1998 Warmwater Fisheries Survey of Island Lake (Mason County)

by

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Abstract

A warmwater fish survey was completed at Island lake, Mason County, during the fall of 1998. This survey was subsequent to the initiation of an aquatic plant control program, targeted mainly at the invasive Eurasian water-milfoil *Myriophyllum spicatum*. There is no previous fish population data available to draw firm conclusions as to the effect of the plant control program on the warmwater fish population. More directed sampling needs to be undertaken to determine the status of the smallmouth bass *Micropterus dolomieu* population before an enhancement plan is developed. An angler creel survey would benefit us in determining angler preference and satisfaction.

Acknowledgments

We would like to thank Steve Anderson, John Pahutski, and Chris Sergeant for their help with all of the data collection and field related work, and Bill Zook and Dan Collins for reviewing this document. We would also like to thank Jennifer Parsons, Washington Department of Ecology, for providing us with her aquatic plant surveys, listed in Appendix B. This project was funded by the Warmwater Enhancement Program, through a license surcharge, which is providing greater opportunity to fish for and catch warmwater fish in Washington.

Table of Contents

List of Tables

List of Figures

Introduction and Background

Island Lake (Figure 1) is a 110 acre natural lake located within the town of Shelton, Mason County. It has a maximum depth of 9.4 m, a mean depth of 6.4 m, and a volume of approximately 2,713,639 m^3. The lake is fed by rainfall and groundwater, there are no year-round natural inflows. Surface water exits the lake through a culvert at the southern end of the lake, and feeds a wetland. The wetland has no direct water outflow; other than to groundwater. When we sampled the lake on September 8 - 10, 1998, the lake level was below the opening to the culvert, so no water was exiting the lake. Surface water is also removed from the lake through a number of pumps that feed the irrigation systems of lake residents.

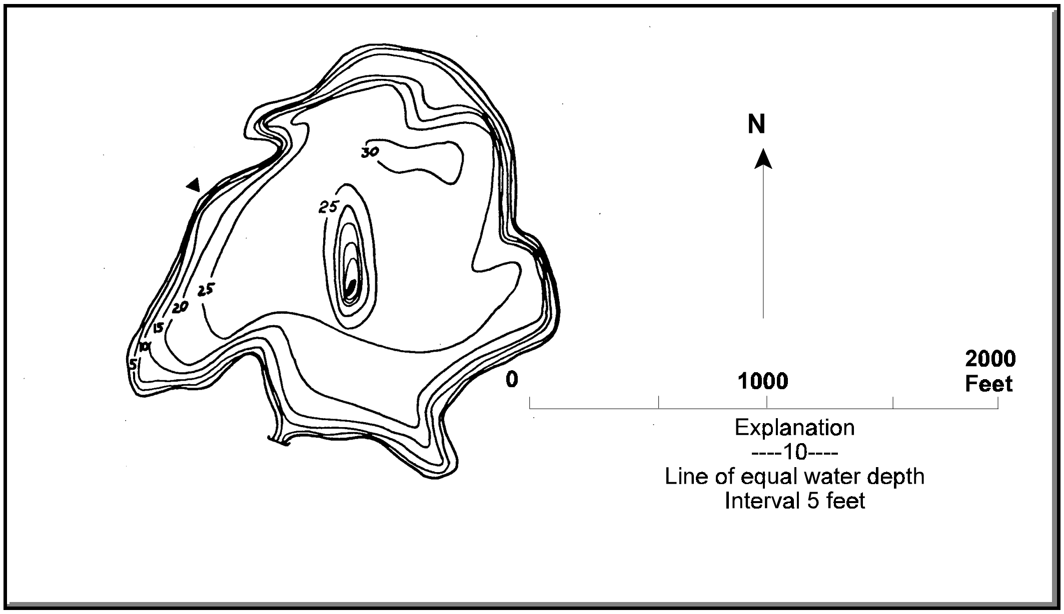

Figure 1. Bathymetric map of Island Lake, Mason County, taken from Bortelson, et al. (1976).

Island Lake supports a relatively small plant community. Historically, the aquatic plant community has been dominated by submersed vegetation, including; milfoil (*Genus* spp.), and various types of pondweed (*Potamogeton* spp.). Emergent vegetation includes white pond-lily (*Nuphar odorata*), water shield (*Brasenia schreberi*), rushes (family Juncaceae), and sedges (family Cyperaceae). During 1998, the community around the lake contracted a local company to help control the submersed vegetation. Although the lake depth drops off fairly quickly, a thick mat of submerged vegetation was reportedly around most of the lake, out to a depth of about 15 ft. The chemical herbicide Sonar®, a fluridone compound, was spread to remove the large mats of vegetation; mostly being Eurasian water-milfoil *Myriophyllum spicatum*.

Island Lake has a highly developed residential shoreline, with few undeveloped lots. The only public access is through a state owned access area with a boat launch on the western shore of the lake.

Materials and Methods

Data Collection

Island Lake was surveyed by a three-person team during September 8 - 10. Fish were captured using three sampling techniques: electrofishing, gill netting, and fyke netting. The electrofishing unit consisted of a Smith-Root SR-16s electrofishing boat, with a 5.0GPP pulsator unit. The boat was fished using a pulsed DC current of 60 or 120 cycles/sec at 3 - 4 amps power. Experimental gill nets (45.7 m long x 2.4 m deep) were constructed of four sinking panels (two each at 7.6 m and 15.2 m long) of variable-size (1.3, 1.9, 2.5, and 5.1 cm stretch) monofilament mesh. Fyke (modified hoop) nets were constructed of 5 - 4 ft diameter hoops with two funnels, and an 8 ft cod-end (6.4 mm nylon delta mesh). Attached to the mouth of the net were two 25 ft wings, and a 100 ft lead.

In order to reduce the gear induced bias in the data, the sampling time for each gear was standardized so that the ratio of electrofishing to gill netting to fyke netting was 1:1:1. The standardized sample is 1800 sec of electrofishing (3 sections), 2 gill net nights, and 2 fyke net nights. Sampling occurred during the evening hours to maximize the type and number of fish captured. Sampling locations were selected from a map by dividing the entire shoreline into 400 m sections, and numbering them consecutively. Nightly sampling locations were randomly chosen (without replication) utilizing a random numbers table (Zar 1984). While electrofishing, the boat was maneuvered through the shallows at a slow rate of speed (~18 m/min, linear distance covered over time) for a total of 600 sec of "pedal-down" time or until the end of the section was reached, whichever came first. Nighttime electrofishing occurred along 80-90% of the available shoreline, for a total fishing time of 8286 seconds. Gill nets were fished perpendicular to the shoreline; the small-mesh end was tied off to shore, and the large- mesh end was anchored off shore. Fyke nets were fished perpendicular to the shoreline as well. The lead was tied off to shore, and the cod-end was anchored off shore, with the wings anchored at approximately a 45° angle from the net lead. We tried to set fyke nets so that the hoops were 1 - 2ft below the water surface, this sometimes would require shortening the lead. Gill nets and fyke nets were set overnight at seven locations around the lake (see Figure 1).

