

HAND HARVESTING EURASIAN WATERMILFOIL
IN LAKE GEORGE

by

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SUMMARY

In 1989, Rensselaer Fresh Water Institute in conjunction with NYS DEC proposed a 2 year program to hand harvest Eurasian Watermilfoil at 24 locations within the Lake George basin. Thirteen of the sites were hand harvested during September 1989. The eleven sites not harvested exhibited substantial expansion growth of Eurasian Watermilfoil populations during the 1989 growing season and hand harvesting was not considered an appropriate technique. Instead, these eleven sites were reclassified to receive alternate physical control techniques during 1990. The thirteen sites that were hand harvested during 1989 were revisited during 1990 to check for regrowth.

During 1990, recolonized Eurasian Watermilfoil plants were hand harvested from 12 of the thirteen sites managed by this technique during 1989. At the remaining site (Gull Bay, M-48), plants were cleared by a combination of suction harvesting and hand harvesting. The suction harvesting was deemed necessary when a small area of moderate density Eurasian Watermilfoil plants was discovered at this site during the preharvest survey.

Analysis of harvested plant material for 1990 showed an 80% reduction in both the number of plants harvested (21200 to 3953) and the total dry weight of the harvested materials (17100 grams to 3216 grams) when compared to 1989. A reduction of 55% in the number of person*hours spent to complete the harvesting (217 to 95.5) was also found.

For the eleven sites reclassified in 1989, 3 received benthic barrier material in 1990, 2 were suction harvested and the remaining 6 sites await future management efforts. Of these 6 sites, the one in Middleworth Bay and the 3 in

Warner Bay are proposed for suction harvesting in August of 1991. For the site at Hague Boat Launch Ramp, conventional dredging was suggested due to a number of limitations at this site. Review of survey information generated during 1990 for the Bay NE of Tea Island indicates that this site may be suitable for suction harvesting, however time constraints for the 1991 season may delay management efforts at this location.

Results from this program highlight a basic reality of aquatic plant management; management of aquatic plants must be an ongoing maintenance activity. The hand harvest sites in Lake George have received primary management for Eurasian Watermilfoil however they now will require annual maintenance to assure that through recolonization and or regrowth, the populations of milfoil at these sites do not return to preharvest levels. Maintenance of the sites managed under this program should require two divers for approximately one month per year.

INTRODUCTION

Eurasian Watermilfoil (Myriophyllum spicatum L.) was first discovered in Lake George by Rensselaer Fresh Water Institute (RFWI) personnel during routine research activities in the summer of 1985. A survey in 1986 revealed a total of 23 sites at which this species was found. In 1987, additional surveys discovered a total of 45 sites with Eurasian Watermilfoil.

As of the end of 1988, a total of 55 sites had been identified as having Eurasian Watermilfoil in Lake George. At twelve of these sites, all of the Eurasian Watermilfoil had been removed for voucher specimens (approximately six plants at each site). Of the remaining sites, 35 had scattered plant communities. An evaluation of these sites determined that 24 of these sites were appropriate for hand harvesting.

The New York State Department of Environmental Conservation (NYSDEC), in conjunction with the Lake George Park Commission (LGPC) and Warren County, submitted a proposal to the United States Environmental Protection Agency (USEPA) for a Phase II Clean Lakes Implementation Project on Lake George, New York. One component of this project deals with control of Eurasian Watermilfoil at 43 sites around the lake using physical control techniques such as hand harvesting, suction harvesting and benthic barrier. Warren County agreed to fund hand harvesting at the 24 sites identified during the 1989 growing season, with follow-up in 1990. This demonstration effort was a combined project of the Rensselaer Fresh Water Institute and the NYSDEC Lake Services Section.

Thirteen sites containing populations of Eurasian Watermilfoil were hand harvested during September 1989. Based upon 1988 survey data, a total of twenty-four sites had been scheduled for hand harvesting. The eleven sites not harvested during September exhibited substantial expansion (growth) of Eurasian Watermilfoil populations during the 1989 growing season and hand harvesting was not considered an appropriate technique. Instead, these eleven sites were reclassified to receive alternate physical control techniques during 1990.

The sites selected for hand harvesting were optimal for the success of this technique. At these sites, generally fewer than 100 plants were found in 1988.

Why attempt to control Eurasian Watermilfoil at these sites, with such low densities? The reasons to apply this control technique at this time included:

1. The permits, costs, and planning for hand harvesting did not require the intensity of other control techniques and had a high probability of initiating control applications during the summer of 1989. We believed it was important to begin some control measures as soon as possible.
2. These sites had the potential to expand into larger colonies in a short period of time. The colony at Northwest Bay was only 10 plants in 1986, but grew into a small bed in 1987 and increased in area 1300% by 1988. If this site had been hand-harvested in 1986, there would not, in all likelihood, be a dense bed there now.
3. These sites would produce fragments, allowing the expansion of Eurasian Watermilfoil both in the adjacent area, and further away.
4. Applying control strategies at these sites as soon as possible would prove to be quicker and less costly than waiting until later, when more extensive control measures would be needed.

METHODS

The methods to be employed, and site-specific information, are also contained in the NYS DEC permit application to the Adirondack Park Agency. The permit application, completed by one of the authors (JWS), was a prerequisite for the hand harvesting project. Twenty-four sites were selected for hand harvesting (See Table 1 and Figure 1). All of these sites had approximately 100 or fewer scattered plants as of the 1988 survey.

All twenty-four of these sites were visited in June and July of 1989 as part of the LGAF-sponsored Eurasian Watermilfoil Survey. The number of plants and areal extent of Eurasian Watermilfoil populations were estimated in preparation for hand harvesting. Evidence from this survey did not disqualify any of the proposed sites.

