

Biological Control of Water Hyacinth in the Kagera River Headwaters of Rwanda: A Review Through 2001

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Abstract

Water hyacinth (*Eichhornia crassipes*) was officially recognized as having invaded the world's second largest lake, East Africa's Lake Victoria in the late 1980's. Since then various management activities have been implemented by the governments of Kenya, Tanzania, and Uganda, with support from a variety international partners, to review, evaluate and develop a Regional Water Hyacinth Management Plan. Recently these countries and Rwanda have begun to coordinate management efforts through regional organizations or projects. Rwanda implemented a *Neochetina* weevil species rearing and release effort in 2000 through coordination of training activities and training visits made to Uganda and Tanzania. This paper presents biological control efforts in Rwanda.

The implementation of the biological control program within the Kagera River system of Rwanda is expected to further support the long-term control of water hyacinth in the Lake Victoria basin via the reduction of water hyacinth biomass in source waters. Funding and technical support for the implementation of the biological control program for water hyacinth in Rwanda is being provided by Clean Lakes, Inc. (CLI) through a two year Cooperative Agreement with the United States Agency for International Development, Greater Horn of Africa Initiative (USAID-GHAI) through the Regional Lake Victoria Water Hyacinth Management Program, and by the Institut des Sciences Agronomiques du Rwanda (ISAR)

Introduction

Water hyacinth was officially recognized as having invaded the world's second largest lake, East Africa's Lake Victoria in 1989. Since then management activities have been implemented by Kenya, Tanzania, and Uganda with support from a variety of international partners and donor organizations. These countries and Rwanda have begun to coordinate management efforts through regional organizations such as the East African Community (EAC), the Lake Victoria Fisheries Organization (LVFO), the Lake Victoria Environment Management Program (LVEMP), or through bilateral memoranda of understandings. Biological control efforts using *Neochetina eichhorniae* and *N. bruchi* began in late 1995 in Lake Victoria through release efforts initiated by Uganda that continue to date. ISAR is currently implementing water hyacinth control through rearing and release efforts through the assistance of CLI, under Cooperative Agreement funding from the United States Agency for International Development (USAID), and through coordination of training activities and visits carried out in Uganda and Tanzania. Weevil stocks maintained in Uganda were the source of weevils imported into Rwanda (Moorhouse et. Al, 2000).

The Lake Victoria Basin water hyacinth infestation extends to its uppermost point within the Kagera River system to the headwaters of Mukungwa River tributary, several kilometers south of Ruhengeri (See Figure 1). To date the highest point of infestation was reported by CLI and ISAR staff in October 2001 (CLI/ISAR, 2001) approximately 300 meters upstream of the Mukungwa river bridge (S01 ° 31.772', E 029° 39.893' at an elevation of 1,649 meters). The Mukungwa River is joined by the Nyaborongo River, keeping the latter's name, until it merges with a small river leaving Lake Rweru, along the Burundi border, to form the Akagera River, also known as the Kagera River. The entire Mukungwa/Nyabarongo/Kagera River system to Lake Victoria is infested with water hyacinth, a length of over 500 kilometers. Water hyacinth ultimately enters Lake Victoria in the form of mats torn away from the shoreline or as individual plants. There is at least one set of major waterfalls along the Rwanda/Tanzania border at Rusoma, Rwanda and a large swamp/lake complex along Rwanda/Tanzania border of the Akagera River where water hyacinth becomes damaged or is caught in the swamp matrix, respectively, thus potentially reducing amounts traveling downstream. Downstream of this large swamp/lake system, which forms a large part of the Akagera National Park (ANP), the Akagera River changes direction to an easterly course, becomes shared by the countries of Tanzania and Uganda, and experiences a series of elevational drops near Kikagati, Uganda where water hyacinth becomes damaged again by turbulent waters (Moorhouse et. Al, 2000).

