An Investigation

of the

Fish Population

in

Winton Woods Lake

(Final Report)

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Introduction

This project was designed to study the present fishery in Winton Lake with a focus on the fish population diversity and relative abundance. This baseline information can then aid in determining the relative numbers and species of fish that should be stocked in the lake following the dredging operation.

When evaluating the health of freshwater ecosystems, fish communities serve as the most viable approach for doing so (Karr and Dudley 1978, 1981). The relative condition of a fish community acts as a sensitive indicator of the health of the aquatic ecosystem (Karr 1987). Physical and chemical variables are inadequate measures of the potential selective pressures of pollution on specific individuals of natural populations. Other organisms, such as benthic invertebrates (Hilsenoff 1988, 1987; Washington 1984), have previously served as indicators for biological monitoring. However, several investigators (Fausch et al. 1990; Ohio EPA 1987; Karr 1986) have provided numerous advantages for the use of fishes.

Fish, as relatively permanent residents and long-lived species, are constant and chronic monitors of the environment and provide a long-term chemical, physical and biological record of environmental stress. Most, if not all,trophic groups are represented in a fish community, and those at the top of the food web, by their dependence on lower levels of both aquatic and terrestrial origin, integrate effects from a variety of components and reflect the entire watershed environment. The relative ease of collection and identification at the field site ensure quick and accurate sampling of a community. The necessary background life-history information is usually more extensive for fish than any other taxonomic group. From a management viewpoint, the results obtained from a fish study are much more meaningful to the public in terms of economic, political, and aesthetic value. Fausch et al. (1990) summarize the major advantages of using fish communities in stating that they integrate all of the effects of stress, direct and indirect, on the entire ecosystem and reveal the ecological significance of the perturbation.

Investigators have employed several approaches to assess aquatic communities. The most common ones have been thoroughly reviewed by Fausch et al. (1990) and are as follows: (1) indicator taxa or guilds, (2) species diversity, (3) multivariate methods, and (4) the index of biotic integrity (IBI). We have chosen to calculate the last index based on its specificity to assessing environmental degradation and ecological relevance. It measures both the structure and function of the community by integrating aspects of the community, populations, and individuals. This type of information is vital in formulating a successful restocking program. Furthermore, because the Ohio Environmental Protection Agency has developed the IBI for its comprehensive monitoring program, all of the background information for most Ohio fishes is readily available. Since the advent of the IBI in 1981 by Karr, many investigators (Angermeier and Karr 1986; Karr et al. 1985) have employed this index to determine and predict the impact of environmental degradation in aquatic ecosystems including streams in Ohio (Larson et al. 1986). It appears to be a very direct and effective method for the biological monitoring of aquatic communities.

Methods & Materials

The project was comprised of two periods, each two weeks in length. The first period was 15 through 26 May 1995 with the second period running from 7 through 18 August 1995. The timing of these sampling periods helped assure a random sampling as well as avoided any absences due to migrations, dredging effects, etc. The work schedule followed the typical five-day work-week. Fish were gathered using gill nets, hoopnets, and electrofishing methods. Sampling locations were selected that are representative of most micro-habitats in the lake (Figure 1 & 2). The final selection of these sites was definitely influenced by the dredging operation.

On the first day of the week, four variable mesh (½, 1, 1½, 2, & 2½ inches) gill nets were set either angled or parallel to the shoreline. Gill nets were checked twice daily for fish (early morning and evening just prior to dusk) as is required by the licensing permit. Four hoopnets (10 ft long, 2 ft mouth, & 1 in. mesh) were set in the same area as the gill nets. All nets were removed from the water at the end of each week (when possible) for cleaning, repair of any damage, and theft prevention. The gill net locations used during the 2 weeks in August were different from those used in May; with the exception of site G1 (see map for net locations)

Electrofishing was performed for 1 hour at each site. Generally 2 sites were shocked each day. The entire accessable shoreline was electrofished at least once over the 4 week study.

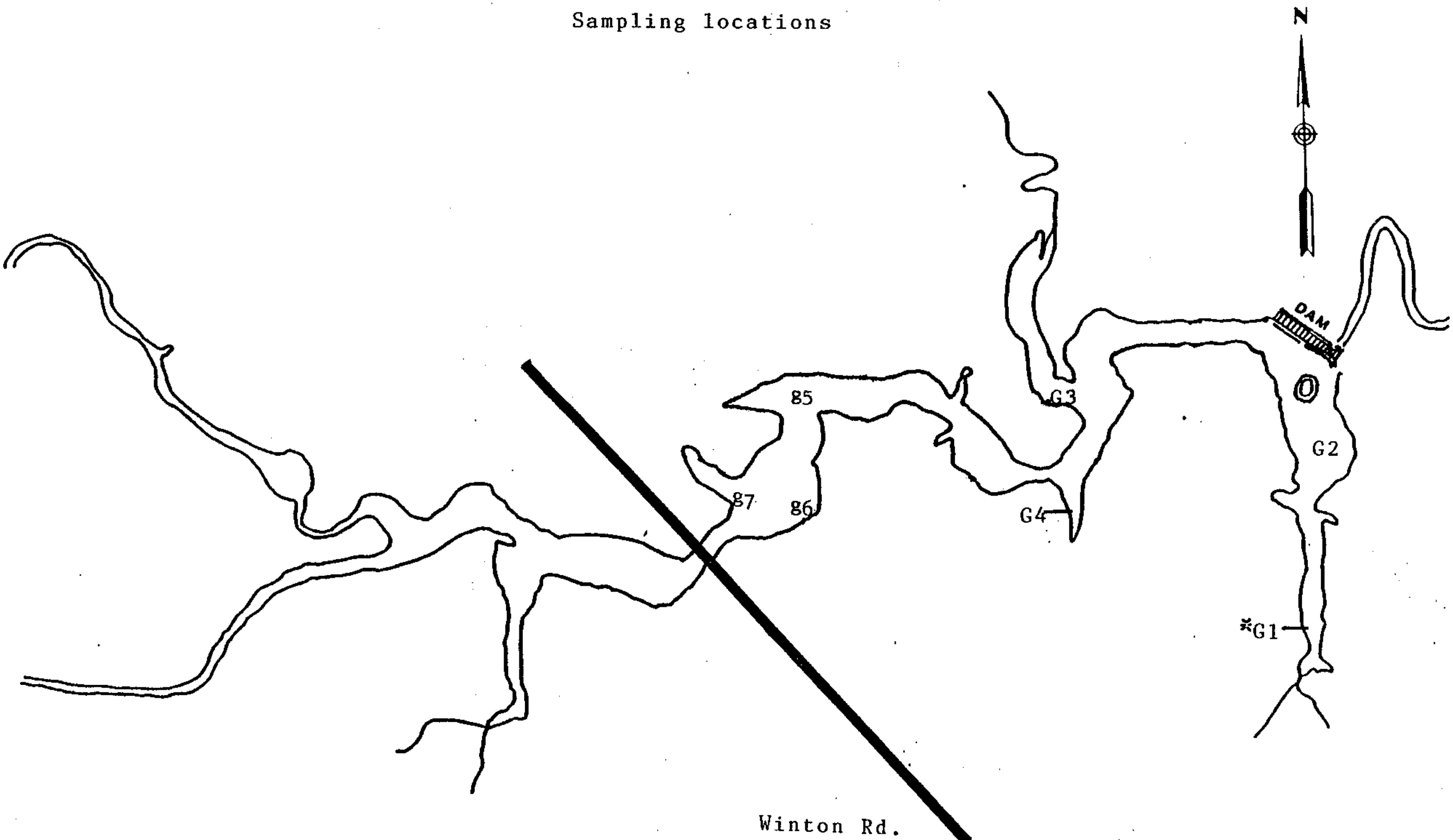
These three collection methods (gillnets, hoopnets, and electrofishing) used in combination increased the accuracy of the database and helped ensure that all species present in the lake were represented in the collections.

