Distribution And Abundance Of Aquatic Macrophytes in Mirror Lake, Wisconsin.

John F. Sullivan

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Introduction

The effect of urban runoff on the primary productivity and phytoplankton biomass of Mirror Lake, Wisconsin has been investigated by Knauer (1975). In December of 1976, the input of stormwater to Mirror Lake from urban runoff was diverted in an effort to reduce the nutrient load to the lake. Continued research on the response of the phytoplankton to stormwater division is presently under investigation (Garrison,1977).

The purpose of this study was to obtain base data on the distribution and abundance of aquatic macrophytes in Mirror Lake. This information is necessary to explain the effects of stormwater diversion on the aquatic macrophyte community in future investigations.

Description of Study Area

Mirror Lake is located in Waupaca County, Wisconsin (T22N, R12E, Sec 29,30). The lake has a surface area of 5.1ha, a maximum depth of 13.1m, and a mean depth of 7.8m (Knauer, 1975). The lake is fed primarily by direct precipitation and by groundwater. An outlet ditch connects Mirror Lake with Shadow Lake at the southern end (Fig. 1).

The littoral zone of Mirror Lake is narrow but has a well developed aquatic macrophyte community.

Methods

A modification of the line intercept method (Lind and Cottam, 1961) was used to sample aquatic macrophytes in Mirror Lake in July of 1977. Eleven transects were selected at approximately 100m intervals around the lake shoreline (Fig. 1). All transects were free from physical disturbances such as boat docks or swimming beaches. A buoyed line, marked at 1m intervals, was run from a stake on shore towards the center of the lake. The end of the line was fastened to a buoy that was anchored in deep water. Plants were reported from a basic sampling unit (BSU) by skin diving. A BSU was a 1.5m line that was bisected by the major transect at 1m intervals from the shore to the center of the lake. Thus, a BSU was parallel with the shoreline and followed the general bottom contour at that site. The depth of a BSU was determined with a sounding bar out to 1.5m and with a weighted line in deeper water.

The areal distribution of the major plant communities were recorded on a field map to supplement the data collected with the line intercept method. Aerial photographs were used to assist in the mapping of the shallow-water plant communities.

An estimation of the standing crop was made by determining the dry weight of the plant species collected from $0.1m^2$ quadrats.

The bottom substrate was described by visual observation at each basic sampling unit. The substrates were categorized as being muck, marl, sand, silt, rubble, rocks, clay or

