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A STUDY ON THE GROWTH CHARACTERISTICS AND DISTRIBUTION OF WATER HYACINTH IN KOLLERU LAKE, ANDHRA PRADESH-INDIA

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ABSTRACT
Water hyacinth (*Eichhornia crassipes* (Mart.) Solms is a causing a serious problem by blocking waterways, and breeding ground for mosquitoes by its massive growth in the Lake Kolleru. There is no data on its seasonal growth and its distribution characteristics therefore the water hyacinth was sampled from five different locations of Kolleru Lake and the following measurements were made on individual plants: plant weight (wet), number of living leaves (green), number of dead leaves (brown), leaf size: length and width, plant height and number of plants for squaremeter for summer, rainy, post monsoon and winter seasons from June, 2009 to Nov, 2011. The average values of the five locations were found to be 230(gms), 9, 4, 16(cms), 14(cms), 75(cms), 26 for plant weight, leaves(green), leaves(brown), leaf size(length), leaf size(width), plant height, and no.of plants for squaremeter respectively. The highest plant weight was recoreded during rainy season June 2009(289) gms which is due to the agricultural runoff and the lowest plant weight was recorded during summer season May 2010 (186) gms. The live leaves were highest (15) during rainy season Aug 2011 and lowest (4) during summer season May 2011. The dead brown leaves were highest (8) during summer season May 2010 and lowest (2) during rainy and winter seasons Aug 2009 and Jan 2010. The leaf lenght was highest (20cms) during summer season June 2009 and lowest during (13cms) during rainy season Aug 2009. The leaf width was found to be highest (17cms) during summer season June 2009 and lowest (11cms) during rainy season Aug 2009. The plant height was highest (87cms) during post monsoon Nov 2010 and lowest (53 cms) during summer season June 2009. The no of plants for square meter were found to be highest (36) during post monsoon Nov 2011 and lowest (15) during summer seaon June 2009. From this research it is evident that water hyacinth is a perennial aquatic weed and its growth characteristics changes with seasonal variation and the Kolleru Lake is eutrophic which enhances the growth of water hyacinth and helps in natural water filteration process.

KEY WORDS: Water hyacinth, Growth characteristics, Biomass allocation, Seasonal distribution, Kolleru Lake

INTRODUCTION

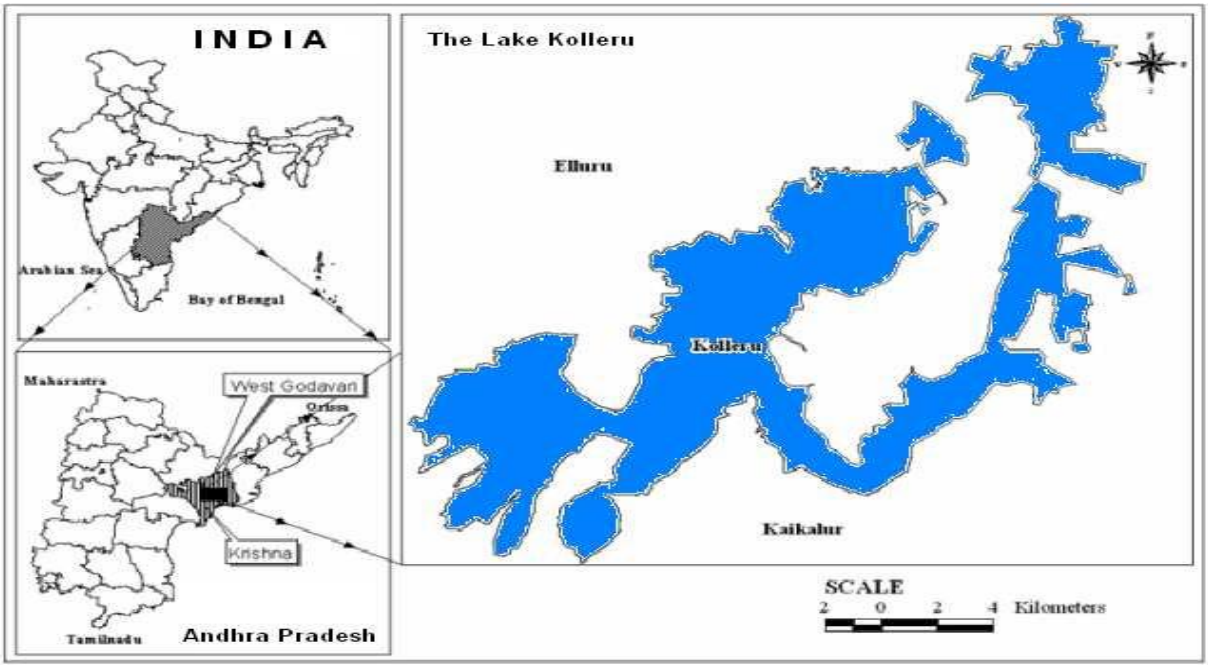
The water hyacinth, *Eichhornia crassipes*, is a free floating aquatic plant of wide distribution in tropical, subtropical, and warm temperate regions throughout the world. Its free-floating plant body comprises of a shoot with a rosette of petiolate leaves, a terminal inflorescence and numerous roots hanging in the water its attractive purple flowers produce viable seeds, but waterhyacinth propagates primarily vegetatively by forming ramets at the ends of stolons. The characteristics that make this plant grow rapidly in polluted waters make it an ideal candidate for large scale application for nutrient removal and water purification (Reddy and Sutton, 1984). It has been reported that these plants help in the uptake of heavy metals from polluted lake and river waters (Zaranyika and Ndapwadza, 1995) as well as improve the overall quality of eutrophic water bodies (DeBusk and Reddy, 1987). The rapid growth of this species has resulted in alterations in many bodies of water, by increasing evapotranspiration, by making navigation impossible, and by bringing about a negative effect on recreation. Population explosions of these plants also cause an increase in appropriate sites for the development of mosquitoes and snails, which are vectors of several diseases, and deplete oxygen in the superficial levels of the water column, which can cause great plankton and fish mortality (NAS, 1981). The high reproductive capacity and rapid growth of *Eichhornia crassipes* endow it with high vegetative development and productivity rates. These characteristics, along with an extreme tolerance, have given this macrophyte efficient mechanism for reproduction and dispersion, rendering it able to form dense stands within a few months in a large variety of habitats, such as rivers, lakes, or reservoirs. This could be the result of the lack of predators, competitors, or natural endemic diseases, added to intrinsic characteristics of the species, or physical and chemical conditions of the habitat (Gopal, 1987). Many researchers have evaluated using different methods to know the biomass production of this species, both in the field and laboratory. However, works carried out under natural conditions have not emphasized demographic approaches, which take into account classical analysis of growth and allow for flow in individuals and their constituting parts (McGraw & Garbutt, 1990). Since this flow represents the cycling of nutrients and the input of organic matter into the water body, its determination is important in studies of the

