Chapter 23
A Historical Approach to Living Resources on the Spanish Coasts from the Alboran Sea Between the Sixteenth and Twentieth Centuries

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23.1 Introduction

"Knowing the past is vital for developing a vision of the future. The oceans and inshore seascapes of the world are rapidly changing, and understanding the human and marine ecosystem forces, trajectories and responses —sometimes over centuries or millennia— is vital for their informed management." Priority actions needed involve "tracing human interactions with marine ecosystems through deep time" and moving towards a "unifying view of our oceans as networks of social-ecological or coupled human-nature systems" (Ocean Past Initiative 2018).

In order to achieve these objectives, multidisciplinary research efforts have been carried out internationally during the last decades, aimed at improving the knowledge and understanding of the interaction of marine environment between man from the earliest of times and the historical variability in coastal and open sea ecology. Several working groups or programmes such as "History of Marine Animal Populations," under the Census of Marine Life (Holm et al. 2010; Starkey et al. 2008); "Study Group on the History of Fish and Fisheries" (ICES 2011); "Marine Environmental History" (Holm et al. 2001) and "Marine Historical Ecology" (Lotze and McClenachan 2013) have contributed towards this goal.

Among other needs, the identification of ecosystem components and the recognition of the dynamics between the ecosystem and society are required, along with an extensive review of the literature to identify sociocultural values related to local or regional fisheries (Ignatius and Haapasaari 2018). The intense search for information of the last centuries should include the multiple historical, scientific and technical

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aspects (Lackey 2005), including the evolution of fishery management concepts and old fishery legislations.

The objective of this chapter is to develop these lines of historical-scientific-technical research for the Alboran Sea and the Strait of Gibraltar, from the sixteenth century. The living resources include distribution and abundance of several fish and cetacean species in pelagic and benthos/demersal habitats. Our exposition on human interactions includes mainly fishermen, consumers and fishery management technicians. The subsequent scientific research work accomplished between 1913 and 2014 in the area by the Oceanographic Centre of Malaga has been described in other documents (Pérez-Rubín 2011, 2014a, b; Baro and Camiñas 2014; Camiñas 2018).

Data of regional interrelations between both historical and marine sciences are presented in order to understand the impact of the climate variability and overfishing in human activity. Furthermore, to identify the most important economically, socially and culturally important historical fisheries in the entire area, three clear focal ecosystem components have been established, with the decisive roles of the Strait of Gibraltar (crossroads of currents and fauna from different areas), the quasi-permanent northwestern Alboran Sea upwelling (waters rich in nutrients, with high planktonic productivity and important concentration of sardines, *Sardina pilchardus*, and other pelagic species) and the Bay of Malaga (with anchovy, *Engraulis encrasicolus*, and sardine nursery grounds).

The Strait of Gibraltar and adjacent areas are of utmost importance to marine biodiversity (e.g. Báez et al. in this volume). Both areas (the Ibero-Moroccan Gulf and the Alboran Sea) have common historical aspects for millennia as they share oceanographic and meteorological environments and present particular geological, zoological and botanical characteristics. For that reason, Ramos et al. (2011) proposed the "geohistorical region of the Strait of Gibraltar" as a target study area where human records have existed since the Pleistocene period.

At the beginning of the twentieth century, the relevance of this Atlantic-Mediterranean transitional area was enshrined during the period 1919–1923 from the oceanographic and fisheries point of view. The first two intergovernmental scientific organizations for the study of the Mediterranean (The Mediterranean Science Commission, CIESM) and the North Atlantic (International Council for the Exploration of the Sea, ICES) established the areas of the Strait of Gibraltar and the Gulf of Cadiz as the geographical limits of their respective areas of competence. French researchers showed the oceanographic and fisheries relationship of the Alboran Sea and the northeastern Atlantic for the European hake (*Merluccius merluccius*), a demersal species, with regard to seasonal variations in spawning areas and preferred period for fishing (Le Danois 1920). Unlike for the pelagic sardine, it was proposed that in the region of the Strait of Gibraltar, the two supposed Atlantic breeds were not mixed: to the south the Moroccan and to the north the common for the Gulf of Cadiz and north Alboran Sea (Furnestin 1948).

In addition, the studies carried out during the last decades on the historical fisheries of the Alboran Sea have confirmed the importance of this "border sea" as a transitional area in the Iberian Peninsula, between the waters of the Atlantic and the

waters of the northwestern Mediterranean, south of the French border including the waters of Cataluña and Levante (the "Balearic Sea"). Both regional seas (Balearic and Alboran) were the first two great areas identified in the Spanish Mediterranean with well-defined characteristics from the hydrographic and biological point of view (Estrada et al. 1989). Other authors gave more weight to the biogeographical criteria (Bianchi and Morri 2000; Würtz 2010) and found stronger relationships between the Alboran Sea and the eastern Mediterranean (Aegean Sea) in relation to the "ocean triads" hypothesis (Agostini and Bakun 2002).

For all these reasons, the opinion of a Spanish oceanographer of the last century is still useful and is applicable to fishery resources:

> Since the sea, as soon as we drift a few miles offshore, is no longer the heritage of any country and the phenomena that take place there are generally influenced by factors that act over a large surface of the globe, it is absolutely necessary that all countries cooperate in their study by agreeing on common work plans and unifying the methods that must be used (Buen 1931).

23.2 Extraordinary Animals

For centuries, the inhabitants of the area knew about the presence of the Atlantic surface current in the Strait of Gibraltar and the entry of pelagic fishes into the Alboran Sea. These included commercially important fish, as well as lone individuals considered strangers and/or monsters or prodigious due to their large size.

