

Chapter 16

Small Pelagic Resources: A Historic Perspective and Current State of the Resources



Ana Giráldez

16.1 Introduction

Fishing was one of the first activities that humans engaged in to meet their nutritional needs. At first these needs were met on an individual basis, but over time, and after the preservative properties of salt were understood, a thriving trade evolved. Some 3000 years ago, one of the most important economic activities in the Mediterranean was a trade in salted and dried fish. For example, the Phoenicians were actively engaged in trading these products.

Small pelagic fishing has been of historic importance in the Alboran Sea, with Malaga as its most important port. The origins of Malaga are almost as old as those of the salting industry. Many authors have attributed its name to the traditional manner in which fish were prepared: some philologists have suggested that the name of the city derives from the Phoenician word *malach* which means salt seasoning or salting, whereas others have suggested where the fish is dried. During the Roman period, the preserved fish industry in southern Spain was so important that there were merchants based in Rome who traded salted fish from Malaga.

In the 1940s and 1950s, Estepona, and Malaga in particular, maintained large canning industries. At that time the fleet could freely fish in the rich fishing grounds of North Africa. Throughout its history, and due to its location, Malaga has always been associated with fishing and its derivatives. However, the coast of Malaga is on a very narrow continental shelf, and thus the amount of fish that can be caught there is low. Therefore, the large commercial activity that has existed since the beginning of the twentieth century has always been based on the unloading of fish taken from the rich Moroccan fishing grounds (both Atlantic and Mediterranean). Boats fished

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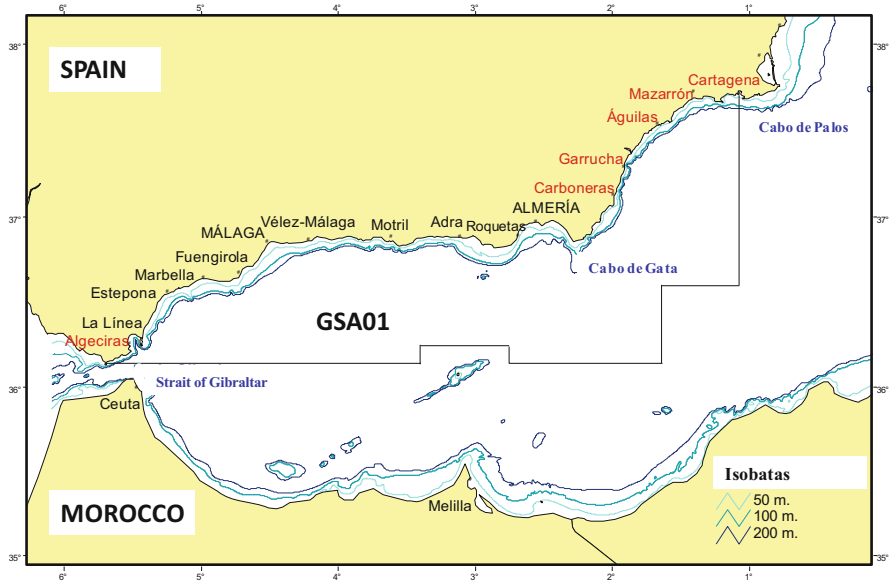


Fig. 16.1 Geographic area of the GSA01 showing the fishing ports. The ports shown in black correspond to the SMR (South Mediterranean Region)

freely in these areas until 1956, when Morocco achieved independence. Thanks to fishery agreements between Spain and Morocco, fishing has continued; however, the same agreements included a reduction in the number of licenses, and thus there has been a marked decrease in landings.

Over the years, small pelagic catches have experienced strong oscillations. The current sardine catch is very low with only 3500 tons being caught in 2017 (30% of the catch in 1992). After 7 years of very low anchovy catches, there was a slight recovery in 2002 (3200 tons); however, they remain at low levels. This situation has been partly compensated for by catches of other less important species such as horse mackerel (*Trachurus* spp.) and mackerel (*Scomber* spp.). Although Malaga has been one of the most important ports in the so-called South Mediterranean Region (SMR) (i.e., from the Strait of Gibraltar to Cabo de Gata and the ports of Ceuta and Melilla) (Fig. 16.1), currently, the most important port is Caleta de Vélez. In the 1940s, 24,000 tons of sardine and anchovy were landed annually in the SMR. The importance of this figure resides in the fact that it represents the amount of all species caught on any gear in the whole area per year at the present time.

The small pelagic fishery in the Alboran Sea has been described by De Miranda (1930, 1931) and Bellón (1950), with a special focus on the so-called Maritime Province of Malaga, and the entire area by Abad and Giráldez (1990a) and Giráldez and Abad (1991, 2000). More studies have focused on Malaga because the Spanish Institute of Oceanography has had a laboratory in the city since 1913 (Pérez-Rubín 2014).

We conducted a review of small pelagic fisheries of anchovy (*Engraulis encrasicolus*, Linnaeus 1758) and sardine (*Sardina pilchardus*, Walbaum 1792) in

the SMR. This overview focuses on a long historical series of landings, the characteristics of the fleet, differential characteristics of this type of fishery by port, the fishery effort during the last decade, acoustic assessment, and the economic aspects of the fishery.

16.2 Geographical Situation and Data Employed

The Alboran Sea covers the marine area running from the Strait of Gibraltar to Cabo de Gata. The latter is connected by an invisible line to Cape Figalo (Algeria), which forms the border on the eastern edge of the area. Over time, fishery studies have slightly modified the way in which fishery statistics are grouped due to special interests concerning management, stock assessment, and logistics.

The oldest historical series of sardine and anchovy landings are grouped into the SMR, which corresponds to the old 37.1.5 division of the General Fisheries Commission for the Mediterranean of the Food and Agriculture Organization (GFCM/FAO). This grouping covers ports from Cabo de Gata to the Strait of Gibraltar and also includes the ports of Spanish cities Ceuta and Melilla in northern Africa (Fig. 16.1).

