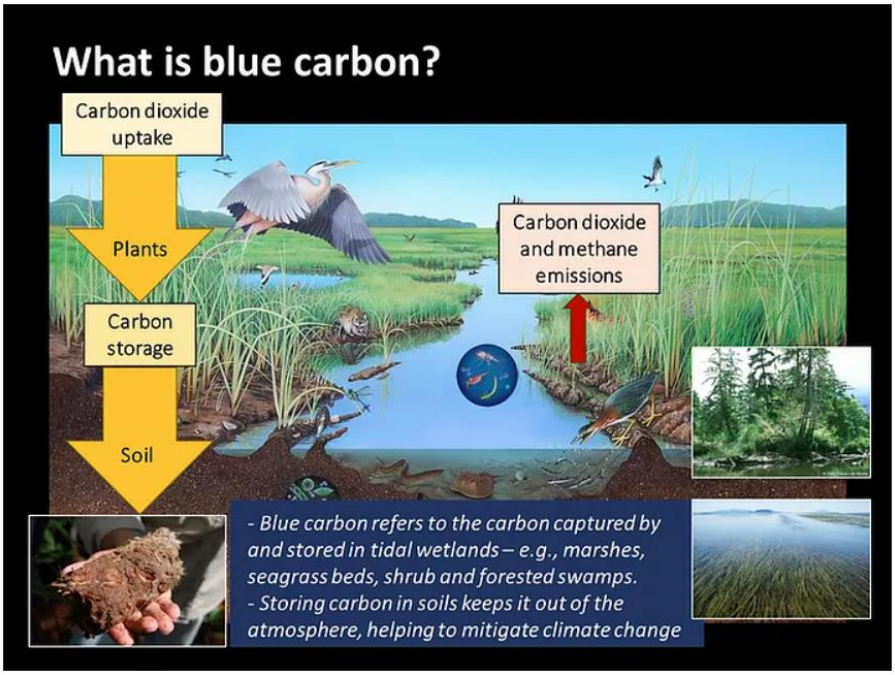
What is Blue Carbon?

Pacific Northwest Blue Carbon Working Group

Blue carbon is the carbon stored and sequestered in the world's ocean and coastal ecosystems, such as mangrove forests, seagrass meadows, and intertidal salt marshes. (www.oceanservice.noaa.gov/facts/bluecarbon, www.thebluecarboninitiative.org).



Tidal wetland image: Barbara Harmon

In the Pacific Northwest, tidal wetlands, including emergent marshes, forested and scrub-shrub swamps, and eelgrass beds, play an important role in the regional carbon cycle by sequestering carbon from the atmosphere (CO_2) continuously over hundreds of years, building stores of carbon in wetland soils high in organic content (Kauffman et al. 2020, Crooks et al. 2014). Thus, tidal wetlands, along with forests and oceans, are important carbon "sinks" that help offset anthropogenic greenhouse gas emissions, working to help mitigate the regional effects of climate change.

Carbon sequestration has been shown to be very high in tidal wetlands. On a per-acre basis, tidal wetlands store 3-5 times more carbon than tropical forests (Murray et al. 2011). Recent studies have quantified carbon storage and sequestration rates in Pacific Northwest (PNW) tidal wetlands (e.g., Kauffman et al. 2020, Crooks et al. 2014). Several factors contribute to high rates of carbon sequestration in Pacific Northwest tidal wetlands:

> Sediment delivery: Due to coastal geomorphology and climate, PNW rivers deliver large quantities of sediment to tidal wetlands and bays. High sediment delivery means higher resilience to climate change since sediment accretion is an important component of tidal wetland equilibration with sea level rise (Peck, Wheatcroft, and Brophy 2020).

High organic content in soils: Evidence is strong that large quantities of carbon accumulate in PNW tidal wetland soils—belowground organic matter generated mainly by wetland plants, including slowly decomposing plant material, roots, buried woody debris. Several studies have shown very high soil carbon content in Oregon's tidal wetlands (e.g. Kauffman et al. 2020, MacClellan 2011). In many of Oregon's estuaries, organic soils are very deep, indicating long-term carbon accumulation and storage.

Sheltered settings: Most of the PNW's tidal wetlands are located in relatively sheltered landscape settings (the "sheltered coast" of bays and river systems, as opposed to the outer coast where wave and storm action is high). The erosion that threatens coastal wetlands in the Gulf of Mexico, for example, is unlikely to threaten PNW tidal wetlands because of this sheltered setting.

Forested tidal wetlands: In the PNW, freshwater and brackish wetlands (<18 PSU) are more likely to release greenhouse gases (e.g., methane) than salt marshes and eelgrass beds which are subject to higher salinity regimes, reducing their net carbon storage. But even though they're situated in the brackish and tidal freshwater portions of PNW estuaries, forested tidal wetlands ("tidal swamps") generate such large quantities of aboveground biomass and woody debris that carbon storage in these systems can greatly outpace greenhouse gas emissions and store great quantities of carbon. PNW coastal areas once supported large expanses of tidal swamps but more than 95% of those habitats have been converted to other land uses (Brophy 2019). There is high potential to recover many of these altered tidal swamps through restoration actions (Brophy 2009, Brophy et al. 2011).

System engineers: In PNW tidal wetlands, system engineers such as beaver (Hood 2012) and Sitka spruce (Brophy 2009) create conditions highly conducive to organic matter accumulation. Beaver dams in tidal wetlands raise water tables, increasing soil saturation. Sitka spruce root platforms support production of large woody debris which eventually becomes buried in the saturated soils below, adding to carbon stocks.

Large tide range and strong tidal/fluvial interactions: Compared to many other parts of the U.S., tide range (the difference between high and low tides) is relatively large in the Pacific Northwest. Large tide ranges and strong seasonal fluctuation in precipitation and river flow have led to the development of tidal wetland plant communities with broad tolerances for inundation and salinity. These broad tolerances may allow higher resilience to climate change and the associated changes in inundation and salinity.

Unlike some coastal areas in the US and globally, the Pacific Northwest has a long history of engaging in well planned tidal wetland restoration and conservation actions. Agencies and organizations in the PNW region are already well positioned to build on past coastal management experiences to incorporate blue carbon strategies into the region's approach to climate change mitigation.

For additional information see also: www.pnwbluecarbon.org