Invasive

Aquatic Plant Management in Ghana

WATCH OUT!!!

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INVASIVE AQUATIC PLANTS

The invasion of rivers, dams and lakes throughout Africa by introduced aquatic vegetation represents one of the largest threats to the socio-economic development of the continent (Cilliers, 2003). The rapid growth of the weed infestations has been both spectacular and frightening. In their highly influential book, "The World's Worst Weeds: Distribution and Biology", Charudattan (2001a) in citing Holm et al., (1977), listed just 10 aquatic weeds including the three most notorious weeds, *Eichhornia crassipes*, *Pistia stratiotes* and *Salvinia auriculata* which was later identified as *Salvinia molesta*. In the quarter century since the book was published, the number of the world's worst aquatic weeds had grown to about three dozen. Five aquatic weeds are especially problematic in Africa: water hyacinth, *Eichhornia crassipes* (Mart) Solms-Laubach (Pontederiaceae); red water fern, *Azolla filiculoides* Lam. (Azollaceae); parrots feather, Myriophyllum aquaticum (Vell.) Verdc. (Haloragaceae); water lettuce, *Pistia stratiotes* L. (Araceae) and Salvinia, *Salvinia molesta*, Mitchell (Salviniaceae) (Cilliers *et al*., 2003).

All these plants are native to South America and except for the rooted M. aquaticum, are free-floating macrophytes. The exact date and mode of introduction of these plants in some countries is obscure, but water hyacinth has been present in Africa since the late 1800s, while water lettuce was used as a medicinal plant in ancient Egypt (Holm *et al*., 1977). These plants were sought after ornamentals, which would have aided their dispersal to new areas. However, in the absence of natural enemies and in, nutrient-enriched tropical waters, these aquatic weeds have proliferated and become problematic (Cilliers *et al*., 2003).

Expanding global trade has enabled modern societies to benefit from unprecedented numbers of species. Agriculture, forestry, fisheries, the pet trade, the horticultural industry and many industrial consumers of

raw materials today depend on species that come originally from other parts of the world. The challenge, however, is to identify how the IAS influences ecosystems and brings about changes that are inimical to the environment, to biodiversity, the economy and the social aspects of society (McNeely *et al*., 2001).

Aquatic plants infestation in water bodies in Ghana

Apart from the Volta system, Ghana has some seven major river systems, namely, the Tano, Ankobra, Pra, Kakum, Ochi, Ayensu and Densu. Some of these river systems have been dammed for potable water production, irrigation and fisheries. However, in nearly all the impoundments, serious aquatic macrophyte infestations have developed affecting the proper use and management of the impoundments (deGraft-Johnson, 1991).

Studies on aquatic vegetation and noxious weeds started in earnest with the establishment of the Volta Basin Research Project (VBRP) at the University of Ghana, Legon, in 1963. The studies were initiated during the implementation stage of the Volta River Project at Akosombo. The studies had been prompted by the experience of Lake Kariba in Zimbabwe, where an explosive development of the water fern, *Salvinia molesta* (Salviniaceae) covered 22% of the surface of the reservoir in the early 1960s (Boughey, 1963, Ameka and deGraft-Johnson, 1998).

However, since then, the development of the problem of aquatic weeds to nuisance proportions has been reported in a number of water bodies in Ghana. These include those recorded for Volta Lake (Hall et al., 1969; Lawson *et al*., 1979); Lower Volta River (Hall and Pople, 1969; Ennin and deGraft-Johnson, 1977); Barekese Reservoir (Fiakpornu, 1988); Weija Reservoir, (deGraft-Johnson, 1977; Allen and Gaudett, 1979; Ameka, 1987; Ameka and deGraft-Johnson, 1998); Kpong Headpond (Gyimah-Amoako, 1988) and the irrigation reservoirs at Dawhenya, Ashaiman, Okyereko and Mankesim (deGraft-Johnson, 1991).

