Current Strategies for the Management of Water Hyacinth on the Manyame River System in Zimbabwe

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Abstract

The Manyame River System consists of the Manyame River and its tributaries, the Mukuvisi and Nyatsime rivers, which discharge water into man-made Chivero and Manyame lakes situated at 29 km and 33 km, respectively, from Harare. Water hyacinth is the predominant floating aquatic weed in the system. About 15 years ago, the water was covered with various aquatic weeds namely: water hyacinth (35%), *Pistia stratiotes* (36.6%) and *Myriophyllum aquaticum* (1.7%). Ten years later, the estimated weed coverage was water hyacinth (3%), *P. stratiotes* (0.3%), *M. aquaticum* (4%). Also, *Azolla filiculoides* had appeared in Lake Chivero, forming a 1% coverage. In 2000, the weed coverage on the system was 2.4, 0.8, 6,8 and 3.5%, respectively, and 9.5% of the water surface of Lake Chivero had been invaded by *Hydrocotyle ranunculoides*. The control of water hyacinth was accomplished through chemical, biological and mechanical means, while the management of *P. stratiotes* was accomplished mainly through classical biological control. The appearance of *M. aquaticum* and *H. ranunculoides* may have been facilitated by the absence of natural enemies, and reduced competition for space and nutrients by the previously dominant water hyacinth and *P. stratiotes*. In 2000, the Zimbabwe Aquatic Weed Management Committee was formed to manage the aquatic weed problem in a holistic manner.

ZIMBABWE has been involved in the biological control of pests, including floating aquatic weeds, since the 1950s (Chikwenhere 1994, 2001). The country has been working through international collaboration and cooperation as a means to achieving sustainable classical biological control technologies.

Following the First IOBC Global Working Group Meeting for the Biological and Integrated Control of Water Hyacinth, held in Harare, Zimbabwe, in 1998, Zimbabwe adopted a new coordinated approach in the management of the water hyacinth problems, with particular attention to the Manyame River System thus including Chivero and Manyame lakes.

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Formation of Zimbabwe Aquatic Weed Management Committee

The Zimbabwe Aquatic Weed Management Committee was formed in July 2000 and it comprises various stakeholders including government, university and private sector representatives (Table 1). The committee's mandate is to identify water impoundments for immediate chemical and biological control strategies for aquatic weeds, including chemical control of newly emerging water hyacinth seedlings, and to train national parks personnel in the proper use of spray equipment. The committee is also charged with preparing an implementation plan for waterweed management in the short and medium terms. This would:

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1. Identify areas for
   – immediate herbicide application in economically important areas
   – areas requiring herbicide application if resources permit
   – areas reserved for biological control.
2. Immediately spray germinating seedlings along the lake shore areas.
3. Train national parks staff in identification and mass rearing of biological control agents for restocking in areas designated for biological control activities.
4. Train national park staff in calibrating spray equipment, spray mixing and handling of herbicides.

The Zimbabwe Government provided the committee with an annual working budget of ZWD6m (US$125,000) for the year 2000 for aquatic weed control along the Manyame River System. This system has a surface area of approximately 60 km^2 and the estimated weed infestation level was below 5%.

Observations on the Pattern of Weed Infestation in Lake Chivero (September 2000)

1. The major part of the weed biomass in the lake was not water hyacinth but the spaghetti weed, *Hydrocotyle ranunculoides*.
2. Water hyacinth mats were visible as isolated patches, brownish and severely weevil damaged, surrounded by vigorously growing spaghetti weed.
3. On the Upper Manyame River System, spaghetti weed and parrot's feather, *Myriophyllum aquaticum,* appeared to be the dominant species, outcompeting both water hyacinth and water lettuce, *Pistia stratiotes,* for space, light and possibly nutrients.
4. The most significant pocket of water hyacinth was observed at Tiger Bay, but even that was not exclusively water hyacinth, as spaghetti weed constituted a larger proportion of the weed biomass.
5. Other significant pockets of water hyacinth were just below the Lake Chivero Spillway but these were less then 10 cm tall and even in these areas, spaghetti weeds constituted a significant proportion of the biomass.
6. Along the northern shore of Lake Chivero, spaghetti weed formed a continuous fringe extending about 3–4 m from the shoreline into the water. After the spaghetti weed fringe, the water hyacinth formed another belt of about 1 m. On average, the entire weed belt around the lake was about 4 m, approximated 6.5% of the surface area. The current weed cover remains far less than the 35% previously recorded on the lake in the 1980s before the release of the *Neochetina* weevils (Table 2).

