Table 1. Continued.

Lake	Center			Coon			Trout		
Year	1997	1998	1999	1997	1998	1999	1997	1998	1999
Species									
Largemouth bass	7	4	23	19	11	25	11	3	20
Black crappie	3	7	12	12	19	17	1	0	1
Bluegill	36	43	131	152	148	149	23	36	43
Redear sunfish	11	3	14	17	20	16	8	5	19
Longnose gar	0	0	1	1	0	0	0	1	0
Florida gar	27	53	12	29	43	19	31	21	0
Bowfin	4	0	3	1	4	3	0	3	36
Gizzard shad	3	0	0	7	1	9	0	0	4
Threadfin shad	0	0	4	3	0	0	1	0	8
Golden shiner	0	5	0	1	3	4	0	0	1
Taillight shiner	0	3	1	0	4	3	0	0	1
Lake chubsucker	0	4	1	9	4	1	3	5	0
Yellow bullhead	0	0	0	1	0	0	0	0	4
Brown bullhead	0	1	0	1	0	0	1	0	0
Channel catfish	1	1	0	5	0	1	0	0	0
Redfin pickerel	0	0	0	0	0	1	0	0	0
Chain pickerel	3	1	3	3	1	1	0	0	0
Atlantic needlefish	0	0	0	0	0	0	0	0	0
Golden topminnow	0	0	0	0	0	0	0	0	0
Seminole killifish	0	0	0	0	3	8	0	0	0
Brook silverside	1	1	5	0	0	3	1	1	1
Warmouth	5	7	12	4	8	11	4	11	12
Dollar sunfish	0	0	0	0	0	0	0	0	1
Spotted sunfish	0	0	0	0	0	0	1	0	0
TOTAL	101	133	222	265	269	271	85	86	151

Note: 15 min transects; Alligator Lake: 6 sites; lakes Gentry, Lizzie, Center, Coon and Trout: 3 sites (1 repetition); night shock.

Table 2. Summary of mean catch-per-unit-effort (fish/h) values for largemouth bass, bluegill and redear sunfish collected from transects in lakes Alligator, Gentry, Lizzie, Center, Coon, and Trout during spring 1999.

	Alligator	Gentry	Lizzie	Center	Coon	Trout
Largemouth bass						
Total	71	20	52	23	25	20
<201 mm	13	3	3	5	7	7
201-355 mm	49	16	47	12	11	13
>355 mm	5	1	3	5	8	0
>499 mm	1	0	0	0	0	0
>599 mm	0	0	0	0	0	0
Bluegill						
Total	110	84	48	131	149	43
<152 mm	91	75	44	124	145	40
>152 mm	19	9	4	7	4	3
Redear sunfish						
Total	36	0	28	14	16	19
<152 mm	14	0	13	7	9	7
>152 mm	22	0	15	7	7	12

Note: Three, 15-minute transects were performed at night in each lake, except Alligator Lake which had six.

Table 3. Average number and diversity of aquatic-oriented birds utilizing the Alligator Chain of Lakes from April through June 1999 (one survey/month).

Lake	Average number of species observed	(Range)	Average number of birds observed	(Range)
Alligator	14	(11-16)	155	(141-165)
Center	6	(5-7)	18	(13-25)
Coon	4	(3-5)	9	(4-16)
Lizzie	10	(7-13)	67	(29-75)
Trout	7	(5-9)	18	(11-24)

While samples from both lakes expressed specific conductance measurements higher than historical averages, no significant differences were detected for other monitored parameters (Table 4). In fact, both lakes continued to exhibit some of the lowest enrichment conditions of all lakes sampled within the Kissimmee River basin.

Table 4. Comparison of monthly averages (February/May 1999) and long-term averages for water quality parameters measured in water samples collected from Alligator Lake (February/May 1997-98) and Lake Gentry (February/May 1995-98)

	Alligator Lake		Lake Gentry	
Parameter	1999 Average	2-year Average	1999 Average	4-year Average
Station depth (m)	4.15	3.88	4.70	4.49
Secchi (m)	1.20	1.53	1.45	1.15
Field pH	6.00	5.85	6.35	5.81
Conductivity	111.00	104.00	176.50	133.38
Phenolphthalein alkalinity	0.00	0.00	0.00	0.00
Total alkalinity	12.50	6.33	11.50	9.00
Sulfate	11.00	9.63	13.50	11.19
Turbidity unfiltered	2.00	2.00	1.00	2.66
Calcium	2.45	3.00	5.30	6.29
Magnesium	2.65	2.85	4.00	3.49
Sodium	11.00	9.33	18.65	12.33
Potassium	2.90	2.88	3.55	2.41
Nitrate nitrogen	0.02	0.04	0.03	0.07
Ammonia nitrogen	0.08	0.08	0.06	0.14
Total organic nitrogen	0.56	0.50	0.69	0.60
Ortho phosphorus (as P)	0.01	0.01	0.01	0.01
Total phosphorus (as P)	0.05	0.05	0.03	0.04
Chlorophyll a (mg/m3)	2.65	3.40	0.65	4.40
Phaeophytin (mg/m3)	0.00	3.80	1.80	1.16