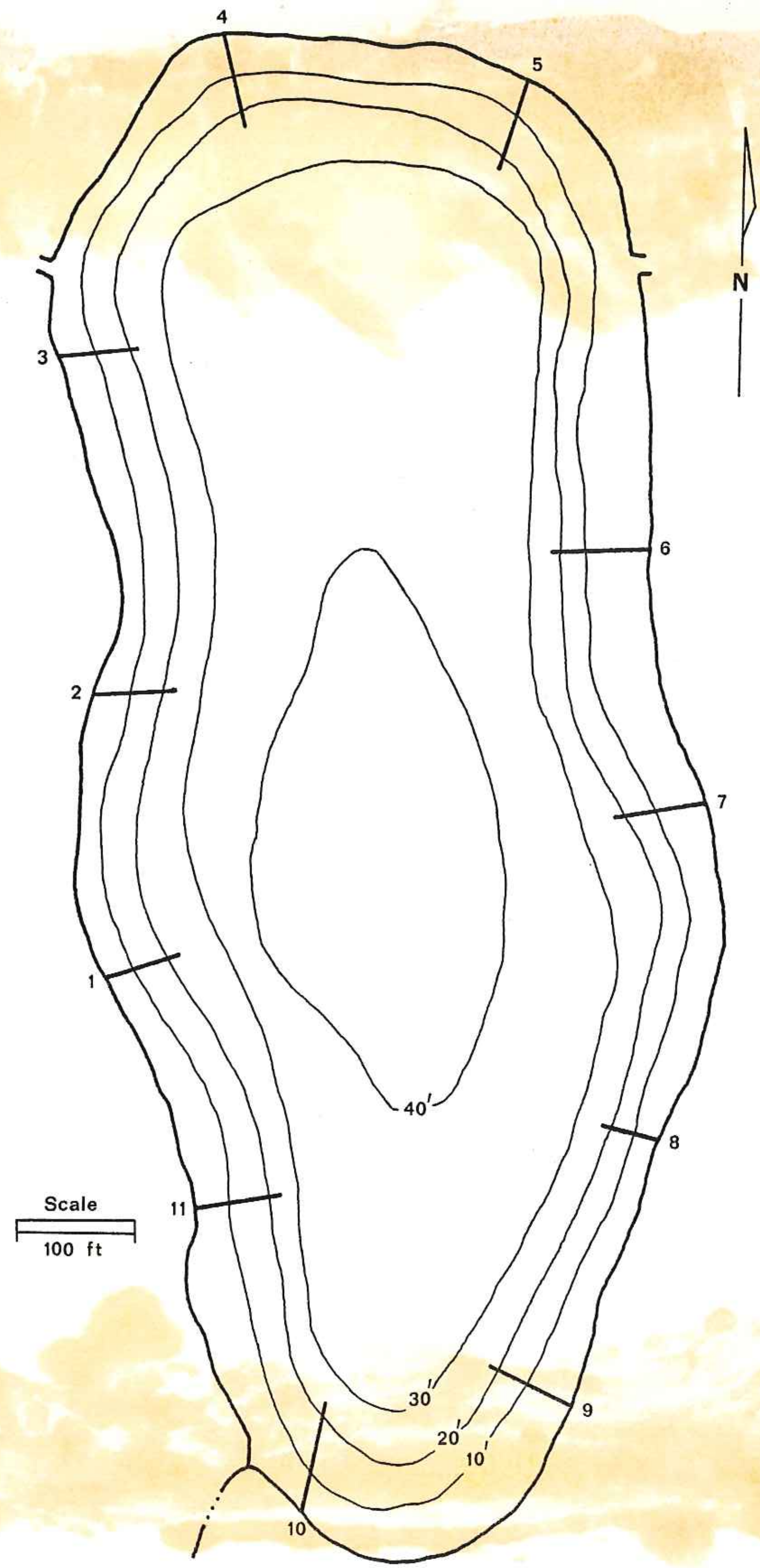

Fig. 1. Depth contour map of Mirror Lake. The location of sampling transects are represented by a heavy line.

combinations of these.

Voucher palnt specimens were collected and are on file at the University of Wisconsin - Stevens Point Herbarium.

Results and Discussion

<u>Frequency Occurence Of Plant Species</u>

There were a total of 187 basic sampling units sampled in the 11 major transects. The total mumber of plant species encountered in all BSU's was 817. Thus, there was an average of 4.4 species reported for every BSU sampled.

Aquatic macrophytes were found in all 187 BSU's surveyed. The occurence of any species within a BSU was then 100 percent. There are two reasons for the 100 percent frequency occurence of plants in Mirror Lake. First, the substrate consisted mainly of silts with mixtures of marl and sand. The substrate was also fairly uniform in the littoral region surrounding the lake. Therefore, the substrate provides an appropriate environment for submergent plant growth throughout the littoral zone. Second, the maximum depth surveyed in this work was only 4.6 meters. The occurence of any species would have declined if the survey was extended to deeper water. This would arise since the chance of a BSU with no plants observed would increase with increased depth.

Table 1 lists the plant species encountered and their respective frequency occurence. There were a total of 14 species found in Mirror Lake. This includes a species of <u>Chara</u>

Table 1. Frequency occurence of aquatic macrophytes in Mirror Lake.

Species	Percent[1] Frequency Occurence	Relative[2] Frequency Occurence
Myriophyllum exalbescens	84.0	19.2
Ceratophyllum demersum	79.7	18.2
Potamogeton pusillus	57.2	13.1
Potamogeton pectinatus	53.5	12.2
Chara spp.	34.8	8.0
Heteranthia dubia	32.1	7.4
Anacharis canadensis	29.9	6.9
Potamogeton zosterformis	24.6	5.6
Potamogeton alpinus	15.5	3.6
Vallisneria americana	12.8	2.9
Nymphaea tuberosa	8.6	2.0
Najas flexilis	3.7	0.9
Numphar variegatum[3]		
Potamogeton natans[3]		
Any species above	100.0	100.0

[1]No. of occurences in BSU/total BSU.
[2]No. of occurences in BSU/total species encountered in all BSU's.
[3]Present but not found in a BSU.

that was not identified. Numphar variegatum and Potamogeton natans were present in the lake but were not encountered in the plant survey work. The frequency occurence data indicates a rather diverse aquatic flora since no individual species dominates. The four species, Myriophyllum exalbescens, Ceratophyllum demersum, Potamogeton pusillus, and P. pectinatus account for 62.7 percent of the plants encountered in a BSU. This is in contrast to the work of Nichols and Mori (1971) where Myriophyllum spicatum accounted for 68.4 percent of the aquatic plant community in Lake Wingra, Wisconsin.

