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TITLE: The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences

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ABSTRACT:

There is great interest in the restoration and conservation of coastal habitats for protection from flooding and erosion. This is evidenced by the growing number of analyses and reviews of the effectiveness of habitats as natural defences and increasing funding world-wide for nature-based defences-i.e. restoration projects aimed at coastal protection; yet, there is no synthetic information on what kinds of projects are effective and cost effective for this purpose. This paper addresses two issues critical for designing restoration projects for coastal protection: (i) a synthesis of the costs and benefits of projects designed for coastal protection (nature-based defences) and (ii) analyses of the effectiveness of coastal habitats (natural defences) in reducing wave heights and the biophysical parameters that influence this effectiveness. We (i) analyse data from sixty-nine field measurements in coastal habitats globally and examine measures of effectiveness of mangroves, salt-marshes, coral reefs and seagrass/kelp beds for wave height reduction; (ii) synthesise the costs and coastal protection benefits of fifty-two nature-based defence projects and; (iii) estimate the benefits of each restoration project by combining information on restoration costs with data from nearby field measurements. The analyses of field measurements show that coastal habitats have significant potential for reducing wave heights that varies by habitat and site. In general, coral reefs and salt-marshes have the highest overall potential. Habitat effectiveness is influenced by: a) the ratios of wave height-to-water depth and habitat width-to-wavelength in coral reefs; and b) the ratio of vegetation height-to-water depth in salt-marshes. The comparison of costs of nature-based defence projects and engineering structures show that salt-marshes and mangroves can be two to five times cheaper than a submerged breakwater for wave heights up to half a metre and, within their limits, become more cost effective at greater depths. Nature-based defence projects also report benefits ranging from reductions in storm damage to reductions in coastal structure costs.

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