Effects of Uprooting on Eurasian Watermilfoil

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INTRODUCTION

Eurasian watermilfoil (*Myriophyllum spicatum* L.) has become a serious weed in many North American waters (4) including Chautauqua Lake, a major recreational resource in western New York State. Eurasian watermilfoil was unknown in Chautauqua Lake in the 1930's (5); however it currently grows throughout the lake in dense quantities. Several weed control measures have been used since the 1950's, including sodium arsenite, (2,4-dichlorophenoxy) acetic acid (2,4-D), 6,7-dihydrodipyrido (1,2-*a*:2',1'-*c*) pyrazinediium ion (diquat), and mechanical harvesting. However, both herbicides and harvesting have become increasingly difficult to use in recent years because of large cost increases, stricter regulation, and public concern over potential harmful effects.

Chautauqua Lake is a large (57 km^2) naturally formed lake 130 km south of Buffalo, N. Y. and 15 km east of Lake Erie. The lake has long been noted for its productive sportsfishery and luxuriant macrophytes. In the past, several native species were common (5), but most were reduced or replaced by the exotics Eurasian watermilfoil and curlyleaf pondweed (*Potamogeton crispus* L.) in the 1970's.

This report considers the effectiveness, possible side effects, and feasibility of complete and selective manual uprooting, a technique thought to be less intrusive ecologically and recreationally than conventional measures.

METHODS AND MATERIALS

Uprooting was tested in a luxuriant milfoil dominated area just south of Chautauqua Institution. Two 2 m x 15 m blocks 2 m apart parallel to the shore and at water depths of 1.1 to 1.4 m (block 1) and 1.5 to 1.8 m (block 2) were staked out as were five 2 m x 3 m plots in each. Three plots in each block were randomly assigned a treatment: complete plant removal (CRP), watermilfoil only removal (MRP), and control (C). Plants were removed by manual uprooting from 1-12 August 1974 in block 1 and from 12-20 August in block 2. Although most plant material was removed in the first few days, removal was continued over many more days to achieve near perfect elimination. Care was taken to extract complete root systems of every plant, but some material was missed because of deep breakage. Plants in all plots were harvested one year after treatment from eight central 0.25 m^2 subplots in block 1 and six in block 2. Biomass was sorted by species, dried at 100 C for 24 hr, and weighed. Since species coverages and heights were similar within blocks before treatment, later differences in species densities between control and treatment plots were considered treatment effects.

RESULTS AND DISCUSSION

Shoot and total biomass of watermilfoil and of all macrophytes combined were lower in most instances in treatment plots (CRP, MRP) than in corresponding controls. Differences were most marked in pooled samples (block 1 + 2) in which both milfoil and community total biomass differed from controls at $P \leq .01$. Uprooting treatments reduced submergent biomass levels by an average of 29% in MRP and 25% in CRP for milfoil, and by 21% and 29% for all macrophytes (Table 1). Though modest, these reductions might be substantial over a period of several years, for a 29% annual reduction over 5 years is an 82% reduction. Further, the consistency of the reductions (Table 1) may reflect the reliability with which future reductions could be achieved, at least in the first few years.

Although uprooting is often mentioned as a potential macrophyte control technique, it has generally been considered too labor intensive to be widely applicable (2, 3, 6). However, this generalization need not apply to mechanized uprooting, should workable devices be developed. Bjork (1) reported on the success of mechanized uprooting of emergents in Europe. Conceivably, efficient uprooting devices could be developed for submergents. If uprooting of watermilfoil gave effective long term results, it might be viable for small, intensively used areas such as bathing beaches, anchorages, and boat channels.

The ecological impacts of uprooting, particularly selective uprooting (MRP) may be less serious than those of most other techniques. Selective removal would have limited effects on animals because macrophytes most valuable for invertebrates (7) would remain undisturbed and would likely benefit from the removal of milfoil. Moreover, even CRP revegetate soon after treatment, noticeably so within a few weeks in the plots studied. Finally, the side effects of uprooting would be minor in a lake the size of Chautauqua, for treated areas would be only a small fraction of the littoral zone, 1-2% at most. In summary, uprooting offers promise of decreasing Eurasian watermilfoil on a long term basis in small areas; however, more study is needed to establish its effectiveness, costs, and environmental impacts.

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TABLE 1. SHOOT AND TOTAL DRY WEIGHT (MEAN G/M^2 ± ONE STANDARD ERROR) OF WATERMILFOIL AND OF ALL MACROPHYTES COMBINED IN CONTROLS (C), WATERMILFOIL REMOVAL PLOTS (MRP), AND COMPLETE REMOVAL PLOTS (CRP) ONE YEAR AFTER TREATMENT.

	Watermilfoil		All macrophytes	
Treatment[b]	Shoot biomass[a]	Total biomass[a]	Shoot biomass[a]	Total biomass[a]
Block 1				
C	116.2±10.8	142.0±12.5	139.4±9.3	169.2±11.2
MRP	84.7±7.6	108.1±8.7	113.3±6.5*	140.9±6.5*
CRP	88.0±11.4*	98.6±11.4**	100.7±11.2**	114.2±10.8***
Block 2				
C	135.3±19.4	184.3±13.3	158.4±9.8	215.1±15.6
MRP	98.0±13.4	117.0±13.9**	119.1±15.0*	160.4±14.6*
CRP	106.4±13.2*	141.9±15.5**	122.5±12.8*	145.0±17.2**
Block 1 + 2 (pooled)				
C	124.4±7.3	160.2±10.5	147.7±7.0	188.8±11.0
MRP	90.4±7.1**	111.9±5.4***	115.8±7.1	142.7±7.9***
CRP	95.9±8.7**	117.2±7.5***	110.0±8.6	134.0±10.6***

[a] Significant differences from corresponding controls by U tests (8) indicated as *** $P \leq .01$, ** $P \leq .05$, and * $P \leq .10$.
[b] Numbers of samples were 8 in block 1, 6 in block 2, and 14 when combined for analysis.

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