The first records of their presence are from the end of the sixteenth century. A fantastic "tattooed tuna" with drawings on its body was found off the coast of Ceuta in May 1565 and reproduced by the ichthyologist C. Gesner (1670) (Fig. 23.1a). Evidence of the Atlantic current dates back to 1574 when a sperm whale (*Physeter macrocephalus*) was cannoned in the Strait, floated adrift and was stranded on a beach in Valencia (Graells 1889).

In the eighteenth century, additional news mentioned another stranded sperm whale in Ceuta (Fig. 23.1b) and a porcupinefish genus *Diodon* (*D. hystrix* or *D. eydouxii*) presumably caught alive in Tarifa in 1777 (Fig. 23.1d). In the following century, another Diodontidae was described on the beach of Tangier, south of the Strait of Gibraltar (Amor 1859). That Diodontidae family, widely distributed in tropical and temperate marine waters (Leis 2006), was cited by Spanish authors in the nineteenth century in Andalusia and Galicia and by Buen (1926) in the Gulf of Cadiz. A specimen of *Diodon eydouxii*, abundant in the eastern Pacific Ocean, was caught in 1975 west of Tarifa (Zahara de los Atunes) and described by Crespo et al. (1987) together with the tropical African species *Acanthurus monroviae* fished in Marbella in 1981.

Among the Tetraodontidae ("pufferfishes"), *Ephippion guttifer*, a species from Atlantic Africa and the Canary Islands, was caught in Malaga in 1871. A previously caught specimen (Fig. 23.1e) is currently preserved in the museum of a secondary

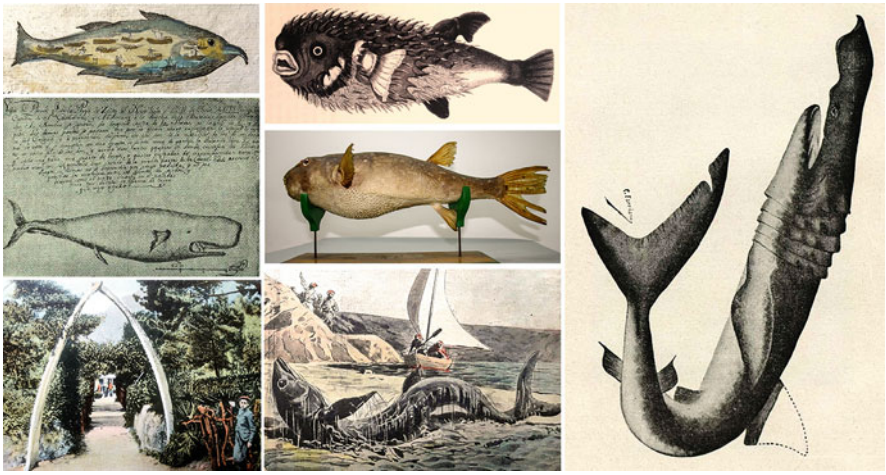

Fig. 23.1 Pelagic "sea monsters" of the Alboran Sea and Strait of Gibraltar (1565–1909). (**a**) Fantastic "tattooed tuna" found in Ceuta in May 1565 (reproduced from Gesner *Fisch-Buch*, 1670). (**b**) Male sperm whale (*Physeter macrocephalus*) stranded in Ceuta in 1753 (reproduced from Barras 1944). (**c**) Whale jawbone arch in a public garden in Gibraltar towards year 1905 (old postcard). (**d**) Porcupinefish genus Diodon (*D. hystrix* or *D. eydouxii*) from Tarifa (reproduced from Brú 1784). (**e**) Pufferfish (*Ephippion guttifer*) caught in Malaga before 1871 and currently preserved in the museum of a secondary school (Photograph by J. Pérez-Rubín). (**f**) Fantastic fish, a mixture of tuna and conger, supposedly beached in Oran in 1906 (reproduced from the French magazine *Le Pélerin*). (**g**) Young specimen of basking shark (*Cetorhinus maximus*) from Melilla (reproduced from Escribano 1909)

school in the town (Garrido 2008). Given this presence in Malaga, the species was included in the Spanish ichthyology by Navarrete (1898).

There are two mentions of "sea monsters" at the beginning of the twentieth century, southeast of the Alboran Sea (African waters). In 1906, a French magazine published the news and illustration of an incredible and fantastic fish that was washed up on a beach of Oran (Fig. 23.1f). Three years later, several Madrid newspapers reported about a "sea monster" found near the coast of Melilla. Then, it was verified that it was a young specimen of basking shark (*Cetorhinus maximus*, Fig. 23.1g) (Escribano 1909). Around 1905, the bones of the lower jaw of a giant whale were used to build an arch in a public garden in Gibraltar (Fig. 23.1c).

23.3 Historical Fisheries and Oceanographic Variability

During the period 1525–1725, we hypothesized that the inhabitants of the Alboran Sea were affected by fluctuations in the abundance of sardines and tuna stocks, as happened in other Spanish Atlantic regions. In fact, during the sixteenth century, the presence of sardine banks in the Galician Rias was highly fluctuating with periods of

absence every 20–25 years approximately, resulting in a dramatic sardine crisis during the period 1525–1575 (Juega 2012). On the other hand, according to the raw catch statistics of bluefin tuna (*Thunnus thynnus*) in the traps of Conil and Zahara during 1525–1725 (García and Fernández 1993), we found the appearance of drastic natural fluctuations. In the period 1525–1575, the highest record was observed (average catch 58,600 tuna/year), while during the period 1676–1725 the poorest records were obtained (1760 tuna/year). The interim period 1576–1675 did not show extreme fluctuations, and an average of 15,170 tuna/year was maintained. According to Gancedo et al. (2009), these fluctuations could have been due to the "Maunder minimum" (the so-called the Little Ice Age, years 1640–1715) affecting both abundance and recruitment of tunas in the North Atlantic and the Mediterranean.