With the exception of sculpin (*Cottidae*), all fish captured were identified to the species level. Each fish was measured to the nearest millimeter (mm) and assigned to a 10 mm size class based on total length (TL). For example, a fish measuring 156 mm TL was assigned to the 150 mm size class for that species, and a fish measuring 113 mm TL was assigned to the 110 mm size class, and so on. However, if a sample included several hundred young-of-year (YOY) or small juveniles (<100 mm TL) of a given species, then a sub-sample (N ~100 fish) were measured, and the remainder were counted. The frequency distribution of the sub-sample was then applied to the total number collected. At minimum of ten fish from each size class were weighed to the nearest gram (g); in some instances, multiple small fish were weighed together to get an average weight. Scales were taken from five individuals per size class, mounted, pressed, and aged using the Fraser-Lee method. However, members of the bullhead family (Ictaluridae), and non-game fish like carp (Cyprinidae), were not usually aged.

Water quality data (Table 1) was collected during midday from two locations on September 14, 1998 (see Figure 1). Using a Hydrolab® probe and digital recorder, dissolved oxygen, temperature, pH, and conductivity data was gathered in the littoral zone and in the deepest section of the lake at 1 m intervals through the water column. Secchi disk readings, used to measure transparency, were taken by the methods outlined by Wetzel (1983).

Table 1. Off shore water quality parameters collected from Island Lake, Mason County. Water quality parameters were collected mid-day, September 14, 1998.

Depth (m)	Temp C	DO (mg/l)	pH
0	22.6	8.7	8.7
1	22.3	8.2	8.7
2	21.9	8.3	8.7
3	21.8	8.3	8.7
4	21.7	8.2	8.6
5	21.7	8.1	8.6
6	21.5	5.9	8.4

Data Analysis

Species Composition

The species composition by number of fish captured, was determined using procedures outlined by Fletcher et al.(1993). Species composition by weight (kg) of fish captured, was determined using procedures adapted from Swingle (1950). The percentage of the aggregate biomass for each species provided useful information regarding the balance and productivity of the community (Swingle 1950, Bennett 1962). Only fish estimated to be at least one year old were used to determine species composition. These were inferred from the length frequency distributions described below, in conjunction with the results of the aging process. Young of year or small juveniles were not considered because large fluctuations in their numbers may cause distorted results (Fletcher et al. 1993). For example, the length frequency distribution of yellow perch *Perca flavescens* may suggest successful spawning during a given year, as indicated by an abundance of fish in the smallest size classes. However, most of these fish would be subject to natural attrition during their first winter, resulting in a different size distribution by the following year.

Table 2. Species composition, excluding young of year, by weight (kg), and number of fish captured at Island Lake (Mason County) during the fall 1998 warmwater fish survey.

	Species Composition					
	by Weight		by Number		Size Range (mm)	
Species	**(kg)**	**(%w)**	**(#)**	**(%n)**	**Min**	**Max**
Largemouth Bass	67.4	68.8	412	50.7	45	502
Yellow Perch	18.2	18.5	230	28.3	108	257
Pumpkinseed Sunfish	7.7	7.9	156	19.2	70	175
Smallmouth Bass	3.6	3.7	2	0.2	467	520
Rainbow Trout	0.6	0.6	5	0.6	65	335
Brown Bullhead	0.4	0.4	1	0.1	302	302
Sculpin	0.1	0.1	7	0.9	70	129
Total	98.1		813			

Catch Per Unit of Effort

The catch per unit of effort (CPUE) of electrofishing for each species was determined by dividing the total number of fish in all size classes equal or greater than stock size, by the total electrofishing time (sec). The CPUE for gill nets and fyke nets was determined similarly, except the number equal or greater than stock size was divided by the number of net-nights for each net (usually one). An average CPUE (across sample sections) with 80% confidence interval was calculated for each species and gear type, and is shown in Table 3.

Table 3. Average catch per unit effort (#fish/hour for electrofishing, #fish/night net sets) for fish sampled in Island Lake during the fall 1998 warmwater fish survey.

	Electrofishing			Gill Netting			Fyke Netting		
Species	**(#/ hour)**	**80% CI**	**Shock Sites**	**No. per GN night**	**80% CI**	**# Nights**	**No. per FN night**	**80% CI**	**# Nights**
Brown Bullhead Catfish	0.66	0.85	9	0.00	--	5	0.00	--	3
Sculpin, Unknown	4.63	3.56	9	0.00	--	5	0.00	--	3
Largemouth Bass	68.71	20.13	9	3.20	0.75	5	0.33	0.43	3
Pumpkinseed Sunfish	91.14	17.28	9	2.80	1.59	5	0.67	0.43	3
Rainbow Trout	0.00	--	9	0.20	0.26	5	0.00	--	3
Smallmouth Bass	0.66	0.85	9	0.20	0.26	5	0.00	--	3
Yellow Perch	68.33	15.49	9	22.20	15.44	5	0.00	--	3

For fishes in which there is no published stock size (i.e., sculpins, suckers, etc.), CPUE is calculated using all individuals captured. Furthermore, since it is standardized, the CPUE is useful for comparing stocks between lakes.

Length Frequency

A length-frequency histogram was calculated for each species and gear type in the sample (see Figures 1, 3, and 5). Length-frequency histograms are constructed using individuals that are age one and older, and calculated as the number of individuals of a species in a given size class, divided by the total individuals of that species sampled. We define the lower length limit of age one fish by subtracting one standard deviation from the mean length of a given species, as determined by the aging process. Plotting the histogram this way tends to flatten out large peaks created by an abundant size class, and makes the graph easier to read. These length-frequency histograms are helpful when trying to evaluate the size and age structure of the fish community, and their relative abundance in the lake.

