Esox lucius	0.098039216	1	0	0	0	0	0	0
Etheostoma caeruleum	0	0	0	0	0	0	0	0
Gasterosteus aculeatus	0	0	0	0	0	0	0	0
Hypentelium nigricans	0.980392157	10	0	3	0	0	0	0
Ichthyomyzon unicuspis	0.196078431	2	0	0	0	0	0	0
Ictiobus sp.	0.196078431	2	0	0	0	0	1	0
Labidesthes sicculus	2.156862745	22	0	1	0	0	0	0
Lampetra appendix	0	0	0	0	0	0	0	0
Lepisosteus osseus	0.098039216	1	0	0	0	0	0	0
Lepomis cyanellus	0	0	0	0	0	0	0	0
Lepomis cyanellus/macrochirus hybrid	0	0	0	0	0	0	0	0
Lepomis gibbosus	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	0	0	0	0	0	0	0
Luxilus chrysocephalus	0.490196078	5	0	0	0	0	0	0
Lythrurus umbratilis	0	0	0	0	0	0	0	0
Micropterus dolomieu	0.490196078	5	1	3	0	0	0	0
Micropterus salmoides	0.098039216	1	0	0	0	0	0	0
Minytrema melanops	1.176470588	12	0	0	0	0	0	0
Morone americana	0.098039216	1	0	0	0	0	0	0
Morone chrysops	0	0	0	0	0	0	0	0
Moxostoma anisurum	0.294117647	3	0	0	0	0	0	0
Moxostoma erythrurum	0.098039216	1	0	0	0	0	0	0
Moxostoma macrolepidotum	1.470588235	15	0	0	3	0	5	1
Neogobius melanostomus	0.098039216	1	0	1	0	0	0	0
Nocomis biguttatus	0.392156863	4	0	0	0	1	0	0
Notemigonus crysoleucas	0	0	0	0	0	0	0	0
Notropis atherinoides	11.8627451	121	1	4	0	2	6	5
Notropis hudsonius	2.843137255	29	0	1	0	1	0	0
Notropis volucellus	0	0	0	0	0	0	0	0
Oncorhynchus mykiss	0.196078431	2	1	0	0	0	0	0
Oncorhynchus tshawytscha	0.098039216	1	0	0	0	0	0	0
Osmerus mordax	17.84313725	182	44	25	3	10	14	17
Perca flavescens	15.39215686	157	6	1	1	5	1	7
Percina caprodes	5.392156863	55	10	29	0	0	1	0
Pimephales notatus	1.960784314	20	0	0	0	0	0	0
Pimephales promelas	0	0	0	0	0	0	0	0
Pomoxis nigromaculatus	0.098039216	1	0	0	0	0	0	0
Salmo trutta	0.098039216	1	0	1	0	0	0	0
Sander vitreus	0.098039216	1	0	0	1	0	0	0
Semotilus atromaculatus	0	0	0	0	0	0	0	0
Total Catch		1020	117	193	35	30	56	49

Appendix 17. Continued.

