

Science for Environment Policy

Management strategies for EU water bodies should consider sustainability of ecosystem services, Italy

Considering the sustainability of the services provided by an ecosystem could help to overcome management challenges and hit water quality targets defined by the EU, says a new study. By exploring 13 of the ecosystem services (ES) provided by the Venice Lagoon, Italy, the researchers identify factors affecting sustainable and unsustainable patterns of ES provision, and suggest that confined and more open water bodies could benefit from different management strategies.

In 2000, the EU adopted the [Water Framework Directive \(WFD\)](#), which committed all Member States to the goal of protecting and restoring aquatic ecosystems. However, its overall objective (achievement of good status for all EU waters) was not achieved in about half of EU surface waters in 2015. Such challenges with implementation have been attributed to a simplified view of the Directive, with some management plans targeting the symptoms rather than causes of water degradation¹.

Research into ES — how ecosystems contribute to and benefit human well-being — must advance to tackle these challenges, say the researchers. They adopt a socio-ecological perspective to understand how multiple ES are produced within a system and apply it to the case study of the Venice Lagoon, Italy, a complex coastal body of water that provides many ES. The lagoon is strongly affected by human activity and its management plan² splits it into 11 water bodies, according to chemical condition, ecological state, and the pressures it faces from its surroundings.

The study modelled the evolution and distribution of the lagoon's ES to determine their present and future sustainability. It assessed a mix of ES (and associated indicators) for the lagoon, including climate regulation (carbon sequestration), waste treatment (denitrification), hunting (yield), and tourism (visitor numbers). These were selected based on marine and coastal ES literature and data, and adapted to reflect the lagoon's characteristics. The model distinguished between 'mediated' ES (MED: those related to human input and activity, such as fishing) and 'direct' ES (DIR: those independent of human input, such as climate regulation by vegetation). These were assigned an aggregated indicator (MED/DIR) which represented the potential (un)sustainability of current ES provision. The model's simulations stopped once a resource had depleted or increased by 50%, and the results were expressed as ES variation over time to illustrate overall trends.

Six of the 11 water bodies, mostly open water, showed negative trends, indicating a risk of ES provision declining over time. The most negative trends corresponded to the bodies with the highest levels of overall ES provision, highlighting both the unsustainability of the multiple ES currently provided by these bodies, and the need for appropriate intervention. In terms of individual services, three of the mediated ES showed major negative consequences: clam harvesting, due to the impact of mechanical harvesting techniques; and tourism and recreational navigation, due to the intensity of related boating activities.

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1. Voulvoulis, N., Arpon, K.D., Giakoumis, T., 2017. The EU Water Framework Directive: from great expectations to problems with implementation. *Sci. Total Environ.* 575, 358–366.
<https://doi.org/10.1016/j.scitotenv.2016.09.228>

2. The 'Hydrographic District of Oriental Alps' management plan, adopted in compliance with the Water Framework Directive.

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(continued)

When the effects of climate change were included, most of the water bodies showed negative trends, with confined bodies (the inner parts of the lagoon, surrounded by salt marshes, where water exchange is low) suffering most — a result that the researchers attribute to the fact that the habitats most at risk from climate change are largely found in confined areas, and that open water bodies are already so compromised that climate-change effects are relatively less important.

The analysis revealed a strong association between water-body type, ES patterns, and ES trend. ES provision that is unbalanced towards mediated services is most likely to be unsustainable — i.e. areas that disproportionately provide services related to human activity and input are most likely to see degradation. The association between the modelled ES trends and the water bodies' degree of confinement suggests that different management strategies are appropriate for confined and open water bodies — the former needing intervention to enhance resilience to climate change, and the latter requiring a 'correction' of ES patterns to develop more sustainable models (through the reduction of anthropogenic pressures, and conservation and restoration of habitats).

The researchers suggest that ES could play a role in selecting the 'biological quality elements' (plants, invertebrates and fish) defined in the WFD, by prioritising metrics that are positively associated with sustainable ES patterns and by supporting the implementation of environmental management strategies within the context of climate change. However, it should be noted that this study only defines a climate change scenario, while increasing tourist pressures could become a major threat to the Venice Lagoon ecosystem in the future.



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