WATER HYACINTH (*EICHHORNIA CRASSIPES*) - MANAGEMENT OF AN INVASIVE WEED, THE INDIAN SCENARIO

S. Prasanth Narayanan[1,*], K. Anitha[1,2] and S. Narendra Prasad[1]

[1]Division of Landscape Ecology, SACON, Deccan Regional Station, Hyderabad-500 017, A.P.
[2]School of Environmental Sciences,Mahatma Gandhi University, Priyadarsini Hills, Kottayam-686 560, Kerala
[*]Email: narayanankc@gmail.com

Introduction

Water hyacinth, *Eichhornia crassipes* (Mart.) Solms of family Pontederiaceae is a native of South America, is one of the worst aquatic weeds in the world. It is introduced into India in 1896 as an ornamental plant at botanical garden at Bengal (Biswas & Calder, 1954). This plant has become an environmental and social menace in most of the water bodies of the country.

The species has invaded almost all water bodies of the country leaving Himachal Pradesh, Jammu and Kashmir and Mizoram. Among these we believe the temperate climate of Himachal Pradesh and Jammu and Kashmir prevented them from the water hyacinth invasion. Our field experiences in different wetlands of India indicate that the water hyacinth infestation is increasing at an alarming rate. Most of the Country's Ramsar sites have been proliferated by the species (see table-1).

Its rapid growth rate enables to invede extensive areas of naturally open water and produce enormous amounts of biomass. The mats of this plant block the air-water interface and reduce oxygen level leading to the degradation of the water quality which in turn reduces the species richness of the aquatic ecosystem. The mats also eliminate submerged plants by blocking sunlight. Moreover, the mats provide shelter to the mosquitoes as causal organisms of several vector borne diseases in human beings and help to spread certain deadly diseases such as schistosomiasis and malaria, encephalitis and filariasis.

Sl. No.	Name	State	Location	Status
1	Ashtamudi Wetland	Kerala	08° 57' N 076° 35' E	√
2	Bhitarkanika Mangroves	Orissa	20° 39' N 086° 54' E	X
3	Bhoj Wetland	Madhya Pradesh	23° 14' N 077° 20' E	ND
4	Chandertal Wetland	Himachal Pradesh	32° 29' N 077° 36' E	ND
5	Chilika Lake	Orissa	19º 42' N 085º 21' E	√
6	Deepor Beel	Assam	26° 08' N 091° 39' E	√
7	East Calcutta Wetlands	West Bengal	22° 27' N 088° 27' E	√
8	Harike Lake	Punjab	31º 13' N 075º 12' E	√
9	Hokera Wetland	Jammu & Kashmir	34° 05' N 074° 42' E	ND
10	Kanjli Wetland	Punjab	31° 25' N 075° 22' E	√
11	Keoladeo National Park	Rajasthan	27º 13' N 077º 32' E	√
12	Kolleru Lake	Andhra Pradesh	16° 37' N 081°12' E	√
13	Loktak Lake	Manipur	24º 26' N 093º 49' E	√
14	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu	10° 19' N 079° 38' E	ND
15	Pong Dam Lake	Himachal Pradesh	32° 01' N 076° 05' E	X
16	Renuka Wetland	Himachal Pradesh	31° 37' N 077° 27' E	X
17	Ropar Wetland	Punjab	31° 01' N 076° 30' E	√
18	Rudrasagar Lake	Tripura	23° 29' N 090° 01' E	ND
19	Sambhar Lake	Rajasthan	27º 00' N 075º 00' E	X
20	Sasthamkotta Lake	Kerala	09° 02' N 076° 37' E	√
21	Surinsar-Mansar Lakes	Jammu & Kashmir	32° 45' N 075° 12' E	X
22	Tsomoriri Wetland	Jammu & Kashmir	32° 54' N 078° 18' E	X
23	Vembanad-Kol Wetland	Kerala	09° 50' N 076° 45' E	√
24	Wular Lake	Jammu & Kashmir	34º 16' N 074º 33' E	X
25	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	28° 33' N 078° 12' E	ND

√ - Present; X – Absent; ND – No Data Available

Table 1. Status of *Eichhornia crassipes* in different Ramsar Sites of India

When water hyacinth spreads, entire ecology of the invaded aquatic body will be changed. It restricts primary productivity by reducing the photosynthesis of phytoplanktons through shading the water column and increase sedimentation. This will leads to de-oxygenation with a detrimental impact on aquatic organisms, especially fish. The shading and crowding of native aquatic plants dramatically reduces biological diversity in aquatic ecosystems.

Water hyacinth mats competitively exclude native submersed and floating-leaved plants. Its prolific growth causes considerable economic problems and affects fisheries, traffic, irrigation, water supply and the whole ecology of the infested lake. Its role in evapotranspiration and changing the ecological character for the adverse is well known. However, this is also recognized as a water purifier due to its ability to absorb heavy metals from the water bodies. At the same time, its death and decay within the wetland can lead to re-entry of these chemicals in water further leading to eutrophication. We outline utility of various technologies into weed management programme.

