# Scottish Wildlife Trust Briefing

## Blue Carbon

**Overview**

Blue carbon refers to natural carbon stocks contained within marine ecosystems. Many of the important blue carbon habitats, such as kelp forests and maerl beds, in Scottish waters are in a poor state of health[1], which has limited their ability to sequester carbon.

The Scottish Wildlife Trust believes that natural recovery (through protection) and enhancement of blue carbon habitats could make a significant contribution towards meeting Scotland's climate change targets, as well as providing many additional benefits that will contribute to achieving Good Environmental Status in Scotland's seas.

**Key recommendations**

- There is a need to improve understanding of the distribution, stock health, and enhancement opportunities for blue carbon in Scottish waters;
- A systematic data collection and monitoring strategy should be implemented to assess the contribution of blue carbon to Scotland's climate change targets;
- Recognition of the carbon sequestration value of blue carbon habitats should be incorporated into the Marine Protected Area designation and management process;
- There is a need for the assessment of blue carbon storage potential at a regional level and for the incorporation of blue carbon storage potential into Regional Marine Plans;
- Further investigation into the potential carbon sequestration value of seaweed aquaculture in Scotland is required.

**Context**

The Climate Change (Scotland) Act 2009 commits the Scottish Government to reducing greenhouse gas emissions by 42% by 2020 and 80% by 2050.[2] A key requirement for achieving this target is the sequestration[3] of carbon by the environment. The carbon-storing potential of terrestrial ecosystems (e.g. woodland and peatland) is well documented, but marine ecosystems actually have a higher capacity for storing carbon. For example, total carbon storage in Scotland's peatland is estimated at 1620 Mt[4], whereas the top 10 cm of Scotland's marine sediments store an estimated 1756 Mt.[5] The carbon storage in Scotland's marine sediments alone equates to 52% of Scotland's 2011 carbon emissions[6] and, unlike many other marine and terrestrial habitats, marine sediments can lock up carbon for thousands of years.[7]

Marine ecosystems store carbon in both living (animals and plants) and non-living (e.g. shells and skeletons) material. Therefore, the more productive, healthy, and biologically diverse marine ecosystems are[8], the higher the potential for carbon sequestration. Protecting and enhancing blue carbon in habitats such as seagrass beds and saltmarshes will improve their health which, in turn, will provide many additional benefits such as enhanced biodiversity, nursery grounds for juvenile fish and shellfish (including commercially important species), water quality regulation, improved seafloor integrity, and ecosystem stability – all of which will contribute towards the Marine Strategy Framework Directive's goal of Good Environmental Status.[9]

**Blue carbon stores in Scotland[10]**

*Marine sediments – 1756 Mt C stored in living and non-living material[11]*
Coastal and offshore sediments are the largest stores of blue carbon, with phytoplankton providing the main resource of carbon entering sediments.

*Saltmarsh – sequestration rate[12] of 14,000 t C yr $^{-1}$*
Currently Scotland has approximately 15% of UK saltmarshes, which cover approximately 3% of the Scottish coastline.

*Seagrass beds – sequestration rate of 1000 t C yr $^{-1}$*
The true extent of seagrass habitat in Scotland is unknown. There are 355 recorded sites, making the concentration of seagrass beds around the Scottish coastline high compared to the rest of Western Europe.[13]

*Kelp forests – sequestration rate of 1,732,000 t C yr $^{-1}$*
Knowledge of the distribution and size of kelp forests around Scotland is limited. The carbon storage capacity of kelp is short-term, due to a high turnover rate. Therefore, carbon storage capacity is directly related to standing crop size and health – the larger and healthier the standing crop, the higher the carbon storage capacity.

*Maerl beds – 440,000 t C stored in living and non-living material*
Maerl beds provide a long-term standing stock of carbon that, in some areas of Scotland, date back 11,000 years.[14] Records of maerl bed presence is improving[15], but data on the distribution around Scotland's coastal waters is still limited. Although maerl beds can be long-lived, the coralline algae that form them are incredibly slow growing and any damage done (e.g. bottom trawling) releases stored carbon and will take decades to recover.[16]

*Biogenic reefs – 142,000 t C stored in non-living material*
These solid structures are formed by accumulations of organisms that build calcium carbonate tubes or shells. Biogenic reefs in Scottish waters include cold-water corals, horse and blue mussel beds and flame shell beds.

## Threats to Scotland's blue carbon stocks

Scotland has a wealth of blue carbon contained within its marine ecosystems. There is considerable potential for increasing carbon sequestration, which would contribute significantly to reducing Scotland's net carbon emissions. However, the threats to these valuable carbon stocks are significant and without appropriate, sustainable management, their long-term potential to remove and store atmospheric carbon will not be realised. There are four key threats:

*Physical disturbance*
Physical disturbance is the principle threat to blue carbon ecosystems and occurs as a direct result of human activity and natural weather events. For example, biogenic reefs and maerl beds are vulnerable to human activities, such as those involving bottom-trawl fishing gear, while saltmarshes and kelp forests are susceptible to damage from storms.

*Increased turbidity*
Marine plants, such as seagrass beds and kelp forests, are found in shallow, clear coastal water as they require sunlight for photosynthesis. Increased water turbidity resulting from increases in land run-off, pollution, and coastal erosion reduces the amount of sunlight reaching the sea floor and, subsequently, the ability of marine plants to photosynthesise.