Fish collected were identified to species and the data compiled in the following manner: totals, mean averages, standard deviations for body weights,

Figure 1

GILL NET AND HOOP NET

Sampling locations



G1-G4 (May Sampling)
g5-g7 (August Sampling)

*G1 remained in place for both May and August sampling periods.

Electroshocking Sampling Stations
(May 15-25 & August 7-18, 1995)

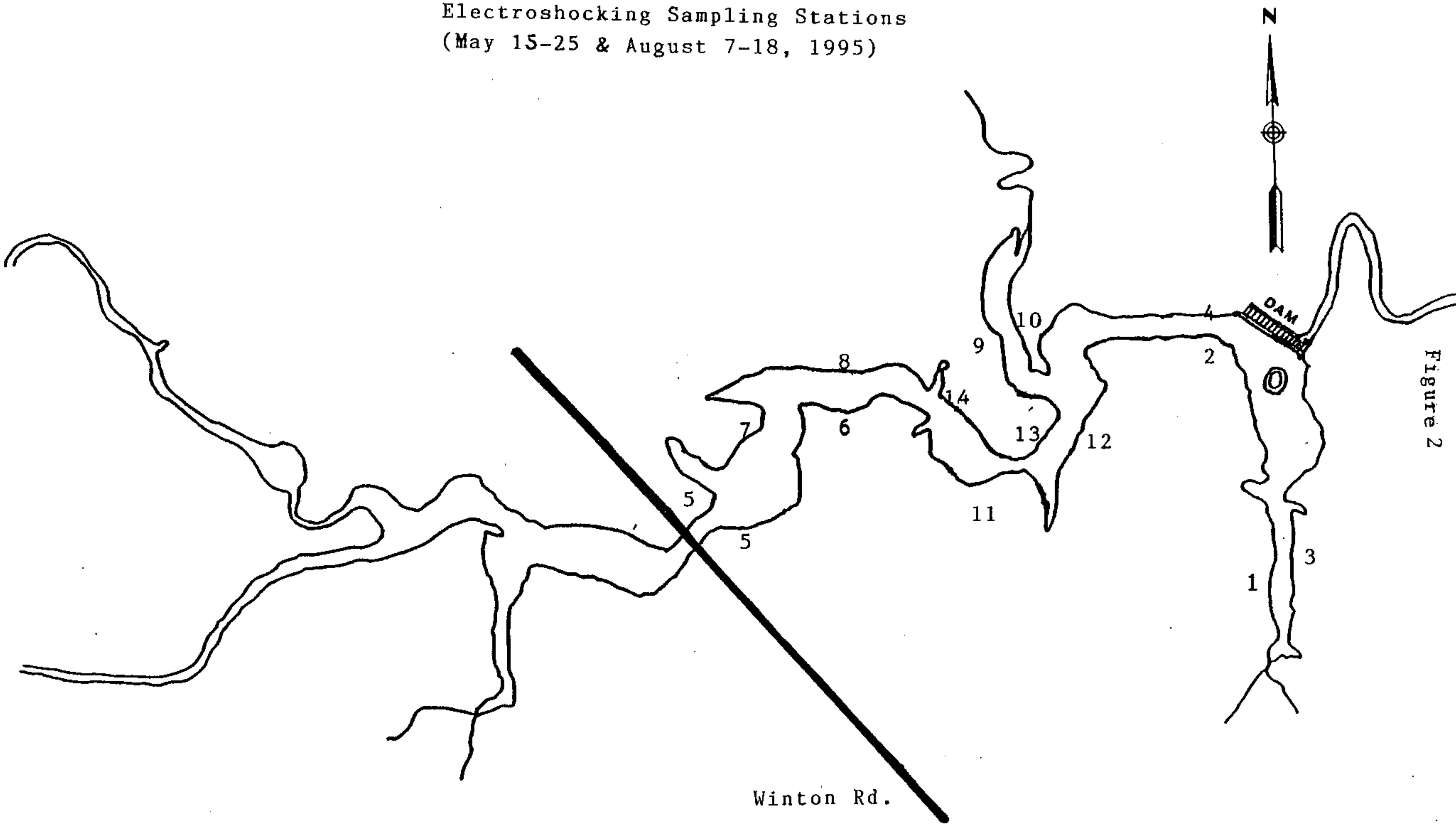


Figure 2

standard and total lengths, and species and family number. These parameters were also be analyzed with respect to each of the collection method. Relative abundance of each species and family was determined for each site as well as the overall lake. Using the electrofishing data the Index of Biotic Integrity was calculated.

The calculation and interpretation of the Index of Biotic Integrity followed guidelines described by Karr (1986) and modifications made by the Ohio EPA (1987) for use of the IBI in Ohio streams. The IBI incorporates 12 different community metrics which can be grouped into three separate categories: species richness and composition, trophic composition, and fish abundance and condition (Ohio EPA 1986). By examining 12 different metrics, some of which respond favorably to environmental degradation and others which are adversely affected, the IBI combines various aspects of other approaches of community assessment and integrates them. Combining these different but related measurements into a single value improves the robustness of the index over other indices because although each metric is unique, they have overlapping ranges of sensitivity (Angermeier and Karr 1986).

