

The carbon cycle, life in the ocean and climate mitigation

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What is Blue Carbon?

Blue carbon: marine ecosystems that sequester and store carbon with a significant impact on atmospheric CO₂ levels

- Storage must be for a long time (centuries – millenia)
- Must be influenced by human intervention / activities (e.g. fishing methods)
- Important to consider implications of loss of ecosystems/ biodiversity that releases CO₂ into the atmosphere

Emphasis has been on coastal blue carbon

Mangrove forests
Salt marshes
Seagrass beds

Living biomass above ground

Living biomass below ground

Trap organic carbon as sediment

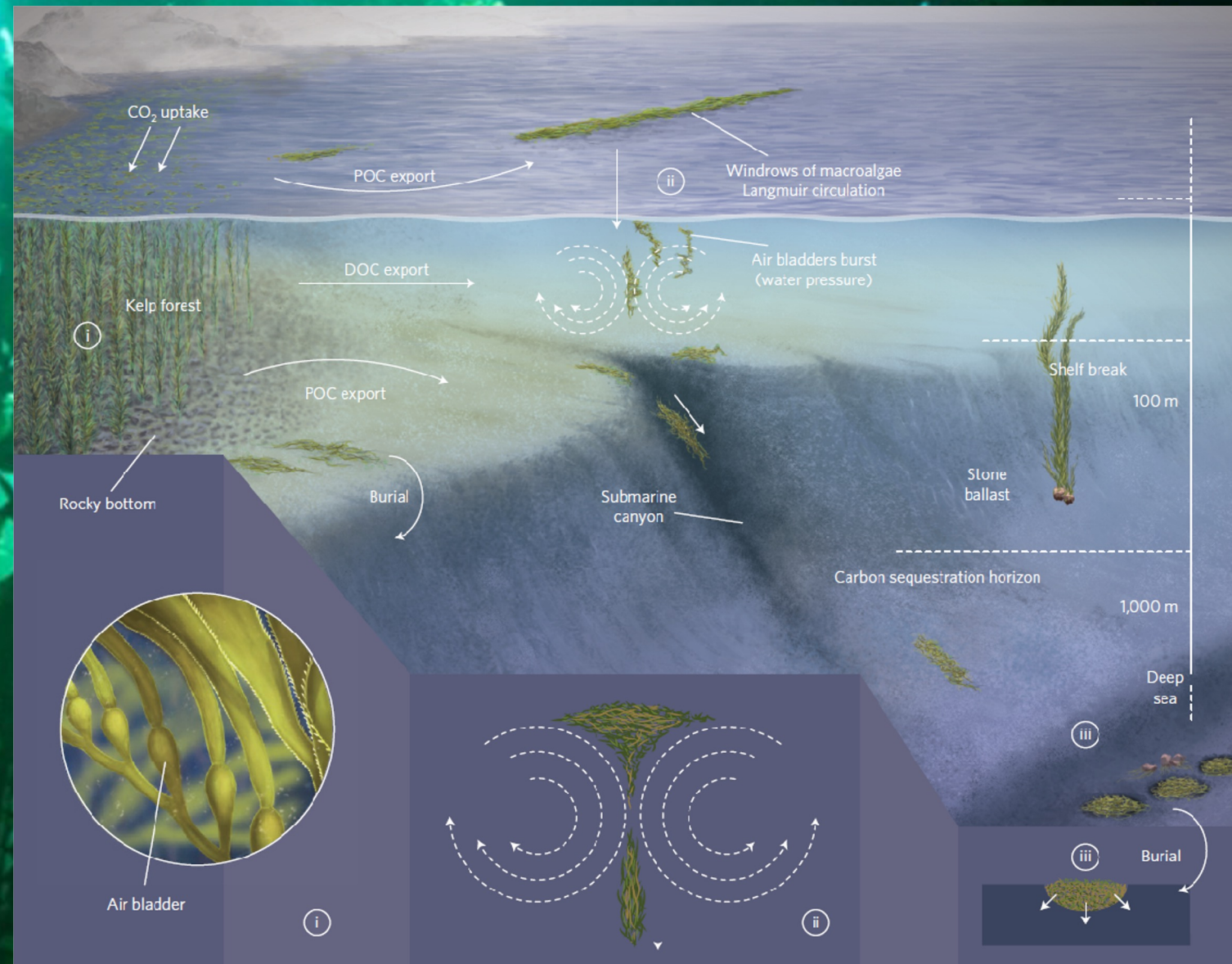
Macroalgae/kelp
No/little in-situ trapping of sediment