Stock Density Indices

Stock density indices are used to assess the size structure of fish populations. Proportional stock density (PSD and relative stock density RSD) are calculated as proportions of various size-classes of fish in a sample. The size classes are referred to as minimum stock (S), quality (Q), preferred (P), memorable (M), and trophy (T). Lengths have been published to represent these size classes for each species, and were developed to represent a percentage of world-record lengths as listed by the International Game Fish Association (Gablehouse 1984). These length categories are provided for reference in Appendix A.

The indices calculated here are described by Gablehouse (1984) as the traditional approach. The indices are accompanied by a 80% confidence interval (Gustafson 1988) to provide an estimate of statistical precision.

Table 4. Stock density indices by gear type and length categories for the fish population at Island Lake (Mason County) during the fall 1998 warmwater fish survey.

		Quality		Preferred		Memorable		Trophy	
	# Stock Length	**PSD**	**80% CI**	**RSD-P**	**80% CI**	**RSD-M**	**80% CI**	**RSD-T**	**80% CI**
Electrofishing									
Largemouth Bass	93	33	6	14	5	0	--	0	--
Pumpkinseed Sunfish	139	24	5	0	--	0	--	0	--
Yellow Perch	103	17	5	1	1	0	--	0	--
Gill Netting									
Largemouth Bass	13	23	15	15	13	0	--	0	--
Yellow Perch	111	57	6	0	--	0	--	0	--
Pumpkinseed Sunfish	14	7	9	0	--	0	--	0	--
Fyke Netting									
Pumpkinseed Sunfish	2	0	--	0	--	0	--	0	--

Relative Weight

A relative weight index (W_r) was used to evaluate the condition (plumpness or robustness) of fish in the lake. A W_r value of 1.0 generally indicates a fish in good condition when compared to the national average for that species and size. Furthermore, relative weights are useful for comparing the condition of different size groups within a single population to determine if all sizes are finding adequate forage or food (ODFW 1997). Following Murphy and Willis (1991), the index was calculated as $W_r = W/W_s$ x 100, where W is the weight (g) for an individual fish from the sample and W_s is the standard weight of a fish of the same total length (mm). W_s is calculated from a standard log weight - log length relationship defined for the species of interest. The parameters for the W_s equations of many fish species, including the minimum length recommendations for their application, are listed in Anderson and Neumann (1996). For the species where data is available, the W_r values from this study are compared to an average W_r value calculated from lakes that have been surveyed across the state by the warmwater enhancement teams (Stephen Caromile, WDFW, unpublished data), and the national standard (W_r=100).

Age and Growth

Age and growth of warmwater fishes were evaluated according to Fletcher et al. (1993). Total length at annulus formation, L_n, was back-calculated using the Fraser-Lee method. Intercepts for the *y* axis for each species were taken from Carlander (1982). Mean back-calculated lengths at each age for each species were presented in tabular form for easy comparison between year classes. Mean back-calculated lengths at each age for each species were compared to averages calculated from scale samples gathered at lakes sampled by the warmwater enhancement teams.

Results and Discussion

Water Quality and Habitat

Water quality information was collected from Island Lake on September 14, 1998 from two locations in the lake. Temperature and dissolved oxygen levels (see Table 1) are well within the levels required by most fish. Dissolved oxygen levels of at least 5 mg/l is required for trout, though some warmwater fish may be able to tolerate less. For a complete list of aquatic vegetation types found at Island Lake, refer to appendix B; this data was provided by Jennifer Parsons, aquatic plant specialist at Washington Department of Ecology.

Species Composition and Relative Abundance

The dominant species in terms of biomass and total number was largemouth bass (see Table 2). Only two smallmouth bass were sampled, but we suspect that they are more abundant than our sampling indicated. It should be noted that our sampling techniques are largely restricted to the littoral zone of the lake, so some species, such as trout, will be under-represented in our sampling.

Catch per unit of effort for each species is shown in Table 3, broken out by gear type, and is given for fish that are stock size and greater. The highest overall catch rates (#/hr) were for pumpkinseed, largemouth bass and yellow perch, respectively. Catch rates were lowest for smallmouth bass, rainbow trout, brown bullhead, and sculpins. Also, electrofishing consistently had higher catch rates than any other gear type, with the exception that gill netting captured more trout (see Table 3).

Electrofishing proved to be the most efficient capture technique for all species. Gill netting was effective for yellow perch only, and even then, the mean catch rate was a fraction of electrofishing. Fyke nets were not effective for any species at Island Lake.

Few stock size fish were captured of any species, though twice as many stock size yellow perch were captured than any other species. Proportional stock density was consistently low for all species, though, if samples from different gear types were to be combined, yellow perch would have the highest PSD. Few quality or preferred size fish were captured, so discretion should be used when viewing this index. Also, be mindful while viewing these stock density indices as they were developed for use on populations that are in a steady state (Willis et al., 1993). Due to the aquatic vegetation control program occurring on Island Lake, the fish community can be described as being in a state of flux. The removal of vegetative cover can prove to be devastating for the younger age classes of fish.

Summary by Species

Largemouth bass (*Micropterus salmoides*)

The size distribution of the largemouth bass population in Island Lake is weighted towards smaller fish, as one would expect, with the frequency of capture dropping off as fish get older and larger. Still, one would expect the frequency of larger fish to be a little higher. The two gear types that were effective at sampling bass captured roughly the same sizes, creating complementary length-frequency histograms.

Length at age for largemouth bass (Table 5) is below the state average for western Washington lakes. This may in part be due to a lack of a prey base. Although there are several potential prey fish species available in the lake, the CPUE of prey suggests that their density is low. In addition, there is a strong possibility that the deep, clear lake is deficient in zooplankton that are needed by young bass before they switch to piscivory. This theory can be partially supported by a slower than normal first year growth.

Relative weights of stock sized and greater largemouth bass (Figure 2) average slightly higher than the national standard, especially for larger fish. Relative weight is an indicator of condition, and has been shown to vary throughout the growing season; being lower in the spring and rising through the year with the increased availability of young of year as prey (*reference here*). The higher relative weights, in this case, can be attributed to the increased prey base that became available with the removal of the littoral zone vegetation.

Table 5. Mean back calculated length at age (Fraser-Lee) of largemouth bass sampled from Island Lake, Mason County, during the fall 1998 warmwater fish survey. Direct proportion means are provided for comparison to historical state averages.