ATTACHMENT III

ATTACHMENT 3

Letter to the Editor

A global awareness is developing regarding the environmental and economic costs precipitated by invasive exotic plants and animals. Many states and foreign nations have begun the costly process of removing the most invasive exotics from public lands as a step toward restoring natural plant and animal diversities.

We in Florida should be proud of the leadership role we have played in waterhyacinth management. The maintenance control philosophy is being adopted by many groups just beginning invasive exotic plant and animal control programs. However, Florida's public lands have been invaded literally by hundreds of exotic plants and animals. Because the science of invasive exotic species impacts is so new, only a decade or so old, most Floridians do not understand or do not know that problems exist. We, as aquatic plant managers, must lead through education and by example to preserve the public waters entrusted to our care. We can no longer introduce invasive exotic species or allow these contaminants to expand for the benefit of special interest. We must balance all of the impacts, current and future, of our actions (or inactions) on the environment. There are still many who would trade future environmental and economic costs for the benefits created today by the invasive waterhyacinth and hydrilla. Most of our governmental leaders still do not understand the repercussions of inadequate funding to manage invasive exotics.

The wake-up alarm is poised to ring on October 1, 1994. During the past two years, the Cooperative Aquatic Plant Management Program has operated with a $9.0 million budget, more than $5.0 million of which was spent on hydrilla management each year. However even this level of funding was inadequate. Hydrilla expanded by 50% to cover 75,000 acres of public waterways in 1993. For fiscal year 1994-1995, the Legislature has authorized slightly less than $6.0 million for aquatic plant management.

Section 212.69(1) (a), Florida Statutes, mandates that the Department spend $1.0 million on melaleuca control each year. The average cost to control waterhyacinth and waterlettuce under the Cooperative Program over the past five years has been about $1.5 million. Minor plant control, to maintain boat trails and access points, cost an average $370,000 during the same period. If these estimated costs are deducted from the fiscal year 1994-1995 aquatic plant control budget, this would leave approximately $3.0 million for hydrilla control. In the annual report to the Governor and Cabinet, the Department estimated that nearly $10.0 million are needed for appropriate hydrilla management during fiscal year 1994-1995.

With this kind of funding gap, we anticipate that hydrilla will go untreated in many waterbodies until funding is significantly increased. In the meantime, we as managers of public waters should do all we can to keep hydrilla populations as low as possible and educate the public in the ultimate dangers of this invasive exotic plant. To do otherwise, would be both environmentally and economically irresponsible.

Jeff Schardt

Hallelujah!
It's summertime.
Photo of "Swimm'n hole on Santa Fe River"
by Nancy Allen

Aquatics

Summer 1994/Vol. 16, No. 2

CONTENTS

AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society Registration No. 1,579,647. This publication is intended to keep all interested parties informed on matters as they relate to aquatic plant management particularly in Florida. To become a member of FAPMS and receive the Society newsletter and Aquatics magazine, send $20.00 plus your mailing address to the Treasurer.