Tg = 1 million tonnes

Quantifying carbon sequestration by macroalgae

- Macroalgal forests cover up to 4.3 million km²
- Although they do not sequester carbon in situ in sediment they export dissolved and particulate organic carbon to coastal and deep-sea sediments
- Potentially sequester 173 (range 61-268) Tg C yr⁻¹



Whales and oceanic blue carbon

Rebuilding global whale stocks:
0.0087 Pg C living biomass
1.9 Tg yr⁻¹ Dead fall (seagrass up to 112)

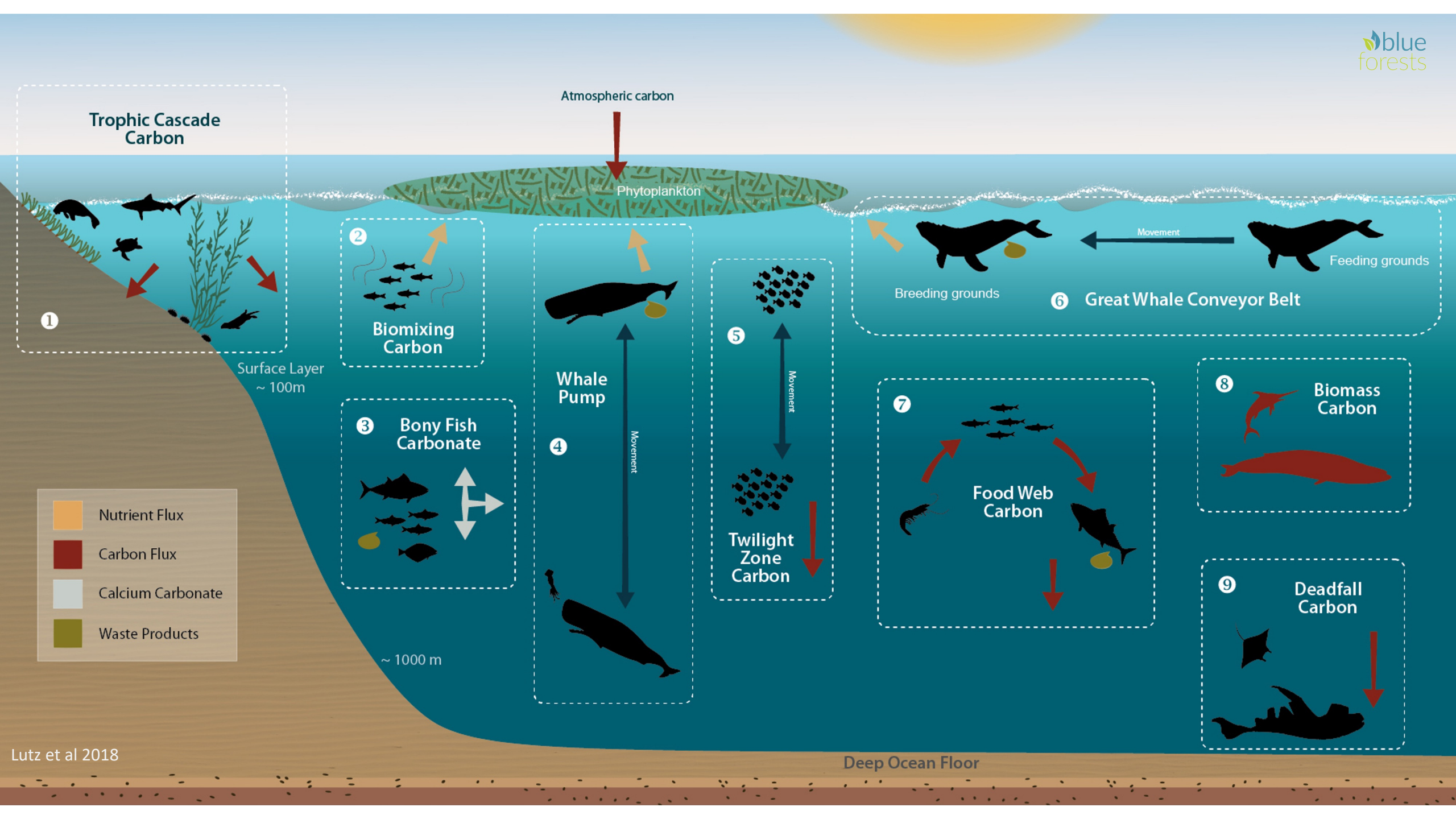
Pershing et al 2010 PLoS ONE 5: e12444

Marine mammal respiration proposed to
reduce the efficiency of the biological carbon
pump in Southern Ocean.

