BLUE CARBON

Management for a lower-carbon future

Blue Carbon plays a significant role in capturing and storing CO_2. Investments in Blue Carbon can also support biodiversity conservation and provide fisheries habitat.

Hectare for hectare, Blue Carbon is the most effective ecological sink for atmospheric CO_2. This makes it an important and exciting natural resource to restore, rehabilitate and maintain. Even small projects within Blue Carbon environments can make a significant contribution to carbon targets. This document summarises the basic science, management challenges and opportunities for local government to enhance Blue Carbon sequestration.

In an effort to combat climate change all of us need to take steps to reduce and minimise CO_2 emissions. However, equally important in the effort to manage atmospheric CO_2 is the need for increased understanding and enhancement of the role natural ecosystems play in capturing and storing CO_2.

Carbon Sequestration

The process of capturing and storing CO_2 in ecosystems over long time scales is called carbon sequestration. Any environment, process, activity or mechanism that removes CO_2 from the atmosphere and stores it, is a carbon sink. Natural sinks for CO_2 include forests, soils and oceans. Some ecosystems gather carbon produced elsewhere and are able to store it long term: this is called

allochthonous carbon storage. Other ecosystems capture and store carbon on site - this is termed autochthonous storage. Blue Carbon systems are capable of both allochthonous and autochthnous carbon storage.

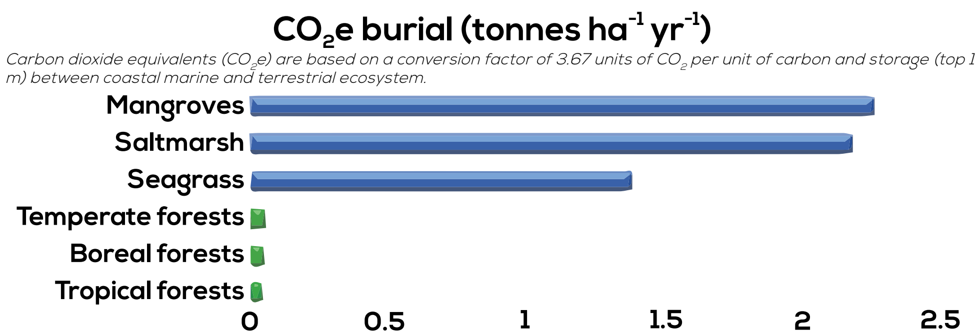
What is Blue Carbon?

Carbon removed through photosynthesis and stored in plants and soil is a vital part of the global carbon cycle. Discourse about this process has traditionally focused on Green Carbon, consisting of terrestrial landscapes such as rainforests and grasslands. However, more recently, scientists have realised that the oceans and Blue Carbon environments, including mangroves, seagrass and saltmarsh, are among the most effective carbon binding ecosystems on the planet.

When considered on a per-hectare basis, Blue Carbon environments trap atmospheric carbon 35-57 times faster than terrestrial forests. For example, the CO_2 equivalent buried in mangrove ecosystems, as measured by McLeod (2011) was a staggering 2.26 tonnes per hectare (about 1½ footbal fields) annually. Similar results have been documented for mangrove and saltmarsh communities in Australia (Saintilan et al. 2013).

While actual rates of carbon sequestration vary greatly from site to site and depend on a number of factors, it is estimated that **every hectare of Blue Carbon habitat is equivalent to 50 hectares of terrestrial Green Carbon** (McLeod et al. 2011). Because Blue Carbon systems exist in hydrodynamically active settings – where tides and currents bring sediments and associated organic carbon – they have the added advantage of locking CO_2 from adjacent terrestrial and offshore ecosystems into sediments which move deep into the ground (allochthonous carbon) (Howard et al. 2014).

Table: Global comparison of carbon burial rates among vegetated habitats.



Ecological services provided by Blue Carbon environments

Shallow and coastal marine environments, including mangroves, seagrass and saltmarsh, are also some of the most ecologically productive environments on the planet. Seagrass, mangrove and saltmarsh habitats act as nursery grounds for juvenile fish and support numerous coastal fisheries. They provide habitat and food for many species including threatened species of birds, microbats, invertebrates, turtles and dugongs (Howard et al. 2014).

These Blue Carbon environments also provide critical shoreline stabilisation, by buffering wave action, trapping sediments and mitigating flood waters (Rogers et al. 2016). These services become increasingly important under sea-level rise scenarios, helping to mitigate climate-driven increases in the frequency and intensity of extreme weather events (Carnell et al. 2015).

Threats to Blue Carbon ecosystems

Land clearance and reclamation for playing fields and waste services have driven sharp declines in Blue Carbon habitats, while changed sediment flows have shifted where mangroves and saltmarsh can establish. Because Blue Carbon ecosystems retain sediment and filter water, their retention maintains water quality and diverse ecosystem services, from fish habitat provision to carbon and nitrogen cycling.

