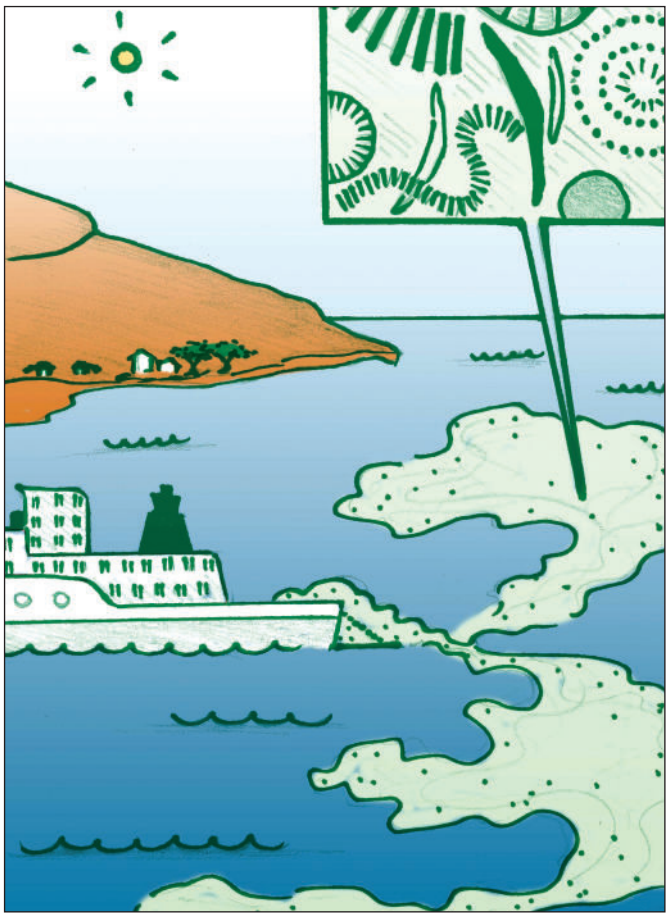
Ocean fertilization

Description and purpose of the technology

Ocean fertilization (OF) is a theoretical CO_2 removal technology that refers to dumping large amounts of micro- or macro-nutrients (like iron or urea) into ocean areas with low biological productivity, aiming to stimulate the growth of phytoplankton. The assumption driving OF efforts is that new phytoplankton growth will absorb atmospheric CO_2, and store carbon as it dies and sinks to the ocean floor. Over the last 30 years, there have been at least 16 open-ocean fertilization experiments. They have failed to prove OF as an effective carbon storage. Some scientists warn that OF could create deoxygenated "dead zones", and deplete nutrients that would fuel phytoplankton growth in other areas. These are some of the reasons why the United Nations, the United Nations Convention on Biological Diversity (CBD) and the London Convention on the Prevention of Marine Pollution adopted decisions to strictly regulate OF activities, which constitute de facto bans against all forms of commercial deployment.



Ocean Fertilization proposes that dumping iron or urea into the ocean will reduce atmospheric CO_2.

Actors involved

One of the first large OF experiments was the LOHAFEX expedition in 2009, where researchers, co-sponsored by the Indian and German governments, dumped 20 tons of ferrous sulphate over 300 km2 of open ocean east of Argentina. Although the German Environment Minister tried to put a halt to the experiment based on the UN CBD moratorium on ocean fertilization, the LOHAFEX experiment went forward.[1]

A notorious OF advocate has been businessman Russ George, who created Planktos Inc. The US-based, private company conducted an initial OF test off the coast of Hawaii from a yacht in 2002. Soon after, Planktos announced plans to dump 100 tons of iron particles over 10,000 km2 of international waters near the Galapagos Islands, a location chosen because, among other reasons, no government permit or oversight would be required. These plans, as well as a similar project near the Canary Islands, were cancelled due to negative publicity and Planktos was barred from ports by the Ecuadorean and the Spanish government.

Point of Intervention:

Reality Check:

Years later, Russ George reappeared with the Haida Salmon Restoration Corporation, which pitched OF to boost salmon populations off the Haida Gwaii archipelago off of Canada's west coast. In 2012, 120 tons of ferrous sulphate were dumped into the Pacific Ocean – the largest-ever OF dump. An international outcry led to an investigation by Environment Canada's enforcement branch - the project was cancelled.[2]

Several entrepreneur scientists involved in the Haida project have resurfaced in the Vancouver-based Oceaneos Marine Research Foundation. Since 2016, Oceaneos is seeking permits from South American governments to dump iron off the coast for OF experiments. In Chile, Oceaneos plans to release up to ten tons of iron (Fe), 130 km off the coast of Coquimbo. Similar requests were filed in Peru and Argentina. The projects have been sharply criticized by ocean scientists in Chilean research institutions.[3]