*Coastal erosion/development*
Coastal ecosystems, such as saltmarshes and seagrass beds, face pressures from coastal developments and flood protection schemes, which encroach into areas where these habitats occur and also restrict their ability to expand and adapt to changing environmental conditions.

*Climate change – immediate and long term damage*
The predicted environmental impacts from climate change, such as rising sea surface temperatures, rising sea levels, ocean acidification, and increasingly powerful and frequent storm events will all have direct impacts on blue carbon habitats. Changes to the physical environment can compromise carbon sequestration rates (e.g. as a result of increased acidity levels), increase physical disturbance events that release carbon, cause geographical shifts in species distribution (e.g. as a result of increased temperature), and alter nutrient availability.

## Protecting and enhancing Scotland's blue carbon asset

*Data collection and improved knowledge*
Knowledge of blue carbon habitats and their role in carbon sequestration is improving but requires further research. The full extent of Scotland's blue carbon ecosystems stock is still unknown, making it impossible to calculate its carbon storage potential accurately. To fully realise the value of this natural capital asset, we need a better

understanding of blue carbon distribution, stock health, and enhancement opportunities. To ensure blue carbon is well managed, data collection must be carried out systematically and combined with a monitoring strategy that assesses its contribution to Scotland's climate change targets.

*Protection and management*
The protection of blue carbon in marine ecosystems is happening to some extent through the designation and management of marine protected areas (MPAs). However, the specific protection of blue carbon as an asset within these designations has yet to be acknowledged. To address this, blue carbon must be recognised and protected for its carbon-sequestration value as well as its biodiversity value as part of Scotland's MPA designation and management process.

*Integration into marine planning*
Marine planning in Scotland, at both national and regional scales, can play an important role in the assessment, protection, and monitoring of blue carbon. The National Marine Plan[17] acknowledges the importance of safeguarding natural carbon sinks[18]. Regional Marine Plans (RMP) should identify natural carbon sinks and assess any potential loss or damage. The Trust believes the value of carbon sequestration should be assessed at the regional level and safeguarding blue carbon assets should be incorporated into RMPs.

*Coastal realignment*
There is the potential to restore lost blue carbon habitats along some of Scotland's coastline by removing artificial barriers and allowing natural coastal realignment (e.g. Nigg Bay, 2003[19]). The intentional flooding of selected coastal areas will help restore lost saltmarshes and will have the added benefits of improving coastal protection from storm events (by creating a natural buffer), improving natural flood management, and increasing biodiversity within the area.

*Aquaculture*
Seaweed cultivation has the potential to quickly sequester large volumes of blue carbon while at the same time improve water quality, provide habitats for marine species, increase employment, and produce carbon-neutral products. The potential for seaweed and multi-trophic[20] aquaculture in Scottish waters need to be investigated further and, where possible, supported.

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[1] Scotland's Marine Atlas - http://www.gov.scot/Publications/2011/03/16182005/0
[2] Climate Change (Scotland) Act 2009 - http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact
[3] The capture and storage of atmospheric carbon
[4] Chapman et al. 2009. Carbon stocks in Scottish peatlands. Soil Use and Management 25: 105-112
[5] Value for both organic and inorganic carbon - Burrows, M.T. et al. 2014. Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment. Scottish Natural Heritage Commissioned Report No. 761.
[6] Burrows, M.T. et al. 2014. Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment. Scottish Natural Heritage Commissioned Report No. 761.
[7] *Op cit* 6
[8] Also included in Marine Scotland's vision for a 'clean, healthy, safe, productive and biologically diverse marine and coastal environment that meets the long term needs of people and nature' - http://www.gov.scot/Topics/marine/marine-environment/Conservationstrategy/marineconstrategy
[9] Marine Strategy Framework Directive - http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm
[10] All values for C storage taken from Burrow et al 2014: Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment. Scottish Natural Heritage Commissioned Report No. 761
[11] Marine sediments, maerl beds, and biogenic reefs are capable of long term storage of carbon in skeletons and shells. Therefore, the value for stored tonnage of carbon is provided.
[12] Saltmarsh, seagrass, and kelp forests store carbon in living material, which is eventually released when the organism dies. Carbon sequestration and release in marine plants is a short but continuous process and, therefore, the sequestration rate is provided.
[13] *Op cit* 6
[14] *Op cit* 6
[15] See for instance, Scottish Wildlife Trust's survey in Wester Ross: http://scottishwildlifetrust.org.uk/what-we-do/living-seas/#go-pgtab-2
[16] Hall-Spencer, J. M. and Moore., P. G. 2000. Scallop dredging has profound, long-term impacts on maerl habitats. ICES J. Mar. Sci. (2000) 57 (5): 1407-1415.
[17] Scotland's National Marine Plan http://www.gov.scot/Publications/2015/03/6517
[18] General Policy 5 Climate Change – p. 18
[19] Coastal realignment at RSPB Nigg Bay nature reserve - https://www.rspb.org.uk/Images/CoastalRealignmentatRSPBNiggBaynaturereserve_tcm9-406978.pdf
[20] The cultivation of multiple species that survive synergistically at a single site