Fish Survey of Miami Whitewater Lake, Hamilton, Ohio

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Introduction

On May 28th through June 04th of 2001, samples were taken from Miami Whitewater Lake (MWL) in Hamilton County. This project was designed to study the current conditions in Miami Whitewater with respect to the fish population diversity and relative abundance. This information, along with previous studies of the community interactions, can then aid in the development of an overall fisheries management plan. Furthermore, from the analysis of fish communities, much information concerning the overall health and conditions of this lake ecosystem can be determined. When conducting any type of aquatic assessment, the analysis of fish communities can 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 ecosystem (Karr 1987). 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.

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.

The specific objectives of the study are to:

- evaluate the present status of the fish community in the Miami Whitewater Lake and
- characterize the physical macrohabitats within the study area.

Methods & Materials

Fisheries: Collections were made from May 28-June 04, 2001. Fish were gathered using electrofishing methods and hoop nets. Electrofishing was conducted daily for approximately 45 minutes at each site with a 5.0 Smith-Root Electrofisher and Generator that produced 8-12 amps of electricity. The boat moved both parallel and perpendicular to the shoreline, ensuring all available habitat was sampled. The electrofishing crew consisted of the principal investigator and three student researchers: one driver to maneuver the boat, two netters on the bow to collect the stunned fish, and one processor to identify, inspect for DELTS (Deformities, Erosions, Lesions, and Tumors), weigh, measure the fish and record the data. Benthic fish species were targeted using hoop nets at sites near the Strimble and South Creeks. These nets were baited with chicken liver and checked twice daily for fish (early morning and evening just prior to leaving for the day). All fish collected were identified to species, weighed (grams), measured for both standard length and total length (centimeters), and released as soon as possible to avoid unnecessary stress on the fish. Voucher and unusual specimens, along with scales from selected species were kept for verification. Overall abundance and biomass, along with relative percentages, of each species were determined for each site as well as the overall lake.

Analysis of Fisheries Data: Diversity indices provide information about species richness (i.e., the number of species present); but also take the relative abundances of each species into account. The Shannon diversity index (H) was employed for this study. The proportion of species i relative to the total number of species (p_i) is calculated, and then multiplied by the natural logarithm of this proportion ($\ln p_i$). The resulting product is summed across species, and multiplied by -1:

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

Shannon's equitability (E_H) or Evenness can be calculated by dividing H by H_{max} (here $H_{max} = \ln S$). Equitability assumes a value between 0 and 1 with 1 being complete evenness.

$$E_H = H / H_{max} = H / \ln S$$

Site Selections: The physical characteristics of the Lake can greatly influence its associated community of fishes. Furthermore, natural differences in the macrohabitats of the various study sites exist. To more accurately assess the distribution of fishes in light of these natural differences, the entire shoreline of Miami Whitewater Lake was sampled and structural differences in these sites were examined. The study sites are designated A-L. Site A begins at the boat ramp and moves towards the golf course. Each subsequent site is continuous with the previous one and consists of a segment of near-shore habitat. The sites continue along the entire shoreline and finish with Site L back at the boat ramp. The length of each site was determined by the distance covered during a 45 minute electroshocking period. Therefore, some sites are longer, in distance, than others; however all represent approximately the same amount of collecting time. Special attention was given to the submerged fish habitat structures (i.e. stake and gravel beds, palettes, and brush piles) that were constructed by the Park managers.

Table 1. Site Locations.

Site	Location
A	Shoreline near the boat ramp and includes parts of the driving range.
B	Shoreline along "Ramsey Bay" where "Golf Stream" enters the Lake.
C	Shoreline from Ramsey Bay to the buoy line near Strimble Creek, along the golf course.
D	Shoreline from the buoy line near Strimble Creek, along the shore, opposite the golf course.
E	Shoreline, opposite the rip-rap across the Lake.
F	Shoreline along the bay across from "Ramsey Bay."
G	Shoreline across from the boat ramp where the Lake is narrowest.
H	Shoreline of the bay where South Creek is located, beyond the buoys.
I	Shoreline from the buoy line near South Creek, to the spillway.
J	Shoreline near the spillway in front of boat house.
K	Shoreline along public area for shoreline fishing.
L	Shoreline across from public fishing area, near the birdhouses and up to the boat ramp.

Results and Discussion

A summary of all the fish collected at all sites can be seen in Table 2. The total number of fish collected within Miami Whitewater Lake from electrofishing was 1337 individuals. Sixteen species from 6 families were collected. There were only seventeen individuals collected from the hoop nets (12 bluegill and 5 white crappie); therefore these numbers are not included in the overall analysis. During electrofishing, over 359,000 grams of fish were collected throughout the lake. A biostatistical summary of the measurements of each fish species at all sites is presented in Appendix Table 2.

