



Generation  
Climate  
Europe

# Builders, Sentinels, and Invaders of Marine Ecosystems

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# Introduction

Europe's seas are made up of marine and coastal ecosystems, ranging from the deep oceans to dynamic coastal waters. The distribution of these ecosystems varies across regional seas, with the Mediterranean hosting the highest natural biodiversity.

**Marine and coastal ecosystems** play a **vital role in human life on Earth**, providing essential [ecosystem services](#) such as pollution control, storm protection, carbon sequestration, transportation, and recreation and tourism.

People have fished, sailed and settled along these waters for thousands of years. Many communities are heavily dependent on marine ecosystems. However, [the spread of non-native species](#), the increase in [pollution](#), and [overfishing](#), can cause negative changes to the structure and functioning of the [marine ecosystem](#). The addition of climate change into this mix has left marine ecosystems at risk of collapse.

Particular functional groupings of marine life, such as ecosystem engineers, bioindicators, and invasive species, can tell us about the current state of the marine environment and its effect on coastal communities.

In this article, we'll meet an **oyster that holds the coastline together, a red algae that flags trouble, and a crab that has overstayed its welcome.**

## Ostrea Edulis: the ecosystem engineer of the seas

**The European flat oyster (*Ostrea Edulis*)**



- **Size:** 4 - 11 cm on average
- **Lives:** Up to 20 years in natural conditions
- **Habitat:** Coastal and estuarine waters, hard substrates
- **Role:** Ecosystem Engineer
- **Why it matters:** A filter feeder, habitat builder, biodiversity enhancer and a food web contributor

Source: *Ostrea Edulis*

<https://www.aquaportail.com/fiche-invertebre-14-ostrea-edulis.html>

Let's celebrate a builder of underwater cities: the European flat oyster, *Ostrea edulis*.

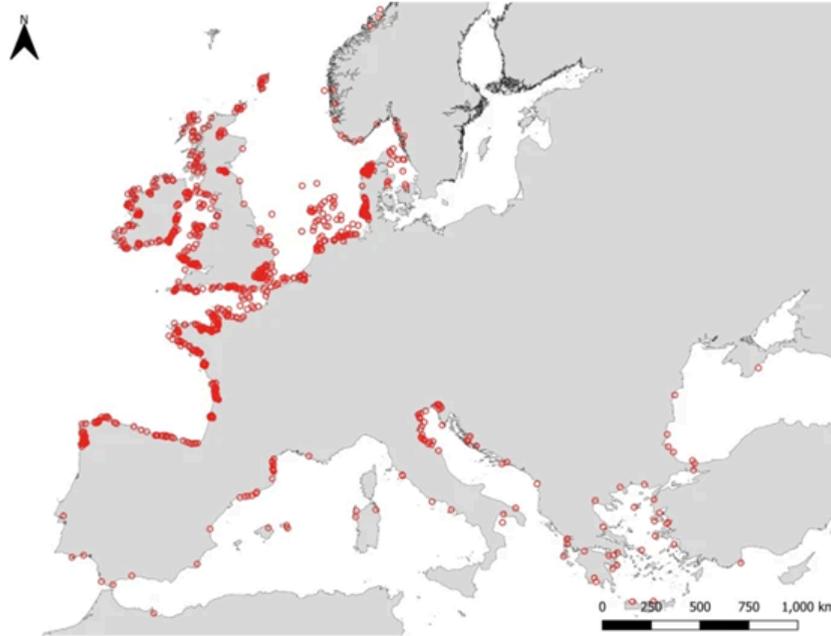
The European flat oyster is known as an [ecosystem engineer](#): a species that contributes to the creation and modification of a habitat, and maintains its health and stability. **The behaviour of an ecosystem engineer strongly supports other organisms and contributes to species richness in an area.**

*Ostrea edulis*, commonly named the [European flat oyster](#), is the [only native European oyster species](#). Sometimes reaching as much as 20 centimeters in size and living [over 20 years](#), these hermaphrodites (male during spawning season, then they switch to female) release up to [1 million eggs](#) each spawn. They inhabit shallow coastal waters from the North-Eastern Atlantic to the [Mediterranean and Black Seas](#).

As **filter feeders**, European oysters are considered important ecosystem engineers. They provide stability to [biogenic reef habitats](#) and sediments for fish, crustaceans and algae. They also remove excess nutrients and particles, and clarify water to improve its quality. By naturally cleaning our bays, they support fisheries and recreation, and help prevent shoreline erosion.

**These oysters** don't only help to **maintain a healthy physical environment**; they also have **important cultural and historical significance**. People living all along the European coastline, where these oysters are found, have harvested these animals for food for [at least 6000 years](#). To this day, despite their decline, European oysters are [still farmed](#) in places like the Zeeland province in the Netherlands. People in this area are proud of their cultural heritage associated with [centuries of oyster harvesting and farming](#).

