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Lake Victoria: The water hyacinth (*Eichhornia crassipes* [MART.] SOLMS), its socio-economic effects, control measures and resurgence in the Winam gulf

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Abstract

The aquatic weed *Eichhornia crassipes* [MART.] SOLMS was introduced in Lake Victoria from Rwanda via the Kagera River by the activities of man. After originally infesting Lake Victoria (Uganda), it eventually spread into the Winam gulf, where its proliferation was spectacular, resulting in an enormous public outcry. The aim of this study was to find out how a beach/bay covered by a weed carpet affected the life of a lakeshore community, if there were any seasonal changes in carpet sizes and to establish if the water hyacinth is a friend or an enemy. Surveys were conducted in selected beaches between June 1995 and November 1999. When surveys were complete, it became clear that this weed is nomadic, except in lagoons and beaches that had little external interference. The open waters remained generally clear due to constant wave action. Interviews conducted on selected beaches/bays indicated that weed carpets impacted both positively and negatively, i.e. they disrupted fishing activities, transport, irrigation, water treatment, enhanced breeding grounds for vectors of human diseases, impacted on biodiversity and had become a source of raw materials for making furniture, paper and artefacts. After successful biological control by the Kenya Agricultural Research Institute (KARI), resurgence and succession were observed. The impact of water hyacinth on the life of the lakeshore communities in the Winam gulf is serious and needs to be quantified. Further research is necessary to establish whether this weed is an enemy or a friend of the lakeshore communities.

Key words: Winam gulf – Lake Victoria – water hyacinth – socio-economic effects – succession – fisheries – resurgence – water supply – irrigation – health – biodiversity

Introduction

Lake Victoria is the second largest fresh water lake in the world. Its shoreline covers three countries, i.e. Kenya (6%), Uganda (45%) and Tanzania (49%). The Winam gulf "a lake within a lake" located in Kenya is a detachment from the larger Lake Victoria with minimal contact through the Rusinga channel (see Fig. 1). The water hyacinth (*Eichhornia crassipes* [MART.] SOLMS-LAUBACH) was introduced into the Lake Victoria (Uganda) from Rwanda via the river Kagera by the activities of man (TWONGO 1998). Even though its spread in its natural range (Brazil) is limited by natural factors, its proliferation in this new range has been very rapid due to an abundance of space, nutrients, solar energy and a few natural enemies. Clonal propagation, a relatively faster means of replication appears to be the preferred method of reproduction in this range. As a stolon grows a clone is formed at its tip; a few days later the parent plant is surrounded by several

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clones. HOLM et al. (1969) while estimating this rate of reproduction reported 30 offspring's from two parents in 23 days when all conditions suitable for growth were fulfilled.

As a result of such a rapid rate of reproduction, a massive accumulation of biomass has resulted in many beaches and bays in the Winam gulf. As the weed carpets continued to colonise one beach after the other, they impacted on the communities living along these shores, thus creating study questions: (1) How does a beach/bay covered completely by a weed carpet affect the life of a lakeshore community? (2) Are there any changes in carpet sizes? (3) Is the water hyacinth a friend or an enemy of the lakeshore community?

Materials and Methods

A survey aimed at answering these study questions was initiated in April 1995. Equipments and materials used included: boats, binoculars, a camera, maps of the Winam gulf and questionnaires.

