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Synthesis of the Conference on Management and Conservation of Seagrass Ecosystems in India

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ABSTRACT

Seagrass has not yet received the necessary attention in Indian research and policies, a major reason for its decline in Indian coastal waters. A conference held in New Delhi, India, in July 2016, aimed to address this lacunae by bringing together renowned national and international seagrass experts. The conference dealt with the status, ecosystem services, and conservation and management options for seagrass. This paper integrates the discussions and recommendations from the conference. Recommendations included, among many others, suggestion for a National Action Plan with an ecosystem approach for seagrass conservation and management in India.

1. Introduction

Seagrass occurs in most coastal waters around the globe. It is a highly productive ecosystem and provides a wide array of services. It is shelter to many associated fauna, nursery, feeding and foraging ground to a large number of fish and other species. About 697 species of fish are caught from seagrass areas in the Indo-Pacific region (Unsworth, 2016). It is home to threatened animals such as the Dugong (*Dugong dugon*), the sea horse, etc. Its services as stabilizers of the coast, sediment traps etc., are also well recognized. The ecosystem service of seagrass in providing food and livelihood security to the coastal fishing communities has a potential to contribute towards poverty alleviation.

The Indian coast is part of the Tropical Indo-Pacific Bioregion 5, a classification developed by Short et al. (2007), to assess seagrass distribution and diversity. It harbours the highest number of seagrass species (24) out of which 14 occur in Indian waters with the highest diversity found along its southeast seaboard (Short et al., 2007). Important seagrass beds are observed in Gulf of Kachchh, Gulf of Mannar, Palk Bay, Chilika Lagoon, and around the islands of Lakshadweep and the Andaman and Nicobar (Jagtap, 1991; Jagtap et al., 2003; Kannan et al., 1999).

Services provided by seagrass ecosystems, especially as coast stabilizers and as provider of food and livelihoods are important for a country like India, where 40% of the population lives within 100 km of the coast (National Disaster Management Authority, 2016). More than 4 million people derive their livelihood directly from the coast, out of which 61% live below the poverty line (Food and Agriculture Organization, 2014; Rao et al., 2016).

A global study demonstrated that seagrass habitats are known to hold twice the amount of carbon as compared to similar terrestrial ecosystems (Fourqurean et al., 2012). With growing concern about climate change and commitments towards mitigation, conservation and proper management of seagrass ecosystems should have become centre piece for countries with extended spread of seagrass beds. However, seagrass ecosystems have not yet found their rightful place in most countries' marine policies. This could be one of the factors making this ecosystem the most threatened worldwide with an annual decline rate of ~7% since the 1990s (Waycott et al., 2009). Though marine and coastal areas are increasingly brought under protection, the conservation objectives usually centre on other coastal components, namely the mangroves and the corals. Only rare instances exist, such as Tululeu Seagrass Conservation Area in Palau (Wood, 2007), which primarily focus on the conservation of seagrass.

With a proved carbon sequestration capability much more than terrestrial ecosystems, seagrass could also play a major role for India's 2015 climate plan (Intended Nationally Determined Contribution), which commits to create an additional carbon sink of 2.5–3 billion tonnes of carbon dioxide (MoEFCC, 2015). Thus, it is most opportune for Indian scientists to take stock of the current knowledge of seagrass ecosystems in India, their distribution and status, a prerequisite for an

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effective and efficient policy towards management and conservation of seagrass ecosystems.

2. The Seagrass Conference, Delhi, India

A first of its kind in India, a two-day conference on "Management and Conservation of Seagrass Ecosystems in India" (henceforth referred to as the Seagrass Conference), brought together 51 seagrass experts–both national and international–in July 2016 in Delhi. The conference dealt with three themes: (i) status of seagrass ecosystems in India; (ii) ecosystem services of seagrass, and (iii) management and conservation of seagrass. The event was jointly organised by the Ministry of Environment, Forest and Climate Change, Government of India, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, and the International Union for the Conservation of Nature (IUCN).

Sixteen presentations showcasing the research carried out on seagrass in India were made during the conference. This set the stage for discussions on issues to be addressed to maintain the productivity of seagrass beds for the benefit of large segments of the coastal population, and to ensure that the ecological services provided are not lost. Most of the conference presentations are included as papers in this Special Issue (SI). The objective of this paper is to synthesise the discussions and the recommendations under the themes mentioned above. Suggestions towards improved conservation and management of seagrass in India are also presented.

2.1. Status of seagrass ecosystems and its research in India

Seagrass studies in India started to appear some 70 years ago. At present, the country stands 16th in terms of the number of publications on this ecosystem (Thangaradjou and Bhatt, 2017 in this SI). Almost all studies have concentrated on its distribution, species diversity and status. According to most of the studies 14 seagrass species exist in Indian waters, spread over some 500 sq. km along the Indian coast (Ganguly et al., 2017 in this SI; Geevarghese et al., 2017 in this SI; Thangaradjou and Bhatt, 2017 in this SI). Though researchers increasingly rely on high resolution satellite data, complemented by in-situ verification, the heterogeneity of seagrass patches, often found interspersed with seaweeds and other epiphytes, require more advanced studies. Geospatial assessments would benefit from improved correction algorithms for satellite data (Geevarghese et al., 2017 in this SI). Molecular studies for seagrass identification and seagrass gene flow could help to better identify the distribution of the various species found in India (Thangaradjou and Bhatt, 2017 in this SI).