		Mean Length at Age (mm)									
Year Class	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1997	24	64									
1996	24	60	117								
1995	25	69	120	184							
1994	25	67	120	180	243						
1993	16	81	139	206	273	325					
1992	4	78	132	194	272	322	364				
1991	1	74	126	178	232	270	330	373			
1990	1	65	140	181	260	297	339	384	421		
1989	0	–	–	–	–	–	–	–	–	–	
1988	1	53	102	168	243	283	335	395	424	450	484
Fraser-Lee	121	68	123	188	255	319	351	384	423	450	484
Direct Proportion		52	111	178	248	291	325	339	346	409	440
State Average (d.p.)		60	146	222	261	289	319	368	396	440	485

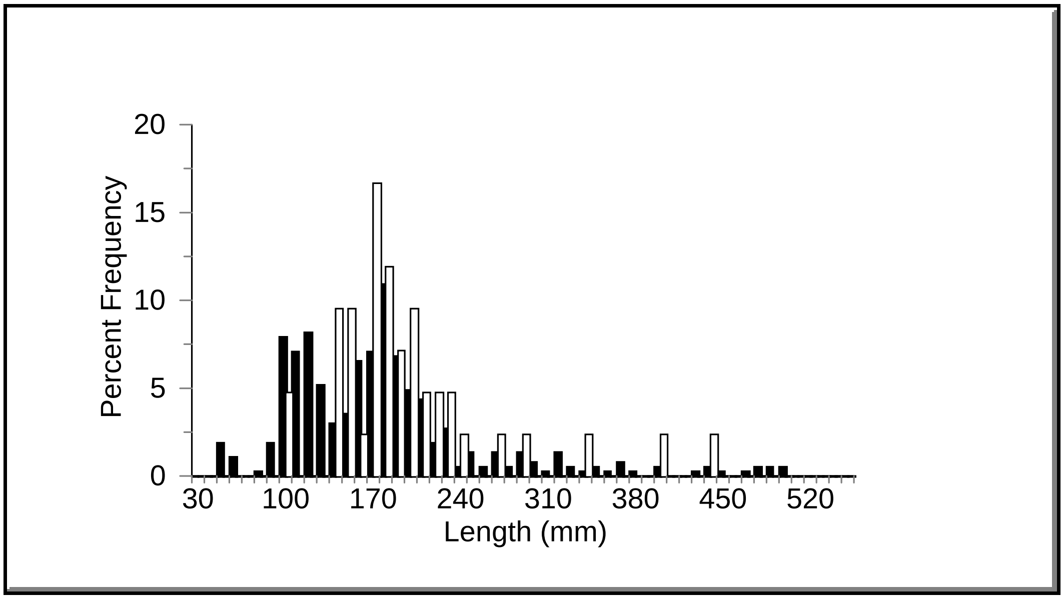

Figure 2. Length frequency distribution of largemouth bass from electrofishing (dark bars) and gill netting (light bars) from the fall 1998 survey of Island Lake (Mason County).

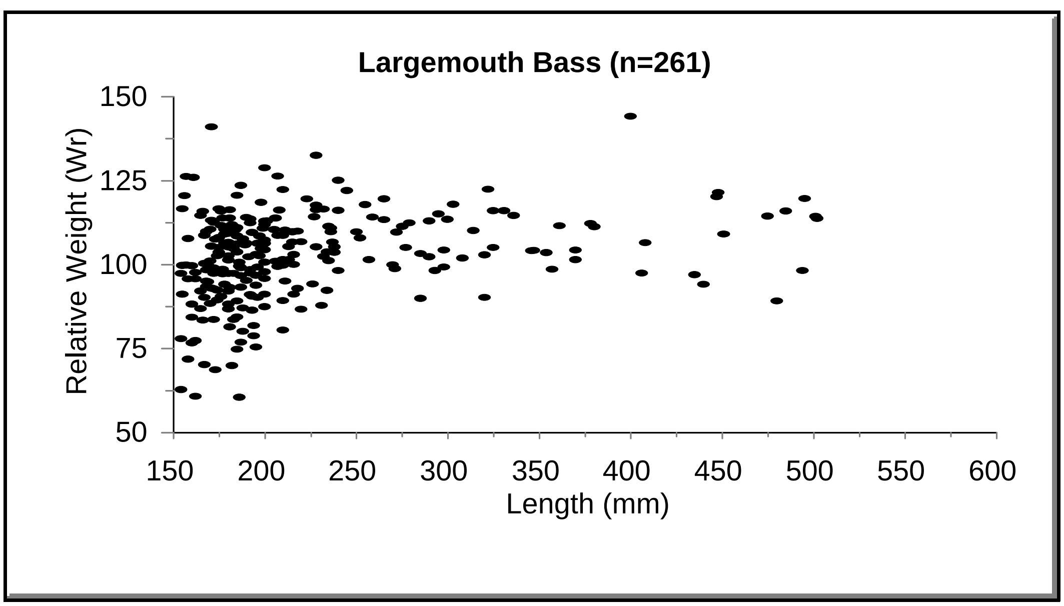

Figure 3. The relationship between total length and relative weight (Wr) for largemouth bass in Island Lake, Mason County, as compared to the national standard (horizontal line at 100).

Yellow Perch (*Perca flavescens*)

Growth of yellow perch is slow compared to that in other western Washington lakes (Table 6). Yellow perch have the tendency to overpopulate, and their growth stunts when their population density gets high. The low relative weights (Figure 4) show the condition of yellow perch is poor when compared to the national index. The poor growth coupled with the low relative weights seem to point to a lack of food availability for yellow perch.

The frequency distribution of yellow perch (Figure 5) shows a definite size bias related to gear type. Gill netting picked up larger size classes than did electrofishing. The larger mesh of the gill nets fish further off shore, where larger perch are moving. Another interesting observation is complete lack of yellow perch below 100 mm in the sample. This, once again, can probably be attributed to the removal of aquatic vegetation, which is used as cover and foraging area for these smaller size classes of fish. Subsequently, these smaller size classes are more vulnerable to be preyed upon by larger fish.

Table 6. Mean back calculated length at age (Fraser-Lee) for yellow perch in Island Lake, Mason County. Direct proportion values have also been provided to aid in comparison to historical state averages.

