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# Deep-water fisheries

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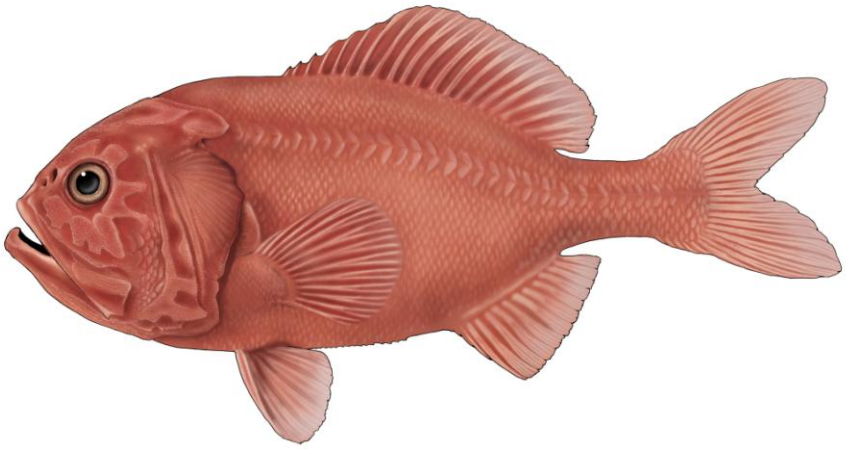
More than 50% of the fishing stocks are operating at their maximum limit, while around 30% are overexploited, depleted or recovering according to FAO information.

Not a recent problem. Already in the 1970s, around 50% of the traditional fishing stocks in continental shelves were considered at their maximum sustainable level, or fully exploited. This led to the migration of the fleets to exploit deeper waters in the 1980s and 1990s. A relevant part of these fleets were composed of deep-sea trawlers, which rapidly reduced the newly discovered fish such as the orange roughy *(Hoplostethus atlanticus)* and the oreos (*Allocyttus niger* and others) in New Zealand and South Australia in the 1980s, and subsequently in the North Atlantic. This deep-sea fishery targeted seamounts spread throughout the oceans. In all cases there was a pattern of rapid development followed by decline clearly related with the movement of the fleets along chains of seamounts.



Orange roughy, *Hoplostethus atlanticus*. This long live, late reproduction species, which aggregates at seamounts, became an icon on deep-sea marine conservation after the decimation of populations in the Pacific, and then, Atlantic oceans.
This species was originally described by Robert Collet, an ichthyologist and collaborator of SAS the Prince Abert Ist of Monaco, based on a specimen collected during a mission lead by the Prince. The holotype is deposited at the Monaco Oceanographic Museum. (Illustration by Les Gallagher © fishpics & *Imag*DOP/Univ. Azores).

The use of intensive trawl technology in deep-sea fisheries was also found to be associated with incidental catch of benthic organisms (i.e. that are fixed or associated with the sea bottom) and habitat disturbance. These fisheries lead to habitat degradation with effects on the local biodiversity and the biomass of the benthic species. Some of the relevant impacted species were deep-water corals and sponge aggregations. Deep-water, or cold-water, corals are really long live. There are colonies of black-corals of the genus *Leiopathes* that were aged 4000 years old.

The importance of these long living organisms, some of which form extensive reefs (e.g. *Lophelia pertusa)*, as structural habitats of the deep-sea is of manifest importance for organism like fish and crustacean which find refuge and food at those spots.

When destroyed by massive trawlers these environments would take from hundred to thousands of years to recover if kept untouched. In actual terms they may be considered un-recoverable.
Management of the deep-sea thus became one of the most challenging ocean issues and matter of importance.

The question that arises is whether it is possible to maintain a sustainable management of deep-sea fisheries? Much of the biomass extracted from the deep-sea is composed of fish. Deep-water fish have high intrinsic vulnerability due to unique features of their life cycles, such as slow growth, high longevity (e.g. the orange roughy and some oreos may reach around 150 years of age, roundnose grenadier – *Coryphaenoides rupestris* – around 56 years), late maturity (e.g. at 40 years old in the orange roughy), reduced natural mortality, etc. These factors make the deep-sea fish more sensitive and vulnerable to exploitation, in comparison with shallower ones. It is generally agreed that the depth trawl and gill nets are equivalent to "mining", and may lead to the commercial extinction of species. The sustainability of deep-sea fish resources seems to be possible only where traditional, small-scale fishing practice exists, as in some archipelagic states where deep-sea trawls are banned.

At present scientists do not know how much of the deep-sea seafloor has been already disturbed by fisheries. A lot more than the component that has been observed and studied. A recent study by Ramirez-Llodra *et al.* [5] describes very clearly the dimension of our ignorance in relation to the deep-sea floor. For example only around 0.25% of the seamounts, which cover solely 2.6% of the deep-sea, wherever targeted by scientific studies. If we consider the all deep-sea floor the component covered by scientific sampling is only 0.000 1%.

Fortunately some governments and inter-governmental organizations, under the influence of scientific and non-governmental organizations, are giving more and more relevance to the implementation of management regulations based on precautionary and sustainability principles and approaches based on the ecosystems as a whole.

A good example of guidance towards the conservation of the deep-sea is given by the Oceanographic Institute, Foundation Albert I$^{st}$, Prince of Monaco, with the promotion of influential outreach and educational initiatives for the great public put together with scientific and policy meetings involving all sectors and stakeholders.
The future of deep-sea fish and deep-sea fisheries needs in fact convergence of these different sectors of society. "Fishing is not just about catching fish and making money; rather it is bound up in the culture of coastal societies. Any factor that affects the viability of the viability of the fishery affects that society, the two are inextricably linked which is why fisheries students and scientists should never forget that human should be considered as part of the marine ecosystems" [2, p. 126].

**Further reading**:

[1] Calcagno R. (2011). *Les Grands Fonds Marins. Voyage dans un monde inconnu*. Éditions du Rocher, Paris, France, 156 pp.
[2] Jennings S., Kaiser M. & Reynolds J. D. (2001). *Marine Fisheries Ecology*. Blackwell Science, Oxford, United Kingdom, xiii + 417 pp.
[3] Pauly D. & Maclean J. (2003). *In a Perfect Ocean: The State of Fisheries and Ecosystems in the North Atlantic Ocean*. Island Press, London, Great Britain, 160 pp.
[4] Pitcher T. J., Morato T., Hart P. J. B., Clark M. R., Haggan N. & Santos R.S. (2007). *Seamounts: Ecology, Fisheries and Conservation*. Blackwell Publishing, Oxford, UK; Iowa, USA; Victoria, Australia, xxvi + 527 pp. with 156 illustrations.
[5] Ramirez-Llodra E. *et al.* (2010). Deep, diverse and definitely different: unique attributes of the world's largest ecosystem. *Biogeosciences*, 7, 2851-2899.
[6] Roberts C. (2007). *The Unnatural History of the Sea: The past and future of humanity and fishing*. Island Press, London, Great Britain, xiv + 448 pp.