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Marsilea quadrifolia L. on the Way to be the Threatened Species in and Around Vadodara City

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Abstract-The present study was aimed to check the frequency and abundance of *Marsileaquadrifolia*in and around Vadodara city based on some selected spots where they were found to be growing in the first year of survey. After a gap of three years, in 2013-2014 the survey was repeated in the same areas. *Marsileaquadrifolia*was found to be decreasing in frequency and abundance in and around Vadodara city during the study period of two- three years. During the fourth year there was drastic change in the frequency and abundance of *Marsileaquadrifolia*in the Vadodara city areas almost reaching to the extent of extinction point even in once flouring areas like Harni pond areas and wetlands near Mahi River areas in Vadodara. The main threats were found to be both abiotic as well as biotic stressors, which resulted in decrease in seed bank affecting the renewal as well as regeneration rate or vice versa. Again small size and isolated population might be due to stochastic variations or vice versa leading to reduced viability and reproductive capacity of individuals to environmental changes. *Marsilea* is a good source of many ethno-medicinal properties. Conservation of these aquatic fern is thus extremely useful to save the biodiversity in Vadodara region.

Key words: Conservation, *Marsilea*, survey, threats, stressors, biodiversity

I. Introduction

Pteridophytes the first true land plants, an important group in plant kingdom offer a very suitable material to study as its worldwide distribution suggests its possible evolution of various adaptation traits for living in different habitats [1].According to Botanical Survey of India (1994) out of 1022 species of Peridophytes recorded from India only 16 species yet are documented from various localities of Gujarat.

*M. quadrifolia*generally were found to be the common species in temperate wetlands within Europe but now has a scattered distribution andaccording to IUCN criteria, it is considered a vulnerable species. Despite the protection and conservation measures, and the fact that new populations that were naturally formed in the wilderness have been reported, the assessments of *M. quadrifolia*populations trend at the temporal and spatial scales showed that they continue to be in decline in UE region. Despite conservation strategies approached

within the European Union, its area of occupancy has decreased; thereby this species has become vulnerable at European Union level [2].

Gujarat is a storehouse of rich biodiversity with diversified habitat. To preserve the rich biodiversity the factors affecting it needs to be identified [3].Vadodara; the third largest city of Gujarat is situated on the bank of the river Vishwamitri and on the fertile plain between the Mahi and Narmada Rivers. In recent years, Vadodara has suffered from increasing air, water and soil pollution from neighboring industrial areas, apart from sudden increase in precipitation and growth in urbanization [4].

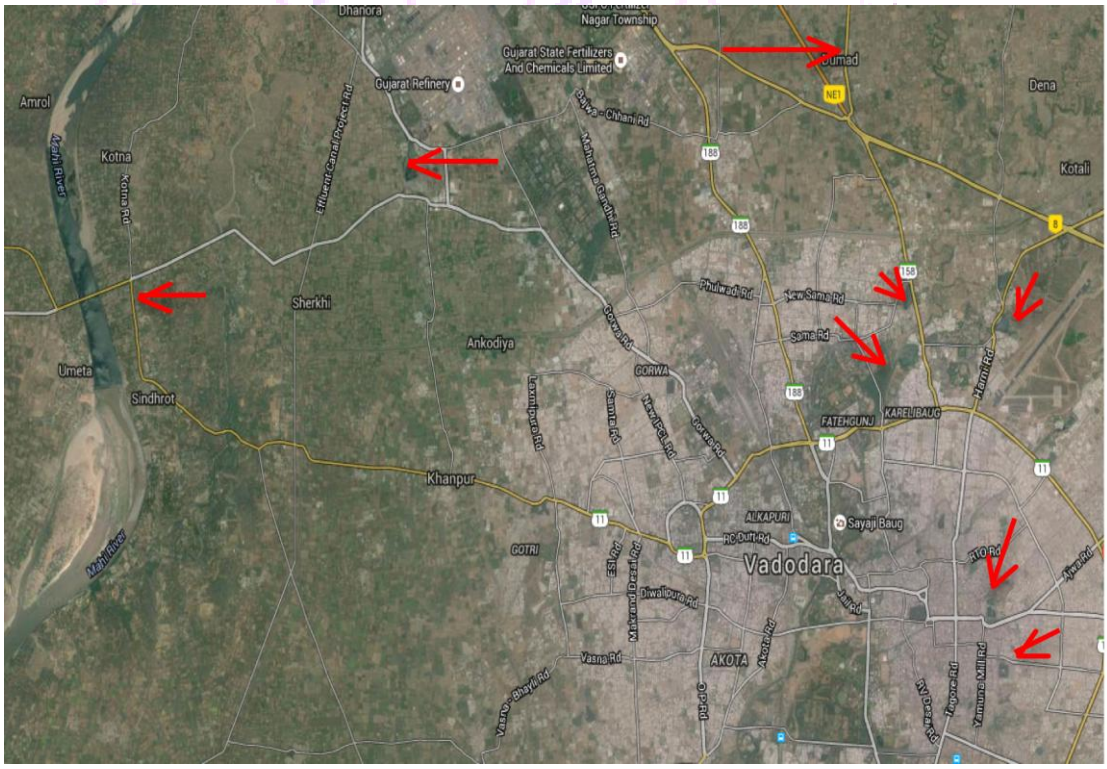
The present study was aimed to check the frequency and abundance of *Marsileaquadrifolia*in and around Vadodara city based on some selected spots where they were found to be growing in the first year of survey.