In terms of overall and relative abundance of the fish populations, gizzard shad (*Dorosoma cepedianum*) was the only species found at every site and comprised just over 66% of the abundance of the total sample. Bluegill (*Lepomis macrochirus*) were found at eleven of the twelve sites but were a distant second, at just over 14%, in terms of relative abundance. In addition to these two species, carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*) and white crappie (*Pomoxis annularis*) were well represented throughout the Lake. However, relatively few individuals of the remaining eleven species were found elsewhere— each having less than fifteen individuals, respectively.

Regarding total biomass, both the shad and bluegill were much less representative of the total sample (12.5% and 2.57% respectively). Rather, the Ictalurids comprised over 41% of the total biomass of the electrofishing sample and in particular the blue catfish (*Ictalurus furcatus*) comprised nearly 26% of the overall biomass. The total biomass for this species (93,150) came from just eleven individuals, averaging 8500 grams each. The largest individual was 20, 450 grams, approximately 45 pounds. Both carp (*C. carpio*) and largemouth bass (*M. salmoides*) were also well represented, comprising 23.39% and 13.06% of the total biomass respectively. In contrast to the blue catfish (*I. furcatus*) which was found at Site H only, these latter two species were collected at nearly every site.

Table 2: Electrofishing Collections: Species Abundance (Relative %) and Biomass in grams (Relative %) for the entire Lake.

Family		
Species	**Number**	**Biomass**
Clupeidae		
Gizzard Shad *(Dorosoma cepedianum)*	887 (66.34%)	44890 (12.50%)
Catostomidae		
Black Buffalo *(Ictiobus niger)*	1 (0.07%)	3200 (0.89%)
Golden Redhorse *(Moxostoma erythrurum)*	14 (1.05%)	3885 (1.08%)
Spotted Sucker *(Minytrema melanops)*	4 (0.30%)	1420 (0.40%)
White Sucker *(Catostomus commersoni)*	4 (0.30%)	1090 (0.30%)
Cyprinidae		
Common Carp *(Cyprinus carpio)*	61 (4.56%)	83980 (23.39%)
Ictaluridae		
Blue Catfish *(Ictalurus furcatus)*	11 (0.82%)	93150 (25.95%)
Channel Catfish *(Ictalurus punctatus)*	12 (0.90%)	12950 (3.61%)
Flathead Catfish *(Pylodictis olivaris)*	5 (0.37%)	41490 (11.56%)
Centrachidae		
Bluegill Sunfish *(Lepomis macrochirus)*	188 (14.06%)	9210 (2.57%)
Green Sunfish *(Lepomis cyanellus)*	2 (0.15%)	60 (0.02%)
Largemouth Bass *(Micropterus salmoides)*	61 (4.56%)	46890 (13.06%)
Longear Sunfish *(Lepomis megalotis)*	10 (0.75%)	270 (0.08%)
Warmouth *(Lepomis gulosus)*	10 (0.75%)	460 (0.13%)
White Crappie *(Pomoxis annularis)*	59 (4.41%)	4395 (1.22%)
Sciaenidae		
Freshwater Drum *(Aplodinotus grunniens)*	8 (0.60%)	11660 (3.25%)
Total	**1337 individuals**	**359000 grams**

When examining the collections at each site separately (Table 3 and Table 4), the number of individuals caught at each site ranged from 312 at Site C down to just 68 at Site L. The number of species found at each site ranged from just two at Site K to twelve at Site H. In addition to being the most speciose, Site H also held the most biomass, and although only 70 individuals were collected, it contained nearly five times more biomass than any other site. This is primarily due to the large catfish collected here. The biomass for each site ranged from 5,750 grams at Site K up to 152, 765 grams at Site H. This is primarily due to the large catfish collected here. Site H was also the most diverse site (H' = 2.72). The average diversity index (H') was 1.74. The lowest diversity was found at Site K (H'= 0.13) where only two species were found and nearly all of them (113 out of 115) were gizzard shad (*D. cepedianum*).