For centuries, the harvest of sardine and anchovy has been of crucial importance from a socioeconomic point of view, as their natural and unpredictable fluctuations have resulted in cyclic periods of poverty/wealth in local fishermen populations. On a larger spatial scale (Pérez-Rubín 2008), interrelationships have been found between the abundance of fish stocks and fishermen from Andalusia (the Alboran Sea and Gulf of Cadiz), Galicia and the Balearic Sea (including Levante and Cataluña) during the dramatic crisis of Spanish fisheries in the period 1920–1950. The grave crisis of the sardine industry in Galician waters in 1923–1927 and in 1947–1956 forced the Galician fishing vessels and canning factories to migrate to different ports in Andalusia such as Malaga and Algeciras.

For benthic and demersal fishing, the first two decades of the twentieth century were of great splendour in the Alboran Sea (Miranda 1923). The greatest activity was still centralized in Malaga, with the only steamboat trawlers of the Alboran Sea that were owned by different companies. In the fishing grounds far from the coast, the hegemonic company was "La Pesquera Malagueña" (1903–1927), whose bankruptcy marked the end of a stage of economic growth in the province. It had 20 steamboats using the port of Malaga for its shipyards and refrigerating installations and which directly employed 400 families. It abundantly exported fish and opened its own fish shops in cities in the provinces of Sevilla, Cordoba and Valencia. Around 1925, the northern and southern seabed fishing grounds of the Alboran Sea were overexploited, and a great part of the Spanish bottom trawl fleet fished in the Atlantic waters of Morocco.

In the Alboran Sea, the historical fluctuations of sardine and anchovy between 1945 and 1990 (Giráldez and Abad 1991, 2000) were related to climatic cycles: the sardine predominated in cooler periods and the anchovy in warmer periods (Pérez-Rubín 1996). Comparable changes were demonstrated in the pelagic fish assemblage of the European continental shelf: shifted from cold-water fish species (the 1960s–1980s) to warmer-water assemblages from the 1990s onwards (Montero-Serra et al. 2014) and the collapse of the bluefin tuna fisheries in the Atlantic during the 1960s (Cort and Abaunza 2015).

Several species of small/medium-size pelagic fish are occasionally present in exceptionally high quantities in the Alboran Sea, and they are useful as bioindicators. The boarfish (*Capros aper*) can reflect a greater flow of Atlantic

waters which transport significant amounts of their eggs and larvae from the Gulf of Cadiz (Pérez-Rubín and Abad 1994). The respective massive temporal presence of three Clupeiforms (anchovy, sardine and gilt sardine, *Sardinella aurita*) could reflect cyclic episodes of warming/cooling of surface waters (Pérez-Rubín 1996).

23.4 Early Fisheries and First Artisanal Fishing Industries

The Nasrid Kingdom of Granada (1232–1492) was extended across the northern coast of the Alboran Sea, from the Strait to Cabo de Gata, including—until the Reconquest—the current Spanish provinces of Malaga, Granada and Almeria. An influential Genoese colony already trading in salted anchovy from Malaga through its active port would become one of the most important in the Mediterranean (Martín Acosta 2010). The particular fishing wealth is also documented in certain coastal sectors in relation to the populations of Almuñecar, Bezmiliana (with tuna traps), Salobreña (commercial and fishing centre) and Marbella, with an abundance of sardines (Malpica 2009). In the late fifteenth century, the elaboration and commercialization of anchovies and salted sardines in Malaga were the main local industry. An influential Catalan and Valencian commercial colony was established and traded with the handmade, salted anchovy in Malaga, which came to be demanded on a large scale by the eastern Spanish trade (Ruiz Povedano 1987).

The production generated an important maritime export trade and was even transported to distant markets of the Late Middle Ages (López Beltrán 2001). This industry exported thousands of barrels of anchovy and sardines annually, from Malaga and Marbella to different European countries. Sometimes, these provisions travelled to the antipodes, like the 200 barrels of anchovy from Malaga that were shipped in 1519 for the expedition of Ferdinand Magellan to the Moluccas Islands in the Pacific Ocean, along with other Andalusian species of dried fish (Fernández-Navarrete 1964).

In order to repopulate Fuengirola in 1502, 20 families were economically motivated to settle under the protection of the military fortress, and it was recommended that two-thirds of this population should be fishermen and small purse seiner boat owners called “jábegas” (López de Coca 1975). In the current provinces of Granada and Almeria, since the sixteenth century, the presence of towed traps to catch tunas and small species of tuna is documented (Abad 1995–1996). Other historical sources (Malpica 2009) located tuna traps in La Herradura and in the vicinity of the current town of La Mamola (Granada), famous in those days for its abundance of Atlantic bonito (*Sarda sarda*).

In the Malaga ordinances of 1611 (Martín Acosta 2010), a great diversity of fish species that landed on the beaches of Malaga and Granada were still mentioned, pointing out those of greater commercial importance and the variety of fishing techniques used, with four different types of net gears, hooks (longlines) and pots. In these municipal ordinances, 22 species of fish or varieties are mentioned, plus the generic name to refer to very small fish, called “morralla.”

On the coast of the current province of Almeria, the fishing village of Balerma was founded and became the most important fishing ground in the area thanks to the protection offered by its fortress against the attack of pirates (García Luján 2002).

For centuries, the greatest source of suffering and mortality for the different populations living on the coast of Andalusia was the continuous pirate and corsair attacks from the north of Africa. They stole the boats and kidnapped the fishermen in order to request a ransom for their freedom. This triggered the depopulation of the coastal zone and the abandonment of fishing and agriculture (Martínez González 1997). On the Almeria coast, given its greater proximity to the Algerian and Tunisian coasts, Berber incursions didn't end until the eighteenth century (Sánchez Picón 1999).

