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Habitat destruction of *Azolla pinnata* in Vadodara, Gujarat

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Abstract **- The survey was aimed to identify the effect of the change in the frequency and abundance of *Azolla pinnata* in Vadodara city of Gujarat. The result showed alarming sign of habitat destruction not only due to industrial pollution but also encroaching of their habitat for anthropogenic activities like building roads, closing of the ponds for human habitation at the cost of the habitat destruction of flora and fauna. Conservation and culturing of *Azolla pinnata* is the need of the hour for the benefit of humanity and should be explored to get the maximum benefit from it, not only in combating the problem of pollution especially in an industrial city but also for suitable supply of fooder for the livestock in a small city like Vadodara.**

Key Words: ***Habitat, urbanization, industrialization, seasonal change, Azolla,***

I. Introduction

An ecosystem is a system of interrelated organisms and their physical-chemical environment (1). According to Kenneth J. Wagner (2010) "Human activity can unduly accelerate the process of lake aging or, in the case of introduced species or pollutants, force an unnatural response. Unnatural responses include the elimination of aquatic species as a result of acid deposition, algal blooms resulting from excessive nutrient enrichment, and the development of a dense monoculture of a non-native aquatic plant. However, it would be unrealistic to assume that managing cultural impacts on lakes can convert them all into infertile basins of clear water. Understanding the causes of individual lake characteristics (i.e., understanding the lake ecosystem) is a fundamental part of determining appropriate management strategies". Increasing rate of pollution due to the industries located nearby added together with the antropogenic activities, like urbanization etc. Richbiodiversitynot only helps in maintaing an ecosystem but at the same time can also help a lot in facing the pollution level at any particular region. Aquatic macrophytes play an important role in the structural and functional aspects of aquatic ecosystems by numerous ways(2). Ferns are poised to become leading players in the search for sustainable relationships

with the natural world (3). *Azolla*, an aquatic fern, a component of rich biodiversity in Vadodara, Gujarat can not only produce more food than any other life forms, but can do so in a biodiversity–friendly way that minimise use of space and energy resources. *Azolla* is a good source of protein as well as biofertlizer, together with having biofiltering capacity of many pollutants as reported by many.The biomass of *Azolla* can be dried for future use during the unfavorable periods as it can be used as fodder for the cows being high in nutrient content especially in protein. In the cities it becomes difficult to grow fodder for the cows but *Azolla pinnata*since can be grown in small tub in small houses also, it should be encouraged to cultivate in the cities like Vadodara as fodder where cows were often found to be allowed to feed from the dustbins by their owners. The objectives were to find out the frequency and abundance of *Azolla pinnata* in Vadodara. Results of survey of the Vadodara city and its adjoining areas would certainly be able to highlight on the presence of the plant in Vadodara region over a period of time thereby highlighting on the effect on its habitat in the region for their survival.

II. Material and Methods

Vadodara and its adjoining areas were initially surveyed for *Azolla pinnata*during the year 2010 to 2011. After a gap of three years, in 2013-2014 the survey was repeated in the same areas to check the frequency as well as abundance of the species of *Azolla*in Vadodara region. The survey was conducted all throughout the year to check its presence, frequency and abundance in this region. The results were based on visual observations (4).

III. Results

Survey of various wetlands, ponds or lakes of Vadodara and its adjoining areas showed that during a period between the year 2010-2011 *Azolla pinnata* was found to be growing wellin only Harni pond (22.3382°N, 73.2185°E) and Koyali wetlands(22.3736°N, 73.1031°E) near the Refinery outlet from October to December in greater frequency and abundance than rest of the year. Sparse growth on Sama pond(22.3424°N,73.201703°E), Vishwamitri River(near LNTcircle)(22.3274°N,73.1976°E) and Dhobi lake(22.3126N, 73.2192°E) was also found fromOctober to November during the same period of the initial survey. The plant was generally found to be growing along with *Pistia* sp., *Ipomoea* sp. and *Lemna* sp. in most of the areas.