In using the IBI, the initial step is to establish expectation criteria for each IBI measurement by selecting a reference stream; i.e. a stream that is considered to be least impacted within the particular biogeographical region of the study site. The criteria expected for Winton Woods Lake are somewhat unique since the IBI values are originally designed for streams and rivers; however our values have been adjusted to better relate to the conditions present in this lake (Table 1.) The characteristics listed under number five are expectations for a community under ideal conditions, a value of three means that these characteristics deviate somewhat, and a one means that the qualities strongly deviate from the traits expected at the reference site.

Table 1. Index of biotic integrity metrics and criteria for scoring for Winton Woods Lake. (Note these values have been adjusted to apply to a lake rather than a large river as originally designed.) Ratings of 5, 3, and 1 correspond to whether the station approximates(5), deviates somewhat(3), or strongly deviates(1) from the value expected.

Community Metric	5	3	1
1. Total Species	>18	8-18	< 8
2. % Catostomid Species	>38	18-38	<18
3. Sunfish Species	> 4	2-4	< 2
4. Sucker Species	> 5	3-5	< 3
5. Intolerant Species	> 3	2-3	< 2
6. % Abundance of Tolerant Species	<15	15-27	>27
7. % Omnivorous Species	<17	17-35	>35
8. % Insectivore Spp.	>55	26-55	<26
9. % Top Carnivore Spp.	> 8	4- 8	< 4
10. Total Number/Sample	>400	150-400	<150
11. % Lithophil Species	>50	24-50	<24
12. % DELT Anomalies	< 0.5	0.5-3.0	> 3.0

Table 3. Summary for Winton Woods Lake Summer 1995 Fish Population Study

Family	Species	Count (n)	%	Biomass (g)	%
Catostomidae	RVRH	1	0.02	85	0.01
Centrarchidae	BCRP	85	2.09	12510	1.92
	BLGL	440	10.84	25655	3.94
	GRSF	14	0.34	640	0.10
	H-SF	16	0.39	465	0.07
	LESF	9	0.22	475	0.07
	LGMB	172	4.24	72036	11.07
	OSSF	5	0.12	40	0.01
	PKSD	79	1.95	2860	0.44
	ROCB	4	0.10	265	0.04
	WARM	6	0.15	505	0.08
	WCRP	146	3.60	17561	2.70
Clupeidae	GZSD	2328	57.34	144283	22.17
Cyprinidae	CARP	575	14.16	311842	47.92
	GNSR	17	0.42	840	0.13
Ictaluridae	BLBH	30	0.74	6630	1.02
	BRBH	71	1.75	12999	2.00
	CHCF	31	0.76	35850	5.51
	YWBH	30	0.74	5105	0.78
Sciaenidae	FWDR	1	0.02	60	0.01
		4060	100%	650706	100%

Table 4. Summary for Winton Woods Lake Summer 1995 Fish Population Study

Family	Species	Count (n)	Mean total length (cm)	Mean standard length (cm)	Mean body weight (g)
Catostomidae	RVRH	1	19.0	17.0	85.0
Centrarchidae	BCRP	85	20.6	16.3	147.2
	BLGL	440	13.2	11.0	58.3
	GRSF	14	12.9	10.9	45.7
	H-SF	16	10.3	8.4	29.1
	LESF	9	13.8	11.3	52.8
	LGMB	172	28.8	24.4	418.8
	OSSF	5	7.6	6.2	8.0
	PKSD	79	11.3	10.0	36.2
	ROCB	4	15.0	12.1	66.3
	WARM	6	16.1	13.2	84.2
	WCRP	146	18.5	14.8	120.3
Clupeidae	GZSD	2328	16.9	13.9	62.0
Cyprinidae	CARP	575	34.0	27.8	542.3
	GNSR	17	15.3	12.6	49.4
Ictaluridae	BLBH	30	24.1	20.2	221.0
	BRBH	71	25.0	21.4	183.1
	CHCF	31	45.3	38.1	1156.5
	YWBH	30	22.8	19.4	170.2
Sciaenidae	FWDR	1	17.0	14.0	60.0
		4060			

Table 5. Electrofishing Results for Winton Woods Lake 1995

				Average			Standard Deviation		
				total	standard		total	standard	
Family	Species	Count	Biomass	length	length	weight	length	length	weight
Centrarchidae	LGMB	153	65031	29.0	24.5	425.0	9.1	7.9	319.8
	OSSF	5	40	7.6	6.2	8.0	1.0	0.7	2.4
	GRSF	13	590	12.5	10.6	45.4	3.0	2.5	35.6
	H-SF	13	375	10.1	8.3	28.8	2.9	2.4	28.1
	LESF	7	360	13.6	11.1	51.4	1.9	1.5	29.5
	WCRP	67	9975	21.5	17.1	148.9	6.4	5.1	90.3
	BCRP	44	8360	23.2	18.4	190.0	3.7	2.9	64.5
	BLGL	353	20746	13.1	11.0	58.8	3.6	7.1	41.0
	PKSD	73	2615	11.2	10.1	35.8	2.2	8.5	23.6
	WARM	4	285	15.8	12.6	71.3	1.8	1.8	30.9
Clupeidae	GZSD	1752	100423	16.5	13.6	57.3	3.1	3.8	27.9
Cyprinidae	CARP	355	184857	33.3	27.3	520.7	9.2	8.3	460.9
	GNSR	5	195	14.6	12.1	39.0	1.6	1.4	10.2
Ictaluridae	BLBH	2	370	25.0	20.8	185.0	2.0	1.3	75.0
	YWBH	6	520	16.3	13.4	86.7	4.7	4.2	62.4
	CHCF	1	470	40.0	32.5	470.0	0.0	0.0	0.0
	BRBH	2	190	19.3	15.8	95.0	2.8	2.3	30.0

