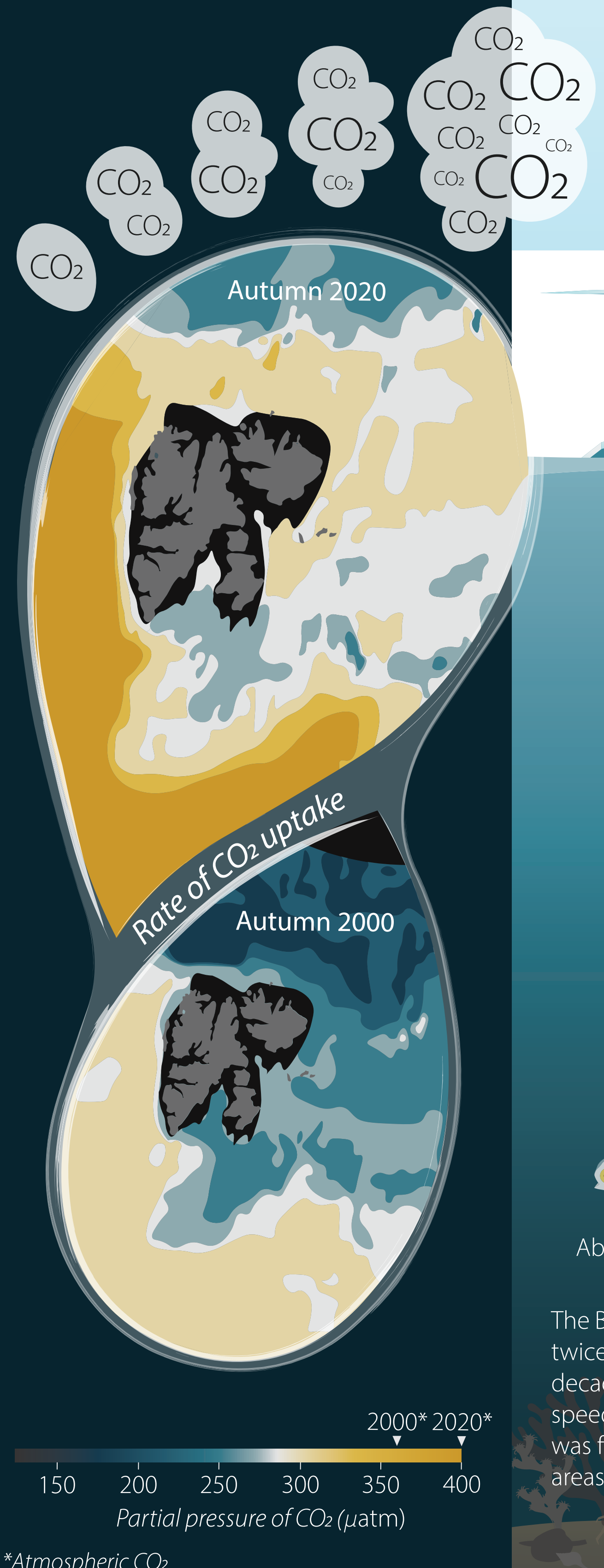
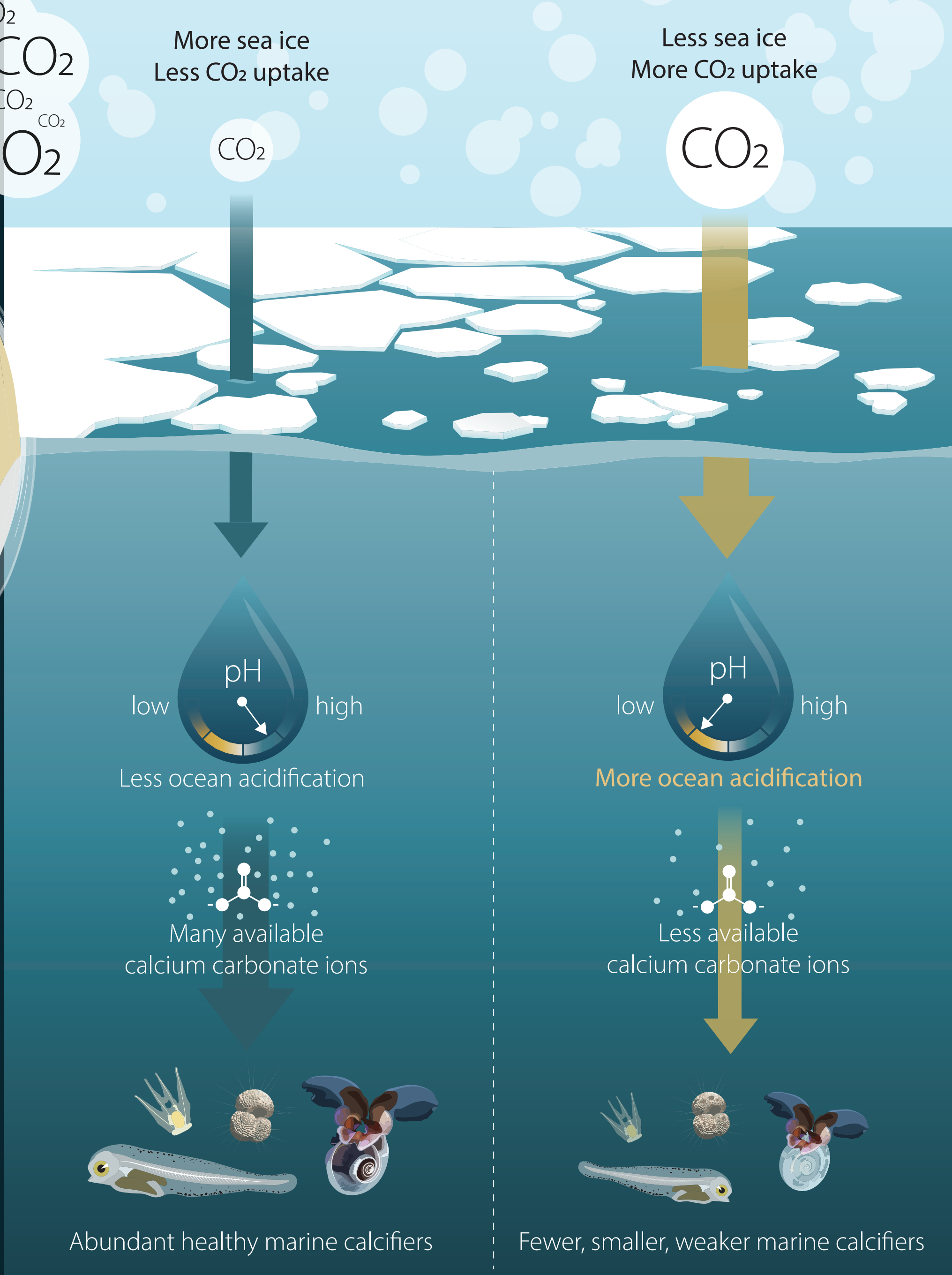
Ocean acidification