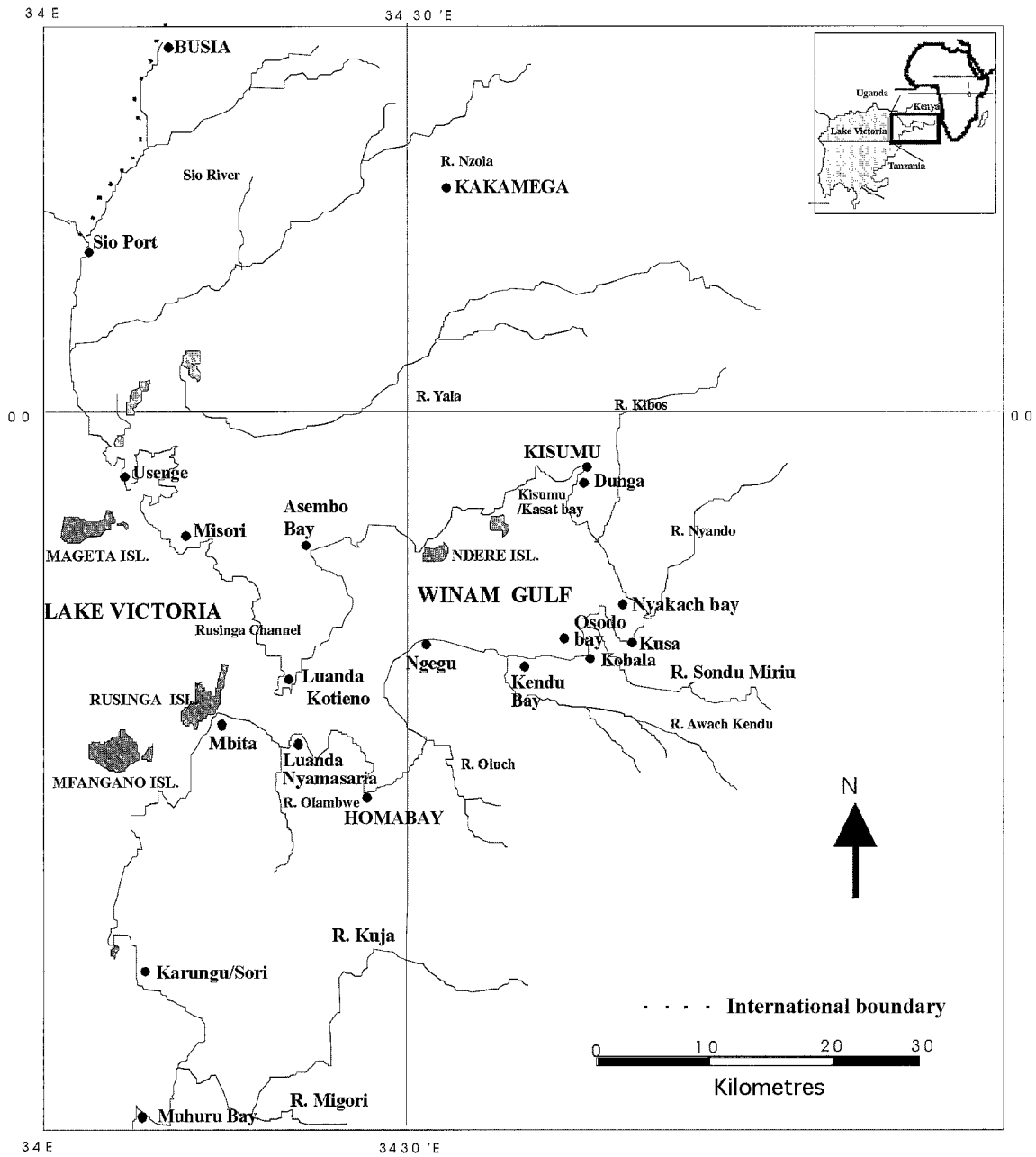

Fig. 1. Map of the study area showing Lake Victoria, Winam gulf and all locations where the study was conducted.

Changes in carpet sizes

When determining if any seasonal changes in carpet sizes occurred, observations were conducted twice annually between June 1995 and November 1999. The locations selected for this study were: Dunga, Kobala, Homa bay and Luanda-nyamasaria (Fig. 1). Observations were conducted from the shoreline and in the lake using boats.

Even though remote-sensing techniques would have provided more accurate figures for changes in carpet sizes, the naked eye and/or a pair of binoculars were used to identify the edges or limits of a carpet during this study. Points thus identified as the edges of a weed carpet were extrapolated onto a map drawn to scale and the approximate surface area covered by these carpets calculated in hectares (ha) and recorded two times in one year.