Bioremediation

Bioremediation is the cheapest and most sustainable control method for weed eradication as chemical and mechanical control measures are expensive and hampered by reinfestation from its long-lived seeds. Bioremediation would serve as the best method for locations where water hyacinth continues to grow at greater than acceptable levels. It has proved to be an adequate control method in several instances in developing countries such as Sudan, Papua New Guinea, and Benin. Table-2 summarises various natural enemies of water hyacinth reported from different parts of world. Using currently available agents, it usually reduces extent of the infestation, climate, water quality, and other control options. In conjugation with other available tools like herbicides application, physical removal, manipulation of flows, and reductions of nutrient input is expected to increase the pace of eradication of the weed from the aquatic ecosystem.

Massive growth of *Eichhornia* in Kolleru Lake

Scientific Name	Group	Parts affected
Neochetina bruchi	Weevil	Vegetative part
Neochetina eichhorniae	Weevil	Vegetative part
Niphograpta albiguttalis	Moth	Vegetative part
Xubida infusellus	Moth	Vegetative part
Orthogalumna terebrantis	Mite	Vegetative part
Eccritotarsus catarinensis	Bug	Vegetative part
Cornops aquaticum	Grass hopper	Vegetative part
Chiromonus larvae	Worm	Vegetative part
Alternaria eichhorniae	Microbes	Vegetative part
Cercospora piaropi	Microbes	Vegetative part
Acermonium zonatum	Microbes	Vegetative part
Brachinus sp.	Carabid	Reproductive part-Flower
Eccitotarsus catarinensis	Mirid	Vegetative part
Thrypticus sp.	Fly	Vegetative part
Megamelus sp.	Plant hopper	Vegetative part

Table 2. List of natural pests of *Eichhornia crassipes* reported from different parts of the world

Application of Geo-spatial tools in Weed Management

The major limitations of traditional methods of water hyacinth eradication programmes are inaccessibility of the areas for field sampling due to the dense mats of water hyacinth, the large geographic areas of infestation which require extensive travel for adequate sampling, the exceptional high growth rate of this weed brings rapid changes in their extent and density, the movement of vegetation mats and effects of weather on plant growth rates.Modern spatial approaches are cost effective and an efficient tool to assess and monitor the relatively homogenous species patches distributed over large geographical areas. Remotely sensed multispectral data with ground measurements of cover, density, biomass, or leaf area, vegetation condition measured at sample points could be extrapolated across a large geographic region. This information is valuable in determining trends, confirming field reports, assessing the efficacy of control measures, providing early warning before a developing problem reaches a critical state, and general strategic planning. Remote sensing provides a critical tool for monitoring the status of infestations as well as detecting impediments to waterborne

transportation caused by aquatic plant infestations. Sensors especially like ASTER, IKONOS, QUICKBIRD and LISS IV MX can be employed in the mapping of *Eichhornia*.

Utility of Water Hyacinth

Despite the detrimental effects of the water hyacinth infestation, the weed has several economic uses, which can be part of its management. The capacity of water hyacinth for accumulating heavy metals and organic contaminants, together with its wide tolerance to environmental conditions is well recognized. Its rapid growth and multiplication has led, among other things, to various applications as an animal food, paper and other products, or as compost (Mehra *et al.*, 1999). Anaerobic digestion of water hyacinth produces biogas -methane (Teherruzan & Kushani, 1989). Water hyacinth is being used to cleanup metal-contaminated aquatic ecosystems. In Hong Kong, water hyacinth has been used for freshwater treatment. Many studies reported the ability of water hyacinth for the accumulation of heavy metals such as lead (Pb), chromium (Cr), zinc (Zn), manganese (Mn), and copper (Cu) (Tiwari *et al.*, 2007).

Suggested Measures for Eradication of water hyacinth

Since water hyacinth infestation is very serious and involves a concentrated effort among all stakeholders, we believe that there is a strong case for establishing linkages between the stakeholders for effective eradication. Table 3 sketches out the eradication potential for water hyacinth for various stakeholders at different spatial scales. Thus community at the local level such as farmers and fisher men can contribute their labor in removing the weed in one or two tanks in a radius of $\geq$ 2 km. Wildlife conservation officials of various protected areas need to mount an action plan for the weed eradication from the respective protected areas and the immediate surroundings. Various NGO's can co-ordinate the effort to eradicate the weed from their area of interest. The activities include creating awareness to various target groups, co-ordinate the eradication programme on a regular basis. National Rivers Conservation Directorate (NRCD) of the Ministry of Environment and Forests, Government of India may mount a serious coordinating mechanism specifically tailored to water hyacinth management. It has launched the river cleaning in

