Aquatic Weed Harvesting -- Effects And Costs

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INTRODUCTION

Since the first weed harvesting attempts in the early 1900's right up to today, there have been many unanswered questions concerning the effects of weed harvesting and its efficacy as a weed control method. Even if harvesting is proven beneficial, perhaps one of the most important questions yet to be answered is that of the cost of harvesting. It is the purpose of this paper to show that there are more benefits from harvesting than just the short term removal of the weeds and, secondly, to offer some definitive costs on the removal of submerged aquatics, using one of the most recently developed harvesting systems.

EFFECTS OF HARVESTING

A prime cause of today's weed problems is an over abundance of nutrients in our waters. Therefore, it would seem logical that a cutoff of nutrient input would effectively retard weed growth through nutrient starvation. This weed-nutrient relationship is being recognized. Massive expenditures on better sewage treatment, effluent diversion proj ects, separation of storm and sanitary sewer systems, and community sewage systems instead of septic tanks are a few of the positive efforts in this direction. But it seems to be a losing battle, with population pressures building faster than our capabilities to cope. To compound our problems, the fertilizer industry has grown exponentially, nearly paralleling the seriousness of the weed problem. A measure of the scope of the nutrient problem is the fact that 32 states reported production of 20,000,000 tons of fertilizer from July, 1967 to June, 1968 (1). Because of rising demand for wood and paper, the forestry industry is presently planning large scale forest fertilizing to promote "instant trees". A side effect will again be enriched water runoffs into lakes and streams! So, for the foreseeable future, nutrients will be entering our waters at an increasing rate and weed crops will ever increase – possibly as a direct function of the nutrients present.

It then is evident that we who are dedicated to the control of noxious aquatic weeds must recognize and minimize nutrients (cause) in our waters equally, or more diligently, than we recognize and minimize weeds (effect) in our waters. Admittedly, there are some promising biological weed control methods, but the only two control methods that are now commercially available are mechanical weed harvesting and chemical herbiciding. Harvesting control attacks both effect and cause through physical removal of both the weeds and the nutrients they contain. Herbicides, while visibly causing the weeds to change form, increase the already too high nutrient levels in the water by leaving the weeds they kill to decay in the water. However, the choice between harvesting and herbiciding must be made on the facts available.

The lack of documentation on the effects of extracting weeds from the water, plus the shortage of accurate information available on costs of harvesting, are probably the two most damaging roadblocks to harvesting's universal acceptance. However, there seems to be a stirring of curiosity within the "anti-pollution community" to find out what harvesting does do to a lake now that some sophisticated harvesting equipment is being produced.

The Wisconsin Water Resources Center in Madison, Wisconsin, is presently backing a weed harvesting research project in Lake Mendota. Professor Grant Cottam, of the Botany Department of the University of Wisconsin, is in the third year of a project to analyze the effects of harvesting Eurasion Watermilfoil (*Myriophyllum exalbescens*). Monthly samples are cut from each of 3 100 sq. m. areas in University Bay. Comparisons are then made against 3 unharvested control areas for density (stems/acre), stem length, and dry weight. Regrowth has been averaging less than 20 cm. per month and, most promising, "harvesting also produces an initial reduction of density since all the cut stems do not resprout in a month's time" (2).

Since 99% of milfoil revegetation is through resprouting, removal of the weeds from the lake after cutting is a critical and necessary prerequisite. This is one reason why it is a Wisconsin state law that all weed cutting programs must incorporate coincidental weed removal.

Although milfoil shows significant growth retardation after harvesting and a cut stem does not resprout in a months time, what of other species? What if each cut end sprouts six new branches? One of two things (or a combination of both) can happen: if each of the 6 new sprigs grow at the same rate as before harvesting, weed tonnage will be produced at six times the former rate in the same area, greatly reducing per ton harvesting costs the second time around and accelerating nutrient removal. More likely the growth rate of each sprig will slow somewhat due to natural retardant effects of shading, crowding, and nutrient removal. However, net weed tonnage grown will still be largely proportional to the nutrients present.

M. E. Grinwald, who has been harvesting weeds for 20 years in Pewaukee Lake in Wisconsin, reports, "A 2000 foot channel, mechanically harvested for four years of heavy weed growth to open a public access tothe lake, did *not* require harvesting a fifth year, while the weed growth on either side of the channel was as dense as ever. A similar situation seems to have occurred in Rib Lake, Wisconsin, where after two years of harvesting, practically none was required the third year. Water clarity and fishing conditions have reportedly improved considerably." (3)

In an experiment begun in 1967, hyacinths were planted in a 2 acre, fenced-in area in a lake near Orlando. Within 6 weeks, the hyacinths had completely filled the area. Within 3 months, the weeds had removed the lake's pollution, reports the Florida Game and Fresh Water Fish Commission. (4) Should not harvesting of the hyacinth then remove the lake's pollution?

