
Photo: Sally Sharrock

A Changing Climate for Maritime Biodiversity: linking science to practice – Case Study

Seagrass and climate change: implications for management

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Mill Bay beach, Salcombe

The Issue

Seagrass is an important link in the marine ecosystem as it supports a high level of biodiversity, acts as nursery areas and spawning areas for commercially important species, baffle waves and currents, promote sediment deposition, bind sediments and are valued carbon capture and storage systems.

The global value of all ecosystem services provided by seagrass beds is estimated to be US$ 3.8 trillion a year (Costanza et al., 1997) and a recent IUCN report (Blue Carbon by Nellemann et al., 2009) stated
“Mangroves, salt marshes and seagrasses are among the most cost effective carbon capture and storage systems on the planet…Preventing the further loss and degradation of these ecosystems and catalyzing their recovery can contribute to offsetting 3-7% of current fossil fuel emissions – over half of that projected for reducing rainforest deforestation”. 2009)

Additionally, seagrasses can help reduce some of the impacts of climate change on our coasts, as they bind sediment, thereby protecting beaches from erosion.

South West Climate Change Impacts Partnership
Met Office
NATURAL ENGLAND
The Marine Biological Association
Marine Environmental Change Network MECN
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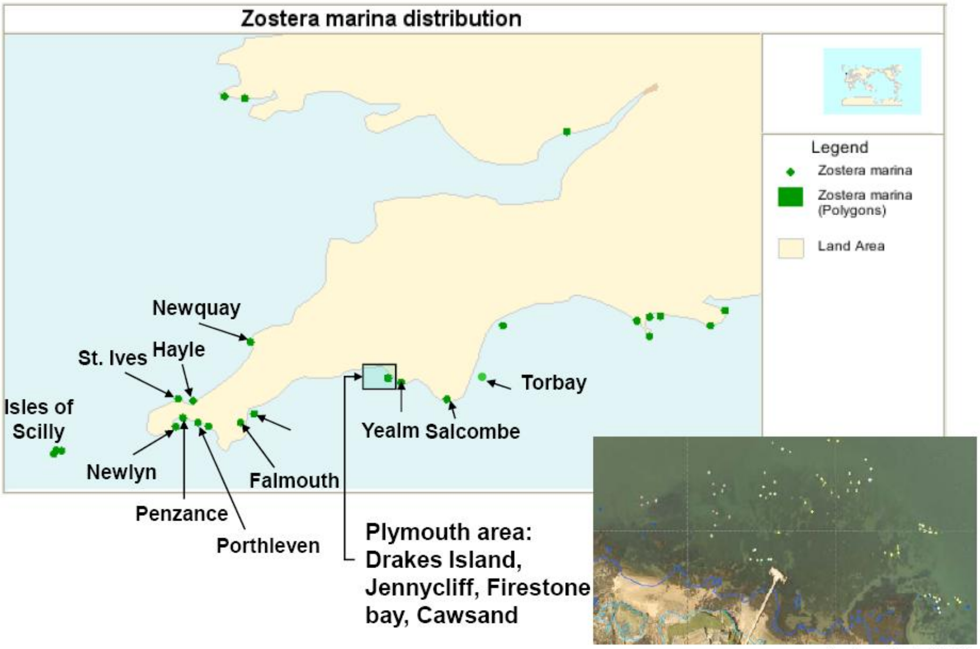