When examining the distribution of fishes throughout the Lake, two distinct groups emerge. The first group of seven species (*D. cepedianum, Moxostoma erythrurum, C. carpio, Ictalurus punctatus, L. macrochirus, M. salmoides and P. annularis*) were common throughout the Lake. This assemblage was found at nearly every site. In contrast, the second group of nine species, (*Ictiobus niger, Minytrema melanops, Catostomus commersoni, I. furcatus, Pylodictis olivaris, L. cyanellus, L. gulosus L. megalotis and Aplodinotus grunniens*) were relatively rare and found at three or fewer sites. Revealing a similar pattern, the sites can grouped into two distinct groups in terms of their diversity values. Six sites, Sites E-J had the highest H' values, averaging 2.29 (Range = 1.98 – 2.72). The other six sites, Sites A-D, Site K and Site L had the lowest H' values, averaging 1.18. Lastly, the Evenness values follow this same pattern. As with the diversity values, Sites E-J typically had the highest Evenness values, averaging 74.27 (Range = 79.9 – 62.3); while the other sites, Sites A-D, Sites K and L, had an average Evenness value of 41.85 (Range = 64 – 12.7).

Table 3: Electrofishing Collections: Species Abundance and Diversity for each Site.

Family Species	A	B	C	D	E	F	G	H	I	J	K	L
Clupeidae												
Gizzard Shad *(Dorosoma cepedianum)*	38	51	265	93	82	69	20	24	61	24	113	47
Catostomidae												
Black Buffalo *(Ictiobus niger)*	0	0	0	0	0	0	0	1	0	0	0	0
Golden Redhorse *(Moxostoma erythrurum)*	0	1	1	1	4	1	1	0	2	2	0	1
Spotted Sucker *(Minytrema melanops)*	0	0	0	0	0	2	0	1	1	0	0	0
White Sucker *(Catostomus commersoni)*	0	0	0	0	0	1	0	0	0	0	2	1
Cyprinidae												
Common Carp *(Cyprinus carpio)*	5	5	7	8	5	8	7	6	0	5	0	5
Ictaluridae												
Blue Catfish *(Ictalurus furcatus)*	0	0	0	0	0	0	0	11	0	0	0	0
Channel Catfish *(Ictalurus punctatus)*	0	4	1	1	1	1	0	2	1	0	0	1
Flathead Catfish *(Pylodictis olivaris)*	0	0	0	0	0	0	0	4	1	0	0	0
Centrachidae												
Bluegill Sunfish *(Lepomis macrochirus)*	5	12	17	7	23	27	37	15	20	19	0	6
Green Sunfish *(Lepomis cyanellus)*	0	0	0	0	0	0	1	1	0	0	0	0
Largemouth Bass *(Micropterus salmoides)*	3	2	5	3	4	5	10	3	9	12	0	5
Longear Sunfish *(Lepomis megalotis)*	1	0	0	0	0	5	3	0	0	0	0	1
Warmouth *(Lepomis gulosus)*	0	0	0	0	0	0	0	0	0	10	0	0
White Crappie *(Pomoxis annularis)*	2	3	12	0	3	9	9	2	18	0	0	1
Sciaenidae												
Freshwater Drum *(Aplodinotus grunniens)*	0	1	4	0	0	0	0	0	0	3	0	0
# of Individuals	**54**	**79**	**312**	**113**	**122**	**128**	**88**	**70**	**113**	**75**	**115**	**68**
# of Species	**6**	**8**	**8**	**6**	**7**	**10**	**7**	**12**	**9**	**7**	**2**	**9**
Shannon Diversity (H')	**1.80**	**1.51**	**0.97**	**1.01**	**2.27**	**2.10**	**2.24**	**2.72**	**1.98**	**2.42**	**0.13**	**1.68**
H' Max	**2.81**	**3.00**	**3.00**	**2.59**	**3.00**	**3.32**	**2.81**	**3.46**	**3.17**	**2.81**	**1.00**	**3.17**
Evenness	**64.0**	**50.2**	**32.1**	**39.1**	**75.5**	**63.1**	**79.9**	**78.5**	**62.3**	**86.3**	**12.7**	**53.0**

undeveloped Shoreline

Table 4: Electrofishing Collections: Species Biomass for each Site.