Hand harvesting was initiated in September 1989. This time was selected to provide the optimal season for spotting plants, yet after heavy boat traffic and other sources of interference had subsided. At each site, plants were harvested by hand using either snorkelers or SCUBA divers. Divers and snorkelers swam grid patterns to patrol the area known to have Eurasian Watermilfoil, collecting plants observed. Harvested plants were placed in a mesh dive bag, for later sorting. Snorkelers also swam areas outside of the previously-known Eurasian Watermilfoil populations to find additional plants that may have escaped previous notice. Snorkelers patrolled the area to collect any fragments created by SCUBA divers, and find additional plants missed. The number of plants harvested were counted for each site, and the plants dried and weighed to determine biomass removed. The number of personnel and hours were

carefully recorded to evaluate work-time, travel-time and support-hours, to calculate control efficiency and cost-effectiveness. A boat tender was used during these operations to ensure the safety of personnel in the water. In later data discussions, this process will be referred to as the "harvest."

Following the hand harvesting operations, all sites were revisited to evaluate the effectiveness of harvest operations, and harvest any plants overlooked (later referred to as "evaluation"). The same data as above were collected and used to calculate the relative efficiency of the hand harvesting operation.

In 1990, all sites harvested in 1989 were revisited and the sites carefully examined for the presence of Eurasian Watermilfoil. All plant specimens found were harvested, the number counted, and plants dried and weighed to assess the relative amount of regrowth and recolonization. Although several visits were made to a number of sites, these activities were not divided into harvest and evaluation.

In the discussions that follow, all numbers were recorded relative to the accuracy of the measurements, and significant digits retained in the calculations of all statistics. However, all numbers are rounded to three significant digits in the presentation.

RESULTS AND DISCUSSION

Summary of Site Activity

This narrative presents the results, for both 1989 and 1990, of site surveys before harvest was initiated, our decision on the treatment for these sites, and the amount of material removed at each site from the harvest and evaluation visits. Table 1 provides information on the pre-harvest site survey for 1989 and the status of the sites at the conclusion of the project in 1990. Table 2 presents the sites harvested, the amount of material (dry weight) collected, and the number of plants removed for both 1989 and 1990. Table 3 is a tabulation of the total effort at each harvest site, with total effort in man-hours required for survey, harvest and evaluation.

The following section is a verbal description of each site, the management practices that occurred at each site, the amount of Eurasian watermilfoil removed from each site and the amount of effort expended to remove the milfoil.

West Green Island (M-5). The September 1989 site survey, preliminary to hand harvesting, found that the moderately dense area of Eurasian Watermilfoil had expanded to a dense bed, extending from the southern-most DEC Facility docks to the adjoining property. Therefore, hand harvesting was not deemed practical, and this site was suction harvested as part of the Lake George Clean Lakes Phase II project in 1990.

Warner Bay (M-11, M-37, M-38). The September 1989 survey found several thousand low-to-moderate density M. spicatum plants growing among an equal number of the native M. sibiricum (ex. M. exalbescens). These populations were

predominantly on the east shore from the five mile per hour marker to within 100 meters of the marsh discharge. This population was deemed too numerous for hand harvesting, so the site was reclassified for suction harvesting in 1991.

Harris Bay, SE Happy Family Islands (M-14). The September 1989 survey found a small bed of M. spicatum by the southern-most channel marker, as well as some plants in among the boat slips in the adjoining marina. A few plants (32, or 25.3 g dw) were harvested before the bed was found, at areas in which Eurasian Watermilfoil was previously found. Because of the dense bed, the site was considered unsuitable for further hand harvesting and was reclassified for benthic barrier. Benthic barrier was installed at the site in August of 1990.

Finkle Brook (M-15). The September 1989 survey found this site suitable for hand harvesting, although the number of plants observed were significantly greater than during the June survey. Hand harvesting activities resulted in 14 person*hours collecting 1400 plants weighing 1300 grams (dry weight, g dw) in the harvest, and an additional 0.67 person*hour spent to harvest 15 plants weighing 3.05 g dw during the site evaluation. A total of 14.8 person*hours was spent collecting 1415 plants weighing 1303 g dw. In 1990 an additional 341 plants were harvested with a dry weight of 180.5 g, and a total of 8.8 person*hours were spent at this site.

Middleworth Bay (M-16). The September 1989 survey found that the southern arm of the bay had several thousand low-to-moderate density Eurasian Watermilfoil plants. The central portion of the bay was barren of Eurasian Watermilfoil. The northern portion of the bay had 50 to 100 plants, beginning at the covered boathouse and extending

northward. Although hand harvesting would be feasible for the north arm of the bay, the entire area was reclassified for suction harvesting, with hand harvesting of the north arm to coincide with physical control in the south portion of the bay. Suction harvesting of this site is planned for 1991.

Hague Boat Launch (M-18). The September 1989 survey found too many Eurasian Watermilfoil plants to count, at least several thousand, and the site was rejected for hand harvesting. Because of heavy sedimentation at this site, and extensive growths of both native and exotic species (M. spicatum and Potamogeton crispus), we recommend traditional dredging of this site.

Lake George Yacht Club (M-23). The September 1989 survey of this site found scattered Eurasian Watermilfoil plants along the beach, and between the third and fourth docks (counting from shore outwards). However, dense beds were found between the first two docks, with moderate growth between the second and third docks. The large number of plants at this site dictated that this area be reclassified as a benthic barrier site. The barrier was applied in October of 1990, and the remaining plants were hand harvested.

West Tongue Mountain, Northwest Bay (M-24). Although the September 1989 survey found substantially more Eurasian Watermilfoil plants than during the June survey, hand harvesting was performed at this site. In the harvest visit, 32.6 person*hours were expended to harvest 1780 plants weighing a total of 3230 g dw. During the site evaluation, an additional 9.9 person*hours were expended collecting 721 plants weighing a total of 120 g dw. Therefore, a total of 42.5 person*hours were spent

collecting 2501 plants weighing 3350 g dw. In 1990, the area was resurveyed and an additional 936 plants weighing 981.5 g dw were removed. A total of 21.5 person*hours were spent during harvest and evaluation activities.