Irving et al., 2006

Impacts of climate change for seagrass

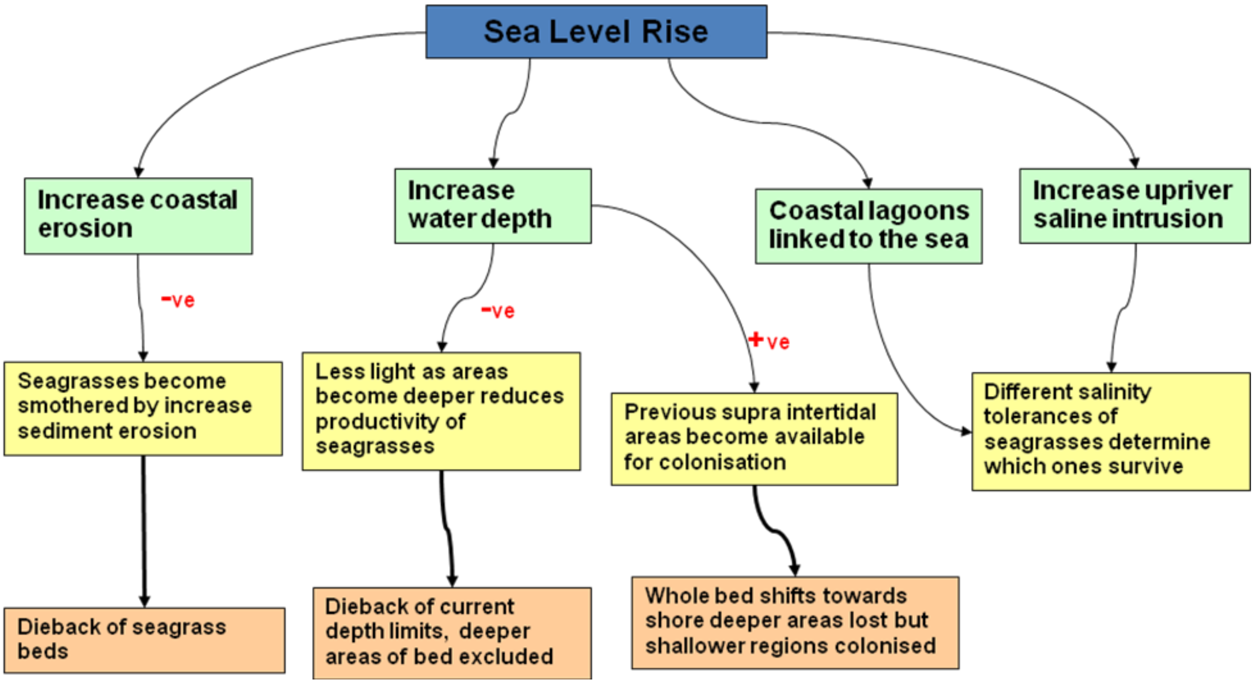
Seagrass growth, distribution and function are regulated by a number of physical (light, hydrology, geology and temperature), chemical (salinity, oxygen, nutrients) and biological (competition, disease, anthropogenic) factors. Climate change has the potential to influence each of these factors. Examples of some of the impacts are detailed below:

Increased temperature

- Increased seagrass metabolic processes - At high temperatures seagrass respiration is greater than photosynthesis, resulting in a negative energy balance
- New niche for invasive species colonisation
- Decreased production species at thermal tolerance
- Increased desiccation for intertidal species
- Shift in distribution of species - Seagrass species vary in their temperature tolerances. Two species of seagrass are found in the South West; *Zostera marina*, which has an upper temperature tolerance of 38ºC, and *Zostera noltii,* which has a tolerance of up to 25ºC. *Zostera noltii* is at the limit of its distribution in the UK and with the chances of dispersal northwards limited, its range could be constricted by rising sea temperatures.
- Enhanced growth of competitive algae
- Increased metabolism of microbes, including the slime mold protest *Labyrinthula* which causes a wasting disease in *Zostera*, outbreaks of which have been linked to changes in temperature and salinity.

Sea level rise

The effects of sea level rise are summarised below. In particular, the depth distribution of seagrass beds will alter in response to sea level rise due to increasing water depths, but the upper limit may be constrained in areas of coastal development and defences resulting in a restricted depth distribution, which in turn may affect the resilience of the bed to other pressures.



