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## LETTERS

edited by Etta Kavanagh

### A World Without Mangroves?

AT A MEETING OF WORLD MANGROVE EXPERTS HELD LAST YEAR IN Australia, it was unanimously agreed that we face the prospect of a world deprived of the services offered by mangrove ecosystems, perhaps within the next 100 years.

Mangrove forests once covered more than 200,000 km<sup>2</sup> of sheltered tropical and subtropical coastlines (1). They are disappearing worldwide by 1 to 2% per year, a rate greater than or equal to declines in adjacent coral reefs or tropical rainforests (2–5). Losses are occur-

ring in almost every country that has mangroves, and rates continue to rise more rapidly in developing countries, where >90% of the world's mangroves are located. The veracity and detail of the UN Food and Agriculture Organization data (2) on which these observations are based may be arguable, but mangrove losses during the last quarter century range consistently between 35 and 86%. As mangrove areas are becoming smaller or fragmented, their long-term survival is at great risk, and essential ecosystem services may be lost.

Where mangrove forests are cleared for aquaculture, urbanization, or coastal landfill or deteriorate due to indirect effects of pollution and upstream land use (3, 4), their species richness is expected to decline precipitously, because the number of mangrove plant species is directly correlated with forest size (6, 7). Examples from other ecosystems have shown that species extinctions can be followed by loss in func-

tional diversity, particularly in species-poor systems like mangroves, which have low redundancy per se (8). Therefore, any further decline in mangrove area is likely to be followed by accelerated functional losses. Mangroves are already critically endangered or approaching extinction in 26 out of the 120 countries having mangroves (2, 9).

Deforestation of mangrove forests, which have extraordinarily high rates of primary productivity (3), reduces their dual capacity to be both an atmospheric CO<sub>2</sub> sink (10) and an essential source of oceanic carbon. The support that mangrove ecosystems provide for terrestrial as well as marine food webs would be lost, adversely affecting, for example, fisheries (11). The decline further imperils mangrove-dependent fauna with their complex habitat linkages, as well as physical benefits like the buffering of seagrass beds and coral reefs against the impacts of river-borne siltation, or protection of coastal communities from sea-level rise, storm surges, and tsunamis (12, 13). Human communities living in or near mangroves would lose access to sources of essential food, fibers, timber, chemicals, and medicines (14).

Emerging from the embrace of a mangrove tree-lined channel in northern Brazil, these pescadores, like coastal fishers worldwide, know that healthy mangroves mean good fishing and a secure livelihood.

We are greatly concerned that the full implications of mangrove loss for humankind are not fully appreciated. Growing pressures of urban and industrial developments along coastlines, combined with climate change and sea-level rise, urge the need to conserve, protect, and restore tidal wetlands (11, 13). Effective governance structures, socioeconomic risk policies, and education strategies (15) are needed now to enable societies around the world to reverse the trend of mangrove loss and ensure that future generations enjoy the ecosystem services provided by such valuable natural ecosystems.

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