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Replacement of Hydrilla by Other Aquatic Plants in A Pond with Emphasis on Growth of American Lotus[1]

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INTRODUCTION

Many times the attempt to control one weed results in the growth and eventual takeover by another weed or re-infestation by the target species. In an aquatic environment, a desirable situation would be one in which noxious weed species are controlled and replaced with aquatic plants possessing characteristics compatible with the desired use of the particular body of water.

The ability of hydrilla (*Hydrilla verticillata* Royle) to colonize and dominate a body of water is well-known (1, 4). Removal of this weed generally results in rapid regrowth of this plant to the exclusion of other aquatic plant species. Under certain conditions the grass carp (*Ctenopharyngodon idella* Val.) will prevent regrowth of hydrilla allowing other aquatic plants to become established and grow.[2] This study was conducted to provide additional information on growth and colonization of various plants in a small pond

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[2]Sutton, D. L., V. V. Vandiver, Jr., R. S. Hestand and W. W. Miley, II. 1979. Use of the grass carp for control of hydrilla in small ponds. Proceedings of the Grass Carp Conference, Gainesville, FL. Jan. 1978. J. V. Shireman, editor. p. 91-102.

where the grass carp was used to prevent regrowth of hydrilla.

METHODS AND MATERIALS

The Vo-Ag pond, an ornamental body of water in Clearwater, Florida with a surface area of 0.25 ha and maximum depth of 1 m was selected for study. The initial control of hydrilla in this pond using 19 grass carp (96 fish/ha) was reported earlier (Sutton, et al., 1979). Upon completion of that study these fish were removed and four grass carp averaging 3.6 kg each were placed in the pond on 16 January 1978 to control regrowth of hydrilla. These fish remained in the pond for the duration of the study. Predominant indigenous plants were cattails (*Typha* sp.) and torpedograss (*Panicum repens* L.). Cattails were restricted to one area of the pond by manually cutting in November 1978; the regrowth was cut again in January, March, and May of 1979. No further cuttings were necessary to maintain the cattails in the desired area. In September 1978 N-(phosphonomethyl)glycine (glyphosate) was applied once to the periphery of the pond to evaluate control of marginal plants, primarily water pennywort (*Hydrocotyl umbellata* L.), torpedograss and other grasses.

Nine aquatic plant species were selected for planting based on their ornamental or fisheries habitat values (3). Several individual plants of the following species were planted in Vo-Ag pond on 4 April 1978: sedge (*Carex* sp.); American lotus (*Nelumbo lutea* (Willd.) Pers.); white waterlily (*Nymphaea odorata* Ait.) pickerelweed (*Pontedaria lanceolata* Nutt.); mermaidweed (*Proserpinaca palustris* L. var. *palustris*); arrowhead (*Sagittaria lancifolia* L.); wapato (*S. latifolia* Willd.) and tapegrass (*Vallisneria americana* Michx.) (2, 5). Prairie iris (*Iris hexagona* var. *savannarum* (Small) Foster) was introduced in March 1979. American lotus seeds had been prepared for germination by scarifying the seed coat with a metal file and allowing seeds to imbibe water for 3 days. Germinated American lotus seeds and vegetative material of the remaining eight species had been planted in pans with a soil-sand mix and cultured in plastic-lined pools at the Fort Lauderdale Agricultural Research and Education Center prior to their transfer to the Vo-Ag pond (Figure 1).

Regrowth of hydrilla was monitored along two, 52 m long transect lines at 2-m intervals bimonthly for 2 years and quarterly for 1 year (cf. Figure 1). Observations for growth of the introduced and indigenous species were also conducted during these time intervals. Values for percent surface coverage of the pond by American lotus were made by visual estimation. The water level had decreased during November 1978 exposing the white waterlilly, pickerelweed, arrowhead, and wapato, and these were transplanted to deeper water at this time. In March 1979 mermaidweed and tapegrass were replanted.

American lotus was harvested twice in 1979 during August and September and once in October 1980 to reduce the abundance of plant material in the pond. The harvests in 1979 were accomplished by cutting the plants at the base with machetes and the plants were collected for biomass

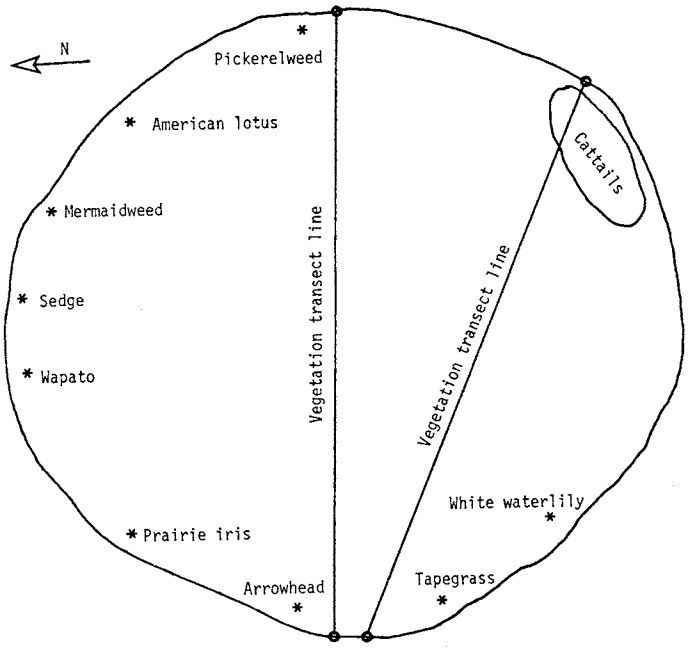

Figure 1. Planting diagram of Vo-Ag Pond.

