Natural England Research Information Note RIN043

Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources

Terrestrial and marine managers can mitigate climate change by adopting practices which promote carbon storage and reduce emissions while enhancing the biodiversity value of ecosystems.

Human activities are having a direct and indirect impact on the global carbon cycle and the capacity of ecosystems to sequester and store CO_2 is decreasing through, for example, deforestation. Meanwhile, we continue producing significant greenhouse gas (GHG) emissions by burning fossil fuels. Despite some improvements, agriculture is still the second largest source of greenhouse gases in the UK.

Carbon storage by marine and coastal habitats has been less studied than terrestrial stores, but recent evidence indicates that they may be of comparable importance.

By restoring some habitats such as grasslands or bogs, or promoting active accretion of sediments in intertidal systems, land and marine managers can help mitigate climate change by directly reducing GHG emissions, safeguarding carbon stores and in some cases re-starting sequestration. Some practices, such as drainage, cultivation, deforestation and habitat destruction, result in GHG emissions. Others, such as afforestation, conversion of croplands into grasslands and the restoration of degraded land, result in sequestration.

The sustainable management of habitats important for carbon storage therefore contributes to meeting national targets for GHG emission reductions, including the carbon budgets set by the UK Climate Change Act. Sequestration from forestry and arable land use change to grasslands slightly outweighs emissions from peat drainage, peat extraction and land use change to croplands. In some cases habitat restoration may pose a dilemma between increasing carbon sequestration or increasing biodiversity (for example, removal of trees to restore lowland heathland) and land managers will need all the available information to underpin their decisions.

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What was done

The aims of this Natural England cross-cutting Evidence project were:

- To collate information and identify knowledge gaps on carbon stocks (both in vegetation and soils) for important terrestrial, coastal and marine habitats in England.
- To determine how different management options may impact on sequestration or loss of carbon by habitat.

The habitats we considered were:

- Grasslands, including Semi-natural and semi-improved grasslands;
- Dwarf shrub Heath, upland and lowland;
- Woodlands, including Broadleaved, Mixed and Yew woodlands and Coniferous woodlands;
- Wetlands, including Bog, Fen, Marsh and Swamp habitats;
- Arable and horticultural land, including improved grasslands;
- Coastal, including Sand dunes, Saltmarshes, Estuaries; and
- Marine, including Sea grass meadows and macroalgal beds, and Offshore sediments (North Atlantic).

The report presents a literature review and an analysis of the findings. It also provides simple tables with figures showing the impact of different management decisions on carbon stocks and emissions.

This is a rapidly developing field and we can only provide a snapshot of current positions.

Results and conclusions

The most important differences that land and marine managers, conservationists and farmers could make by through changing management practices are:

- Reduce, and where possible reverse, the erosion and degradation of peatlands, including by grip blocking in the uplands and restoration of lowland agricultural peats.
- Where appropriate, consider the conversion of arable to permanent grassland or other semi-natural habitat which requires less soil disturbance.
- Avoid or reduce soil (or coastal substrates) disturbance when managing and even restoring habitats. Consider gradual changes to habitats and soils, instead of more disturbing approaches, such as clear felling of large areas.
- Reduce the amount of waste or by-products which are burned or sent to landfill from management interventions. This could require developing new market opportunities.
- Reduce the amount of fertiliser from intensively managed land leaching into water courses and coastal and marine habitats. Consider instead, and where appropriate, using legumes to fix nitrogen, for example, reseeding them with rye-grass, also the use of buffer strips beside water courses.

The main uncertainties which remain after this review are:

- Much of the existing evidence comes from models at European or global scale. We need to ground-truth these models at smaller scale to be able to see what they mean for field-scale practices.
- This review collated the results of a variety of projects and research objectives. Large uncertainties remain on the extent to which some data is relevant for the English context. Some uncertainty may also have been introduced when transforming the units used to be consistent for this work from a large number of sources.
- It is not possible yet to translate the impact of a particular management decision or climatic forecast into a precise amount of carbon which will be stored or released as a result into the atmosphere or the ocean.

However, this project will help to understand some general processes and the consequences of some decisions, even if not to fully quantify them.

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Natural England's viewpoint

Natural England is already working with land managers to mitigate climate change. The main tool we have is Environmental Stewardship and its choice of options which can contribute to enhance soil and vegetation carbon stocks as well as deliver biodiversity targets and other ecosystem services. We are working with partners to develop the evidence base to progress this further in future.

There is not a similar mechanism to support marine management but we are working with the fishing and aggregates industries to limit the negative impacts of some operations and when possible to enhance coastal and marine ecosystems.

Selected references

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Further information

For the full details of the research covered by this information note see Natural England Research Report NERR043 – *Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources*.

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For further information contact the Natural England Enquiry Service on 0300 060 0863 or e-mail **enquiries@naturalengland.org.uk**.

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