Table 6. Gillnet Summary for Winton Woods Lake Summer 1995 research

				Average			Standard Deviation		
				total	standard		total	standard	
Family	Specie	Count	Biomass	length	length	weight	length	length	weight
Centrarch	BCRP	21	2910	20.2	16.1	138.6	5.9	4.8	84.2
	BLGL	14	760	12.6	10.3	54.3	2.6	2.1	33.4
	GRSF	1	50	18.0	15.0	50.0	0.0	0.0	0.0
	H-FS	3	90	11.0	9.0	30.0	1.4	1.4	28.3
	LGMB	18	6525	27.6	23.4	362.5	7.6	6.8	310.9
	PKSD	2	95	12.3	8.5	47.5	0.3	1.0	2.5
	ROCB	1	55	14.0	11.0	55.0	0.0	0.0	0.0
	WARM	2	220	16.8	14.3	110.0	2.3	1.8	30.0
	WCRP	64	6401	15.8	12.6	100.0	8.1	6.7	149.6
Clupeidae	GZSD	553	42230	17.9	14.8	76.4	4.8	4.1	57.7
Cyprinida	CARP	204	121530	35.6	29.1	595.7	7.5	6.3	319.1
	GNSR	12	645	15.6	12.9	53.8	3.2	2.8	24.8
Ictalurida	BLBH	7	1340	21.6	18.9	191.4	3.5	3.2	84.6
	BRBH	5	905	22.3	18.4	181.0	5.8	4.4	100.2
	CHCF	28	31960	45.5	38.2	1141.4	10.7	9.3	749.8
	YWBH	8	1950	25.8	21.8	243.8	2.4	2.4	66.8
Sciaenida	FWDR	1	60	17.0	14.0	60.0	0.0	0.0	0.0

Table 7. Hoopnet Summary for Winton Woods Lake Summer 1995 research

				Average			Standard Deviation		
				total	standard		total	standard	
Family	Species	Count	biomass	length	length	weight	length	length	weight
Catostomidae	RVRH	1	85	19.0	17.0	85.0	0.0	0.0	0.0
Centrarchidae	BCRP	20	1240	15.2	11.9	62.0	3.5	2.8	45.8
	BLGL	73	4149	14.1	11.3	56.8	1.9	1.8	27.0
	LESF	2	115	14.5	12.0	57.5	0.5	0.5	2.5
	LGMB	1	480	32.0	25.0	480.0	0.0	0.0	0.0
	PKSD	4	150	12.0	9.3	37.5	0.4	0.3	2.5
	ROCB	3	210	15.3	12.5	70.0	1.0	0.8	24.5
	WCRP	15	1185	17.1	13.5	79.0	4.2	3.3	63.1
Clupeidae	GZSD	23	1630	18.4	15.1	70.9	2.0	1.6	22.5
Cyprinidae	CARP	16	5455	30.6	24.9	340.9	5.4	4.8	177.4
Ictaluridae	BLBH	21	4920	24.8	20.6	234.3	3.1	2.9	88.3
	BRBH	64	11904	25.4	21.8	186.0	3.1	2.8	75.9
	CHCF	2	3420	46.0	39.0	1710.0	21.0	19.0	1490.0
	YWBH	16	2635	23.8	20.5	164.7	2.6	2.1	73.3

The most productive gill net site was G1, while the least productive was G5. It must be noted that gillnet G6 was not in place for the entire 2 week time period because it was destroyed as a result of dredge hose accident. The dredge hose perportedly broke and whipped about in the water one night and in the processed totally annihilated gill net G6 (Appendix 1). This was most unfortunate because the most productive hoopnet location was G6, while the least productive hoopnet site was G2 (Appendix 2).

The scores from each of the IBI metrics as well as the sum total are shown in Table 8 and generally reflect the differences in habitat along the shoreline of Winton Woods Lake. Those sites with a gravelly substrate, less pronounced banks, and greater cover tended to support a greater diversity of fish, particularly, a greater assemblage of sunfish species. These sites are indicative of the southeastern most point of the lake, along the east bank near Pine Grove Campground, and along the Frisbee Golf Field. Those areas more depauperate tended to have no cover, little/no rip-rap and/or often had very steep banks, such as the shore along Lakeview Dr., just east of the Boathouse.

The total IBI score is simply a summation of each individual metric's raw score calculated from the collection of species and their abundances. The species' designations concerning their respective species group, trophic category, pollution tolerance status, and breeding guild are listed in Table 2 and follow the classifications by the Ohio EPA (1987). Metric One, the total number of species (excluding exotic) collected at each sampling site on the Lake varied from a minimum of four species at station #5 to a maximum of 11 at station #11 (mean=7.28 $\pm$ 1.79).

No round-bodied catostomids were found throughout Winton Wood Lake.

The third metric, the number of sunfish species, includes all members of the family Centrachidae, except for the blackbasses (Micropterus spp.) and the redear sunfish, Lepomis microlophus, since it is considered an exotic (Ohio EPA 1987). The sunfish family was best represented in the Lake. At least two species were found at each station and as many as seven at station #3. Similar to Metric 1 and 2, metric 4, the number of sucker species (including all members of the family Catostomidae) increases with the size of the drainage area for a given stream; However, this metric, as with #2, is more relevant to lotic systems and the values are somewhat lower than expected.

Metric 5, the number of intolerant species, includes only those that are highly intolerant to a number of disturbances (Ohio EPA 1987). Too many species included in this metric will reduce its discriminatory power. The species included are those with a designation of I (common intolerant), R (rare intolerant), and S (special intolerant). Typically no species that are regarded as M (moderately intolerant) are counted; however due to the inherent differences between lotic and lentic systems with regards to siltation and turbidity we did included those species regarded as at least moderately intolerant. Using these specifications, up to three species were found among the stations, P. annularis, P. nigromaculatus, and L. machrochirus.

Metric 6, the percent abundance of all tolerant species, is a change from Karr's original metric of the percentage of green sunfish (Karr 1981). Although the green sunfish is abundant in Ohio and often predominates in degraded areas, it tend to be more common in smaller streams and therefore is less useful for assessing impacts in larger rivers and lakes(Ohio EPA 1987). Tolerant species are those that are either common at sites that have a fair or poor rating, show no historical change in abundance or distribution compared to Trautman's (1981) earlier findings, or tend to predominate in areas of

Table 2. Fish species collected by electroshocking during May and their species designation concerning trophic guild (T.G.), pollution tolerance (P.T.), and breeding group (B.G.). (Ohio EPA 1987).