Family Species	A	B	C	D	E	F	G	H	I	J
Clupeidae										
Gizzard Shad *(Dorosoma cepedianum)*	1900	3490	13250	4850	4100	3450	1000	1200	3050	1150
Catostomidae										
Black Buffalo *(Ictiobus niger)*	0	0	0	0	0	0	0	3200	0	0
Golden Redhorse *(Moxostoma erythrurum)*	0	185	180	280	1350	220	350	0	510	560
Spotted Sucker *(Minytrema melanops)*	0	0	0	0	0	620	0	300	500	0
White Sucker *(Catostomus commersoni)*	0	0	0	0	0	120	0	0	0	0
Cyprinidae										
Common Carp *(Cyprinus carpio)*	5050	6600	8580	8400	7700	13200	9250	11500	0	8500
Ictaluridae										
Blue Catfish *(Ictalurus furcatus)*	0	0	0	0	0	0	0	93150	0	0
Channel Catfish *(Ictalurus punctatus)*	0	4600	1500	650	800	2400	0	1700	500	0
Flathead Catfish *(Pylodictis olivaris)*	0	0	0	0	0	0	0	39990	1500	0
Centrachidae										
Bluegill Sunfish *(Lepomis macrochirus)*	245	395	940	455	1480	1285	1435	715	935	1050
Green Sunfish *(Lepomis cyanellus)*	0	0	0	0	0	0	30	30	0	0
Largemouth Bass *(Micropterus salmoides)*	3150	1100	3750	1670	4100	2940	6080	900	9680	8590
Longear Sunfish *(Lepomis megalotis)*	10	0	0	0	0	140	90	0	0	0
Warmouth *(Lepomis gulosus)*	0	0	0	0	0	0	0	0	0	460
White Crappie *(Pomoxis annularis)*	110	420	1040	0	150	810	665	80	1070	0
Sciaenidae										
Freshwater Drum *(Aplodinotus grunniens)*	0	2300	2110	0	0	0	0	0	0	7250
Total Biomass	**10465**	**19090**	**31350**	**16305**	**19680**	**25185**	**18900**	**152765**	**17745**	**27560**

From the electrofishing data, it is clear that this lake is highly productive. During the seven-day sampling period, over 1,300 individuals and 359,000 grams of biomass were collected. Furthermore, much of the biomass (over 50%) was contained in desirable species such as the three catfish species and the largemouth bass. However, the data also revealed two less than desirable trends: 1) the fish populations are not evenly distributed throughout the Lake and 2) several sites yielded very low diversity and evenness levels. In particular, Sites A-D, and Sites K-L had low diversity values. Although there were several species at most of these particular sites, gizzard shad and to a lesser extent the common carp, tended to dominate. On the contrary, the diversity and evenness levels at Sites E-J were much higher. Furthermore, shad were much less dominant at these latter sites. Much of the differences observed in these samples can be attributed primarily to habitat differences along the shoreline. Numerous studies have demonstrated this link between the quality of habitat and diversity of the fish communities (Lehtinen et al. 1997, Plafkin et al. 1989, Clements 1987).

Overall, there is much greater environmental heterogeneity within the lake and positive influence from the riparian vegetation at those sites with higher diversity levels. At most of these sites (Sites E-I), there was a mix of snags, submerged logs, undercut banks and overhanging branches which provide adequate shade, refuge and food to support a rich assemblage of fishes. The other site with a relatively high diversity value, Site J, primarily contained a rocky substrate providing an ideal breeding habitat for lithophils such as the sunfish (Carlander 1970). In general, at those sites with lower levels, the shoreline was barren, often muddy, with only small patches of gravelly substrate or woody debris. In addition to the lack of epifaunal substrate within these depauperate sites, the riparian zone was either lacking all together (i.e. along the boathouse and picnic area) or very narrow (i.e. along the golf course) and disturbed by human activities. This lack of adequate vegetative protection can lead to increased run-off and subsequent sediment deposition, bank instability and higher erosion rates (Armour et al. 1981) all of which contribute to degraded habitat and poor water quality. Karr et al. (1986) rank an altered habitat as a major stressor of aquatic system and thus likely to result in reduced diversity levels. Despite the addition of woody structures (stake beds, palettes, and brush piles) and gravel along the impacted shorelines, the habitat within these sites does not support as rich of communities as the natural habitat found along the shore, opposite the golf course and boathouse.

However, this finding should not deter the maintenance of existing sites and establishment of new ones. It is likely that additional time is necessary to document any potential improvements from these added structures. Furthermore, the runoff expected from the golf course within the same areas and associated adverse effects such as increased sedimentation, eutrophication and potential oxygen deficits might outweigh the beneficial aspects of the artificial substrate. In order to accurately assess the success of such efforts, the concerns, associated with the runoff, should be addressed in concert with improvements to the physical habitat. Perhaps the implementation of mechanisms to reduce the impacts of the golf course such as those outlined in the previous study of this lake (Miller et 1l. 1997), along with continued placement of woody debris and stocking efforts, will improve the habitat and increase the diversity of the fish community throughout the lake.

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Appendix Table 1: Key for Abbreviation used in the spreadsheets.