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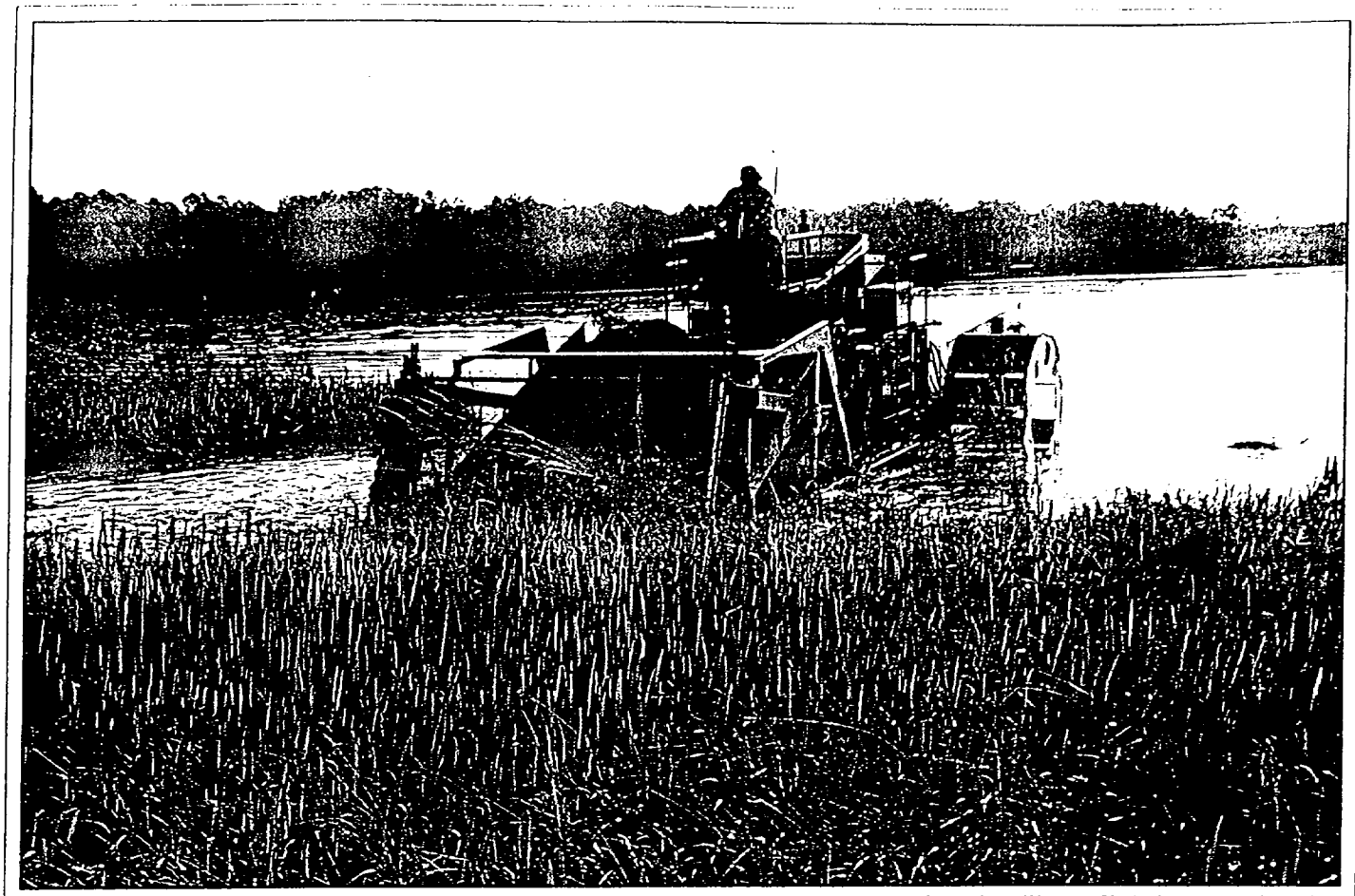

Figure 1. One of two Adirondock Inc. harvesters removing nine acres of tussocks from Coon Lake from the Alligator Chain in eastern Osceola County.

by
Bob Hujik
Florida Game and Freshwater Fish Commission
Kissimmee, Florida

Backround

The Alligator Chain of Lakes, located in eastern Osceola County, is made up of six lakes ranging in size from 225 acres (Coon Lake) to 5,100 acres (Alligator Lake). The Chain is connected by a series of canals, and water levels are regulated by the South Florida Water Management District (SFWMD).

Florida's rainfall pattern historically produced a wide range of water level fluctuations in the Alligator Chain. Aquatic plant and animal communities adapted to high- and low-water periods. Lake levels fluctuated as much as 7 feet on an annual basis. However, since implementation of flood control practices in the mid-1960's, annual lake level fluctuations have been strictly regulated within a 2 foot range. Restrictive water level fluctuation regimes have encouraged the growth of dense monotypic bands of pickerelweed (*Pontederia cordata*), cattail (*Typha* spp.), American cupscale grass (*Sacciolepis striata*) and burhead sedge (*Scirpus cubensis*). Most of the growth has occurred within the regulated low-pool stage of the lakes' shallow littoral zone. These bands of vegetation, referred to as tussocks, root in the loose bottom substrate at low-pool stage and float at higher lake stages. Tussocks impede water exchange in the shallow littoral areas, decrease habitat available for fish reproduction and interfere with other recreational uses. If the present water level schedule remains unchanged and/or nutrient loading as a result of development along the shoreline continues to increase, organic material and dense bands of vegetation will continue to build up around the lakes and severely impact productivity. The diversity and abundance of fish, invertebrates and aquatic plant communities in the Alligator Chain have already begun a slow decline. To determine if the trend could be reversed, an experimental aquatic plant harvesting/revegetation program was implemented in 1992 on lakes Coon