Currently, the aggregated data for the CGPM working groups is obtained from the Geographical Subarea 01 (GSA01, Fig. 16.1), which groups together the SMR and the Gulf of Vera (between Cabo de Gata and Cabo de Palos). However, this study uses the SMR for purposes of comparison with the old series.

The ports of Ceuta and Melilla used to be important landing points. However, Melilla no longer has a purse seine fleet, and in 2005 the number of landings in the port of Ceuta (last updated info) represented only 1% of the landings from the total area of the SMR.

Data on the historical series of catches (from 1945 to 2017) were obtained from the official statistics of the General Fisheries Secretariat (SGPM), Fisheries Regulatory and Market Fund (FROM), and the Spanish Institute of Oceanography (IEO).

Data on the historical fleet were obtained from the statistics of the SGPM. This series is smaller than the landings for the following reasons: until 1964, only the number of fishing gears was counted; between 1965 and 1971, purse seine fishing was not counted separately; after this period, only ships of more than 20 GT (gross tonnage) were counted; and from 1973, the statistics included the technical characteristics of the ships.

16.3 Description of the Fishing Activity

16.3.1 Target Species

The main target species of the purse seine fishing fleet in the Alboran Sea are sardine and anchovy. Less relevant species are horse mackerel *Trachurus* spp., mackerel *Scomber* spp., and gilt sardine *Sardinella aurita* (Fig. 16.2). These species sometimes comprise a large proportion of the total catch. Seasonal catches of frigate mackerel *Auxis rochei* (Risso 1810), Atlantic bonito *Sarda sarda* (Bloch 1793), and Atlantic saury *Scomberesox saurus* (Walbaum 1792) are of great importance in the most eastern ports, thus differentiating the purse seining activity according to base port.

Anchovy and sardine species are short-lived coastal pelagic fish (anchovy, 3–4 years maximum, and sardine, 7–8 years maximum). These species are characterized by seasonal migrations, fast growth, early maturity, and shoaling. Both species feed on plankton (Yebra et al. 2019). Anchovies spawn in the northern Alboran during spring-summer (Giráldez and Abad 1995) and sardines during autumn-winter (Abad and Giráldez 1992).

This overview of fishery activity mainly focuses on anchovy and sardine species, whose catches have strongly varied over time. Of the two species, anchovies are the most valuable in the current market; nonetheless, the fishery activity is strongly complemented by catches of sardine because it is the most abundant species.

In addition, some purse seine bycatch species have recently found a place in the market. For example, mackerel species are mainly used for tuna fattening, and gilt sardines are used for bait. These species have high yields per night of fishing. Horse mackerel is exported to Portugal when they are abundant. These secondary species represent 50% of landings and 30% of overall economic value.

Due to variable annual recruitment, the small pelagic populations experience strong fluctuations in abundance, which leads to fishing crises because of the lack of fish.

16.3.2 Methods and Fishing Gears

Small pelagic fish inhabit open waters and form shoals. They are fished using a purse seine boat (“Traíña” in Spanish), an auxiliary boat, and a light boat (Fig. 16.3).

Purse seine fishing gear comprises a rectangular net which is lowered vertically, thus surrounding the shoal, and ends in some triangular parts called “puños” (Abad and Giráldez 1990a). When the shoal is completely surrounded, the lower part is closed to avoid escaping and to catch the fish and then lifted back into the boat. Spanish legislation defines the technical characteristics of these fishing gears, which can be up to 450 m long by 82 m high (Fig. 16.4).

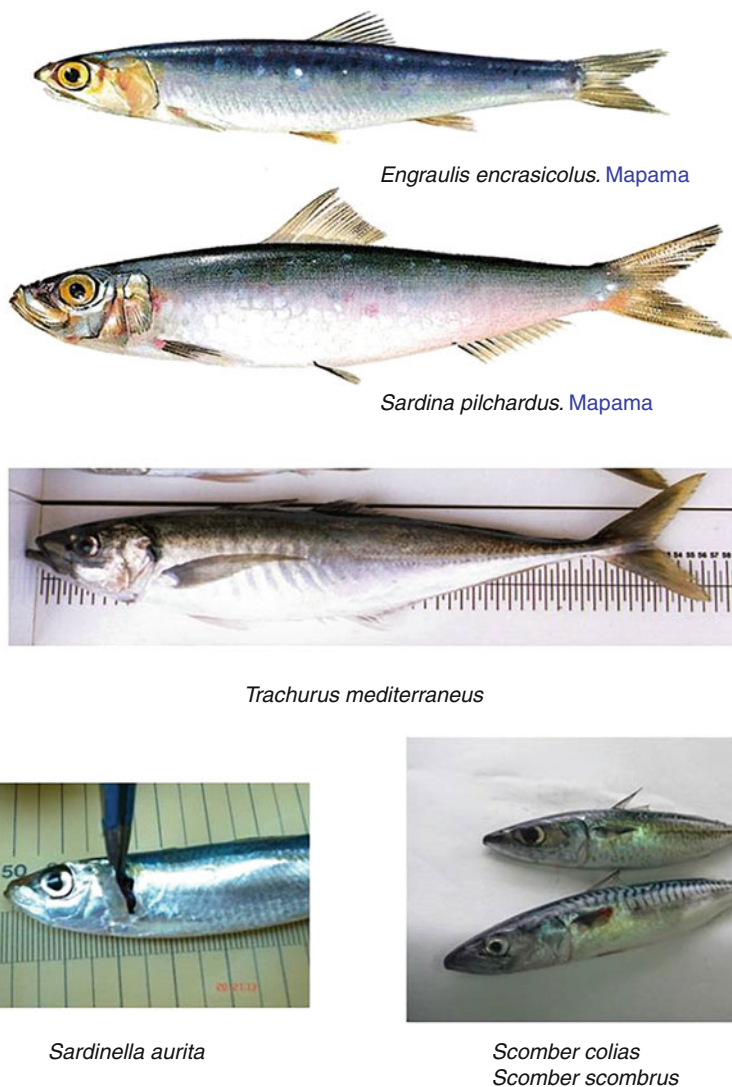


Fig. 16.2 Main species (top) and secondary species (bottom) targeted by the purse seine fishing in the SMR. Picture source: [MAPAMA](#)

Locating Fish Using Echo Sounders Firstly, the boat searches for fish shoals using echo sounder systems. During the fishing maneuver, the auxiliary boat holds one end of the net, and the larger boat sails in a circle while dropping the net around the shoal. Once the fish are caged in the circular net, the fishermen pull a rope called the “jareta,” which closes the large net, just like a bag (Fig. 16.4).