The ocean absorbs around 30% of anthropogenic carbon dioxide (CO_2) emissions from the atmosphere, thus reducing warming from the greenhouse effect. However, this has shifted the ocean chemistry towards enhanced CO_2 and lower pH (ocean acidification). Ocean acidification has negative consequences for marine organisms, particularly in early-life stages and those forming shells and skeletons made up of calcium carbonate minerals, such as sea butterflies, mussels, sea stars and corals. Ocean acidification can also affect survival, growth and reproduction with further impacts for the rest of the food chain.

Our carbon footprint is also visible in the Arctic.

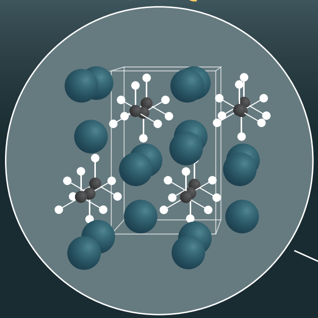


*Atmospheric CO_2

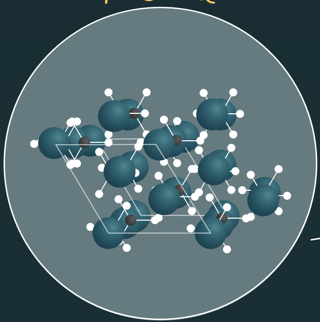


The Barents Sea acts as a CO_2 sink all year round and shows rapid ocean acidification, twice as fast as expected from increased atmospheric CO_2 emissions during the last decade. This implies that processes other than anthropogenic CO_2 contribute to speeding-up ocean acidification in the Barents Sea. The fastest ocean acidification was found in areas with the largest sea ice loss. This suggests that more open-water areas and increased sea-ice meltwater enhanced ocean acidification.

