

# Neptune's flowers

## The importance of seagrasses

A seagrass meadow

### Key words

flowering plants  
marine biology  
seagrasses

*Neptune, the Roman god of the sea, was not short of flowers for his valentines. I am not referring to the sea anemones that Disney's Little Mermaid uses to decorate her hair. I mean real flowers from flowering plants – angiosperms. Yes, there are angiosperms in the sea.*

Still, these angiosperms do not do well in bouquets. No large and colourful petals, no beautiful scents. The flowers of marine angiosperms are water-pollinated and, much like terrestrial wind-pollinated plants, are not great at showing off.

### Seagrasses

It is the simple look of these flowers, together with the narrow leaves, that has gained marine angiosperms the name of seagrasses, even though they are more closely related to lilies and gingers than to grasses.

### Glossary

**angiosperms:** flowering plants

**anoxic:** free of oxygen

**climax community:** the final stage of an ecological succession

**epiphytic:** a plant growing on another plant without parasitizing it

**eutrophic:** describes a body of water excessively rich in nutrients and vegetation, whose decomposition causes oxygen depletion and death of aquatic animals

**pericarp:** the part of a fruit which has developed from the ovary wall



Gerard Graud

The flower and fruits of a seagrass (*Posidonia oceanica*)

The photos show the leaves and flower of a typical seagrass, one of 50-60 species of marine flowering plants. They descend from terrestrial flowering plants (Angiospermae) which colonised the sea during the Cretaceous, around 120 million years ago. Their adaptations to sea life include:

- The leaves have a narrow blade shape to withstand the mechanical action of waves and currents.
- There are no stomata; instead a thin cuticle allows ions and CO<sub>2</sub> to be absorbed through the leaves.
- The flowers are water-pollinated.
- A system of air spaces allows internal gas flow (to allow oxygen to reach the roots and rhizomes which are buried in the anoxic sediment, and to remove carbon dioxide).

Relying on photosynthesis, seagrasses are confined to waters where light can penetrate. They form large meadows on muddy and sandy bottoms in shallow, coastal waters. These meadows are among the most productive ecosystems on the planet, with an average net production of about 400 g of carbon per square metre per year. Few marine animals graze on seagrass leaves, so the majority of the carbon fixed is locked in the sediment, making up 10-15% of the total marine carbon storage.

### The value of seagrass meadows

Historically, seagrasses have been used as fertilisers, animal fodder, packing material, mattress filling and to weave objects (like rattan). But it is now apparent that the economic value of seagrass pastures goes well beyond these uses and they are estimated to be the third most valuable ecosystem on a global scale after estuaries and wetlands.

From an engineering point of view, seagrass meadows protect coastlines by taking the brunt of currents and waves. In tropical areas, the meadows are often associated with coral reefs. By slowing down the water currents, the meadow causes an increased rate of sedimentation, thus improving the transparency of the water to the greater benefit of the adjacent corals. Seagrass meadows are very diverse ecosystems, offering shelter and food to many species, and acting as fish nurseries for commercially valuable prawn and fish species.



A dugong feeds among seagrass rhizomes, accompanied by pilot jack fish.

### *Posidonia oceanica*

Named after the Greek God of the sea, *Posidonia oceanica* is endemic to the Mediterranean, where it covers about 3% of the area of the Mediterranean basin (corresponding to about 38 000 km<sup>2</sup>).

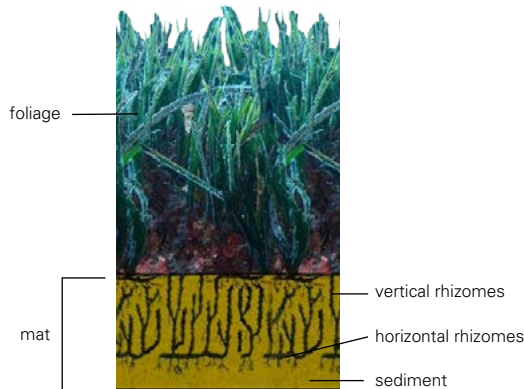
In autumn, just like terrestrial deciduous plants, *Posidonia* sheds its leaves. This is when seashores become covered in rotting *Posidonia* leaves, rhizomes and 'egagropili', balls made of fibres from the *Posidonia* leaves knotted together by the rolling of the waves.



*Posidonia egagropili* on a Spanish beach

Unpleasant to the sight and to the nose as it might be, beached *Posidonia* detritus brings good news: as well as protecting sandy beaches from erosion, it testifies to the quality of the water, as *Posidonia* cannot survive in turbid, eutrophic waters.

*Posidonia oceanica* is one of the largest, slowest growing and most long-lived plants. Each meadow is a clone of one plant, slowly growing vertically (1 m/century) through its vertical rhizomes, and horizontally (about 7 cm/year) via its horizontal rhizomes. One living specimen has been DNA-tested to show that it is a single clone, forming a patch over 15 km long off the coast of the Spanish island of Formentera. Given its slow rate of growth, its age is estimated at over 100 000 years.