Due to the commercial importance of sharks, they were sold either fresh or air-dried. The first mention about shark fisheries in the Alboran Sea was in the municipal ordinances of Malaga during the period 1489–1501, in relation to the net fisheries. In these ordinances, 10 different species were named, and up to 5 different types of fishing were authorized. Concerning hook fisheries aimed at sharks, the first information comes from the southeastern Alboran Sea in the sixteenth century, where Spanish ordinances (1536–1540) mentioned 4 species of elasmobranch fish that were consumed dried (López Beltrán 1984). In the year 1611 in the municipal ordinance of Malaga, the only shark species named is the "cazón" (*Galeorhinus galeus*), although apparently this term is used as a generic name. In 1789, up to 40 species of elasmobranch are mentioned in Malaga (Martínez-González 1993). During the eighteenth century, the "cazonales" bottom nets were used from Cabo de Gata (Almeria) to Malaga, generally from April to the beginning of July (Sáñez-Reguart 1791–1795). In addition, a decrease in shark catch was observed due to the proliferation of bottom trawl nets. In earlier times, in certain areas, a single vessel could catch on average of around 1700 kg with nets. Using hook handline ("cordel"), it was common to port 10–12 dozen sharks in less than 24 h (Sáñez-Reguart 1791–1795).

23.4.1 The Pelagic Habitat

At the beginning of the sixteenth century, fishing was abundant and varied. In the municipal ordinances of Malaga city council, January 1501, some 30 main species of fish of commercial interest in the area (Mondéjar 2001; Malpica 2009), including 8 cartilaginous species, are mentioned. In a document from Malaga in 1502, 31 fish drying facilities ("percheles") were registered. Foreign trade in the Andalusian Mediterranean was concentrated mainly in the port of Malaga and smaller ones in Marbella, Velez-Malaga, Almuñecar and Almeria. A decade later, in 1512, the entire coastline of the Kingdom of Granada was considered a favourable area for fishing and processing anchovy (Ruiz Povedano 1987).

During the sixteenth and seventeenth centuries, on the coast of Almeria, there was a fishing activity developed with varied techniques, such as pots, gillnets, beach

seines, hooks gears (to catch sharks) and two types of tuna traps. One of these, the beach seine trawl modality, was practised in Cabo de Gata from 1566, with intermittent activity until at least the year 1659 and which gave rise to a settlement of fishermen that grew over the years. The first buche's tuna trap ("almadraba de buche") was in Roquetas and leased in 1671 for a 10-year period. At the end of that century, tuna traps were also found in the town of Balerma (Abad 1995–1996).

Throughout the eighteenth century, the greatest fishing force was still concentrated in the capital city of Malaga, and its large industry was intended for salting fish and processing anchovy (Burgos 1994a). Fishing for sardines and anchovies in the northwestern Alboran Sea with "jábegas" was still very important during almost the whole year. In summer, both species started to be salted, as well as tuna and bonitos (Sañez-Reguart 1791–1795). There was a huge number of salting places in several towns on the Malaga coast, where many women and girls worked, exporting production to different Spanish provinces and to France and Italy. The Catalans went to the waters of Manilva and Estepona to fish for sardines, and their salting factories employed around 650 women per campaign (García and Fernández 1993). The activity was equally intense in several locations in the city of Malaga. In countless houses in the fishermen's district, salting anchovy and sardine continued as well as in 16 large anchovy factories. Independently, the Catalans had their own salted fish production on the beaches, where they employed another 100 women and prepared their catches for export, particularly large amounts of dried conger and pickled sea bream (Burgos 1994a).

In the mid-eighteenth century, the port of Malaga had a large number and variety of ships. According to the official register of vessels (Villas 1995), in 1753, there were 112 boats, including 15 large "jábegas" and 20 large longliners (with 7–8 men each). Throughout the north Alboran Sea, a total of 231 fishing boats of different types were registered in the period 1758–1765, plus an additional number of vessels coming annually from the Catalan Sea. The "jábegas" were the most emblematic ones in the province of Malaga. At the end of the century, they used to fish continuously during the daylight hours, and even artificial light was used for fishing at night. These boats caught great quantities of fish, mainly anchovy and sardine (Sáñez-Reguart 1791–1795). The size of these boats and the necessary manpower were increasing so that in some cases, they had 33 men, including the crew and the staff on land. They used an auxiliary boat to take the catches to the selling places (Sáñez-Reguart 1791–1795). The fishing grounds near the Strait were of prime interest and a great rivalry area. Fishermen from Malaga and from the villages of Manilva, Casares and Estepona came to catch mainly tuna. In Spanish Gibraltar, fishing was the only local industry; in the Bay of Algeciras and the rough Levante coast, fishing was very intense. These fish were exported inland and to the ports of Seville and the coast from Malaga to Valencia. At the end of the eighteenth century, Spanish fishermen from Algeciras preferred the "jábegas," whereas in British Gibraltar, the Genoese fishermen preferred the smallest beach trawl nets called "boliches" (Sañez-Reguart 1791–1795).

In the eastern area (the Nerja-Almeria sector) around 1786, the "jábegas", longline and pots were predominant, salting a large quantity of fish which was

exported to distant inland populations. In the current province of Almeria, large tunas and small tuna species were temporarily caught with traps (in Vera and Agua Amarga) and with nets called "sedales" (with double the length of the "jábegas"). Fishing was carried out mainly in Balerma and Roquetas (Sañez-Reguart 1791–1795).

Throughout the nineteenth century, the province of Malaga and the northwestern area near the Strait of Gibraltar still maintained the largest fishing catches followed by Almeria, Roquetas and Adra. Around 1817, east of Marbella, bonitos were captured from March to May by obstructing their movements with the "sedal" fishing gear which was installed from offshore to the coastal waters (Burgos and Lacomba 1993). From the beginning of the century, in the Strait, Ceuta had a fish trap to catch small tunas. The trap was set during the summer-autumn months and in the spring with workers from Alicante and Valencia capturing on several occasions as many as 11,000 bonitos that were exported already salted (Madoz 1986a).