Figure 1. Map of Rwanda



Below Kikagati, Uganda, at a point approximately 160 km from Lake Victoria, the river flattens and passes primarily through Tanzania where water hyacinth flourishes along river banks growing toward the river center to a width of about 2 m from the shoreline. Water currents and velocity prevent water hyacinth from growing much beyond that with exception in some bends, inlets or sloughs, or during periods of drought or flood. Considering that all rivers contain two riverbanks, these 160 km of river, therefore, produce 320 km of linear shoreline growth potential for the weed to a width of approximately two meters, or a total of about 64 ha. It has been visually estimated by Clean Lakes, Inc. staff that within 1 km of Lake Victoria the daily rate of weed flowing down the Kagera River ranges between 0.2 ha/day to in excess of 1.5 ha/day (average 0.75 ha/day or 300 ha/year), depending on seasonal river volume conditions. If a growth rate model of 1% per day were assumed, then these 64 ha growing along the shoreline would generate about 0.64 ha of new weed growth/day. This is, on average, equivalent to documented rates (Moorhouse, et. al., 2000).

The Rwandan Biological Control Effort – A Summary

It was recognized that in order to bring the water hyacinth under management within the entire Lake Victoria basin, that a cooperative effort should be encouraged between the concerned countries. Recommendations were made in various regional and East African Community fora to include Rwanda and Burundi in efforts of lake basin water hyacinth management activities. In 1997 the Rwanda and Uganda governments signed a memorandum of understanding on Common Agriculture Issues to cooperate on water hyacinth management, among other areas. Both governments committed their countries to full collaboration in management of the water hyacinth problem.

As a result of the various recommendations made and through funding made available through a Cooperative Agreement with USAID, CLI facilitated the training of Rwandan and Burundian government officials. The training was led by the Ugandan National Agriculture Research Organization (NARO) - Namulonge Agriculture and Animal Production Research Institute's (NAARI) Dr. James Ogwang, Head of Biological Control programs along with staff of the Uganda Ministry of Agriculture,

Animal Industries and Fisheries/Water Hyacinth Unit (MAAIF/WHU) in November 1999.

During the next nine months, plans were made that led to the identification and establishment of the first weevil rearing site at the Karama Animal Husbandry and Fisheries Unit, an ISAR branch located approximately 70 km southeast of Kigali in the Commune of Gashora on the shores of the small Lake Kilimbi and near to the Nyabarongo river. An authorization to import water hyacinth weevils was secured from the Rwanda Ministry of Agriculture, Livestock as well as a weevil export authorization from Uganda's National Agriculture Research Organization. Additional training in the way of sites visits to the LVEMP Tanzania operated weevil-rearing facilities at Bukoba and Kyaka were performed prior to collection and transport of weevils to Rwanda.

On 25 September weevils were collected in cooperation with the Uganda's NARO from the NAARI weevil rearing tanks under the direction of the Head for Biological Control programs and assisted by NAARI, ISAR, and CLI staff. The number of weevils collected for transport totaled 854 (See Table 1).

Table 1. Weevils collected and transported to Rwanda on September 25, 2000

	<i>Neochetina bruchi</i>*	<i>Neochetina eichhorniae</i>**
Females	117	330
Males	127	280
Total	244	610

*Chevroned water hyacinth weevil

**Water hyacinth weevil

In order to support documentation of weevil release efficacy, a satellite image acquisition was made in late September 2000, through the use of IKONOS one (1) meter PAN and four (4) meter multispectral band data in coordination with the United States Geological Survey-EROS Data Center (USGS-EDC). One image each was acquired for the small lakes named Lake Mpanga and Lake Mihindi, in the Akagera River area of Akagera National Park, (Eastern Rwanda) at the upstream and downstream ends of the swamp/lake complex, respectively. These images revealed that Lake Mihindi (see image 1) was heavily impacted (approx. 300 ha) while Lake Mpanga did not appear to be impacted, though a small portion of Lake Mpanga was not visible in the image.