Basin Bay (M-25). Eurasian Watermilfoil hand harvesting was initiated at this site in 1989, despite finding a small bed, an adjoining area of moderately-dense Eurasian Watermilfoil, and scattered plants in the area surrounding the mouth of the tributary. Harvest visits of 15 person*hours resulted in 2310 plants weighing 2750 g dw being removed, while the evaluation visit expended an additional 3 person*hours that removed 201 plants weighing 33.6 g dw. The total effort expended was 18 person*hours to harvest 2511 plants weighing 2783.6 g dw. In 1990, this site was found to contain only scattered milfoil plants. Harvesting at this site required 11.6 person*hours to harvest 528 plants with a dry wt. of 159.9 g dw.

NW Cooper Point (M-27). The initial survey in 1989 found scattered plants throughout much of this small bay, while the previous survey had found less extensive distributions of fewer plants. However, hand harvesting was pursued. The harvest visit took 5.2 person*hours, yielding 324 plants weighing 125 g dw. The evaluation discovered plants in areas not previously observed, namely in among floating-leaved and emergent vegetation along the northern end of the bay in water depths less than 2 feet. The evaluation expended 4.8 person*hours, yielding 853 plants for a total weight of 346 g dw. A total of 9.98 person*hours were expended to harvest 1177 plants weighing 471 g dw. Even with this effort, some plants may still be found in the northeast corner of the bay, where the shallow water as well as very high turbidity and a flocculent bottom combined to hamper thorough harvesting of Eurasian Watermilfoil.

In 1990, a total of 152 plants with a dry wt. of 44.6 g were removed from this site. A total of 6 person*hours were required. A moderately dense stand of very low growing milfoil persisted in the northeast corner of the bay.

Bay NE of Tea Island (M-29). The September 1989 survey discovered a large area of moderate-to-dense Eurasian Watermilfoil in 1 to 4 meters depth in the southern portion of this small bay, with the northern portion having low-to-moderate densities of M. spicatum containing total numbers too numerous to estimate. Because of the high number of plants involved, this site was deemed not suitable for hand harvesting, and reclassified for other control techniques. Suction harvesting of this site is anticipated in 1991.

English Brook (M-31). This site, located south of the brook's delta, was found to have significantly more plants than observed in the June 1989 survey. However, hand harvesting was pursued. The 1989 harvest visit, taking 31.3 person*hours, resulted in 4250 plants weighing 4650 g dw being harvested, while the evaluation took an additional 4.5 person*hours to yield 481 plants weighing 228 g dw. Therefore, in 1989 a total effort of 35.8 person*hours was spent harvesting 4731 plants weighing 4878 g dw. During 1990, 831 plants were removed from this site with a dry wt. of 927.6 g. Harvesting of these plants required 13.8 person*hours.

Bay E of Dark Bay (M-36). The September 1989 survey revealed significantly more Eurasian Watermilfoil plants than observed in June in the area where plants were first observed. All of these plants were harvested, yielding 255 plants weighing 140 g dw from 6.5 person*hours effort. However, the survey also discovered a previously-unknown bed within a boatslip. This bed was not hand harvested,

but was classified for benthic matting. The scattered plant zone was evaluated, with 30 plants removed weighing 6.4 g dw for an effort of 1 person*hour. Note that this site was not completely cleared of plants, but was included in Tables 2 and 3. Benthic barrier was installed in the boat slip area in 1990 and the remaining milfoil plants were hand harvested. In 1990, a total of 90 plants with a dry wt. of 48.7 g were removed from this site, using 3.75 person*hours.

S Kattskill Bay (M-39). The September 1989 survey indicated approximately no change in the Eurasian Watermilfoil population from the June survey. A harvest of 0.2 person*hours yielded 4 plants weighing 0.5 g dw, while the evaluation required another 0.2 person*hours and yielded 4 more plants weighing 0.94 g dw. A total of 0.3 person*hours was expended picking 8 plants that weighed a total of 1.44 g dw. In 1990, a total of 7 plants weighing 2.7 g dry wt. were harvested from this site. A total of 2 person*hours was spent.

Commission Point Bay (M-40). The 1989 harvest visit took 2.2 person*hours to harvest 115 plants weighing 150 g dw, while the evaluation visit required 0.8 person*hours to harvest 6 plants weighing 2.45 g dw. A total of 3 person*hours was expended to harvest 121 plants weighing 152 g dw. In 1990, a total of 4 person*hours spent harvesting yielded 149 plants with a dry wt. of 93.4 g.

Paradise Bay (M-41). The Eurasian Watermilfoil population at this location was found in the easternmost arm of the bay, in 2 to 4 meters water depth. Harvest conditions were rather poor, with a clay sediment that rapidly diminished visibility. The harvest effort took 3.8 person*hours to harvest 272 plants weighing 256 g dw. The evaluation effort took an additional 1.9 person*hours to harvest 80 plants

weighing 24.5 g dw. The total effort was 5.73 person*hours to harvest 352 plants weighing 281 g dw. A total of 99 plants were harvested from this site in 1990 with a dry wt. of 57.3 g. Harvesting at this site required 3.3 person*hours.

Bolton Bay (Bixby Beach) (M-43). The September 1989 survey discovered significantly more plants than previously observed, with most occurring around a submersed crib in the central portion of the small bay. The harvest effort took 22.5 person*hours to harvest 1640 plants weighing 800 g dw, while the evaluation effort was an additional 5.75 person*hours to harvest 861 plants weighing 65.2 g dw. Total effort expended was 28.3 person*hours harvesting 2500 plants weighing a total of 865 g dw. A total of 264 plants with a dry wt. 388.7 g were harvested from this location in 1990. A total of 8.7 person*hours were required to complete the 1990 harvest at this location.

