A SURVEY OF EURASIAN WATERMILFOIL IN LAKE GEORGE

by

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Rensselaer Fresh Water Institute

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Warren County
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FINAL REPORT

on

A SURVEY

of

EURASIAN WATERMILFOIL IN LAKE GEORGE

prepared by

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INTRODUCTION

Eurasian watermilfoil, Myriophyllum spicatum var. spicatum (hereafter referred to as milfoil) was discovered in Lake George by the FWI in August, 1985. This non-native nuisance aquatic plant (macrophyte) has the potential to grow explosively, with undesirable consequences to recreational and potable use of Lake George waters. The abundant growth of this plant can foul motorboat propellers, prevent access of boats to remaining open water, cause undesirable swimming conditions, and clog drinking water intake pipes. There is also a considerable amount of evidence suggesting that this plant may accelerate eutrophication by actively bringing nutrients tied up in the lake bottom (sediment) back into the water column. Lakes within the Lake George region suffering from infestation of this species of macrophyte include Saratoga Lake, Lake Champlain, and Lake Bomoseen - any of which could have been a source for the present Lake George infestation.

The plant spreads from lake to lake by transport of plant fragments or seeds. The actual mechanism of transport occurs in a variety of ways, but "hitch-hiking" is probably the most common. The plant easily tangles on boat motors, anchors, or trailers and when the boat is moved to another lake, the plants are carried along. Even very small pieces of the plant are capable of rooting and growing to mature plants. Waterfowl including ducks, geese, seagulls and the like can also transport plant fragments and/or more likely seeds from one lake to another. Given these two most likely scenarios as the route of entry of this plant into Lake George, one source of continual reentry can be controlled by boaters if they would take the responsibility to carefully check boats, trailers and equipment prior to launching their boats in Lake George. It is equally important to check this equipment while operating or removing a boat from Lake George to prevent the spread of this plant to other sections of the lake or to other lakes. The spread of the plant by waterfowl cannot be controlled. A vary minor suggestion would be to not encourage the presence of these birds by refraining from feeding them.

In-lake spread of milfoil is principally accomplished by plant fragmentation and the transport of these fragments within the lake. Milfoil is a rather fragile plant, breaking easily as a result of disturbance by wind and wave action, boats, swimmers, etc. Plant fragments then float to the surface or in the water column, drift for a period of time and then settle to the lake bottom. If they land in a place where conditions are acceptable for their growth, they will root and start a new colony of milfoil. Roots frequently develop along the stem of a plant (adventitious roots) before fragmentation or while the plant fragment is floating prior to sinking to the lake bottom. Thus plant fragments are often ready to grow as soon as they reach a favorable habitat. As the plant becomes established, it tends to produce dense beds in water depths of from 1 to 5 meters (3 to 16 feet). At first, plants spread by putting out underground shoots and by the fragmentation mechanism.

After being established in an area for approximately three years, the plants flower and are able to spread over larger distances by seed dispersal. With the production of seeds comes the possibility for greater genetic diversity of the plant population which could produce a strain of plant that would be even more adapted to a particular lakes environment and therefore be even more aggressive than the original infestation.

During the late summer and fall of 1985, three areas were observed to possess populations of what was believed to be Eurasian watermilfoil - Huddle Bay, Dunham Bay and an area adjacent to the Sheriff's Dock in Lake George Village. These beds were discovered incidental to water sampling by the FWI while conducting the Lake George Association Fund sponsored Lake George Monitoring Programs. Since these three areas were discovered without any serious effort to find the plant, the presence of milfoil in other areas seemed likely. In order to devise effective control or eradication strategies, the extent of milfoil infestation in Lake George had to be determined. To this end, the FWI generated a proposal, which Warren County funded, to survey the littoral (shallow water) portion of Lake George for the presence of milfoil. The following report is the result of that survey.

METHODS

Surveys were conducted of sites determined to be optimal for the growth of milfoil. The characteristics used to determine desirability for milfoil colonization included: suitable water depth (1-5 m), bottom slope (gentle), sediment type (rich organic), degree of wave and wind generated turbulence (low), and proximity to likely sites of introduction by boat (marinas, launch ramps, areas of high boating activity, etc.), waterfowl (wetlands) and movement of fragments from known infestations.

Survey techniques included echo sounding (Sitex, Models 356B and 357 and Vexilar, Model NJA-155B) and visual inspections from a boat and via diver. Initial surveys in April and May indicated that some areas where milfoil was not found would need to be resurveyed later in the growing season to provide more assurance that in fact milfoil was not present. In order to facilitate resurveys, areas with conditions highly favorable for milfoil growth were noted during the initial survey. Visual observation from the boat was aided through the use of a viewing tube constructed specifically for the purpose. The viewing tube eliminated surface reflection and light scatter due to wave action greatly improving the ability to observe milfoil plants in deeper water. After the initial discovery of milfoil plants in a given area, detailed mapping was done with the use of prismatic range finding equipment, calibrated echo sounder, and topographic maps. The perimeter of milfoil infestations were temporarily marked with buoys to provide reference points for determination of area covered. Distances between reference buoys were determined and the results transferred on to gridded forms. The number of blocks of known dimension were counted and an approximation of the area of milfoil infestation derived. These dimensions were then transferred to topographic map and the areas verified by the use of a Leitz planimeter (Model 3651-30).

For mapping purposes areas of infestation were coded as to the density of milfoil growth. Density was determined subjectively as percent of total macrophyte community that milfoil comprised. Density estimates were made by diver or underwater viewing tube observation from a boat. A number of echo sounding transects were run over an area to determine the extent of milfoil colonization. Three different designations for the degree of milfoil infestation are used on the enclosed maps:

* beds;
* impacted areas; and
* scattered plants.

Beds were considered to be areas where 50 percent or more of the total macrophyte community was milfoil. Impacted areas were considered to be communities composed of between 10 and 50 percent milfoil with the remainder being native species. Zones of scattered plants were defined as macrophyte communities composed of less than 10 percent milfoil.

RESULTS

The Rensselaer Fresh Water Institute began its survey of Lake George for milfoil on April 13, 1986. The first areas to be surveyed were the three previously reported infestations at Huddle Bay, Dunham Bay and Lake George Village (Figures 2, 3 and 4). Observations of the milfoil in these locations were used to evaluate the plant's survival over the winter and the ability of our survey techniques to discover milfoil infestations. Echo sounding results from Dunham Bay (April 13, 1986; Figure 13) indicate that although milfoil was not visible from the lake surface, it was still able to be detected by this technique. The plants appeared to be approximately one half meter in height from the echo traces. Inspection of specimens collected at this time however, indicated that the plant stems were much longer than one meter albeit in a state of partial decay. Many specimens still had healthy, green portions indicating that the plant overwintered successfully. Later echo sounding obtained on May 11 showed that the stems of some of the plants were approaching the surface, height 2 meters, and one or two plants were visible on the surface. Specimens of milfoil collected during this time of the season were generally heavily fouled with debris and were brown in color. Fresh growth (green portion of the plant) was present mainly at the apical ends of the plant and some small healthy plants were observed.

On April 15th Huddle Bay was surveyed and the milfoil present was generally visible from the lake surface. Most plants appeared brown in color and heavily fouled with debris - filamentous algae, diatoms and associated invertebrates. Closer inspection revealed that the plants were still green and in all likelihood capable of continued growth. The brown color was primarily due to the dense fouling community attached to the surfaces of the milfoil leaves. This milfoil bed was then mapped to provide a better estimate of the area covered by the plant. Results of this mapping describe the infestation as somewhat smaller than originally estimated but still covering a considerable area (1.5 acres). Additional scattered plants were observed along the shoreline on the southwestern side of the bay. The difficulty of observing small or widely scattered plants due to the overall poor condition of the plants and the turbid water conditions in the bay required that later surveys of this area be done to accurately determine the extent of the milfoil infestation.

Spring surveys in the Lake George Village area also showed the plant to be visible from the surface in 2 to 3 meters water depth. The largest area of milfoil infestation was recorded southeast of the Sheriffs Dock and tentative mapping indicated that this area of infestation was considerably larger than previously estimated. The average height of plants in this bed was 1 meter on May 8. In addition, numerous scattered plants were observed along the shoreline running north and west towards Shepards Park.

Surveys of shoreline areas not previously reported to harbor milfoil were begun on April 25. Bolton Bay, Huddle Bay and the shoreline south to Cotton Point were inspected first. Three

additional areas with milfoil present were observed including Congers Point, American (Lambs) Marina and an area in front of Chic's Marina and the Algonquin Restaurant (Figures 2 and 5). Additional scattered plants were also observed over larger areas of Huddle Bay. Sawmill Bay was also surveyed at this time (April 30) and no milfoil plants were observed. However, later in the survey two milfoil infestations were noted in Sawmill Bay. A small bed of milfoil was found at the south end of the DEC Green Island facility and a few scattered plants were observed at the north edge of the Finkle Brook delta. The next area to be surveyed (April 30) was the Northwest Bay wetland upstream to the boat launch and the bay adjacent to the mouth of the wetland. Only a few scattered plants were observed in the bay lakeward from the mouth of the wetland. No milfoil plants were observed in the wetland.

The embayments on the southeastern side of the lake were the next areas to be surveyed (May 10) and included Warner, Kattskill, Sandy, Harris and Dunham Bays. Scattered plants were observed at the southern end of Warner Bay between the mouth of the wetland and the Castaways Marina. No milfoil plants were observed in the wetlands of Warner or Dunham Bay nor along the shoreline of Sandy, Kattskill, or Harris Bays at this time. Surveys conducted later in the season (July 17) discovered scattered plants in Harris Bay, southeast of the Happy Family Islands. The survey continued northward along the eastern shore as far north as Pilot Knob and no milfoil plants were observed on initial inspection.

The shoreline from English Brook delta south around the southern end of the lake to Ushers Park was the next area to be surveyed. A moderate sized bed was observed just south of Shepards Park and scattered plants were present as far south as the Sheriffs Dock area where the previously reported infestation began. A small bed of milfoil and a larger area of scattered plants were observed between the western edge of the West Brook delta and the Steamboat Pier. One small bed was found at the western edge of Million Dollar Beach and numerous scattered plants were observed along the outer buoy line of the beach. A third bed in the Village area was observed at the delta of East Brook near the eastern edge of Million Dollar Beach. No additional milfoil plants were observed from this location north to Ushers Park.

Surveys in the north basin were initiated in the Huletts Landing area. A moderate-sized bed and numerous scattered plants were found in Sunset Bay, but no milfoil was found in the other bays in the Huletts Landing area. The next area to be surveyed was Gull Bay where no milfoil was found. The survey then moved to the area between Mossy Point and the lake's outlet. Two small beds of milfoil were observed near the outlet and numerous scattered plants were observed near the Mossy Point Launch Ramp. No milfoil was observed on the east shore from Tioga Point north to Mossy Point nor on the west shore from Hearts Bay north to Mossy Point. A number of echo tracing transects were done from Howes Landing across to Spencer Point and Tioga Point in order to survey the large areas of shallow water from Tioga Point north to the outlet. There were

no milfoil plants observed along these transects.