Table 1. Composition of Zimbabwe Aquatic Management Committee

Institution/organisation	Representative	Area of interest
Harare City Council	Mr T. Mafuko	Urban water supply and effluent disposal systems
Ministry of Agriculture, Plant Protection Research Institute	Dr G. P. Chikwenhere	Biological control using insects
Agruricura: Agricultural Chemical Company	Mr A. Brent	Chemical control
University of Zimbabwe, Department of Biological Sciences	Prof. B. Marshal	Use of lake waters and water hyacinth control
Ministry of Environment and Tourism, Department of National Parks and Wildlife	Mrs S. Mutsekwa	Fish ecology and committee chairperson
Commercial Farmers Union	Unadale Farm	Tobacco and mixed cropping systems
Lazy River Fisheries	Mr G. Manuwere	Fishing
Zvevanhu Fisheries	Mr B. Chidawanyika	Fishing

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Table 2. Comparisons on previous and present weed cover on the Manyame River System in Zimbabwe

Locality/area	Weed species		Estimated surface area covered (%)	Year observed
	Common name	Scientific name		
Upper Manyame	Water hyacinth	*Eichhornia crassipes*	60.0	1986
	Water lettuce	*Pistia stratiotes*	35.0	
	Parrot's feather	*Myriophyllum aquaticum*	0.1	
	Red water fern	*Azolla filiculoides*	–	
Lake Chivero	Water hyacinth	*Eichhornia crassipes*	35.0	
	Water lettuce	*Pistia stratiotes*	40.0	
	Spaghetti weed	*Hydrocotyle ranunculoides*	–	
	Red water fern	*Azolla filiculoides*	–	
Mukuvisi River	Water hyacinth	*Eichhornia crassipes*	10.0	
	Water lettuce	*Pistia stratiotes*	35.0	
	Parrot's feather	*Myriophyllum aquaticum*	5.0	
	Red water fern	*Azolla filiculoides*	–	
Upper Manyame	Water hyacinth	*Eichhornia crassipes*	4.0	1996
	Water lettuce	*Pistia stratiotes*	0.5	
	Parrot's feather	*Myriophyllum aquaticum*	4.5	
	Red water fern	*Azolla filiculoides*	0.1	
Lake Chivero	Water hyacinth	*Eichhornia crassipes*	5.0	
	Water lettuce	*Pistia stratiotes*	0.5	
	Spaghetti weed	*Hydrocotyle ranunculoides*	3.5	
	Red water fern	*Azolla filiculoides*	1.0	
Mukuvisi river	Water hyacinth	*Eichhornia crassipes*	0.8	
	Water lettuce	*Pistia stratiotes*	0.1	
	Parrot's feather	*Myriophyllum aquaticum*	4.5	
	Red water fern	*Azolla filiculoides*	2.7	
Upper Manyame	Water hyacinth	*Eichhornia crassipes*	3.5	2000
	Water lettuce	*Pistia stratiotes*	1.5	
	Parrot's feather	*Myriophyllum aquaticum*	4.5	
	Red water fern	*Azolla filiculoides*	5.5	
Lake Chivero	Water hyacinth	*Eichhornia crassipes*	3.5	
	Water lettuce	*Pistia stratiotes*	1.0	
	Spaghetti weed	*Hydrocotyle ranunculoides*	9.5	
	Red water fern	*Azolla filiculoides*	0.5	

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Table 2. (Cont'd) Comparisons on previous and present weed cover on the Manyame River System in Zimbabwe

Locality/area	Weed species		Estimated surface area covered (%)	Year observed
	Common name	Scientific name		
Mukuvisi River	Water hyacinth	*Eichhornia crassipes*	0.2	
	Water lettuce	*Pistia stratiotes*	0.1	
	Parrot's feather	*Myriophyllum aquaticum*	6.5	
	Red water fern	*Azolla filiculoides*	2.4	

Discussion

There is still an overall reduction in water hyacinth biomass on Lake Chivero, as has been observed by Chikwenhere and Phiri (1999). The rapid increase of spaghetti weed and other floating macrophytes, particularly in Lake Chivero, may have been facilitated by the absence of natural control enemies, as well as the competitive ability of the weed in the presence of water hyacinth plants heavily stressed by *Neochetina* weevils and water lettuce stressed by *Neohydronomus affinis* weevils. Furthermore, nutrients previously utilised by large mats of water hyacinth and water lettuce became available and may have contributed to the rapid proliferation of the other weeds. At the same time, accelerated succession of spaghetti weed seemed to be favoured by dead biomass of water hyacinth plants, which provided a suitable substrate for the new invader.

The committee has recommended chemical control targeted only on spaghetti weed, but it remained unclear whether water hyacinth will show an upturn once the spaghetti weed levels have gone down.

Herbicidal and mechanical control have traditionally been the methods of choice, but the rising cost of herbicides, and environmental concerns, prompted an investigation of the possibility of using biological control. This aspect of research was initiated during the 1980s (Chikwenhere 1994), and during the 1990s significant improvement in water hyacinth and water lettuce control was achieved, especially in the Manyame River System.

Observations during the past decade have shown that, while effective control of water hyacinth has been achieved, spagetti weed, *A. filiculoides* and *M. aquaticum* have increased, and replaced water hyacinth and water lettuce in many places. Studies of the competitive interactions of the weeds may assist development of holistic weed management strategies.

In Zimbabwe, lakes and reservoirs provide water for domestic use and for irrigation of commercial agriculture and small-scale farming communities. They have aesthetic value and are an important source of foreign exchange earning through tourism. The Aquatic Weed Control Management Committee was formed in 2000 to oversee management of aquatic weeds. The committee will draw up an implementation plan to accomplish aquatic weed control in a holistic and prioritised approach. It will also be responsible for monitoring, evaluation and impact assessment of the control measures.

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