In 1814, the previously abundant anchovies and sardines were missing in Malaga. Nevertheless, their production remained an important economic activity in the city until 1824 when a sudden rise in salt prices for fishing purposes caused the decline of the fishing sector (Miravent 1850). A similar situation occurred in Marbella during 1845–1846 because sardines and mackerels (*Scomber scombrus*) entering from the Strait of Gibraltar, which in former times were abundant, decreased substantially (Burgos 1994b).

Mellado (1845) reported that the greatest catches in the Alboran Sea were apparently from the coasts of Estepona, Marbella, Salobreña, Antas, Bédar, Carboneras and Vera. He highlights the coastal "salinas" (solar salterns) of Roquetas (Almeria) and insists on the importance of the Malaga fishing fleet. According to another contemporary description (Marzo 1851) about the fishing activity from Nerja to Estepona, a greater fishing catch from locations near the Strait of Gibraltar is reported. The waters of Manilva were famous for their sardine abundance. Fishermen from Valencia and Alicante fished in the area from the beginning of the century. Madoz (1986b) also reported on the fishing importance in localities in the province of Malaga: Estepona, Marbella, Manilva and, especially, Fuengirola are highlighted. By mid-century, the port of Algeciras became more important (fish of all sorts were abundant and cheap, and in particular cases, sardines were salted). Tarifa annually exported 453,600 kg of tuna, bonito, albacore (*Thunnus alalunga*), mackerel, sardine and anchovy to Valencia (Madoz 1986a).

In the last decades, considerable changes were detected in the abundance and spatial concentration of certain pelagic species on the coast of Malaga. In 1881, sardine catches in Malaga (only with traditional techniques) accounted for 50% of the whole Alboran Sea catches. The only salting factories in the Alboran Sea were in Malaga: three factories and a production of 3,000,000 sardines which consumed 35,000 kg of salt (Lacomba 2006).

During the twentieth century, fishing research was intensified specially for species of great commercial preference. In the year 1920, it included the first reliable statistics on a national scale. The data from the Alboran Sea was detailed, including the Spanish Moroccan Sea (Miranda 1923). The province of Malaga annually landed

more than 90% of the total fish catches, and sardine represented nearly 92% (14.3 tons). The local fishing fleet was diversified in multiple modalities and with different types of hooks, gears and nets: longliners, trawlers (with sail and steamboats), large "jábegas" (with as many as 20 oarsmen), fixed gillnets ("trasmallos") and drifting ("sardinales").

On the other hand, the abundance of large cetaceans in the Strait of Gibraltar and adjacent waters boosted the settlement of Spanish whaling factories from the beginning of the twentieth century. According to Aguilar (2013) in the Strait area, with plenty of sharks in the nineteenth century, big shoals of sperm whales (*Physeter macrocephalus*) were discovered. Following this evidence, North American whaling vessels reached the region and hunted whales between 1 and 4 months during the April to September season. In the 1920s, sperm whales were rare, the common whale (*Balaenoptera physalus*) being the most frequent species; that is why some years later more than 700 individuals were caught on the Spanish coasts. Norwegian businessmen maintained the Getares factory (near Algeciras) from 1921 to 1926. During its lifetime, 3610 whales and 352 sperm whales were processed. A new modern factory, which processed 356 whales and 347 sperm whales, was established in the Bay of Benzu (Ceuta) from 1947 to 1954. A businessman from Malaga relaunched the Getares whaling factory in 1950 with less total results during its 10 years of functioning (291 whales and 372 sperm whales). The history of whaling factories in northern Morocco during the 1929–1955 period has been reviewed by other authors (Serrais and Domínguez 2015).

23.4.2 Benthos and Demersal Fish Habitats

In the eighteenth century, in the whole northern area of the Alboran Sea, a variety of deep fishing techniques with hooks were used. Small Catalan longliners (manned by 5–6 sailors) would reach these waters every year from winter to the middle of Lent. They used to operate 23 miles away from the coast with several lines containing hundreds of hooks. Specific hooks existed for bottom fish (both benthic and demersal) which were used to catch conger (*Conger conger*), hake (*Merluccius merluccius*), sparids, groupers, sharks and rays (Sáñez-Reguart 1791–1795). Large catches of sharks were also obtained with specific nets ("cazonales"), mainly in the season April to June. Mule drivers ("arrieros") went particularly to Almeria to buy sharks and took them to the people in the mountains, where they were specifically consumed (Sañez-Reguart 1791–1795).

In the rich waters of the Strait where the currents are stronger, large vessels were needed (manned by 8–12 men). The most used gears of hooks in deep waters were the so-called "cordel" (handline), which could submerge even up to 365 m in depth to capture adult specimens of a variety of species (Sáñez-Reguart 1791–1795).

During the eighteenth and nineteenth centuries, the province of Malaga was the firmest defender of maintaining the most artisanal fishing gear types and untirelessly fought with the new "parejas de bou" of sailing vessels (bottom pair trawl) (Burgos

1996a). For that reason, the exploitation of demersal and benthic species on the seabed of the continental shelf was moderate. These species were caught with simple gear "jábegas" nets (which could fish close to the bottom) and a variety of specific nets for sharks and meagre (*Argyrosomus regius*), as well as pots and hooks aimed at deep-sea fish. The largest volume of demersal fish for exports was composed of hake, cured conger and pickled sparids (*Pagellus* spp.).

