J. Aquat. Plant Manage. 25: 63-64

NOTES

WATERHYACINTH CONTROL BY NATURAL WATER LEVEL FLUCTUATIONS IN BYRAMANGALA RESERVOIR, INDIA

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INTRODUCTION

The spread of waterhyacinth (*Eichhornia crassipes* (Mart.) Solms.) throughout the world, especially in tropical countries including India, outside its original habitat, is one of the major ecological disasters of the century and perhaps no other aquatic weed is receiving as much attention and notice. Unlike in South America to which the plant is endemic and where natural enemies keep it under check, in other regions the absence of such controlling forces coupled with favourable conditions have encouraged its alarming proliferation.

Measures such as manual removal, mechanical harvesting, chemical and biological control and integrated practices have been effective in varying degrees in management of waterhyacinth. The plant in the wild always remains as a source of regrowth and sudden population explosions have frustrated attempts of its control. The high water content ($\simeq$ 95%) makes physical removal of the plant uneconomical, although it is still the most acceptable form of control in many countries, not withstanding increased labour costs and shortages. Mechanical harvesting of waterhyacinth is not widely practiced in developing countries like India on account of escalation of costs of equipment, fuel and maintenance. Chemical control by herbicidal sprays are quite effective, economical and energy saving. However, the constraints of environmental safety, operational problems and monitoring facilities have restricted its wider adoption. Biological control by phytophagous insects, a recent ecological management tool, is still in developing stages and may take several years for the impact to be felt (1). A case of how natural drawdown and sudden flooding brought about the control of waterhyacinth in the tropical Byramangala reservoir in Karnataka State, India, while studying the role of the plants in the abatement of pollution through the uptake of heavy metals, pesticides and detergents discharged into the reservoir by several industries in Bangalore is reported in this communication.

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CASE STUDY AND DISCUSSION

In January 1985 Byramangala reservoir (area: 412 ha; latitude: 12° 47′ N; longitude: 77° 20′ E) 38 km from Bangalore was heavily chocked with waterhyacinth and was highly polluted. Water qualities (Table 1) reflect chronic anoxic conditions, harmful to aquatic life including fish, since the plant covered the surface completely, excepting for a few pockets of open water. The growth of weeds obstructed light penetration and exchange of gases and affected other ecological conditions, causing heavy siltation by entrapment of solids, root sloughing and decay of plants, which in a living waterhyacinth infestation is estimated to be up to 4.8 t dry weight ha^{-1} (3). The offensive odour, tainting of water colour and reduction in water surface restricted the irrigation potential, recreational facilities and fishery exploitation of the reservoir, as also hampered the fish seed production in the farm below, fed by it.

TABLE 1. WATER QUALITY OF BYRAMANGALA RESERVOIR IN JANUARY 1985 ($\bar{x}$ VALUES IN mg l^{-1}; n=3) UNDER DENSE WATERHYACINTH INFESTATIONS.

Water qualities	Concentration
Colour*	Brownish
Turbidity	<100
pH*	7.5
Dissolved oxygen	1.0
Phenolphthalein alkalinity	Nil
Total alkalinity	304.0
Hardness	230.0
Specific conductivity (μ mhos cm^{-2})	95.0
Ammonical nitrogen	16.0
Total nitrogen	27.0
Organic nitrogen	11.0
Chemical oxygen demand	88.0
Biological oxygen demand	7.0
Chlorides	164.0
Fluorides	0.6
Calcium (calcium carbonate)	44.0
Magnesium (magnesium carbonate)	29.0
Iron	0.6
Sodium	0.14
Manganese	0.10
Zinc	0.20
Lead	0.10

*not expressed in units.

The water level was above 1 m in the deepest regions of the reservoir in November 1985 and about 70% of the surface area was infested with waterhyacinth. The highly polluted nature of water was characterized by foul smell, practically no plankton life and scarce fish food organisms. The water area shrank to less than 20% in February 1986 because of the prevailing drought conditions, with scattered shallow water pools holding medium and large lush green weeds near the inlet, in the mid-reservoir and outlet zones. The exposed basin of the reservoir with dried, stranded or buried plants was extensive. The local people burned dried plants at several places and grazing by cattle also damaged them.

Fairly good pre-monsoon rains received in May 1986 gradually filled the reservoir to a mean depth of about 1 m, covering over 80% of the area. In spite of the partial destruction of the plants by burning and grazing, the rooted plants grew rapidly in the shallow, nutrient rich, polluted water and the mean weight of individual plants increased from 300 g in February to 560 g in May. Due to the increased water area, the plants were not densely packed and the biomass was less (45 plants/25 kg as against 146 plants/61 kg fresh weight m^{-2} in February).

A rapid swelling of the reservoir due to rains in June and July, discharges through breakway channels and from the main Vrishabhavathi river on which the reservoir is built, prevented the plants from rising above the water, since they were mostly rooted and devoid of the normal buoyant leaf stalks. The reservoir was almost free of the weed by August with a clear water surface and nearly full, with a mean depth of about 10 m. There was no overflow from the spillway from where annually at least 20 to 30% of the plants are flushed out during the monsoon. It is remarkable how a massive infestation of such proportions was subverted by natural forces. The water level fluctuations caused by nature from the near drawdown to the flooding condition fully vindicated the modern concept of water management in control of weeds in large reservoirs (4), and the present observation appears to be the first instance of such control of waterhyacinth.

The ecological regeneration of the reservoir after the disappearance of waterhyacinth and its changed complexion was evident from the increased turbidity due to flushing of suspended particles from the catchment area and the fastly developing bloom of *Microcystis aeruginosa*. These factors apparently contributed to the rapid decay of the underlying plants, the rate of decomposition of living mats of waterhyacinth under anaerobic conditions being relatively slow (2). In addition, other changes in hydrobiological conditions of the reservoir were also listed. Dissolved oxygen content of the water naturally increased ($\bar{x}$ 8.5 mg l^{-1}) and plankton, which was almost absent in the earlier weed infested condition, developed again and settling in the range 1.1 to 1.6 ml l^{-1} by volume and 1,141 to 2,463 l^{-1} by number. Phytoplankters associated with the bloom of *M. aeruginosa* were *Spirulina* spp., *Ulothrix* sp., *Oedogonium* sp., *Pinnularia* sp. and *Navicula* sp. The zooplankters consisted mainly of rotifers, cladocerans and copepods.

Since the reservoir is likely to go through cyclic water level fluctuations, waterhyacinth being a highly viable plant and the reservoir a sink for pollutants, the problem may soon reappear. However, by proper management and maintenance through periodic removal of weeds before they go out of hand, the reservoir could be kept free from the weed menace, taking off from the present position.

ACKNOWLEDGEMENT

Authors are grateful to Dr. A. G. Jhingran, Director, Central Inland Fisheries Research Institute, Barrackpore, West Bengal, India for the interest shown in the work.

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