ecology of aquatic systems (Pinto-Coelho & Greco, 1999). This research aimed at measuring the net primary production of *Eichhornia crassipes* using both a traditional method and a demographic approach to determine the temporal variations in its growth rate according to the biomass variation and the number of plants and leaves.

MATERIALS AND METHOD

Waterhyacinth plants growing in Kolleru Lake (Fig.1) from five different locations were sampled at seasonal (summer, rainy, Post monsoon and winter) from June 2009 to Nov 2011. Plants were washed with water to remove the dust and solid particles. The samples were returned to our research laboratory and the following measurements were made: plant weight, number of green leaves, number of brown leaves, length and width of plant leaf, Plant height (measured as the distance between the base of the tallest leaf and the top most portion of the lamina), and the no.of plants for square meter. The average of the five locations was taken for the estimation of biomass.The minimum and maximum values were observed for all the seasons. Water hyacinth is 5 to 7% solid matter and the rest, 93 to 95%, is water (Gopal, 1987). Biomass (total weight of shoots and roots per unit areas) is high in water hyacinth, higher than for other macrophytes, and it varies considerably with age, size and crowding. The variety of ways to estimate biomass was calculated by the methods of Gopal (1987).

FIGURE 1: Location of Lake Kolleru in India



Study area

RESULTS AND DISCUSSION

From the Table 1 it is evident that water hyacinth is a perennial aquatic weed which is found throughout the year. The biomass of water hyacinth was found to be in the ranges of 186-289(gms), 4-15, 2-8, 13-20(cms), 11-17(cms), 53-87(cms), 15-36 for plant weight, no.of leaves green, brown, leaf lenght, leaf width, plant height and no.of plants for one square meter respectively. The optimal growth was observed at temperatures of 29 to 32°C, while growth ceased when water temperatures drop below 11°C and it is retarded above 35°C. Frosts kill the leaves and upper petioles which protect the rhizome, but prolonged cold temperatures, below 5°C, may kill the rhizome resulting in death of the plants (Owens & Madsen, 1995).The worldwide distribution of water hyacinth illustrates that this is a well adapted weed and tolerates considerable environmental variation. Its northern and southern limits appear to be imposed by winter temperatures and the presence of permanent mats of water hyacinth occurs in latitudes of about 40°N and S (Gopal, 1987; Julien *et al.*, 2001). Water hyacinth is 5 to 7% solid matter and the rest, 93 to 95%, is water (Gopal, 1987). Biomass (total weight of shoots and roots per unit areas) is high in water hyacinth, higher than for other macrophytes, and it varies considerably with age, size and crowding. Under conditions suitable for growth, the only requirement is water or wet mud. Rates of growth are enhanced in eutrophic water and may be low in pristine waters with no or low flow. In natural systems with flow, the hydroponic effect of passing low nutrients over the roots constantly can lead to development of massive infestations such as that which occurred on the Sepik River of Papua New Guinea (Julien & Orapa, 2001).