Community and Plant Species Distribution

The distribution of the major plant communities of Mirror Lake is shown in Figure 2. The shape and the depth-distribution of the shallow-water communities (Chara, Chara-Potamogeton, and Nymphaeaceae) could be easily determined from the field survey and with the aid of aerial photographs.

The Chara communities were basically monotypic and were found in water less than 2.5m deep. Valisneria americana, and Potamogeton pusillus were the two major associates with this community in water less than 1.0m deep. Myriophyllum exalbescens was the major associate in deeper water.

The Chara-Potamogeton community was found in one shallow-water region (1.5m) on the northwest side of the lake. This community was more diverse than the Chara community and was not heavily dominated by Chara spp.. Potamogeton natans was very abundant in the Chara-Potamogeton community. Other associates included Potamogeton pusillus, Vallisneria americana, Ceratophyllum demersum, and Myriophyllum exabescens.

Stands of Numphar variegatum and Nymphaea tuberosa were grouped together as the family Nymphaeaceae on the community

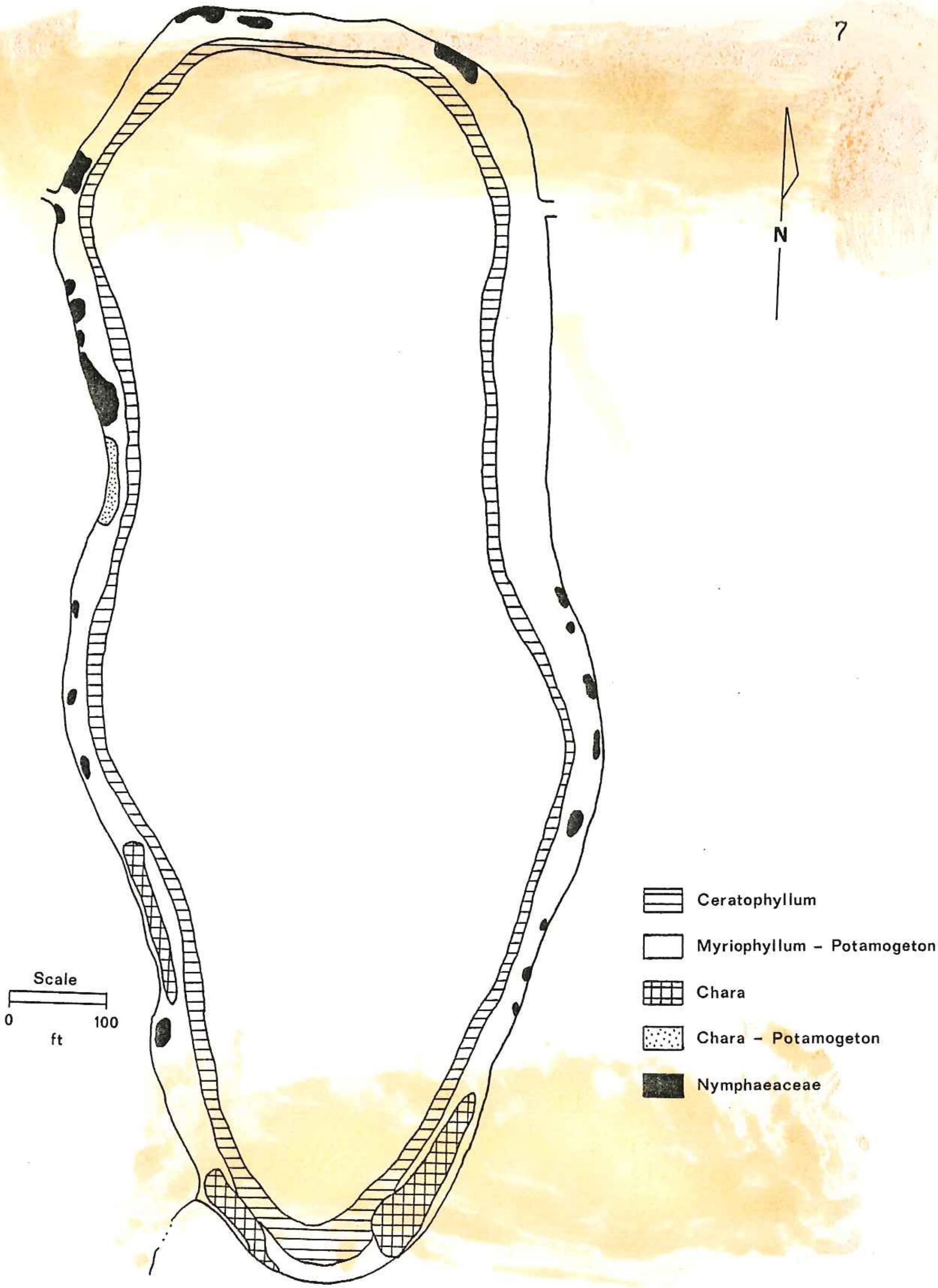

Fig. 2. Map of Mirror Lake illustrating the major plant communities.