Throughout the eighteenth century, bottom trawling was highly controversial in Malaga, until its definitive ban in 1783. In 1702, the first discussion between the fishermen of the city and the foreigners who used primitive bottom trawls (with individual boats, precursor of the trawling pairs or "bous") took place. Initially, the population of Malaga welcomed this new capture technique because it reduced the price of fish for local people and convents (Reder 1991). In the eastern sector of the Alboran Sea, the foreign vessels were mainly incorporated to the towns of Almeria, Roquetas, Dalias, Adra, Albuñol, Almuñecar, Nerja and Velez-Malaga (Fernández and Martínez-Shaw 1984). Among them were the Catalan vessels "laudes," who worked in Almeria, Nerja and Malaga, and after having sold their catch on the nearby beaches, they returned to their places of origin with loads of fish skins (shark hides) or dried fish (Reder 1991). The first three pairs of modern sailboat trawlers from Malaga were conceded in October 1766: two for the supply of the city and the other for the military garrison. These vessels had 10–12 men each and could operate 9 miles away from the coast but needed strong winds to sail. For that reason, the most appropriate seasons to operate were autumn and the beginning of winter. Although they used to catch all types of living animals from the seabed, the most frequent or abundant species were large and small hake, red mullet (*Mullus barbatus*), flat fishes and sparids. Their catches were so abundant that it was calculated that in 6 h, they obtained the same amount of fish as the other techniques (nets, hook gears and pots) which took 48 h to obtain (Fernández and Martínez-Shaw 1984). There is also information about the temporary use of bottom trawl nets on the beaches of Mijas and Fuengirola at least during 1777–1778 (Reder 1991), with high daily catches of hake obtained during winter time in this virgin seabed (60–180 kg per vessel).

At the beginning of the nineteenth century, the king granted the noble Count of Lalaing two pairs of bottom trawlers for Malaga (1801) again, although they did not operate frequently. The number of these trawlers increased to seven pairs in 1814 and continued to rise. Years later, fishermen's associations related to the owners of the "jábega" fishery, protesting against the use of the two granted vessels because their fish was 25% cheaper. They would commit themselves to compensate the heirs of the countess so that these vessels could not fish anymore (Fernández 1866). During the last decades, in certain seasons, part of the Valencian fleet fished in Malaga (Estepona-Sabinillas sector). Other fishing vessels from the Levantine area migrated to the waters near Melilla. In the latter and in the Strait of Gibraltar, a new fishing modality with well-boats (ships with integrated seawater tanks to transport live fish) began (Viruela 1995). In 1895, two steam trawlers, which fished individually, started operating in Malaga.

23.5 Technical Fishery Management: Legislation, Conservation and Statistics

In 1482, the ordinance of the rope makers of Seville (García Cornejo 2001) established the regulations on the mesh size for every piece of the marine fishing nets with their respective lengths. A dozen different types of net gears were mentioned corresponding to two basic categories: the complete "jábegas," their 6 different sections and the four specific types of nettings to catch sharks and meagre. Those legal regulations were applied later in the Alboran Sea, from the times of the first municipality of the Castilian Malaga during 1489–1495. A valuable fishing regulation, with several provisions for the protection of marine resources, was introduced (García Cornejo 2001). Strict rules regulated the capture, handling and sale of fish, both fresh and salted. A specific place on the coast was arranged for the unloading of the fish coming from all the municipal places, and supply preference was given to residents. As most of the catches from the beach seine trawl ("jábegas") in the Bay of Malaga were mainly destined to neighbours (for direct consumption or for artisanal processing), only the remaining ones could be exported, fresh or cured. The fish was exported to inland cities as far away as Cordoba and Jaen (about 170–200 km away). The illegal and fraudulent activities of non-resident fishermen and merchants were prosecuted by the municipal authorities. They were obliged to pay the corresponding taxes for foreign trade of fresh or salty fish from the city, by sea or by land (López Beltrán 2001).

According to an ordinance of 1489, the elaboration of anchovies and sardines in Malaga was reserved exclusively for the neighbours, both Spaniards and registered foreigners, the Genoese being the most interested. The salting factories had a large number of workers. Due to hygienic problems and bad odours, the processing of all kinds of fish inside the city was banned, both drying fish outdoors and salting factories. Years later, before the sale to wholesalers, a municipal inspector verified the quality of the preserved fish in the barrels before closing and sealing them (López Beltrán 2001). In addition to this, different measures for the conservation of fishery resources were added. A time-space closure was set to prohibit the use of "jábegas" in determined coastal sectors between April and September with the objective of protecting the immature fish fry of commercially important species. The mesh size of the codends was regulated (the mesh opening cannot be less than the width of the index finger, which was measured by inspectors using a ring) (López Beltrán 2001).

At the southeast end of the Alboran Sea, for several decades after the incorporation of the African city of Bugia to the Crown of Castile, its ordinances from 1536 to 1540 were in force (López Beltrán 1984). They contained information on the local market regulation: rules on fresh fish related to fixed prices for different species and the obligation to sell it publicly in a reserved place. The legislation distinguished among the most valued fish, the species that were caught with the "jábega" and other minor fish that could also be eaten dried (rays and sharks). In the next decade, in the Castilian municipal ordinances of Gibraltar (1555), the great importance that fishing

had for the population was clear, both for direct feeding and for exchanging it with another basic foodstuff (Sarriá 1990).

New guidelines were included in the Malaga ordinances of 1611 (Martín Acosta 2010). The diversity of fish species that were unloaded on the beaches of Malaga and Granada was sold both fresh and salty, in both capitals at regulated prices. The municipal control was extended on the beaches with inspectors who measured the lengths of the nets and the size of the meshes of various nets and pots. In order for the post-larval fish and juveniles to escape, a mesh opening of the size of the second finger of a hand was established (verifiable with a mayor's ring). Most species of fish (78%) were selected to specifically supply the city.

