European Commission

Science for Environment Policy

Environmental conditions in winter can be used to predict European anchovy stock

The European anchovy is one of the most important small pelagic fish in the Adriatic Sea, but the size of the stock can fluctuate year on year. This study aimed to investigate the link between anchovy catch and winter circulation patterns in the North Adriatic sea. The findings show that oceanographic conditions during winter determine anchovy abundance. Prediction of these conditions could help to guide sustainable fisheries management in the region.

Fish stock predictions are important for guiding fisheries management and may help prevent over-exploitation (as fishing can be reduced when stocks are predicted to be low). Methods of prediction involve measuring environmental parameters, such as sea temperature and salinity (salt content), and correlating them to fish stocks.

Such efforts are especially important for commercially significant species, such as the European anchovy (*Engraulis encrasicolus*). This Mediterranean species is economically important for regions in the Adriatic, including Italy (a major anchovy fishing region, which lands around 90% of the European anchovy catch) as well as Croatia and Slovenia.

Following a large decrease in 1987, the anchovy catch recovered until the end of the 1980s. It fluctuated over the next 15 years between 11 000 to 29 000 tonnes (with a peak in 2004 of 33 000 tonnes). This peak coincided with changes to the winter weather, and especially increases in 'type A' winters, one of two major types of winter seen in the Northern Adriatic. More recent data however (2007 onwards) show a decline in anchovy stock, causing some fisheries to be closed[1].

This study was interested in the link between winter type and stock. In 'type B' winters, waters are exported out of the Adriatic and salt content increases. In type A winters, waters from the Po River in Northern Italy spread across the Adriatic and the salinity of the Sea decreases, causing the abundance of phytoplankton to increase. Phytoplankton is one component of the opportunistic anchovy's diet, but also the food for its main prey, zooplankton.

In a study published in 2011, researchers hypothesised that winter conditions are crucial for Adriatic anchovy, and – based on indications of a correlation between type A winters and the abundance of anchovy – that type A winters increase stocks. In this more recent study, as well as oceanographic data, they considered numbers of zooplankton and used a longer time series of environmental and catch data (1977–2007, compared to 1990–2004).

Although there was no immediately observable connection between winter type and yearly catch, two distinct increases in stock during the extended time series (in 1977 and 2004) showed a clear link to winter type A. According to the researchers, this is because spreading of nutrient-rich freshwaters from the Po River leads to increased production of phytoplankton, followed by zooplankton, leading to high anchovy stocks and thus high catch. A good example of this is the increased yearly catch between 2005 and 2007, which they say resulted from favourable winter conditions during the anchovy pre-spawning period (February) in 2004.

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10 March 2016
Issue 450

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Source: Kraus, R., Supić, N., Lučić, D. & Njire, J. (2015). Impact of winter oceanographic conditions on zooplankton abundance in northern Adriatic with implications on Adriatic anchovy stock prognosis. *Estuarine, Coastal and Shelf Science*, 167: 56-66. DOI: 10.1016/j.ecss.2015.10.008

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1.http://ec.europa.eu/fisheries/marine_species/wild_species/anchovy/index_en.htm

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Overall, the results support the hypothesis that sea conditions in the winter are critical for anchovy stock in the Northern Adriatic. However, it is important to note that anchovy stock may fluctuate due to multiple natural and anthropogenic factors.

The findings could enable development of predictive models for anchovy fisheries in the Adriatic, enabling management based on the meteorological conditions in autumn, or sea conditions at the beginning of the year.

Continuation of intense fishing without regard for fish stocks creates a risk of overfishing. To reduce this risk, restrictions on fishing and increasing aquaculture have been proposed. Instead of these methods, the researchers suggest the use of 'smart fishing' — fishing based on scientific predictions of stock — such that the amount of fish caught is in line with the limits of the fish population.

The researchers say continuous monitoring of the anchovy stock, alongside monitoring of winter conditions, could help to plan sustainable fishing activities. This novel approach, which they call a 'fine-tuning' prediction mechanism, could benefit the environment and the economy. In the Adriatic Sea, they suggest anchovy fishing should only be incentivised by government in favourable years. In poor years for anchovy stocks, they say fishing should be discouraged by government. This approach, which is based on linking long-term changes in geostrophic currents to biological values, could be used to predict fish stocks in other regions, as geostrophic currents can be easily obtained from standard oceanographic data.