Surveys were then conducted in the area around Hague from Forest Bay south to the town beach and boat launch. As late as June 19, no milfoil was found in these areas. However, during the second week of July Mr. Richard Bolton, Town Supervisor of Hague, called to report seeing milfoil plants in the boat launch area. An inspection on July 15 verified the presence of scattered milfoil plants within the boat launch channel.

Blairs Bay in Glenburnie was the next area to be surveyed. No milfoil plants were observed in the Glenburnie area. The survey then moved south to the area from Log Bay south to Pilot Knob. No milfoil plants were observed in these areas.

Several bays on the western shore of the southern basin were visited next; including Boon Bay, Middleworth Bay and Pitcairn Bay (Bay 46-N). None of these bays were found to contain milfoil plants in June; however, on a visit to Middleworth Bay on July 22, scattered milfoil plants were observed at the southern end of the bay.

Initial surveys and followups were completed by June 19 and the emphasis of the project after that date was placed on mapping known infestations. Concerned individuals have been contacting the FWI staff on a daily basis asking for identification of macrophytes and requesting that staff members visit specific locations where they believe they have seen milfoil. While the bulk of these reports have proven to be native species, three locations with infestations not initially observed to have milfoil by our survey group were found. These infestations include Hague Boat Launch, Green Island and a site not presently mapped at the south end of Three Brothers Island.

A listing of sites with populations of milfoil and the approximate areas and percent of total macrophyte population observed is included as Tables 1 and 2. Each infestation has been mapped a number of times over the course of the survey. The dynamic nature of these plant communities became readily apparent early in the survey and contributed to the difficulty of generating accurate up-to-date maps. It was finally determined that maps would have to be based on the information gathered as of the day intensive mapping activities were done in a particular area. Therefore, all areas reported must be viewed as approximations of the present infestation. Maps are listed with the last date when a review or final mapping of the area was done. Also an arbitrary date of July 22 was chosen as the last date for survey and sighting information to be included in this report.

The growth (stem elongation) of milfoil plants in Dunham Bay was estimated from echo traces taken approximately every two weeks beginning April 13 (see examples in Figure 13). The maximum stem elongation of between 4 and 5 centimeters per day (about 2 inches/day) was observed between July 2 and July 18 (Figure 14).

The absolute increase in plant stem length prior to July was lower than that observed in July with only a slight increase observed in April and May. However, the time required for plants to double in heigth (about 33 days) was fairly constant between May and July. The FWI will continue to monitor plant growth in Dunham Bay prior to it reaching the surface in an attempt to determine times of maximum growth. Such information will be vital to control and/or eradication programs and has often been requested by regulatory agencies.

DISCUSSION

Milfoil is capable of occupying large areas of the littoral zone of Lake George. As of the most recent survey dates, milfoil plants were present in approximately 21.7 hectares (53.6 acres). This areal estimate is extreme in that only a few plants scattered over a large area may represent a significant portion of the total area of impact. However, this estimate may also be conservative since, in all likelihood, not all the sites of milfoil infestation were found by this survey. The estimates published in this document represent our best efforts at mapping the areas containing milfoil plants at the time of the most recent mapping effort.

Results of the current survey indicate that milfoil plants can be found throughout the lake. Due to the large geographic area involved, more than a single point of introduction is likely. Since two principle methods of introduction are assumed to be boats and waterfowl, techniques for controlling these sources need to be implemented. The activities of the Lake George Boaters Association in publicizing to boaters the precautions they can take to control the spread of milfoil are to be commended. Expansion of their activities by state and local authorities is highly desirable. Control of introduction by waterfowl is much more difficult. Little or nothing can be done in the way of preventative activities, however an annual survey of preferred waterfowl habitats and removal of any milfoil plants that become established may be a viable control technique.

Review of available control techniques for the milfoil already present in the lake is currently being addressed by numerous agencies and will not be included in this report. Whatever control techniques are used need to be evaluated carefully to determine their effectiveness and whether additional control activities are needed.

The question of the rate of spread of milfoil in Lake George remains to be answered. Milfoil spreads in three distinct ways; 1) runners from established plants, 2) drifting and establishment of fragments, and 3) seed dispersal. Evidence from diver surveys indicates that numerous newly settled fragments are present in areas adjacent to known infestations. Newly settled fragments are identified as ones where the plant stem is not in contact with the sediments and some of the visible adventitious roots are embedded in the bottom. The newly settled fragments appear healthy and capable of growing into mature plants. This method of spread is obviously occurring but as yet no attempts have been made to quantify it. The areas observed to possess scattered plants in Lake George Village, Huddle Bay and Dunham Bay have increased considerably since early in the growing season. The FWI is currently implementing a study to address spread by runners and fragments. Spread by seed dispersal is impacted by such a large number of variables that an effective way to determine the rate of spread by this factor does not currently exist.

APPENDIX 1

TABLES

Table 1. Locations and dimensions of Milfoil beds observed in the present survey.

Location	Date Found	Description
1. Northwest Bay	4-30	Scattered individual plants at the mouth of the wetland.
2. N Bolton Bay	4-25	Small bed inside Congers Point.
3. NW Bolton Bay	4-25	Small bed at American (Lambs) Marina.
4. W Bolton Bay	4-25	Scattered individual plants between Chic's Marina and the Algonquin Restaurant.
5. Green Island	7-5	Small bed at the south end of the DEC boat facility.
6. Sunset Bay, Huletts Ldg.	4-30	Moderate sized bed and numerous scattered plants offshore of Washington County Beach.
7. N Lake George Village	5-7	Moderate sized bed and numerous scattered plants from Shepards Park to the Sheriffs Dock.
8. E Lake George Village	6-5	Small bed at the delta of West Brook.
9. Million Dollar Beach	6-5	Small bed and numerous scattered plants along outer buoy line of beach.
10. East Brook	6-5	Small bed and scattered plants at the outer edge of the delta.
11. Warner Bay	6-3	Scattered individual plants at the end of the bay.
12 & 13. Outlet near Mossy Pt.	6-19	Two small beds near the outlet and numerous scattered plants near Mossy Point launch ramp.
14. Harris Bay	7-17	Scattered plants adjacent to Happy Family Islands.
15. Sawmill Bay	7-5	Scattered plants on north edge of Finkle Brook delta.
16. Middleworth Bay	7-22	Scattered plants at the south end of the bay.
17. Echo Bay	7-22	Scattered plants at the eastern end of the bay.
18. Hague Boat Launch	7-10	Scattered plants in the boat launch channel.

Table 2. Area and density of milfoil infestations in Lake George.

SITE NUMBER	SITE NAME	AREA SQ M	DENSITY	DEPTH M	MAP DATE
1	Northwest Bay	60	S	2-3	7-14-86
2	N Bolton Bay	80	B	2-3	6-19-86
3	NW Bolton Bay	130	B	1-2	6-19-86
4	W Bolton Bay	1200	S	1-2	7-08-86
5	Green Island	75	B	1-3	7-18-86
6	Sunset Bay	3000	B	2-3	7-15-86
		11500	S	1-3	7-15-86
7	N Lake George Village	1100	B	2-3	7-09-86
		12000	S	2-4	7-09-86
8	E Lake George Village	60	B	2-3	7-09-86
		1300	S	2-4	7-09-86
9	Million Dollar Beach	20	B	2-3	7-09-86
		13600	S	2-4	7-09-86
10	East Brook	30	B	2-3	7-09-86
11	Warner Bay	5580	S	1-2	6-19-86
12	Outlet	20	B	1-2	7-15-86
		30	B	1-2	7-15-86
13	Mossy Point	2140	S	1-2	7-15-86
14	Harris Bay	550	S	1-2	7-22-86
15	Sawmill Bay	40	S	2-3	7-18-86
16	Middleworth Bay	2200	S	1-2	7-22-86
17	Echo Bay	100	S	1-2	7-22-86
18	Hague Boat Launch	570	S	1-2	7-15-86

Table 3. Area and density of milfoil in proposed treatment locations.

SITE NAME	AREA SQ M	DENSITY	DEPTH M	MAP DATE
Dunham Bay	4500	B	4-6	7-09-86
	80000	S	1-6	
Huddle Bay	11300	B	1-4	7-08-86
	16700	I	2-4	7-08-86
	44000	S	1-5	7-08-86
Lake George Village	6900	B	1-4	7-09-86
	4000	I	1-4	7-09-86
	12000	S	2-5	7-09-86
	1100	B	2-4	7-09-86

Note: The Lake George Village site includes the previously named Sheriffs Dock area and the North Lake George Village area.

Table 4. Total areas impacted with milfoil in Lake George.

DENSITY TYPE	SQUARE METERS	HECTARES
BEDS	27245	2.7245
IMPACTED AREAS	20700	2.07
SCATTERED PLANTS	169260	16.926
TOTAL AREA	217205	21.7205