Species List	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b
Alosa pseudoharengus	0	4	3	1	1	0	0	0	0	0
Ambloplites rupestris	0	3	0	0	0	0	2	0	3	0
Amia calva	0	0	0	0	0	0	0	0	0	0
Aplodinotus grunniens	0	0	2	0	0	9	3	0	0	0
Carpiodes cyprinus	0	0	0	0	0	0	0	0	0	0
Catostomus commersonii	5	5	4	3	2	0	22	8	0	2
Coregonus sp.	0	0	0	0	0	0	0	0	0	0
Cottus bairdii	0	0	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	0	0	0	0	0	0	0	0	0
Cyprinus carpio	1	4	3	0	1	1	6	1	0	0
Dorosoma cepedianum	0	0	0	0	0	0	2	0	0	0
Esox lucius	0	0	0	0	0	0	1	0	0	0
Etheostoma caeruleum	0	0	0	0	0	0	0	0	0	0
Gasterosteus aculeatus	0	0	0	0	0	0	0	0	0	0
Hypentelium nigricans	1	0	0	1	0	0	5	0	0	0
Ichthyomyzon unicuspis	1	0	0	0	0	0	1	0	0	0
Ictiobus sp.	0	0	0	0	0	0	0	0	0	1
Labidesthes sicculus	1	15	1	0	3	0	1	0	0	0
Lampetra appendix	0	0	0	0	0	0	0	0	0	0
Lepisosteus osseus	0	0	0	1	0	0	0	0	0	0
Lepomis cyanellus	0	0	0	0	0	0	0	0	0	0
Lepomis cyanellus/macrochirus hybrid	0	0	0	0	0	0	0	0	0	0
Lepomis gibbosus	0	0	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	0	0	0	0	0	0	0	0	0
Luxilus chrysocephalus	0	3	0	0	1	0	1	0	0	0
Lythrurus umbratilis	0	0	0	0	0	0	0	0	0	0
Micropterus dolomieu	0	0	0	1	0	0	0	0	0	0
Micropterus salmoides	0	0	0	0	0	0	0	0	0	1
Minytrema melanops	6	1	0	0	0	0	3	1	0	1
Morone americana	1	0	0	0	0	0	0	0	0	0
Morone chrysops	0	0	0	0	0	0	0	0	0	0
Moxostoma anisurum	0	1	2	0	0	0	0	0	0	0
Moxostoma erythrurum	0	0	0	0	0	1	0	0	0	0
Moxostoma macrolepidotum	0	0	0	0	2	0	1	1	0	2
Neogobius melanostomus	0	0	0	0	0	0	0	0	0	0
Nocomis biguttatus	0	2	0	0	0	0	1	0	0	0
Notemigonus crysoleucas	0	0	0	0	0	0	0	0	0	0
Notropis atherinoides	2	17	3	13	13	15	17	6	9	8
Notropis hudsonius	0	9	0	0	0	0	12	6	0	0
Notropis volucellus	0	0	0	0	0	0	0	0	0	0
Oncorhynchus mykiss	0	0	0	0	0	0	0	0	0	1
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	1
Osmerus mordax	0	3	12	9	28	13	0	4	0	0
Perca flavescens	17	44	1	4	6	2	43	19	0	0
Percina caprodes	0	0	0	1	0	0	0	0	10	4
Pimephales notatus	0	0	0	0	0	0	0	0	0	0
Pimephales promelas	0	20	0	0	0	0	0	0	0	0
Pomoxis nigromaculatus	0	0	0	0	0	0	1	0	0	0
Salmo trutta	0	0	0	0	0	0	0	0	0	0
Sander vitreus	0	0	0	0	0	0	0	0	0	0
Semotilus atromaculatus	0	0	0	0	0	0	0	0	0	0
Total	**35**	**131**	**31**	**34**	**57**	**41**	**122**	**46**	**22**	**21**

Appendix 18. Species catch summary at each sub-site, July 2004, St. Clair River.

Species List	%Composition	Total	1a	1b	2a	2b	3a	3b
Alosa pseudoharengus	0.135135135	1	0	0	0	0	0	1
Ambloplites rupestris	0.405405405	3	0	0	0	0	0	1
Amia calva	0.135135135	1	0	0	0	0	0	0
Aplodinotus grunniens	1.621621622	12	1	0	0	0	2	1
Carpiodes cyprinus	0.135135135	1	0	0	0	0	1	0
Catostomus commersonii	2.972972973	22	0	0	2	3	2	3
Coregonus sp.	0	0	0	0	0	0	0	0
Cottus bairdii	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0.135135135	1	0	0	0	0	0	0
Cyprinus carpio	2.297297297	17	0	1	0	0	10	2
Dorosoma cepedianum	0.27027027	2	0	1	0	0	1	0
Esox lucius	0	0	0	0	0	0	0	0
Etheostoma caeruleum	0	0	0	0	0	0	0	0
Gasterosteus aculeatus	0.135135135	1	0	0	0	0	0	0
Hypentelium nigricans	0.405405405	3	0	1	0	0	0	0
Ichthyomyzon unicuspis	0.27027027	2	0	1	0	0	0	0
Ictiobus sp.	0	0	0	0	0	0	0	0
Labidesthes sicculus	0	0	0	0	0	0	0	0
Lampetra appendix	0	0	0	0	0	0	0	0
Lepisosteus osseus	0.135135135	1	0	0	0	0	0	0
Lepomis cyanellus	0	0	0	0	0	0	0	0
Lepomis cyanellus/macrochirus hybrid	0	0	0	0	0	0	0	0
Lepomis gibbosus	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	0	0	0	0	0	0	0
Luxilus chrysocephalus	0.810810811	6	0	0	3	0	0	1
Lythrurus umbratilis	0.135135135	1	0	0	0	0	0	1
Micropterus dolomieu	1.081081081	8	0	1	0	0	0	0
Micropterus salmoides	0	0	0	0	0	0	0	0
Minytrema melanops	0.675675676	5	0	0	0	0	1	3
Morone americana	0.405405405	3	0	0	0	0	1	0
Morone chrysops	0.810810811	6	0	3	0	0	0	2
Moxostoma anisurum	2.297297297	17	0	0	0	0	2	1
Moxostoma erythrurum	2.567567568	19	1	0	0	1	0	13
Moxostoma macrolepidotum	23.78378378	176	11	37	0	8	43	47
Neogobius melanostomus	0	0	0	0	0	0	0	0
Nocomis biguttatus	0.810810811	6	0	1	1	0	0	0
Notemigonus crysoleucas	0.135135135	1	0	0	0	0	0	0
Notropis atherinoides	24.45945946	181	1	31	0	0	64	12
Notropis hudsonius	0.945945946	7	0	0	0	0	0	2
Notropis volucellus	0.540540541	4	0	0	0	0	1	1
Oncorhynchus mykiss	0.405405405	3	0	1	0	0	0	0
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0
Osmerus mordax	1.486486486	11	0	3	3	0	1	0
Perca flavescens	24.18918919	179	7	1	10	1	31	22
Percina caprodes	3.783783784	28	1	1	0	0	2	12
Pimephales notatus	0.945945946	7	0	0	0	0	0	3
Pimephales promelas	0	0	0	0	0	0	0	0
Pomoxis nigromaculatus	0	0	0	0	0	0	0	0
Salmo trutta	0	0	0	0	0	0	0	0
Sander vitreus	0.675675676	5	0	0	0	0	2	0
Semotilus atromaculatus	0	0	0	0	0	0	0	0
Total Catch		740	22	83	19	13	164	128