1. LIMNOCHARIS FLAVA

Description: Perennial plants from a short thick erect rhizome, the scapes erect, 20-40 cm high; leaves erect or ascending, not floating, often exceeding the scapes, long-petiolate, the petiole vaginate; leaf blades variable in shape, lanceolate to oblong-elliptic in Central American plants, sometimes broadly ovate in other regions, mostly 8-18 cm long, acute to rounded at the apex, attenuate at the base; inflorescences umbelliform, 2-12-flowered, the pedicels 3-4 cm long, somewhat dilated and trigonous above; flowers yellow, about 1.5 cm broad, the sepals green, broadly ovate, obtuse; petals broadly ovate or suborbicular, longer than the sepals; mature follicles about 1 cm long.

Ecological impact / threat: It is found in fresh water pools, rice paddies and irrigation ditches where it is a serious weed of rice and forms dense, choking infestations. The mats clog waterways, disrupting navigation, fishing and other recreational activities. They also reduce water flow, increase siltation and evapotranspiration. It also seriously disrupts hydro-electric installations.

Propagation: By seed and vegetative shoots and it is water dispersed. It is an attractive plant and can be spread by aquatic plant enthusiasts. It is also eaten as a green vegetable in South-East Asia and has been moved by people for this purpose.

Management information

Strategies employed to control *L. flava* should emphasis public education. The effects of the invasive weed should be outlined, and the practices necessary for limiting its spread should be made clear. For example, plants should be uprooted and burnt (or deep-buried) to prevent them from re-establishing and the plants should be (preferably) removed before the weed flowers and sheds its seeds. An increased understanding of the life cycle of the weed should be emphasised through ecological studies as these may highlight the most vulnerable stages of the life cycle and eventually lead to more effective control measures. The use of the plant as a leafy vegetable, green manure, medicine, or in other applications should be documented so that the social and economic factors contributing to the spread of the plant can be addressed (and potentially reduced).

Preventative measures: In general, early detection of any invasive weed species provides the best opportunity for intervention. This is because eradication or control programs implemented at an early stage of an invasion have a higher chance of success and are more cost-efficient. To encourage Early Detection and Rapid Response, the UNEP/GEF IAS PROJECT in collaboration with the Faculty of Renewable Natural Resources of the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana have undertaken a survey of the distribution of some known weeds and the occurrence of new weeds in Ghana. Field surveys such as this provide current distribution records of weeds in an area and are necessary for fast detection of a new invasive weed.

Locations in Ghana: Kumasi Metropolis including (KNUST- Kumasi, River Wiwi, Ejisu streams, Besease valley bottom rice project site, Nobewam, Kumasi Airport roundabout-Antoa road, Sunyani road, Ejisu-Lake Bosomtwe road and Nkawkaw in the Eastern Region.

2. AZOLLA FILICULOIDES(Water Fern)

Description: This is a small free-floating aquatic fern often growing in extensive colonies on ponds, pools and still waters and reproducing from fertile spores. The plant is greenish at the early stages of its life cycle but turns pink or dull reddish brown with age.(sometimes confused with *Azolla pinnata* and *Azolla Africana* which has roots with laterals).

The plants are small, 1.5 - 2.5cm long, with a more or less straight main axis with pinnately arranged side branches, progressively longer towards the base, thus roughly triangular in shape, the basal branches themselves becoming pinnate and eventually fragmenting as the main axis decomposes to form new plants. Roots with fine lateral rootlets, having a feathery appearance in the water. Leaves minute, 1-2mm long, overlapping in 2 ranks, upper lobe green, brown green or reddish, lower lobe translucent brown; minute, short, plae, +/- cylindrical unicellular hairs often present on the upper lobes. When fertile, round sporocarps 1 - 1.5mm wide can be seen on the under side at the bases of the side branches. The leaves often have a maroon-red tinge and the water can appear to be covered by red velvet from the distance. The upper surface of the leaves is totally water-repellant, and if completely submerged the plants quickly refloat with the right side up.

Ecological impact / threat
It can rapidly colonise an open water surface and completely cover the surface. Major consequences of dense mats (5-30 cm thick) are: reduced quality of drinking water caused by bad odour, colour and turbidity; leading to increase in waterborne diseases; increased silt flow in irrigation channels and rice paddies

Locations in Ghana: Tano River and Lagoon complex, Kpong Headpond, Lower Volta River at Tefle, Sogakope and Ada and other water bodies countrywide.