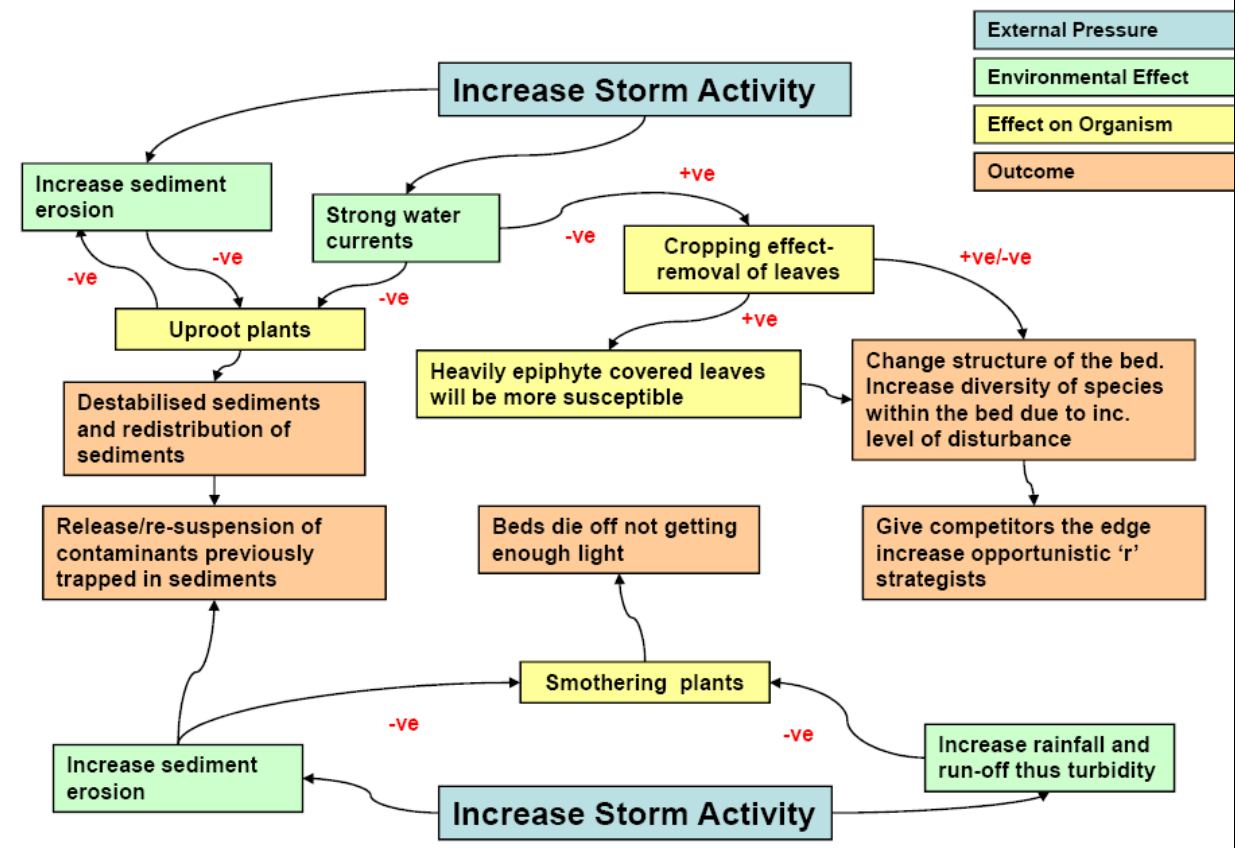
Ocean acidification

Increasing levels of CO_2 in the atmosphere are making the oceans more acidic - the Inter-governmental Panel for Climate Change (IPCC) predict an increase of dissolved inorganic carbon and decrease in seawater pH of up to 0.5 units by 2100. This will have consequences for seagrass:

- Seagrasses can utilise HCO_3 – so the increase in the HCO_3-/CO_2 ration in seawater will lead to an increase in photosynthetic rate
- Ocean acidification will alter the compensation depth
- There will be impacts on the epiphytic load but also on mollusc grazers with calcareous shells. (Invers *et al*., 2002 Bull Mar Sci 71(3))

Increased Storm activity and shifts in prevailing wind directions

Changes in wind strength and direction, seagrass exposure and light will all effect seagrass. The diagram below summarises some of the consequences of increased storminess.



Deposition of Physical Materials

Photo: Sally Sharrock

Adaptation strategies

We can help seagrasses adapt to the impacts of climate change by helping them become more resilient. Resilience-building adaptation strategies include working to:

- Protect diversity of seagrasses from gene to geographical/environmental distribution. Past die backs in seagrass due to the wasting disease indicate that the key to survival of some beds was due to environment and genetic variation.
- Protect seagrass from manageable vectors of change which may stress or remove populations of seagrass (particularly those important to the point above).
- Identify and fully protect seagrass communities that are at low risk of succumbing to climate change and anthropogenic impacts (for example subtidal beds in shallower waters and sheltered from winds from most directions).
- Restore critical seagrass areas that are positioned to survive climate change impacts by eliminating manageable pressures.
- Raise awareness of the value and threats to seagrasses, ensure that coastal zone management or land use policies and plans address potential impacts to seagrasses and implement codes of conduct for fishing and boat anchoring to reduce disturbances.

(see **Bjork et al., 2008 IUCN Resilience Science Group Working Paper Series - No 3**)

Adaptive management suggestions:

- Develop good baseline maps (Plymouth Sound, Salcombe, Torbay, Isles of Scilly etc.)
- Implement monitoring that provides feedback on the results of coastal management, (SeagrassNet; Isles of Scilly monitoring programme) not just for reporting cycles
- Monitor the right things at the right time (pressures and state)
- One of the most direct early warnings for declining seagrass meadows is a decrease in growth and productivity – it is therefore important to measure photosynthesis
- Accept uncertainty and set appropriate operational targets and review periods

Photo: Sally Sharrock

Challenges

- Currently monitoring of seagrass beds in the UK (an important indicator of environmental change) is limited, and includes measurement variables without adequate temporal and spatial replication to give valuable indications of change (e.g. measuring epiphyte load once every six years, at different times of the year and in different parts of a meadow). Data on environmental conditions and human pressures are not collected simultaneously and it is, therefore, difficult to ascertain cause and effect.

- Based on climate change predictions, we need to model impacts on seagrass beds spatially to identify risk levels

- We need to assess genetic diversity of UK seagrass beds

- Support UK SeagrassNet stations (the Fal and Helford is home to the first UK site in this global monitoring network!)

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Relevant links:

http://cmsdata.iucn.org/downloads/managing_seagrasses_311008_1.pdf
www.**seagrassnet**.org
http://zosteramarina.blogspot.com/
http://seagrassli.blogspot.com/
http://www.unep-wcmc.org/marine/seagrassatlas/index.htm
http://www.ccfhr.noaa.gov/stressors/extremeevents/wemo.html

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