

# Science for Environment Policy

## Shifts in Mediterranean fish farming increase pressure on wild fish stocks

**Fish farming in the Mediterranean** has increasingly shifted from producing fish such as grey mullet, which are herbivores near the bottom of the food chain, to species such as sea bass, which are predators. This 'farming up' the food chain requires wild fish to be caught to provide feed. A return to farming fish lower in the food chain would use marine resources more efficiently, a new study says.

**Between 1950 and 2011, Mediterranean fish farming** changed from predominantly cultivating shellfish and herbivorous fish, to producing mainly seabream and seabass, which prey on other fish. This shift from farming species lower in the food chain to species higher up is known as 'farming up the food chain'. This has implications for fisheries, as small fish are caught to produce feed for the farmed fish, with a direct impact on wild fish stocks. More recent formulations of feed have, however, substituted some of the fishmeal and oil with plant material, in an effort to reduce the need for wild fish.

In this study, the researchers investigated the extent to which farming up the food web occurred in the Mediterranean Sea during 1950–2011. They included all species farmed in the Mediterranean during this period and estimated the average trophic level of the farmed fish (i.e. how far up the food chain they are), based on the diet they would have eaten in the wild. The researchers obtained production levels of farmed fish and shellfish as well as trophic level data of their natural food from the Food and Agricultural Organisation and from FishBase<sup>1</sup>.

The researchers also estimated the trophic levels of the aquafeed of five species, which account for most of the farmed production: four seabream species, the common dentex (*Dentex dentex*), common pandora (*Pagellus erythrinus*), gilthead seabream (*Sparus aurata*), red porgy (*Pagrus* sp.) and the European seabass (*Dicentrarchus labrax*). The analysis was based on the proportions of the fishmeal, oil and plant material constituents of the feed, using data from formulations used in previous studies or from commercial aquafeed.

The results revealed that during 1950–2011, the average trophic level of aquafeed was 3.93. This was higher than the average trophic level of 3.72 for the prey the farmed fish would have eaten, had they lived in the wild during the same period. Fish production grew rapidly from 1980 to 2011. During this period, the researchers estimated that the trophic level of aquafeed for all maritime farming increased by 0.48 per decade, compared with a 0.43 per decade increase for the diet the farmed fish would have eaten in the wild.

Taken together, these results indicate that changes in marine aquaculture in the Mediterranean have indeed led to 'farming up' the food web. Other fish, such as the greater amberjack (*Seriola dumerili*), which are even higher up the food chain, are being trialled in the Mediterranean, which will put further pressure on wild fish caught for aquafeed.

The researchers anticipate that further replacement of fishmeal and oil with plant material will reduce the amount of wild fish caught for aquafeed. There could, however, be consequences of increasing the amount of plant-based food in a carnivore's diet. For example, nutritional balance could be affected, resulting in slower growth rates, longer production times, higher costs and the increased use of veterinary products.

The researchers call for an increase in the production of low-trophic-level fish, such as grey mullet and sharp-snout seabream (*Diplodus puntazzo*), as well as making the most efficient use of marine food resources in aquafeeds.

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1. See: [www.fishbase.org](http://www.fishbase.org)