3. CYPERUS PAPYRUS(Papyrus reed)

Description: This tall, robust, leafless aquatic plant can grow 4 to 5 m (13 to 16 ft) high. It forms a grass-like clump of triangular green stems that rise up from thick, woody rhizomes. Each stem is topped by a dense cluster of thin, bright green, thread-like stems around 10 to 30 cm (4 to 10 in) in length, resembling a feather duster when the plant is young. Greenish-brown flower clusters eventually appear at the ends of the rays, giving way to brown, nut-like fruits.

Papyrus ranges from subtropical to tropical desert to wet forests, tolerating annual temperatures of 20 °C (68 °F) to 30 °C (86 °F) and a pH of 6.0 to 8.5. Papyrus flowers in late summer, and prefers full sun to partly-shady conditions. Like most tropical plants, it is sensitive to frost. In the

United States it has become invasive in Florida and has escaped from cultivation in Louisiana, California and Hawaii.

Ecological impact / threat

Papyrus sedge forms vast stands in swamps, shallow lakes, and along stream banks throughout the wetter parts of Africa, but it has become rare in the Nile Delta. In deeper waters it is the chief constituent of the floating, tangled masses of vegetation known as sudd. It also occurs in Madagascar, and some Mediterranean regions such as Sicily and the Levant.

Locations in Ghana: Kpong Headpond, Silicon Hotel, Kumasi and Accra

4. SALVINIA MOLESTA(Kariba weed)

Description: Floating, rootless aquatic fern. Consists of horizontal stems that float just below the water surface and produce at each node, a pair of floating or emergent leaves. Floating and emergent leaves are green in color and ovate to oblong in shape. Plants bear a third leaf that is brown, highly divided and dangles underwater. Submersed leaves are commonly mistaken as roots. They may grow to great lengths, and by creating drag, act to stabilize the plant.

Reproduction: *Salvinia molesta* effectively reproduces through vegetative means. Stems fragment spontaneously as plants mature. New

branches develop from apical and lateral buds. Each node harbors up to five serial lateral buds adding to the high potential for growth and dormancy. *Salvinia molesta* will withstand periods of stress, both low temperature and dewatering, through latent buds.

Habitat: Quiet water of lakes and ponds, oxbows, ditches; slow flowing streams and rivers, backwater swamps, marshes and rice fields.

Ecological impact / threat *Salvinia molesta*, one of the world's most noxious aquatic weeds, is notorious for dominating slow moving or quiet freshwaters. Its rapid growth, vegetative reproduction and tolerance to environmental stress make it an aggressive, competitive species known to impact aquatic environments, water use and local economies.

Locations in Ghana: Tano River and Lagoon complex, Kpong Headpond and the Lower Volta River

5. EICHHORNIA CRASSIPES(water hyacinth)

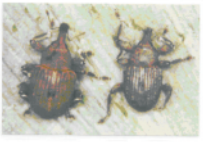
Description

Water hyacinth, *Eichhornia crassipes* is a free-floating perennial herb which is native to the Amazonian Regions of South America. It is the worst waterweed of the tropics and subtropics throughout the world.

Ecological impact / threat

Forms dense mats which completely cover the water surface. The mats clog waterways, disrupting navigation, fishing & other recreational

activities. They also reduce water flow, increase siltation and evapotranspiration, and seriously disrupt hydro-electric installations. Thick mats disrupt the aquatic environment by reducing light penetration. Rotting material can reduce the oxygen level, and increase the acidity of the water. Conditions are created which are suitable for the breeding of mosquitoes and bilharzia-carrying snails. The degradation of water bodies reduces the biodiversity of the ecosystem.



Neochetina weevils used in bio-control of water hyacinth

Methods of Control

Physical Control: This includes the removal of the weeds by manual labour or by mechanical harvesters, the use of physical barriers such as floating booms and where feasible, by draining water body. These techniques are useful and sometimes essential in the short term. However, they are expensive and physical control will have to be a permanent operation if it is the only means of control used. In Ghana, manual removal has been the first control option practiced throughout the country. This has been at the individual or community level. In addition physical barriers have been used to prevent water hyacinth blocking boat access to landing sites.

Chemical Control: This is the most commonly used method of control. It is effective against the smaller growths of weeds but has proved expensive and ineffective against large infestations.