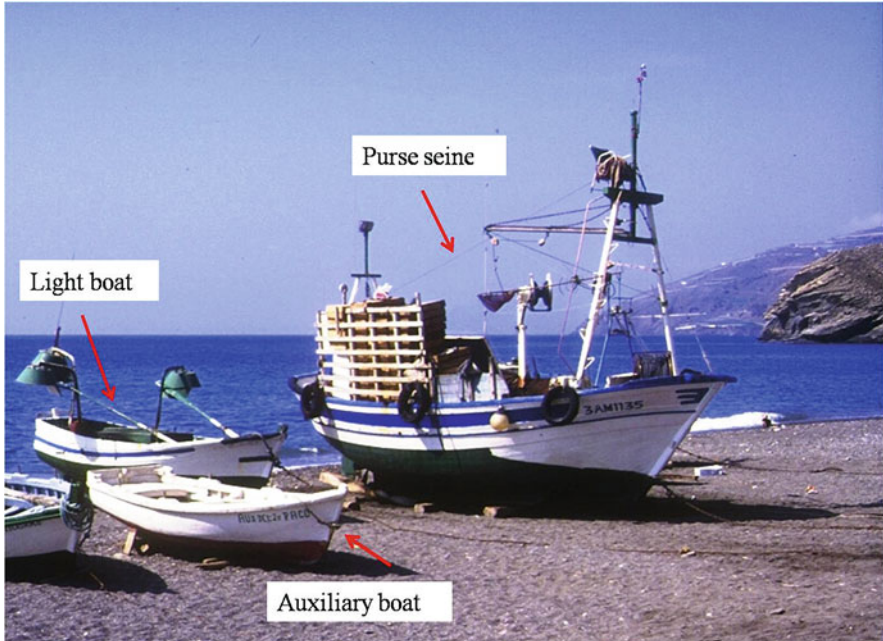


Fig. 16.3 Purse seine boat, light boat, and auxiliary boat. Albuñol beach (Granada, Spain) 1989

Fishing with Lights On dark nights, the light boat uses its lights to concentrate fish beneath it since anchovies and sardines are positively phototropic (i.e., attracted by light). Subsequently, the fish are captured following the previous method using echo sounder and loaded onto the vessel.

“Arda” Fishing On moonless nights, this method is used to catch negatively phototropic species. The purse seine skippers locate the schools using the “arda,” which is phosphorescence produced by some plankton organisms when fish shoals pass by. The target species of this fishing method are small tuna species, such as *A. rochei* and *S. sarda*.

These boats set out around sunset and return at sunrise. Atypical fishing day comprises two fishing operations: the first in the late afternoon (“prima” in Spanish) and the second at sunrise (“alba” in Spanish).

Fishing Area

Currently, sardines are caught throughout the Alboran Sea, whereas anchovies are caught mainly in Malaga Bay (Fig. 16.5). In the years of abundant catches, all the fleets from all the SMR ports were concentrated in the bay. For this reason, the boats used to land in the Port of Malaga, taking advantage of the high price of anchovies in this city (Abad and Giráldez 1990a, 1997; Giráldez and Abad 1991; Giraldez et al. 1997). At present, the port of Caleta de Vélez is more important than the Port of Malaga.

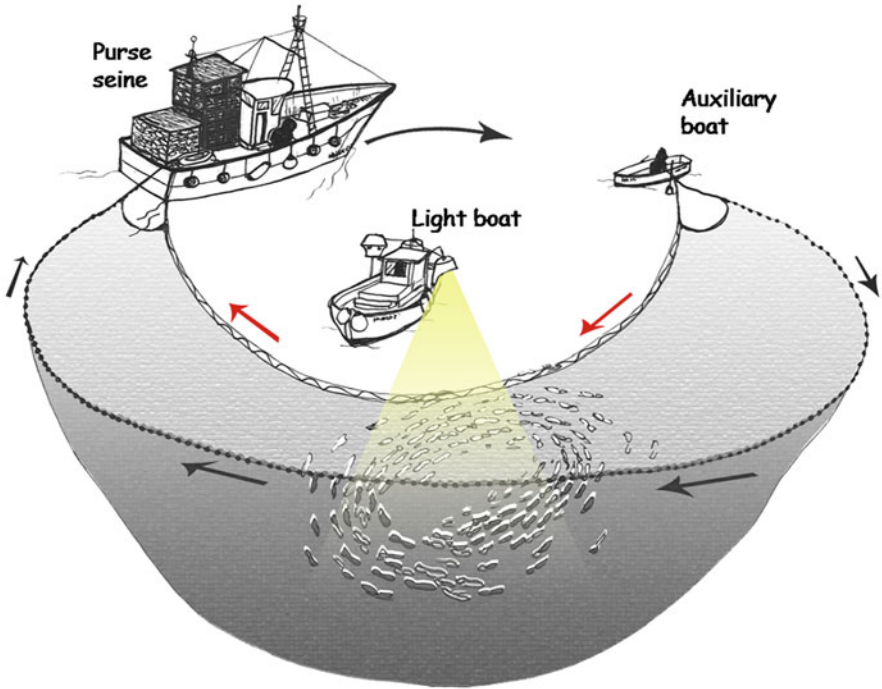


Fig. 16.4 The purse seine fishing technique (author: Ana Flores)

