Chapter48. Mangroves

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2. Spatial patterns and inventory

Mangrove distribution correlates with air and sea surface temperatures, such that they extend to ~30°N, but to 28°S on the Atlantic coast (Soares et al., 2012), and in the Indo-West Pacific (IWP), to 38°45'S to Australia and New Zealand (Hogarth, 2007). The latitudinal distribution of mangroves is limited by key climate variables such as aridity and frequency of extreme cold weather events (Osland et al., 2013; Saintilan et al., 2014). The distribution and structural development within areas with suitable temperatures is further limited by rainfall or freshwater availability (Osland et al., 2014; Alongi 2015). The area covered by mangroves (between 137,760 and 152,000 km^2) and the number of countries in which they exist (118 to 124) have been the focus of many studies (FAO, 2007; Alongi, 2008; Spalding et al., 2010; Giri et al., 2011). The accuracy of these ranges is affected by the

true mangrove species in common, except for *Rhizophora mangle*/*R. samoensis* (Duke and Allen, 2006). *Acrostichum aureum*, which is classified by some as a mangrove ‘associate’, is also found in both regions. The genera *Rhizophora* and *Avicennia* are unique in having worldwide distribution (Duke et al., 2002).

3. Rate of loss/changes and major pressures

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Despite widespread knowledge of their value, mangroves are being lost globally at a mean rate of 1-2 per cent per year (Duke et al., 2007; FAO, 2007), and rates of loss may be as high as 8 per cent per year in some developing countries (Polidoro et al., 2010).

macrotidal coastlines (>4 m tidal amplitude) with significant riverine inputs, are believed to be least vulnerable (Ellison and Zouh, 2012). While there are varying opinions on the nature and level effects on mangroves from climate change drivers, it is widely agreed that the vulnerability of mangrove forests is increased by occupation and urbanization of the coastal zone, including the conversion of mangrove area to other land uses (Soares, 2009).

Some of the other effects of climate change (e.g., increased precipitation, temperature and atmospheric CO_2 concentration) may actually increase mangrove productivity (Gilman et al., 2007) and the ability of mangroves to keep pace with sea level rise (Henzel et al. 2006; McKee et al., 2007a; Langley et al., 2009; McKee, 2011; Krauss et al., 2014) because elevated CO_2 increases productivity and biotic controls of soil elevation. Increased temperatures are correlated with mangrove range expansion (Osland et al. 2013), due to the reduction in intensity, duration and frequency of extreme cold weather events that are expected to support mangrove poleward migration. The genus *Avicenna* has already proliferated at or near their polar limit at the expense of salt marshes (Saintilan et al., 2014). Mangroves may therefore be more resilient to climate change than was previously thought (Alongi, 2007) and certainly the effects will vary greatly depending on local conditions (e.g., geomorphology and shoreline stability). Indeed, the role of mangroves in carbon sequestration and mitigation of climate change effectst shoreline stabilization and coastal protection (Kathiresan and Rajendran, 2005; Wells et that conserve mangroves (Brazil offers one example among many other countries (Glazer, 2004)), yet progress is being made through legislation, new partnerships between governments and local communities, and the REDD+ programme (Reduced Emissions from Deforestation and forest Degradation) in developing countries

restoration efforts to consider the risks of trading preservation of ecosystems for their intrinsic value and the emerging paradigm of prioritizing some elements of nature that are economically useful, at the potential cost of other values that are less economically valuable or are useful only to certain groups. In this process of assigning a monetary value to an ecosystem service, cultural and social values, such as those held by communities that live near and depend directly on the forests and that possess a deep the sustainable management of mangrove forests in Guatemala, Honduras and Nicaragua, the Satoyama Initiative in Benin, and Mangrove Action Project (MAP-Asia) in Thailand, among others.

Although several initiatives are concerned with capacity building, capacity building will be more effective if it is integrated and follows a set of basic assumptions about training and knowledge base. Increased effectiveness can be achieved through: (i) training related to conservation and sustainable use of mangrove forests and their resources; (ii) raising awareness among as many stakeholders as possible (especially policy-makers); (iii) political empowerment of stakeholders; (iv) cooperation within and between governments, institutions, organizations and agencies that are engaged in these activities; (v) identification and development of innovative proposals; (vi) maintaining systems for the reduction and resolution of conflicts; (vii) ensuring that programmes include measures to address threats from climate change and human activities.

Specific ideas for capacity building include: use of standardized methods for mangrove species distribution and area surveys (Manson et al., 2012) and development of capacity in the use of base maps on digital terrain models. These would display areas where mangroves are mostly at risk from submersion due to sea level rise. Capacity to conduct surveys and geographical information systems (GIS) mapping in all regions would be useful, along with the development of capacity for "climate-smart conservation" (Hansen et al., 2010), which would involve strategies for promoting mangrove adaptation to sea level rise. It would be useful for nations to develop the capacity to better identify and evaluate potential barriers for landward migration in response to sea level rise and have more accurate information regarding the location of landward migration corridors as well as improved strategies for ensuring that these migration corridors are present in the future. It would also be useful to know specifically how other drivers of change (e.g., urbanization, other coastal land uses) may affect the potential for landward migration of mangroves in response to sea level rise. onduc60.1fule

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