

MANAGEMENT OF MEDITERRANEAN FISHERIES AND IMPACT ON THE MARINE ECOSYSTEM: HOW TO ACCOUNT FOR TOP PREDATORS?

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Abstract

We review different types of interactions between fisheries and top predators, particularly seabirds, in the Mediterranean. Fisheries affect top predators in a variety of ways, resulting from strongly detrimental (mortality caused by long-lines and other activities) through beneficial effects (at least in the short term, consumption of discards). These interactions should be studied in detail and taken into account when designing managing strategies, in order to reduce collateral effects over the marine ecosystem.

Keywords: conservation; discards; ecosystem-based management; long-lining; seabirds

Fisheries have for long been regarded as an extracting activity only affecting their targeted fish stocks, but their impact over the whole marine ecosystem is now receiving increasing attention (1-3). Top predators, due to their high position in the food webs, can be particularly affected by the deterioration of the ecosystem. In this report, we review the interactions between top predators and fisheries in a low productive and highly diversified sea, the Mediterranean, with particular attention to seabirds. We also suggest possible ways of taking these organisms (often of high conservation concern) into account when managing fisheries.

The Mediterranean is a sea of relatively low production (4), holding relatively low developed fisheries, primarily of artisanal type (5), and modest populations of top predators, though in some cases (e.g. seabirds) of particular conservation concern due to their diversity and often restricted distribution. The degree of interaction between predators and fisheries seems high and diverse in nature, ranging (considering the predator's point of view) from directly prejudicial (mortality caused by some fishing activities) to potentially beneficial (discards).

• **Interactions causing direct mortality: Two fishing techniques** are particularly prejudicial for their undesired but direct effect on top predators, drift-netting (officially banned) and long-lining. Long-lines are responsible for high mortality rates of seabirds, cetaceans, sea turtles and sharks worldwide (1, 3). Since most top predators are long-lived organisms, with low reproductive rates that are counterbalanced by high survival, this additional factor of mortality can strongly influence their population dynamics and, in some cases, lead to near-extinction. This seems to be the case of the endemic and critically endangered Balearic shearwater *Puffinus mauretanicus* (6). In any case, few studies have addressed this problem for the Mediterranean (7), where the diversity of fishing gears employed and the artisanal nature of the fleets could make the implementation of mitigating measures (e.g. timetable changes, line weighting and the use of bird-scaring lines) difficult.

• **Competition: Top predators often share target species with** fisheries, thus leading to a potential conflict. This seems to be negligible for the fisheries in most occasions, but the reverse could not be true. In the Mediterranean, the decline in some pelagic fish stocks, e.g. anchovy *Engraulis encrasicolus*, could bring about a severe reduction in food resources for some seabirds, though other clupeoids that seem to be in better situation (e.g. sardine *Sardina pilchardus*) (8), could mitigate such a reduction. Although there is no consensus about the relative importance of fishing and climate in driving clupeoid fluctuations, it seems reasonable to suppose that fisheries could reduce stocks significantly (2). Particular attention should be drawn to purse-seine fisheries, since they target species (i.e. small- and medium-sized epipelagic fish) which serve as prey for many top predators (particularly large pelagic fish and seabirds). Management strategies could range from reductions in effort through temporal (already carried out) and spatial closures of the fishery.

• **Scavenging: Several fishing activities, particularly trawling**, provide large amounts of discards that are consumed by a variety of scavengers, from invertebrates to seabirds and large predatory fish. Recent energetic estimations reveal that seabirds consume over 80% of these discards in some Mediterranean areas, and this resource seems to meet up to 75% of the energy requirements of some seabird populations (9), including those of endangered species (10). Thus, although the reduction of discards is desirable (11), management strategies directed to attain this should take into account seabirds and try to minimise the impact on them. There is the example of trawling

moratoria, a management strategy already in use, appearing to affect negatively some threatened seabirds through temporal food shortage coinciding with their breeding season, thus reducing their reproductive success (9). Nevertheless, this is a short-term effect that would probably be reversed into neatly beneficial in the long term if the fish stocks and the ecosystem in which they are embedded will actually benefit from such moratoria. However, little effort has been directed to assess this potential benefit for the fish stocks (12). Monitoring programs need to be developed in order to maximise the positive effects of trawling moratoria over fish stocks and the whole ecosystem. Potential impacts on seabirds should be considered and, if not detrimental for other organisms, reduced.

Concern on the impact of fisheries on ecosystems, and particularly on top predators' conservation, is important. Although fish stocks lie at the heart of fisheries management, considering other organisms will help preserving the ecosystem.

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