Contribution of macroalgal forests

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Substantial role of macroalgae in marine carbon sequestration

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Vegetated coastal habitats have been identified as important carbon sinks. In contrast to angiosperm-based habitats such as seagrass meadows, salt marshes and mangroves, marine macroalgae have largely been excluded from discussions of marine carbon sinks. Macroalgae are the dominant primary producers in the coastal zone, but they typically do not grow in habitats that are considered to accumulate large stocks of organic carbon. However, the presence of macroalgal carbon in the deep sea and

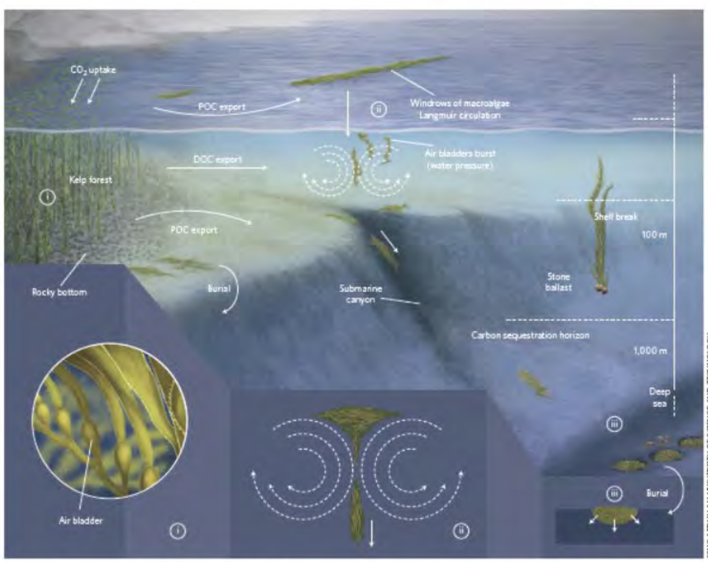
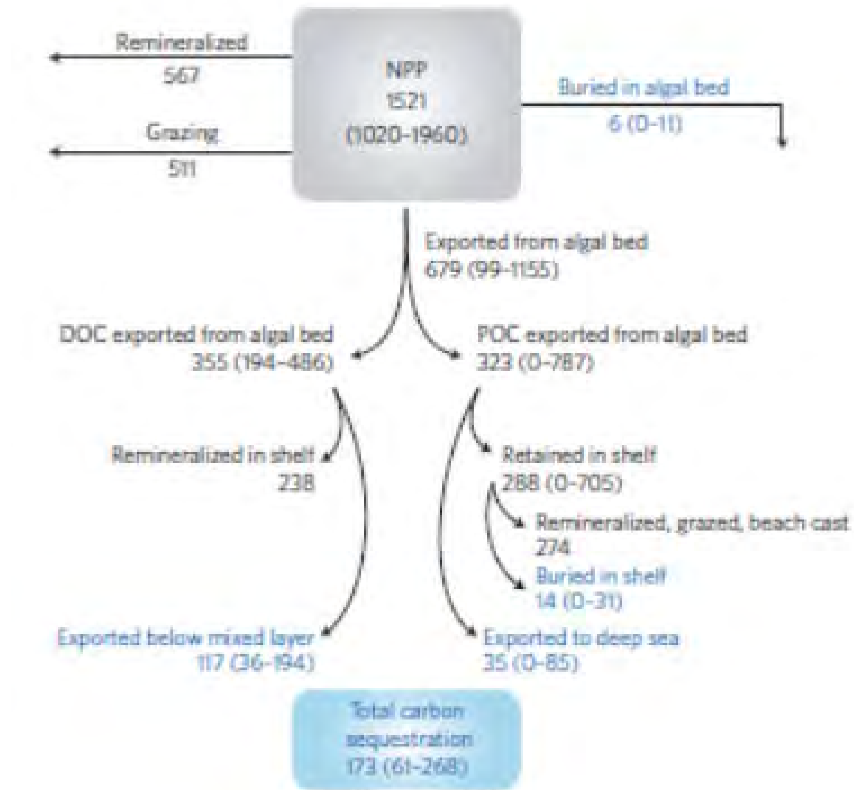
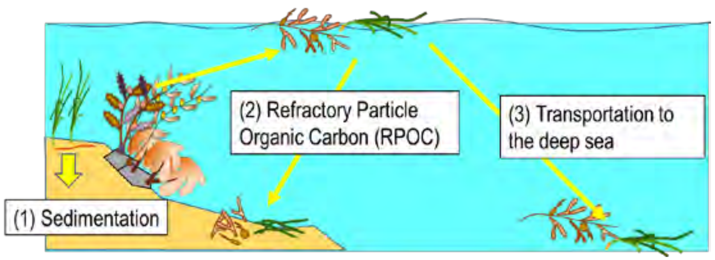