Family Species	T.G.	P.T.	B.G.
Centrarchidae			
Green sunfish (*Lepomis cyanellus*)	I/P	T	C
Pumpkinseed (*Lepomis gibbosus*)	I/P	P	C
Bluegill (*Lepomis macrochirus*)	I	P	C
Longear sunfish (*Lepomis megalotis*)	I	M	C
Orangespotted sunfish (*Lepomis humilis*)	I	-	C
Warmouth (*Lepomis gulosus*)	C	-	C
Largemouth bass (*Micropterus salmoides*)	P	-	C
Black crappie(*Pomoxis nigromaculatus*)	I/P	M	C
White crappie (*Pomoxis annularis*)	I/P	M	C
Clupeidae			
Gizzard shad (*Dorosoma cepedianum*)	O	-	M
Cyprinidae			
Common carp (*Cyprinus carpio*)	O	T	M
Ictaluridae			
Black Bullhead (*Ameieris melas*)	I	P	C
Yellow bullhead (*Ameieris natalis*)	I	T	C

Trophic Guild: C-Carnivore
I-Insectivore
P-Piscivore
O-Omnivore

Pollution Tolerance: M-Moderately Intolerant
P-Moderately Tolerant
T-Highly Tolerant

Breeding Guild: C-Complex with Parental Care
M-Simple, miscellaneous

decreasing water and habitat quality (Ohio EPA 1987). Of all the species collected with designations regarding their tolerance to pollution, six of the none collected were either moderately tolerant or highly tolerant.

Metric 7, the proportion of omnivorous species, includes all species that do not show any feeding specialization (i.e. at least 25% of the adults diet consists of plant material and another 25% consists of animal material (Karr et al. 1986)) but excludes specialized filter feeders such as Polydon spathula, the paddlefish. since they are generally sensitive to perturbations (Ohio EPA 1987). The percentages of omnivores were quite high for all stations since D. cepedianum and C. carpio, both of which are omnivores, dominated the collections.

All insectivorous species, with the exception of those that are generalized and opportunistic in their feeding behavior (e.g. S. atromaculatus, the creek chub), are including in Metric 8. Insectivores are those fish that consume more than 75% insects in their diet (Karr et al. 1986). Although many of the species collected are insectivores, they made up a much smaller fraction of the overall trophic community due again to the abundance of the aforementioned omnivores.

Metric 9, the proportion of top carnivores, includes all species that feed primarily on other vertebrates and/or crayfish and excludes those meat-eaters that may switch to other items throughout different times of the year (Ohio EPA 1987). Due the somewhat ubiquitous presence of largemouth bass throughout the lake, the percentages for top carnivores nearly always met the expected percentage of at least 8% or more. Only at three stations did this value fall below the expected numbers.

Metric 10 assesses the size of the fish populations (measured as the number of individuals collected per sampling effort (Ohio EPA 1987)) but excludes all tolerants that may proliferate under degraded conditions, exotic, and hybrids. Although the actual number of fish collected was much higher, the number used to calculate a score for this metric was significantly reduced by the exclusion of tolerant species.

The proportion of individuals as simple lithophilic spawners, metric 11, has been used by the Ohio EPA (1986) as a substitute for Karr's (1981) original metric: the number of hybrid individuals. Typically the frequency of hybrids is positively correlated with environmental degradation; however in many Ohio streams this relationship is inconsistent (Ohio EPA 1987). Many minnow hybrids have been collected in high quality streams, and other hybrid products of sensitive parents have been absent from smaller and low quality areas. Lithophils are fish that spawn without the use of any nest but rather scatter their eggs over a clean gravel and/or substrate (Ohio EPA 1987). No simple lithophilic spawners were collected.

The final metric, the proportion of individuals with deformities, eroded fins, lesions, and/or tumors (i.e. DELTS) takes considers the health of the fish collected. Although several largmouth bass exhibited black spots and several bullheads possessed lesions, the incidence of DELTs throughout the lake was relatively low.

The scores were also placed into one of the five integrity classes used to characterize varying stages of degradation (Table 8) (Karr 1981). The Very Poor class are those sites where most expected species are absent, only most tolerant species remain, and community organization is lacking. The Poor class is indicative of areas where many expected species are absent or, at least, low in abundance, sensitive species are absent, and the tolerant species predominate. The Fair class is representative of a site where some expected species are absent or low in abundance, sensitive species are absent or very low in abundance, and tolerant species are beginning to predominate. Many of the sites fell just between the Poor and Fair Class and thus were given a FP rating. None of the sampling station fell into the highest two categories: Good and Excellent. The Good integrity class represents areas that contain the typical assemblage of expected species and sensitive species and has a high species richness. The Excellent class consists of areas comprised of an exceptional association of species, and abundance of sensitive species, and endangered, threatened, or special concern species.

DISCUSSION

The existing fish community contains a large number of "undesirable" species, particularly Gizzard Shad & Common Carp. This poses two problems - the Gizzard Shad compete for the common food resources with the sunfish species; while the common carp appear to be monopolizing & destroying the limited breeding habitats for desired species. The evidence for these problems are demonstrated in the appearance of stunted growth in the sunfish, in particular the Bluegill; and the high incidence of hybridization within the sunfish family.

A comparison of the IBI scores among the stations on Winton Woods Lake calculated from the fish collected revealed major differences between regions. The disparity between the stations within the Lake can be explained by examining each individual metric that are combined to make up the total IBI score, but most likely are a reflection in the differences in substrates and structure along the shoreline. The first six metrics assess species richness and composition considering especially two major families: sunfishes (Centrarchidae) and suckers (Catostomidae).

Beginning with Metric One, the number of species found in at particular site is largely dependent upon the stream's drainage area (Ohio EPA 1987); therefore the expected values for Winton Woods Lake are based upon the drainage area. At present the most of the sights closely approximate the value expected from a reference site within the same region.

Through previous studies, it is well documented that the total number of species (excluding exotics and hybrids) in a particular stream of a given size will decrease with environmental degradation (Karr et al. 1986; Karr 1981). The same relationship is seen with particular sensitive species belonging to certain families such as those included in metrics 2-4. Because of their reliance on clean gravelly substrate for both reproduction and benthic feeding, the suckers are a very sensitive group of fishes and are typically associated with high water quality and in particular good habitat conditions. The increase in siltation and particulate associated with lentic systems explains the absence of any sucker species. Perhaps both metrics 2 and 4 should have been replaced with others more specific to lake ecosystems; however none currently exist. To counteract this limitation, an adjusted integrity class for each sampling site was computed.