Abbreviation	Species	Common Name
A.gru	*Aplodinotus grunniens*	Freshwater Drum
C.car	*Cyprinus carpio*	Common Carp
C.com	*Catostomus commersoni*	White Sucker
D.cep	*Dorosoma cepedianum*	Gizzard Shad
I.fur	*Ictalurus furcatus*	Blue Catfish
I.nig	*Ictiobus niger*	Black Buffalo
I.pun	*Ictalurus punctatus*	Channel Catfish
L.cya	*Lepomis cyanellus*	Green Sunfish
L.gul	*Lepomis gulosus*	Warmouth
L.mac	*Lepomis macrochirus*	Bluegill
L.meg	*Lepomis megalotis*	Longear Sunfish
M.ery	*Moxostoma erythrurum*	Golden Redhorse
M. mel	*Minytrema melanops*	Spotted Sucker
M.sal	*Micropterus salmoides*	Largemouth Bass
P.ann	*Pomoxis annularis*	White Crappie
P.oli	*Pylodictis olivaris*	Flathead Catfish

Appendix Table 2: Biostatistics for each Species at each Site.

SITE A	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	1500	49	40.5
DATE	*C.car*	1200	46	36.5
4-Jun-01	*C.car*	900	42	35.5
	C.car	500	33.5	27.5
	C.car	950	40.5	37
		Total = 5050		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
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D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total = 1900		
L.mac	50	14	11
L.mac	70	16.5	13.5
L.mac	50	13.5	12
L.mac	35	13	10.5
L.mac	40	14.5	12
	Total = 245		
L.meg	10	8	6.5
	Total = 10		
M.sal	1750	48	40.5
M.sal	500	32	28
M.sal	900	38.5	32
	Total = 3150		
P.ann	70	18	14.5
P.ann	40	16.5	13
	Total = 110		

SITE B	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	A.gru	2300	56	46
DATE		Total = 2300		
30-May-01	*C.car*	900	42	34
	C.car	2500	62	53
	C.car	1100	47	40
	C.car	1200	45	39
	C.car	900	47	38
		Total = 6600		
	D.cep	20	15	12.5
	D.cep	60	19	16.5
	D.cep	50	15	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
	D.cep	70	16.5	12
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D.cep	70	16.5	12
D.cep	70	16.5	12
D.cep	70	16.5	12
D.cep	70	16.5	12
D.cep	70	16.5	12
D.cep	70	16.5	12
	Total = 3490		
I.pun	750	47	41
I.pun	1750	53	46
I.pun	1500	56	49
I.pun	600	38	32
	Total =4600		
L.mac	70	13.5	10
L.mac	10	7	5
L.mac	30	13.5	10.5
L.mac	70	16	12.5
L.mac	10	7	5
L.mac	20	11	9
L.mac	40	13	11.5
L.mac	40	12.5	10
L.mac	20	12	10.5
L.mac	30	12	10
L.mac	25	11.5	9.5
L.mac	30	10.5	9
	Total = 395		
M.ery	185	25	20
	Total = 185		

M. sal	700	39	30
M.sal	400	27	22
	Total = 1100		
P.ann	60	18.5	14.5
P.ann	40	17	15
P.ann	320	32	25
	Total = 420		

SITE C	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	A.gru	500	37	29
DATE	*A.gru*	600	35	28
30-May-01	*A.gru*	660	39	37
	A.gru	350	35	29
		Total = 2110		
	C.car	1300	49	41
	C.car	1400	51	41
	C.car	1360	49	40
	C.car	520	36.5	29
	C.car	1500	50	39
	C.car	1100	46	38
	C.car	1400	47	39
		Total = 8580		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
	Total = 13250		
I.pun	1500	49	43
	Total = 1500		
L.mac	90	17.5	14
L.mac	60	15.5	13
L.mac	70	14.5	12.5
L.mac	30	14	11

L.mac	85	17	14
L.mac	70	15	12
L.mac	70	14.5	13
L.mac	40	12	9.5
L.mac	70	14.5	12.5
L.mac	50	13.5	11.5
L.mac	35	13.5	11
L.mac	40	12	10
L.mac	70	16	13
L.mac	30	11.5	9.5
L.mac	30	17	14
L.mac	70	15	12
L.mac	30	11	9
	Total = 940		
M.ery	180	22	20
	Total = 180		
M.sal	1050	43	38
M.sal	1600	49	41
M.sal	700	36	30
M.sal	200	25	21
M.sal	200	27	22
	Total = 3750		
P.ann	80	21	16
P.ann	75	19	15
P.ann	60	20	15.5
P.ann	80	21	16
P.ann	370	32.5	25.5
P.ann	50	15.5	12.5
P.ann	60	16	13
P.ann	40	15.5	13
P.ann	50	17	13
P.ann	55	17.5	14.5
P.ann	60	19	15
P.ann	60	17	13
	Total = 1040		