Bolton Bay - NE of Green Island Bridge (M-44). The September 1989 survey found the Eurasian Watermilfoil population had expanded to form a small dense bed in the area between the bridge, submersed crib, shore, and boat channel on the northeast side of the bridge. Therefore, the site was not hand harvested, and was reclassified for suction harvest which was completed in September of 1990.

Gull Bay (M-48). The September 1989 survey found significantly more Eurasian Watermilfoil at the previously-known site off of the beach and stream, and an additional area of a few scattered plants on the southern point extending into the bay. The latter area had not been previously examined. Because of this extensive area of plants, the entire bay was snorkeled to locate additional plants, whereas the June survey had only examined the area adjacent to the tributary. However, hand harvesting did

proceed at this site. In the harvest visit, 36.5 person*hours was expended to harvest 4680 plants weighing 1660 g dw. The site evaluation took an additional 4.5 person*hours to remove 529 plants weighing 50.7 g dw. The total effort was 41 person*hours to harvest 5209 plants weighing 1710.7 g dw. The survey of this site in 1990 found in addition to scattered plants a small dense bed which was removed by suction harvesting. The hand harvested plants totaled 202 with a dry wt. of 88.9 g and required 2.2 person*hours to complete.

Clark Hollow Bay (M-50). A similar number of plants were found in the surveys of June and September of 1989. The harvest spent 0.93 person*hours to harvest 25 plants weighing 39.5 g dw. The site evaluation took an additional 1 person*hour to harvest 19 plants weighing 8.36 g dw, for a total of 1.93 person*hours to harvest 44 plants with a total weight of 47.9 g dw. In 1990, 97 plants with a dry weight of 69.8 g were removed from this site. The harvest required 3.0 person*hours to complete. The plants from this site were generally small (less than 20 cm. in height) and widely scattered in the search area.

Rogers Rock State Campground Beach (M-52). The survey of this site in September 1989 found the Eurasian Watermilfoil population essentially the same as in June. The harvest attempt took 4 person*hours to collect 280 plants weighing 1050 g dw, while the site evaluation expended another 2 person*hours to collect 30 plants weighing 8.8 g dw. The total effort was 6 person*hours to harvest 310 plants weighing 1058.8 g dw. In 1990, harvest of this site took 6.2 person*hours to remove 99 plants with a dry wt. of 72.8 grams.

Clay Bay, Northwest Bay (M-53). The September 1989 survey found the Eurasian Watermilfoil population essentially

unchanged from the June survey. The harvest visit took 1.7 person*hours to harvest 58 plants weighing 39 g dw, while the evaluation spent another 0.33 person*hours to harvest 1 plant weighing 0.16 g dw. Thus, the total effort was 2.03 person*hours to harvest 59 plants weighing 39.2 g dw. An additional 163 plants with a dry wt. of 99.2 g were removed from this site in 1990, this required 5.9 person*hours in order to complete. The majority of plants removed in 1990 were found in depths of 1 meter or less. The increase in numbers of plants harvested from 1989 to 1990 is probably due to the character of the bay. Fine grained clay sediments disturbed easily and severely restricted visibility once harvesting was initiated.

Of the twenty-four sites initially selected for hand harvesting, all Eurasian Watermilfoil plants were hand harvested at 13 sites. In 1989, plants were also harvested from the scattered plant zone of one site (M-36) for both a harvest and evaluation trip, and plants were harvested at one other site (M-14) during a harvest visit, with no site evaluation. Of the remaining eleven sites, three sites (M-5, M-44 and M-48) were managed with a combination of hand harvesting and suction harvesting in 1990 and three sites (M-14, M-23, and M-36) received benthic barrier material in addition to hand harvesting. Four of the remaining five sites are scheduled to be managed with a combination of hand harvesting and suction harvesting in 1991, and at the final site (Hague Boat Launch) conventional dredging is suggested due to the excessive sedimentation at this location.

Considering all sites in which the 1989 harvest and evaluation efforts were made, a total of 217 person*hours were spent to harvest 21,200 plants with a total dry weight of 17,100 g dw (Table 3). Upon return to the hand harvest sites in 1990, a total of 3953 plants were removed with

a dry wt. of 3216 g. If a conversion factor of 8% dry weight to wet weight is used, a total harvest of 214 kg wet weight of Eurasian watermilfoil was made in 1989 compared to a 1990 total of 40 kg wet weight.

In 1989, harvest and evaluation required 217 person*hours. The time required to complete the 1990 harvest evaluation and plant removal at all sites was 95.5 person*hours or a 56% reduction in the effort required to manage milfoil at these locations.

Analysis of Harvest Effort

A comparison of the hand harvest activities in 1989 and 1990 (Table 2) indicates a 81.4% reduction in the number of plants harvested. In other words, the initial year of hand harvesting was over 80% effective in removal of milfoil from these locations. A comparison of the effort required to hand harvest the thirteen sites included in this program (Table 3) yields a 56% reduction in the number of hours required to harvest these same sites. The fact that the effort required to hand harvest these sites did not decline at the same rate as the number of plants harvested is an indication of the greater difficulty entailed in locating and harvesting widely scattered milfoil plants.

In Figure 2, the relationship between the number of plants harvested is compared to the effort expended for 1989 and 1990. Several facts are immediately apparent: 1) The number of plants harvested during 1990 was generally 20% that of 1989, 2) the effort to hand harvest each site was substantially less in 1990 than in 1989, and 3) The amount of effort per plant (slope of the regression line) was greater in 1990 than in 1989, but the initial input of surveying (intercept) was less since the location of the plants was known.