II. Materials and Methods

Survey of selected spots in Vadodara city and its adjoining areas during the first year (2010-2011) to check the frequency as well as abundance of the species *M. quadrifolia based* on visual observations [5].

After a gap of three years, in 2013-2014 the survey was repeated in the same areas. The survey was conducted all through out the year to check its presence, frequency and abundance in this region, based on visual observations [5].

III. Results and Discussion



Map: Vadodara city and its adjoining areas showing site of location (arrow) of *M. quadrifolia*during 2010-2011.

*Marsileaquadrifolia*was found to be growing in amphibious conditions in Harni pond (22.3382°N, 73.2185°E), Sama pond, Raja and Rani pond (22.3000904°N, 77.217045°E) Mohammad pond (22.1735°N, 73.139°E), Dumad lake (22.376288°N, 73.189593°E),

wetlands at Koyali, as well as in terrestrial conditions also along the banks of River Mahi (22.436127°N, 73.075840°E) and marshy lands, in gardens, along the sides of roads (during rainy seasons only), within the city area from August to November in high frequency. The plant was found to be growing along with other aquatic plants like *Ipomoea* sp. etc.

*Marsileaquadrifolia*was found to be decreasing in frequency and abundance in and around Vadodara city during the study period of two- three years. During the fourth year there was drastic change in the frequency and abundance of *Marsileaquadrifolia*in the Vadodara city areas almost reaching to the extent of extinction point even in once flouring areas like Harni pond areas and wetlands near Mahi River areas.*Marsileaquadrifolia*was still found to be growing well in abundance and frequency in Savli village ponds than in the ponds of proper city areas during the final year survey observations.

Biodiversity is mainly threatened by extinction and population reduction of species. Habitat destruction may happen due to changes in the climate of the region as well as due to pollution and thus often leads to extinction and reduction in population. Species diversity of an ecosystem often gives protection in sustenance against environmental changes such as global warming [6, 7].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 one. Loss or addition of species can cause detectable changes in ecosystem rates as species makes unique contribution to the function of an ecosystem [7].

The main threats might be due to the small sized populations, low genetic diversity and genetic erosion of populations, habitat degradation and chemical pollutions of waters by herbicides and fertilizers used in modern agricultural practice as specially found in the Harni pond area of Vadodara city.

Fragmentation, which subdivides sites and isolates populations, also induces negative effects of small population size on population viability [8].The persistence of small, isolated populations is threatened by environmental, demographic and genetic stochasticity [9]as observed in Mahi river areas and the surveyed wetlands within Vadodara city.

As a consequence of modified wetland systems and complexes, the connections between populations within metapopulations have been disrupted and the increasing distance between patches further enhances the probability of species extinction. Fragmentation of wetland habitats also leads to the decrease in the total surface area and thus in the total size of populations, as well as the size of the remaining habitat patches which increases their vulnerability as observed in Harni pond area.