The third metric, the number of sunfish species (excluding the black-basses), is a reflection of the quality of their preferred habitats, slow-moving pools and their preferred diets, surface and mid-water invertebrates (Angermeier 1983; Gammon 1981). Because these areas, along with much inlake cover created by fallen branches and items associated with urban pollution, still exist throughout Winton Woods Lake, less disparity between stations is present with this metric relative to the previous one. Adequate conditions exist for many sunfish species, in particular, <u>L. macrochirus</u> and <u>L. cyan-ellus</u>, with the former found in high abundance throughout the lake. Yet it should be noted that bluegill and green sunfish are considered highly tolerant. In fact Trautman (1981) states that the green sunfish is more tolerant to siltation and turbidity than any other sunfish species with the exception of L. humilis, the orangespotted sunfish, which was indeed collected in the lake.

Metric 4, the number of species in the family Catostomidae, is similar to Metric 2 in its evaluation of stream quality in that most suckers, prefer a clean, gravelly substrate for their lithophilous breeding and predominantly benthic feeding behavior. The loss of this habitat and subsequent loss of the macroinvertebrates and algae associated with it explain the absence of the expected sucker species such as the redhorses. Furthermore, chemical pollution is found to severely affect this family of fishes (Trautman 1981). The combined effect of the degraded habitat and the elevated concentrations of chemicals from urban runoff can explain the absence of these species.

Metric 5, the number of intolerant species, and Metric 6, the percent abundance of tolerant species, complement one another in that the former is especially sensitive at the highest end of biotic integrity (i.e. only the most pristine sites will contain a substantial number of intolerants); while the latter detects a decline in water quality and distinguishes among the more degraded areas (Ohio EPA 1987). Regarding both metrics, few intolerants were collected in the lake the majority were found to be moderately or highly tolerant. However the presence of both black and white crappie throughout the lake is encouraging and suggests that the lake may support more intolerant species if perhaps the trophic dynamics were adjusted.

The following three metrics, 7, 8, and 9, assessed the trophic composition of the aquatic community, particularly three major feeding groups:

omnivores, insectivores, and top carnivores. An abundance of omnivores, a reflection of the disruption of the food base, was observed at each site due predominantly to the large abundance of gizzard shad and, to a lesser extent common carp. The eutrophic nature of the lake, especially evident in the August sampling period, provides more than adequate food supplies for both of these species. However, we expect with the deeper levels of the lake subsequent to the dredging operation part of this problem will be rectified. Even so selective removal of significant portions of both populations is strongly recommended. These actions should provide both more balance, in terms of the trophic dynamics of the lake, and more suitable breeding habitats for the preferred species, such as the members of the sunfish family.

The proportion of insectivores, a typically dominant trophic group in most midwestern streams and associated lakes, was somewhat low and indicates a decrease in the abundance of insects which is primarily due to the aforementioned increase in siltation and loss of suitable areas for this food base to colonize.

However, the loss of top carnivores was less than expected. Even with the poor health of the community and its simplified trophic structure, many largemouth bass of various age classes were collected. Most likely the abundance of adequate prey species attributes to the carnivore's success.

The final metrics evaluated aspects of the fish abundance and their condition. The number of individuals collected at each station was somewhat lower than expected. However, this may more indicative of the difficulty in collecting along the shoreline where tree branches were low and debris was high. Furthermore during the first week of sampling, water levels rose extremely high which pushed the shoreline even further into the trees. Often fish were shocked but not collected in the nets. Overall, the lake is very productive in terms of the number of fish present and its biomass.

Metric 11, the proportion of individuals as simple lithophilic spawners, was consistent with the degree of siltation at each station. The number of species exhibiting this type of spawning behavior has been shown to significantly decrease with an increasing presence of siltation (Berkman and Rabeni 1987). Similar results were obtained in this study. Evidently the success of reproduction of most lithophilic species was severely limited by the loss of suitable gravelly habitat in the lake.

The final metric, the proportion of individuals with DELTs (deformities, eroded fins, lesions and/or tumors) focused on the condition of the individuals collected. The cause of most DELTs can be attributed to a variety of disturbances, including bacterial, viral, fungal and parasitic infections, neoplastic diseases, chemical pollutants, overcrowding, improper diet, and excessive siltation (Ohio EPA 1987. These and others are described in Allison et al. (1977). The incidence of these characteristics increase in areas of severe degradation (Mills et al. 1966; Berra and Au 1981; Baumann et al. 1987). Relatively few fish experienced DELTS; however several individuals possessed tumors near the mouth and fin regions and exhibited excessive redness and hemorrhaging during preservation in formalin. Perhaps these fish are affected by the runoff from the surrounding landscape; the nonpoint runoff may be the cause of the observed tumors.

In summarizing the IBI data the impact of the different habitat types in Winton Woods Lake are most evident when comparing the composite scores of the 12 metrics among the sampling stations. Those stations that covered areas of high siltation with little structural complexity on the substrate were significantly lower than other stations and from the expected IBI scores calculated from the reference areas. These are less than optimal, represent severely degraded habitats, and would benefit from added structure on the bottom.

Therefore in order to establish a balanced fish community these species (Shad & Carp) should be removed. No doubt removing most of the fish through the proposed means of draining and netting will achieve the goal of removing the undesirables; at the same time, it is important to realize that the existing fish community does contain a productive Largemouth Bass population and the proposed draining and netting may be detrimental to this desired species. Although alternative measures exist (selective fishing, limited rotenone kills, etc.) that may not be as effective as the current proposed means at removing the undesirables, there would be less risk to the desired game species.

In summary we see the need for the removable`of the undesirables but also express our concern for the well-established Bass and to a lesser extent Crappie populations. We concur that there is a definite need to provide suitable spawning habitats. The high incidence of hybridization in the sunfish attests to this. Furthermore, most of the existing spawning areas have been covered by silt/sediment. Both the removal of Carp and the addition of gravel beds, rock piles, and rip-rap should promote the establishment of sustainable populations of game species.

Lastly, we feel that overall your fisheries restoration plan is sound. However, we're curious about the stocking of hybrid sunfish rather than true sunfish species. It appears that the fish community is stressed but care should be provided for the relatively strong Bass population present. This population is worth keeping.

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Appendix Table 1: Family, Common, and Scientific Names of Fishes and associated abbreviations used in tables.