Appendix 18. Continued.

Species List	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b
Alosa pseudoharengus	0	0	0	0	0	0	0	0	0	0
Ambloplites rupestris	0	0	0	0	0	0	2	0	0	0
Amia calva	0	0	1	0	0	0	0	0	0	0
Aplodinotus grunniens	0	0	1	3	0	0	4	0	0	0
Carpiodes cyprinus	0	0	0	0	0	0	0	0	0	0
Catostomus commersonii	5	2	1	0	0	0	3	1	0	0
Coregonus sp.	0	0	0	0	0	0	0	0	0	0
Cottus bairdii	0	0	0	0	0	0	0	0	0	0
Cyprinella spiloptera	0	1	0	0	0	0	0	0	0	0
Cyprinus carpio	2	2	0	0	0	0	0	0	0	0
Dorosoma cepedianum	0	0	0	0	0	0	0	0	0	0
Esox lucius	0	0	0	0	0	0	0	0	0	0
Etheostoma caeruleum	0	0	0	0	0	0	0	0	0	0
Gasterosteus aculeatus	0	0	0	0	0	0	0	0	1	0
Hypentelium nigricans	0	0	1	0	0	1	0	0	0	0
Ichthyomyzon unicuspis	1	0	0	0	0	0	0	0	0	0
Ictiobus sp.	0	0	0	0	0	0	0	0	0	0
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	0
Lampetra appendix	0	0	0	0	0	0	0	0	0	0
Lepisosteus osseus	0	1	0	0	0	0	0	0	0	0
Lepomis cyanellus	0	0	0	0	0	0	0	0	0	0
Lepomis cyanellus/macrochirus hybrid	0	0	0	0	0	0	0	0	0	0
Lepomis gibbosus	0	0	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	0	0	0	0	0	0	0	0	0
Luxilus chrysocephalus	0	0	1	0	0	0	1	0	0	0
Lythrurus umbratilis	0	0	0	0	0	0	0	0	0	0
Micropterus dolomieu	0	1	3	2	0	0	0	1	0	0
Micropterus salmoides	0	0	0	0	0	0	0	0	0	0
Minytrema melanops	0	0	0	0	0	0	1	0	0	0
Morone americana	0	1	0	0	1	0	0	0	0	0
Morone chrysops	0	1	0	0	0	0	0	0	0	0
Moxostoma anisurum	0	2	6	0	2	2	1	1	0	0
Moxostoma erythrurum	0	0	1	0	0	1	1	1	0	0
Moxostoma macrolepidotum	4	5	4	3	1	4	4	5	0	0
Neogobius melanostomus	0	0	0	0	0	0	0	0	0	0
Nocomis biguttatus	0	2	0	0	0	0	2	0	0	0
Notemigonus crysoleucas	0	1	0	0	0	0	0	0	0	0
Notropis atherinoides	0	48	1	0	11	0	4	2	1	6
Notropis hudsonius	0	0	0	0	0	0	5	0	0	0
Notropis volucellus	0	1	0	0	0	0	1	0	0	0
Oncorhynchus mykiss	0	0	0	0	0	0	0	0	2	0
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	0
Osmerus mordax	1	0	0	0	2	1	0	0	0	0
Perca flavescens	6	12	20	4	16	9	38	2	0	0
Percina caprodes	1	0	1	9	0	0	1	0	0	0
Pimephales notatus	0	3	0	0	0	0	1	0	0	0
Pimephales promelas	0	0	0	0	0	0	0	0	0	0
Pomoxis nigromaculatus	0	0	0	0	0	0	0	0	0	0
Salmo trutta	0	0	0	0	0	0	0	0	0	0
Sander vitreus	2	1	0	0	0	0	0	0	0	0
Semotilus atromaculatus	0	0	0	0	0	0	0	0	0	0
Total	22	84	41	21	33	18	69	13	4	6