distribution map (Fig. 2). The two species were not intermixed but were normally found quite close together. These stands were usually quite small and were grouped together to facilitate mapping. Myriophyllum exalbescens and Ceratophyllum demersum were common members of the Nymphaeaceae community. This community was found in water that was less than 2.0m deep.

The transition of the shallow-water Myriophyllum-Potamogeton community to the deep-water Ceratophyllum community was not easily determined by skin diving. The boundary of these two communities was derived from a plot of the depth-distribution of plant species (Fig.3). It is evident that the genus Potamogeton is most abundant in the 0 to 3 meter contour interval. Two species of Potamogeton (P. pusillus and P. pectinatus) were also found in the 3 to 4 meter contour interval but their abundace was reduced. Myriophyllum exalbescens was very common out to 4.0m and exhibited an abrupt decline in deeper water. The deep-water boundary of the Myriophyllum-Potamogeton community was determined with the 3.0m (approx. 10ft) contour interval from these results. Ceratophyllum demersum was the major associate with this community.

The maximum depth distribution of the Ceratophyllum community could not be determined by skin diving. The maximum depth of this community was arbitrarily set at 4.6m (15.0ft), the maximum depth surveyed in this study. SCUBA divers have found Ceratophyllum demersum in small monotypic stands out to 5.5m (18.0ft) at transect number 1. (REF) Thus, the maximum depth-distribution of the Ceratophyllum community is probably