Restoration initiatives such as France's [FOREVER](#) project (Flat Oyster Recovery Project), the [Voordelta project](#) in the Netherlands, and the creation of the [Native Oyster Restoration Alliance \(NORA\)](#) in 2020 are reviving the oyster's habitat to support coastal resilience and secure food supplies for humans and other marine species.



Locations of oyster reefs mapped from historical sources. Source: Thurstan, R.H., McCormick, H., Preston, J. *et al.* Historical dataset details the distribution, extent and form of lost *Ostrea edulis* reef ecosystems. *Sci Data* 11, 1198 (2024). <https://doi.org/10.1038/s41597-024-04048-8>

## Red algae, red flags: what *Corallina officinalis* reveals about our seas

### Common Coral Weed (*Corallina officinalis*)



- **Size:** 6-12cm tall
- **Lives:** Perennial species, can persist for multiple years
- **Habitat:** Rocky shores, mid-lower littoral zone and shallow subtidal waters, tide pools
- **Role:** Bioindicator, useful to monitor coastal ecosystem health
- **Why it matters:** An important role in the carbon cycle of coastal ecosystems

Source: *Corallina* photographs © M.D. Guiry; *Hippolyte* © Dave Fenwick. [https://www.seaweed.ie/descriptions/Corallina\\_officinalis.php](https://www.seaweed.ie/descriptions/Corallina_officinalis.php)

Let's start with a bioindicator species. Have you ever heard of *Corallina officinalis*? Also known as red algae, this species can actually help us gauge an ecosystem's health by signalling pollution, habitat disruption or climate-related stress.

Ideal **bioindicators** are abundant, naturally occurring, easy to identify and sample, and span areas with different pressures. *Corallina officinalis* ticks all the boxes.

*Corallina officinalis* thrives on [North Atlantic](#) rocky shores and has spread to the [Mediterranean Sea](#), the English Channel and the North Pacific. Given that the algae's calcification rates and pigment are influenced by changing water pH and nutrient levels, *Corallina officinalis* is a good [bioindicator](#) of ocean acidification and [eutrophication](#).



The [distribution](#) of *Corallina officinalis* in European waters.

Source: Marine Life Information Network (n.d.). Coral Weed. Species Information. *The Marine Biological Association*. <https://www.marlin.ac.uk/species/detail/1364>

Unfortunately, climate-driven heatwaves and rising dissolved CO<sub>2</sub> levels lower seawater pH and the availability of carbonate ions that coralline algae need to build their calcified shell and skeleton. [A study](#) demonstrated that this **prolonged warming weakens their growth and survival**.

But why should we care about this red algae? Its **role as an indicator is crucial**, but that's not all. *Corallina officinalis* play an important role in the [carbon cycle of coastal ecosystems](#). Indeed, the algae participates in CO<sub>2</sub> fluxes through its production and dissolution of calcium carbonate.

Moreover, *Corallina officinalis* can be of significant benefit to us due to [its chemical properties](#). Indeed, the algae has antibacterial and antioxidant properties that can be efficient in absorbing toxic dye in the water from the textile industry. If this solution is

developed at scale, *Corallina officinalis* could well become essential in water treatment technology and help reduce water pollution due to industrial waste.

Extracts taken from this algae have both anti microbial and anti fungal properties. The [skin conditioning properties](#) of red algae also make them important components in different skin care products or dietary supplements.

Have you already heard about bacterial resistance to antibiotics? It becomes increasingly necessary for humans to find alternative antibiotics able to kill bacteria surviving current treatments. As research progresses, we may see *Corallina officinalis* in new antibacterial or even anticancer remedies, though for now, these applications are still in the lab.

It is therefore safe to say that *Corallina officinalis* can play many important roles in our lives.

## Blue Crab: an invasive alien species in European waters

### Blue Crab (*Callinectes sapidus*)



- **Size:** Up to 23 cm across the shell
- **Lives:** 1 - 4 years
- **Habitat:** Bottom dwelling in estuaries, bays, coastal waters, tolerates wide salinity range
- **Role:** Invasive alien species in Europe
- **Why it matters:** A predator, scavenger, prey species with economic value, especially in the US

Source: Female Blue Crab. Little Talbot Island, Duval County, Florida 10/15/2004 .  
<https://www.jaxshells.org/bcrab.htm>

From a desired indicator species we now move to an undesired guest. [An invasive species](#) is a non-native organism whose introduction and spread can cause economic harm, environmental damage in the ecosystem it colonises, and sometimes even harm to human health.

The [Blue crab](#) (*Callinectes sapidus*) is a species native to the Americas that has become an invasive species in southern Europe.