Blue Carbon habitats in NSW are now generally protected under the Fisheries Management Act (NSW) 1994, and the Coastal Management Act (NSW) 2016. Coastal saltmarsh in NSW is also protected under the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). However, these environments remain threatened by coastal development and by existing infrastructure that prevents inland migration and thus adaptation to climate change and associated sea-level rise.

As part of the NSW Coastal Reform process being implemented in 2017, wetlands are proposed to include a 100m perimeter buffer area that will allow for natural fluctuations in wetland extent and provide protection from the effects of developments in close proximity (Rogers et al. 2016). This would provide an improvement to the current legislative protection.

The ecosystem services provided by tidal marshes/mangroves globally was estimated in 2011 to be in the order of **US $194,000** per hectare per year.

Costanza 2014

90% of Australias recreational fish catch spend part of their life in Blue Carbon habitats. **Blue Carbon Lab 2016**

Weedy sea dragon Richard Ling CC-BY-SA-3.0

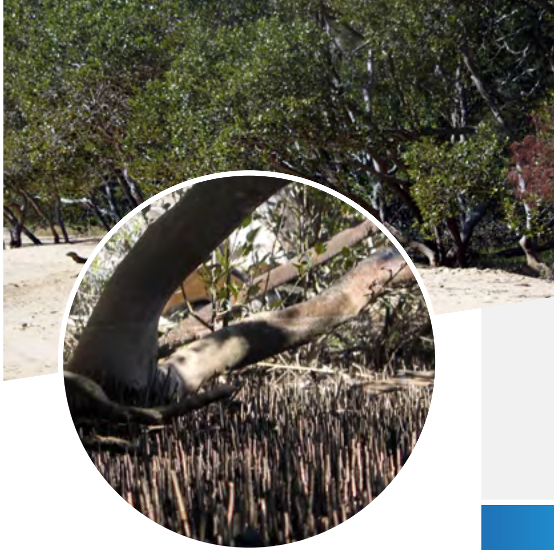
Conservation and restoration of Blue Carbon environments

The ecosystem services provided by Blue Carbon environments mean that conserving and restoring these ecosystems has multiple benefits. Projects which enhance Blue Carbon environments have potential to reduce carbon in our atmosphere, provide coastal protection against rising sea levels, reduce impacts of extreme weather events associated with climate change, improve water quality, reduce erosion, improve nutrient cycling and support biodiversity.

In Australia, we have lost an estimated 200,000ha of Blue Carbon habitats and the annual rate of loss for saltmarsh and mangroves is around 1-2% (Carnell et al. 2015).

In a 2001 study 'Auditing the health of Australia's ecosystems' it was reported that 40% of NSW estuaries were 'extensively modified' (Tait et al. 2000). This provides some indication of the loss these habitats may have experienced in NSW.

Degraded and lost coastal wetland ecosystems are estimated to have emitted at least 22.5 million tonnes CO_2 eq into the atmosphere since European



settlement and continue to emit up to 0.22 million tonnes CO_2 eq. each year in Australiaa. This is the equivalent of an additional 4,397 cars on Australian roads each year (Lawrence et al. 2012).

Role of Local Government

Carbon and specifically Blue Carbon should be a consideration for all natural resource managers, land-use planners, bush regenerators, community educators, assessment officers and the many others who have the responsibility and passion for landscape management. Further, opportunities to restore and promote the benefits of these environments and to ultimately include them within the national carbon budget or carbon farming initiative, need to be encouraged & actively pursued.

Conserve, Restore, Advocate

Engage your communities so that they understand and value the importance of Blue Carbon. The capacity of Blue Carbon environments to sequester carbon means they offer prime opportunities for carbon offset programs and nature-based climate change mitigation initiatives. Despite this fact, Blue Carbon ecosystems are

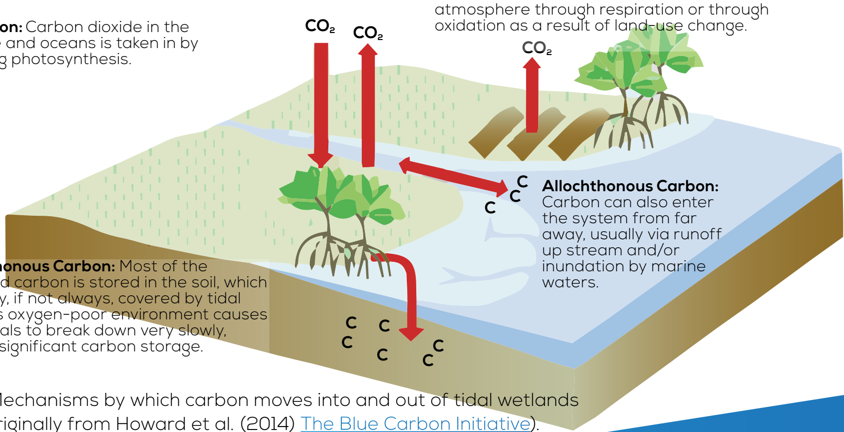


Figure: Mechanisms by which carbon moves into and out of tidal wetlands (figure originally from Howard et al. (2014) The Blue Carbon Initiative).

not currently included in any national carbon budgets or carbon mitigation initiatives.

