THE USE OF GRASS CARP FOR SUBMERGED WEED CONTROL

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Summary

A 1.72 ha sand dune lake was stocked with grass carp (*Ctenopharyngodon idella*) to control egeria (*Egeria densa*). Techniques for measuring weed growth and biomass have been developed. Selective feeding by grass carp was clearly demonstrated at a low stocking density.

INTRODUCTION

Herbivores are uncommon in freshwater environments and grass carp are one of the few potential candidates for biological weed control. The species is a fast swimming, shoaling fish which can grow to a large size. Grass carp have been a cultivated food fish in Asia for at least 800 years but their use as weed control agents has only recently been considered (Prowse 1969). Grass carp were imported into New Zealand on three occasions. In 1966 and 1968 by Auckland University and in 1971 by the Ministry of Agriculture and Fisheries (Edward and Hine 1974). All surviving fish are now held at the Fisheries Research ponds at Rotorua or in two isolated experimental situations.

Parkinsons Lake is the site of an experiment to assess the impact of grass carp on a lake ecosystem. The lake has an area of 1.72 ha and is near to the North Island coast west of Waiuku. Kirk (1870) recorded *Limosella aquatica*, azolla (*Azolla rubra*) and the common european watercress (*Nasturtium* sp) from the margins of shallow sand lakes in this area. Cunningham *et al* (1953), found the submerged vegetation of nearby lakes to be dominated by *Chara* and *Potamogeton* spp.

Egeria was placed in the lake as a source of cover or food for trout prey during the early sixties and is now the dominant plant. Stands of the rush (*Eleocharis sphacelata*) form a dense border around most of the lake which is a highly eutrophic body of water. Stratification and total deoxygenation of the bottom water occurs during the summer. Algal blooms and sheets of blue green algae give the lake a turbid, uninviting appearance. Weed beds are exposed during periods of low lake levels and become covered in filamentous green algae. As this lake is now considered of little value by trout fishermen it was agreed by the Auckland Acclimatisation Society that it could be used for a series of experiments with grass carp.

METHODS

The lake was divided by a 60 x 7 m barrier of 1 cm² nylon mesh in August 1976. Grass carp were stocked in the main body of the lake

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(1.36 ha) to a final density of 22 fish/ha in January 1977 (See Figs. 2 and 3). This is lower than the stocking density of 50-100 fish/ha recommended for fisheries waters by Vinogradov and Zolotava (1974). However, Terrell and Terrell (1975) recorded a 79% reduction in *Eleocharis* sp one year after stocking 4 fish/ha.

Plant growth was measured by monthly vegetation transects. Weed height and water depth were recorded at 1 m intervals across the lake. This enabled profiles showing the weed and bottom contours to be plotted (Fig. 1). The proportion of weed occupying the profile between the outer limits of the rush beds and the lower depth limit of the egeria was then estimated by plane planimetry and expressed as a percentage (Fig. 2). On one occasion, biomass samples were collected as the height of the weed was measured. Chlorophyll *a* levels were measured from monthly water samples by the method of Strickland and Parsons (1968).

FIG 1. TRANSECT PROFILES

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RESULTS

A graph of weed profiles showed a rapid decline in the weed stands during the autumn with a slow regrowth over the following year. Chlorophyll *a* levels in the water appeared to be inversely-related to the growth of egeria (Fig. 2). Variation between the control and experimental areas did not appear to be significant. The correlation coefficient for the height of weed against biomass was $r = 0.44$. Separation of the data into 1-2, 2-3, 3-4 and 4-5 m depth categories gave r values of -0.08 , 0.66 , 0.32 and 0.68 respectively. The three orders of magnitude difference between the 1-2 m samples and the remainder indicates that the shallow water samples were in some way different. This relationship will be investigated. In addition, by April 1977, the rush had disappeared in a strip 3-4 m wide along the lakeward margin of the stands in the stocked portion of the lake. The deepest stalks were in water 0.75 m shallower than the pre-stocking margin (Fig. 3). Old rootstocks were still present in the bottom mud in this strip but regrowth was not apparent.

Grass carp excreta collected from the lake were largely composed of rush fibers and septa.

DISCUSSION AND CONCLUSIONS

These initial results indicate that grass carp are selective feeders and that egeria, a dominant submerged plant in highly eutrophic waters, has a lower palatability than the rush. Cattle exhibit a similar preference by browsing the rush in water from 0.5 m deep shorewards. Floating and stranded masses of egeria are ignored. Weed preference trials (Edwards 1973) ranked egeria 12 out of 14 species. This low consumption rate may be due to factors other than taste alone as Stanley (1974), reported a negative nitrogen balance for grass carp fed solely on winter egeria. The fish have been used to control regrowth of mown rush stands as they will browse on young growing shoots (Vinogradov and Zolotava 1974). Loss of air and penetration

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of water into the lacunal spaces of the rootstock then destroys the plant (B. Coffey, pers comm).

This preliminary experiment has been used to test techniques and to show the effects of low stocking rates. It can be concluded that a substantial increase in stocking density is required to ensure an impact on the submerged weeds. Stepwise stocking and removal will elucidate the fish numbers required to achieve a desirable and predictable level of weed control.

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