APPENDIX 2

FIGURES

List of Figures

LAKE GEORGE

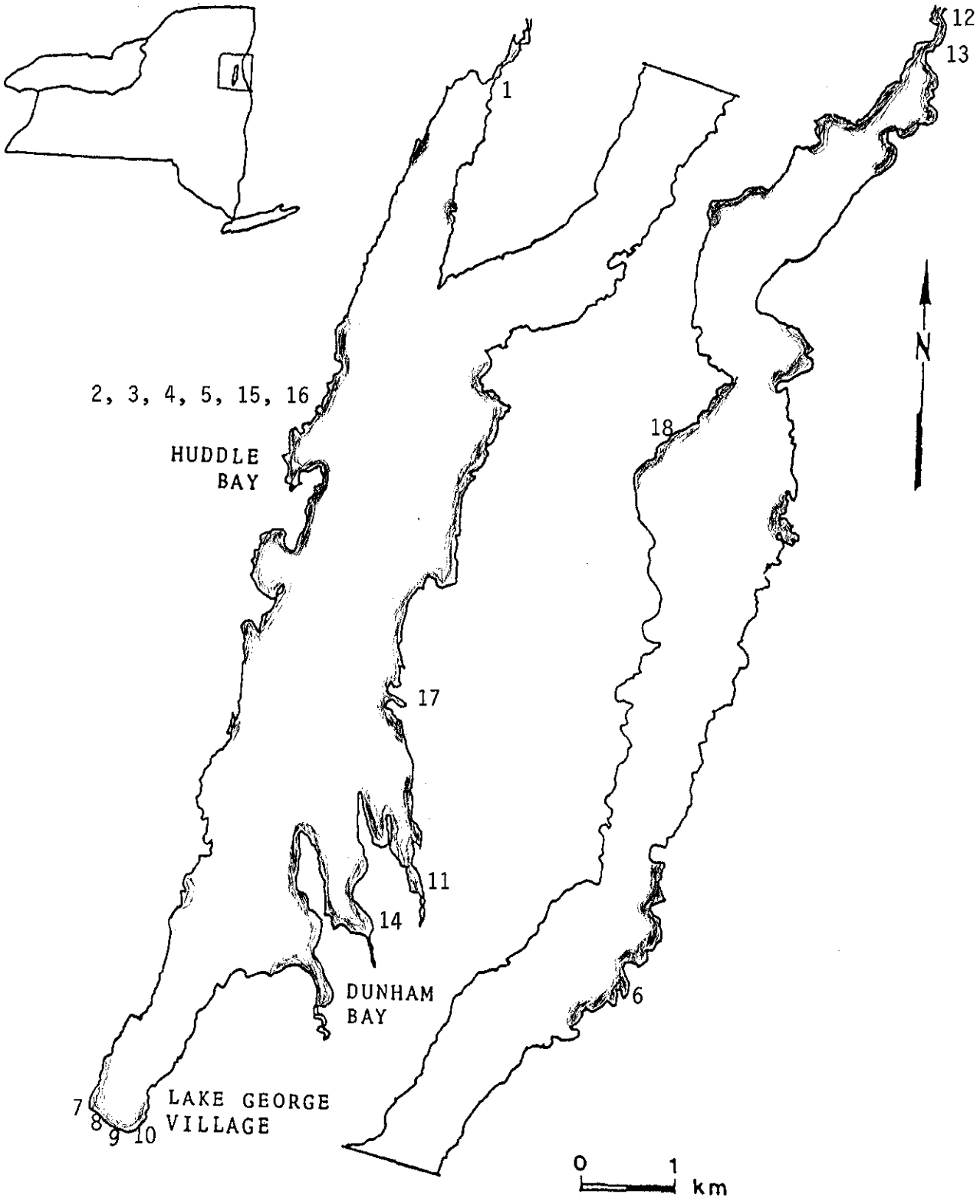
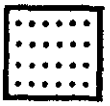
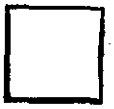


Figure 1. Map of Lake George showing shoreline visited during survey. (Numbers refer to locations given in Table 1 and used in subsequent figures)

L E G E N D

BED 

IMPACTED AREA 

SCATTERED PLANTS 

BED	Greater than 50 percent of the macrophyte community is composed of milfoil.
IMPACTED AREA	Between 10 and 50 percent of the macrophyte community is composed of milfoil.
SCATTERED PLANTS	Milfoil plants are present but comprise less than 10 percent of the macrophyte community.

Figure 1a. Legend for figures 2 through 12.

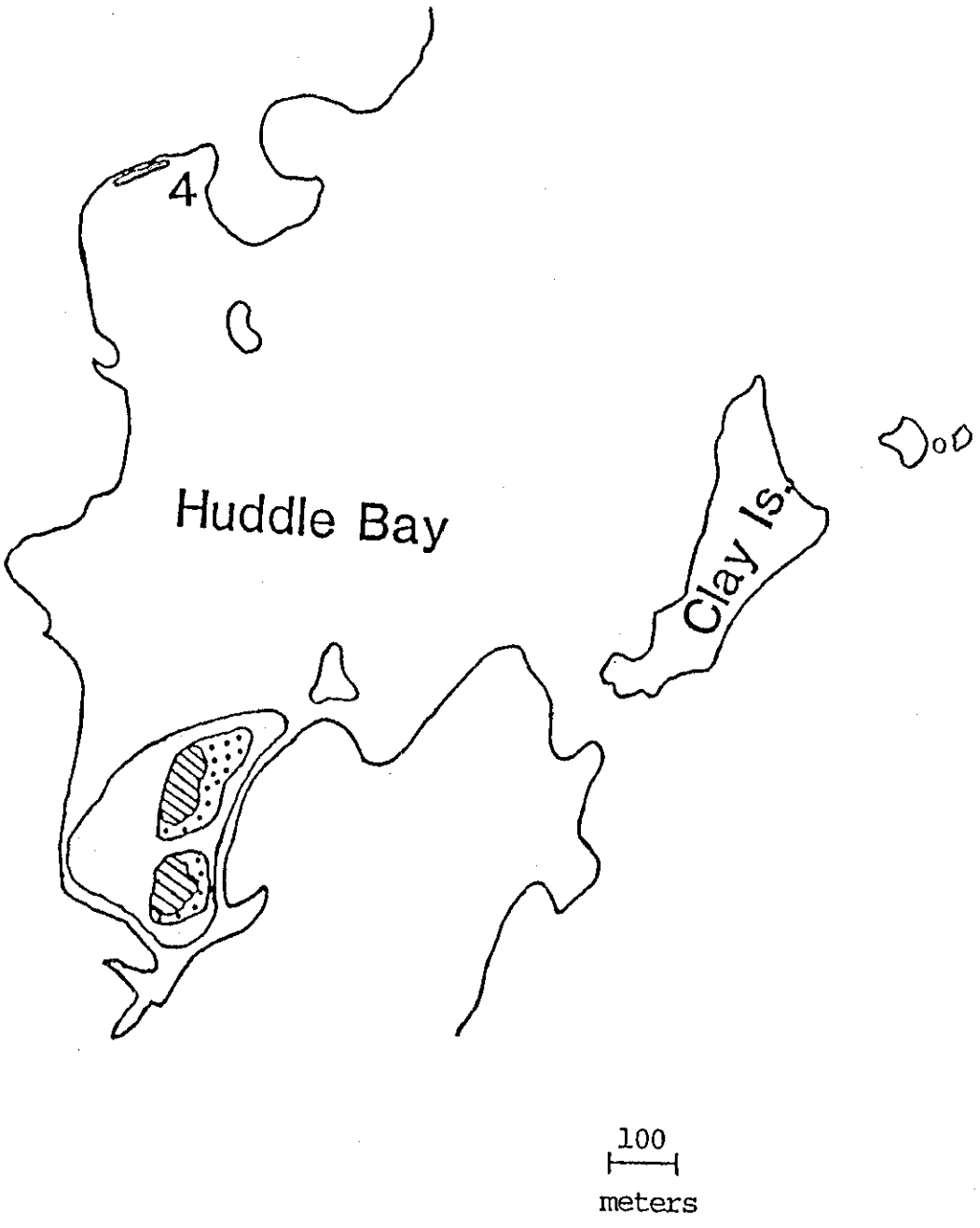


Figure 2. Map of milfoil in Huddle Bay.

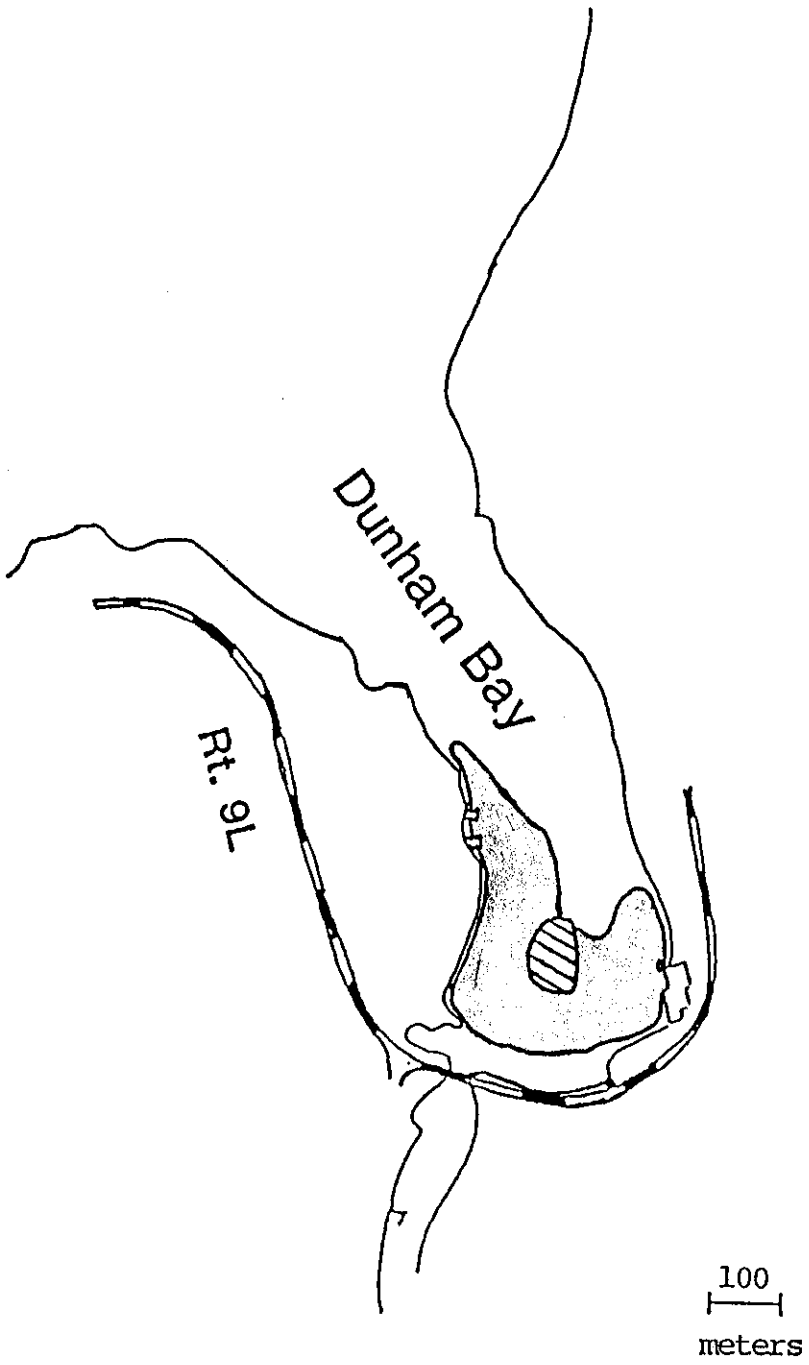


Figure 3. Map of milfoil in Dunhams Bay.