Beyond the science, the successful implementation of Blue Carbon offset programs requires establishing a political, legal, and financial framework that can be universally applied. A number of legal issues, relating to claiming carbon credits and

> Actions that build upon the momentum to mitigate climate change by sequestering carbon– 'Blue Carbon' – could achieve **multiple desirable objectives**, including climate-change mitigation and adaptation, floodplain rehabilitation and habitat protection.
>
> **Rogers 2016**

Mangrove jack CC-BY-2.0 Taro Taylor

land ownership (e.g. projects on public, private, leasehold, and Indigenous land), need to be resolved. These obstacles are surmountable however, and momentum is building for a national scheme which incorporates Blue Carbon (Carnell et al. 2015).

Urban local governments have a particularly valuable role as managers and advocates: Blue Carbon represents a high carbon storage return for a small area, and represents their best opportunity for being a part of the solution. Councils will also benefit from financial incentives to preserve, enhance and manage these systems.

A better future

The preservation and restoration of Blue Carbon ecosystems has major implications for a range of ecosystem services with overall positive implications for public assets. In contrast, degradation and loss of Blue Carbon habitats reduces global carbon stocks and compounds concerns over declining water quality, fishery productivity and biodiversity.

Accounting for the contribution Blue Carbon ecosystems make by sequestering CO_2 should elevate these systems in land management decision making. Projects which focus on Blue Carbon ecosystems have multiple benefits for the environment, community, biodiversity and climate change mitigation.

What can NRM managers do?

1. **Protection** – avoid loss of the carbon stock through strengthening legal and planning protections. This can be achieved by strengthening Local Environment Plans, restricting access or limiting activities within these environments, improving 'upstream' water quality and flow or identifying and controlling pollution sources.
2. **Mapping** – Clear, current vegetation and threat mapping will allow for consideration of the full extent of these habitats in land use planning and development assessment. Mapping will also enable early planning to improve the ability of these ecosystems to migrate in response to sea-level rise.
3. **Carbon Loss prevention/reduction** – Care should be taken to reduce activities that release stored Blue Carbon. The principal losses of carbon from mangrove ecosystems are due to respiration and tidal export. Activities such as harvesting of wood or clear felling, draining, infilling or flood mitigation works should be stopped or appropriately controlled. Once you remove inundation from these ecosystems, sediments become aerobic and carbon decomposes more rapidly and is released to the atmosphere (Alongi 2014).
4. **Restoration** – Enhance carbon sequestration capacity. For restoration projects, carbon in living plant biomass will increase each year as plants grow, then level off as plants mature (similar to terrestrial forests). The notable difference in Blue Carbon habitats is that the sediment continues to accrete with carbon even after plant biomass reaches a steady state (Howard et al. 2014).
5. **Research** – Improve our knowledge of these environments. Efforts to understand and quantify the mechanisms and processes impacting these environments will improve restoration and enhancement projects and provide valuable insights to engage the community.
6. **Carbon accounting** – Calculate the carbon stored or annually accrued within a particular Blue Carbon environment. Recently-released international frameworks and methodologies (International Blue Carbon Initiative) now present key opportunities to adapt validated methods to an Australian context, and in so doing, enhance greatly the feasibility of Blue Carbon projects in Australia. Good accounting in a number of demonstration projects that validate the logistics, methodologies, and expected carbon returns of Blue Carbon projects will provide a robust basis for ongoing programs.
7. **Advocacy** – Call for the addition of Blue Carbon to national carbon inventories in order that funding can be made available to support the protection, enhancement and management of these systems. These market-based instruments may also be used to encourage landholders, both public and private, to protect wetlands and their ecosystem services, and improve resilience.
8. **Community Engagement** – Promote the benefits and relative value of these environments in terms of their carbon sequestration capacity and their ecological importance. Inspire community action and support for Blue Carbon environments.

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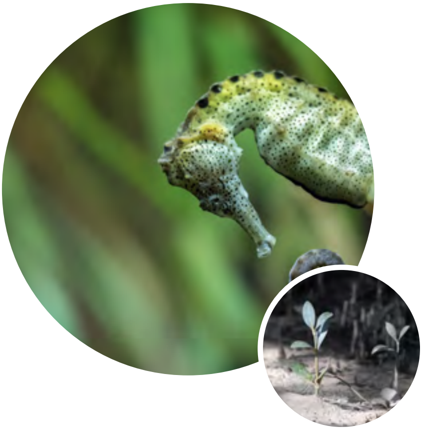

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Information on Blue Carbon is rapidly increasing.

Explore the references in this fact sheet to learn more. These ecosystems are incredibly valuable and need everyone's support.

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