The same relationship expressed per unit plant weight was significantly different than for number of plants (Figure 3). The effort expended per unit weight was greater (slope) for 1990 than for 1989, including the initial input to find plant biomass (intercept).

The relationship of the number of plants harvested versus the weight of plants harvested (Figures 4) indicates the average weight of a plant (e.g., one basal stem) per site. Plant size was very variable for the harvest in 1989 (Figure

4), and average plant size was substantially greater in 1989 (slope) than in 1990. During the 1989 harvest, plants of 1 meter or more height were harvested, and plants often occurred in clumps of several stems per clone. During the site evaluations in 1989 and in the majority of sites in 1990, very few clumps were found. More often, plants of 10 cm or less were collected. These plants were generally hidden among the native vegetation, under the layer of the native canopy, or located near the root crowns of plants previously harvested.

Figure 5 indicates the relationship between the number of plants harvested on the harvest visit to the number of plants harvested on the site evaluation during 1989. The slope of the relationship shown would indicate that the initial harvest was about 80% efficient. However, three points are obviously inconsistent with the relationship of the other ten. At these three sites (M-24, M-27, M-43) significantly more plants were found during the evaluation than at other sites. For two of these sites (M-24 and M-43), the sites were particularly difficult to hand harvest, having numerous bottom obstructions and fine particulate sediments. At the other site (M-27), a large number of plants were found in an area not previously searched. If these three sites are not considered, the harvest was 90% efficient in number of plants removed. The relationship between the initial harvest and evaluation in 1989 holds true when comparing the hand harvesting efforts in 1989 to those in 1990, where an effectiveness of slightly greater than 80% was found.

Figure 6 indicates the relationship between the dry weight of harvested material obtained during 1989 versus that of 1990. The slope of the regression relationship indicates that the harvest was over 80% efficient with respect to weight of material removed. This was consistent with our

observations during evaluation: the vast majority of plant weight (biomass) was removed during the first visit.

The relationship between harvest time in 1989 and 1990 (Figure 6) shows a fairly consistent amount of effort between harvests and evaluations. Sites at which a large initial amount of time was spent required a proportionately large (approximately 20%) amount of "second effort."

The above discussion makes it apparent that site evaluations are required whenever hand harvesting is done. Not only will an evaluation be required soon after the first visit, but these sites should be revisited year after year. An investment of 30 minutes by two divers at each of these sites each year may be enough to ensure that Eurasian Watermilfoil will not regrow at these sites.

Given the constraints of this project, relating to permit acquisition and time, it was quite successful. Not only were 13 sites substantially cleared of Eurasian Watermilfoil, but initiative was regained in attempts to control the plant after a hiatus of almost three years. This program also provided cost share and survey information necessary to acquire federal assistance for aquatic plant management through the US EPA Clean Lakes Program. Several significant facts were learned about controlling Eurasian Watermilfoil in Lake George, as well as the strengths and limitations of hand harvesting.

Results from this program highlight a basic reality of aquatic plant management; management of aquatic plants should be an ongoing maintenance activity in Lake George. With continued maintenance of the hand harvest sites, the time commitment per site should continue to decline but needs to continue at some minimum level.

RECOMMENDATIONS

Monitoring and Management

1. Survey and harvesting of sites in Lake George for Eurasian Watermilfoil should not begin until July. If the survey is conducted too early in the year, the results merely reflect overwintering conditions or the growth of the previous year.
2. A more effective mechanism for permitting individual sites must be enacted to enable hand harvesting of sites with low numbers of plants in the same year in which they are found, rather than waiting until the following year. A generic permit application is currently being reviewed with the Adirondack Park Agency. Otherwise, the plants cannot be harvested until the following year, which allows them to grow to greater densities.
3. Hand harvesting has proven effective in controlling low plant densities and low numbers of plants per site. However, it is very tedious and less efficient when plant densities approach moderate or high densities. We recommend hand harvesting for low density peripheral areas, and for sites with low density plants numbering less than 100 plants total.
4. Maintenance of the sites managed under this program and/or through the EPA Clean Lakes Phase II Program (suction harvesting and benthic barrier installation) is imperative. This maintenance would require two to three divers for approximately one month per year.

ACKNOWLEDGMENTS

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Table 1. Sites selected for the hand harvesting permit,
1989 Survey Information and current status.

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                SEPTEMBER 1989                CURRENT
M   SITE                OBSERVATION
#   NAME                STATUS      NUMBER      STATUS      TREATMENT
=====
  5  W Green Is         bed           tntc        cleared     SH
 11  Warner B          scatt'd      3000       scatt'd    SH, 1991
 14  Harris B         bed           tntc        matted     BB
 15  Finkle Bk        scatt'd      1000       cleared    HH
 16  Middleworth Bay moderate     tntc        moderate   SH, 1991
 18  Hague Boat Lnch  scatt'd      tntc        scatt'd    D
 23  L.G. Yacht Club  bed           tntc        cleared    HH, BB
 24  NWB- W Tongue M  scatt'd      3000       cleared    HH
 25  Basin B          bed           2000       cleared    HH
 27  NW CooperPt     scatt'd      200        cleared    HH
 29  B-NE Tea Is     scatt'd      tntc        moderate   SH, 1991
 31  English Bk      scatt'd      500        cleared    HH
 36  B-E Dark B      bed           tntc        cleared    HH, BB
 37  S Warner B      see site 11
 38  S Warner Bt     see site 11
 39  S KatskillB     scatt'd      5          cleared    HH
 40  Commission B    scatt'd      100        cleared    HH
 41  Paradise B      scatt'd      25         cleared    HH
 43  Bolton B        scatt'd      1000       cleared    HH
 44  Bolton B Brdg   bed           tntc        cleared    SH, HH
 48  Gull Bay        scatt'd      1000       cleared    HH, SH
 50  Clark Hollow    scatt'd      50         cleared    HH
 52  Rog Rk Beach    scatt'd      100        cleared    HH
 53  Clay Bay        scatt'd      50         cleared    HH
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HH - Hand Harvest BB - Benthic Barrier
SH - Suction Harvest D - Dredge

Table 2. Summary of hand harvesting effort for 1989 and 1990.