Biological impacts of ocean acidification in the Barents Sea



Stronger structure, more resilient to ocean acidification

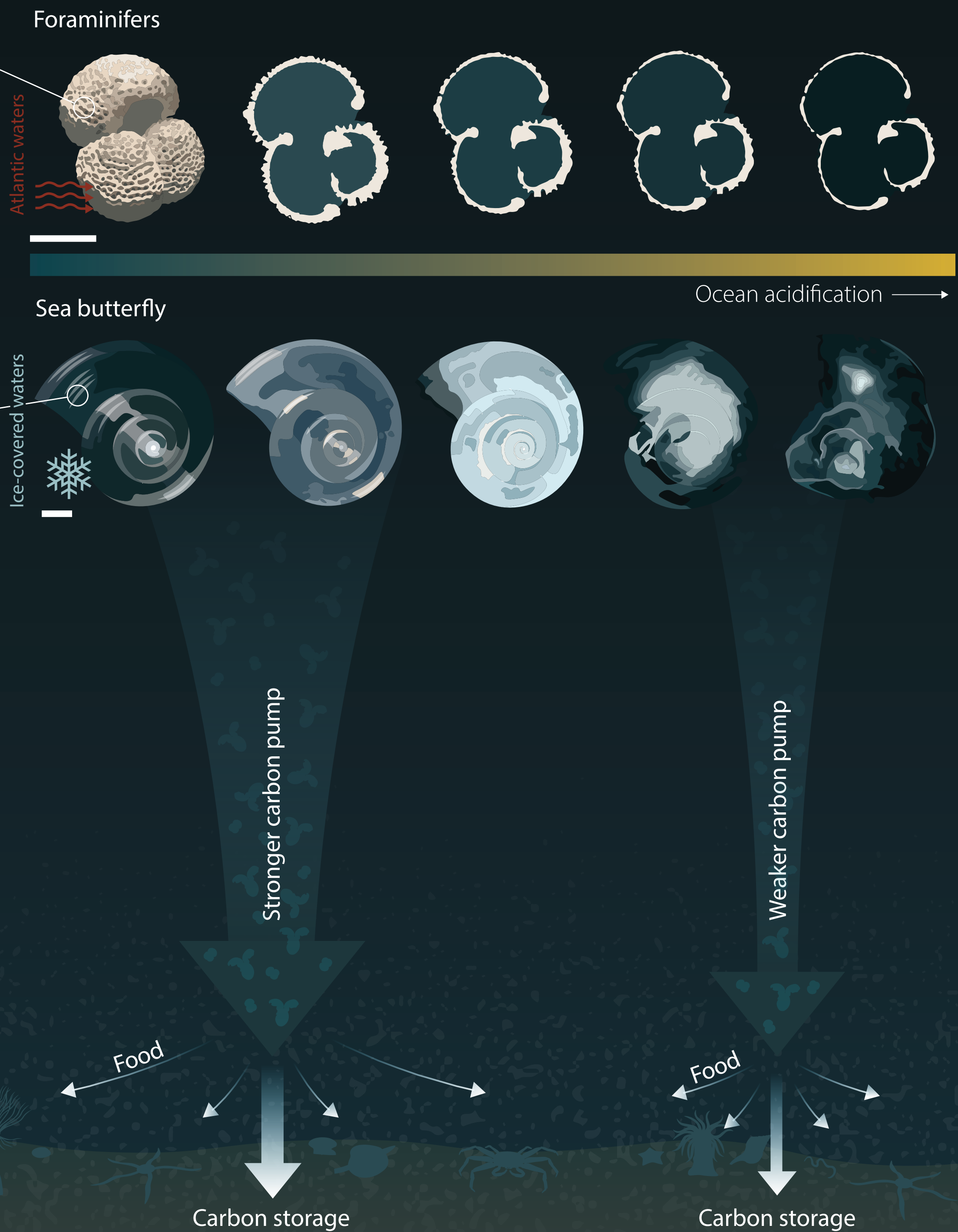


Weaker structure, more prone to ocean acidification

Carbon pump

The role of foraminifers and pteropods in the carbon pump consist of exporting organic and inorganic carbon from the surface water to the sea floor. In the Barents Sea, pteropods contribute with the largest carbon export, mainly due to their large size relative to the foraminifers. This implies that a loss of pteropods due to shell thinning from ocean acidification may have large consequences on the carbon export and the rest of the marine ecosystem.

Planktonic marine calcifiers are organisms with a shell made of calcium carbonate. From all of them, we studied foraminifers and shelled pteropods (sea butterflies) due to their important role in the carbon pump and sensitivity towards ocean acidification. We have found more foraminifers in areas influenced by warm Atlantic waters, and more pteropods in the cold and seasonally ice-covered Arctic waters. Consequently, the most vulnerable organism (sea butterfly) resided in the area where we found the fastest acidification and largest sea ice loss.



RECOMMENDATIONS

The Nansen Legacy project clearly showed the combined effects of climate change and ocean acidification. The Barents Sea is an efficient carbon sink and absorbs CO_2 from the atmosphere all year round. In the last two decades, surface acidification progressed faster than other global oceans, particularly in areas with the largest sea ice loss. Ocean acidification can have negative consequences for organisms such as pelagic calcifiers, and thereby impact the amount of carbon sinking to deeper layers. This will ultimately affect the ocean's CO_2 uptake, carbon storage, and food supply to benthic organisms. It is unclear how the combined effects of ongoing warming ('Atlantification') and ocean acidification will affect CO_2 uptake in the future. Moreover, little is known about how ocean acidification will influence other chemically controlled processes, such as the bioavailability and toxicity of trace and heavy metals (e.g. mercury). Multi-disciplinary observations, particularly in the seasonally ice-covered areas where the largest change was observed, are important to understand ecosystem response to the effects of anthropogenic carbon emissions.

The Nansen Legacy (2024) Fact Sheet: Ocean acidification. Zenodo. DOI: 10.5281/zenodo.10842735

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