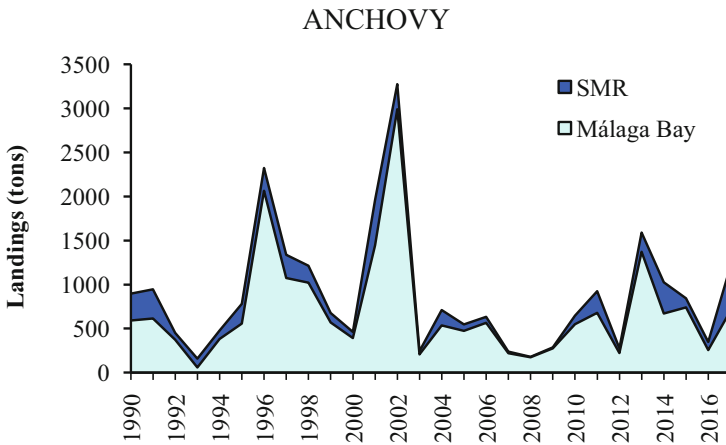


Fig. 16.5 Anchovy catches in the SMR and Malaga Bay (1990–2017)

Fishery Periods

The principal fishery periods for sardine and anchovy are summer-autumn. Summer anchovy catches correspond to spawners and autumn catches to recruits (Fig. 16.6).

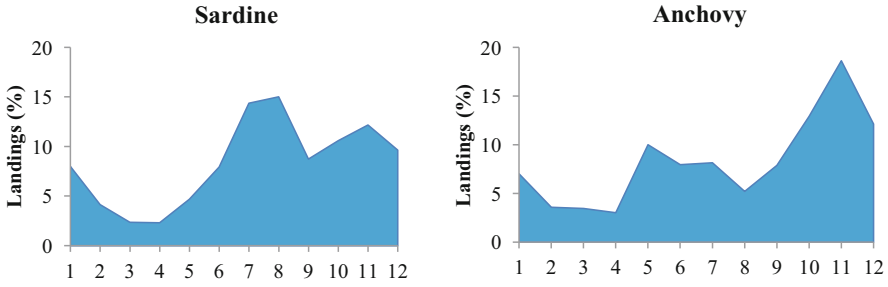


Fig. 16.6 Seasonality of sardine (left) and anchovy (right) catches in the SMR. Averages (2009–2017)

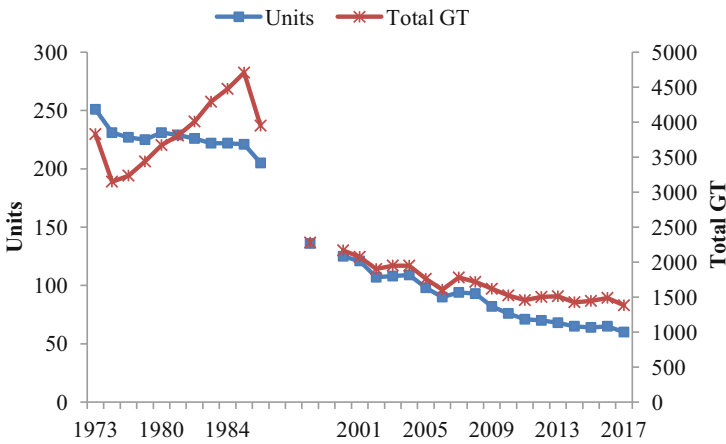


Fig. 16.7 Number of boats and overall change in GT of the SMR purse seine fleet (1973–1986, 1998, 2000–2017)

16.3.3 *Technical Characteristics and Historical Evolution of the Fleet*

The SMR purse seine fleet underwent a continuous decrease from 251 boats in 1973 to 61 in 2017 (i.e., a 76% reduction) (Fig. 16.7). This decrease accelerated from 1986 onward but has slowed down in recent years. At present, this fleet comprises small boats: 70% are less than 30 GT (i.e., average 23.0 GT and 158 HP). Only 9% of the fleet is less than 12 m long. Of these, only two of the boats are less than 9 m long, and these boats will continue fishing until they are decommissioned (Table 16.1).

Figure 16.8 shows the reduction in the size of the fleet after the implementation of legislation governing the minimum size of boats. However, larger boats disappeared due to the collapse of anchovy fishing grounds off North Africa, which is where the Spanish fleet used to work under fishing agreements with Morocco. Another reason for this disappearance is the fall in anchovy catches in the Gulf of León, the mouth of

Table 16.1 Purse seine fleet by SMR ports (2017)

Ports	GT interval										TOTAL	Average GT	Average HP	Length interval	
	<10	10-20	20-30	30-40	40-50	50-60	>60	6-12	12-24						
Almería		5	4	1	1						11	25.3	165.2		11
Roquetas		2									2	18.2	136.5		2
Adra		1	2	3	1						7	30.3	213.1		7
Motril			1	1							2	28.1	200.5		2
Caleta de Vélez	2	3	6	3	1						15	24.5	165.7	1	14
Malaga		1			1						2	30.5	232.0		2
Fuengirola	2										2	6.7	67.5	1	1
Marbella	2	3	2			1					8	21.9	139.8	2	6
Estepona	2	2			1						5	21.1	160.8	1	4
La Línea	1										1	6.8	87.0	1	
Ceuta	2	4									6	13.1	78.3		6
Total	11	21	15	8	4	1	1	1	1	61	22.8	156.5	6	55	

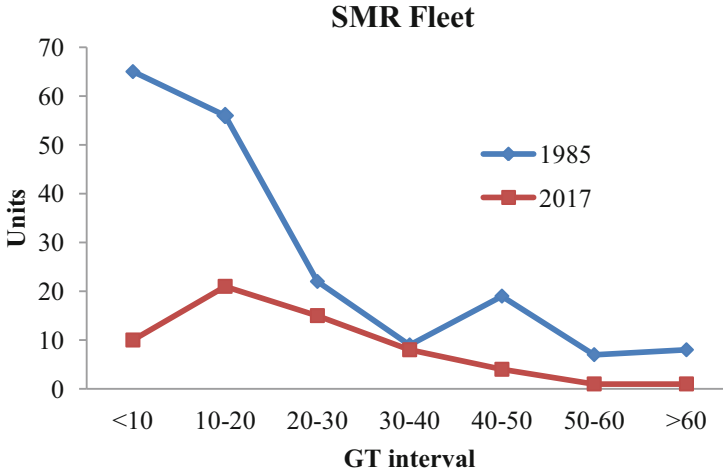


Fig. 16.8 SMR purse seine fleet by GT interval (1985 and 2017)

