

Underwater 'Cystoseira zosteroides' forests, the Mediterranean algae, threatened by human activity impact

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The authors note that the slow growth and low reproduction of this alga make it difficult for its capacity to adapt to the environmental. Credit: Pol Capdevila, UB-IRBio

The effects of an intense storm every 25 years could threaten the marine alga populations of *Cystoseira zosteroides*—an endemic species of the Mediterranean with great ecological value for the biodiversity of marine benthos, according to a new article in the international *Journal of Ecology*.

The new study is signed by the experts Pol Capdevila and Bernat Hereu, from the Department of Evolutionary Biology, Ecology and Environmental Sciences and the Biodiversity Research Institute of the University of Barcelona (IRBio) and Juan Lluís Riera and Cristina Linares, from the same department.

Marine algae forests in danger

C. zosteroides, a brown alga of the order Fucales, is a species that creates dense underwater forests that create habitat, protection and food for the marine organisms. Despite its ecological value, there is not much scientific bibliography about this algae species yet, which is one of the most sensitive under the environmental and anthropogenic impacts in the Mediterranean.

According to the researcher Pol Capdevila, first author of the article, "There has been a dramatic decline regarding the habitat-forming algae—mainly the ones belonging to *Cystoseira* or *Sargassum*— over the last years. For example in France, the *C. zosteroides* has dramatically decreased in some marine areas, mostly due to activities of anthropogenic origins (harbor building, pollution, etc.).

"In the Medes Islands, there is a *Cystoseira* population which is still recovering from the effects of the storm of September 26, 2008, an extreme episode with unusual strong winds, and waves up to fourteen meters, which provoked the death of around 79% of the communities of this species."

Surviving in the sea like trees in the forest

There are many enigmas about biology and the distribution of this Mediterranean species. Therefore, from 2008 to 2012 the UB team and IRBio studied the *C. zosteroides* communities in the Columbretes Islands, the Montgrí Coast, Medes Islands and Cap de Creus (Girona, Spain). "All scientific studies on marine algae are difficult since it is necessary to dive to get to the sea beds. The *Cystoseira zosteroides* alga lives in very deep environments and these conditions make us to have less time to dive and study them in situ," says Capdevila.

The algae adopt life strategies that are very different in the marine habitats, according to the authors. Some behave like herb plants (live a few years and reproduce a lot), although others are more similar to trees (live a lot of years, grow slowly and don't reproduce much), with a series of intermediate strategies.

The species of *C. zosteroides* and forest trees have a similar survival strategy: slow growth, high survival and a low reproduction and dispersion line. "Survival, reproduction and growth are three essential demographic processes in all living beings. Since resources are limited, each species will opt for a different strategy: some put more resources on functions to increase individuals' longevity (survival) or to increase the number of descendants (reproduction)."

"Terrestrial trees and *C. zosteroides* place lots of resources in structural biomass (growth of a tree trunk, etc.), that is why they have a high survival rate and live lots of years, more than fifty, in the case of the alga" added.

A vulnerable alga that could disappear soon

This strategy makes it difficult for the alga to adapt to the external perturbations in the marine environment. "The alga lives in deep-water and lasting environments, where resources –mostly light and food- are limited. Since it has evolved in a very tranquil environment, the alga finds it difficult to react towards short-time changes" warns the researcher.

Local impacts such as abandoned fishing gears (nets, trammel nets, threads), pollution, turbidity, etc. and more global (ocean warming and acidification) are the most threatening factors for the Mediterranean *C. zosteroides* population.

According to the authors, the alga can compensate the perturbations through the arrival of new individuals (new-born individuals) which benefit from the space left by the adults. However, even if the community doesn't disappear, the population loses structural value in their functions since, regarding biomass; a small individual doesn't bring the same than an adult one, so the marine forests –complex tri-dimensional structures that help other species- decrease. In addition, the slow dynamics of the algae population demand lots of years, even decades, to recover.

"The episodes with light perturbation frequency – for example, a strong storm every twenty-five years – could mean the extinction of the *C. zosteroides* population shortly. And not only due the loss of individuals but also loss of community functions" warns Pol Capdevila.

Since it is a habitat-forming species, its disappearance involved the loss of marine-related species. Moreover, it has an important role in the primary production of marine ecosystems, and therefore, contribution of carbon to the system. To elaborate the study, the authors applied for the first time –demographic models of big complexity to describe the population dynamics and foresee the consequences of the perturbations

in the long run. These models have considered several factors such as the intraspecific competence and negative effect of adults in the development of young individuals.

Protecting structural algae to preserve marine biodiversity

Marine ecosystems are rarely known and this lack of knowledge hardens the protection of lots of endangered marine species. The results of the article published in the *Journal of Ecology* open doors to new perspectives in the study of biology and ecology of the algae, and bring new knowledge that coincides with the life history theory, which tries to find universal principles that rule the life strategy of the species.

"Generally, algae are species that don't create a lot of empathy and it is difficult to get economic resources to study them. But it is essential to know how to distinguish them with an essential role in the benthic marine ecosystems so as to protect and preserve them. We think that protecting *C. zosteroides* from these perturbations could be a very good solution. Also, we are developing repopulation tools for this algae to improve their preservation state in the areas where they have disappeared," says Pol Capdevila.

More information: Pol Capdevila et al. Unravelling the natural dynamics and resilience patterns of underwater Mediterranean forests: insights from the demography of the brown alga, *Journal of Ecology* (2016). [DOI: 10.1111/1365-2745.12625](https://doi.org/10.1111/1365-2745.12625)

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