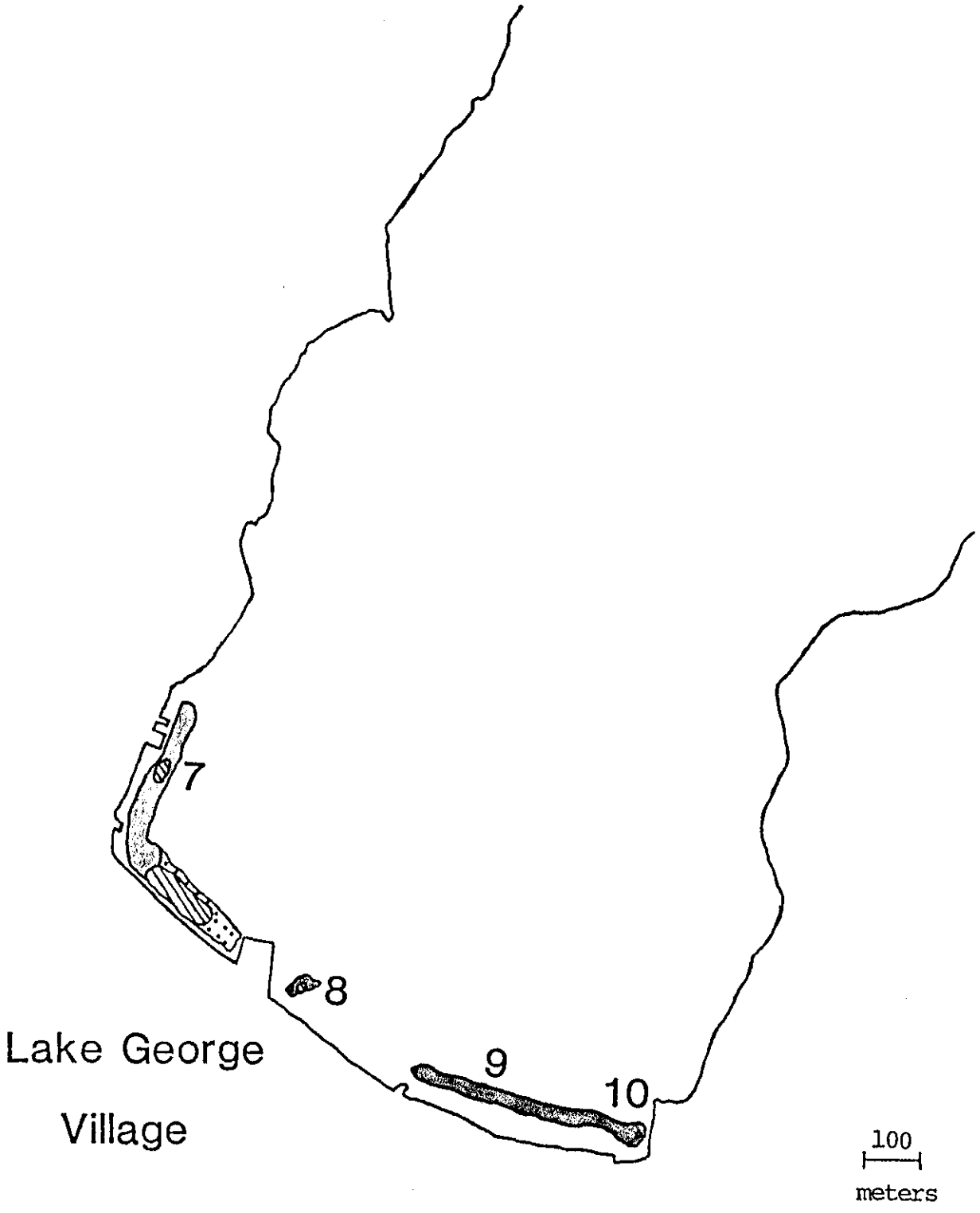


Figure 4. Map of milfoil around Lake George Village

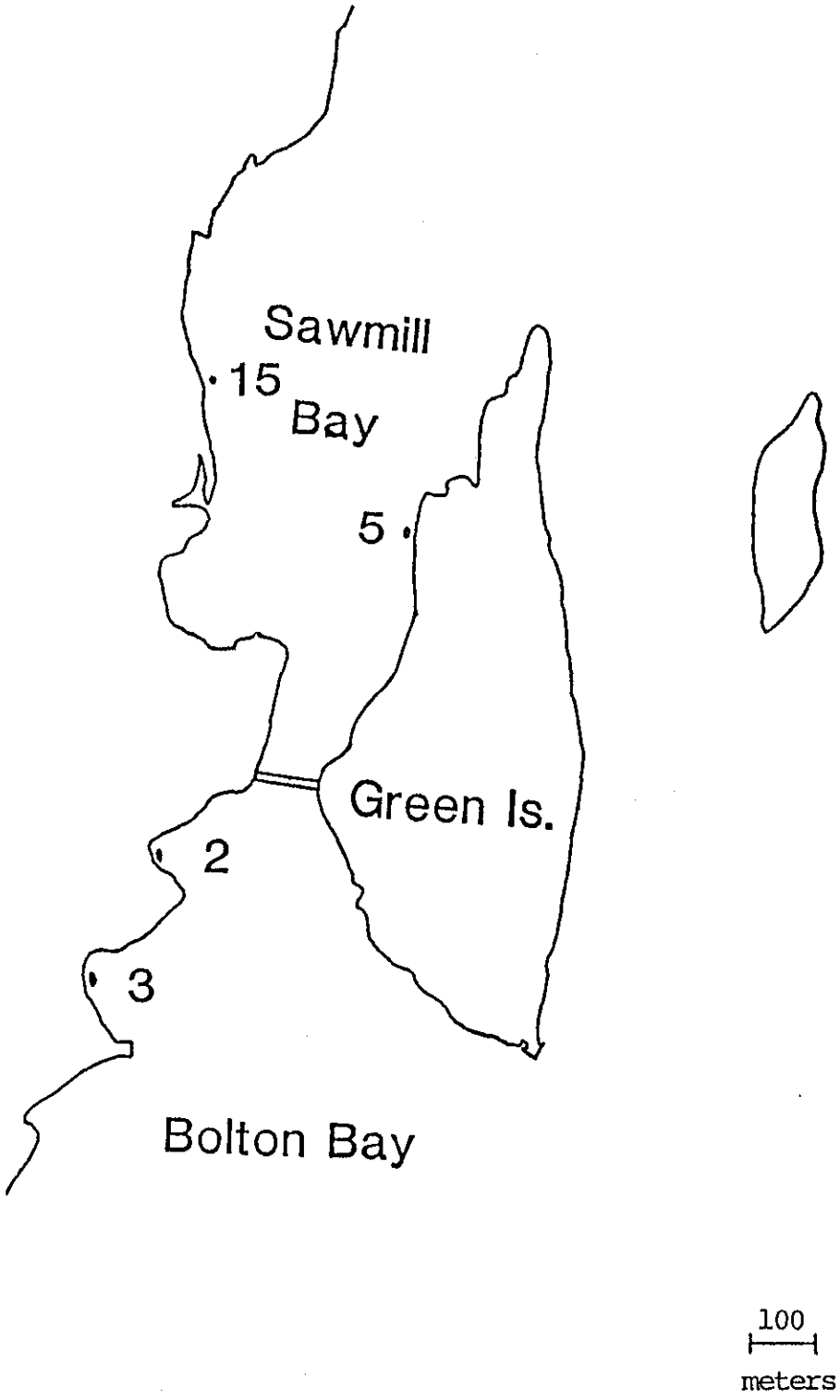


Figure 5. Map of milfoil in Sawmill and Bolton Bays.

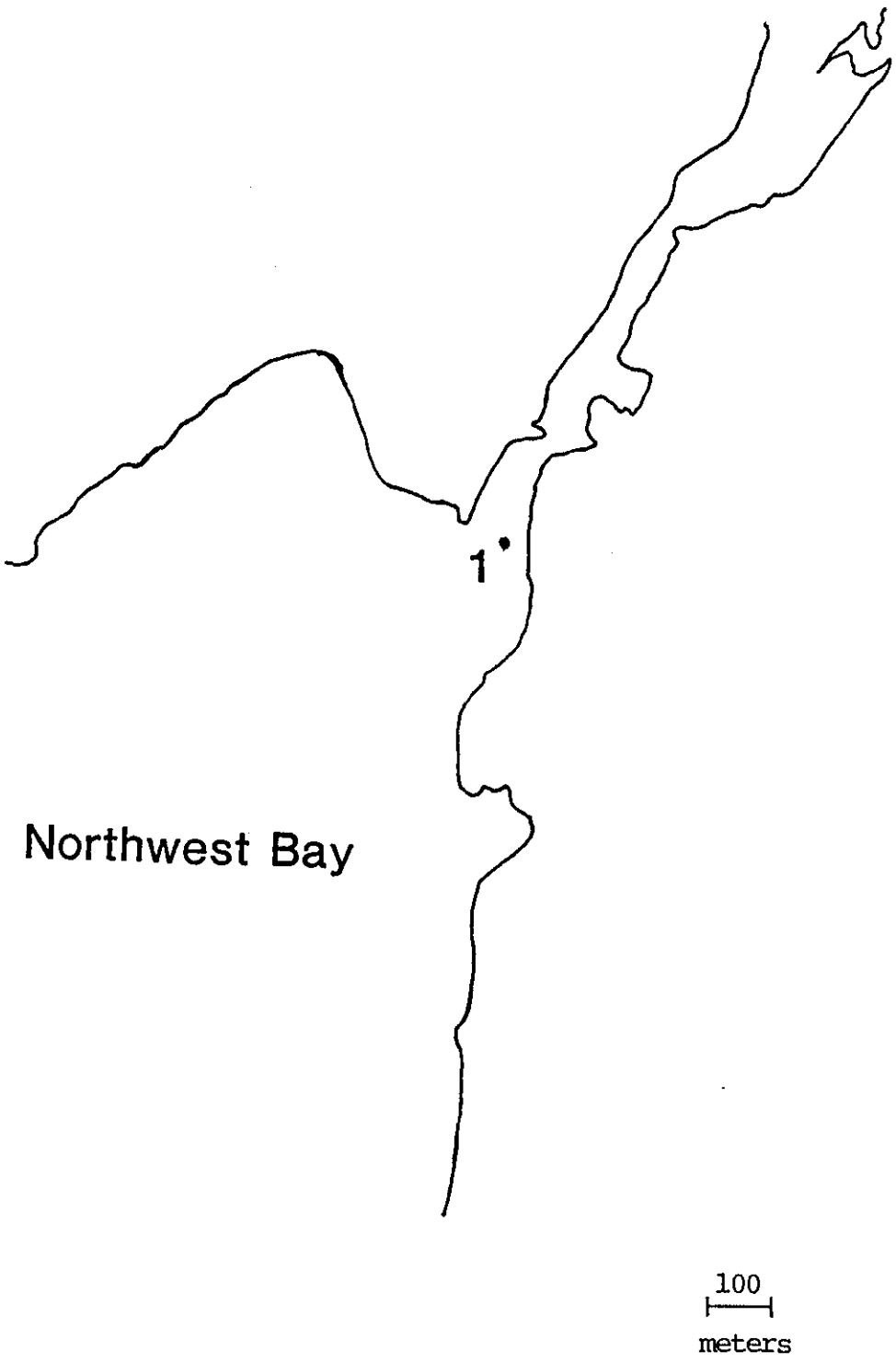


Figure 6. Map of milfoil in Northwest Bay.