		Mean Length at Age (mm)				
Year Class	**n**	**1**	**2**	**3**	**4**	**5**
1997	16	84				
1996	10	81	125			
1995	8	81	136	174		
1994	7	87	118	160	197	
1993	19	80	107	140	161	181
Fraser-Lee	60	82	118	152	138	181
Direct Proportion		64	105	141	163	180
State Average (d.p.)		60	120	152	193	206

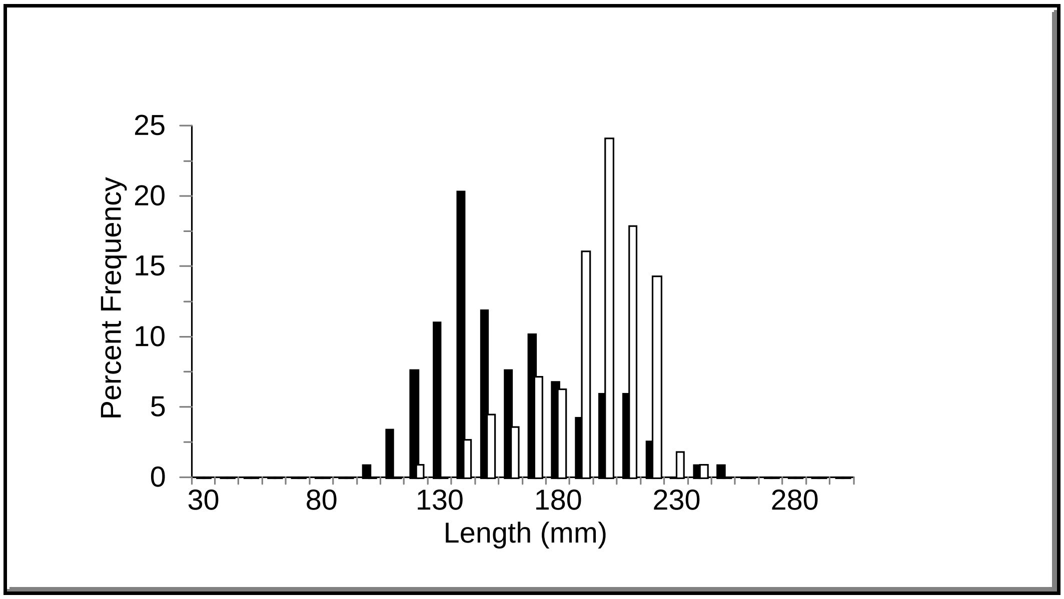

Figure 4. Length frequency distribution of yellow perch from electrofishing (dark bars) and gill netting (light bars) from the fall 1998 survey of Island Lake, Mason County.

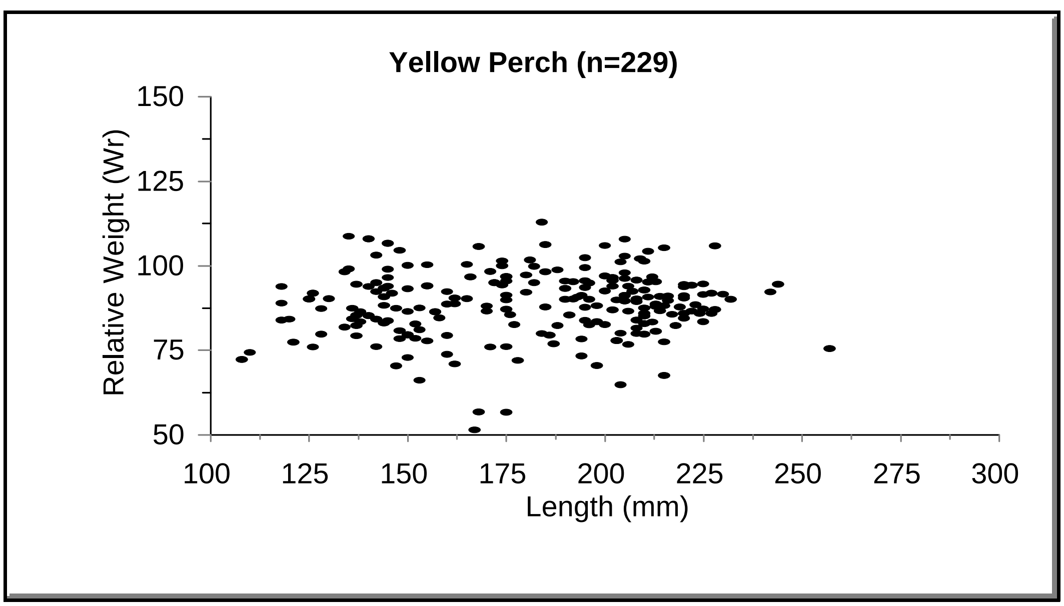

Figure 5. The relationship between total length and relative weight (Wr) for yellow perch in Island Lake, Mason County, as compared to the national standard (horizontal line at 100).

Pumpkinseed (*Lepomis gibbosus*)

The growth of pumpkinseed is consistently higher than the average growth for western Washington lakes for all age classes (Table 7). Coupled with the relative weights (Figure 7) that are close to the national standard of 100, one can believe that there is plenty of prey species available.

The frequency distribution of pumpkinseed (Figure 6) shows a low abundance of age one fish. In fact, there seems to be a lower abundance of age 0 through age 2+ than would be expected.

The most probable explanation again is, the removal of the aquatic plant community. Pumpkinseed, like many of the other sunfishes, are usually found close to the cover of aquatic vegetation or log jams. The removal of their major form of cover from Island Lake has most likely caused a high amount of predation on the smaller year classes by bass. There is also likely to be an extremely weak, or non-existent year class for the next few years due to predation. Additionally, the distribution of pumpkinseed around the shoreline will likely become spotty; limited to areas that have some sort of plant or woody cover.

Table 7. Back calculated length at age (Fraser-Lee) for pumpkinseed sampled from Island Lake, Mason County, during the fall 1998 warmwater fish survey. Direct proportion values are provided for comparison to historical data.