Appendix 19. Species catch summary at each sub-site, June 2004, St. Clair River.

Species List	% Composition	Total	1a	1b	2a	2b	3a	3b
Alosa pseudoharengus	0	**0**	0	0	0	0	0	0
Ambloplites rupestris	4.819277108	**32**	19	9	0	0	0	0
Amia calva	0	**0**	0	0	0	0	0	0
Aplodinotus grunniens	0.753012048	**5**	0	0	0	0	2	2
Carpiodes cyprinus	0	**0**	0	0	0	0	0	0
Catostomus commersonii	3.313253012	**22**	0	0	0	0	1	3
Coregonus sp.	0.903614458	**6**	0	0	0	0	0	0
Cottus bairdii	0.15060241	**1**	0	0	0	0	0	0
Cyprinella spiloptera	0	**0**	0	0	0	0	0	0
Cyprinus carpio	4.518072289	**30**	0	0	0	0	1	0
Dorosoma cepedianum	0	**0**	0	0	0	0	0	0
Esox lucius	0	**0**	0	0	0	0	0	0
Etheostoma caeruleum	0.15060241	**1**	0	0	0	0	0	0
Gasterosteus aculeatus	0.301204819	**2**	2	0	0	0	0	0
Hypentelium nigricans	0	**0**	0	0	0	0	0	0
Ichthyomyzon unicuspis	0	**0**	0	0	0	0	0	0
Ictiobus sp.	0	**0**	0	0	0	0	0	0
Labidesthes sicculus	0	**0**	0	0	0	0	0	0
Lampetra appendix	0.15060241	**1**	0	0	0	0	0	0
Lepisosteus osseus	0.15060241	**1**	0	0	0	0	0	0
Lepomis cyanellus	0.451807229	**3**	2	0	0	0	0	1
Lepomis cyanellus/macrochirus hybrid	0.15060241	**1**	1	0	0	0	0	0
Lepomis gibbosus	0.15060241	**1**	0	0	0	0	0	0
Lepomis macrochirus	1.656626506	**11**	2	5	0	0	0	0
Luxilus chrysocephalus	0	**0**	0	0	0	0	0	0
Lythrurus umbratilis	0	**0**	0	0	0	0	0	0
Micropterus dolomieu	4.36746988	**29**	8	8	0	0	0	0
Micropterus salmoides	0.301204819	**2**	0	0	0	0	0	0
Minytrema melanops	0	**0**	0	0	0	0	0	0
Morone americana	0	**0**	0	0	0	0	0	0
Morone chrysops	0.602409639	**4**	0	0	0	0	0	0
Moxostoma anisurum	0.451807229	**3**	0	1	0	0	1	0
Moxostoma erythrurum	1.054216867	**7**	0	0	0	0	0	3
Moxostoma macrolepidotum	5.271084337	**35**	0	1	0	1	11	8
Neogobius melanostomus	4.21686747	**28**	10	6	0	0	4	1
Nocomis biguttatus	1.204819277	**8**	2	4	0	0	1	0
Notemigonus crysoleucas	0.15060241	**1**	0	0	0	0	0	0
Notropis atherinoides	6.777108434	**45**	23	0	0	0	19	1
Notropis hudsonius	3.915662651	**26**	0	1	0	0	6	2
Notropis volucellus	0.15060241	**1**	0	0	0	0	0	0
Oncorhynchus mykiss	1.506024096	**10**	1	0	0	0	0	0
Oncorhynchus tshawytscha	0.15060241	**1**	0	0	0	0	0	0
Osmerus mordax	0.753012048	**5**	0	0	2	1	2	0
Perca flavescens	48.64457831	**323**	11	30	1	0	27	35
Percina caprodes	1.054216867	**7**	0	0	0	0	1	6
Pimephales notatus	0.451807229	**3**	1	0	0	0	0	0
Pimephales promelas	0.451807229	**3**	0	0	0	0	0	0
Pomoxis nigromaculatus	0	**0**	0	0	0	0	0	0
Salmo trutta	0.15060241	**1**	0	1	0	0	0	0
Sander vitreus	0.602409639	**4**	0	1	0	0	0	2
Semotilus atromaculatus	0.15060241	**1**	0	0	0	0	0	0
Total Catch		**664**	82	67	3	2	76	64

Appendix 19. Continued.