Figure 2 | Conceptual diagram of the pathways for export and sequestration of macroalgal carbon. Air bladders are common among brown algal taxa and facilitate their long-range transport (I). Langmuir circulation forms windrows of macroalgae (II) and can force the algae to depths where water pressure makes the air bladders burst and the algae then sink. Macroalgal carbon can be sequestered either via burial in the habitat or by transport to the deep sea where it is sequestered whether buried or not (III).



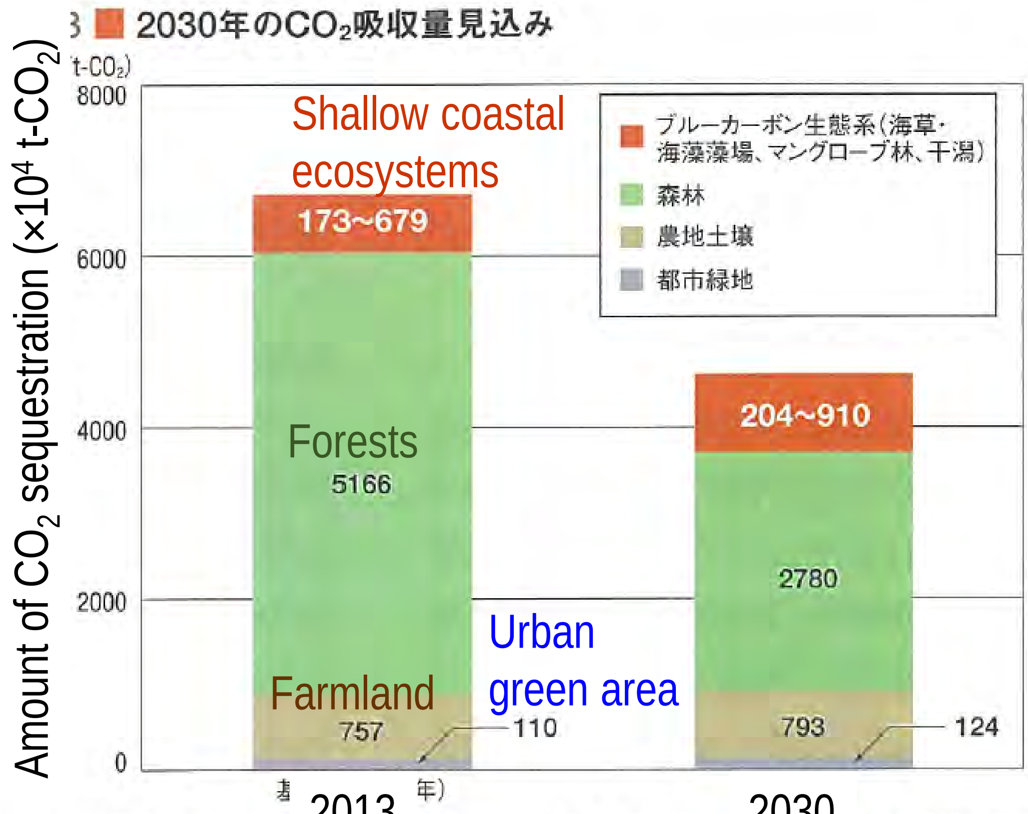
More than 10% of annual net production of sargassum species can be considered as blue carbon storage

Estimation of BC sequestration in a national scale



	Sequestration rate ($t\text{-}CO_2$/ ha / year)	
	average	Maximum
Seagrass	5.8	33.4
Sargassum	2.7	5.1
Saccharina	10.3	36.0
Ecklonia	4.2	7.9
Mangrove	68.5	68.5
Tidal flat	2.6	2.6