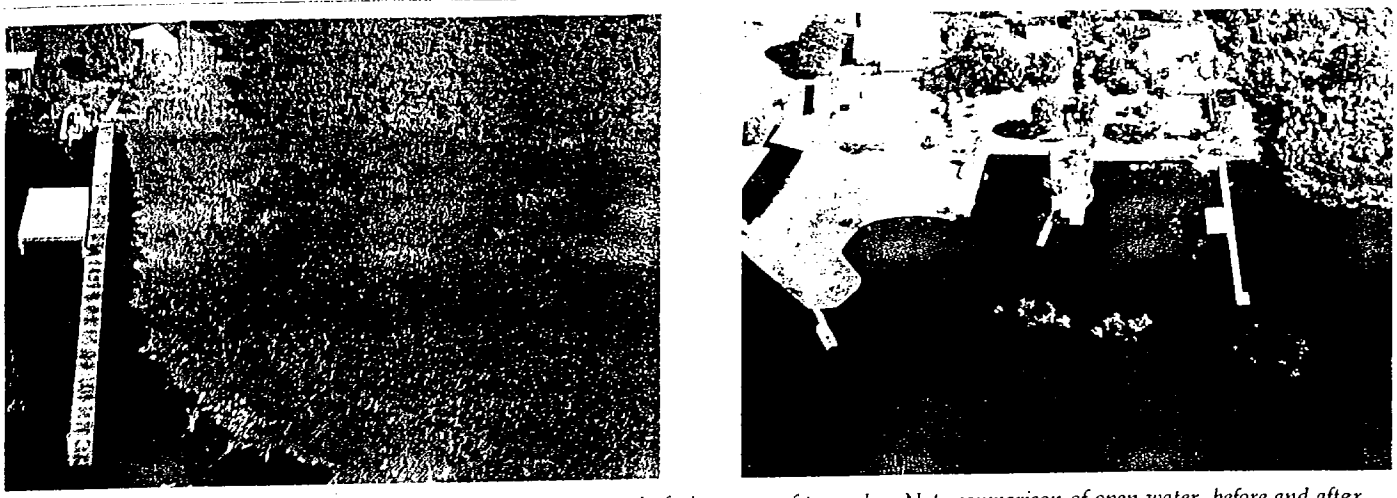

Figure 2. A portion of Coon Lake before (A) and after (B) removal of nine acres of tussocks. Note comparison of open water, before and after harvesting, in reference to dock.

and Center (600 acres) and continued during 1993 on Lake Center.

The 1992 Experimental Project

On 20 January 1992 Adirondack Harvesters Inc. began removing nine acres of floating tussocks from Coon Lake (Figure 1). The tussock band averaged 70 feet wide and encompassed three-quarters of the lake's shoreline. The tussocks were predominantly pickerelweed, burhead sedge, water primrose (*Ludwigia* spp.) and organic muck. Tussocks were removed with mechanical harvesters (one 8-foot and one 10-foot), off-loaded onto a 10-foot shore conveyor and trucked to adjacent upland disposal sites. A SFWMD canal bank and county right-of-way were used for disposal. The material was left to decompose. The mechanical harvesters were unable to work in water less than 2 feet deep therefore, harvesting was done when lake levels were at high-pool stage (64 ft msl) so the maximum amount of tussock material could be removed. Crews worked 7 days/week and were rotated weekly to complete this part of the project by 23 March 1992 (Figure 2).

On 24 March 1992, harvesting began on a 5-acre section of Lake Center. Since lakes Coon and Center are connected by a canal, only part of a day was used to move equipment to Lake Center. Tussocks at the new site consisted mainly of burhead sedge, American cupscale grass, water primrose and cattail, the average width of this tussock band was 150 feet.

The Florida Game and Fresh Water Fish Commission (GFC) and SFWMD cost shared $100,000 for the experimental project. Two homeowners on Coon Lake provided funding to Adirondack Harvesters Inc. for 0.1 acres of tussocks to be removed in front of their residences. In addition, ten lakefront property owners payed Adirondack Harvesters Inc. to harvest approximately one acre of tussocks at a cost of $1,000. All work was completed by 11 April 1992.