estimates. A CHUB[3] mechanical harvester was used for the third cutting. Representative subsamples of harvested plant material were dried at 60 C for estimates of dry weight.

RESULTS AND DISCUSSION

American lotus became the dominant plant of the nine species introduced into the Vo-Ag pond during the study period of April 1978 to June 1981. White waterlily became established and remained in an area approximately 2 m by 3 m located opposite the original planting of the American lotus. Individual plants of arrowhead and pickerelweed were noted sporadically during the 3 years in locations other than where they were originally planted. The sedge was not seen following the original planting; wapato was not seen following the November 1978 transplant; mermaidweed was not seen after May 1979; tapegrass was not seen after July 1979; and the prairie iris was seen sporadically following initial planting in March 1979.

American lotus became well established by November 1978, 8 months after being planted, and covered 20% of the surface area of the pond. By March 1979, American lotus declined to 1% then increased to 30% coverage by May 1979. The plants were flowering at this latter time and the leaves were 0.6 m in diameter. By July 1979 the plants had proliferated to such an extent that they covered 85% of the pond surface area and existed as two distinct stories—emergent and floating. The upper story was 1.0 to 1.5 m above the water, and consisted of leaves, flowers, and seed heads with the latter two comprising about 35% of this layer. The lower story consisted mainly of floating leaves. Plant growth was dense to the waters' edge and

[3]Registered trademark of Aquamarine Corporation. Mention of a trademark name or a proprietary product does not constitute a guarantee or warranty of the product by the University of Florida and does not imply its approval to the exclusion of other products that also may be suitable.

some terrestrial growth was present. In August 1979, the American lotus covered 95% of the surface with a significant increase in density and an abundance of flowers and seed heads. Plants were removed in August 1979 leaving 35% surface coverage. This harvest resulted in an estimated dry weight of 1,246 kg/ha. By mid-September, 1 month later, the American lotus had regrown and occupied 90% of the surface. Plants were again removed with 10% being left on the pond periphery. The amount of plant material removed during this harvest was estimated at 724 kg dry plant material per ha. American lotus was dormant until March 1980 and occupied less than 5% of the surface of the pond but by June the plants increased to 50% coverage. At the time of the October 1980 harvest American lotus densely covered 95% of the pond and plants exhibited late stages of flowering with many seed heads. The amount of plants harvested was estimated at 2,071 kg/ha dry weight. After the harvest less than 5% of the pond was covered with American lotus plants. By June 1981 the American lotus had attained a surface coverage of 85% but the density appeared less than during the previous observations.

Among indigenous plants in the pond, cattails and torpedograss were the most prominent. Water pennywort and bacopa (*Bacopa monnieri* L.) were intermixed with the torpedograss. Cattails remained in one area of the pond following four manual cuttings beginning November 1978 and no further maintenance was necessary after the May 1979 cutting. By July 1979 the American lotus had extended to the fringe areas of the cattails. Torpedograss did not appear to grow as densely following expansion of the American lotus. Little effect was noticed on growth of the torpedograss following the single herbicide treatment.

The grass carp appeared to be effective in controlling regrowth of hydrilla since no hydrilla plants were ever seen along the transect lines, and only a few sprigs were seen once at the pond margin during a period of low water in November 1978. The prolific growth of the American lotus may have served as an additional influence in preventing regrowth of hydrilla. American lotus may have contributed to the lack of expansion of most of the other introduced aquatic plants by effective interspecific competition. However, in the case of tapegrass, grazing by the grass carp could have placed an additional stress on the plants.

The quantity of plant production at a particular site is influenced by the effect of physical, chemical, and biological environmental factors on the species present. Nutrient levels, temperature variation and selective elimination of certain species through aquatic weed control measures, directly effect the plant communities in aquatic ecosystems. This study demonstrates the feasibility of reducing the competitive advantage of certain weed species (in this situation by using grass carp to remove and prevent regrowth of hydrilla) thus allowing other plants to become established. It indicates that it is possible to take an active role in shifting plant communities in enclosed bodies of water. However, it also shows that care must be exercised in plant selection as other aquatic plants may grow as prolifically as the original weed species which was controlled.

More work is needed in researching such concepts as interspecific competition among plants under controlled situations where it is desired to shift plant communities to include desirable species compatible with the intended use of the particular body of water. However, continual management may be necessary to maintain the desired species composition balance.

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