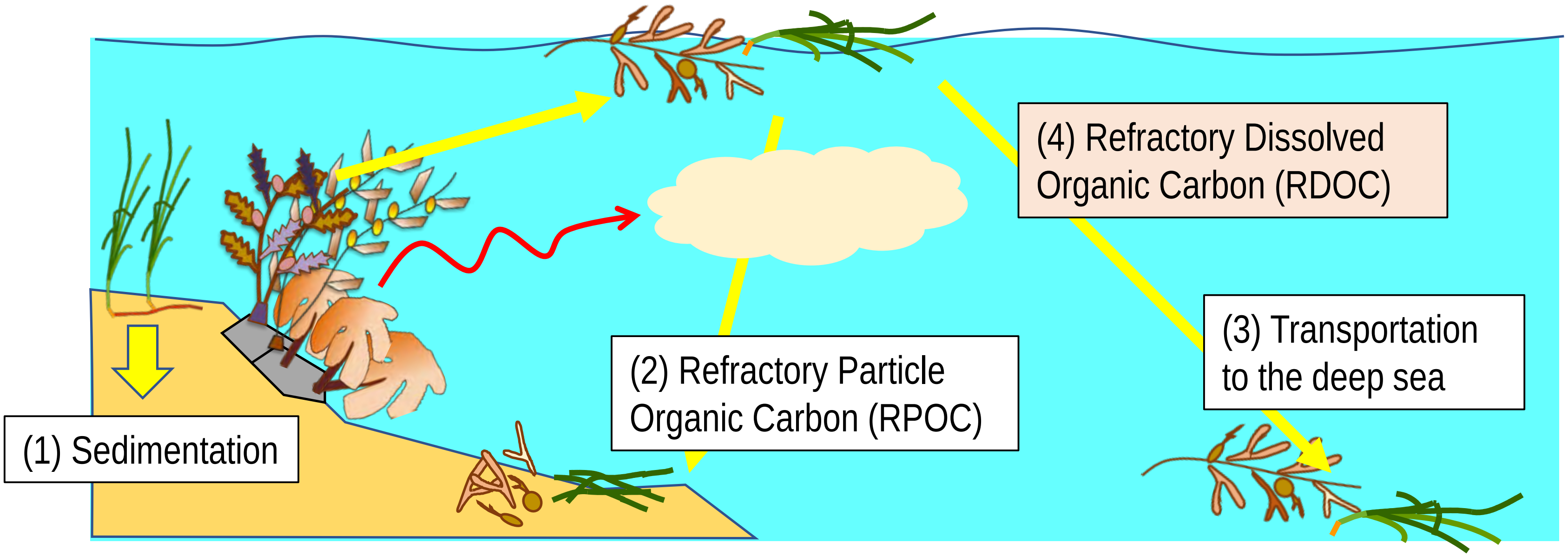
Area total: 28.3 $\times 10^4$ ha

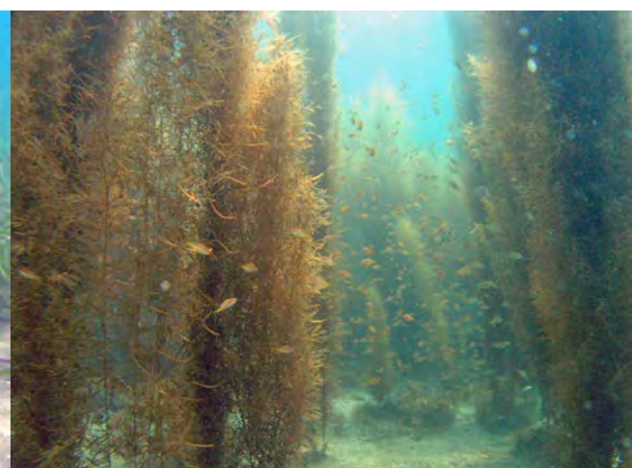


排出量を考慮した推… ーカーボン生態系のグラフに…基に作成している。基準年の値については、森林・農地土壌・都市緑地は地球温暖化対策計画における2013年度の実績値、ブルーカーボン生態系は既存の知見（藻場面積2009～10年、マングローブ林・干潟面積は1996～98年）による推計値（資料:ブルーカーボン研究会）