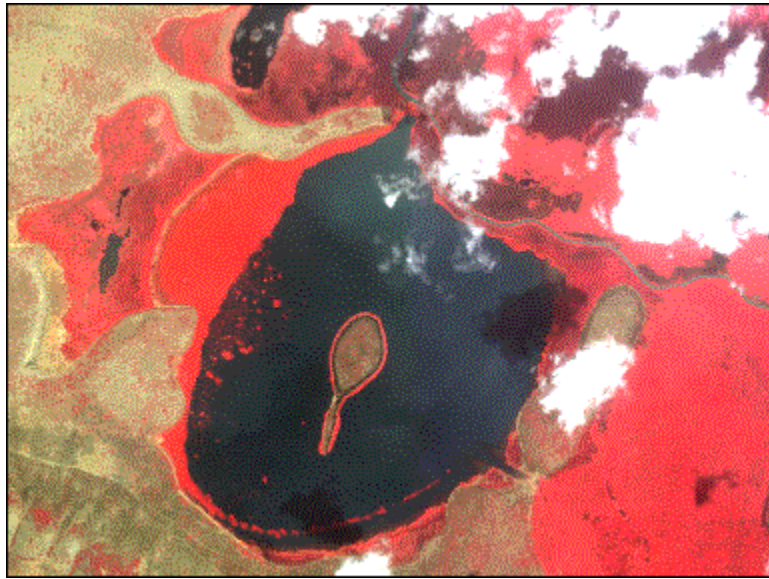


Image 1. September 2000 Ikonos multispectral image of Lake Mihindi, Akagera National Park, Rwanda, with areas of water hyacinth and other aquatic weeds appearing on the lake in reddish orange (©Space Imaging 2000).

On 27 September 2000, ISAR and CLI staff traveled from Entebbe, Uganda to Kigali, Rwanda by air with the consignment of *Neochetina spp.* Upon arrival in Kigali, they were met and transported to the ISAR Karama weevil rearing facility in order to inoculate water hyacinth within previously established tanks. Approximately 800 weevils were placed in the water hyacinth plants of the two tanks. The weevils were deliberately mixed when placing them in the tanks. On 28 September approximately 25 weevils of each species were released, for a combined total of 50 weevils, in a small depression named Lake Kiruhura in the Nyabarongo River flood plain, approximately 2 km east of the Nyabarongo River Bridge, 20 kilometers south of Kigali. This seasonal lake lies approximately 200 meters south of the Nyabarongo riverbank. This one hectare plus depression was 60% infested with water hyacinth averaging an estimated height of 30 to 40 cm. Flowering was observed in about 40% of this population (Moorhouse, et. al., 2000).

From December 5 to December 8, 2000 CLI supported a trip of the Uganda Water Hyacinth Unit to visit Rwanda, review efforts of biological control and to interact with those responsible for efforts in Rwanda. The Water Hyacinth Unit then reported its findings to the LVEMP regional water hyacinth group meeting in order to plan a larger regional group visit. The official request for the trip was made by the Uganda Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) to the Institute des Sciences Agronomique du Rwanda (ISAR). Clean Lakes, Inc. supported the trip via Cooperative Agreement funding from USAID. The team that traveled to Rwanda included Eng. Wadda, Head of the Uganda Water Hyacinth Unit/MAAIF, Mr. Edward Rukunya, Head of Biological Control/MAAIF, and Mr. Agaba Patrick, Local Coordinator Clean Lakes, Inc. Their recommendations included: need for sensitizing all stakeholders on the problems of water hyacinth in Rwanda; construction of two more rearing stations, one in Kibungo and another in Ruhengeri for mass rearing and distribution; capital equipment for effective office and operations, need for establishing coordination among the affected institutions so as to avoid duplication of efforts, and that the planned regional surveillance system should cover Rwanda especially the Kagera River, among others. This visit ultimately prepared for a study visit of the LVEMP water hyacinth group that took place in July/August 2001 (Water Hyacinth Control Components, July/August 2001).

During the period 20 to 23 June 2001, a baseline survey of various water hyacinth parameters was carried out at locations in Rwanda. These sites were located at Kamira Bridge on the Mukungwa River,

Ruhengeri; Gashora Swamp Bridge on the Nyabarongo River, Kigali rural; Rusomo on the Akagera River, Kibungo; and Lake Mihindi within the Akagera National Park on the Akagera River. Monitoring reports are available from CLI on request. It was during this survey that two additional sites for water hyacinth weevil rearing station establishment were selected for ISAR/Ruhengeri and Lake Ihema within the Akagera National Park. A follow-up visit from 2 to 8 July 2001 was made to establish stations at ISAR/Ruhengeri (Station No. 2) and at Lake Ihema (Station No. 3) which added ten (10) 500 liter tanks (diameter = 0.78 m) at each station. Five additional tanks were placed at ISAR/Karama (Station No.1).

On 30 July 2001, 802 weevils (206 N. Bruchi and 596 N. Eichhorniae) were collected from NAARI and exported to Rwanda by air. On the following day 400 weevils were introduced to the Ruhengeri Rearing Station No. 2 and the balance taken to Lake Ihema Rearing Station No. 3 (See Image 2) on 1 August 2001. Additional weevils were taken from Uganda since the existing ISAR/Karama station had carried out recent weevil releases and weevil populations were in the process of repopulating the tanks.