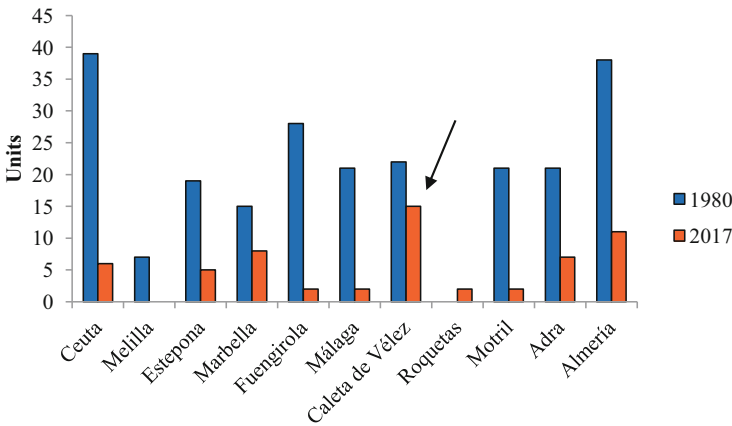


Fig. 16.9 SMR purse seine fleet by port (1980 and 2017)

the Ebro River, and off the coast of Valencia, which is where boats from Adra, Almería, and Málaga used to fish each season (Abad and Giráldez 1997). Nowadays, only the largest boats from Adra and Almería work regularly on the Spanish east coast during summer and only if anchovy species are abundant. In 2013, 22% of the fishing activity and landings in the GSA06 (Northern Spain) were conducted by purse seiners based in the GSA01.

Figure 16.9 shows the fleet by port between 1980 and 2017. Over time, all these ports have experienced a great reduction in the number of boats. In 1980, the most important fishing ports were Ceuta (North Africa) and Almería. Nowadays, Caleta de Vélez is the most important by port and is also the one that has been less affected by this decrease (Table 16.1).

16.4 Historical Series of Catches

16.4.1 Historical Series of Catches in the SMR (1945–2017)

Sardine From 1945 to 1956, a high percentage of catches occurred in North Africa. However, there was a decline in interest in these species with the coming of Moroccan Independence in 1956. Together with other decreases in ports such as Melilla, the collapse continued in North Africa until the virtual disappearance of sardine landings in 1985 (Fig. 16.10).

Until the 1960s, the most valued species were sardines. However, in 1962, the price of anchovies reached the same value on the market following the high demand for preserves, which was probably due to changes in culinary tastes. The value of anchovies was further raised by the use of new synthetic nets. This is because anchovies tend to become stuck in nets and then putrefy, which makes nonsynthetic nets rot. However, synthetic nets are resistant to this process. Subsequently, the price of anchovies surged so much that they became the main target of the Spanish fishing activity. Nowadays, sardine catches are low. Thus, their value and market price have increased to the point that their price can sometimes match that of anchovies.

Anchovy Until 1978, it was impossible to physically separate anchovy catches from the north and south of the Alboran Sea. During the 1940s and 1950s, the economic value of anchovies was low. During these periods, they were typically caught by fleets operating out of Ceuta and Melilla, as well as by some from northern Alboran ports. From the 1970s until 1984, a large fishery became established in the southern Alboran Sea. Spanish boats fished in this area thanks to an agreement between Spain and the Moroccan government. Some 28,000 tons of this species

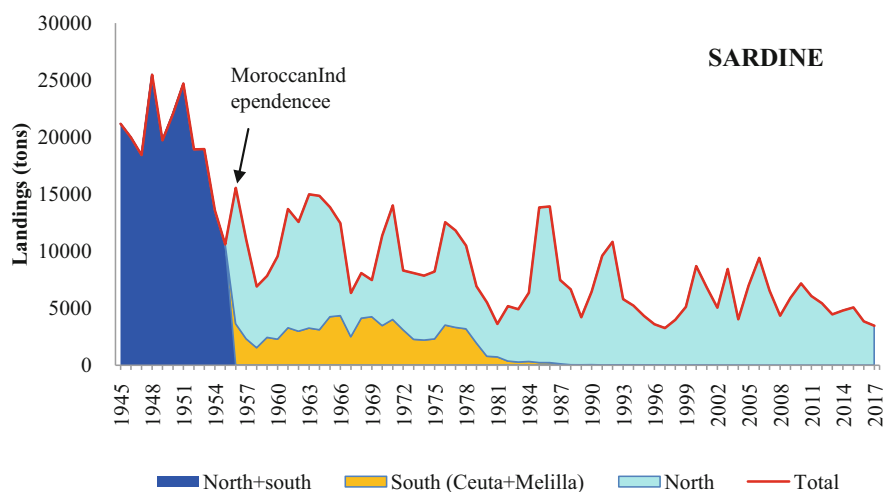


Fig. 16.10 Sardine landings in the SMR (1945–2017)

