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Biological Control of Water Lettuce in Various Impoundments of Zimbabwe

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ABSTRACT

An initial colony of 150 *Neohydronomus affinis* (Hustache) was imported from Australia in September, 1987. Between 1988 and 1991, about 8,000 *N. affinis* were released in five localities in northern Zimbabwe. Monitoring of water impoundments revealed that *N. affinis* caused severe damage and death of water lettuce plants through feeding scars caused by adults on growing shoots and mines by larvae on leaves. In less than ten months of initial releases, the populations of *N. affinis* reached 18 insects per plant and the reduction in water lettuce permitted water hyacinth and other macrophytes to fill the vacant niche, particularly on the Manyame River system. However, in four other localities, where only water lettuce was a problem, more than 85% of the water area became free from water lettuce. *N. affinis* populations decreased from 18 to 2 per plant and at the same time water lettuce populations and plant size were reduced.

Key words: *Pistia stratiotes*, Water hyacinth, *Neohydronomus affinis*, Nile cabbage, *Polygonum*, *Myriophyllum*.

INTRODUCTION

Water lettuce or Nile Cabbage (*Pistia stratiotes L.*) has a wide distribution in the tropical and sub-tropical world. In Africa, water lettuce is reported to occur in South Africa, Botswana, Namibia, Zimbabwe, Zambia, Tanzania, Malawi, Kenya, Uganda, Nigeria, Cote d'Ivoire, Ghana and Senegal (Mulligan 1974, Cilliers 1987, deGraft-Johnson 1988, Sharma and Edem 1988, Cilliers 1991, Chikwenhere and Forno 1991, Harley 1993).

In Zimbabwe, water lettuce was first observed on the Mukuvisi River near Harare in 1937, and 50 years later, has become the major water weed in northern Zimbabwe. By the end of 1988, water lettuce had spread over the entire Manyame River system (formerly Hunyani River) Seke and Manyame (formerly Prince Edward and Darwendale) dams, Lake Chivero (formerly Lake Mcllwaine), Chakoma, Chivake and Kaitano dams, Nyadiri River, Lake Kariba and its tributaries the Sanyati and Gachegache Rivers. Water lettuce is increasing rapidly in Africa mainly through vegetative reproduction in rivers, dams, lakes, lagoons and other water bodies (Sculthorpe 1967, Harley 1991) and is abundant in the Volta Ghana and in Lake "A" Yame Cote d' Ivoire (Mulligan 1974), Letaba River, Kruger National Park South Africa (Cilliers 1987) and Lake Chivero Zimbabwe (Chikwenhere and Forno 1991) Water lettuce in tropical Africa is an important habitat for mosquito borne malaria diseases (Mulligan 1974) and it destroys water resources by forming vast mats capable of choking water and eventually drying water impoundments (deGraft-Johnson 1988).

Water lettuce is second to water hyacinth (*Eichhornia crassipes* (Martus) Solms-Laubach) in importance as an aquatic weed problem in Zimbabwe. The two weeds are becoming serious pests in several of Zimbabwe's wetland areas which contain unique flora and fauna. The long dry-season (April-October) has necessitated construction of several impoundments in many areas for water storage for domestic use and irrigation. However, the constant infestation of the impoundments by floating aquatic weeds have negative implications on the country's future economy which depends mainly on agriculture. In the event of water weed outbreak in the reservoirs, safe and environmentally friendly control methods are being encouraged. Consequently biological control of water lettuce by *N. affinis* commenced in Zimbabwe in 1987 (Chikwenhere and Forno 1991). Good biological control of the weed at five localities of northern Zimbabwe where water lettuce was once a serious problem is described.

MATERIALS AND METHODS

From September 1988 to December 1991, a total of 8,000 adults, pupae and larvae of *N. affinis* were released on water lettuce plants of Manyame River upstream of Lake Chivero (80 ha), Lake Chivero (450 ha), Chakoma (2.6 ha), Chivake River (16 ha) and Kaitano reservoirs (1.75 ha) (Table 1). The last three reservoirs were on different streams which had little water flow. Further, at these impoundments water hyacinth was absent, and there was minimal mechanical disturbances by livestock and human activity.

Parameters measured in all study areas were; leaf area, root length, number of plants per m^2 and number of damaged plants due to *N. affinis* attack. A total of 30 infested plants were randomly collected every 1-2 months from each site where *N. affinis* was released and placed in 20 litre plastic containers. The mouth of each container was covered with a fine mesh containers were transported to the laboratory for evaluation. Four mature leaves per plant were measured using a portable leaf area meter (LI-3000) and a ruler was used to measure root length and plants per m^2 were counted. Daughter plants which had not yet developed roots were not considered as individual plants.

At Lake Chivero, more detailed studies were carried out and in addition to above measurements, data was also collected on number of daughter plants per m^2, mean number of adult weevils per plant and number of active

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TABLE 1. RELEASE SITES AND AREA OF WATER LETTUCE CONTROLLED BY *N. AFFINIS* IN ZIMBABWE.

