

The variability of upwellings

Upwelling systems are areas where cold, nutrient-rich water rises, which contains high numbers of fish and is important for fisheries. But their productivity varies from year to year. Where do these fluctuations come from?



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Fishing off the coast of Peru.

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Of all the upwellings, the one off the coast of Peru is the most productive by far - it alone accounts for 5-6% of the world's fishing. However, this cornucopia sometimes dries up completely, as in 1972, causing the sudden collapse of an entire economic sector.

Such abrupt changes have led research teams to question the upwelling's local and global mechanics. It appears that the driving force is not located in the depths of the ocean - rather, the winds and Coriolis force push surface waters out to sea like a conveyor belt, causing the nutrient-rich waters beneath to rise... very slowly.

... Scientists have sought to gain
a better understanding of the complex mechanics
of upwellings in order to anticipate fluctuations
in fishing productivity ...

This is the key to the zone's extreme productivity. Because in these calm, nutrient-rich, well-lit waters, phytoplankton flourish and, with them, so does the entire food chain. However, in some years during the El Niño phenomenon, the machine breaks down and the deep waters no longer rise. A layer of water from the Equatorial Zone, warm and low in nutrients and plankton, then accumulates on the surface, stopping photosynthesis and driving away the fish.

Conversely, when the upwelling is in full swing, so much organic matter is produced that some of it (dead organisms, faecal pellets, etc.) sinks and is consumed by ocean bacteria, which breathe and consume the ambient oxygen. This creates a deep layer of water with very low oxygen content which, in certain cases, due to an ocean wave from the north, can rise and destroy the entire ecosystem in one go.



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Collecting oceanographic data during the intense upwelling season, Senegal.

The way in which upwelling zones are stirred up by winds and waves therefore influences their productivity. This complex mechanism could be at work in other parts of the world, such as in West Africa, along the coast of Senegal, and in South Africa. What will happen to it in the context of climate change? In the 1990s, measurements suggested that wind speeds would increase, speeding up the engine and therefore the productivity of upwellings. But more recent research shows that this trend is only true for high latitudes. In regions close to the tropics, this would not be the case, which could ultimately lead to a drop in the productivity of upwellings in Peru and Senegal.

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Children fishing on a reef flat in Reao, French Polynesia. © IRD/S.Andréfouët

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