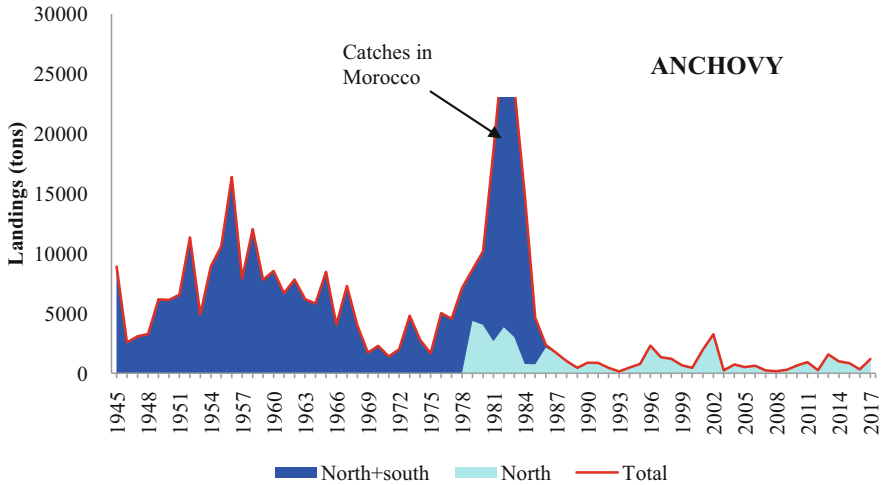


Fig. 16.11 Anchovy landings in the SMR (1945–2017)

were landed in the SMR ports in 1982 (Fig. 16.11), of which 87% came from the southern side of the Alboran Sea and 13% from the northern side (Giráldez and Abad 1991).

In 1993, landings in the northern area reached an all-time low at 157 tons. In that year, there was very low recruitment of anchovies, which was probably due to the demographic boom of boarfish *Capros aper* (Linnaeus, 1758) species in the Alboran Sea (Abad and Giráldez 1990b).

16.4.2 Most Recent Historical Series of Catches in the SMR (1985–2017)

In the last 24 years, there have been marked fluctuations in catches of the main species (sardine and anchovy) (Fig. 16.12) and secondary species (horse mackerel and mackerel) (Fig. 16.13). Of the total catches, sardines comprise between 39% and 58% and anchovies between 1% and 22%. Obviously, variability is very high. The horse mackerel series includes catches using other gears and represents 30% of the total catch.

16.4.3 Catches by Port

Between 2009 and 2017, the largest catches in the most eastern ports, such as Almería, Adra, and Motril, were *Trachurus* spp. and *Scomber* spp. (Fig. 16.14).

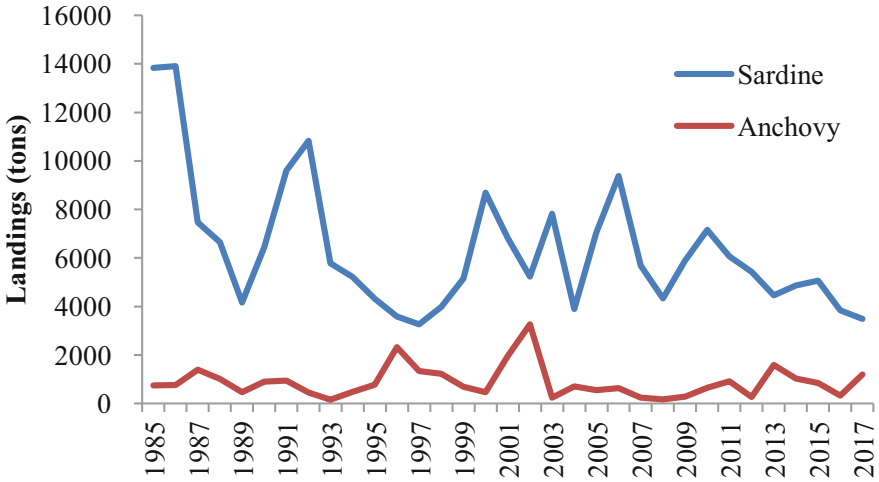


Fig. 16.12 Sardine and anchovy landings in the SMR (1985–2017)

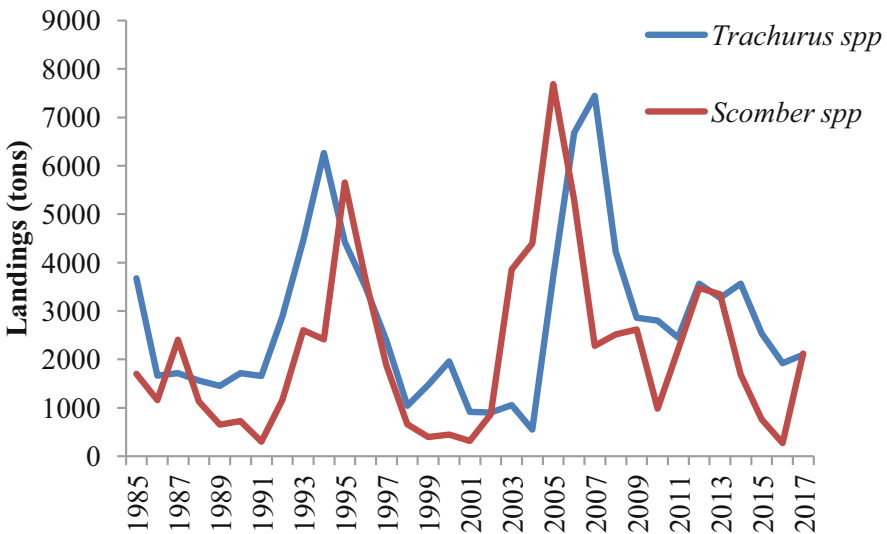


Fig. 16.13 *Trachurus* spp. and *Scomber* spp. landings in the SMR (1985–2017)

However, sardines remained the most important species. In these ports, the catch of secondary and other bycatch species comprised 79% of the total catch and 59% of the economic value. In the ports of Malaga Bay (Caleta de Vélez, Malaga, and Fuengirola), sardines comprise a higher percentage of the total catch. This area is the only one with relevant levels of anchovy catches. In most western ports (Marbella and Estepona), sardines are the most important species.