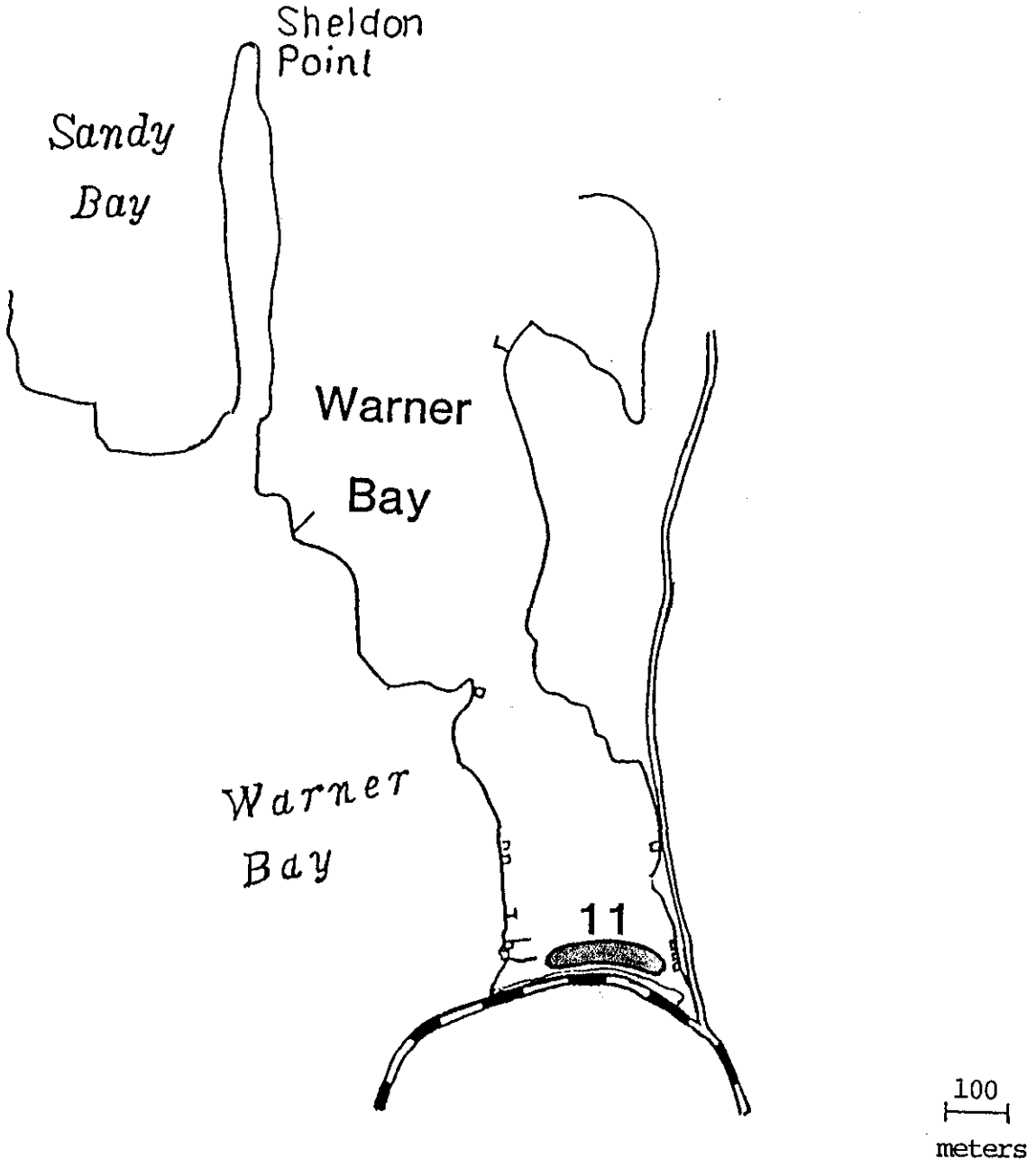


Figure 7. Map of milfoil in Warner and Sandy Bays.

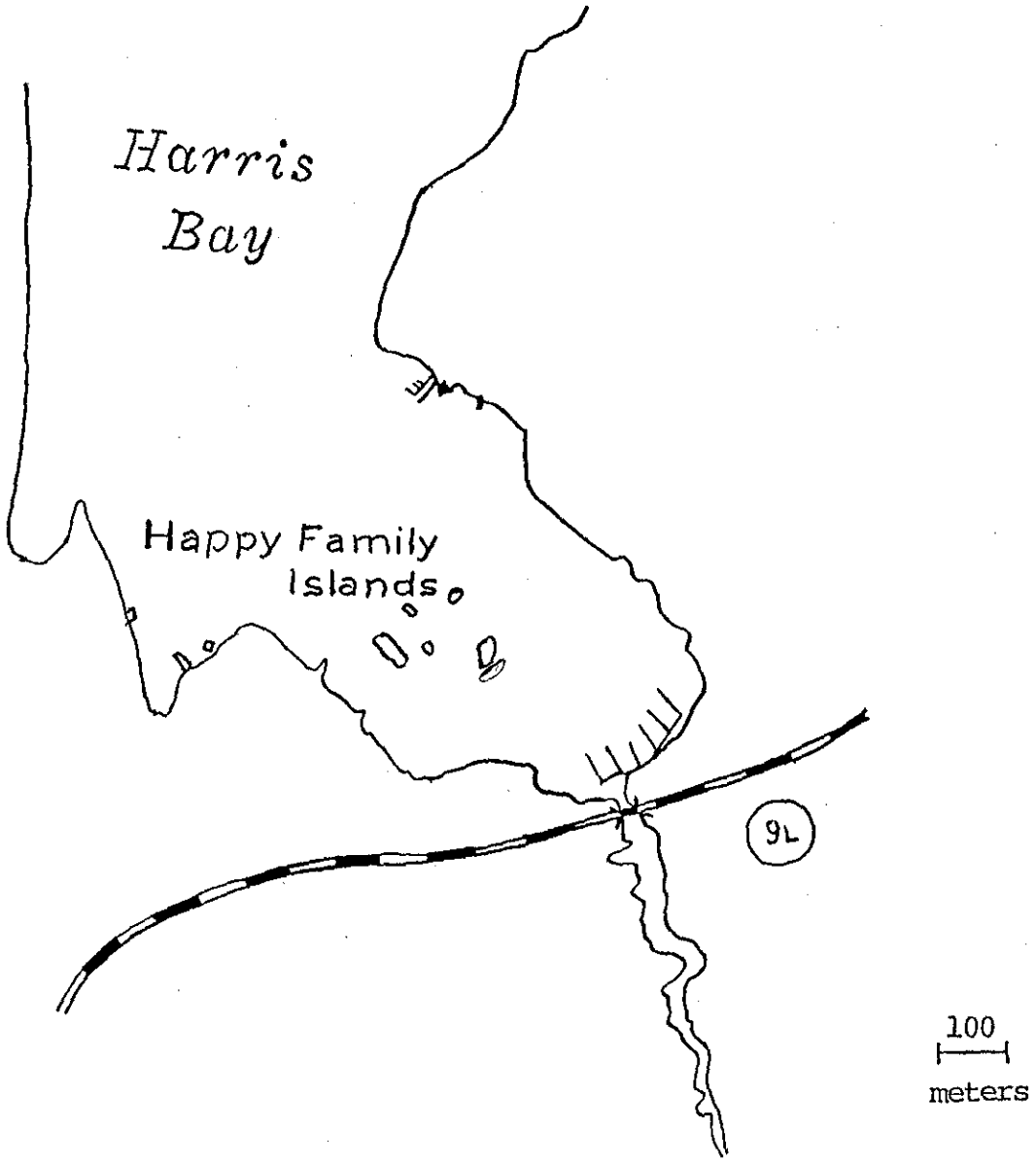


Figure 8. Map of milfoil in Harris Bay.

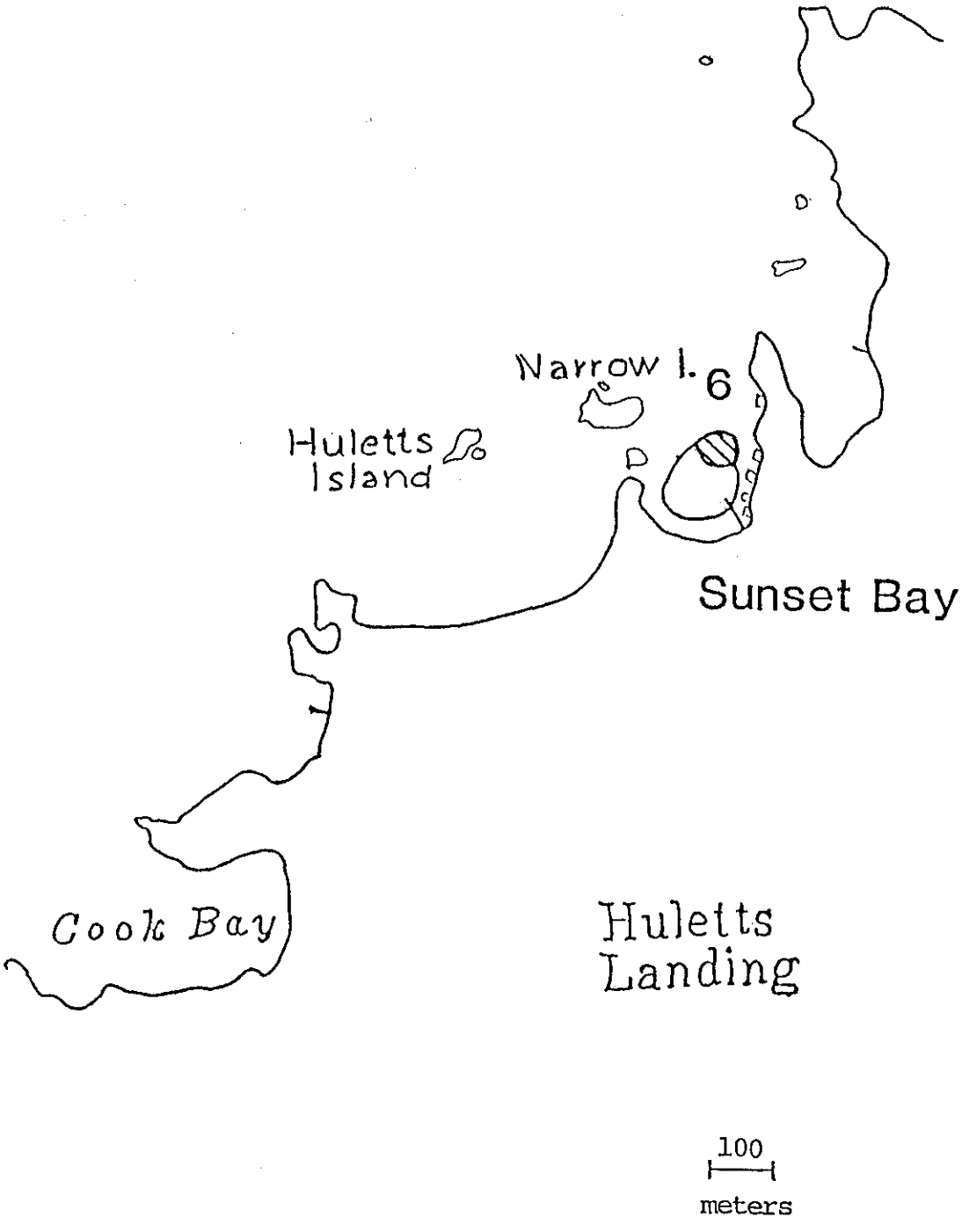


Figure 9. Map of milfoil in Sunset Bay (Huletts Landing).