The selected plant was found to be decreasing in frequency and abundance in and around Vadodara city during the study period of three years. During the final survey *Azolla pinnata* was found to be growing, though in reduced frequency and abundance, in small population and in isolated places were still found to be growing in the nearby wetlands of Koyali areas near the outlet channel of Gujarat Refinery during the post monsoon seasons only. During the other seasons it was found to be growing with extremely meager size of population very difficult to observe at first glance as they were found growing under the canopy of either other aquatic plants like *Pistia*sp or under any leaves of other plants growing in the wetlands perhaps to avoid the dry whether in both summer and winter seasons. Post monsoon periods were found to be favorable for them. Drastic change in the frequency and abundance in the Vadodara city areas almost reaching to the extent of extinction point in almost all the wetlands, ponds, lakes found during the final year survey and even in Harni pond areas which was considered to be a collection spot for almost allvariety of aquatic plants especially *Azolla pinnata*.

IV. Discussion

Pollutants, anthropogenic activities, along with a constant and uncomfortable increase in average temperatures across all three seasons had lead to habitat destruction together with its associate flora and fauna. Uncontrolled chemical dump from nearby industries has arguably turned the local river Vishwamitri into one big dumping channel (5). Once the plant was found in Dhobi lake may be due the phosphorus content of the water because of washing of clothes in that lake. Deteoriation in the phosphorus content or any nutrient imbalance may be the cause of decline of the species from that area. It was reported that phosphorus content could limit the growth of this plant (6). Harni Lake is located in the outskirts of city. The lake has a much-diversified biodiversity, many species of plants exist there and even migratory birds come and reside there. Now a day it is undergoing deterioration due to anthropogenic activities. According to a study conducted by Dave and Krishnayya (2004) "the area around Harni Lake was subjected to degradation in diversity and density of species and the overall change in community structure could be attributed to the urbanization and anthropogenic pressure in the study area".Reduction in the availability and utility of the valuable aquatic plants for nutritional as well as other purposes are the result of destruction and reduction of wetlands. Hence these species are needed to be domesticated for further utilization in various ways to solve the problems of mankind and live haomoniously with nature.

Extreme heat and cold reduces the size of the leaves as well as the rejuvenation capacity. Increase in average temperature together with more rainfall than earlier years in Vadodara region may be an another cause of decline of *Azolla* which require comparatively lower temperature and high humidity than other species of a particular area. Flood like situation in these regions during the past years may be responsilble for the decrease in seed bank frequency, as well as washouts of habitat soil, change of the soil composition etc. effecting the renewable as well as regeneration rate of these plants in Vadodara region. Thus the main threats are both abiotic as well as biotic which includes the small size populations, habitat degradation, change in microflora and fauna, climatic changes, chemical pollutions of waters by herbicides, fertilizers used in modern agricultural practice together with increase of construction of cemented buildings, charcoal roads, highways near the wetlands due to spread of urbanisation of the cities like Vadodara.

Extiction and polulation reduction are the major threats to biodiversity. Pollution and climate change leading to habitat destruction are the main cause of extiction and reduction in population. Biodiversity buffers ecosystem against environmental changes such as global warming. Elimination of species from tropic level can cause destruction of ecosystem as well as biodiversity. However in a complicated ecosystem having several tropic levels, loss of one or more species do not cause any serious problem because of the availability of an alternative. Loss or addition of species can cause detectable changes in ecosystem rates as species makes unique contribution to the function of an ecosystem (7). *Azolla* since can not only grow well in nitrogen defficient media, but at the same time can add nitrogen to the defficient habitat region helping in the growth of other nitrogen requiring species because of its symbiotic association with *Anabaena azollae*, a cyanobacteria. It also had the capacity of accumulating pollutants like heavy metals which not only can protect other sensitive flora and fauna but can also protect the surrounding habitat of human population by not allowing mosquitoes to breed, a major problem faced by people in Vadodara region. Thus not only plants gets benefited from their co-operating neighbours but also human beings are equally benefited from being in neighbour with beneficial plants like *Azolla* in this polluted environment. Extiction of this species might cause a serious threat to the ecosystem.

V. Conclusion

Azolla pinnata, an aquatic ferns should be cultured and conserved to sustain the rich biodiversity of Vadodara region for the benefit of Humanity and should be explored to get the maximum benefit from it in combating the problem of pollution especially in an industrial city like Vadodara.

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