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## First report of a swordfish (*Xiphias gladius* Linnaeus, 1758) beneath open-sea farming cages in the Western Mediterranean Sea

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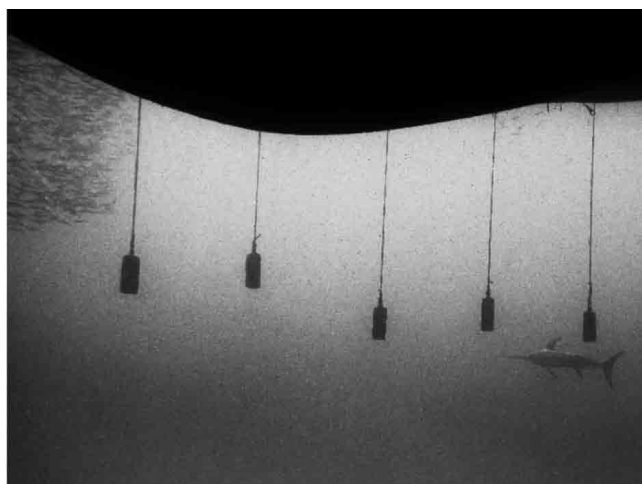
### Abstract

An adult swordfish (*Xiphias gladius* L.) was reported for the first time at coastal Mediterranean fish-farm facilities. This record highlights the necessity to assess the potential ecological changes to wild fish assemblages caused by coastal farming activity, especially to this type of endangered large migratory fish predator, which could be taken into account in future management strategies.

**Keywords:** aquaculture, wild fish assemblages, interactions, Spain.

Marine fish are attracted to a high variety of natural and artificial structures in the sea, commonly called “fish aggregation devices” (FADs; Dempster & Tanquet, 2004). It is known that coastal fish-farm facilities act as FADs, providing shelter and abundant food to a large variety of fish species with both ecological and economic importance around the world (for a review see Sanchez-Jerez *et al.*, 2011). In the Mediterranean, several studies have reported high abundances of farm-aggregated species, composed of around 40 different species, which vary significantly in abundance and assemblage composition across geographical areas, farms and seasons. The assemblages of small wild fish commonly concentrated in large numbers around fish farms, such as members of the Clupeidae, Sparidae, Mugilidae and Carangidae families, also attract larger predatory fin fish species, due to the increase in foraging

opportunities. For instance, it is highly frequent to observe aggregated species of both ecological and economic interest such as the common dolphinfish (*Coryphaena hippurus*), greater amberjack (*Seriola dumerili*), bluefish (*Pomatomus saltatrix*), common dentex (*Dentex dentex*) and Atlantic bluefin tuna (*Thunnus thynnus*) (Sanchez-Jerez *et al.*, 2011; Šegvić-Bubić *et al.*, 2011; Bacher *et al.*, 2012; 2013). However, swordfish (*Xiphias gladius*) have never been reported before within the limits of a Mediterranean fish-farm facility. On the 26<sup>th</sup> of August 2011, an adult swordfish (2 - 3 m in body length approx.) was observed foraging on aggregated small pelagic fish (i.e. *Sardinella aurita*, *S. maderensis*, *Boops boops*) beneath open-sea cages in the Western Mediterranean Sea (Fig. 1). These farm facilities produce about 1200 t y<sup>-1</sup> of gilthead sea bream (*Sparus aurata*) and are located at a distance of



**Fig. 1:** Swordfish recorded beneath Mediterranean open-sea cages (SE of Spain).

at least 4.5 km from the nearest coast (SE of Spain; UTM: 30S 0710736 4219249). The bathymetry is quite homogeneous in the farming area, presenting muddy bottoms with an average depth of 30 metres. Neither sea mounts nor structures are present in the surrounding areas, which could have an attraction effect on this migratory species. Although local fishermen have sporadically captured swordfish individuals along this Mediterranean coast, this is the first record of this species attracted to Mediterranean fish-farm facilities. Swordfish are one of the larger marine fish predators, a highly oceanic migratory species, which is occasionally found in coastal waters. Nevertheless, the presence of swordfish individuals during the day beneath Mediterranean open-sea cages might indicate some alterations in their natural behaviour and migratory patterns. It is known that fish farm activity in floating structures add significant ecological changes to surrounding wild stocks (Dempster *et al.*, 2002). Additionally, fish farm floating structures might act as “ecological traps” by serving as a super-stimulus and misleading fish to make inappropriate habitat selections (Hallier & Gaetner, 2008). Since they attract fish from the surrounding waters, it makes fish more susceptible to be captured in a restricted area, and therefore, the possibility of overfishing through increased fishing around farms exists (for a review of ecological traps, see Battin, 2004). Although swordfish are listed as least concerned species in the IUCN Red List (Collette *et al.*, 2011; <http://www.iucnredlist.org>) due to the population’s decreasing trend at global scale over the last 20 years, they are an important target species for worldwide recreational and commercial fisheries (e.g. Buencuerpo *et al.*, 1998; Mejuto *et al.*, 1999; De la Serna *et al.*, 2004; Damalas *et al.*, 2007). Therefore, previous cited negative effects of farms on such species are likely to be amplified since this activity and the fishing effort around farms will increase over time in many countries. Sea-cage aquaculture should be taken into account in fisheries management as it has a potential effect on the spatial distribution and demographic processes of a range of important target predatory species. Finally, the necessity to improve aquaculture and fisheries management strategies is highlighted; such strategies include site selection programmes or surveillance zones around farms, regarding the existing knowledge about the migratory pathways of large pelagic fish.

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