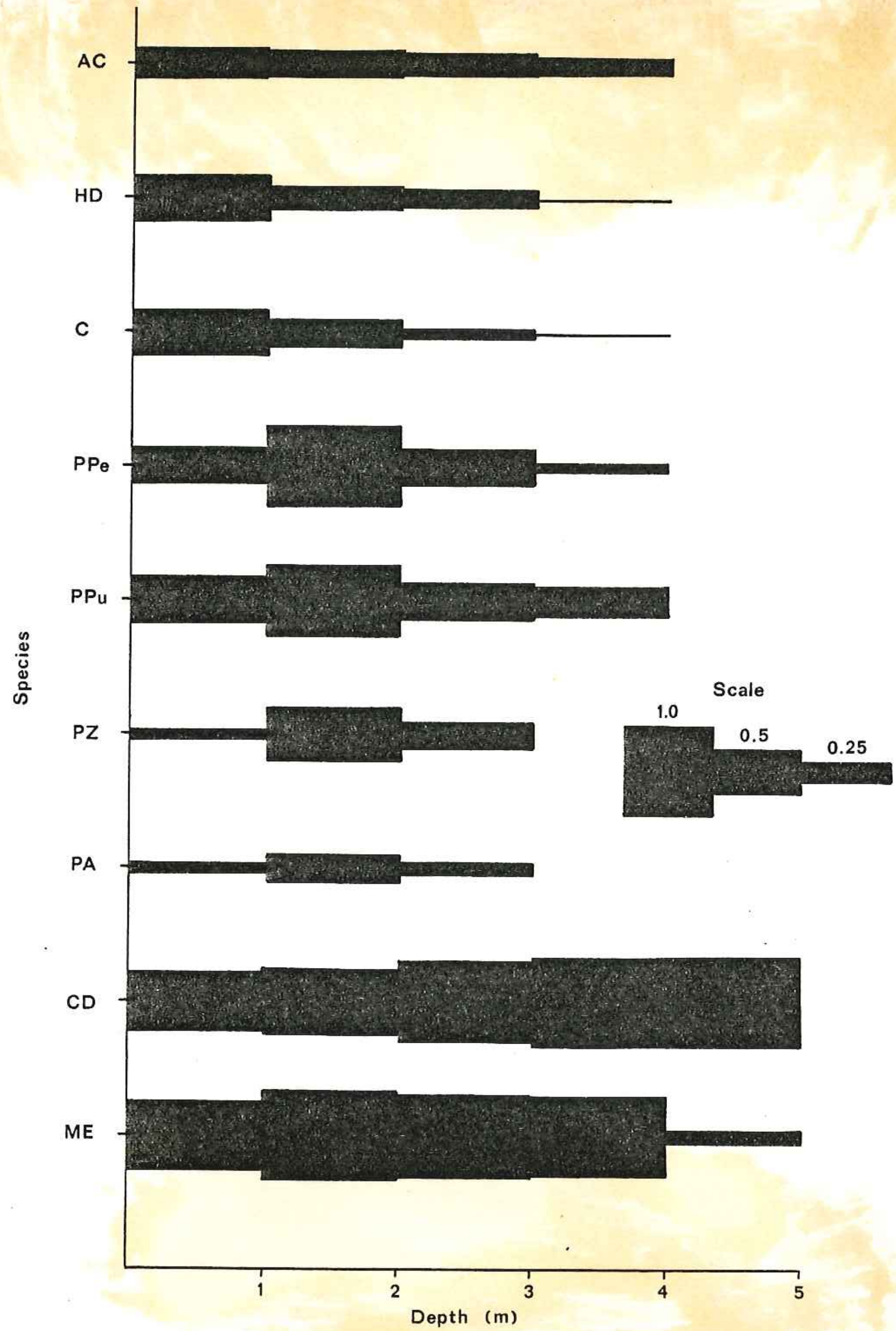

Fig. 3. Frequency occurence of the 9 major species at various depths. Ordinate symbols: AC= Anacharis canadensis, HD= Heteranthia dubia, C= Chara spp., PPe= Potamogeton pectinatus, PPu= Potamogeton pusillus, PZ= Potamogeton zosteriformis, PA= Potamogeton alpinus, CD= Ceratophyllum demersum, ME= Myriophyllum exalbescens.

underestimated by about one meter. The primary associate of this community was Myriophyllum exalbescens.

Definite stands of Anacharis canadensis and Heteranthia dubia were observed, but these communities were too small (less than $2m^2$) to be illustrated on the community distribution map. These two species, in addition to Chara spp., exhibit a decline in abundance with increased depth (Fig. 3).

Standing Crop

The standing crop of three shallow-water plant communities (Chara, Chara-Potamogeton, and Myriophyllum-Potamogeton) are presented in Table 2. There is a very high variability of standing crop data since only two $0.1m^2$ quadrats were sampled for each community. Thus, the significance of this information is limited because of the small sample size. A discussion of the standing crop of each community sampled can't be justified for this reason.

The three most important taxa (omitting Chara spp.) were Myriophyllum exalbesecens, Ceratophyllum demersum, and Potamogeton spp. when the standing crop data for the three communities are grouped together. This corresponds very well with the frequency occurrence of plant species determined (Table 1). Chara spp. has the highest standing crop when the three communities are considered together. This result is biased since two of the communities sampled had Chara as a dominant member. In addition, the dry weight data of Chara includes a large portion attributable to encrustations of $CaCO_3$. The standing crop

Table 2. Standing crop of some shallow-water (0.5m) macrophyte communities in Mirror Lake.

Community	Species	g. dry wt /0.1m^2	S.D.
Chara-Potamogeton	M. exalbescens	32.3	25.2
	Chara spp.	28.4	40.2
N = 2	P. natans	19.2	4.5
	P. pusillus	10.0	4.0
	C. demersum	8.4	3.4
	Total	98.3	
Chara	Chara spp.	133.2	11.1
	M. exalbescens	2.7	3.8
N = 2	Potamogeton spp.	1.2	0.3
	V. americana	1.1	1.6
	Total	138.2	
Myriophyllum-Ceratophyllum	C. demersum	50.0	36.2
	M. exalbescens	38.0	4.9
	Chara spp.	17.8	25.1
N = 2	Potamogeton spp.	4.2	4.9
	Total	110.0	
Average of all communities	Chara spp.	59.8	60.9
	M. exalbescens	24.3	20.5
	C. demersum	19.5	29.0
N = 6	Potamogeton spp.	11.5	14.4
	H. dubia	0.5	1.2
	V. americana	0.4	0.9
	Total	116.0	20.5

of Chara spp.is probably overestimated for the shallow-water littoral zone for these reasons.

The average standing crop of the six quadrats sampled was 1,160g/m^2 ± 205. This represents a coefficient of variation of 18 percent. This high standing crop value may represent the upper limit of plant biomass in the shallow-water littoral zone in Mirror Lake.

Acknowledgements

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