Image 2. Lake Ihema Weevil Rearing Station No. 3, Akagera National Park, Rwanda

In late October 2001 Clean Lakes Inc. and ISAR made a trip to Rwanda to identify the upper most infestation of water hyacinth within the Kagera River system, evaluate weevil status in the rearing stations, carry out weevil releases, and finalize plans for a public awareness campaign. The highest point of infestation was found at S 01° 31.772', E 029° 39.893' at an elevation of 1,649 meters. This site is located approximately 300 meters upstream of the Mukungwa River Bridge in Ruhengeri Prefecture. CLI and ISAR staff made a historic, but symbolic release of two weevils from the Ruhengeri Rearing Station No. 2 at this site. Weevil numbers were low at the ISAR/Ruhengeri station as expected due to the low air temperatures that tend to extend the weevil growth cycle. The Lake Ihema rearing station exhibited approximately 40 feedings scars per second youngest leaf and 37 weevils per tank (47 weevils/sq. meter). ISAR/Karama site was not visited during this trip.

One tank of water hyacinth plants was released into Lake Ihema so that all life cycles of the weevil would be present to begin distribution to the plants within the system. Two tanks of water hyacinth plants were transported to Lake Mihindi where the plants were placed among shoreline infestations and in open water adjacent to a large mobile infestation of several hundred hectares.

During late October 2001 travels and a visit to the ISAR Secretariat, the public awareness campaign plans were discussed and finalized. The awareness effort took place during the period 12 to 16 November 2001.

The public awareness effort was carried out as planned at Kayonza, a fishing community outside the park boundaries; Gashora near the Gashora swamp, Kumugenbo village next to the Kazenze Bridge; the ISAR/Ruhengeri weevil rearing station; an area near the Kamira Bridge, Ruhengeri at the Mukungwa River, and at a trading center next to the Nyabarongo river near to Kigali on the Kigali/Butare Road.

Awareness efforts were carried out in the following order: introduction of the water hyacinth topic by the local leader; introduction of CLI and ISAR team members; origin, distribution, impacts of the water hyacinth; Kagera and Lake Victoria infestations; control options; biological (weevil) control implementation in Rwanda; the weevil life cycle; review of water hyacinth posters; question and answer session; a closing session; distribution of water hyacinth posters (Kinyarwanda, French, English); and finally the release of weevil infested plants into impacted water bodies.



Image 3. Kamira, Ruhengeri Awareness Exercise – discussions



Image 5. Kigali Ville Awareness Exercise – Question & Answer session.



Image 4. Gashora Awareness Exercise – poster distribution.



Image 6. Kayonza Awareness Exercise – poster distribution.

Visual aids used were in the form of weevil free and weevil infested plants, blown up photographs (aerial and land based) of impacted areas and the various control options, and water hyacinth posters. See images 3 through 6.

Planned Activities

Activities planned over the next several months include additional weevil releases, monitoring distribution of weevils and impacts to plants, and public awareness exercises through February 2002.

In addition to the planned activities outlined above, under the Nile Basin Initiative (NBI), the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) includes a component for Water Hyacinth Abatement in the Kagera River Basin that is expected to be implemented in the future (Nile Basin Initiative Secretariat, 2001)

Conclusion

A program for the biological control of water hyacinth in the Kagera River Headwaters of Rwanda was implemented in 2000. Efforts to expand the program are continuing, and it is expected that the efforts combined with planned efforts will support the reduction of water hyacinth in the Lake Victoria Basin.

Recommendations

- The public awareness campaign against water hyacinth should intensify to educate the masses about the problems caused by the weed and identification of the plant throughout the country.

This could take place at universities, local government offices, key ministries, and major towns or trading stations.

- There is a need for strengthening collaboration efforts in the management and control of water hyacinth among the Ministries and Institutions responsible in Rwanda with their East African country counterparts.
- The Government of Rwanda should put in place a mechanism to stop or limit the spread of water hyacinth, especially by the ornamental plant sellers.
- Additional rearing centers or increasing the capacity of existing stations in order to raise and release more weevils would allow for potentially faster weevil impacts and water hyacinth reduction.
- Investigation of major rivers and lakes should be carried out to accurately determine the extent of the Water Hyacinth distribution in Rwanda.

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