Summary

Gujarat is bestowed with complex ecosystems with diverse plant diversity. The diversity pertains to the biogeographical variations in form of desert, semi-arid scrublands, coastal-reef-rich mangrove belts and dry-moist deciduous forests interspersed with fertile agricultural fields. The biogeographical regions have resulted in mosaic of geoclimatic conditions resulting in diverse zone with arid, semi-arid and ever green plants in different forest types. With the ever-increasing human interventions and large-scale habitat destruction, many of the plant species are facing risk of extinction.

Gujarat being a state of Industralisation there is lot of anthropological pressure on the forest. Industralisation has also lead to the invasion of exotic plant species, which compete with our indigenous and endemic plant species. In such a scenario it is essential to know the status of plant species occurring in Gujarat. Visualising the present scenario, as a first step all the species occurring in Gujarat were documented. The documentation showed that Gujarat harbours nearly 2603 taxa belonging to 155 families. This was further executed to the endemic and indigenous threatened plant species based on critical review of literature.

The status of each taxon was even cross-checked with IUCN Red List of threatened species. The review showed that 417 taxa *i.e.*, sixteen percent of the total floristic diversity of Gujarat have been evaluated by the IUCN Red List. The analysis revealed that nine percent (23 taxa) fall under threatened categories, which includes four Critically Endangered species: *Chlorophytum borivilianum, Tribulus rajasthanensis, Commiphora wightii* and *Jasminum azoricum*; six Endangered species: *Eriocaulon richardianum, Ischaemum vembanadense, Pterocarpus santalinus, Guaiacum officinale, Ammannia nagpurensis* and *Swietenia mahagoni*, and thirteen Vulnerable species: *Curcuma pseudomontana, Acacia ferruginea, Dalbergia latifolia, Saraca asoca, Garcinia indica, Joannesia princeps, Cleistanthus collinus, Khoya senegalensis, Swietenia macrophylla, Chloroxylon swietenia, Dyerophytum indicum, Santalum album* and

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Jacaranda mimosifolia. Rest others, nearly 84% (2186 taxa) are still not evaluated owing to data deficiency.

The objective of the study was to know the present status of endemic and threatened plants in Gujarat. The assessments of selected 199 taxa revealed that six species are strict endemic to Gujarat state, while remaining 169 are species endemic to India and occurring in Gujarat. Additionally, 24 non-endemic taxa but with restricted distribution in Gujarat were also assessed.

Plant species that are endemic to Gujarat were assessed at a global scale. Of the six endemics, *Tamarix kutchensis* is a shrub while remaining herbaceous. *T. kutchensis* is confined only to its type locality and no conservation measures have been taken till date. The species has been assessed as Critically Endangered based on the criterion for small population size and decline. *Tephrosia jamnagarensis,* a leguminous herb was assessed Endangered B1ab(i,ii,iv)+2ab(i,ii,iv), that is confined only to Jamnagar and Junagadh districts The species is assessed as Endangered owing to narrow geographic range of 86 km^2, and area of occupancy is 8 km^2. *T. jamnagarensis* is threatened by cattle grazing and vigorous growth of invasive species *Senna uniflora* in grassland. Two endemic grasses (*Spodiopogon aristatus* and *Ischaemum sayajiraoi*) were assessed as Vulnerable. Both the species have been collected from southern Gujarat wherein the habitat is similar to that of Maharashtra. Probably, further extensive studies of the species will assist in understanding the actual status of such species. While southern Gujarat showed endemic grass species, semi-arid zones of Kachchh and Saurashtra represents an Asteraceae member *Helichrysum cutchicum;* it has been evaluated as Vulnerable.

Species those are endemic to India, with extended distribution in Gujarat, 169 taxa, were assessed at regional scale. These, 169 taxa come under 106 genera and 37 families. Of which, Fabaceae was the dominant family represented by 27 taxa, followed by Poaceae (24), Acanthaceae (18), Asteraceae (11), Euphorbiaceae (10), and Orchidaceae (9). The IUCN assessments resulted in 6 species (*Ceropegia odorata, Achyranthes coynei, Euphorbia deccanensis, Flemingia tuberosa, Geissaspis tenella* and *Heterostemma dalzellii*) critically endangered, 35 endangered, 61 vulnerable, 15 near threatened, 34 least concern and 7 data deficient (Appendix-I).