Most of the seagrass species in India, though protected directly or indirectly through various legal provisions, show a decline similar to the global trend (IUCN, 2017). Anthropogenic pressures such as modification of coastal space; pollution due to dumping of untreated waste; well-intended (though often conflicting) conservation legislations; and the absence of dedicated policies towards conservation of seagrass are just some of the major causes for decline.

While India has a long history of providing extensive legal frameworks for the protection of nature, as evidenced by the Indian Wild Life (Protection) Act 1972, the conservation agenda is often driven by a focus on charismatic species. This also holds true for the marine and coastal realm, where turtles, whale sharks, dugongs, etc., are given prominence in protection. A consequence of such an approach, albeit unintended, is witnessed in certain atolls of Lakshadweep Islands. Here the disappearance of the seagrass species *Syringodium isoetifolium* is also attributed to the overgrazing by marine turtles that enjoy full protection under Schedule I of the Indian Wild Life (Protection) Act 1972 (Prabhakaran and Arunkumar, 2016 in this SI). Recent studies show that turtles foraging on seagrass meadows not only negatively impact seagrass cover but also inhibit regrowth of seagrass by consuming below-ground roots and rhizomes (Christianen et al., 2014).

Recommendations from participants emphasized the importance of adopting an ecosystem-based approach to conservation, may it be for research programmes or formulation of conservation measures. Thus, it is important to improve the currently available estimates of total seagrass distribution and its seasonal variation through geospatial analysis, using standardized density-level mapping protocols. It was agreed that mapping of the distribution of various seagrass species across India using DNA barcoding should be undertaken. Another area of concern for the participants was the limited knowledge in India about the ecological and socio-economic role of flora and fauna associated with seagrass, which are often exploited by small- and large-scale industries. Discussions on the latter led to a general consensus that there was need for a more holistic approach to research on the impact of anthropogenic interventions on the status and distribution of seagrass in India.

2.2. Ecosystem services

Studies on the services offered by coastal ecosystems are becoming more frequent in India. However, very few studies have so far dealt with seagrass, and if so, most of them investigated its role in carbon sequestration (Ganguly et al., 2017 in this SI). Such studies reported mean values of 636 mg C/m^2/day for Indian waters, which compares favourably with global estimates of carbon sequestration by seagrass attaining only slightly more than 300 mg C/m^2/day (Ganguly et al., 2017 in this SI). While there are marked differences between seagrass species in their capacity to store carbon, they all have in common that they store substantially more carbon in the sediments than in the plant's biomass–both above and below ground (Ganguly et al., 2017; Ramachandran et al., 2017a, 2017b in this SI). In *Halophila ovalis*, the percentages of carbon stored in sediments and in seagrass biomass were estimated as 95.3% and 4.7% respectively. Ganguly et al. (2017), in this SI also suggested that given the carbon sequestration capacity of seagrass ecosystems and thus, their role in climate mitigation, proper management of seagrass ecosystems needs to be included in climate policy frameworks such as REDD+ (Ganguly et al., 2017 in this SI).

In the Gulf of Mannar Marine National Park, the density of fish larvae was found to be higher in seagrass areas (198 individuals/m^2) in comparison to the open sandy areas (112 individuals/m^2) (Choudhury and Sivakumar, 2009). This is a clear indicator of the eminent role seagrass plays in supporting fisheries (Sivakumar et al., 2017). The role of seagrass meadows in enriching fauna and flora is of immense importance for various ancillary industries in India, namely, aquarium trade, lime industry etc., and for local livelihoods (Jeyabaskaran et al., 2017).

2.3. Management and conservation of seagrass

Conservation and management of seagrass is possible only through a multipronged approach that includes regulatory efforts, management with provisions of sustainable use, awareness protocols and advocacy with interdepartmental cooperation being the given. Actions need to be initiated at three interdependent levels, namely scientific, management and societal levels to arrive at principles by which seagrass ecosystems should be protected (Fortes, 2017 in this SI).

The example of Chilika Lagoon in Odisha on the eastern coast of India demonstrates that active interventions such as opening of the barmouth, dredging, banning of aquaculture etc., have done well for its seagrass (Pattnaik et al., 2016). These interventions resulted in a much improved flow of saline water into the lagoon, providing a stable salinity regime, improving water clarity etc., and allowed for a natural recolonialization of seagrass in the lagoon.

The participants felt that awareness building across the spectra of stakeholders such as coastal communities, policy makers, implementers etc., will go a long way in supporting seagrass conservation efforts. Improving monitoring and assessment of health of seagrass ecosystems, developing stringent measures to control land based pollution, and enforcing implementation of already existing legal instruments (namely