STEFAN RAHMSTORF

WILD OCEAN

Stefan Rahmstorf is a physicist and climatologist. He is currently head of Earth System Analysis at the Potsdam Institute for Climate Impact Research in Germany and Professor of Physics of the Oceans at Potsdam University. From 2004–2013 he served on the German Advisory Council on Global Change (WBGU). Rahmstorf is an Honorary Fellow of the University of Wales and Fellow of the American Geophysical Union. He has authored over 90 scientific papers and several books, including *Our Threatened Oceans* and *The Climate Crisis*.

+ CLIMATE SCIENCE, OCEANOGRAPHY, MARINE BIOLOGY

The global ocean is far from a pristine wilderness. Human activities have transformed the oceans in profound and lasting ways. In fact, in the past 50 years we have triggered changes in the oceans that are bigger than anything experienced for millions of years.[1] In a recent book, Katherine Richardson and I described two futures for the global ocean: a bleak one and an optimistic one.[2] Our dark vision was of an ocean in further decline, heated up by global warming, acidified by carbon dioxide, with dying coral reefs, more oil spills like that of Deepwater Horizon, widespread ecosystem collapse, algal blooms and jellyfish instead of fish. Eating wild fish would become an expensive luxury commodity for the lucky few, and rising seas would erode away beaches, overtop coastal defences during storms and force us to abandon cities and once populated islands. It is easy to arrive at such a bleak vision by just looking at what is already happening. After several millennia of stability, sea levels started rising in the late 19th century and are now rising at a rate of three centimetres each decade – three times as fast as in the early 20th century. It takes rather more imagination to see the brighter path that is open to us.

The human transformation of the oceans has been going on for so long that people living today cannot remember what was lost, how plentiful our seas once were. This is known as the shifting baselines syndrome. Ocean historians, who trawl ancient records and log books, tell us astonishing and moving tales of bays that were so full of fish one could have almost walked across them, or oyster reefs so plentiful that they formed a shipping hazard.[3] In the meantime, we have mostly emptied out the oceans and destroyed most of this abundance of life.

In one sense we still treat the ocean like the wild, though: we exploit marine life in hunter-gatherer mode. And often enough as poachers – illegal, unreported or unregulated fisheries make up between one-seventh and one-third of global catches.[4] But modern hunters use satellites and electronic fish finders to locate even the last fish in the ocean emptiness. And they use huge nets, dragged along the ocean floor, destroying everything in their way. This is rather like hunting for deer with a net by dragging down an entire forest from an air ship – this would be unthinkable on land, simply because there the collateral damage would be visible.

The health and survival of our oceans depends on us taking an active, thoughtful stewardship role rather than letting marine exploitation run wild. We need to stop treating the world ocean like a garbage dump and resource mine. We need to become more like gardeners, as we already do in many cases on land. Ultimately it is us who suffer the consequences of our reckless neglect of the health of the seas. If we keep polluting the seas, littering them with plastics and acidifying them with carbon dioxide, we should not be surprised when entire ecosystems collapse and dead zones are spreading. If we keep heating up the globe, the seas will inevitably rise further at an accelerating rate, drowning cities and entire island nations including much of our cherished heritage as humans.[5]

The oceans are a common heritage of mankind. This idea was put forward as early as the 1960s by Arvid Pardo and Elisabeth Mann Borgese in the negotiations on the United Nations Convention on the Law of the Sea. The oceans need to be governed based on this recognition, keeping them in good condition for future generations. Fully implementing this "common heritage" concept in the Law of the Sea may seem utopian today, but in fact the basis for this is already in the law – though it currently applies only to the bottom of the high seas. It needs to be extended to all but the territorial waters of coastal nations.[6] The many initiatives working on specific projects for sustainable use of the oceans could add this to their long-term agenda: building a groundswell of support for such visionary reform of the Law of the Sea.

The oceans can offer many opportunities if managed properly. They can help to feed a growing population if we succeed in rebuilding depleted fish stocks and developing sustainable forms of marine aquaculture – designs of spherical cages floating freely in the ocean with the current have already been tested.[7] The oceans can help to provide us with clean, climate-friendly electricity from offshore wind (including from floating platforms), ocean currents, or waves. Of these, wind has the largest potential: even using only the technology available today, it would greatly exceed the current global demand for electricity.[8]

The oceans can also help us to store electricity – a key technology needed in a future world driven by a 100% renewable but fluctuating energy supply. This can be achieved by large hollow balls made of concrete situated on the ocean floor at great depths. Water is pumped out when excess electricity is available, and let back in through a turbine when power is needed. This works like pump storage on land – but many times more effectively due to the large water pressure available at the ocean floor. Prototypes of these devices are being built in Germany and the US.[9] Another option is wind gas – using surplus electricity at offshore wind farms for first producing hydrogen from water through electrolysis, then combining it with CO2 from the air to make methane. While such uses of the oceans do not come free of environmental impacts (which need to be carefully evaluated), these are much smaller than those of a continuation of the fossil fuel age – both in direct impacts from offshore drilling in increasingly deep waters and the Arctic, and the indirect but pervasive double whammy of global warming and acidification.

New multi-use platforms are also being designed combining renewable-energy generation, aquaculture, transport services, and leisure activities[10] – why not use the foundations of offshore wind farms as artificial reefs and farm fish and algae amongst the windmills? With increasing pressures on the limited coastal ocean areas we need to think about such synergies and, as fishing typically does not happen in amongst offshore wind farms, these could become effective fish sanctuaries.

To get our oceans into a better state again, we need to think long term and systemically, understanding the global ocean as an ecosystem and a crucial and beautiful part of the larger Earth system. We need to act in a precautionary way, taking uncertainties that might work against us into account. We need to cooperate to overcome the tragedy of the commons, rather than following just our short-term self-interest.

The future of planet Earth's oceans is open, and it depends on us.

1 Bärbel Hönisch, et al. "The Geological Record of Ocean Acidification," *Science* 335, no. 6072 (2012) 335: 1058–1063.

2 Stefan Rahmstorf & Katherine Richardson, *Our Threatened Oceans* (London: Haus Publishing, 2009).

3 Callum W. Roberts, Ocean of Life. How Our Seas are Changing (London: Penguin, 2012).

4 David J. Agnew, et al. "Estimating the Worldwide Extent of Illegal Fishing," *PLoS ONE* 4, no. 2 (2009): e4570–e4577.

5 German Advisory Council on Global Change (WGBU), *The Future Oceans - Warming Up, Rising High, Turning Sour* (Berlin: WBGU, 2006).

6 WGBU, *Governing the Marine Heritage* (Berlin: WBGU, 2013).

7 Kampachi Farms, "Further and Deeper – Developing Technology for Next-Generation.

8 WGBU, *Governing the Marine Heritage.*

9 Ibid.

10 B.H. Buck, G. Krause & H. Rosenthal, "Extensive Open Ocean Aquaculture Development within Wind Farms in Germany: the prospect of offshore co-management and legal constraints," *Ocean & Coastal Management* 47 no. 3–4 (2004): 95–122.