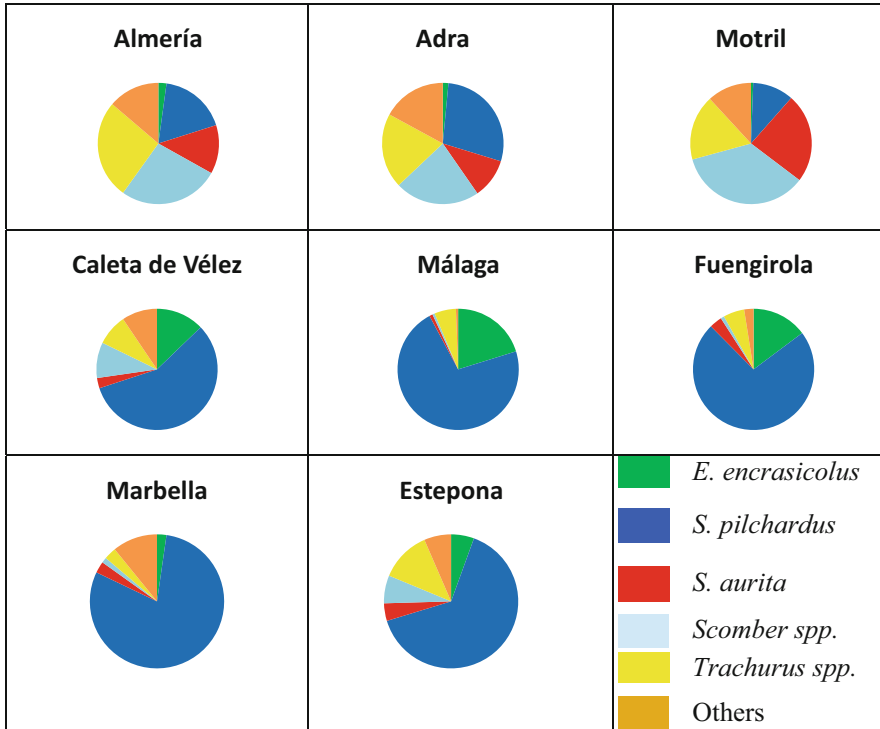


Fig. 16.14 Distribution of landings by port (2009–2017)

Data on the ports of Roquetas de Mar and La Línea have not been taken into account because, on the one hand, landings from the area of Roquetas de Mar are made in the port of Almería and, on the other hand, La Línea only has one small purse seiner.

16.4.4 Catch per Unit of Effort

Catch per unit of fishing effort (CPUE) is the total catch divided by the total amount of effort used to harvest the catch. The standardized CPUE is typically used as an abundance index. In the present case, the effort unit used is a fishing night.

The CPUE of sardine had a spike in 2010 and another in 2015–2016. It then underwent a dramatic decrease in 2017 (Fig. 16.15), when the catch was at its lowest in the entire historical series. In contrast, the catch and CPUEs of anchovy are increasing (Fig. 16.16).

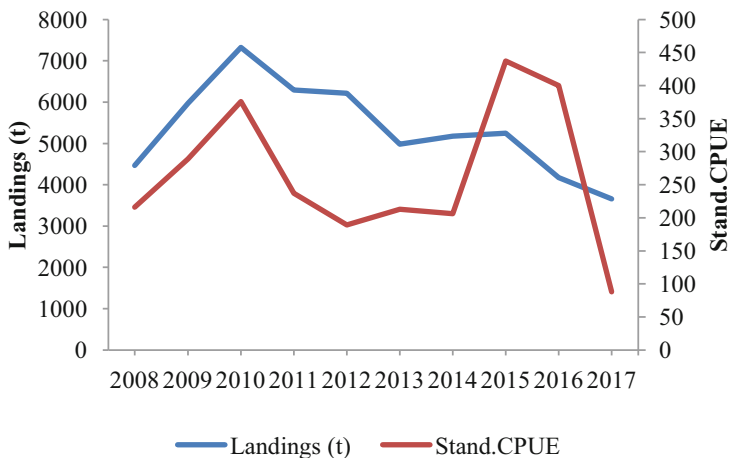


Fig. 16.15 Trends in sardine landings and standardized CPUEs in the SMR. 95% total landings GSA1 (2008–2017). Abbreviation: stand. CPUE, standardized CPUE. Modified from Serghini et al. (2018)

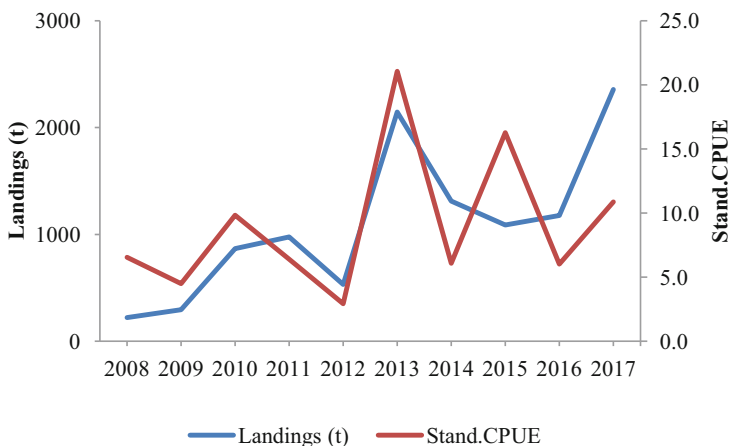


Fig. 16.16 Trends in anchovy landings and standardized CPUE in the SMR. 85% total landings GSA1 (2008–2017). Abbreviation: stand. CPUE, standardized CPUE. Modified from Serghini et al. (2018)

16.5 Independent Information on the Fisheries: Acoustic Surveys

The IEO conducts an annual acoustic assessment survey to establish the biomass of small pelagic species in the Spanish Mediterranean Sea. Until 2009, the ECOMED survey was conducted every year between November and December, which is when anchovies undergo recruitment and sardines spawn. Nevertheless, in 2009, the