SITE D	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	900	42	35
DATE	*C.car*	800	41	35
30-May-01	*C.car*	1000	41	34
	C.car	2000	53	44
	C.car	1100	44	36.5
	C.car	900	44	36
	C.car	600	36	29
	C.car	1100	36	38
		Total =8400		
	D.cep	250	28	24.5
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total = 4850		
I.pun	650	43	36
	Total = 650		
L.mac	80	13.5	13
L.mac	50	12.5	10
L.mac	60	14.5	11.5
L.mac	60	15	12.5
L.mac	65	15	12
L.mac	30	12	9.5
L.mac	110	17	14
	Total = 455		
M.ery	280	29	25
	Total = 280		
M.sal	340	30	27
M.sal	1300	42	35.5
M.sal	30	12.5	10.5
	Total = 1670		

SITE E	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	2300	56	45
DATE	*C.car*	2300	61	48
30-May-01	*C.car*	1100	48	37
	C.car	1100	48	38
	C.car	900	44.5	35.5
		Total = 7700		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total = 4100		
I.pun	800	45	37
	Total = 800		
L.mac	80	16.5	14
L.mac	80	15	13
L.mac	70	15	12
L.mac	50	13.5	11
L.mac	80	17	13
L.mac	70	15.5	13
L.mac	100	17	13
L.mac	60	13.5	11.5
L.mac	90	16	13
L.mac	40	12.5	10
L.mac	40	11.5	9
L.mac	80	16	13.5
L.mac	80	12.5	12.5
L.mac	70	11.5	12.5
L.mac	110	16	14
L.mac	40	15.5	10.5
L.mac	140	15	15.5
L.mac	45	17.5	10.5
L.mac	35	13	11
L.mac	25	17.5	9
L.mac	30	12	10
L.mac	35	12.5	10.5
L.mac	30	11.5	9.5
	Total = 1480		
M.ery	500	32	27
M.ery	300	28	22
M.ery	250	29	24
M.ery	300	29.5	23
	Total = 1350		

M.sal	1200	47	44
M.sal	1500	45.5	39
M.sal	700	35.5	29
M.sal	700	36.5	30
	Total = 4100		
P.ann	40	15	12
P.ann	50	16	12.5
P.ann	60	17.5	14
	Total = 150		

SITE F	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	3100	63.5	52
DATE	*C.car*	1500	52	44
31-May-01	*C.car*	1700	51	42.5
	C.car	1800	46	42
	C.car	1500	46.5	37.5
	C.car	1400	43	37
	C.car	1450	49	41.5
	C.car	750	41.5	34
		Total = 13200		
	C.com	120	22.5	19
		Total = 120		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12

D.cep	50	15	12
	Total = 3450		
I.pun	2400	26	48
	Total = 2400		
L.mac	60	15.5	13
L.mac	50	14	11.5
L.mac	60	12.5	10
L.mac	40	15	13
L.mac	30	11.5	9
L.mac	70	16	13
L.mac	70	15	12.5
L.mac	70	15.5	13
L.mac	80	15.5	14
L.mac	60	14	11
L.mac	60	15	13
L.mac	70	14.5	12
L.mac	45	14	12.5
L.mac	35	13	10.5
L.mac	50	14	11.5
L.mac	15	11	9.5
L.mac	70	14	12.5
L.mac	40	20	17.5
L.mac	40	14.5	12.5
L.mac	30	12.5	10.5
L.mac	20	12	9.5
L.mac	55	15.5	13
L.mac	35	14	11.5
L.mac	40	14	11
L.mac	25	13	10.5
L.mac	45	15.5	13.5
L.mac	20	11	9.5
	Total = 1285		
L.meg	40	13	11
L.meg	40	13	11
L.meg	15	10	8.5
L.meg	30	12	10
L.meg	15	9.5	8
	Total = 140		
M.ery	220	26.5	22
	Total = 220		
M. mel	300	31	26.5

M. mel	320	31	27
	Total = 620		
M.sal	1100	41	35
M.sal	1300	43	37
M.sal	20	12	10.5
M.sal	120	24	21
M.sal	400	31	27
	Total = 2940		
P.ann	220	28	24
P.ann	65	17.5	13.5
P.ann	60	17.5	14.5
P.ann	100	19	16
P.ann	125	22	19
P.ann	100	21.5	17
P.ann	50	16.5	13
P.ann	50	15.5	12.5
P.ann	40	15.5	13
	Total = 810		