		1989		1990	
SITE NAME	M SITE NUM	TOTAL N OF PLANTS	DRY WT OF PLANTS	TOTAL N OF PLANTS	DRY WT OF PLANTS
Finkle Br	15	1415	1303	341	180.5
W Tongue Mtn	24	2501	3350	936	981.5
Basin Bay	25	2511	2784	528	159.9
Cooper Pt	27	1177	471	152	44.6
English Br	31	4731	4878	831	927.6
E Dark Bay	36	285	146.4	90	48.7
Kattskill Bay	39	8	1.44	7	2.7
Commission Pt	40	121	152.5	149	93.4
Paradise Bay	41	352	280.5	99	57.3
Bolton Bay	43	2501	865.2	264	388.7
Gull Bay	48	5209	1710.7	202	88.9
Clark Hollow	50	44	47.9	97	69.8
Roger's Rock	52	310	1058.8	99	72.8
Clay Bay	53	59	39.2	163	99.2
TOTAL		21200	17100	3953	3216

Table 3. Total harvest and evaluation activity for 1989 and 1990.

M SITE NUM	1989		1990	
	PICKER PERSON *HOURS	TOTAL N OF PLANTS	PICKER PERSON *HOURS	TOTAL # OF PLANTS
15	14.8	1410	8.8	341
24	42.5	2500	21.5	936
25	18	2510	11.6	528
27	9.98	1180	6.0	152
31	35.8	4720	13.8	831
36	7.5	285	4.25	80
39	0.334	8	2.0	7
40	3	121	4.0	149
41	5.73	352	3.3	99
43	28.3	2500	8.7	264
48	41	5210	2.2	202
50	1.93	44	3.0	97
52	6	310	6.2	99
53	2.03	59	5.9	163
TOTAL	217	21200	95.5	3953

Figure 1. Map indicating the location of the proposed 24 hand harvesting sites as indicated by milfoil site number, with an inset showing the location of Lake George in New York State.

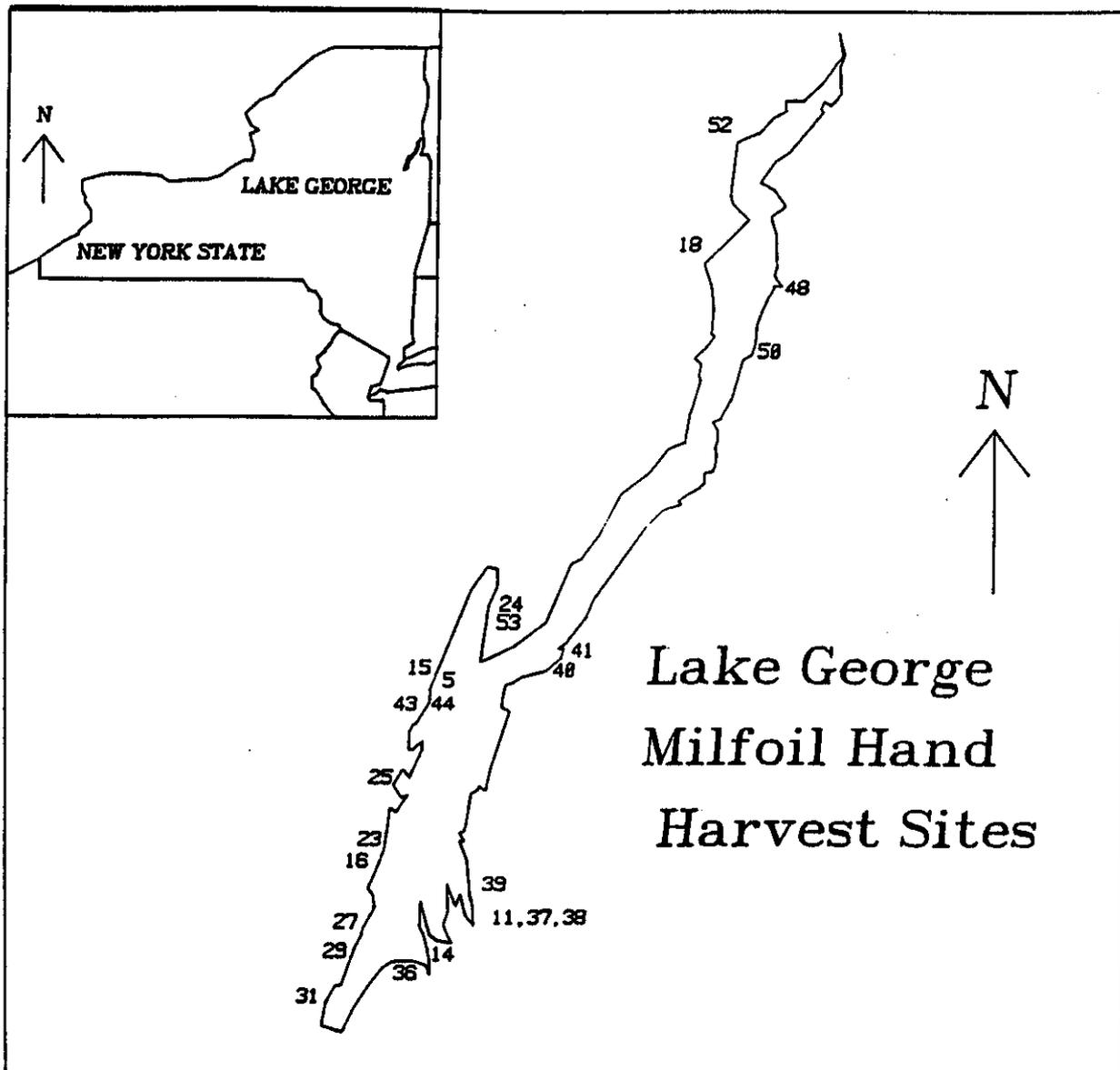


Figure 2. The number of Eurasian Watermilfoil plants harvested in 1989 and 1990 versus the amount of time expended for harvest.

