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TITLE: Threats to sandy beach ecosystems: A review

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ABSTRACT:

We provide a brief synopsis of the unique physical and ecological attributes of sandy beach ecosystems and review the main anthropogenic pressures acting on the world's single largest type of open shoreline. Threats to beaches arise from a range of stressors which span a spectrum of impact scales from localised effects (e.g. trampling) to a truly global reach (e.g. sea-level rise). These pressures act at multiple temporal and spatial scales, translating into ecological impacts that are manifested across several dimensions in time and space so that today almost every beach on every coastline is threatened by human activities. Press disturbances (whatever the impact source involved) are becoming increasingly common, operating on time scales of years to decades. However, long-term data sets that describe either the natural dynamics of beach systems or the human impacts on beaches are scarce and fragmentary. A top priority is to implement long-term field experiments and monitoring programmes that quantify the dynamics of key ecological attributes on sandy beaches. Because of the inertia associated with global climate change and human population growth, no realistic management scenario will alleviate these threats in the short term. The immediate priority is to avoid further development of coastal areas likely to be directly impacted by retreating shorelines. There is also scope for improvement in experimental design to better distinguish natural variability from anthropogenic impacts. Sea-level rise and other effects of global warming are expected to intensify other anthropogenic pressures, and could cause unprecedented ecological impacts. The definition of the relevant scales of analysis, which will vary according to the magnitude of the impact and the organisational level under analysis, and the recognition of a physical?biological coupling at different scales, should be included in approaches to quantify impacts. Zoning strategies and marine reserves, which have not been widely implemented in sandy beaches, could be a key tool for biodiversity conservation and should also facilitate spillover effects into adjacent beach habitats. Setback and zoning strategies need to be enforced through legislation, and all relevant stakeholders should be included in the design, implementation and institutionalisation of these initiatives. New perspectives for rational management of sandy beaches require paradigm shifts, by including not only basic ecosystem principles, but also incentives for effective governance and sharing of management roles between government and local stakeholders.

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