SITE G	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	1500	53	42.5
DATE	*C.car*	750	37	31.5
31-May	*C.car*	1500	54	43.5
	C.car	1000	41	37.5
	C.car	1500	49.5	40.5
	C.car	1500	51	42
	C.car	1500	50	31
		Total = 9250		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
		Total = 1000		
	L.mac	50	14	11.5
	L.mac	70	16	13.5
	L.mac	75	16.5	14
	L.mac	60	15	12.5
	L.mac	30	13	11
	L.mac	80	16	13
	L.mac	85	17	14.5
	L.mac	50	14.5	12
	L.mac	30	14	11.5

L.mac	90	17	14.5
L.mac	30	13	10.5
L.mac	30	14	11.5
L.mac	80	15.5	13
L.mac	50	15.5	13
L.mac	35	14.5	12
L.mac	20	12.5	10.5
L.mac	20	12.5	10.5
L.mac	35	14	12
L.mac	25	13.5	11.5
L.mac	20	12	10.5
L.mac	40	13.5	11.5
L.mac	20	13	10.5
L.mac	50	15.5	13.5
L.mac	20	11	9.5
L.mac	20	13	10.5
L.mac	30	15	12.5
L.mac	25	13.5	11.5
L.mac	30	11.5	9.5
L.mac	40	14.5	12.5
L.mac	20	12.5	10.5
L.mac	20	13	10.5
L.mac	25	12.5	9.5
L.mac	30	14	11.5
L.mac	15	12	9.5
L.mac	20	12.5	10.5
L.mac	30	13	12.5
L.mac	35	13	11.5
	Total = 1435		
L.meg	30	12	10
L.meg	30	12	10.5
L.meg	30	12.5	12.5
	Total = 90		
M.ery	350	28	22.5
	Total = 350		
M.sal	750	49	33
M.sal	1800	51.5	44.5
M.sal	850	41.5	34.5
M.sal	700	35	31
M.sal	400	30	25
M.sal	200	25.5	22

M.sal	400	31	25
M.sal	350	30	26.5
M.sal	600	36	31.5
M.sal	30	13	11
	Total = 6080		
P.am	70	20	15.5
P.am	80	21	16.5
P.am	220	25.5	22
P.am	60	18	14.5
P.am	70	20	16.5
P.am	40	16	14.5
P.am	50	18	15.5
P.am	25	15.5	12.5
P.am	40	19	15.5
	Total = 655		

SITE H	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	1500	51.5	41
DATE	*C.car*	2600	54	45
31-May-01	*C.car*	2000	55	46.5
	C.car	1000	44	35
	C.car	700	40	34.5
	C.car	3700	61	50.5
		Total = 11500		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
		Total = 1200		
	I.fur	7300	80	64
	I.fur	6800	82.5	68
	I.fur	8200	81	70
	I.fur	5450	77	69
	I.fur	8200	82	69
	I.fur	10000	85	69
	I.fur	7300	86	75

I.fur	3650	69	60
I.fur	3600	64	59
I.fur	12200	87	79
I.fur	20450	102	90
	Total = 93150		
I. niger	3200	75	67
	Total = 3200		
I.pun	700	17.5	39
I.pun	1000	46	40
	Total = 1700		
L.cya	30	13.5	12
	Total = 30		
L.mac	70	17	13.5
L.mac	60	16.5	14
L.mac	55	14.5	12
L.mac	30	14	11.5
L.mac	40	14	11.5
L.mac	50	15	13
L.mac	70	16.5	14
L.mac	55	14	11.5
L.mac	90	16	13.5
L.mac	30	14	11.5
L.mac	40	13.5	11.5
L.mac	30	14	11.5
L.mac	30	14	11.5
L.mac	30	13.5	11
	Total = 715		
M.mel	300	29	26
	Total = 300		
M.sal	500	34	28
M.sal	300	27	23
M.sal	100	23	19.5
	Total = 900		
P.ann	50	18.5	15
P.ann	30	17	14
	Total = 80		
P.oli	15910	105	88
P.oli	5450	70	60
P.oli	7730	89	79
P.oli	10900	81	76
	Total = 39990		

SITE I	*SPECIES*	**WEIGHT(gm)**	**TL (cm)**	**SL (cm)**
	D.cep	50	15	12
DATE	*D.cep*	50	15	12
4-Jun-01	*D.cep*	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12

D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total 3050		
I.pun	500	34.5	26
	Total = 500		
L.mac	50	15	12.5
L.mac	50	15.5	13
L.mac	40	13.5	11
L.mac	60	14	12
L.mac	35	13	12
L.mac	30	12	10
L.mac	10	8.5	7.5
L.mac	50	15	12.5
L.mac	40	13	11.5
L.mac	30	12	10
L.mac	40	14	12.5
L.mac	30	13.5	11.5
L.mac	60	14.5	12
L.mac	80	17	14
L.mac	40	13.5	11
L.mac	40	13.5	11