The nutrients in our waters show up visibly in the form of weeds and algae. A great deal of research is being done to locate some herbivore with a yen for aquatic weeds or a water flea with a voracious appetite for algae. But does this not beg the question? The successful location and transplanting of this manatee, flea, snail, or whatever, only removes the weeds from sight and transforms them into another form of nutrient on the bottom of the lake, or in solution, ready for another weed growth cycle. It might be argued that this is a better alternative than a solid, floating surface of hyacinth. But if we are successful in controlling the hyacinth without controlling the nutrients, nature will immediately fill the vacuum with elodea, milfoil, or worse.

In consideration of the nutrient problems, Professor A. D. Hasler, Director of the University of Wisconsin Limnology Department, ventured the following in "Natural History" magazine in November, 1968: "The best that can be said for spraying chemical poisons on lakes in the grip of algae and weeds is that it is usually a futile undertaking. Treating a lake with copper sulfate or other toxic chemicals is no more effective than taking aspirin for a brain tumor. It offers only temporary relief, masking the symptoms of cultural eutrophication. In the long run it makes a lake sicker. Poisoning algae and weeds simply accelerates the natural progess of growth, death, and decay, thereby freeing nutrients for another cycle of plant production." (5)

Perhaps the weed problem is so staggeringly massive that we must close our eyes to accelerated cultural eutrophication in exchange for making the weeds go away for awhile. Lacking a potential alternate solution might justify shunting the eutrophication problem into the laps of our children and grandchildren. But harvesting of weeds on a big scale can potentially let us eat our cake and have it, too: weed control plus nutrient removal.

A 3 year program to prove such a double benefit is presently underway at Detroit Lakes, Minnesota. Funded by $140,000, a joint venture of local groups, city and county governments, the Department of Interior, and the Minnesota Conservation Department, has purchased a harvester and is harvesting weeds in Lakes Sallie and Melissa, downstream from the Detroit Lakes sewage plant. It is their hope to remove more nutrients in the form of weeds in the summer months than flow into the lake in a year. A "Save the Lakes Symposium" on the Detroit Lakes' problems is scheduled in Detroit Lakes, Minnesota, for August 18 and 19, with, hopefully, some positive preliminary results.

HARVESTING COSTS

In November of 1968, the City of Maitland contracted with Aquamarine Corporation to harvest 20 acres of Florida elodea (*Hydrilla Verticillata*) as a demonstration of the new AQUA-TRIO system on Lake Maitland.

Demonstation

A 20 acre area of Florida elodea was selected in a bay of Lake Maitland, the acreage being determined from a scale map of the lake. The weeds had been at the surface for sometime and were densely packed in a layer 2 to 4 feet thick. The density of the weeds in the as-harvested condition (compacted by their own weight in a 3 foot deep pile) was measured at 10 lb./cu. ft. The average distance from the weeds to the lake access point from which the weeds were trucked away was 800 feet, one way. The average distance from the lake access point to the orange grove to which the weeds were trucked was 1200 ft., one way.

Equipment Used

The harvesting system used consisted of an AQUA-TRIO (one H-650 harvester, one T-650 transport and one S-650 short conveyor). This equipment is shown in Figure I. Note that the transport used the optional paddle wheels for propulsion instead of the outboard motors shown. One dump truck with a 14′ bed and 4′ sides was used to haul the weeds to the dump site. Three operators were required, one of them performing the dual function of starting and stopping the shore conveyor plus driving the truck. The harvester picked up weeds until it had 500 cu. ft. in its hold, on the average, at which point the transport received these weeds and transported them to the shore conveyor. The harvesting data is presented in Table I.

Harvesting Results

The amount of weeds harvested was 307.5 tons or 123 loads at 2.5 tons/load. The average weed concentration was 15.4 tons/surface acre of water. 171 man hours were expended, resulting in an average of 1.8 tons of weeds at the dump site per manhour. Dollar costs based on this performance is presented in Table 2.

Based on the above 1.8 tons per manhour, a 40 hour week produced 216 tons of weeds at a cost of $620.00. The

TABLE 1. Harvesting Production Figures on Florida Elodea in Lake Maitland, Florida.

Table 1

Date 1969	Transport Loads Harvested	Crew Harvesting Hours**	Loads Per Hour	Tons Per Crew Hour
11/13	9.5	5	1.9	4.8
11/14	11	6	1.8	4.5
11/15	16	7	2.3	5.8
11/16	4	1	2.9	7.3
11/18	12	4.5	2.7	6.8
11/19	4	1.5	2.7	6.8
11/20	6	3	2.0	5.0
11/21	11.5	6	1.9	4.8
11/22	15	6	2.5	6.3
11/23	22	6	3.7	9.3
11/25	2	2	1.0	2.5
11/26	3	2	1.5	3.8
11/27	9	7	1.3	3.3
	Total 123	Total 57	2.2 Average	5.5 Average

*Loads and times independently tabulated by K. Downey, City of of Maitland.