Sperm whales export 50t of iron from deep
ocean to the surface stimulating primary
production and increasing C sink by 200,000t

Lavery et al 2010 Proc. R. Soc. B doi:10.1098/rspb.2010.0863

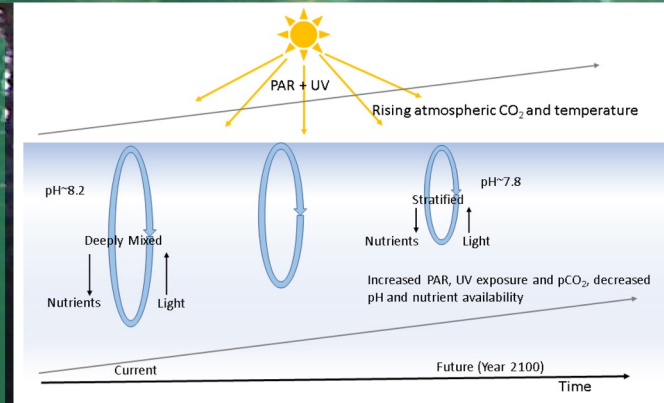




Can human influence these carbon sinks?

- **Climate change**
 - Reduced primary production
 - Reduced size/productivity of fish
 - Loss of habitat/species carbon sinks
- **Fishing**
 - Reduction of biomass
 - Reduction of active transport
 - Release of sediment carbon
 - Bycatch of predators
 - Habitat destruction
- **Other habitat destruction**
 - Dredging, mining
 - Pollution (e.g. plastics)

Images: Basu & Mackey 2018 Sustainability 10:869; Nereus Project; Hans Hillewaert; WWF 2021