FAMILY	ABBR	COMMON NAME	ABBR	SCIENTIFIC NAME
Catostomidae	CATO	River Redhorse	RVRH	Moxostoma carinatum
Centrarchidae	CENT	Black Crappie	BCRP	Pomixis nigromaculatus
		Bluegill	BLGL	Lepomis machrochirus
		Green Sunfish	GRSF	Lepomis cyanellus
		Hybrid Sunfish	H-SF	
		Longear Sunfish	LESF	Lepomis megalottis
		Largemouth Bass	LGMB	Micropterus salmoides
		Orangespotted	OSSF	Lepomis humilis
		Pumpkinseed	PKSD	Lepomis gibbosus
		Rockbass	ROCB	Ambloplites rupestris
		Warmouth	WARM	Lepomis gulosus
		White Crappie	WCRP	Pomoxis annularis
Clupeidae		Gizzard Shad	GZSD	Dorosoma cepedianum
Cyprinidae		Common Carp	CARP	Cyprinus carpio
		Goldenshiner	GDSR	Notemigonous crysoleucas
Ictaluridae		Black Bullhead	BLBH	Ameierus melas
		Brown Bullhead	BRBH	Ameierus nebulosus
		Channel Catfish	CHCF	Ictalurus punctatus
		Yellow Bullhead	YWBH	Ameierus natalis
Sciaenidae		Freshwater Drum	FWDR	Aplodinotus grunniens

Appendix 2. Gill Net Site Summary for Winton Woods Lake 1995

				Average			Standard Deviation		
				total	standard		total	standard	
Site	Specie	Count	Biomass	length	length	weigth	length	length	weight
G1	BCRP	4	645	23.0	18.6	161.3	4.2	3.4	70.0
G1	BLBH	2	560	25.0	21.8	280.0	1.0	0.8	40.0
G1	BLGL	3	65	9.8	7.8	21.7	1.9	1.9	16.5
G1	BRBH	1	240	24.0	21.0	240.0	0.0	0.0	0.0
G1	CARP	133	85490	36.7	30.1	642.8	7.5	6.3	316.6
G1	CHCF	8	10200	47.6	40.1	1275.0	2.9	2.8	251.9
G1	FWDR	1	60	17.0	14.0	60.0	0.0	0.0	0.0
G1	GNSR	10	555	16.0	13.2	55.5	3.2	2.8	25.2
G1	GRSF	1	50	18.0	15.0	50.0	0.0	0.0	0.0
G1	GZSD	236	19885	18.7	15.5	84.3	4.1	3.5	56.5
G1	HYSF	2	20	10.0	8.0	10.0	0.0	0.0	0.0
G1	LGMB	7	3870	32.4	27.9	552.9	6.7	6.0	351.3
G1	WARM	2	220	16.8	14.3	110.0	2.3	1.8	30.0
G1	WCRP	15	2509	16.6	13.6	167.3	10.2	8.2	239.1
G1	YWBH	1	280	29.0	25.0	280.0	0.0	0.0	0.0
G2	BCRP	7	975	18.8	15.1	139.3	6.4	5.4	95.3
G2	BLBH	4	620	19.8	17.0	155.0	3.4	3.0	78.9
G2	BLGL	7	460	13.6	11.1	65.7	2.0	1.5	29.8
G2	CARP	10	7600	39.2	31.9	760.0	5.3	4.6	235.6
G2	CHCF	3	1450	34.5	28.3	483.3	6.8	5.2	332.5
G2	GNSR	2	90	14.0	11.5	45.0	3.0	2.5	20.0
G2	GZSD	93	8290	18.8	15.2	89.1	5.3	4.4	69.2
G2	HYSF	1	70	13.0	11.0	70.0	0.0	0.0	0.0
G2	PKSD	2	95	12.3	8.5	47.5	0.3	1.0	2.5
G2	WCRP	27	1550	12.3	9.8	57.4	6.2	5.2	96.2
G2	YWBH	1	340	25.0	21.0	340.0	0.0	0.0	0.0
G3	BLBH	1	160	22.5	20.5	160.0	0.0	0.0	0.0
G3	BLGL	2	125	12.3	10.5	62.5	0.3	0.0	12.5
G3	CARP	6	3835	33.9	27.9	639.2	11.0	8.3	540.4
G3	CHCF	4	2755	36.3	31.6	688.8	12.1	10.7	524.8
G3	GZSD	84	4190	16.1	13.3	49.9	4.0	3.4	34.0
G3	LGMB	1	600	35.0	30.0	600.0	0.0	0.0	0.0
G3	WCRP	1	7	8.5	6.5	7.0	0.0	0.0	0.0
G4	BLGL	1	10	10.0	8.0	10.0	0.0	0.0	0.0
G4	BRBH	1	25	11.5	10.0	25.0	0.0	0.0	0.0
G4	CARP	16	10150	35.6	29.3	634.4	5.6	5.0	251.2
G4	GZSD	72	5740	18.6	15.7	79.7	3.7	4.3	50.6
G4	LGMB	1	320	27.0	24.0	320.0	0.0	0.0	0.0
G4	WCRP	1	30	9.0	7.0	30.0	0.0	0.0	0.0
G5	BCRP	4	510	19.6	15.3	127.5	7.4	5.8	85.0
G5	CARP	15	6395	32.2	26.0	426.3	5.0	4.2	198.4
G5	CHCF	4	5475	52.5	44.0	1368.8	8.3	5.5	834.7
G5	GZSD	7	600	20.3	16.2	85.7	3.6	2.4	51.4
G5	LGMB	1	80	20.0	16.0	80.0	0.0	0.0	0.0
G5	WCRP	9	1145	23.0	18.8	127.2	5.7	4.6	64.6
G5	YWBH	1	260	28.0	24.0	260.0	0.0	0.0	0.0
G6	BRBH	1	270	26.0	20.0	270.0	0.0	0.0	0.0
G6	CARP	2	770	32.0	24.5	385.0	3.5	3.0	115.0
G6	GZSD	7	460	18.1	14.6	65.7	5.6	4.2	39.7
G6	YWBH	1	275	28.0	25.0	275.0	0.0	0.0	0.0
G7	BCRP	6	780	20.5	15.9	130.0	4.2	3.4	75.0
G7	BRBH	1	100	22.0	18.5	100.0	0.0	0.0	0.0
G7	CARP	10	2960	30.6	25.1	296.0	6.5	6.1	210.9
G7	CHCF	3	7200	59.2	50.5	2400.0	6.6	6.0	648.1
G7	GZSD	9	535	18.2	14.8	59.4	0.9	0.5	11.4
G7	LGMB	3	805	23.3	19.3	268.3	8.7	7.3	287.8
G7	WCRP	2	85	14.3	10.8	42.5	0.8	0.3	7.5
G7	YWBH	4	795	24.0	19.9	198.8	1.9	1.3	62.9
G1*	BLGL	1	100	17.0	13.0	100.0	0.0	0.0	0.0
G1*	BRBH	1	270	28.0	22.5	270.0	0.0	0.0	0.0
G1*	CARP	12	4330	30.5	24.0	360.8	6.0	4.9	179.7
G1*	CHCF	6	4880	42.8	35.0	813.3	8.7	8.4	560.7
G1*	GZSD	45	2530	14.0	11.4	56.2	6.8	5.5	70.1
G1*	LGMB	5	850	23.4	19.5	170.0	3.8	3.5	69.3
G1*	ROCB	1	55	14.0	11.0	55.0	0.0	0.0	0.0
G1*	WCRP	9	1075	19.4	15.3	119.4	5.3	4.4	124.4