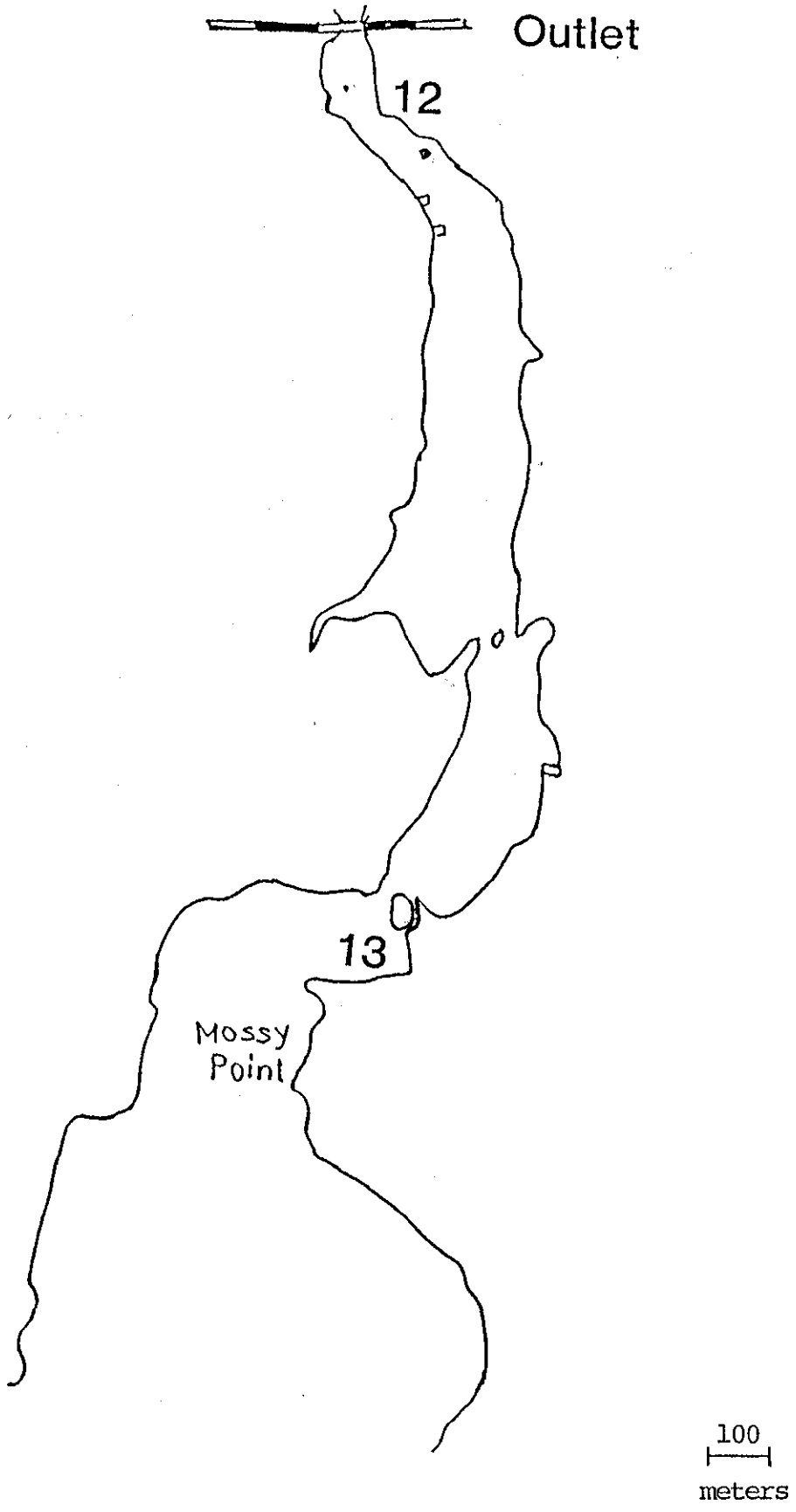


Figure 10. Map of milfoil in the area of the Lake George Outlet.

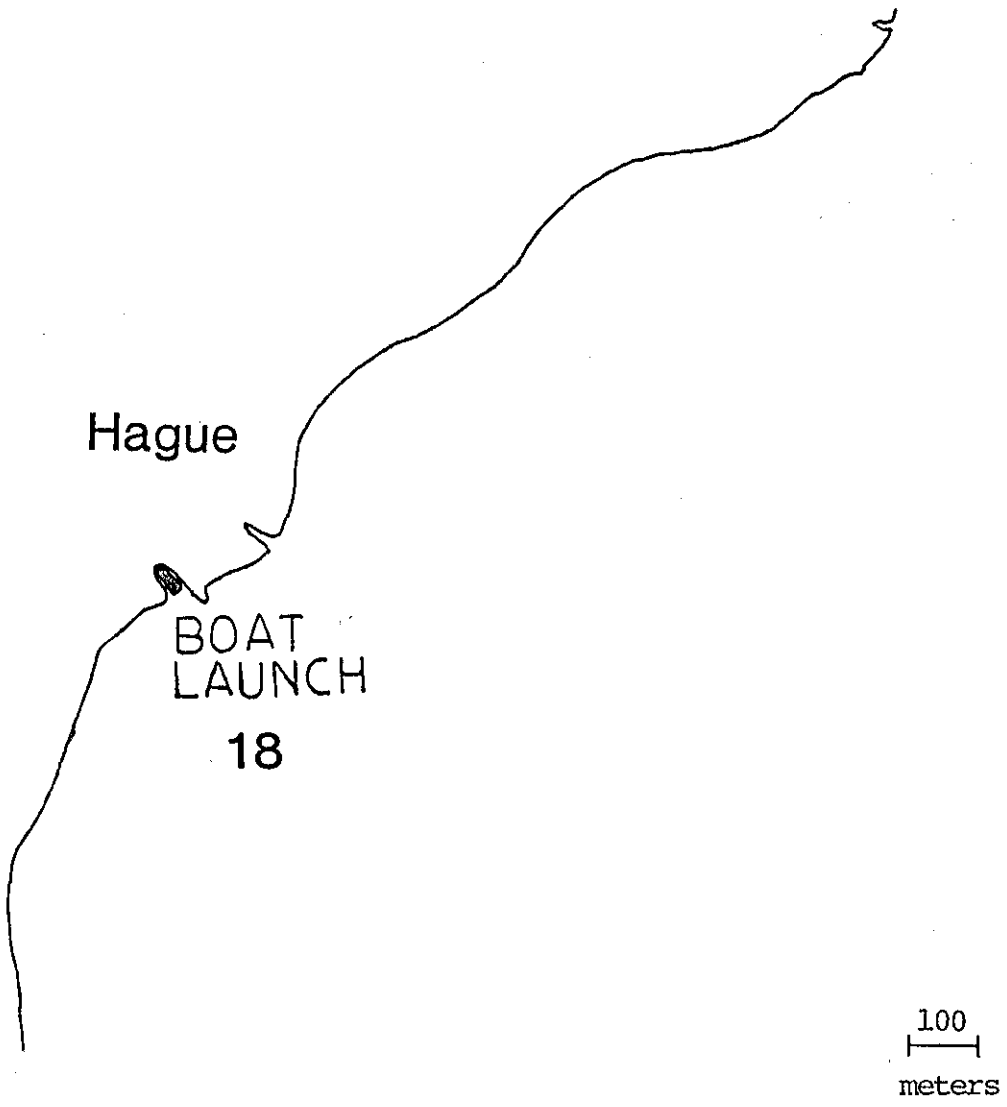


Figure 11. Map of milfoil in the area of the Hague boat launch.

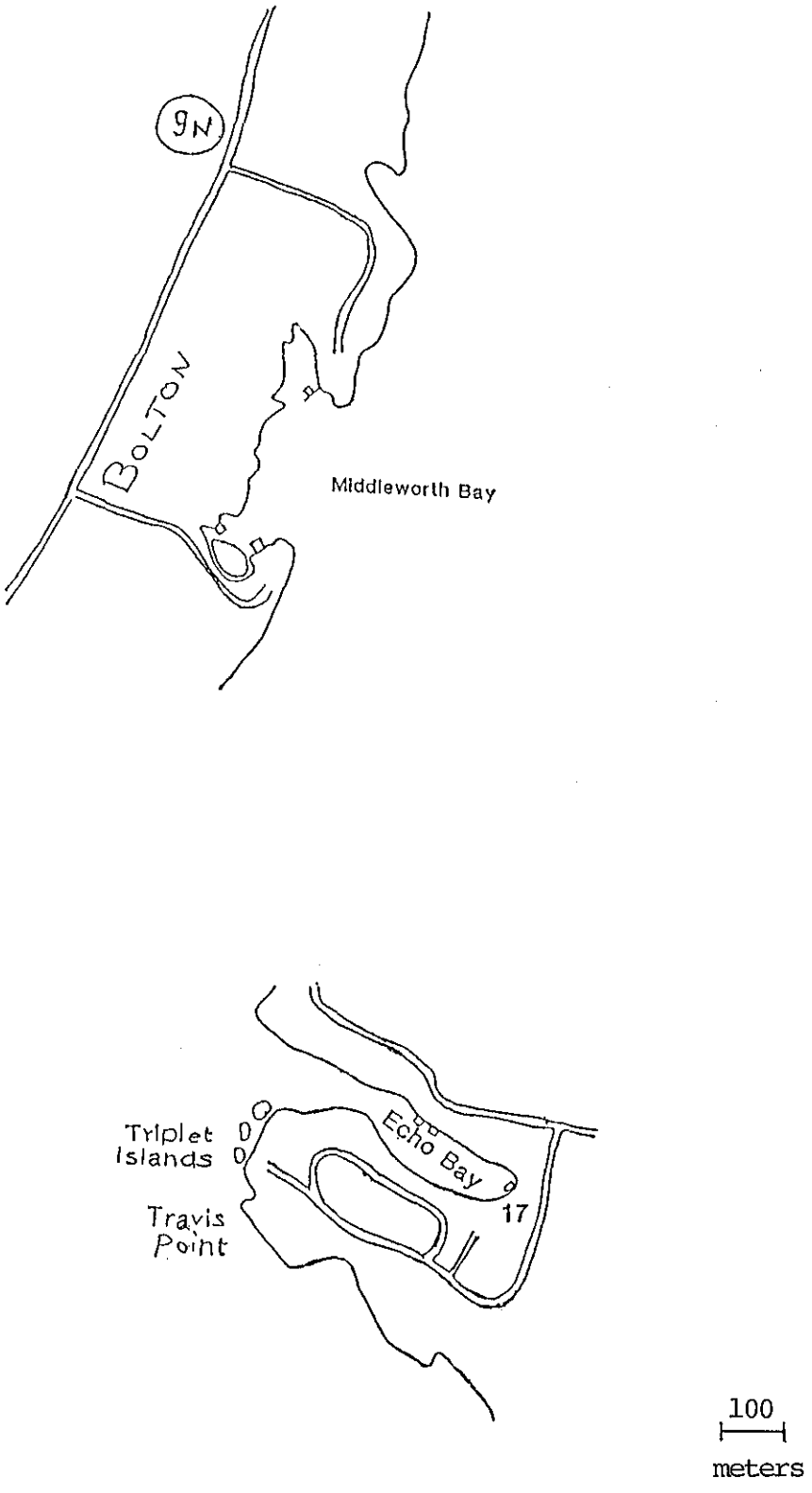


Figure 12. Map of milfoil in Middleworth and Echo Bays.