TABLE 1: Biomass of water hyacinth from different stations of Kolleru Lake from June 2009 to Nov 2011

Growth characeristics of water hyacinth (Average of 5 different locations of Kolleru Lake)									
S.No	Month	Season	Plant weight (gms)	Leaves (Green)	Leaves (Brown)	Leaf Size-Length (cm)	Leaf Size - Width (cm)	Plant Height (cm)	No.of Plants (M^2)
1	Jun-09	Summer	188	5	7	20	17	53	15
2	Aug-09	Rainy	289	14	2	13	11	82	27
3	Nov-09	Post Monsoon	240	11	4	17	14	87	36
4	Jan-10	Winter	199	8	2	17	15	74	25
5	May-10	Summer	186	5	8	19	14	57	16
6	Aug-10	Rainy	285	13	4	15	13	80	28
7	Nov-10	post Monsoon	238	10	4	14	14	87	34
8	Jan-11	Winter	196	9	3	18	16	77	26
9	May-11	Summer	186	4	7	17	15	56	17
10	Aug-11	Rainy	286	15	4	16	12	84	23
11	Nov-11	Post Monsoon	237	10	3	14	13	85	36
		Average	230	9	4	16	14	75	26
		Minimum	186	4	2	13	11	53	15
		Maximum	289	15	8	20	17	87	36
		Median	237	9.5	4	17	14	80	26
		STD Deviation	42	4	3	2	2	13	8

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Doubling times for plant numbers and biomass are widely quoted to be between 1 to 3 weeks, sometimes less, the variation depending on the situation and the environment. Doubling times (reviewed by Gopal, 1987) varied from 5.9 to 28.1 days for weight and from 3.7 to 57.8 days for numbers of plants as measured in the open (outside ponds) or in the field. Averages, with the same assumptions indicated above, for doubling times, were, 6.2% for weight and 6.1% for number of plants. Under ideal growth conditions using the lowest doubling times (5.9 for weight and 3.7 for number), over 16 tonnes would have grown in 11 weeks and 2 048 plants would have grown after 5.5 weeks. Knowing the growth rate of plants in an area to be controlled and the condition that encourage growth is important for some control techniques. Most spread of water hyacinth is by floating plant material rather than by seed. Plants are spread downstream by normal flow when they break away from mats and during floods when large mats may be displaced across floodplains. Plants may also be spread when individuals or small clumps are blown by wind, the leaves acting as sails, on low-flow waters. Spread may also occur by seed in silt due to flow and by the movement of machinery, man and animals carrying the tiny seeds in mud. Spread between catchments, regions and continents is by man, deliberately as an ornamental plant, for example, into Europe via for the ornamental plant trade (EPPO, 2007), and inadvertently when plants or seeds are unwittingly transported to a new location. Plant weight was gradually increased from summer to rainy and gradually decreased during post monsoon and winter. The highest plant weight was observed during the end of rainy season, this is due to the inflow of high nutrients and minerals from the agricultural runoff and the prawn fields. The lowest plant weight was observed during the summer season due to the decreased inflow of water into the lake and also due to the hot summer. The no.of green leaves were found to be highest during the rainy season and lowest during summer season.The brown leaves were highest during summer and lowest during rainy and winter seasons.The length and width of the leaves were reached to its maximum length during summer and lowest during rainy season. The lowest length is found in the rainy season because the leaves are in the initial stage of forming, due to the rains. The plant height was highest during the post monsoon and the lowest during the summer season. The no.of plants were gradually increased from rainy to post monsoon and decreased to the lowest in summer. This is due to the formation of ramets during the rainy season and reached maximum during the post monsoon seasons.

CONCLUSION

Although the conduit through which the water hyacinth infested in Lake Kolleru remains a mystery, the eutrophication and conducive climate facilitated its rapid spread. The results from this paper reveal that Kolleru Lake is eutrophic which receives high nutrient load from the various industries and drainage canals which enhances the growth of water hyacinth. The plant biomass was increased to several folds during the last five years and its spread to the lake is rapidly increasing from day to day. The biomass of the water hyacinth should be properly utilized for mushrooms production and biogas production as found in the literature. The nutrients and the drainage from the industries should be well treated before the passage of effluents into the lake. As the Lake Kolleru is recognised as the Ramsar site of international importance the concerned authorities should take necessary action to protect this lake and should make its glory as before with in a short period.

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