Socio-economic impacts on the lakeshore communities

In order to better understand the way water hyacinth carpets that blocked a beach or a bay affected a lakeshore

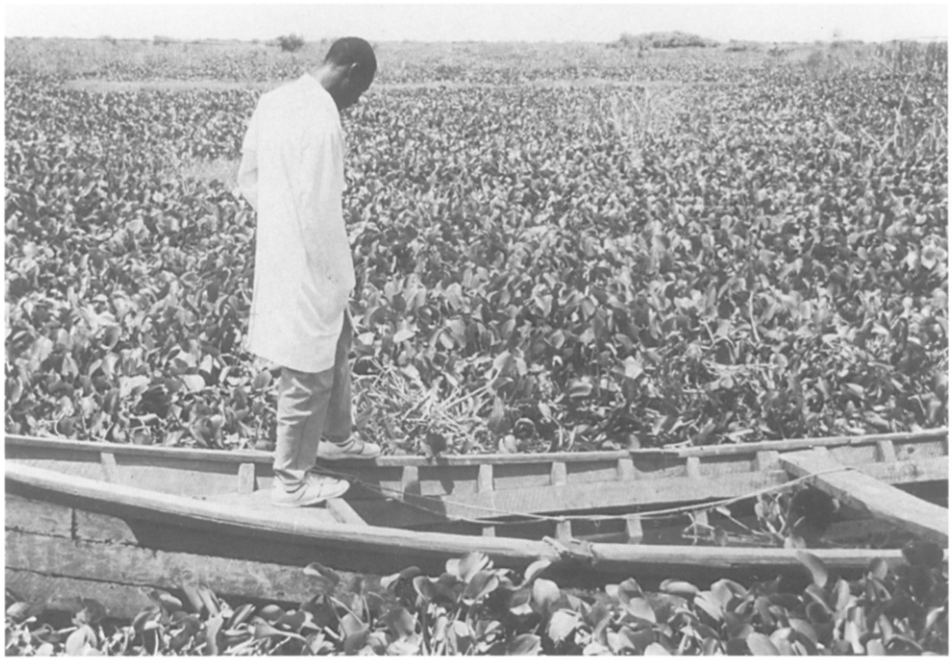

Fig. 2. A weed carpet stretching for kilometres from the shorline at Osodo bay.

Fig. 3. Discussion with a local fisherman at Kendu bay.

Table 1. Approximated changes in water hyacinth carpet sizes from 1995–1999 (the size of the approximated weed carpet is given in hectares).

Bay/Beach	1995		1997		1999	
	June	Nov	June	Nov	June	Nov
Kisumu	< 2 ha	< 2 ha	10 ha	< 2 ha	10 ha	< 2 ha
Kobala	< 2 ha	< 2 ha	9 ha	9 ha	9 ha	9 ha
Homa bay	< 2 ha	< 2 ha	< 2 ha	12 ha	< 2 ha	12 ha
Luanda-nyamasaria	6 ha	3 ha	< 2 ha	8 ha	< 2 ha	9 ha
Total	32 ha	27 ha	23 ha	31 ha	23 ha	32 ha

community, interviews were conducted at Dunga, Kusa, Kobala, Nyakwere, Kendu bay, Homa bay, Sori bay, Luanda-k'otieno and Luanda-nyamasaria (see Fig. 1). Questions posed in the questionnaires included: (1) Name; (2) age; (3) sex; (4) residence; (5) occupation; (6) how the blockage does affect the life of the persons; (7) which problems (financial, disease etc.) persons are experiencing as a result of the blockage; (8) what the community is doing to manage these problems.

Results and Discussion

Changes in carpet sizes

Two carpet types (i.e., the mobile and the stationary mats) were observed in the locations were the studies were conducted. The surface areas of the beaches/bays within the lake that these carpets covered varied in size from when the beach is almost empty to a time when it is totally covered (Figs. 2 and 3). Table 1 shows some of these changes in sizes.

Socio-economic-impacts of the water hyacinth invasion in the Winam gulf

Whenever mats cover a beach or bay, they impact on the community living along its shoreline. Two most notable impacts that were reported by most people interviewed were: disruption of boat-transport due to the blockage of beaches and the interference these blockages create to the fishing industry. The fishing industry in the Winam gulf supports more than 15 million people and is estimated to be worth 5.8 billion Kenya shillings (≅ US $ 83,000,000,000) per annum (ATONGA 2001). The major problems to the fishing industry sited as a result of weed blockage included the blockage of fish landing spots, destruction of fishing gear and interference to fish transportation throughout the lake. As a result of these blockages fewer and fewer fish catches are recorded in areas whose entrances are blocked (MANYALA et al. 1992).