Biological control: This involves the use of host-specific bio-agents. Biological agents that have been used successfully to control water hyacinth in Ghana are the *Neochetina eichhorniae* and *Neochetina bruchi*

Locations in Ghana: River Oti arm of Volta Lake, Tano River and Lagoon complex, Jewi Wharf, Kpong Headpond, the lower Volta River and the Odaw stream in Accra.

6. PISTIA STRATIOTES(water lettuce)

Description

Water lettuce resembles a floating open head of lettuce. Water lettuce has very thick leaves. The leaves are light dull green, are hairy and are ridged. There are no leaf stalks. The roots of water lettuce are light-colored and feathery. Its flowers are inconspicuous.

Ecological impact / threat

It forms dense mats which completely cover water surface. The mats of Pistia stratiotes clog waterways, making boating, fishing, other recreational and almost all other water activities, impossible. Water lettuce mats also degrade water quality by blocking the air-water interface and greatly reducing oxygen levels in the water, eliminating underwater animals such as fish. The mats greatly reduce biological

diversity: mats eliminate native submerged plants by blocking sunlight, alter immersed plant communities by pushing away and crushing them, and also alter animal communities by blocking access to the water and/or eliminating plants the animals depend on for shelter and nesting. It also provides a breeding place for mosquitoes and bilharzia-carrying snails.

Management options
Biological: There are some successes in management of Pistia stratiotes using the Neohydronomous affinis weevils imported from South Africa. The weevils were introduced into Ghana and they successfully brought down the Pistia infestations in the Tano River and Lagoon complex.

Locations in Ghana: Weija Lake, River Volta, Volta Lake, Tano River and Lagoon complex, Kpong Headpond, Barekese Dam, Owabi Dam, Kwanyako Dam, Mankessim Dam, Dawhenya Reservoir and many other water bodies country-wide.

7. MIMOSA PIGRA

Description
Mimosa is a branched prickly shrub, growing up to 6 m. The stem is greenish in young plants but becomes woody as the plant matures. The fernlike green leaves, which fold together at night or when touched, are made up of many fine leaflets and occur in pairs along branches. Larger thorns (5–10 mm long) are found on the stem, with smaller thorns on

branches between leaves. Round flower heads (10–20 mm in diameter) are composed of 100 pink– mauve individual flowers. Each flower head produces between 10 and 20 olive-green seed pods, 60–80 mm long, which turn brown and break into segments when mature. Each segment contains an oblong-shaped seed, 4–6 mm long and 2 mm wide. The seed segments, which are covered with many fine hairs, float on water and adhere to clothing or hair. The root is a branching taproot, reaching to between 1 and 2 m depth.

Ecological impact / threat

Mimosa forms dense stands that replace all native vegetation on the ecologically and economically valuable wetlands. *Mimosa* invasion threatens the production, cultural and conservation values of wetlands, and reduces the scope for exploitation of resources by land users. Pastoralists are affected because the inedible and thorny mimosa smothers and replaces grasslands; blocks access to stock watering points and hinders mustering.

Additionally, the harvesting of bush foods by indigenous people is hampered by *Mimosa*. In environmental terms, nationally and internationally significant wetlands are threatened by mimosa, which reduces the biodiversity of plant and animal life on the floodplains by outcompeting native plants and reducing available habitat for animals. Although currently limited in distribution, if left unchecked mimosa has the potential to dominate wetlands across the whole of Ghana.

Propagation

Mimosa mainly reproduces via seeds. Large plants can produce vast amounts of seeds, up to 220,000 per year. *Mimosa* seeds are typically dispersed in two main ways: carried downstream during flooding or transported by animals or machinery. Animals can spread seeds in their droppings (eg cattle, horses) or in mud attached to their bodies (eg pigs, buffalo).

Humans transport seed attached to their clothing or equipment (eg boats, cars, tractors) after contact with an infestation. Therefore, appropriate care and routine hygiene measures (ie wash downs, inspections) should be used after contact with mimosa. Non-essential activities should not be conducted in *Mimosa* patches to limit the likelihood of spread.

Locations in Ghana: Volta River system, Mole National Park, Daboya, Akuse, Yeji, Oti, Bui Damarea, Amedeka, Bamboi ferry, Dodowa Road, Bawku on the White Volta, Kete-Krachi, Tano River, Weija Lake, Tefle, Ada road and lagoons and streams in the Accra plains.

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