In the last decades of the seventeenth century in Spain, there was a decline in fisheries. Its consequences had not been overcome yet in the mid-eighteenth century, when the Spanish fishing fleet and its auxiliary industries continued to decrease, leading to the importation of salted cod from foreign countries. The Bourbon monarchy considered "the advance of fisheries as an inexhaustible treasure of wealth, providing a continuous occupation for the people and a school of sailors" a priority to stimulate better socioeconomic conditions (García and Fernández 1993). A slow process of reconversion of the fishing sector took place by ameliorating the fishing techniques and their abilities, establishing a renewed salting industry and optimizing the fish catch distribution network along the coasts and inland. The price of salt was specifically decreased for the fishing sector, and in different local coastal populations, the Economic Societies of Friends of the Country fostered the establishment of local fisheries (García and Fernández 1993). Within the national fishing grounds regulations, in 1751, there were orders regarding the conservation of different fish species (by prohibiting fishing during spawning seasons and setting mesh size regulations), and in 1753, for the Ensenada Cadastre, the fleet and sailors' inventory for the ports of the province of Malaga was carried out (Villas 1995).

The local fisheries were encouraged by the elimination of municipal taxes on fishery products. Commissioners of the Naval Ministry started to inspect the local fisheries and, consequently, proposed better measures for their regulation. The most prominent and expert of them was A. Sáñez-Reguart and wrote the "Report on the restoration of fishing along the Andalusian coasts." For 15 years, from 1780 to 1795, that naval inspector classified the Spanish fauna captured by the fisheries and published a descriptive five-volume inventory of the varied fishing techniques and skills used in the country (Sáñez-Reguart 1791–1795). The significant inspection in Malaga during 1786 led to the publication of the "Regulatory ordinance for Mediterranean fishing" and of the "Regulation and Order for the Registration of Seamen" (a register of shipowners, skippers, fishermen and sailors) which was published in the city (Burgos 1994a).

Concern about the impact of Catalan bottom trawling on benthic and demersal fauna on the coast of Malaga was constant during this century. Therefore, a conservationist controversy arose against the trawling couples, with important men and local fishermen who reported their harmful effects (Fernández and Martínez-Shaw 1984).

From ancient times, the fishermen of Malaga have been associated to defend their rights before the local authorities (Villas 1984; Burgos 1994a). On many occasions, the "jábega" fishermen in the capital managed to get a limited number of Catalan trawling pairs and the prohibition of pots, arguing that they made their beach seine trawl difficult (Burgos 1996a). The claims of the fishermen with the support of Malaga city council led to the final ban in 1783 for the three local pair trawlers because it was considered that they destroyed the habitats of the adult fish and their juveniles. In 1789, the fishermen kept the privilege of selling from their boats and on the beaches, but if they decided to introduce their catch into the city of Malaga, they would be subject to the police rules, and prices would also be imposed by the city council (Burgos 1994a).

The conflicting situations of the bottom fisheries of Malaga resumed in 1814, when the parliament granted the use of 7 trawl pairs with a reduced period of temporary fishing closure (July and August). In autumn, 4 "parejas" were fishing along the coast of Malaga. The local fishermen provided written documentation on the negative consequences, such as a generalized scarcity of the local catches for the remaining coastal vessels and the need to go fishing beyond 18 miles. The shortage of fish provoked the ruin of some small boat owners and the alarming decrease of the "jábega" catches (85% less) and the longliners and "espineles" (40% less on average). The city council established an inspecting commission to check practical experiences and the effects of bottom trawls on the spot. The commission's vessel approached the pair trawlers, examined the catches of each haul and wrote an extensive report about it (Fernández 1866).

In the middle of the century, the Naval Ministry recognized the need to restore and promote the national fishing industry. Thanks to the impulse of research in 1847, reports from different ports in the province of Malaga are currently available (Burgos 1994b, 1996b). They include data on the species caught and an inventory of fishermen and vessels during the period between 1842 and 1846.

Great advances were made between 1860 and 1870 in relation to fishing regulations and the protection of living resources (Pérez-Rubín 2006). In Madrid, the Permanent Commission of Fisheries was created by the navy to assess the fishery sector, which was represented by delegations from each part of the national coasts. Time-space closures were established, and the number of vessels destined to fishing was limited. The expansion of the national fisheries was supported by the establishment of fishing agreements between 1860 and 1866 with Morocco, Portugal and Gibraltar. Three basic regulations on priority species were published in 1866: ostreiculture (oyster farming), tuna traps and bottom trawling (beyond 12 miles off the coastline). For the trawlers, in the Strait of Gibraltar and the Alboran Sea, an absolute seasonal closure of 3.5 months (from June to September) was enacted aiming to facilitate the reproduction of the species.

The "Freedom of Fishing Regulations" (1885) prohibited a total of 11 types of destructive fishing gear. Unfortunately, the definitive authorization of the "new bou industry" in 1890 caused the fall of traditional fisheries, provoking much civil unrest (Lacomba 2006). Until then, in twelve coastal towns extending from Marbella to Nerja, 7000 families subsisted on the exploitation of classical fishing gear

("jábegas," "sardinales" and longliners), with 900 small vessel types suffering from an unbalanced competition against the 16 "bou" pairs working intensively (Anonymous 1894). New petitions to ban the "bou" fishing gear on behalf of shipowners and artisanal fishermen achieved the prohibition of fishing less than 6 miles from the coast. In 1895, the spatial limits of each province were delimited on the basis of the greater or lesser extent of the continental shelf. An average depth of 90 metres together with a distance of 5–6 miles from the coast was calculated for the North Alboran Sea. In the year 1895, the first two steam trawlers were registered in Malaga to dedicate them individually to trawl farther than 10 miles offshore. This situation led to the fact that shipowners of sail pairs also joined the protests. In 1898, after a provisional closure of the waters off Malaga (June to August), a new regulation for bottom trawling of all types of vessels was approved (Burgos 1997).