		Mean Length at Age (mm)					
Year Class	**n**	**1**	**2**	**3**	**4**	**5**	**6**
1997	1	45					
1996	19	42	78				
1995	12	48	85	120			
1994	11	47	85	120	148		
1993	0	-	–	–	–	–	
1992	1	48	75	107	146	160	168
Fraser-Lee	44	45	81	119	148	160	168
Direct Proportion		26	71	116	146	158	167
State Average (d.p.)		24	72	102	123	139	147

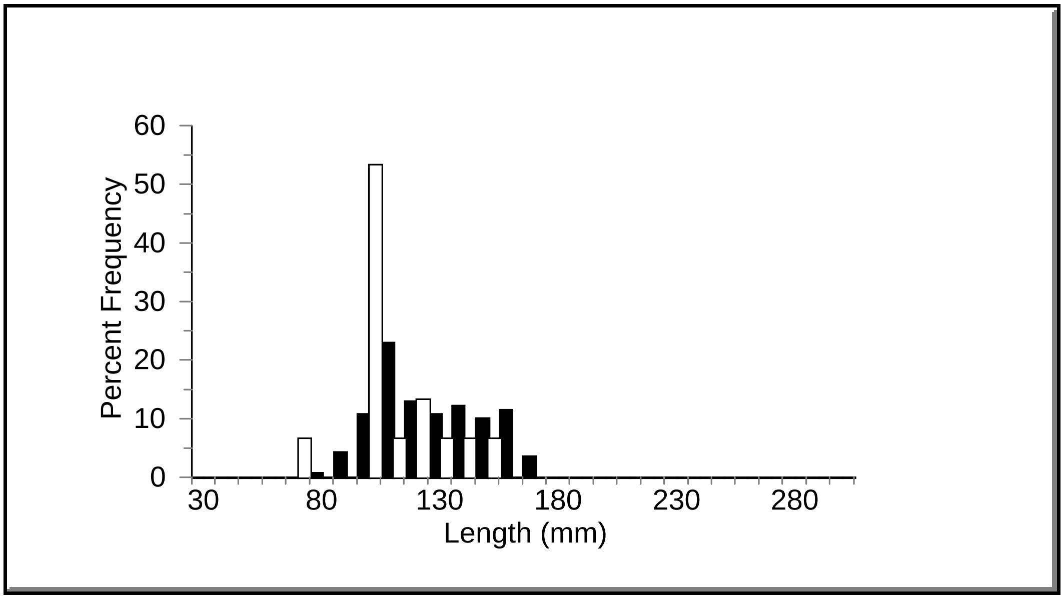

Figure 6. Length frequency distribution of pumpkinseed sampled at Island Lake, Mason County, during the fall 1998 warmwater fish survey using electrofishing (dark bars) and gill netting (light bars).

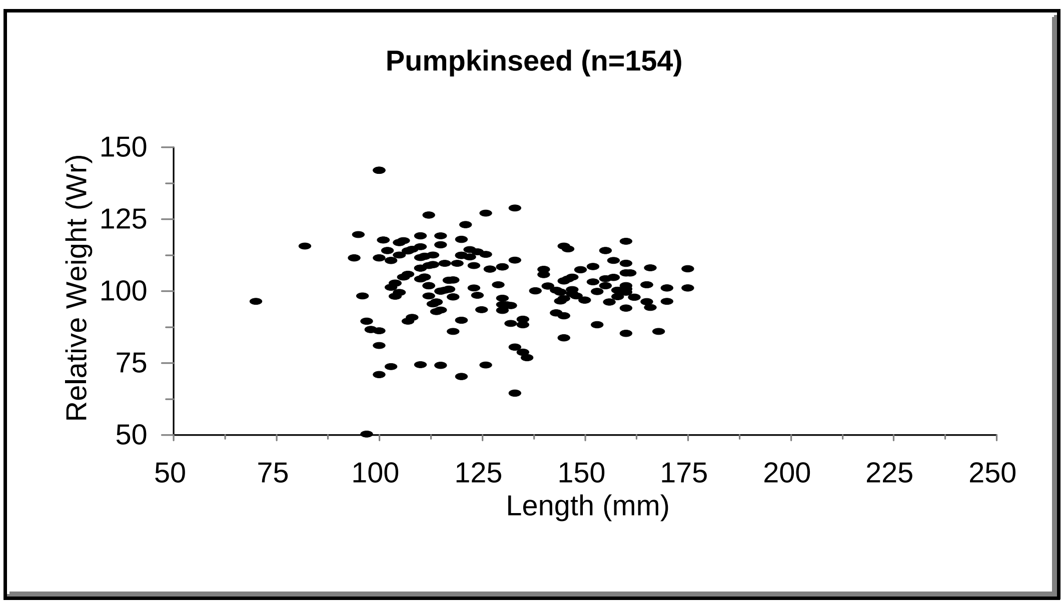

Figure 7. The relationship between total length and relative weight (Wr) for pumpkinseed sampled from Island Lake, Mason County, during the fall 1998 warmwater fish survey; as compared to the national standard (horizontal line at 100).

Smallmouth Bass (*Micropterus dolomieu*)

Only two smallmouth bass were captured during our sampling efforts at Island Lake. Yet, many of the anglers we had talked with reported that it was their favorite lake to fish for smallmouth. Both specimens that we captured were large, and their relative weights were close to the national standard (Figure 8). Only the smaller individual was aged, and it was shown to be a five year old fish. A largemouth bass of the same size (roughly 450mm) would be nearly twice as old (see Table 5). This may suggest that the smallmouth bass and largemouth bass are separated enough spatially, to be surviving on different prey bases. Also, the clear, cool and deep water and rocky substrate found in Island Lake is known to be better suited to smallmouth bass.

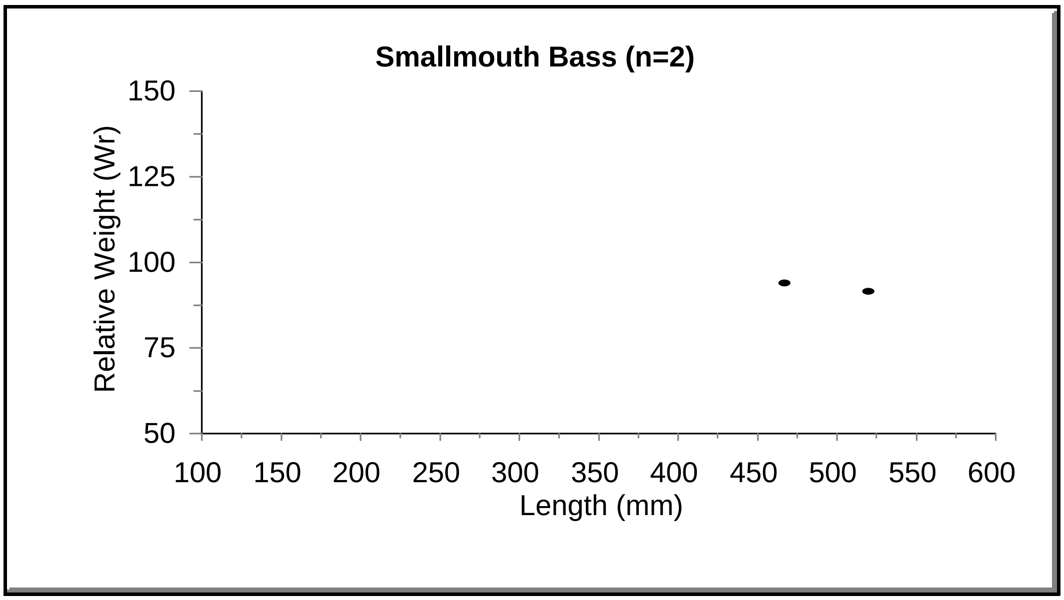

Figure 8. The relationship between total length and relative weight (Wr) for smallmouth bass sampled at Island Lake, Mason County, during the fall 1998 warmwater fish survey, as compared to the national standard (horizontal line at 100).