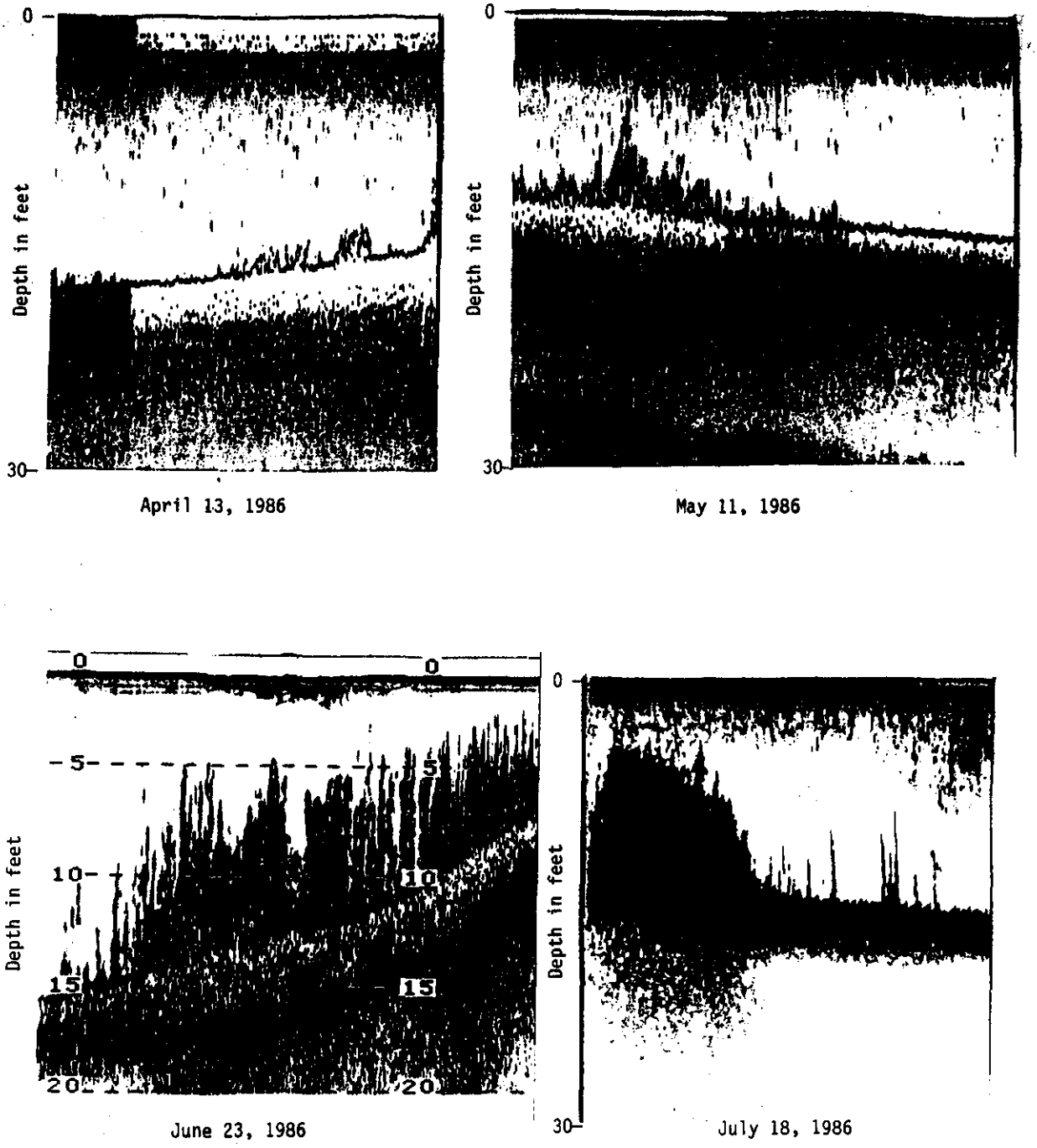


Figure 13. Echo tracings of the milfoil bed in Dunham Bay.

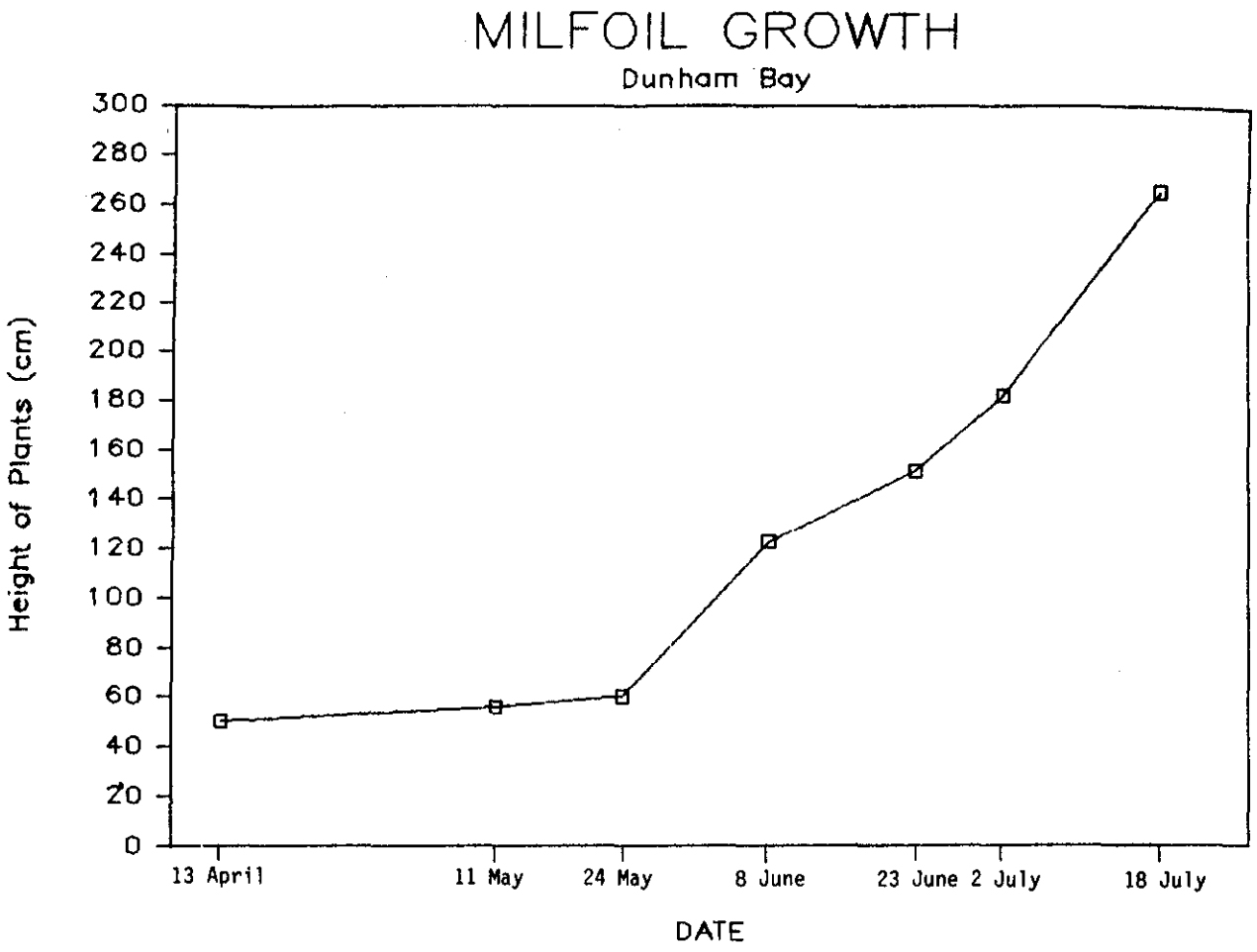
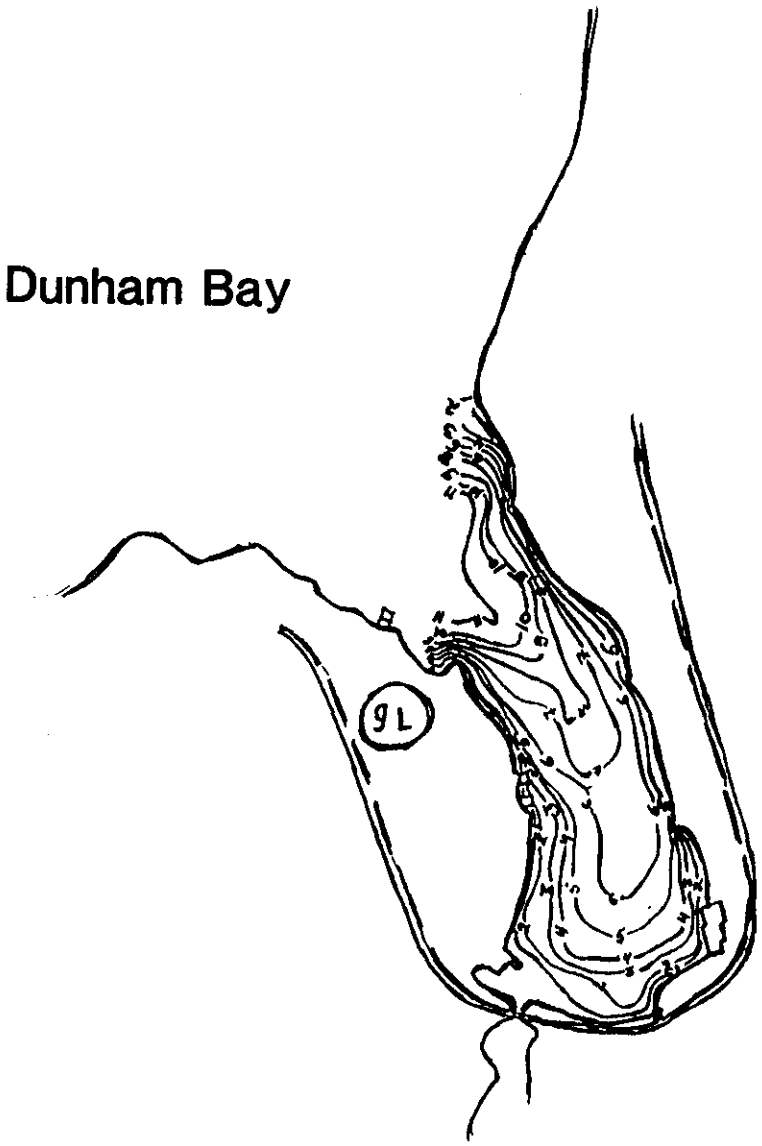


Figure 14. Growth of milfoil in Dunham Bay.