L.mac	70	12.5	12.5
L.mac	100	17	15
L.mac	40	13.5	11
L.mac	40	13	11
	Total = 935		
Lcya	30	11	9.5
	Total = 30		
M.ery	250	28	23
M.ery	260	27	23
	Total = 510		
M.mel	500	34	29
	Total = 500		
M.sal	2400	53	46.5
M.sal	1400	47	41.5
M.sal	1000	39	34.5
M.sal	420	31.5	26.5
M.sal	400	31	28
M.sal	1700	48	42
M.sal	1600	49	42.5
M.sal	700	36	32
M.sal	60	24	20.5
	Total = 9680		
P.ann	40	17	14.5
P.ann	60	18.5	14.5
P.ann	65	18.5	15
P.ann	80	20	16
P.ann	100	21.5	16.5
P.ann	60	17	15.5
P.ann	60	19	15.5
P.ann	85	20	17
P.ann	50	17	13.5
P.ann	70	17	15.5
P.ann	50	17.5	15
P.ann	50	17.5	15
P.ann	60	17	14
P.ann	40	17	14.5
P.ann	60	17	14
P.ann	50	17.5	15
P.ann	40	17	14.5
P.ann	50	17.5	15
	Total = 1070		

P.oli	1500	50	42
	Total = 1500		

SITE J	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	A.gru	2250	57	46.5
DATE	*A.gru*	2800	59	50
4-Jun-01	*A.gru*	2200	51.5	43.5
		Total = 7250		
	C.car	1200	48	39
	C.car	2000	58	42
	C.car	2200	56.5	48
	C.car	1600	52.5	43.5
	C.car	1500	47.5	40.5
		Total = 8500		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
		Total = 1150		
	L.gul	80	14	13
	L.gul	120	18	16
	L.gul	30	12	11
	L.gul	50	13.5	11.5
	L.gul	30	11	10

L.gul	35	12.5	11.5
L.gul	30	11.5	9.5
L.gul	20	10.5	9
L.gul	40	12	10
L.gul	25	11.5	9.5
	Total = 460		
L.mac	70	16	13.5
L.mac	90	16.5	14
L.mac	80	15	12.5
L.mac	90	17	15.5
L.mac	60	14.5	13
L.mac	70	15	12
L.mac	70	14.5	13
L.mac	65	15	13
L.mac	55	14	12
L.mac	50	13.5	12
L.mac	55	14	12
L.mac	40	13	11.5
L.mac	45	14.5	13
L.mac	60	14	12
L.mac	40	12.5	10.5
L.mac	20	11.5	10
L.mac	40	12	11
L.mac	25	12	10.5
	Total = 1050		
M.ery	300	29	23.5
M.ery	260	27.5	23
	Total = 560		
M.sal	1800	49	43
M.sal	1200	45.5	39
M.sal	600	40	34.5
M.sal	500	34	28
M.sal	320	29.5	24.5
M.sal	770	36.5	32
M.sal	200	24.5	21
M.sal	700	37	31.5
M.sal	1000	40.5	35
M.sal	1200	42.5	35.5
M.sal	150	22	18.5
M.sal	150	22.5	18.5
	Total = 8590		

SITE K	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.com	350	32	26.5
DATE	*C.com*	300	26	22
4-Jun-01		Total = 650		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12

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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
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D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total = 5100		

SITE L	SPECIES	WEIGHT(gm)	TL (cm)	SL (cm)
	C.car	1700	53	46
DATE	*C.car*	1000	42	34.5
4-Jun-01	*C.car*	1100	46	37
	C.car	400	29	24
	C.car	1000	43	36.5
		Total = 5200		
	C.com	320	32	26.5
		Total = 320		
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12
	D.cep	50	15	12

D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
D.cep	50	15	12
	Total = 2350		
I.pun	800	42	37
	Total = 800		
L.mac	50	16.5	14
L.mac	50	14.5	11.5
L.mac	60	14	11.5
L.mac	25	11	9.5
L.mac	40	14.5	11.5
L.mac	50	14	11
	Total = 275		
L.meg	30	12	9.5
	Total = 30		
M.ery	250	26.5	22
	Total = 250		
M.sal	2000	45.5	41
M.sal	880	39	33
M.sal	350	26	22
M.sal	700	37	31.5
M.sal	1000	42	37
	Total = 4930		
P.ann	50	16.5	14
	Total = 50		