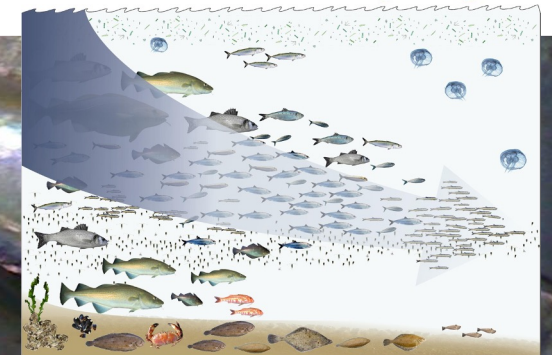
Under a high CO₂ emission scenario

2000

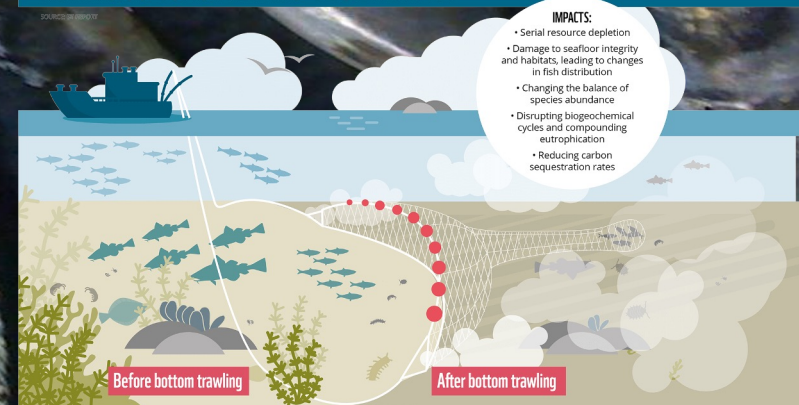
2050



14-24% shrink in body weight



THE IMPACTS OF BOTTOM TRAWLING - BEFORE AND AFTER

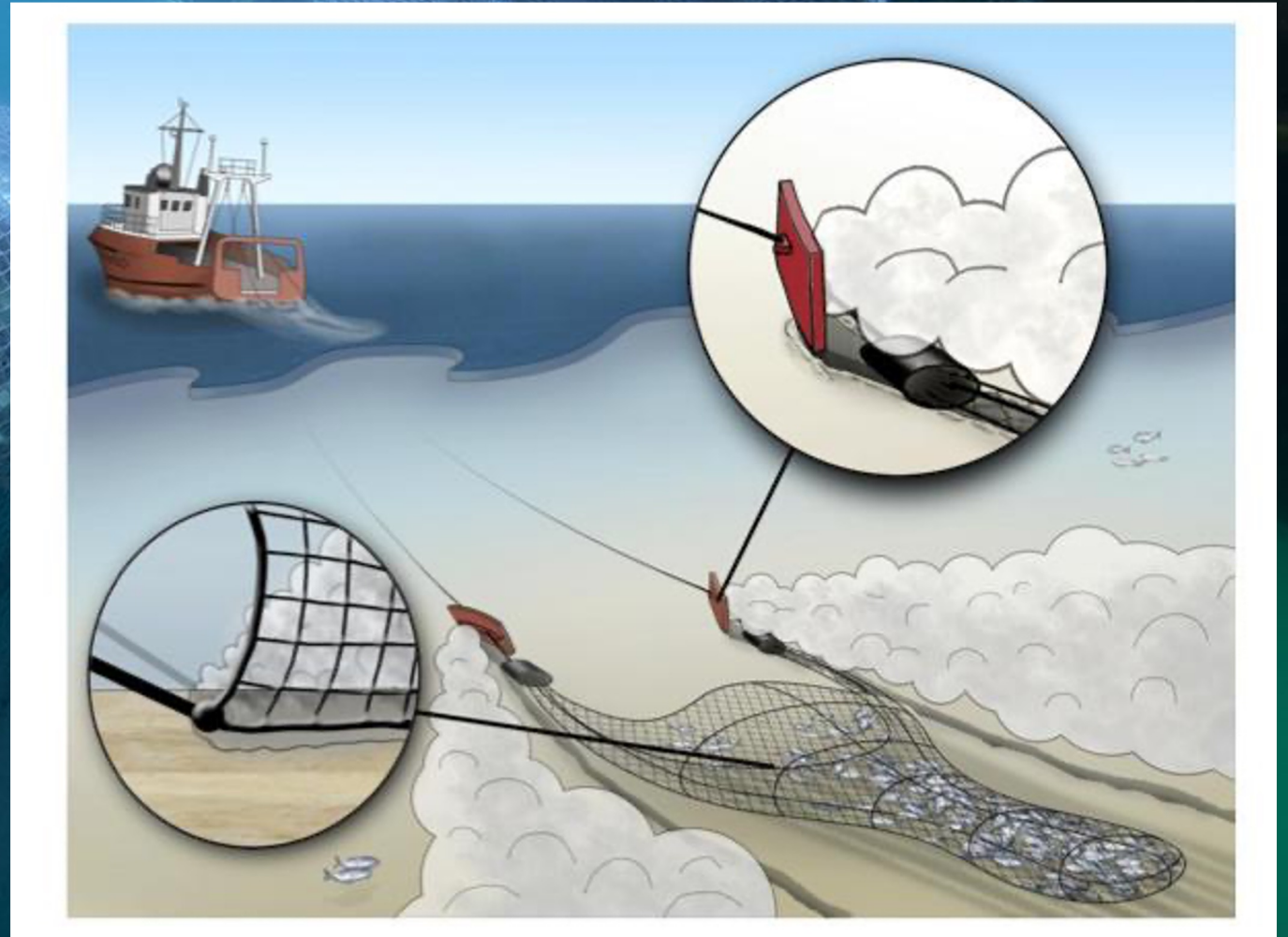


Bottom trawling resuspends sediment and releases CO₂

- 4.9 million km² trawled per annum
- 1.3% of the seafloor
- 1.47 Pg of increased emissions as a result of increased carbon metabolism in sediment
- Emissions decrease in subsequent years for repeated trawling but still 0.58 Pg per annum