**Adjusted to account for down time, weather and demonstration delays.

cost per ton from the lake to dump site was $2.87. At 15.4 tons per acre, the cost per acre was $44.20.

CONCLUSIONS

Before extrapolating these costs into any other waters or weed infestations, adjustments must be made to allow for changes in labor rates, weight of harvested weed, average weight of unharvested weeds per acre of lake, distance of weeds to shore conveyor site, dump truck haul distance, and design of harvesting equipment.

Significant cost reductions may be expected as a study of Fig. 1 will show. Note that peak production was hit after the new operators became experienced in the capabilities of the system. On November 23, a rate of 9.3 tons per crew hour was achieved, or $1.69 per ton cost. The balance of the harvesting was largely cleanup work, reflecting lower production figures and higher costs. (a)

(a) In the interim between this report on the Lake Maitland demonstration and its being published, a harvesting operation using 2 new Aqua-Trios in Crystal River, Fla., has been harvesting at a rate of 200 tons/day.

REFERENCES CITED

1. Anonymous. January, 1969. Production Table, Commercial Fertilizer. 118 (1)
2. Seinwill, G. D. 1968. Mechanical Harvesting of Lake Weeds. University Industry Research Newsletter. University of Wisconsin. 3 (3) page 16-17.
3. Grinwald, M. E. June, 1968. Harvesting Aquatic Vegetation. Hyacinth Control Journal, Vol. 7, page 32.
4. Unpublished data.
5. Hasler, A. D. November, 1968. "Dwindling Lakes," Natural History magazine.

TABLE 2. Cost for Harvesting of a 20 Acre Area of Florida Elodea in Lake Maitland, Florida.

Description of Cost	Weekly Cost
1. Depreciation of AQUA-TRIO @ $44,000 acquisition cost (a) and a dump truck @ $3500 based on a 10 year life	$100.00
2. Interest at 10% on $47,500	$100.00
3. Labor of 3 man crew at $8/hr. for 40 hours	$320.00
4. Maintenance and running costs (est.)	$100.00
Weekly Cost	$620.00

(a) Manufactured by Aquamarine Corporation, Waukesha, Wisconsin.

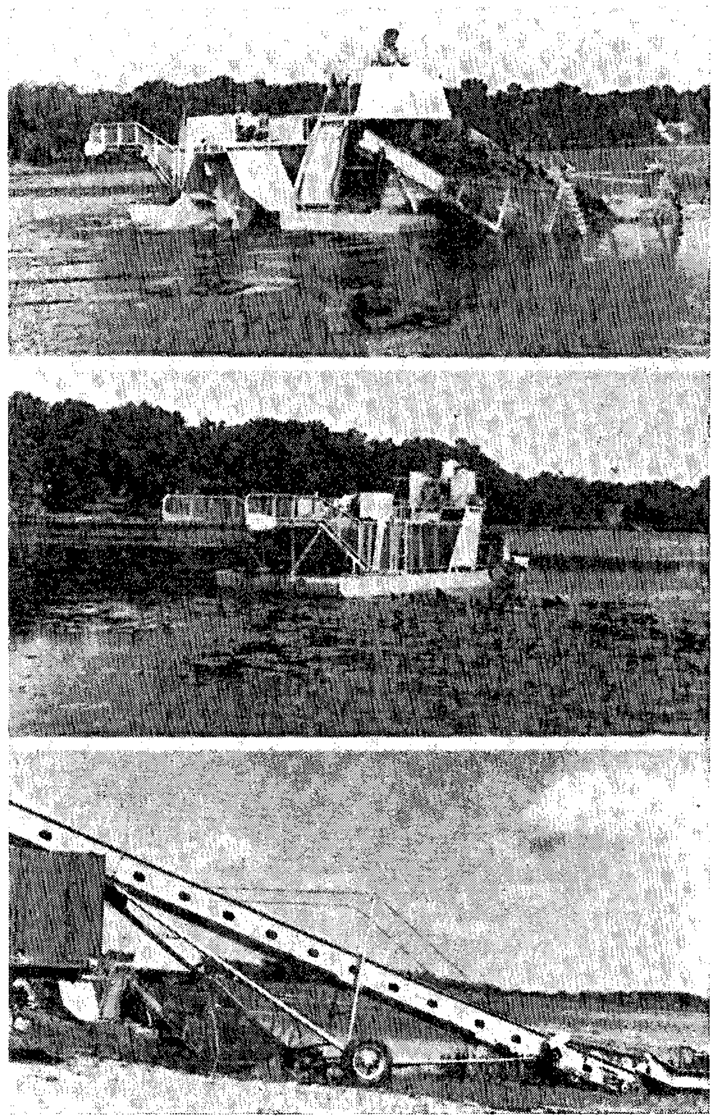

Figure 1—(Top) H-650 AQUA TRIO Harvester; (Middle) T-650 AQUA TRIO Transport; (Bottom) S-650 AQUA TRIO Shore Conveyor.