Site (area)	Month/year released	Area of water covered by water lettuce (%)	Time taken to control (months)	Reduction in water lettuce infestation (%)
Manyame River (80) (ha)	Sept/88	10	11	90
Lake Chivero (450 ha)	Dec/88	5	13	80
Chivake Dam (16.0 ha)	Mar/89	10	8	95
Chakoma Dam (1.75 ha)	Jan/90	15	15	85
Kaitano Dam	Dec/91	30	11	95

TABLE 2. EFFECT OF *NEOHYDRONOMUS AFFINIS* ON WATER LETTUCE GROWTH AT A SITE ON MANYAME RIVER UPSTREAM LAKE CHIVERO.

Date	Plant density (No./m²)	Leaf area (cm²/plant)	No. damaged plants (m²)	Root length (cm)
Apr/88	110	90	0	50
Jun/88	101	46	57	50
Jul/88	113	44	101	52
Oct/88	130	31	130	26
Feb/88	96	15	96	15
Apr/90	11	7	9	9
Mar/90	4	5	4	8
Jan/91	20	2	3	6

larval mines on leaves per plant. The number of plants which were randomly sampled remained the same as above, but for this study measurements were taken once per fortnight.

RESULTS AND DISCUSSION

N. affinis became established at all the study impoundments 4 to 7 months after the first releases. Many plants were severely damaged by adults and larvae causing the plant to rot and sink. The size of daughter plants was also greatly reduced. The weevil took between 8 to 15 months to reduce the water lettuce infestation by 80% or more at all sites. The area covered by water lettuce prior to insect releases in respect to the area in each impoundment was; Chakoma 15%, Chivake 10%, Kaitano 30%, Manyame River 10% and Lake Chivero 5% (Table 1).

At a site on the Manyame River upstream of Lake Chivero there was a dramatic reduction in leaf area, root length and number of plants per m² (Table 1). Continued detailed monitoring at the above locality revealed that *N. affinis* sufficiently increased in numbers to reduce the water lettuce infestation to minimal levels.

Further, many aquatic plant species as such water hyacinth, *Myriophyllum aquaticum, Polygonum senegalesis* and *Azolla* invaded the water lettuce mats which were stressed by *N. affinis*. In Lake Chivero itself, the weevil took 13 months to reduce thick mats of water lettuce by more than 90%. In less than six months after good biological control of water lettuce, water hyacinth invaded the majority of the lake, indicating antagonistic competition and succession between two plant species (Figure 1). This observation indicates that a holistic approach to water weed management and control is necessary.

Biological control generally is a long term approach which takes several years to reduce pest problems. However, *N. affinis* has brought rapid control of water lettuce in less than 16 months in five water bodies of Zimbabwe. These observations were similar to results in Australia and South Africa (Harley et al. 1984), (Harley 1990) and (Cilliers 1991) and was indicated by laboratory experiments in Zimbabwe by Chikwenhere and Forno (1991).

It is significant to note that from a single release at each infested site, *N. affinis* spread to cover the whole area bringing it under good biological control in less than one and a half years. The present study suggests that any future outbreaks of water lettuce should be controlled biologically, rather than using herbicides because of their risk of contaminating domestic water supplies and the relatively small cost of using *N. affinis*.

Field observations since 1988 at Manyame River clearly demonstrate that water lettuce is unlikely to cause any future concern in Zimbabwe impoundments. The rapid increase in other aquatic macrophytes in replacing water lettuce, at the above mentioned site emphasizes the need to have an aquatic vegetation control plan for water systems in the event that one weed is replaced by another.

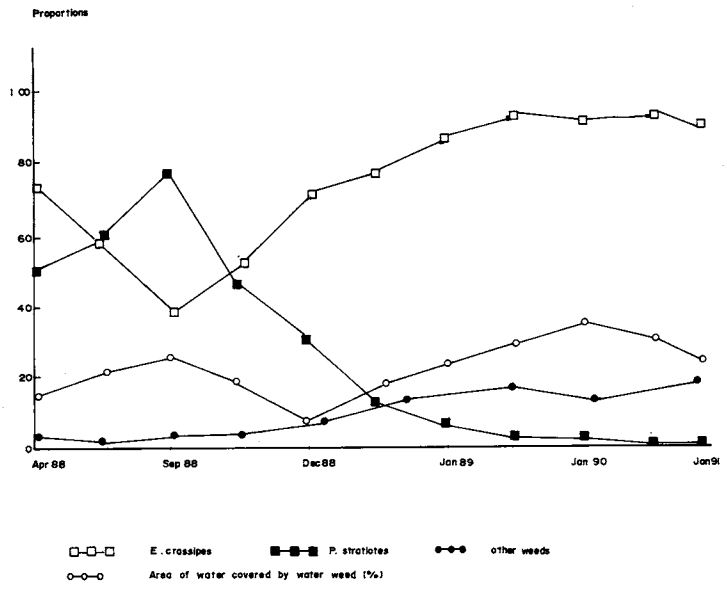

Figure 1. Response of *E. crassipes* to a decline in *P. stratiotes* at Lake Chivero.

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