# The Portuguese purse seine fishery (2006-2016): what has changed in 10 years?

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The purse seine fishery is one of the most important fisheries in Portugal, accounting for about 50% of landings in weight. Historically, the sardine (*Sardina pilchardus*) is the target species of the purse seine fleet. However, with the decline of the sardine stock and the reduction of annual quotas, this fleet has supplemented its yields by capturing other pelagic species such as chub-mackerel (*Scomber colias*), horse mackerel (*Trachurus trachurus*) and anchovy (*Engraulis encrasicolus*).

This work aims to investigate changes in the purse seine fleet activity and catch composition associated with the decline of sardine, including inter-annual variations of fishing effort, catch, slipping and discards compositions, using on-board observations from 2006 to 2016.

The Portuguese mainland coast was split in three main areas: North (from Caminha to Nazaré canyon; ports: Viana do Castelo, Matosinhos, Aveiro and Figueira da Foz), Centre (from Nazaré canyon to Cape São Vicente, ports: Peniche, Sesimbra, Setúbal and Sines) and South (from Cape São Vicente to Vila Real St. António; ports: Portimão, Quarteira and Olhão) (Feijó et al., 2018).

In trips on-board commercial vessels (length-overall >16 m), during the period of 2006-2016, the observers had training to follow the same standard protocol (Feijó et al., 2012). Most trips (266) were carried out within the framework of PNAB/EU-DCF. Since 2010 and in the ports of Peniche, Olhão and Portimão, 80 trips were performed within the scope of SAFESEA and Life+MARPRO projects (Marçalo et al., 2015).

Data was collected on set characteristics (number, depth, geographic position), fishing activities and catch compositions (total biomass and species composition for retained, slipped and discarded catch). Total duration of each trip and time spent in each operation were calculated from corresponding start and end times. Four main operations take place in purse-seine trips such as steaming, searching, fishing and resting as described in Feijó (2013). Every time the net was in the water was considered a fishing set.

All calculations were carried out with R version 3.5.1 (2018-07-02) (R. Core Team, 2018).

Between 2006-2016, 346 trips and 427 sets were recorded, corresponding to 0.5% of the total fleet effort (Silva et al., 2015). On-board observation work was carried out in 69 vessels (53% national fleet). Fishing occurred along the year but effort decreased between November and April due to voluntary area closures (in the North and Centre areas, fishing stops for 2 months - February and March), due to sardine ban restrictions (2012-2016) or because bad weather conditions. In 346 trips, only 402 net-sets were successful and the CPUE was between 0 to 10 ton/h per set.

In earlier years, most trips were short and on average took 8.7 h (2.5-20.9 h) with one to two sets observed. Each trip had on average 1.13 sets per trip (±S.D. 0.76) and a fishing depth of 37.9 m (10.9-121 m). Also, the number of trips without net setting increased. During the study period, the number of sets (3-4 sets) performed and time dedicated to searching increased (Fig. 1), especially in the two last years, in order to obtain the same catch.

Overall, most of the trip time was dedicated to searching (42.4%) and the remaining time was split between fishing (23.7%) and steaming (26.2%). Resting periods were usually shorter than 2 hours (7.7%) and occurred in 48.6% of observed trips (Fig. 1).

Over the 10 years of observations, there was a decline of sardine catches and landings mostly due to quota restrictions, which were compensated by the increase of chub mackerel catches and landings. Over this period, changes in the target species were also observed but sardine was still the main species captured. The reduction of annual quotas and establishment of daily limit quotas led to the increase of slipping, creating the differences between catches and landings. We observed behavior changes in the fleet along the country, such as looking for new fishing grounds and other species with more market value. Our results are of interest to stakeholders as they provide a perception of changes in the fishery at the national and regional level.
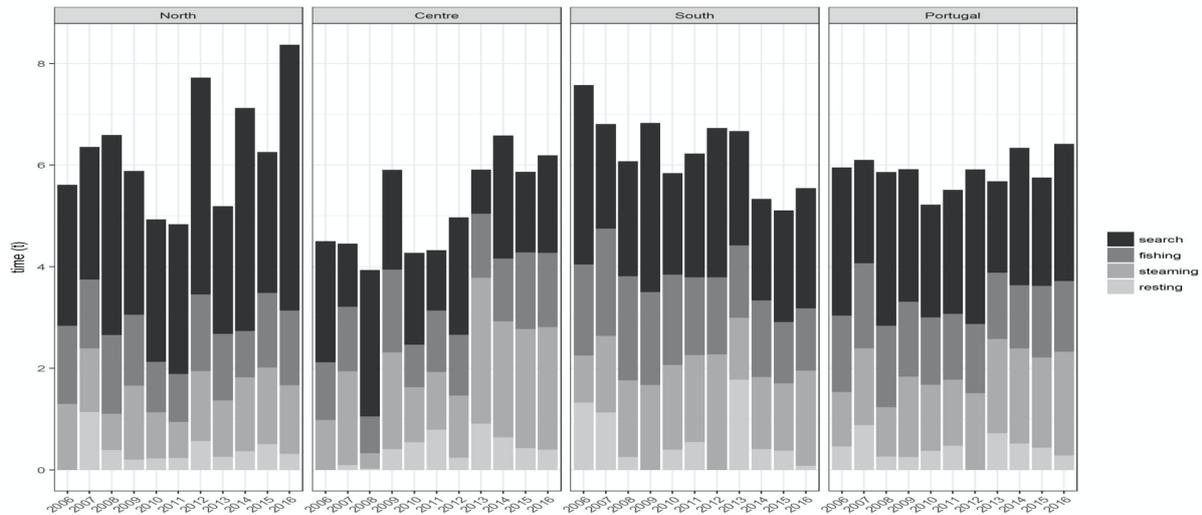
**FIGURE 1**. Mean time spend in each fishing operation (search, fishing, steaming, resting) in monitored fishing trips off the Portuguese continental coast by area (North, Centre, South and Portugal), between 2006 and 2016.

## ACKNOWLEDGEMENTS

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