Rainbow trout (*Oncorhynchus mykiss*)

Island Lake is managed as a mixed species lake; receiving rainbow trout fry as well as legal sized plants to provide a recreational trout fishery, but it is not managed strictly as a trout water. Three rainbow trout were captured during our sampling efforts. No attempt was made to age these fish, but relative weights were calculated from their lengths and weights, and are shown in Figure 9. The relative weights of these few fish are low when compared to the national standard.

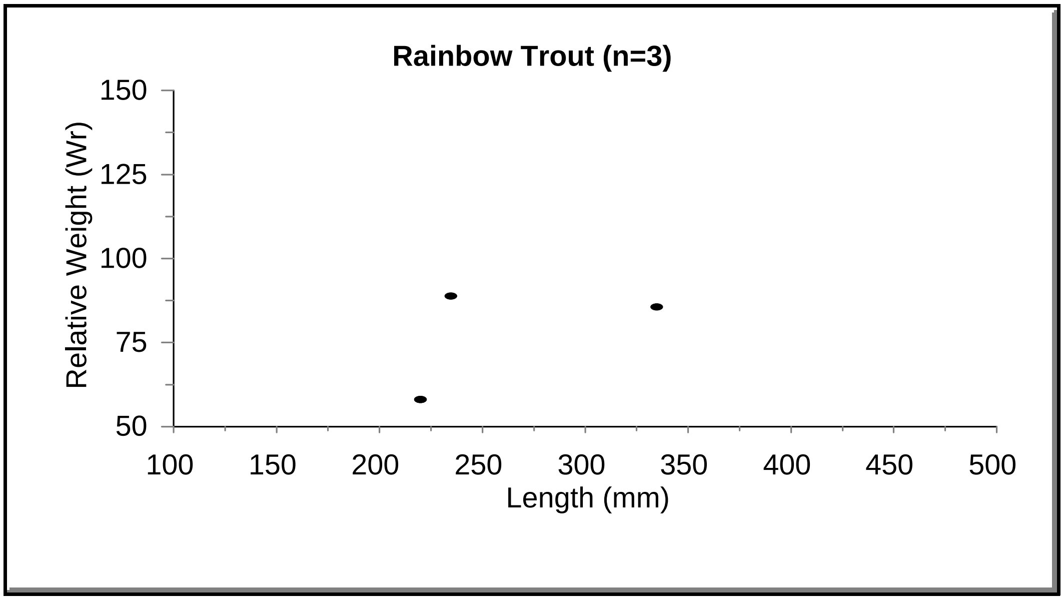

Figure 9. The relationship between total length and relative weight (Wr) for rainbow trout sampled in Island Lake, Mason County, during the fall 1998 warmwater fish survey, as compared to the national standard (horizontal line at 100).

Brown bullhead (*Ameiurus nebulosus*)

Few brown bullhead were collected in the sample; not nearly enough to calculate any stock density indices or to show a length frequency histogram. Often, bottom dwelling and negatively buoyant fish are hard to see during the sampling process. Hence, abundance and total weights may be under estimated, and caution should be used when viewing Tables 2 and 3.

Although they are not usually managed for, brown bullhead are often an important sport and food fish in lakes in which they occur.

Sculpin (*Cottidae*)

Few sculpins were captured in the sample. Like other bottom dwelling and negatively buoyant species, sculpins were most likely under represented in the sample. With that being said, caution should be used when viewing Tables 2 and 3; CPUE and total weights are probably higher than are indicated by these tables. Sculpin are not an important sport or food fish, but may be an important prey species for bass. This section is merely to recognize their existence in the fish community at Island Lake.

Due to their morphological variation, we identify these fish only to the family level, Cottidae. But, the most commonly found sculpin species in western Washington lakes will be the prickly sculpin *Cottus asper* (Paul Mongillo, WDFW, personal communication). Other possibilities will include the reticulate sculpin *C. perplexus* and the torrent sculpin, *C. rhotheus*.

Discussion and Management Options

Fish Community

Island Lake cannot be described as being in a “steady state”. Due to the aquatic vegetation removal program that is currently under way, growth, mortality, and recruitment of any of the species of fish inhabiting the lake will likely fluctuate over the next few years. Consequently, indices such as PSD and RSD will provide little useful information to make any management decisions (Willis et al. 1993).

The removal of the large aquatic vegetation mats possibly has altered the fish community. Aquatic vegetation plays a key role in fish communities by providing habitat for many species of fish, foraging grounds, refuge for young of the year, and spawning substrate. It has also been demonstrated to be a necessity for improving survival and recruitment into the fishery (Willis et al. 1997). Bettoli et al. (1993) found that removal of the aquatic vegetation in Texas lakes changed the structure of the fish community, and Wiley et al. (1984) showed that a decrease in aquatic macrophytes equates to a decrease in fish production. The current expectation for Island Lake is just what is outlined above; a change in the overall fish community brought on by a sharp decrease in aquatic macrophyte abundance. Bettoli et al. (1993) has demonstrated that the removal of vegetation may not always affect the overall biomass within a lake. But, the survival of age 1 and older fish may decrease greatly due to an decrease in the age (or total length) at which a fish becomes piscivorus (Bettoli et al. 1992) which is brought on by the reduction in plant cover. The biomass within the lake will then end up being comprised of a large number of small, young individuals. Survival and recruitment will probably be low for some species until some of the submerged vegetation grows back.

Currently, there is a proposal to change the harvest regulations for bass (both largemouth and smallmouth) in some Washington lakes. This proposal, a slot limit regulation, would require that the larger fish (within the slot length) be released alive, while still allowing harvest of older and younger fish (above and below the slot length). The problem with many regional lakes is that there is low density bass populations, and that these populations can be easily decimated by angler harvest.

