

Invasion of *Volkameria inermis* L. in mangrove habitat of estuarine area of southern Gujarat: a future threat to mangrove species

Volkameria inermis L. belongs to Lamiaceae family which is a gregarious and bushy shrub species and mostly used as medicinal, ornamental, and home garden plants in India; but it has been observed frequently in coastal and estuary areas, therefore, various studies (Tomlinson 1986; Parani et al. 1998) considered it as semi mangrove, back mangrove or mangrove associate. This plant makes colonial growth due to floating of seeds in tidal water as a result of mass regeneration and establishment of population in the coastal as well as estuarine areas due to its high reproduction ability and prolific growth capability in new locations (Raju & Kumar 2016). A study done by Liang et al. (2022) described natural habitats of *V. inermis* are coast, beach, and tide with salt tolerant ability, while earlier study done by Biswas et al. (2018) described it as a native and terrestrial ornamental plants but now it has escaped in coastal areas,



A patch of *V. inermis* in Ambika Estuary area of Samapore Village, Navsari, Gujarat. © Rajkumar Yadav.



A patch of *V. inermis* in Ambika River Estuary area near Shikottar Mata temple, Jalalpor, Navsari, Gujarat. © Rajkumar Yadav.

estuarine areas, mangrove areas and therefore considered a potential invasive species for those areas.

Generally, plant invasion is defined as alien and exotic plant species occurring in

non-native range due to some anthropogenic activities such as introduction or introduced accidentally (Richards & Friess 2015) and such kind of species have shown highest threat to biological diversity (Vitousek 1994; Yadav et al. 2020) and

it may create their communities because they are better competitors than resident native species (Leger & Espeland 2010). More or less, similar characteristics have been observed for *V. inermis* during a floristic study in estuarine areas of Purna and Ambika rivers in Navsari District of Gujarat where *V. inermis* has been frequently observed in estuarine areas of Samapore (20.9458° N & 72.7947° E) and nearby Sikkotar Mata temple (20.9336° N & 72.8131° E). These areas were found to be potential areas for various mangrove species such as *Avicennia marina* (Forssk.) Vierh., *Acanthus ilicifolius* L., *Sonneratia apetala* Banks, *Ceriops tagal* (Perr.) C.B. Rob., and *Bruguiera cylindrica* (L.). Bhatt et al. (2009) reported a total of seven mangrove species from Purna Estuary area.

In the study area, *V. inermis* was found to be healthy competitor in estuarine area by which all open potential mudflat areas have been densely covered. Moreover, a mangrove associate community, i.e., *Porteresia coarctata* (Roxb.) Tateoka, was also observed perpetually, but these plants are important constituents of mangrove plant succession along the estuaries of India (Jagat et al. 2006). Despite the competition for the growth of *V. inermis* in the estuarine areas of Purna and Ambika rivers in southern Gujarat, this species was found to be a potential invasive species, which may alter the growth and structure of mangrove species due to its high prolific growth and seed dispersal mechanism. The seeds of *V. inermis* may disperse due to various dispersal mechanism, in which, various vectors such as water, wind and coastal birds are involved (Biswas et al. 2018). However, mangrove species are more resilient to plant invasion in coastal areas because they

grow into saline and intertidal environment where common terrestrial or fresh water plant species may struggle to survive or reproduce (Biswas et al. 2018). Nevertheless, mangrove habitats localizing in estuary (Purna and Ambika rivers) areas of southern Gujarat were found to be facing threats of some plant invasion which obstruct the growth of mangrove species. Estuarine areas are most productive, very dynamic areas which show dynamic nutrient and oxygen rich conditions and subsequently change the biota as per the high and low tides and salinity status of rivers. This ecosystem contains numerous micro habitats, i.e., mangrove, coastal grasslands, mudflats, which support the growth of halophytic and non-halophytic plant species.

In the current observation study, all open space of the estuarine areas especially landward side was occupied with enormous growth of *V. inermis* by which the growth of mangrove species was in stress and even new recruitments were found to be less than the mangrove recruitments found in coastal areas. Hence, during current observation, two locations, i.e., Samapore and nearby Sikkottar Mata temple of Purna and Ambika estuaries, respectively, were found to be dominated by *V. inermis*. The dominance of the species will be other than these areas as well, because it may expand its range beyond original noted sites due to its high prolific growth and fast spreading mechanisms.

Mangrove habitats in estuarine area are more sensitive for widespread growth of invasive species (Biswas et al. 2018) and it is considered as most threatened habitat in the world (Valiela et al. 2001) during reduced water and

soil salinity (Biswas et al. 2018). Scientifically, it is proved that *V. inermis* prefers reduced water and soil salinity for its healthier growth and the landward side of estuary areas are most favourable habitat for this plant due to upstream and downstream water connectivity. During current observation, dense patches of *V. inermis* were found in landward side in estuary area, hence, this observational study suggests that there is urgent need for structured monitoring of co-evolution of *V. inermis* in estuarine areas of Gujarat by mangrove conservators and managers so that future threats by it can be controlled earlier before it spreads in vast ranges in other areas of southern part of Gujarat.

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