Eichhornia spreading in Hussain Sagar Lake

S.No.	Stakeholders	Scale of operation	Potential
1	Community Farmers / Fishermen	1-2 tanks in a radius of $\geq$2 km	Can be extended with appropriate linkages with NGO's and Govt. authorities
2	Officials of Wildlife Conservation	Protect areas (few sq. km – several sq. kms)	Structured programme to be evolved for district to regional level
3	NGO's	Few water bodies	Co-ordination with communities
4	NRCD (National Rivers Conservation Directorate), MoEF, GOI	Several hundred of kms	River basin level
5	Pollution Control Board	Regional level	Local to regional level
6	Tourism department	Regional level	Local to regional level

Table 3. Matrix of stakeholders and weed eradication potential

1995 to cover 18 major rivers in 10 states of the country. Pollution control board can be performed various monitoring programmes for pollution abatement and weed eradication from local-regional level. Tourism department can be involved in weed management programmes of area of aesthetic and recreational value from local-regional level.

References

Biswas, K. and Calder, C.C. (1954). *Handbook of common water and Marsh Plants in India and Burma*. Health Bull, 24 pp.

Mehra, A., Farago, M. E. and Banerjee, D. K. (1999). The water hyacinth: an environmental friend or pest? A review. *Resource, Environment and Biotechnology*, 2: 255–281.

Teherruzan, Q. and Kushani, D. P. (1989). Evaluation of some aquatic macrophytes cultivated in enriched water as possible source of protein and biogas. *Hydrobiological Bulletin*, 23: 207-212.

Tiwari, S., Dixit, S. and Verma, N. (2007). An Effective Means of Biofiltration of Heavy Metal Contaminated Water Bodies Using Aquatic Weed Eichhornia crassipes. *Environmental Monitoring and Assessment*, 129: 253–256.

Vijayan, V.S., Prasad, S.N., Vijayan, L. and Muralidharan, S. (2004). Inland wetlands of India – conservation priorities. Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Recent Publications

Bhattacharyya A., Sharma, J., Shah, S. K. and Chaudhary, V. (2007). Climatic changes during the last 1800 yrs BP from Paradise Lake, Sela Pass, Arunachal Pradesh, Northeast Himalaya. *Current Science*, 93(7): 983-987.

Gogoi, R. (2007). Conserving Deeper Beel Ramsar Site. *Current Science*, 93(4): 445-446.

Reddy, C. S., Pattanaik Chiranjibi and Murthy, M. S. R. (2007). Assessment and monitoring of mangroves of Bhitarkanika Wildlife Sanctuary, Orissa, India using remote sensing and GIS. *Current Science*, 92(10): 1409-1415.

Pattanaik Chiranjibi and Reddy, C. S. (2007). Need for conservation of wetland ecosystems: A case study of Ansupa Lake (Orissa, India) using remote sensing based data. *National Academy Science Letters*, 30(5&6): 161-164.

Upcoming Events

- Wetlands in the 21st Century: Altered Landscapes & Changing Climates, 31 January - 1 February 2008, Oconomowoc, Wisconsin
  Organized by: Wisconsin Wetlands Association
  Contact: http://www.wisconsinwetlands.org/2008conference.htm
- EPA 2008 Wetlands and Watersheds Conference 7-11 April 2008, Kansas City, Missouri
  Organized by: United Environment Protection Agency, USA
  Contact: http://08wetlandswatershed.com/
- Coastal Environment 2008 Conference, 19 - 21 May 2008, The New Forest, United Kingdom
  Organized by: Wessex Institute of Technology
  Contact: http://www.wessex.ac.uk/conferences/2008/coast08/
- Capitalizing on Wetlands International Conference 2008, 26-30 May 2008, Washington D.C.
  Organized by: The Society of Wetland Scientists
  Contact: http://www.sws.org/2008_meeting/
- Third International Conference BALWOIS 2008, 27-31 May 2008, Ohrid – Republic of Macedonia
  Organized by: Balkan Institute for Water and Environment
  Contact: http://balwois.viabloga.com/
- The 8th International Wetlands Conference, 20-25 July 2008, Cuiaba, Brazil
  Organized by: International Association For Ecology
  Contact: http://www.cppantanal.org.br/intecol/
- Coast to Coast Conference 2008 ,18-22 August 2008, Darwin, Australia
  Organized by: Australian Coastal Society
  Contact: http://www.coast2coast.org.au/
- International Conference on Climate Change and Global Warming (CCGW 2008), 12-14 September 2008, Heidelberg, Germany
  Organized by: World Academy of Science, Engineering and Technology
  Contact: http://www.waset.org/ccgw08/cfp.html
- Wetlands 2008: Wetlands and Global Climate Change, 16-18 September 2008, Portland, Oregon
  Organized by: Association of State Wetland Managers
  Contact: http://www.aswm.org/
- The 11th International Conference on Wetland Systems For Water Pollution Control 2008 - India, 1-7 November 2008, Vikram University, Indore
  Organized by: International Water Association
  Contact: http://www.wetland2008.org/SaveWater/

World Wetlands Day - 2nd February

"Healthy Wetlands - Healthy People"