A diagrammatic view of part of a *Posidonia* mat

Sexual reproduction also occurs, with male and female flowers in the same inflorescence. The flowers appear in September and October and the fruit reaches maturity after six months. Then it detaches itself from the plant and floats to the surface, thanks to the high oil content of its pericarp. The free-floating fruit resembles an olive and, in Italy, it is popularly called 'the olive of the sea'. When the pericarp decays, the seed is released and sinks to the sea floor. If it finds a bed with a high humus content, it will germinate. This means that new *Posidonia* meadows will only start in areas where organic detritus is present, making *Posidonia* meadows the climax community of the Mediterranean.

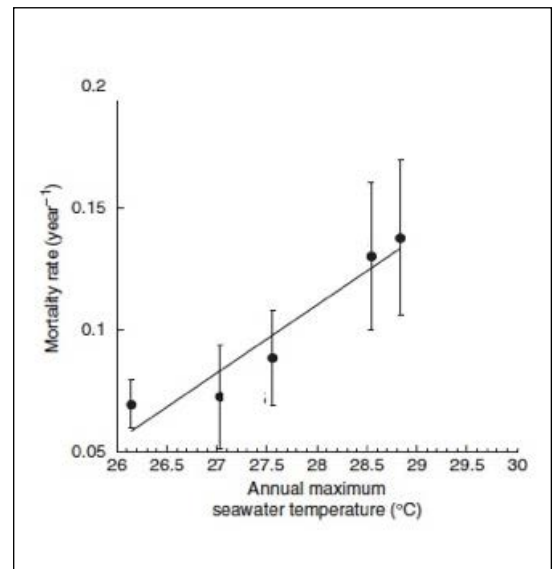
## Human threats to underwater meadows

Human activity is the main threat to seagrasses. Maritime constructions, coastal water pollution, anchoring by boats, fishing by trawling and sea warming, are the main culprits.

Maritime construction, by increasing water turbidity, decreases the ability of the seagrass to photosynthesise. Eutrophication, as well as being directly toxic to seagrasses – which do not tolerate high levels of nitrates and phosphates – causes an increase in the growth of epiphytic and floating algae, which in turn affect the amount of light reaching the seagrass's photosynthetic organs and cause the seagrass to die. In a positive feedback mechanism, the increased decaying matter stimulates algal growth, further increasing water turbidity.

Seagrasses are also affected by the speed of sedimentation: too slow, and the rhizome will be exposed; too fast, and the plant will be suffocated.

But by far the most insidious threat to seagrass meadows is global warming. A recent study of *Posidonia* meadows in the western Mediterranean has shown a correlation between higher sea temperatures and increased mortality of *Posidonia* shoots, with the meadows particularly vulnerable in the growing season. This effect is visible even in relatively pristine areas, ruling out other stress factors. Only 60% of the shoots present at the beginning of the 2002-2007 period of study (which, significantly, included the heat waves of 2003 and 2006) were surviving at the end of the study.



A clear relationship between increased *Posidonia* shoot mortality and warming – the mortality rate roughly doubles for a 2 degree temperature rise.

A gradual sea warming by 4°C during this century could potentially cause losses of 20% of shoots per year, which is beyond the plant's regenerative abilities. The mechanism by which this damage occurs could be linked to the lower concentration of oxygen in warmer waters, which causes higher production of sulphides – to which *Posidonia* is particularly vulnerable – by the anaerobic bacteria living in the sediment.

Seagrasses worldwide are declining at a rate of 1-2% per year – higher than that of tropical forests (0.5%) – and *Posidonia*, with its slow rate of growth, is shrinking even faster (5-10%). The Mediterranean Sea has seen *Posidonia* being replaced by invasive exotic macroalgal species with inferior carbon sequestration abilities (i.e. *Caulerpa racemosa*).

Thankfully, awareness of the ecological importance of seagrasses has increased and the *Posidonia* meadows off the coasts of the Spanish islands of Ibiza and Formentera were declared UNESCO World Heritage sites in 1999.

*Stefania Hartley is from Sicily, home to Mediterranean seagrass meadows.*

### Look here!

The *Posidonia* Project:  
[posidoniaproject.org/med/](http://posidoniaproject.org/med/)

The 'Posidonia festival' (an International Festival of Art, Environment and Sustainable Development):  
[posidoniafestival.com/posidonia/](http://posidoniafestival.com/posidonia/)

Blue Carbon Initiative: [bluecarbonportal.org/](http://bluecarbonportal.org/)

Seagrass Recovery, a Florida-based company which can provide solutions for all your seagrass meadow's needs!  
[www.seagrassrecovery.com/](http://www.seagrassrecovery.com/)