No noxious plant regrowth was observed on the restored areas of either lake one year after mechanical harvesting. Since it took 15 to 20 years of stabilized water levels for the tussocks to form, regrowth should not be apparent one year later. However, small areas of sparse maidencane (*Panicum hemitomon*) and spatterdock (*Nuphar luteum*) have regrown on the restored areas. Apparently the tussocks were supressing the growth of those plants. Cattails, that were cut off a maximum of 12 inches above the lake bottom, showed no new growth. Bottom organic sediments that measured up to 12 inches deep after removal, were only 0.5 inches to 3 inches in depth one year later. It appears that wave action in harvested littoral areas flushed the sediments lakeward, leaving hard sandy substrate behind.

Cost per acre estimates averaged $9,300/acre for Coon Lake and $3,700/acre for Lake Center. Lower cost estimates for Lake Center were primarily due to the shorter travel distance between the work site and the shoreline conveyor. The physical density of the tussock directly influenced the cost per acre. The burhead sedge/American cupscale grass tussocks on Lake Center were less dense and much easier to harvest than the pickerelweed tussocks on Coon Lake.

In June 1992, project personnel planted 2,200 giant bulrush on the restored areas of Coon Lake (2,000 plants) and Lake Center (200 plants). An additional 200 bulrush plants were given to the Alligator Chain Homeowners Association to be planted throughout the Chain. All bulrush showed signs of regrowth, averaging three stems of new growth per planted stem. Some plants had as many as 14 new stems of growth.

The 1993 Aquatic Plant Harvesting Project

On January 11, 1993, Adirondack Harvesters Inc. again began removing 19 acres of floating tussocks from Lake Center. A total funding package of $135,000 from the GFC and SFWMD was allocated for the project. Three harvesters were used (one 8-foot and two 10-footers) instead of two to increase the rate of removal. Harvesting procedures were the same as described in the 1992 project. Disposal sites within

one mile of the off-loading site were difficult to find. An area of pine/oak scrub was finally located and used. The tussock band (150 ft wide) was comprised of burhead sedge, water primrose and pickerelweed that were rooted in floating organic muck. Cattail, which was rooted to the bottom, and American cupscale grass, which was floating, formed the outside edge of the tussock. The project was completed 18 March 1993.

Areas of sparse spatterdock and maidencane have regrown on these restored area. Again, as on Coon Lake, the growth of these native vegetation types was suppressed by the tussock. No regrowth of the cattails was observed. The roots were examined in the field and appeared dead. A major wind storm, that moved through Central Florida on 13 March 1993, pushed organic bottom material from the restored areas on to dry ground, thus bottom sediment depths averaged only 2 inches.

. Cost estimates to harvest tussocks averaged $5,200/acre, almost 30% higher than the 1992 Lake Center estimates ($3,700/acre). The higher cost estimate was primarily due to the fact that some work sites were on the opposite side of Lake Center; approximately 0.75 to 1 mile from the shoreline conveyor.

In July 1993, an additional 2,200 bulrush plants were planted on Lake Center and 300 more on Coon Lake by GFC and SFWMD personnel. Also, 250 bulrush plants were given to the Alligator Chain Homeowners Association to be planted throughout the Chain. During August 1993, 150 eel-grass (*Vallisneria* spp.) plants were planted on a restored area in Coon Lake. This area was marked and will be monitored to determine growth.

Parameters such as water quality, dissolved oxygen and sediment depths are being analyzed quarterly. Annual fish and vegetation surveys are also being conducted. This information will help evaluate the success of the project.

Conclusions

Several factors such as proximity of off-loading sites to work sites, areas for disposal and time allowed for mechanical failure impact cost of harvesting operations. Off-loading sites close (< 1 mile) to the work site will keep project costs down. It was noted that during 1993 costs on Lake Center were much higher because of longer travel distance. It is important to locate off-loading areas that are deep enough (≥ 3 ft) for the harvesters to maneuver up to the conveyor. Easy access areas where the water gets deep quickly, such as boat ramps or canal banks, work well.

Finding upland disposal areas close to the off-loading site for the tussock material is also important. In rural areas, owners of large parcels of land were targeted. Many landowners did not want tussock material on their properties even though it reduces 50% by volume during the first year of drying. In metropolitan areas, landfills and/or areas specifically designated by the city or county could be used.

Finally, each project was hampered by mechanical breakdowns. At least two weeks were lost during each project because of mechanical failures.

Harvesting is a very practical lake restoration technique in smaller systems where travel time can be kept to a minimum. Future projects will depend on the availability of nearby disposal sites and funding. While drawdown/muck removal operations are less expensive than harvesting ($2,000/acre vs. $6,000/acre), it is often unfeasible or impossible to implement drawdowns when and where they are needed.