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## Why are seagrasses important? - Goods and services provided by seagrass meadows

**Seagrass meadows produce a variety of goods (finfish and shellfish) and provide ecological services (maintenance of marine biodiversity, regulation of the quality of coastal waters, protection of the coast line) which are directly used or beneficial to humans and condition the economic development of European coastal zones. In addition seagrasses are indicators of the status of the coastal zone which can be used in coastal management strategies aiming at preserving or improving the environmental quality of the coastal zone.**

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Although seagrasses might not be widely known by the public nowadays, they were known and used for different purposes by coastal communities in the past. The leaves of *Posidonia oceanica* were traditionally used as packing material to transport fragile items (i.e., glassware, pottery) in Mediterranean countries. They were also used to ship fresh fish from the coast to cities. As parasites thrived less in *P. oceanica* leaves than in straw, they were used as cattle bedding in stables and, later, as filling material for mattresses and cushions (Pope Julius III popularized this practice throughout Italy in the 16th century). Respiratory infections seemed to be prevented when sleeping in this type of bedding; other medicinal uses included the alleviation of skin diseases (i.e. acne) and pain in legs caused by varicose veins. When straw was scarce dry *P. oceanica* leaves were used to make adobes, and as roof insulation (i.e., in SE Spain and the Balearic islands), and leaves of *Zostera marina* (eelgrass) have been used as roof covering (Fig. 1). In the Netherlands eelgrass leaves have been used as constituents of dikes ("wierdyken"), were the preferable stuffing of baby mattresses until the 1950's, and they are still used in chair seats. Seagrass leaves have been used as soil amendment and to feed pigs, rabbits and hens in several areas.

The large knowledge about the biology and ecology of seagrasses gained during the last third of the 20th century has driven increased awareness of the economic value of seagrasses to humans. The biological resources and ecological services provided by seagrasses are

based on the physical structure of the plants themselves and the underwater meadows they form, their biological activity, and that of the associated fauna and flora. The first appraisal of the value of the services provided by seagrass ecosystems produced a minimum estimate of  $15837 \text{ € ha}^{-1} \text{ y}^{-1}$ , which is two orders of magnitude higher than the estimate obtained for croplands. Even if these estimates have limitations and caveats, they highlight the importance of seagrass ecosystems.

### **Seagrasses as promoters of biological productivity and biodiversity**

Seagrasses provide habitat for a large set of organisms which can not live in unvegetated bottoms. The leaf canopy and the network of rhizomes and roots provide substratum for attachment, which is scarce in unconsolidated bottoms, stabilize the sediment, and reduce irradiance producing an array of microhabitats not present in unvegetated bottoms. In addition, the three-dimensional structure of seagrasses creates hiding places to avoid predation. As a result, the abundance and diversity of the fauna and flora living in seagrass meadows are consistently higher than those of adjacent unvegetated areas. Seagrasses, therefore, increase habitat diversity and the biodiversity of the coastal zone.

Seagrasses feature high rates of primary production. As any other photosynthetic organism, seagrasses fix carbon dioxide using the energy provided by light and transform it into organic

carbon to sustain seagrass growth and biomass production. High rates of biomass production imply high rates of oxygen production, a by-product of photosynthesis, which is released to the surrounding waters. The biomass of some seagrasses decomposes slowly and certain species (i.e. *Posidonia oceanica*) store a significant amount of carbon in the sediment over long periods. Seagrass primary production is only 1% of total primary production in the oceans but seagrasses are responsible for 12% of the total amount of carbon stored in ocean sediments. This uncoupling between carbon dioxide fixation by photosynthesis and release by respiration determines that seagrasses play a significant role in the regulation of the global carbon cycle.



Figure 2.1. Seagrass leaves have for centuries been used as soil amendment, cattle feed and as filling and building material. Here leaves of *Zostera marina* are used for roof covering on a farm house. Photo: J. Borum

The primary production of periphytic algae growing on seagrasses and of benthic algae living in seagrass meadows is comparable to that of the seagrasses themselves. Together with the secondary production of associated fauna, those contribute to make seagrass ecosystems as productive as many agricultural crops and forests on land. The coastal zone is a dynamic environment and currents and waves detach part of seagrass biomass and transport it to adjacent marine and terrestrial ecosystems. These inputs of organic matter may locally be quite high (i.e., to the point that they sustained direct exploitation by humans as described previously), and contribute significantly to the function of biological communities of adjacent habitats (such as beach fauna).