23.5.1 Nineteenth-Century Fisheries Statistics

During the nineteenth century, the navy elaborated the official fishing statistics. Nevertheless, they could have been considered unreliable for many years, with large gaps, and generally, catches were not classified by species. Table 23.1 summarizes the statistical catch information available for our area.

The most important conclusions are summarized. In general for fish catches as a whole and sardine catches in particular, an alternation is confirmed for the maximum values for Galicia, Huelva, Malaga and Atlantic Morocco. In some specific years, fishing catches in Andalusia were much higher than those in Galicia (1883) or similar (1889, 1892) (Viruela 1995).

In the Alboran Sea, the greatest fishing effort and the maximum annual catches were concentrated in the province of Malaga, increasing progressively. The global

Table 23.1 Statistical catch information available in relation to the Alboran Sea and/or Andalusia (1829/1892)

Years	Areas	Authors
1831, 1861	Malaga vs Gulf of Cadiz	Fernández (1866)
1829, 1831–1835, 1845–1847	Alboran Sea vs Gulf of Cadiz	Burgos and Lacomba (1993)
1842–1846	Marbella, Velez-Malaga, Nerja	Burgos (1994b, 1996b)
1831, 1858, 1860, 1861, 1883, 1889, 1892	Andalusia vs Galician	Viruela (1995)
1883	Alboran Sea vs Gulf of Cadiz	Lacomba (2006)
1881 (sardine)	Alboran Sea vs Gulf of Cadiz	Lacomba (2006)
1888	Alboran Sea vs Gulf of Cadiz	García Solá (1888)

catches in this province between 1831 and 1861 multiplied by 12, with 7056 tons and 3415 sailors, compromising 43% of all Andalusia (the Alboran Sea as well as the Gulf of Cadiz). This was caused by the maintenance of the prohibition of the "bou" trawl fishing, and only minor artisanal fishing gear was allowed, thus employing a larger number of vessels and their associated labour workforce (Fernández 1866). The highest percentage was reached in 1883: in the Alboran Sea, 50% of the catches (total species and sardine) and numbers of boats and fishermen were concentrated in the province of Malaga. It was followed by the former maritime provinces of Algeciras and Almeria, which accounted for 21% and 17%, respectively (Lacomba 2006). During 1888, the province of Malaga increased its dominance in the regional fisheries again, which represented 56% of the ships (945 vessels) and gross register tonnage (GTR) and 70% of the manpower (8963 fishermen) (García Solá 1888).

23.6 Summary and Concluding Remarks

From the earliest of times, the study area has been a meeting place for very different civilizations and marine fauna, in both cases coming from distant European, African, Atlantic and Mediterranean coasts. This human confluence, with the exchange of cultures, using their own fishing techniques, has been constant and enriching throughout the centuries. The local marine resources have always been essential for food and economic development of the inhabitants in the area. However, in the cyclical periods of regional fishing crisis, the European-African fishing grounds of the near Atlantic area have been the salvation of the fishing economy. Conversely, in the periods of sardine crisis in the Spanish Atlantic waters, fishermen migrated to different ports in the Algeciras-Malaga sector. This pattern has been repeated throughout centuries with fishermen and their industries moving great distances in order to overcome the fisheries crisis.

In the northern area of the Alboran Sea, African piracy was controlled in the mid-eighteenth century. Since then, fishermen have faced other serious, local and regional fishing crises. Independently, but cyclically, pelagic and seabed fishing was affected. Pelagic fishing was characterized by boom and fall, with the temporary absence of target species. Seabed fishing alternated between the years of prohibition of the trawlers and those of authorization, with serial depletion of the fishing grounds. In both fisheries, the causes of collapse were different (oceanographic variability/overfishing) but had the same negative effect. In the independent cyclical periods of fishing shortages, the majority of both fleets had to migrate to other coasts with more abundant resources. Logically, this process was reflected in the economy: impoverishment on the coasts of origin and enrichment in the new areas of exploitation and processing of the catches.

On the other hand, the advanced technical information collected in relation to the ancient strategies to manage fisheries for sustainability since the fifteenth century is impressive. Those societies were highly dependent on local resources and needed to avoid resource collapse. Initially, the fishing legislation was dictated by municipal

authorities. The pioneering laws (ordinances) of the city of Malaga between the years 1489 and 1611 included fishing regulations focussed on protecting the immature fish, regulating on the lengths of the nets, the size of the meshes and the establishment of spatio-temporal closures. These ancient documents cite between 24 and 33 fish species of great commercial interest. Unfortunately, nowadays, the reliable identification of real species with regard to the older common names appears to be a difficult or impossible task to do, also complicated by the high specific richness of the Alboran Sea.

During the eighteenth century, fishing legislation was the responsibility of the navy. Since early times, the fishermen from Malaga were registered in guilds to defend their rights and until the end of the nineteenth century actively fought against the use of seabed trawls. The fishermen's arguments can be described as ecologists, since their detractors tried to prohibit the use of those nets as they were considered destructive for small or immature fish and for the soft seabed ecosystems. By avoiding this local industrial fishing, the greatest fishing effort in Andalusia (in number of boats and fishermen) was centralized in the province of Malaga, owing to the fact that artisanal fishing gear needed more boats and seamen.

Since the mid-nineteenth century, regulations have been improved with the participation of the local fishermen themselves. In the Local Fishing Commission in Malaga, fishermen representing each category of fishing met the commander of the navy and a naturalist advisor periodically. At the end of the century, that naturalist became the natural history professor at a secondary school in the city. He argued and defended the necessary protection of the coastal seabed characterized by the presence of laminarian and coralline algae. Such assumptions are valid in the twenty-first century, because it has been confirmed that both floor types constitute valuable habitats that are necessary to preserve the biodiversity in benthic communities. Likewise, much of the "modern" international fishing management is based on those "ancient" conservationist ideas implemented since the end of the fifteenth century on the coast of Malaga.

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