Appendix 3. Hoopnet Site Summary for Winton Woods Lake 1995

				Average			Standard Deviation		
				total	standard		total	standard	
Site	Species	Coun	Biomass	length	length	weight	length	length	weight
G1	BLBH	9	2180	24.0	20.4	242.2	2.6	2.2	79.7
G1	BLGL	2	160	14.3	11.5	80.0	1.3	1.0	20.0
G1	BRBH	6	1385	24.8	21.7	230.8	1.7	1.8	56.0
G1	CARP	1	200	26.0	20.0	200.0	0.0	0.0	0.0
G1	CHCF	1	220	25.0	20.0	220.0	0.0	0.0	0.0
G1	GZSD	8	575	18.1	14.9	71.9	1.4	1.2	20.0
G2	BLGL	1	70	12.0	9.5	70.0	0.0	0.0	0.0
G2	GZSD	1	50	17.5	14.0	50.0	0.0	0.0	0.0
G2	YWBH	1	250	28.0	25.0	250.0	0.0	0.0	0.0
G3	BLGL	3	355	14.2	11.3	118.3	1.6	1.2	22.5
G3	CARP	1	750	40.0	33.0	750.0	0.0	0.0	0.0
G3	GZSD	3	175	17.0	14.0	58.3	1.4	1.4	11.8
G4	BLBH	1	190	22.5	19.0	190.0	0.0	0.0	0.0
G4	BLGL	2	65	13.5	11.5	32.5	0.5	0.5	7.5
G4	BRBH	1	450	32.0	29.0	450.0	0.0	0.0	0.0
G4	CARP	2	890	34.5	29.5	445.0	1.5	2.5	125.0
G4	GZSD	7	595	19.9	16.3	85.0	2.3	1.7	27.1
G5	BCRP	1	50	13.0	10.0	50.0	0.0	0.0	0.0
G5	BLBH	1	375	31.0	26.5	375.0	0.0	0.0	0.0
G5	BLGL	1	50	15.0	12.0	50.0	0.0	0.0	0.0
G5	BRBH	11	1504	25.1	21.7	136.7	3.4	3.3	58.4
G5	CHCF	1	3200	67.0	58.0	3200.0	0.0	0.0	0.0
G5	GZSD	4	235	17.8	14.5	58.8	1.1	1.1	2.2
G5	WCRP	2	75	14.3	11.0	37.5	1.8	1.5	7.5
G5	YWBH	1	80	24.5	21.0	80.0	0.0	0.0	0.0
G6	BCRP	6	360	15.3	12.0	60.0	3.5	2.9	39.6
G6	BLBH	4	660	23.8	19.1	165.0	2.4	3.6	20.9
G6	BLGL	59	3159	14.1	11.3	53.5	1.9	1.9	24.0
G6	BRBH	12	1820	23.7	20.1	151.7	3.4	2.8	45.0
G6	CARP	8	2630	30.6	24.9	328.8	4.6	3.5	131.8
G6	PKSD	4	150	12.0	9.3	37.5	0.4	0.3	2.5
G6	RVRH	1	85	19.0	17.0	85.0	0.0	0.0	0.0
G6	WCRP	4	380	17.5	13.8	95.0	5.5	4.2	79.6
G6	YWBH	10	1450	22.7	19.7	145.0	2.0	1.5	45.9
G7	BCRP	12	775	15.1	11.8	64.6	3.6	2.8	51.9
G7	BLBH	1	250	27.0	23.0	250.0	0.0	0.0	0.0
G7	BLGL	3	190	14.8	12.0	63.3	2.1	1.9	17.0
G7	BRBH	13	2590	26.5	22.8	199.2	1.7	1.8	49.1
G7	CARP	3	795	27.7	22.3	265.0	6.0	5.6	166.8
G7	WCRP	1	40	15.5	12.5	40.0	0.0	0.0	0.0
G7	YWBH	3	655	25.3	21.3	218.3	3.4	2.6	110.5
G1*	BCRP	1	55	18.0	14.5	55.0	0.0	0.0	0.0
G1*	BLBH	5	1265	25.7	20.8	253.0	3.4	2.6	110.6
G1*	BLGL	2	100	14.3	11.5	50.0	3.3	2.5	25.0
G1*	BRBH	21	4155	25.5	21.9	197.9	2.9	2.5	78.2
G1*	CARP	1	190	27.0	21.0	190.0	0.0	0.0	0.0
G1*	LESF	2	115	14.5	12.0	57.5	0.5	0.5	2.5
G1*	LGMB	1	480	32.0	25.0	480.0	0.0	0.0	0.0
G1*	ROCB	3	210	15.3	12.5	70.0	1.0	0.8	24.5
G1*	WCRP	8	690	17.9	14.1	86.3	3.8	3.1	59.0
G1*	YWBH	1	200	25.0	21.5	200.0	0.0	0.0	0.0

Table 8: Evaluation of the fish community at fourteen sampling stations (sites) in Winton Woods Lake. Scores are assigned based on whether the individual metric values approximate(5), somewhat deviate(3) or strongly deviate(1) from what is expected.

SAMPLING STATION

IBI	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	3	3	1	1	1	3	1	1	1	3	3	1	3
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	5	5	3	3	3	5	3	3	5	5	5	3	5
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	3	3	3	3	1	1	3	1	1	3	3	3	3	3
6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	3	5	5	5	1	3	5	1	5	5	5	5	5	5
10	3	3	3	3	1	3	3	1	3	3	3	3	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Sum	28	34	34	30	24	28	34	22	28	32	34	34	28	32
IC	P	FP	FP	FP	P	P	FP	VP	P	FP	FP	FP	P	FP
AIC	FP	F	F	FP	FP	FP	F	P	FP	FP	F	F	FP	FP

IC=Integrity Class: F-Fair
FP-Fair to Poor Range
P-Poor
VP-Very Poor

AIC=Adjusted Integrity Class