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TITLE: Ecoengineering with Ecohydrology: Successes and failures in estuarine restoration

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ABSTRACT:

Ecological Engineering (or Ecoengineering) is increasingly used in estuaries to re-create and restore ecosystems degraded by human activities, including reduced water flow or land poldered for agricultural use. Here we focus on ecosystem recolonization by the biota and their functioning and we separate Type A Ecoengineering where the physico-chemical structure is modified on the basis that ecological structure and functioning will then follow, and Type B Ecoengineering where the biota are engineered directly such as through restocking or replanting. Modifying the physical system to create and restore natural processes and habitats relies on successfully applying Ecohydrology, where suitable physical conditions, especially hydrography and sedimentology, are created to recover estuarine ecology by natural or human-mediated colonisation of primary producers and consumers, or habitat creation. This successional process then allows wading birds and fish to reoccupy the rehabilitated areas, thus restoring the natural food web and recreating nursery areas for aquatic biota. We describe Ecohydrology principles applied during Ecoengineering restoration projects in Europe, Australia, Asia, South Africa and North America. These show some successful and sustainable approaches but also others that were less than successful and not sustainable despite the best of intentions (and which may even have harmed the ecology). Some schemes may be 'good for the ecologists', as conservationists consider it successful that at least some habitat was created, albeit in the short-term, but arguably did little for the overall ecology of the area in space or time. We indicate the trade-offs between the short- and long-term value of restored and created ecosystems, the success at developing natural structure and functioning in disturbed estuaries, the role of this in estuarine and wetland management, and the costs and benefits of Ecoengineering to the socio-ecological system. These global case studies provide important lessons for both the science and management of estuaries, including that successful estuarine restoration is a complex and often difficult process, and that Ecoengineering with Ecohydrology aims to control and/or simulate natural ecosystem processes.

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