ID: W2154998026

TITLE: Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change

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ABSTRACT:

This review assesses the degree of resilience of mangrove forests to large, infrequent disturbance (tsunamis) and their role in coastal protection, and to chronic disturbance events (climate change) and the future of mangroves in the face of global change. From a geological perspective, mangroves come and go at considerable speed with the current distribution of forests a legacy of the Holocene, having undergone almost chronic disturbance as a result of fluctuations in sea-level. Mangroves have demonstrated considerable resilience over timescales commensurate with shoreline evolution. This notion is supported by evidence that soil accretion rates in mangrove forests are currently keeping pace with mean sea-level rise. Further support for their resilience comes from patterns of recovery from natural disturbances (storms, hurricanes) which coupled with key life history traits, suggest pioneer-phase characteristics. Stand composition and forest structure are the result of a complex interplay of physiological tolerances and competitive interactions leading to a mosaic of interrupted or arrested succession sequences, in response to physical/chemical gradients and landform changes. The extent to which some or all of these factors come into play depends on the frequency, intensity, size, and duration of the disturbance. Mangroves may in certain circumstances offer limited protection from tsunamis; some models using realistic forest variables suggest significant reduction in tsunami wave flow pressure for forests at least 100 m in width. The magnitude of energy absorption strongly depends on tree density, stem and root diameter, shore slope, bathymetry, spectral characteristics of incident waves, and tidal stage upon entering the forest. The ultimate disturbance, climate change, may lead to a maximum global loss of 10?15% of mangrove forest, but must be considered of secondary importance compared with current average annual rates of 1?2% deforestation. A large reservoir of below-ground nutrients, rapid rates of nutrient flux and microbial decomposition, complex and highly efficient biotic controls, self-design and redundancy of keystone species, and numerous feedbacks, all contribute to mangrove resilience to various types of disturbance.

SOURCE: Estuarine, coastal and shelf science

PDF URL: None

CITED BY COUNT: 1403

PUBLICATION YEAR: 2008

TYPE: article

CONCEPTS: ['Mangrove', 'Disturbance (geology)', 'Climate change', 'Storm surge', 'Environmental science', 'Shore', 'Ecology', 'Physical geography', 'Ecological succession', 'Ecosystem', 'Geography', 'Storm', 'Geology', 'Oceanography', 'Geomorphology', 'Biology']