Species List	4a	4b	5a	5b	6a	6b	7a	7b	8a	8b
Alosa pseudoharengus	0	0	0	0	0	0	0	0	0	0
Ambloplites rupestris	0	0	0	0	0	0	1	0	0	3
Amia calva	0	0	0	0	0	0	0	0	0	0
Aplodinotus grunniens	0	1	0	0	0	0	0	0	0	0
Carpiodes cyprinus	0	0	0	0	0	0	0	0	0	0
Catostomus commersonii	0	15	2	0	0	0	1	0	0	0
Coregonus sp.	0	0	0	0	0	0	0	0	0	6
Cottus bairdii	0	0	0	0	0	0	0	0	1	0
Cyprinella spiloptera	0	0	0	0	0	0	0	0	0	0
Cyprinus carpio	0	28	0	0	0	0	1	0	0	0
Dorosoma cepedianum	0	0	0	0	0	0	0	0	0	0
Esox lucius	0	0	0	0	0	0	0	0	0	0
Etheostoma caeruleum	0	0	0	1	0	0	0	0	0	0
Gasterosteus aculeatus	0	0	0	0	0	0	0	0	0	0
Hypentelium nigricans	0	0	0	0	0	0	0	0	0	0
Ichthyomyzon unicuspis	0	0	0	0	0	0	0	0	0	0
Ictiobus sp.	0	0	0	0	0	0	0	0	0	0
Labidesthes sicculus	0	0	0	0	0	0	0	0	0	0
Lampetra appendix	0	1	0	0	0	0	0	0	0	0
Lepisosteus osseus	0	1	0	0	0	0	0	0	0	0
Lepomis cyanellus	0	0	0	0	0	0	0	0	0	0
Lepomis cyanellus/macrochirus hybrid	0	0	0	0	0	0	0	0	0	0
Lepomis gibbosus	0	1	0	0	0	0	0	0	0	0
Lepomis macrochirus	0	4	0	0	0	0	0	0	0	0
Luxilus chrysocephalus	0	0	0	0	0	0	0	0	0	0
Lythrurus umbratilis	0	0	0	0	0	0	0	0	0	0
Micropterus dolomieu	0	1	5	1	0	0	1	0	0	5
Micropterus salmoides	0	1	0	0	0	0	0	0	0	1
Minytrema melanops	0	0	0	0	0	0	0	0	0	0
Morone americana	0	0	0	0	0	0	0	0	0	0
Morone chrysops	0	4	0	0	0	0	0	0	0	0
Moxostoma anisurum	0	1	0	0	0	0	0	0	0	0
Moxostoma erythrurum	0	3	1	0	0	0	0	0	0	0
Moxostoma macrolepidotum	0	10	1	1	2	0	0	0	0	0
Neogobius melanostomus	1	0	0	2	0	0	0	0	2	2
Nocomis biguttatus	0	0	0	0	0	0	1	0	0	0
Notemigonus crysoleucas	0	1	0	0	0	0	0	0	0	0
Notropis atherinoides	1	1	0	0	0	0	0	0	0	0
Notropis hudsonius	0	5	0	0	11	1	0	0	0	0
Notropis volucellus	0	1	0	0	0	0	0	0	0	0
Oncorhynchus mykiss	0	0	0	0	0	0	0	0	0	9
Oncorhynchus tshawytscha	0	0	0	0	0	0	0	0	0	1
Osmerus mordax	0	0	0	0	0	0	0	0	0	0
Perca flavescens	7	177	2	6	12	3	4	1	0	7
Percina caprodes	0	0	0	0	0	0	0	0	0	0
Pimephales notatus	0	2	0	0	0	0	0	0	0	0
Pimephales promelas	0	3	0	0	0	0	0	0	0	0
Pomoxis nigromaculatus	0	0	0	0	0	0	0	0	0	0
Salmo trutta	0	0	0	0	0	0	0	0	0	0
Sander vitreus	0	1	0	0	0	0	0	0	0	0
Semotilus atromaculatus	0	1	0	0	0	0	0	0	0	0
Total	**9**	**263**	**11**	**11**	**25**	**4**	**9**	**1**	**3**	**34**