Vital epidemiological data pertaining to incidences of human diseases were not obtained during this study, even though the information obtained from the interviews indicated a general increase in disease incidences as a result of the enhancement of vector breeding grounds on beaches. Some of the human diseases reported included: skin rash, cough, malaria, encephalitis, bilharzia, gastro intestinal disorders and schistosomiasis.

Massive interferences to irrigation and water treatment were reported at the West-Kano irrigation project and the water treatment works at Dunga (Kisumu), while interference to sewage treatment was reported in Homa bay and Kisumu. One of the most significant financial losses attributed to water hyacinth carpets was the recorded reduction of 25% to the Kisumu Municipal Council water supply in 1999, when weed carpets blocked the Dunga water intake point resulting in a multi-million shillings loss until the weed problem was rectified manually (OPANDE 2002).

Some innovative lakeshore communities are currently using dry plant materials to manufacture artefacts and furniture. The most notable example is at Dunga beach (Kisumu), where the dry plant material is being used to manufacture seats, stools and tables. At Dunga beach, Kisat bay, Usenge, Sio-port, Port-Victoria and Luanda k'otieno, local fishermen have adopted the use of smaller fish species that breed underneath weed carpets as live baits to trap *Lates niloticus*. *L. niloticus*, the Nile perch as it is better known, is processed and later exported to Europe, Middle East, America and Japan. Currently the fish baiting industry is a multi-million dollar industry that has improved the quality and sizes of *L. niloticus* caught in the Winam gulf (OPANDE 2002).

Management of the water hyacinth

After a spectacular spread and an enormous public outcry, three strategies namely biological, mechanical and physical were employed to manage the water hyacinth invasion of the Winam gulf. The application of chemical herbicides even though known to be faster in controlling the spread of aquatic weeds in other water bodies was greatly discouraged by environmental scientists due to the fragile nature of the lake ecosystem. In 1996 the Kenya Agricul-

tural Research Institute (KARI) introduced two insect weevils (*Neochetina bruchi* and *Neochetina eichhorniae*) from the Republic of Benin to control the spread of the water hyacinth in the Winam gulf (OCHIEL & NJOKA 2001). The water hyacinth mite (*Orthogalumna terrebrantis*) from Argentina was later released as a second biocontrol agent (OCHIEL & NJOKA 2001). With the release of these natural enemies of the water hyacinth, meaningful control was achieved due to *Neochetina* spp. feeding activities (OCHIEL & NJOKA 2001).

In 1996 the Kenya government contracted a private company from the United States of American to mechanically harvester weed carpets from the lake surface. After initially clearing large chunks of the lake, the exercise stalled before completion due to political and financial reasons. With no mechanical clearance in progress, manual removal under the guidance of a beach leader or village elder has remained as the quickest and only method of clearing weed carpets from fish landing beaches.

Water hyacinth resurgence in the Winam gulf

After an initial success by the *Neochetina* spp. to control the spread of water hyacinth in the Winam gulf, the water hyacinth has shown resurgence. Resurgence was observed during this study at Nyakach, Kendu bay, Homa bay, Karungu bay, Muhuru bay and Olambwe bay. A close examination of the leaves, roots and stems of plants picked from the water surface in the areas where resurgence was observed, indicated that most plants had no sign of the *Neochetina* spp. insect feeding scars (OPANDE 2002).

Succession within weed carpets

Ecological succession appeared to be progressing within weed carpets in a manner reported in other water bodies (GOPAL & SHARMA 1981; TWONGO 1998). In January 2000, indigenous emergent species (*Vossia cuspidator*, *Cyperus papyrus*, *Phragmites* sp. and other grasses) dominating the floating carpets that covered the Kisat bay (Kisumu) compounded problems in transport, fishing and water supply.

Conclusion

Water hyacinth carpets in the Winam gulf may either be mobile or stationary. They cover surface areas that are determined by prevailing environmental factors such as wind and wave action. More precisely, they are nomadic, except in lagoons and beaches that have little external interference.

The problems cited during these interviews including major economic losses, diseases, transport problems and interference to irrigation and water treatment plants in the Winam gulf imply that the socio-economic impacts of water hyacinth are serious and need to be quantified.

There being both negative and positive socio-economic impacts, it is more correct to state that the water hyacinth is not just an enemy but a friend of the lakeshore communities in the Winam gulf.

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