Sala et al 2021 Nature <https://doi.org/10.1038/s41586-021-03371-z>

27.09.2021



Ferdinand Oberle

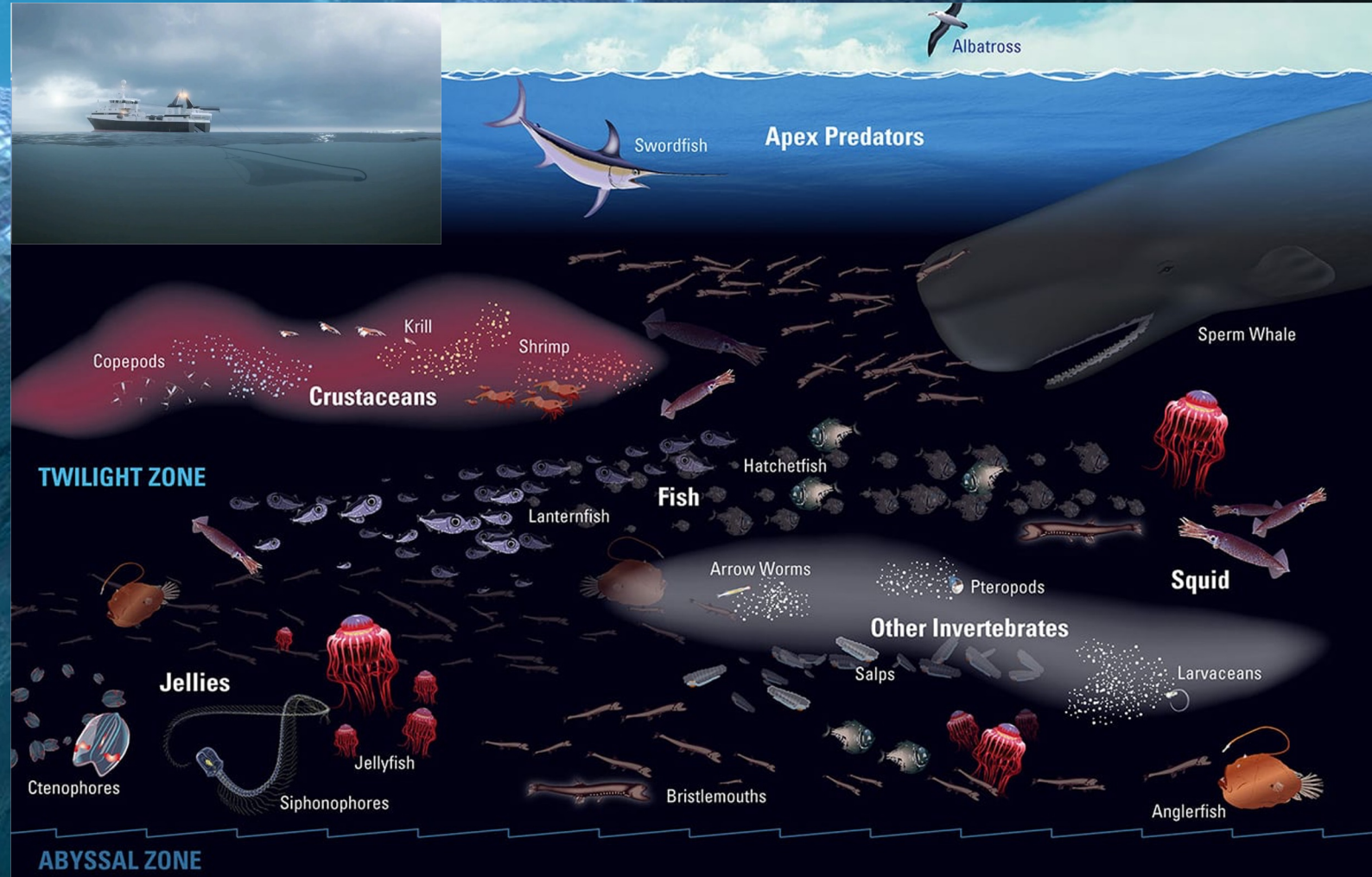
Fishing down the food web into the twilight zone

10-15 billion tonnes of biomass

Active transport of carbon
 $900 - 3600 \text{ Tg Corg yr}^{-1}$

Boyd et al (2019) Nature 568: 327-335

Even taking a small % of mesopelagic fish biomass represents a globally significant loss of CO_2 sequestration



Summary

- Coastal blue carbon is now recognised as a certifiable mechanism of carbon sequestration (mangroves, salt marshes, seagrass)
- Oceanic blue carbon has enormous potential and is clearly affected by human activities (e.g. climate change and fishing)
- Need for research to understand the mechanisms and quantify carbon sequestration and emission pathways
- Ocean management including of fisheries can reduce direct carbon emissions (e.g. fuel use) and also indirect emissions (e.g. overfishing, habitat destruction, fishing down the food web)
- Understanding of sequestration by macroalgae is increasing and seaweed farming may be certifiable for carbon sequestration



Thanks to Our Fish.
Thank you for listening!



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