KIFES, the Korean Iron Fertilization Experiment in the Southern Ocean, is a research program designed and led by the Korean Polar Research Institute (KOPRI), funded by the Korean Ministry of Oceans and Fisheries and carried out in cooperation with domestic and international partners. KIFES aims to conduct OF tests in the eastern Bransfield Basin, not far from the Antarctic Peninsula. Although these plans didn't find approval during a London Convention Meeting in 2017, KOPRI announced OF activities involving two drops of two tonnes of iron, covering an ocean area of 300 km^2. KIFES's declared interest is in providing "a clear answer as to whether or not ocean iron fertilization is promising as a geoengineering solution."[4]

The Ocean Nourishment Corporation Pty Ltd (ONC) and the Ocean Nourishment Foundation Ltd (ONF) are further commercial OF companies, both based in Australia and headed by Ian Jones. ONC planned to add 500 tonnes of urea nitrogen into the Sulu Sea in 2007, with devastating impacts on over 10,000 artisanal fishers and algae cultivators. The plan was stopped, after a campaign organized by a coalition of civil society groups and the Philippine government forced the cancellation of the experiment. In 2019, ONF announced plans to fertilize the ocean in Moroccan waters, close to El Jadida. Both, ONC and ONF look for contracts and funding to commercialize their activities.

"Essential nutrients depleted by sudden plankton blooms could reduce overall marine biological productivity. This would have a negative knock-on impact on all other marine life."

Ian Jones has taken out patents that claim, astonishingly, to own any fish nurtured through ocean fertilization.[5]

The United Nations established a de facto moratorium on OF in 2008 through the Convention on Biological Diversity,[6] and on geoengineering in general in 2010.[7] The London Convention / London Protocol (LP) to prevent marine pollution also adopted a moratoria decision in 2008. Later in 2013 an amendment to the LP, to prohibit all marine geoengineering techniques that were included in a new specific annex (except for legitimate scientific research). Only OF is currently listed in that annex.[8]

Impacts of the technology

There is a wide scientific agreement that OF could have negative impacts in the marine food web. This would also have huge negative impacts on on artisanal fishers, alage cultivators and the livelihood of coastal communities, as it was shown in the case of ONC in the Sulu Sea.

OF studies conducted so far show how phytoplankton communities quickly become dominated by larger diatom phytoplankton, which is very concerning from an ecological viewpoint as phytoplankton species form the base of the marine food web. Any changes in the phytoplankton community will have unknown, unpredictable, and potentially highly damaging impacts on the food web in marine ecosystems. Phytoplankton blooms also reduce oxygen levels, impacting negatively on many marine organisms. A modelling study of large-scale iron fertilization predicted that it would lead to significant deep ocean oxygen depletion in the region studied. OF could also lead to eutrophication or harmful toxin-producing algal blooms.[9]

Red tide: could OF result in toxic phytoplankton blooms? Photo from P. Alejandro Díaz via Flickr

OF also results in other essential nutrients being depleted by the phytoplankton bloom, which could negatively affect down-current phytoplankton that depends on these nutrients and reduce overall biological productivity. This would have a negative knock-on impact on all other marine life. This would be detrimental for communities that depend on fishing and the cultivation of different marine resources. Modelling studies have also predicted that commercial-scale iron fertilization of the oceans could have a significant detrimental impact on fisheries.[10]

> **"Ocean Fertilization studies conducted so far show how phytoplankton communities quickly become dominated by larger diatom phytoplankton, which is very concerning from an ecological viewpoint as phytoplankton species form the base of the marine food web. Any changes in the phytoplankton community will have unknown, unpredictable, and potentially highly damaging impacts."**

Experiments have shown that a number of greenhouse gases are released through OF, which on a large scale could initiate positive feedback effects on the global climate. For example, modelling studies predicted that any benefits of carbon sequestration by large-scale iron fertilization could be outweighed by the production of nitrous oxide and methane – greenhouse gases that are far more potent than carbon dioxide.[11]

Finally, scientific studies have highlighted the fact that the amount of carbon exported to the deep sea is either very low or not detectable; much of the carbon absorbed by phytoplankton growth is released again via the food chain.[12]

Reality check

Before the de facto moratorium at CBD and the London Convention, numerous open-ocean OF experiments have taken place, aided by the fact that such experiments are logistically simple to carry out. Notwithstanding, in addition to the above-mentioned proposals (by Oceaneos, ONC/ONF and KIFES), there are further projects in the pipeline, including OF with a buoyant fertilizer, made of rice husks, lignin and added nutrients, and OF with nano-sized iron particles produced by iron-oxidizing bacteria.[13] To sidestep negative publicity, OF is increasingly rebranded, e.g. as "marine snow", "ocean seeding" or "ocean nourishment".

Further reading

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Greenpeace, ***A scientific critique of oceanic iron fertilization as a climate change mitigation strategy***
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CBD, ***Scientific Synthesis of the Impacts of Ocean Fertilization on Marine Biodiversity***

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Endnotes

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