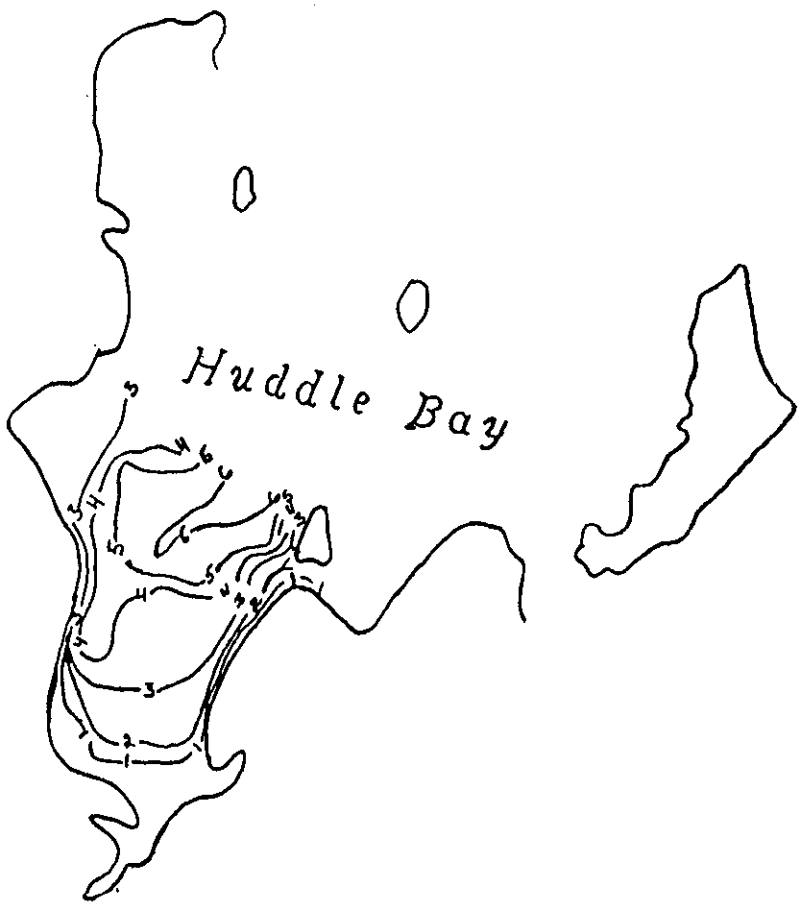
APPENDIX 3

BATHYMETRY

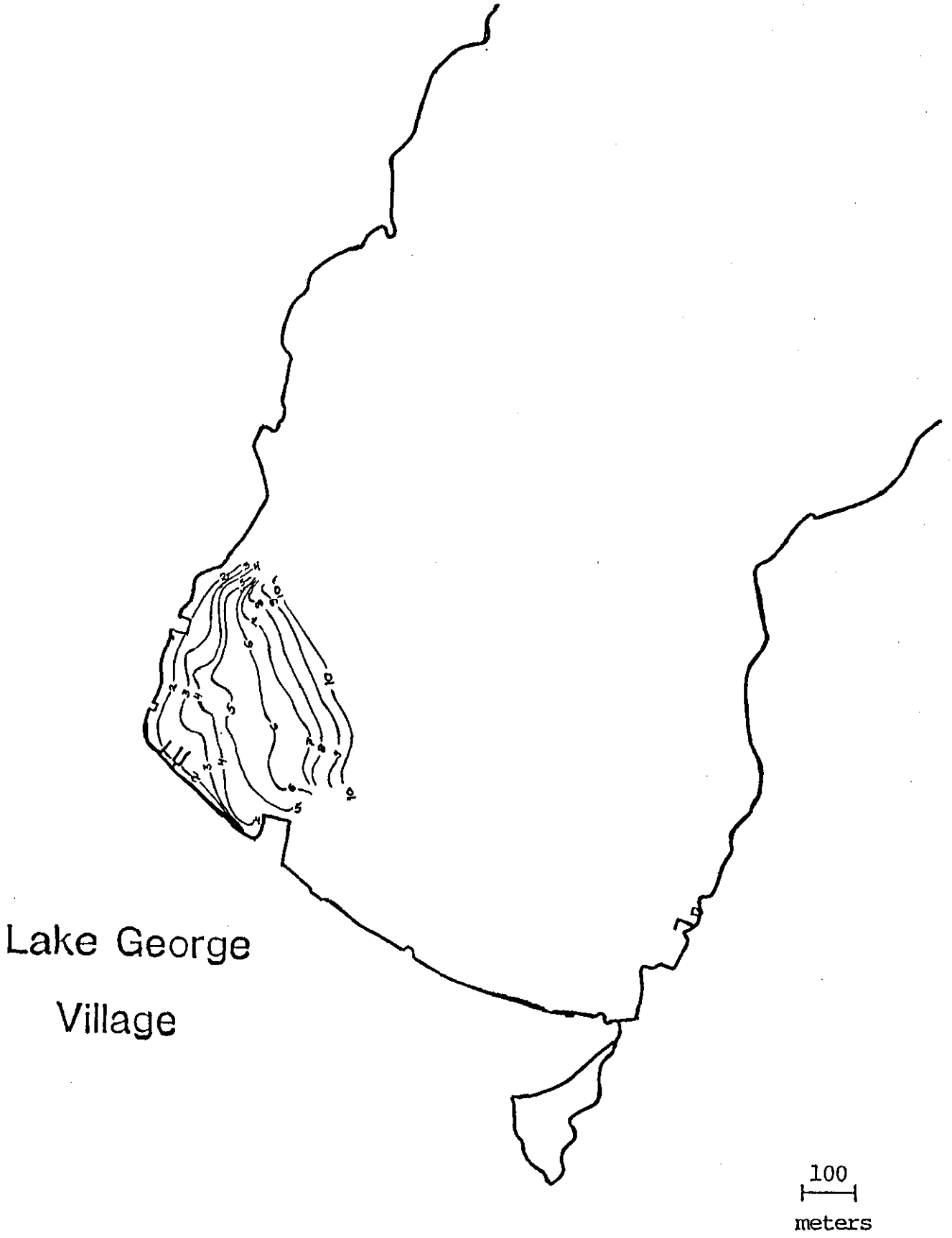
Bathymetric maps of Dunham Bay, Huddle Bay and Lake George Village areas were prepared from echo sounding data (Sitex, Model 357). Multiple transects of predetermined lengths were echo sounded through each of the areas. The depth data from these transects was transferred to USGS topographic maps and profiles at one meter depth intervals were generated. The enclosed figures are the results of these surveys.



Bathymetric Map of Dunham Bay



Bathymetric Map of Huddle Bay



Bathymetric Map of Lake George Village

APPENDIX 4

MACROPHYTE COMMUNITIES

Surveys of the macrophyte communities of Huddle and Dunham Bays were completed on June 6 and 7, 1986. The macrophyte species present and their relative abundance in the overall plant community was estimated by diver survey. Divers swam transects through the littoral zone just above the bottom of each bay to a depth of 4 to 5 meters. Percent cover values for each species were recorded at one meters depth intervals and the total amount of bottom covered by macrophytes was also recorded at each depth. Voucher specimens of each species encountered were collected to assure accurate identification. Relative abundance values were assigned ranges:

Abundant (A) signifying a species contributing 20 or more percent of the bottom cover;

Common (C) signifying a species contributing 10 to 20 percent of the bottom cover;

Occasional (O) signifying a species contributing 1 to 10 percent of the bottom cover; and

Rare (R) a species contributing less than 1 percent of the bottom cover.

Since these surveys were made very early in the growing season, there is a strong possibility that some of the smaller species or later developing species may not have been present at the time of the survey.

Additional surveys are planned for the Lake George Village area and Sunset Bay in Huletts Landing. Surveys in the Dunham Bay and Huddle Bay areas will also be repeated later in the growing season as time permits.

SURVEY RESULTS FOR HUDDLE BAY

SPECIES	DEPTH IN METERS 0-1	1-2	2-3	3-4	4-5
Bidens beckii	O				
Ceratophyllum demersum	O				
Elodea canadiensis		O	C	O	
Fontinalis	C				
Heteranthera dubia	O	C	C		
Isoetes	R				
Myriophyllum spicatum	C	A	A	A	
Najas flexilis	O	C			
Nuphar	C				
Nymphaea					
Pontedaria	C				
Potamogeton amplifolius	O	C	A	O	
P. gramineus	C				
P. natans	O				
P. perfoliatus	O	O	C	C	
P. praelongus			C	C	
P. robbinsii	C	A	A	A	
P. zosteriformes		O	C	C	
Ranunculus	R				
Sagittaria graminea	A	A	O		
Sparganium	A				
Typha	C				
Utricularia		R			
TOTAL COVER (% OF BOTTOM)	50	60	80	100	

SURVEY RESULTS FOR DUNHAM BAY

SPECIES	DEPTH 0-1	1-2	2-3	3-4	4-5
Bidens beckii	O	O			
Elodea canadiensis	O	O	O	O	
Heteranthera dubia					
Juncus	C	C			
Myriophyllum spicatum	R	O	C	C	C
Myriophyllum tenellum	A	O	O	R	
Najas flexilis		O			
Nitella sp.		R			
Nuphar	R				
Pontedaria	R				
Potamogeton amplifolius		C	C		
P. gramineus	O	O	O		
P. perfoliatus		R	O	C	
P. praelongus		O	C	A	C
P. robbinsii		C	C	C	C
P. zosteriformes	R	O	C	C	O
Ranunculus	R				
Sagittaria graminea	A	C			
Sparganium	R				
Typha	R				
Utricularia		O	R	R	
Vallisneria		O			
TOTAL COVER (% OF BOTTOM)	55	75	90	80	70