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The Red List categories that have been determined for different taxa during the present study are fixed as per the current knowledge. But these have to be re-evaluated after a specific period (generally ten years) and the status should be updated, wherever necessary. The specified period of re-evaluation will depend on the disturbances caused to the habitat. However, the IUCN rules to govern the movement of taxa between categories are: (a) a taxon may be moved from a category of lower threat if none of the criteria of the higher category has been applied for 5 years or more, (b) if the original classification is found to have been erroneous (based on re-analysis of the new data or new information), the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay and (c) transfer from lower risk to higher risk categories of threat should be made without delay.

The present study also demonstrates that endemics are mostly concentrated in southern region, and they are primarily herbaceous (108 members), followed by 22 trees, 21 shrubs, 13 climbers and 5 undershrubs. Many of the endemics are habitat specific, while some of them are known either only by type collections of just a few additional collections. Moreover, size of the family is directly proportional to the number of endemics.

Based on the AOO density, 77 taxa showed the value 0 indicative of being sparsely occupied, 15 taxa showing valuses in the range of 0.03 to 0.09, 19 taxa showed the values from 0.1 to 0.17, 25 taxa show their values from 0.2 to 0.29, 18 taxa show their values from 0.3 to 0.39, 8 taxa show their values between 0.4 to 0.49 and 7 taxa show their values between 0.5 to 0.57.

Estimation of population size and number of mature individuals could not be undertaken for all the species because of terrain inaccessibility, logistics issues and methodological challenges. The threat status of selected plant species as established through this study should help in focused and streamlined conservation efforts in the state.

The most significant threat to our flora is loss of habitat to agriculture and grazing. Other significant threats include roadworks, weed competition, industrial and urban development, changed fire regimes, collecting, mining and forestry.

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Tourism activities have contributed to the introduction and spread of weeds in many natural habitats *esp.* the invasion of *Senna uniflora* is noteworthy. History is rich with tales of the disastrous outcomes of some intentional introductions such as that of *Prosopis juliflora*, which resulted in the local extinction of indigenous species. We can avoid repeating such mistakes by learning from history. Yet surprisingly, potentially damaging introductions continue. Careless behaviour leads to unintentional introductions. So-called 'accidents' now account for the majority of successful invasions. Today, alien invasion is second only to habitat loss as a cause of species endangerment and extinction.

For conservation of the wildlife in Gujarat, all the existing protected areas are mainly due to protection of large animals. There is not a single protected area in the state specifically for wild plants. During conservation movement, only the category of threat is not necessarily sufficient to determine priorities for such action. The category of threat simply provides an assessment of the likelihood of extinction under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation actions such as costs, logistics, and chances of success and even perhaps the taxonomic distinctiveness of the subject. Different types of protective measures have been proposed by various scientists form time to time to conserve the threatened plants. However, based on the present study the following measures are suggested:

i. *Tephrosia jamnagarensis*, taxa which are threatened and restricted in a single locality should be conserved by creating protected areas at the community or species level.

ii. Developmental activities cannot be stopped, but during such activity efforts have to be made to do minimum harm to the habitat of threatened plants. If any construction or developmental work is essential at any place, the area should be explored properly and all the endemic as well as threatened plants to be transferred carefully to other similar habitats and should also be preserved in botanical gardens as an *ex-situ* method.

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iii. Plants like *Ceropegia odorata* which are sensitive to climatic changes, and can be propagated only natural habitat should be transplanted to other habitats having similar climatic as well as edaphic conditions.

iv. *Ex-situ* conservation of some plants, particularly those having aesthetic values like *Begonia* sp., *Arisaema* sp., *Jasminum* sp., should be done.

v. Overgrazing must be controlled particularly to conserve the threatened grasses and other herbaceous vegetation.

vi. Awareness should be created among the local people regarding the importance of conserving the plant species also, as they are aware of importance in conserving wild animals at present.

vii. Natural calamities like soil erosion, floods, land-slides should be controlled by various available methods to save the critical habitat of threatened plants.

viii. University and college teachers should be made aware about the threatened plants, which will subsequently refrain the students from collecting it, particularly on mass scale. In fact, teachers can keep a specimen or photo of such plants to show to students.

ix. However, the most effective method to conserve the threatened plants is considered to multiply these plants through tissue culture technique and then transplanting the offspring to the natural habitats. This should be given top priority where habitat destruction is contemplated in the immediate future.

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