Combining seascape connectivity with cumulative impact assessment to support ecosystem-based marine spatial planning

Cumulative impact assessment (CIA) is a simple yet promising approach to guide marine management interventions, but one not without limitations. Jonsson and colleagues report a novel method which combines CIA with seascape connectivity to account for remote effects of local environmental impact.

Human activities are having a catostrphic impact on ocean biodiversity, meaning effective policies and management actions are needed to facilitate the sustainable use of marine resources.

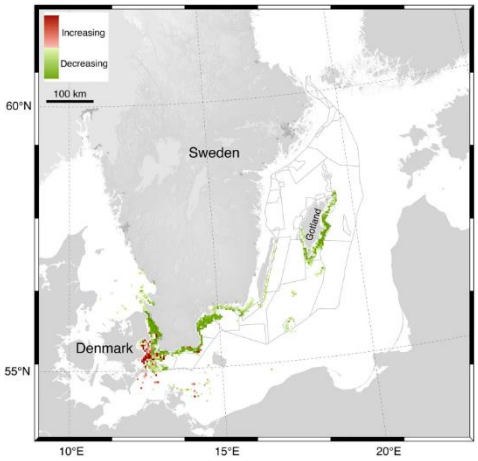
Marine Spatial Planning (MSP) aims to engage and coordinate various stakeholders and, within this, Cumulative Impact Assessment (CIA) is a promising tool to guide the MSP process. In a CIA, information is collected about multiple human pressures and their effects on important ecosystem components, to yield geographic maps of the total impact in the seascape.

The CIA method provides a simple and transparent framework which matches well the requirements for many management and decision processes like MSP. However, CIA also carries several simplifications implying some substantial limitations. One such limitation is the neglect of seascape connectivity.

Current CIA assessment protocol disregards the possibility that locations are ecologically connected due to dispersal and migration of organisms. This limitation is particularly relevant for spatial planning of hazardous activities and the design of MPAs, where remote human pressures may have significant impact within areas aimed for protection and restoration.

In our study, we show how seascape connectivity can be implemented into a CIA framework. We focused on species where connectivity is governed by the passive dispersal of planktonic eggs and larvae, which is typical for most marine invertebrate and fish species. To demonstrate how CIA can be extended to include seascape connectivity, we used a recently developed tool, Symphony.

Symphony considers 37 pressures and we explored their cumulative impact on blue mussels in the Baltic Sea, with and without considering seascape connectivity. Connectivity of mussel larvae, which spend about 25 days as drifting plankton, was simulated using an oceanographic model of sea currents. The modelled connectivity specifies the dispersal probability between all locations within the mussel habitat.



Marine spatial planning (MSP)-related changes to blue mussel connectivity impact across the Baltic Sea. Red colour indicates a slight net increase of connectivity impact while green colour indicates net decrease in connectivity impact

By considering connectivity, we show how local pressures can result in remote impacts through two different effects – a source and a sink impact. The source impact occurs in remote areas, losing recruits because of reduced larval production in the site affected by the pressure. The sink impact occurs when connected upstream mussel banks suffer reduced fitness caused by their loss of recruits in the site affected by the local pressure.

In the Baltic Sea, CIA modelling reveals that connectivity impact is generally small for blue mussels, but may in some areas exceed 20 percent. The neglect of seascape connectivity within MSP could be particularly serious for valuable or sensitive areas, e.g. biodiversity hotspots or fish spawning areas – where distant pressures here may compromise management measures, e.g. implementation of MPAs. This merits further studies of connectivity impacts.

Read the full article, Combining seascape connectivity with cumulative impact assessment in support of ecosystem-based marine spatial planning, in *Journal of Applied Ecology*

Originally posted on The Applied Ecologist

Jonsson, PR, Hammar, L, Wåhlström, I, et al. Combining seascape connectivity with cumulative impact assessment in support of ecosystem-based marine spatial planning. *J Appl Ecol*. 2021; 58: 576– 586. https://doi.org/10.1111/1365-2664.13813