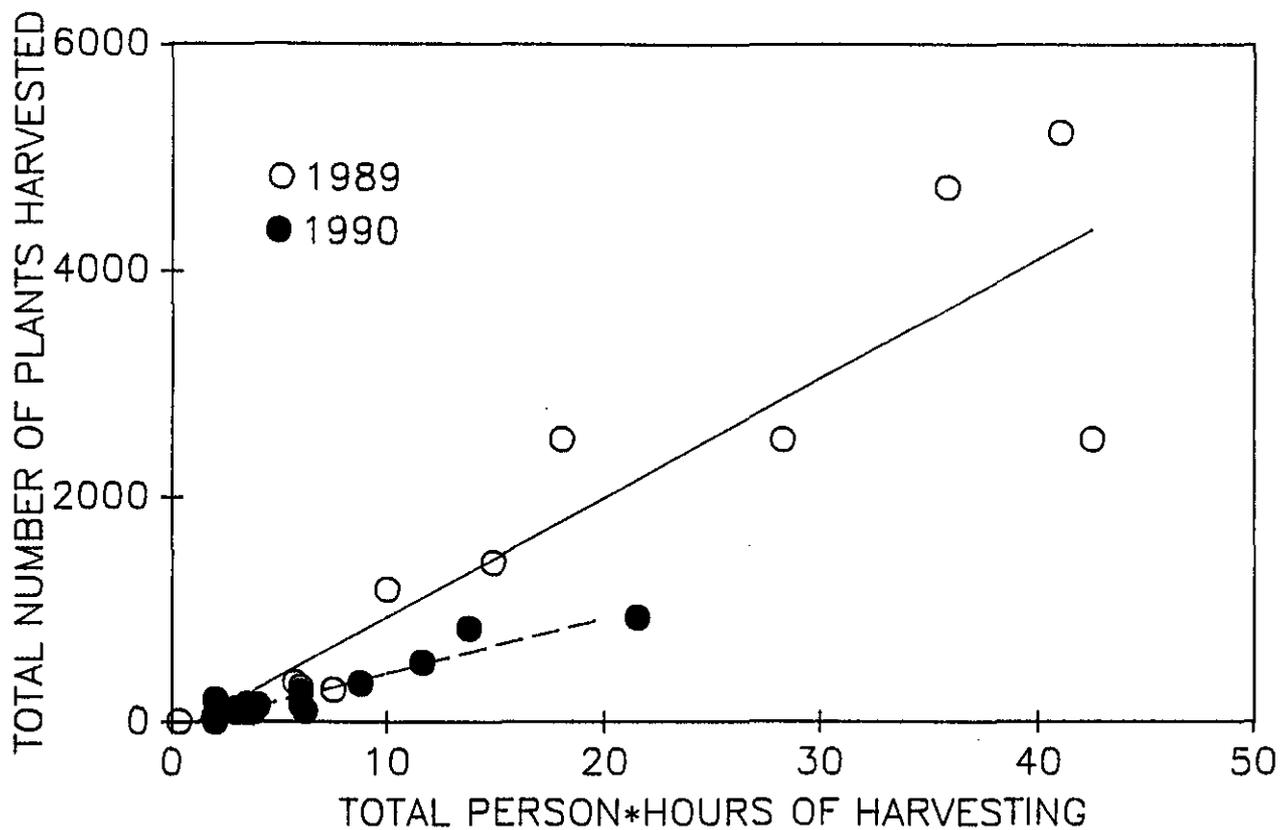


Figure 3. The dry weight (grams dry weight) of Eurasian Watermilfoil plants harvested versus the amount of time expended for harvest in 1989 (open) and 1990 (closed).