In case of any prolonged disturbance the population cannot survive [10]may be due to small size of population and low genetic variability because the plant usually has clonal multiplication and doesn't make reproductive structures [2].

Marsileaquadrifolia had been found in most of the areas of Vadodara with both vegetative as well as sexually reproductive structures. Sporocarps were only found to develop in winter seasons, from November to February in the study area. Plants cultured in the green house of MSU and Arboretum though failed to develop sporocarps for continuously two years but produced sporocarps after two and half years. This might be due the fact that the plant cultured were continuously being used up for performing other tests in both the pre and post monsoon periods for almost two years, were thus continuously being disturbed and thus perhaps failed to bear sporocarps due to this wear and tear indicating that they preferred to grow vegetatively in disturbed environmental conditions [11].

Similar to many aquatic and wetland plant populations, *M. quadrifolia*appears to function as dynamic metapopulations [12], which means that these populations are linked by exchange of genetic material, thus increasing their resilience to natural changes in the availability of suitable habitats as found in the Dumad pond area near Sama Savli road near Vadodara city.Dumad pond area is still remaining to be fragmented due to comparatively less anthropogenic interferences and might be the cause that *M. quadrifolia*is still found to be in flourishing condition in that area.

Low genetic diversity may be a critical element for adaptations to environmental changes and for long-termsurvival of the species [13].The strategy of vegetative propagations allow the *M. quadrifolia*to colonize new growth sites and the spread of this species in its distribution range and even in non-native areas [14], thereby perpetuating the persistence and self-maintenance of the populations [10, 12]in the new places [2].

Rare species in altered habitat will be more susceptible to extinction than common species because their population becomes smaller than those of co-occurring species of higher abundance [15].During our survey in the post monsoon periods it was observed that *Marslieaquadrifolia*were among the last species to be flourished after the shower season than its neighboring aquatic and terrestrial species.

If a species with a fragmented distribution suffers further range contraction, vulnerable small and/or isolated populations will go extinct first [16], as found within Vadodara city wetlands. The water pollution may still be the primary cause of population reduction due to nutrient load, use of herbicides, pesticides, construction works of roads and buildings nearby the water bodies as well as industrial wastewaters mainly in Vadodara region.

Extreme heat and cold though reduces the size of the leaves as well as rejuvenation capacity [6]of *Marsileaquadrifolia*in Vadodara but addition of water helps in quick recovery of *Marsileaquadrifolia*in summer and monsoon seasons than in the winter periods [11].

Increase in average temperature together with more rainfall than earlier years in Vadodara region may be another cause of decline *Marsilea*,being belongs to ferns 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 responsible 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.

Changes in water quality due to anthropogenic activities, habitat destruction and excessive rains leading to wash out are some of the biotic and abiotic stressors. Due to vegetative propagation in response to environmental changes deleterious recessive alleles may get expressed due to homozygosity. Thepopulation's ability to adapt to future environmental changes could thus be limited by loss of diversity due to expression of deleterious recessive alleles [17]. Thus environmental stressors could reduce the viability and reproductive capacity of individuals.

Marsilea is a good source of many ethno-medicinal properties. Conservation of these aquatic fern is thus extremely useful to save the biodiversity in Vadodara region. Thus, as habitat degradation makes it difficult to develop in situ conservation programs, in vitro micropropagation as well as invivo propagation in greenhouses could be an efficient procedure for ex situ and insitu germplasm multiplication and conservation [18].

IV. Conclusion

Thus the main threats are both abiotic as well as biotic which includes the small size populations, low genetic diversity and genetic erosion of populations, habitat degradation, change in micro flora 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 urbanization of the cities like Vadodara.

M. quadrifolia is thus mainly facing habitat destruction at various regions of Vadodara in Gujarat. Based on the Survey report of Vadodara city and its adjoining areas, *M. quadrifolia* is now conserved in the Arboretum of Maharaja Sayajirao University of Baroda, being a medicinal plant.

V. References

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