Seagrass meadows are key habitats in the life cycle of many organisms. The populations of crustaceans (e.g. shrimps) and fishes living in

seagrass meadows are typically composed of a high proportion of larvae and juvenile individuals suggesting that seagrass meadows are preferred nursery habitats. Increased food availability and/or refuge from predation explains the importance of seagrass meadows as nursery and feeding habitats for these organisms, some of them target of highly important commercial fisheries. In addition, migrating birds use shallow and intertidal seagrass meadows as resting and feeding areas during their travels. Brent geese, wigeons and pintails feed preferentially on seagrasses, other birds feed on associated fauna.

### Seagrasses as filters improving water quality

Seagrass leaf canopies dampen water movement and favor the retention of suspended particles, both living and dead, becoming a sort of a filter for coastal waters.

The particle trapping capacity of seagrasses is enhanced by the organisms living on the leaves either through filter feeding and active capture, or through the direct attachment of the suspended particles to the mucus-covered seagrass surfaces which result from their activity. As a result seagrasses can to a certain extent control the transparency of the water column. Increased light availability at the bottom facilitates the life of seagrasses themselves and that of other benthic plants which will further increase the control of water transparency.

Seagrasses and associated algae are able to absorb inorganic nutrients through both roots and leaves. The acquisition of nutrients from the water column allows seagrasses to compete with phytoplankton for the inorganic nutrients that support the primary production of coastal ecosystems. Lower phytoplankton abundance means higher irradiance at the bottom because the phytoplankton cells absorb the light. Seagrass meadows, therefore, can be considered as filters with capacity to control some of the elements (suspended dead particles, phytoplankton cells, nutrients) that determine the quality of coastal waters.

### Seagrasses as coastal protection elements

The leaf canopy and the network of rhizomes and roots fix and stabilize the sediment over which seagrasses grow, and reduce the resuspension of the sediment by currents and waves. This role is

driven by reduced water motion due to canopy friction and by the structural frame that rhizomes and roots provide to the sediments. Sediments vegetated by seagrasses are less likely to be mobilized by waves and currents, so that seagrasses can reduce the erosion of the coastline.

Detached seagrass leaves, which are lost either at the end of their life or earlier due to waves and storms, and their accumulation in the beaches represent another way by which seagrasses have a role in the protection of the shoreline. Large accumulations of leaves, such as those of *Posidonia oceanica* in the Mediterranean and eelgrass in northern Europe, dissipate wave energy and directly protect beach sediments from the impact of waves.

Seagrasses are important elements of coastal protection not only because they protect the sediments from being eroded but also because they actually may produce sediment. In the Mediterranean, for example, the particles that constitute the sediment have in many cases a biological origin being fragments of the skeletons, shells or spines of marine animals or being the calcareous remains of benthic algae. As seagrasses harbor a large diversity of marine organisms, the meadows can be considered a net source of new sediment. Biogenic particles can be the main component of sediment in coastlines with no rivers or with low fluxes of particulate matter from land to the sea. In such areas sediment produced by seagrass meadows may contribute significantly to feed the beaches, further contributing to curb coastal erosion.

## Conclusions

Seagrass meadows produce a variety of goods (finfish and shellfish, sediment) and provide ecological services (maintenance of biodiversity, water-quality control, shore-line protection) that are directly used or beneficial to humans. The presence and abundance of seagrasses, can be considered, therefore, as indicators of the overall environmental quality of the coastal zone. Hence their long-term maintenance could be a surrogate target of coastal management strategies aiming at preserving or improving the environmental quality of the coastal zone.

In addition to fisheries, urban development, tourism and other recreational activities are significant parts of the economy of European countries with access to the sea, and these activities are highly dependent on the quality of the coastal water and the stability of the coastline, conditions which are strongly supported by healthy, well-developed seagrass meadows. Seagrasses are, therefore, a valuable resource amenable to economic quantification and their conservation should be given high priority in coastal management.

## References

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