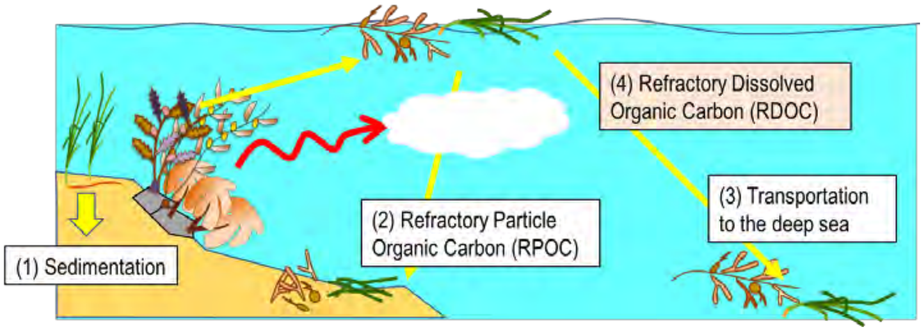
Japan Blue Carbon Research Group (2019), *Nikkei construction*

Newly unraveled storage processes

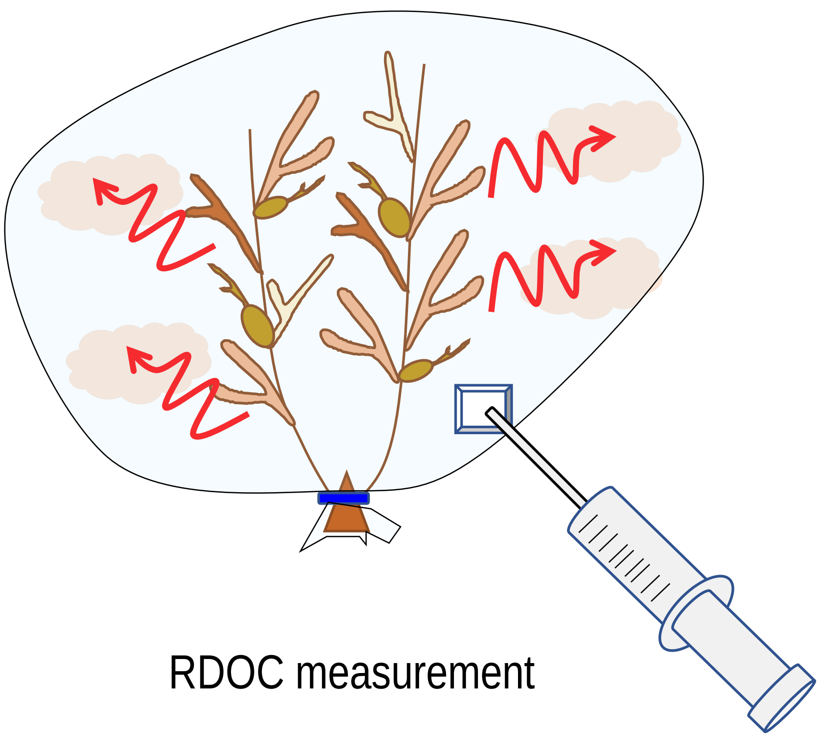




Newly unraveled storage processes



This process have never been included in any estimation of Blue Carbon storage!



RDOC measurement

Watanabe et al. (in prep)

Aquaculture can work as a climate change mitigation and adaptation measures: macroalgal (kelp, wakame, sargassum, nori laver, etc.) cultivation

RDOC released from growing algae contributes to blue carbon storage

Take-home message:

- The blue carbon contribution to atmospheric CO_2 sequestration is larger than terrestrial green carbon
- Approximately 50% of blue carbon sequestration is conducted in shallow coastal areas where is only 0.8% of the total ocean area
- Coastal marine vegetation can work not only as fishery grounds and fish nurseries but also as an effective CO_2 sink
- Macroalgal forests also function as CO_2 sink due to various organic carbon storage process
- Macroalgal aquaculture can also work as CO_2 sink by considering refractory dissolved organic carbon

Need conservation and restoration of coastal marine vegetation!