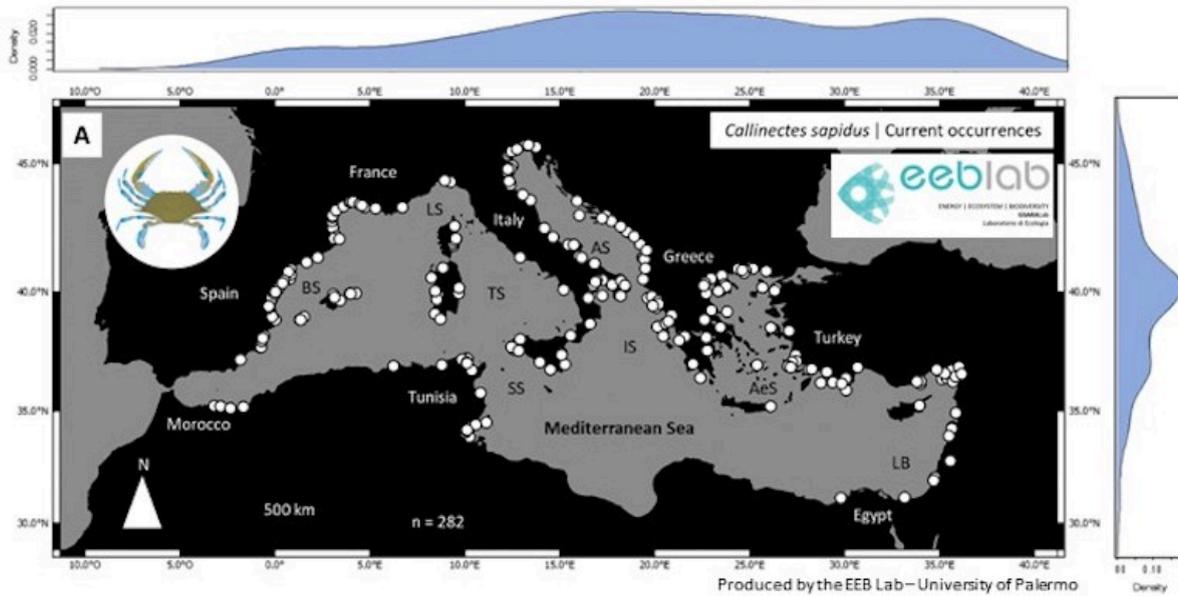
This species is [highly fertile](#), reproducing up to four times in a year and with litters of about 100,000 eggs per female. [Climate change](#) also supports its spread by raising water temperatures, enabling it to survive for longer periods of time. Additionally, its adaptability to various salinity levels and the absence of specialised predators contribute to its invasive success.

Little is known about its means of transportation to Europe, but it was **first identified** on the Atlantic coast of France as far back as **1901**. In the Mediterranean Sea it was [first recorded in 1949](#). More than **60 years after its arrival**, this crab **has established itself in the Mediterranean Sea**, and it is currently expanding its reach to the Adriatic Sea and the Black Sea.

The **widespread presence** of the blue crab **threatens [local biodiversity](#), tourism, and elements of the economy such as the [seafood market](#)**. In the Elbro Delta, data shows opposite abundance patterns between the blue crab and other native species such as the sea bass, sea bream, and the common carp. Fishermen have reported their nets being shredded and catches ruined by this species. This results in a lot of crab that is not desirable in the market and is not known in the region, thereby affecting the market for seafood in a disastrous way. However, some fishers in Italy and Tunisia have reacted by changing their practices: they now catch [the blue crab](#) and try to see it as an economic opportunity. Fishers even advocate for a strict regulation and protection of the blue crab to guarantee them a stable source of income. Indeed, we can eat *Callinectes sapidus*! Would you try it? The blue crab could support whole industries, especially restaurants on the very touristic Mediterranean coast.

**Climate change** also plays an **important role in the spread of the blue crab**. In winter when temperatures below 10 degrees Celsius, the blue crabs become inactive, with a significant decline in reproduction and survival. However, the current increase in surface temperatures in the Mediterranean and Atlantic waters, as well as in the Adriatic area, makes their survival increasingly likely.

The blue crab is an invasive species that has dominated Europe. Its persistence is due to its high reproductive capacity, adaptability, the lack of specialised predators, and warmer waters due to climate change.



Current distribution of *Callinectes sapidus* in the Mediterranean Sea.

Source: Baggi, Guia. 2022, August 10th. *Love 'em and loathe 'em: Mediterranean grapples with tasty, voracious invasive crabs.* Mongabay.

<https://news.mongabay.com/2022/08/love-em-and-loathe-em-mediterranean-grapples-with-tasty-voracious-invasive-crabs/>

## Conclusion

Our oceans tell their story through the species that inhabit them.

*Ostrea edulis* shows how a single species can support an entire ecosystem, while *Corallina officinalis* signals when environmental conditions begin to deteriorate. In contrast, the *Callinectes sapidus* reminds us how easily this balance can be disrupted.

By **protecting** ecosystem engineers, monitoring bioindicators and managing invasive species, we can help **safeguard marine ecosystems for generations to come.**

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