

CEE is an independent, not-for-profit, global network of researchers and stakeholders that publishes evidence syntheses to inform environmental policy and practice

Systematic Map
CEE 21-021

Insufficient evidence exists on the marine ecosystem response to anthropogenic drivers in relation to their provision of ecosystem services

C. Sylvie Campagne, Laurie-Anne Roy, Joseph Langridge, Joachim Claudet, Rémi Mongruel, Damien Beillouin, Éric Thiébaud



@wilfriedthomas
Cultural service – Scientific and education contribution.
Scientific experiments on marine kelp forests to measure their productivity and their role in the carbon cycle.

This systematic map, based on 653 articles, highlights the existing evidence on how changes in marine and coastal ecosystems influence the provision of ecosystem services. The articles were unevenly distributed across geographic regions, ecosystem types, ecosystem services, and types of pressure. Articles on marine ecosystem services decrease with accessibility and distance from the coastline. Less attention is paid to deep-sea ecosystems and ice-associated marine ecosystems. Food provision was the most commonly studied ecosystem service, followed by climate regulation, and recreation activities, while pest and disease control and air quality regulation were the less studied.

Why is this Evidence Synthesis Needed?

Marine ecosystems provide a wide range of ecosystem services on which human societies depend (i.e., benefits humans obtain from nature). The ecosystem services that marine ecosystems provide now and in the future are threatened by anthropogenic activities such as habitat loss and degradation, overexploitation, or climate change. In response to these threats, marine ecosystems are also increasingly included in national and international conservation and management programmes to counteract the negative impacts of human activities and, promote biodiversity conservation and the sustainable use of marine ecosystems. Nevertheless, the differences in available information on different marine and coastal ecosystems and their services is a major obstacle to guide decision-makers in their actions.

The main goal of this review was to map existing evidence on the impacts of changes due to anthropogenic activities in marine and coastal ecosystems on the services that they provide. This systematic map includes data on all types of marine ecosystems and the species that they contain, from coastal to deep-sea habitats, and on changes of biodiversity, from species to ecosystems. All qualitative or quantitative values of marine ecosystem services and disservices, i.e., negative benefits of nature as perceived by humans, are considered.

This Collaboration for Environmental Evidence Systematic Map highlights knowledge gaps and knowledge clusters in the existing literature. Based on 653 articles, the results can be used by research funders to guide future studies and analyses and to identify gaps in knowledge. The long-term objective is to have all the necessary evidence-based knowledge to guide the decisions of managers and stakeholders on the conservation of marine ecosystems, and to enable them to anticipate future changes in marine ecosystems.

Main Findings

What studies are included?

A total of 653 articles were relevant to our aim and were included in the final database, spanning from 1977 to July 2021. The number of studies is unevenly distributed across geographic regions, ecosystem types, ecosystem services, and types of drivers of change.

The most studied ecosystems are pelagic ecosystems on continental shelves and intertidal ecosystems, while deep-sea and ice-associated ecosystems are the least studied. About half of the articles focus on specific coastal ecosystem types with mangroves receiving the most attention followed by tidal saltmarshes and seagrass meadows. Surprisingly, there were only a few studies on coral reefs and kelp forests.

Food provision is the major focus of ecosystem services articles across all types of marine ecosystems, followed by climate regulation and recreation activities. While recreation and tourism are highly important, other cultural services – like aesthetic, spiritual or bequest values - need to be studied more extensively. Ecosystem services can be assessed through different types of values. Biophysical values – related to physical and biological proprieties of the services - are assessed in most of the articles, while economic values are assessed in a third of articles and socio-cultural values – related to psychological, historical, cultural, social, ecological, and political contexts and conditions of the services - in only a few.

Management actions were the most studied driver of changes on ecosystems, followed by overexploitation (e.g. over fishery and mass tourism) and climate change, in particular the increase in seawater temperature. Lastly, the introduction of non-indigenous species and de-oxygenation due to climate change were the least studied.

What are the Implications of the Review Findings?

The current lack of evidence is a threat to the sustainability of human activities and evidence-based marine conservation.

There is a need to develop knowledge-based management actions plans for marine ecosystems and for more research to be done to understand marine ecosystem services and the impact human activities have on them. Our database is a useful resource for those interested in marine management activities and future analyses of management effectiveness as 'management practices' were the most common driver of change among the articles.

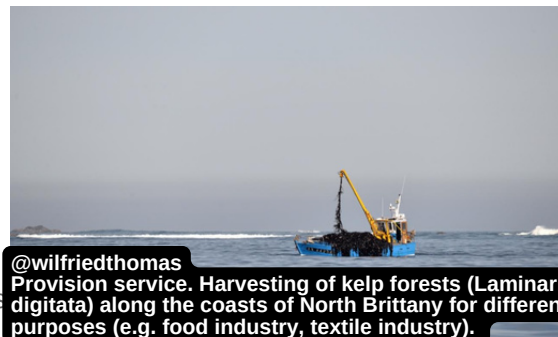
One perspective is to extend the scope of the systematic map to the feedback loop of the use of an ecosystem service on the provision and demands of other ecosystem services. Indeed, some drivers of change affect the potential delivery of marine ecosystem services, which affect other and the ecosystems, which in turn also affect their sustainability. A concrete example could be to analyse how climate change impacts tourism which will affect the delivery of other ecosystem services but also the sustainability of tourism itself. In addition, the multifunctionality through the assessment of combination of services as well as the synergies between ecosystem services are not sufficiently studied and have only been rarely studied in the marine realm.

While the assessment of the different values (biophysical, economical and socio-cultural values) is absolutely essential to consideration the overall ecosystem services contribution to our well-being, the economic and socio-cultural values of marine services are still poorly known.

The knowledge gaps and clusters highlighted in the present study have an impact on the beneficial development of policy and management practises.



@guillaumerosello
Cultural service. Recreation activities at low tide like shore fishing and observation of marine plants and animals.



@wilfriedthomas
Provision service. Harvesting of kelp forests (*Laminaria digitata*) along the coasts of North Brittany for different purposes (e.g. food industry, textile industry).

Synthesis Time Frame

The authors searched published studies in publication databases, on-line search engines, and the websites of international organizations without any time restriction (e.g., since 1788 for Scopus) in July 2021. This CEE Systematic Map was published in July 2023.

Full Citation

Campagne C.S., Roy L-A., Langridge J., Claudet J., Mongruel R., Beillouin D., Thiébaud E. (2023). Existing evidence on the impact of changes in marine ecosystem structure and functioning on ecosystem service delivery: A systematic map. *Environmental Evidence*. 12 (1), 1–29. doi: [10.1186/s13750-023-00306-1](https://doi.org/10.1186/s13750-023-00306-1)

Link to Publication

<https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-023-00306-1>

Funding

This research is a product of the IndySEM project and part of the IMACES project. The IndySEM project is funded by the synthesis centre (CESAB) at the French Foundation for Research on Biodiversity (FRB). The IMACES project received funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement No 899546, part of the BIENVENUE programme with the Bretagne Regional Council.