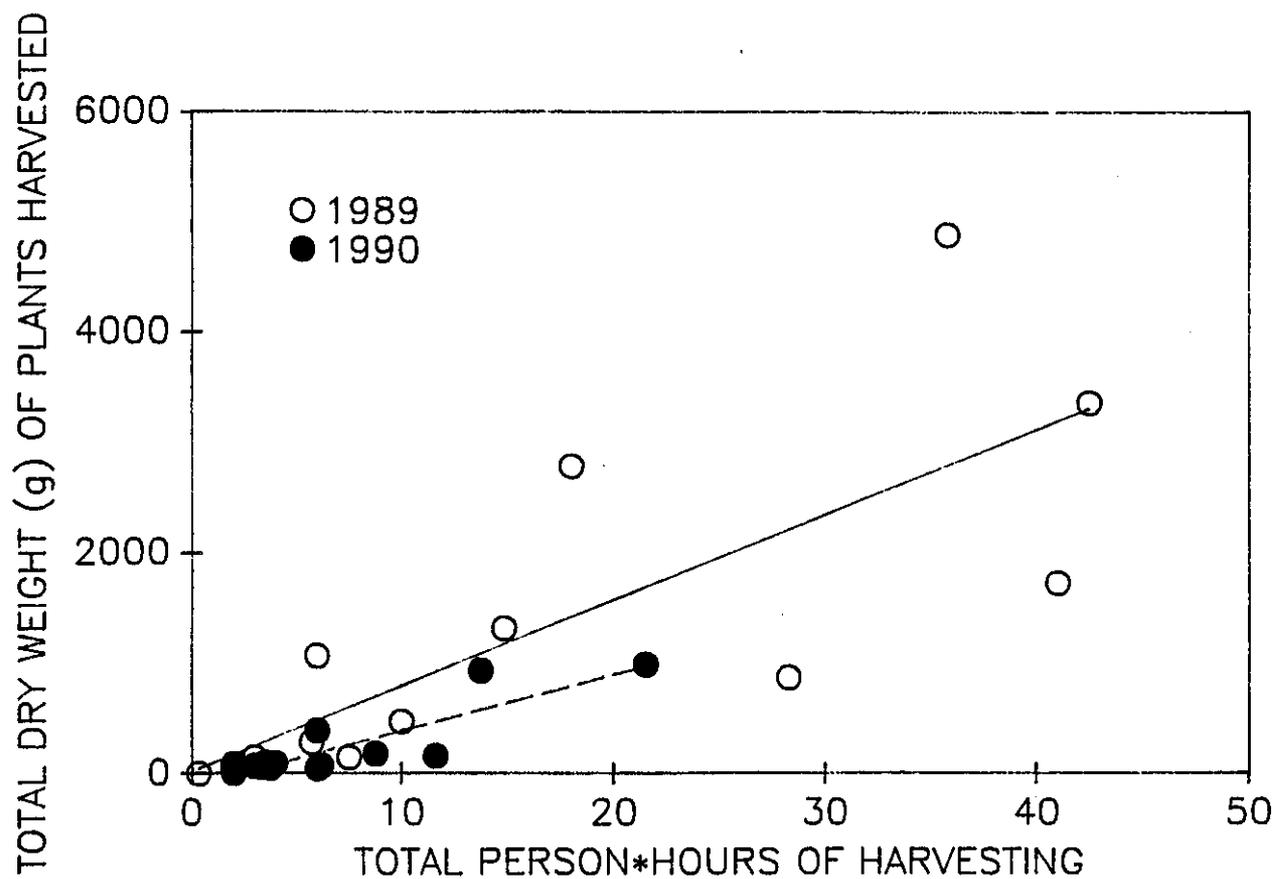


Figure 4. The number of Eurasian Watermilfoil plants harvested versus dry weight (grams dry weight) for 1989 (open) and 1990 (closed).

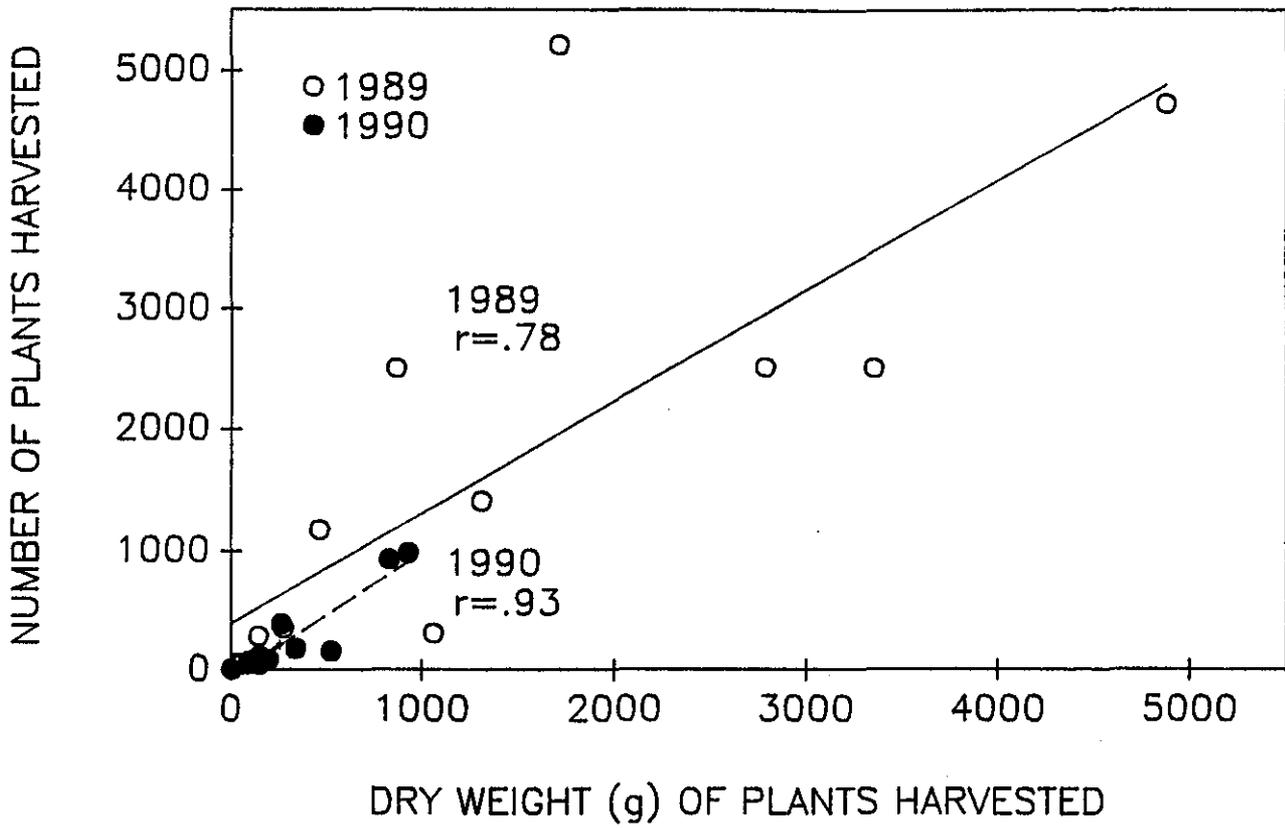


Figure 5. The number of plants removed during the harvest phase in 1989 versus the number of plants harvested during the evaluation phase of 1989.

