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Monitoring the restoration of coastal and estuarine ecosystems

Restoring ecosystems in estuaries and along coasts is an important part of European environmental policy. A new analysis of degraded ecosystems has indicated that, although some restoration can take less than five years, when there has been a century of degradation, it can take a minimum of 15-25 years.

Estuaries and coastal zones are prone to many changes caused by both human activities and natural processes. For example, dams cause structural changes, urban and industrial waste produces chemical pollution, suspended sediments in the water and excess nutrients. These changes can negatively affect wildlife and their habitats in the area as well as ecosystem services, such as provision of fish, nutrient recycling and recreational value.

One of the primary goals of the Water Framework Directive[1] is to restore degraded habitats. However, without long-term monitoring data using reliable indicators of recovery, it is difficult to assess the recovery of an ecosystem. The study examined available evidence on the recovery of coastal and estuarine ecosystems as part of the EU WISER project [2]. From a review of current studies, it identified 51 long-term cases where actions have been taken to restore ecosystems affected by human pressures and medium or long-term monitoring of recovery has occurred. The case studies were on a range of different wildlife and from different geographical regions.

The time taken to recover varied considerably, ranging from several months for small invertebrates living on the seafloor, to more than 22 years for some seagrass species and macroalgae that inhabit rocky seabeds. Severe impacts, such as oil spills, or longer lasting impacts, such as sewage disposal, require periods of up to 10 to 25 years for complete recovery. However, restoration after disturbance of the seafloor, such as after dredging, usually took around 1.5 to 10 years to recover, providing that the disturbance did not leave any ongoing stressors, such as persistent pollutants. Additionally, some sensitive organisms, such as angiosperms, may take 20 years to recover. The data did not suggest any geographical pattern in recovery rates.

The study classified the 51 cases of recovery into six groups according to the type of stressor and organisms studied: recovery from changes in sediment generally caused by dredging; recovery from changes in habitat, such as marsh restoration; recovery by breaking down organic material, as in oil spills; recovery from persistent pollutants; recovery from excessive removal of wildlife, which relates to commercial fishing; and recovery from excessive extraction of water. The researchers found that the studies tend to focus on the initial reappearance of a particular form of wildlife as an indicator of restoration. However, this does not ensure that full recolonisation of all species in the habitat or a complete restoration of the ecosystem will occur.

Lastly the study looked at the case of long-term recovery of the Nervión River Estuary in northern Spain, which has suffered pollution from industrial development since the mid-nineteenth century. Despite an extensive effort at recovery through closing down industrial plants and installing water treatment processes, recovery is still incomplete as many ecosystems, such as salt-marshes, have been reduced or lost. This confirms that the path to recovery is different to the path of degradation and, despite large restoration efforts, complete recovery cannot be guaranteed. Recovery also depends upon the interactions of species within the ecosystems, such that the system often recovers to a new state, rather than return to its original state.

The researchers suggest that recovery initiatives require long-term goals and criteria by which to measure recovery. Both of these should include the interactive nature of ecosystems, for example, recovery should not be measured simply by the restoration of habitat or one species, but by the achieving a fully functioning ecosystem.

1. See: http://ec.europa.eu/environment/water/water-framework/index_en.html
2. WISER (Water bodies in Europe: Integrative Systems to assess Ecological status and Recovery) is supported by the European Commission. See: www.wiser.eu

Source: Borja, A., Dauer, D.M., Elliott, M. & Simenstad, C.A. (2010) Medium- and Long-term Recovery of Estuarine and Coastal Ecosystems: Patterns, Rates and Restoration Effectiveness. *Estuaries and Coasts.* 33:1249-1260.
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