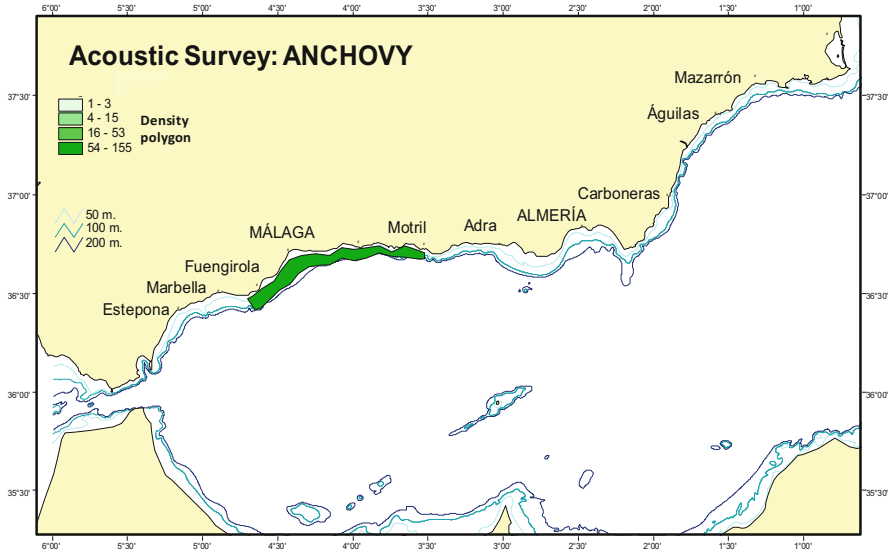


Fig. 16.17 Anchovy distribution (November–December) in the northern Alboran Sea (GSA01). IEO acoustic Survey

European Union provided funds for an acoustic assessment survey coordinated by other Mediterranean countries known as the MEDIAS survey. The need to coordinate and standardize methodologies with other European Union countries meant that the IEO had to switch their survey from autumn to summer, which is the anchovy reproductive season and the sardine resting season.

Figure 16.17 and 16.18 shows distribution densities of the two most important species in November and December.

Although anchovy abundance is highly variable between years, Fig. 16.17 provides an averaged representation, showing that the anchovy population is concentrated in Malaga Bay. The differential characteristics by port (Fig. 16.14) are a representation of the map shown in this figure.

Although sardine abundance is highly variable between years, Fig. 16.18 provides an averaged representation, showing that sardines are distributed throughout the whole northern Alboran zone with a greater abundance in the western area. The differential characteristics by port (Fig. 16.14) are a representation of the map shown in this figure.

16.6 Economic Aspects of the SMR (2002–2017)

Figure 16.19 shows the volume of landings and economic value of the species taken by the purse seine fleet in the SMR. Sardines are the most caught species. Even though the unit price of sardines is low, they are of great economic value to the

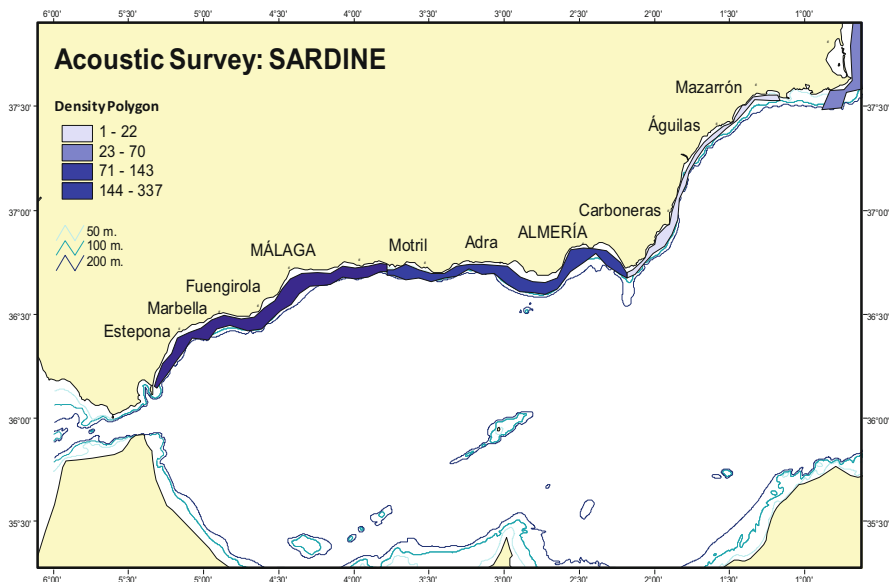


Fig. 16.18 Sardine distribution (November–December) in the northern Alboran Sea (GSA01). IEO acoustic survey

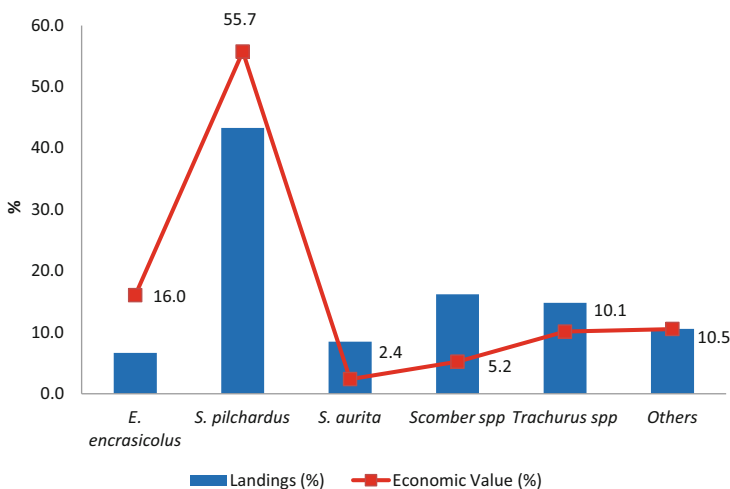


Fig. 16.19 Average catch and economic value (%) by species in the SMR (2009–2017)

fishing industry because they are the most caught species. The catch of secondary species is relevant because they represent as much as 50% of the total landing by weight and 29.1% of the economic value of the total catch.

In 2017, small pelagic landings in the SMR represented 68.9% by weight and 33.1% of the economic value.

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