Monitoring angler effort and catch in this lake may provide valuable information. There have been anecdotal reports from anglers and members of local fishing clubs describing an exceptional smallmouth bass fishery. Unfortunately, we were not able to support these claims through our sampling, as we only captured two smallmouth bass. A well designed angler creel survey can provide a wealth of information about the performance of a lake over time. Creel surveys also can provide us with information we cannot gather during our standard surveys, such as angler satisfaction, and species preference. These surveys can help us tailor our management plans to suit the anglers main preference.

Though one should not make concrete conclusions from such a small sample, the growth of smallmouth bass appears to be better than that of largemouth bass. This is understandable given the life history of smallmouth bass, which are more suited to deep, cool, clear waters than are largemouth bass. To be more certain about the status of the smallmouth bass community, more directed sampling needs to take place when the smallmouth are in closer to shore, possibly early in the spring closer to spawning season. It is possible that more information on smallmouth bass can be obtained through the creel survey mentioned above, or through the monitoring of fishing tournaments. Once we learn more about the population status and harvest numbers, we may find that it would be beneficial to enhance the smallmouth bass population through a limited stocking program; but that decision cannot be made without the addition of a little more information.

Access

Island Lake has an improved public access site that is owned and maintained by the Department of Fish and Wildlife. During the summer of 1998, the Washington Conservation Corps were funded partially by the Warmwater Enhancement Program to work under our access area maintenance program. Under this pilot project, they provided the extra labor required to complete some of the time consuming cleaning projects that the access maintenance staff normally does not have the time, or budget, to complete.

The shore angling access is minimal; about 20-30 meters long, with a few trees that are needed for bank stabilization. Access for shore anglers can be increased through the installation of a boat dock or floating fishing pier.

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Appendix A

Appendix Table 1. Length categories that have been proposed for various fish species. Measurements are for total lengths (updated from Neumann and Anderson 1996).

	Category									
	Stock		Quality		Preferred		Memorable		Trophy	
	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)
Black bullhead[a]	6	15	9	23	12	30	15	38	18	46
Black crappie	5	13	8	20	10	25	12	30	15	38
Bluegill[a]	3	8	6	15	8	20	10	25	12	30
Brook trout	5	13	8	20						
Brown bullhead[a]	5	13	8	20	11	28	14	36	17	43
Brown trout	6	15	9	23	12	30	15	38	18	46
Burbot	8	20	15	38	21	53	26	67	32	82
Channel catfish	11	28	16	41	24	61	28	71	36	91
Common carp	11	28	16	41	21	53	26	66	33	84
Cutthroat trout	8	20	14	35	18	45	24	60	30	75
Flathead catfish	11	28	16	41	24	61	28	71	36	91
Green sunfish	3	8	6	15	8	20	10	25	12	30
Largemouth bass	8	20	12	30	15	38	20	51	25	63
Pumpkinseed	3	8	6	15	8	20	10	25	12	30
Rainbow trout	10	25	16	40	20	50	26	65	31	80
Rock bass	4	10	7	18	9	23	11	28	13	33
Smallmouth bass	7	18	11	28	14	35	17	43	20	51
Walleye	10	25	15	38	20	51	25	63	30	76
Warmouth	3	8	6	15	8	20	10	25	12	30
White catfish[a]	8	20	13	33	17	43	21	53	26	66
White crappie	5	13	8	20	10	25	12	30	15	38
Yellow bullhead	4	10	7	18	9	23	11	28	14	36
Yellow perch	5	13	8	20	10	25	12	30	15	38

a As of this writing, these new, or updated length classifications have yet to go through the peer review process, but a proposal for their use will soon be in press (Timothy J. Bister, South Dakota State University, personal communication).

Appendix B

Date: 23-Jul-96

Scientific name	Common name	Distribution Value	Comments
Brasenia schreberi	watershield	4	thick patches to 2.5 m deep
Carex lenticularis		2	shoreline
Chara sp.	muskwort	3	more dense in deeper water
Elodea canadensis	common elodea	2	low growing
Iris pseudacorus	yellow flag	2	patches on shore
Isoetes lacustris	lake quillwort	3	thick in rocky sediment
Myriophyllum spicatum	Eurasian water-milfoil	2	thickets near launch, scattered small plants in other areas
Najas flexlis	common naiad	2	
Nymphaea odorata	fragrant waterlily	2	patch
Potamogeton amplifolius	large-leaf pondweed	2	growing in water to 3.5 m deep
Potamogeton foliosus	leafy pondweed	1	
Potamogeton gramineus	grass-leaved pondweed	1	small patch observed
Potamogeton pusillus	slender pondweed	1	
Scirpus sp.	bulrush	2	along the shoreline

Date: 24-Jun-97

Scientific name	Common name	Distribution Value	Comments
Brasenia schreberi	watershield	3	dense in patches
Chara sp.	muskwort	2	
Elodea canadensis	common elodea	2	
Iris pseudacorus	yellow flag	2	
Iris sp.	Iris	1	with orange flowers, smaller than I.
pseudacorus			
Isoetes lacustris	lake quillwort	1	only a few seen, early in the season
Myriophyllum spicatum	Eurasian water-milfoil	3	some dense patches
Najas flexilis	common naiad	1	few
Nitella sp.	stonewort	3	dense in deeper water
Nymphaea odorata	fragrant waterlily	2	scattered patches on east and south shores
Potamogeton amplifolius	large-leaf pondweed	2	from shallow to deep water
Potamogeton sp (thin leaved)	thin leaved pondweed	2	no achenes for ID to species
Potamogeton sp.	pondweed	1	could not ID, few on east shore
Ranunculus aquatilis	water-buttercup	1	few, submersed
Scirpus sp.	bulrush	2	patches in shallows

Date: 09-Jul-98

Scientific name	Common name	Distribution Value	Comments
Brasenia schreberi	watershield	3	some dense patches, especially along south shore
Eleocharis sp.	spike-rush	1	
Elodea canadensis	common elodea	2	
Iris pseudacorus	yellow flag	2	
Myriophyllum spicatum	Eurasian water-milfoil	4	to 4 m deep
Najas flexilis	common naiad	2	
Nitella sp.	stonewort	2	
Nyphaea odorata	fragrant waterlily	1	one or 2 patches, east shore
Potamogeton amplifolius	large-leaf pondweed	2	
Potamogeton sp (thin leaved)	thin leaved pondweed	1	
Scirpus sp.	bulrush	2	

Notes:

- They started treatment with Sonar June 24, 1998, plants were just starting to show some effects (turning white) by the July survey.
- Besides the *M. spicatum*, the other non-natives are *Iris pseudacorus* and *Nymphaea odorata*.