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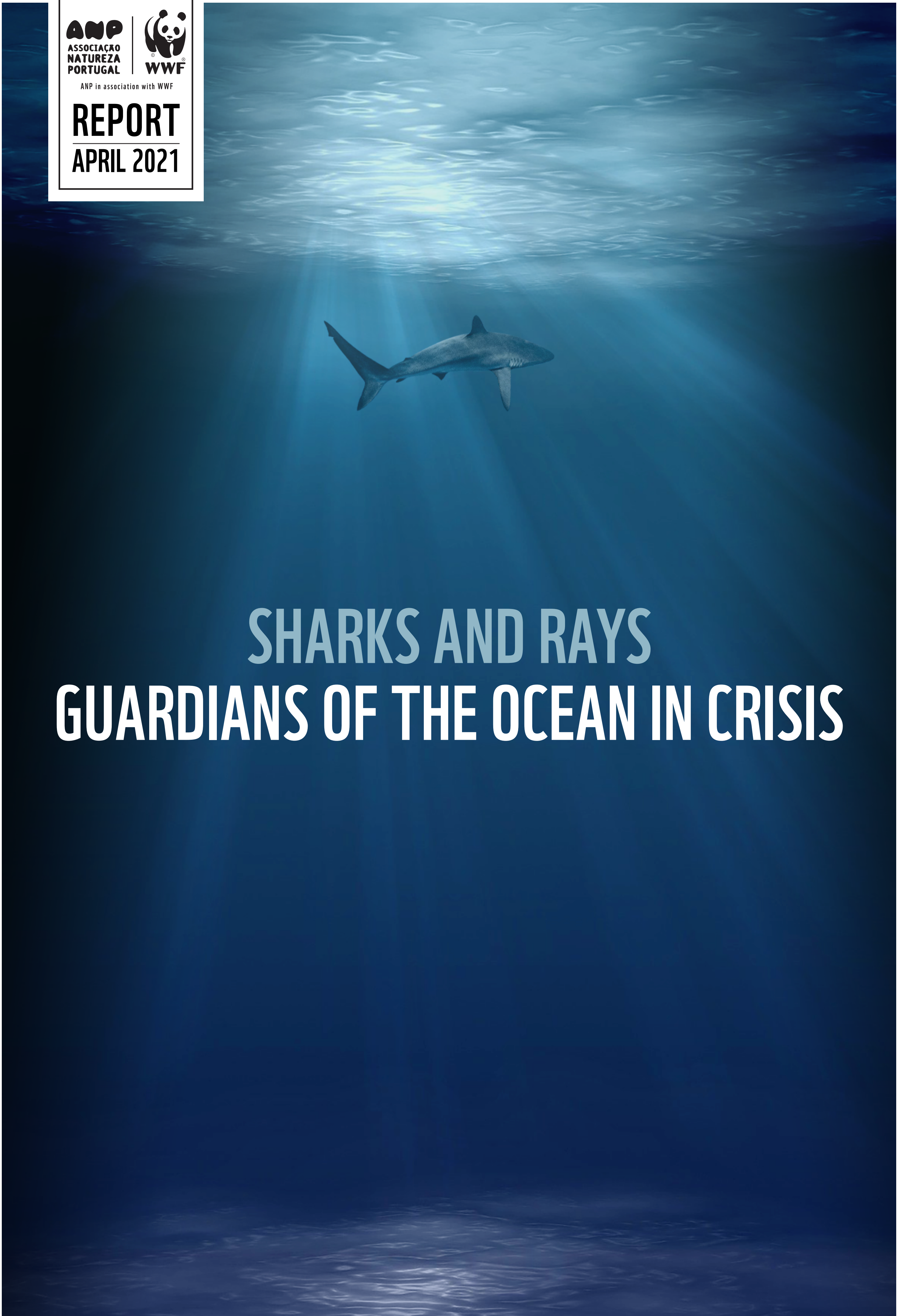

SHARKS AND RAYS
GUARDIANS OF THE OCEAN IN CRISIS

INDEX

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Brief note

Sharks and rays have inhabited our planet's oceans for millions of years and play a key role in their balance. **These marine creatures, despite their reputation as villains, are actually *guardians of the ocean* - and they are in crisis.**

ANP|WWF and Oceano Azul Foundation want to contribute to the awareness and adoption of conservation and research policies applied to these species, which are collectively known as Elasmobranchs.

WWF, through initiatives specifically directed to the Mediterranean and Southeast Asia, aims to improve the knowledge and protection of shark and ray species through communication directed at the general public and relevant stakeholders. The Mediterranean, where the conservation statuses of sharks and rays are particularly concerning, was the subject of a report[i] emphasising the urgent need to implement conservation measures for these animals in this geographical area.

The Oceanário de Lisboa and Oceano Azul Foundation, on the first edition of their Ocean Conservation Fund dedicated to sharks and rays, promoted awareness-raising, conservation, improvement of the current level of knowledge, testing of solutions, and the definition of strategies that can be applied globally and adjusted locally for shark and ray species. The supported projects apply non-invasive methods to detect and estimate shark and ray abundance, identify critical habitats, analyse distribution and migration patterns, and seek ways to reduce fisheries' bycatch[ii].

The present report, titled "Sharks and Rays: Guardians of the Ocean in Crisis", aims to be an important contribution to improve the available knowledge on sharks and rays in Portugal. In addition to framing the situation of elasmobranchs regarding threats and conservation statuses, this report makes an in-depth analysis of the commercial fisheries, trade & consumption, and governance & policies currently used in Portugal, aiming to support a set of recommendations addressed to the main stakeholders. The technical-scientific information presented here can, and should, serve as a basis for the elaboration of a Plan of Action for the Management and Conservation of Sharks and Rays in Portugal.

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i WWF 2019, Sharks in Crisis - A Call to Action in the Mediterranean: http://awsassets.panda.org/downloads/wwf_sharks_in_the_mediterranean_2019_v10singles.pdf

ii See Annexes 1 to 3 for more information about national and international projects aiming to improve the scientific knowledge about sharks and rays.

Executive Summary

Sharks and rays belong to the Elasmobranch class and, together with Chimaeras, compose the group of cartilaginous fish, one of the oldest and most ecologically diverse vertebrate group that inhabits the ocean. More than 1,200 species are known, of which sharks and rays constitute the majority, inhabiting a wide environmental range, from coastal areas to the open sea and deep sea habitats. They play a key role in the balance and productivity of marine ecosystems, often occupying top positions in food chains. As such, they structure and connect marine communities and habitats, increase biodiversity, and even benefit commercial stocks exploited by fishing communities. Their biological characteristics make them especially vulnerable to human activities. Overfishing is considered the main threat to the survival of sharks and rays as well as the main reason for the decline of many populations and their poor conservation statuses.

Commercial fisheries for Elasmobranchs have been increasing all over the world, as new fishing areas are explored and fishing effort is increased. Since the 1980s, official catches of sharks and rays have tripled, reaching a maximum of 869,000 t in 2000. In the last 20 years, a general decreasing trend in catches of about 20% has been observed. However, official catches can be three to four times higher than those reported for these species, which are often misidentified or unreported and represent a high proportion of bycatch and discards. Bycatch, together with overfishing, is considered one of the main threats to shark and ray survival. In some fishing gears targeting large bony fish, such as tuna or swordfish, bycatch often exceeds the targeted fish. Blue shark is one of the most fished shark species worldwide due to its broad environmental range, faster growth, and higher population growth rates, when compared to other pelagic species. Shark and ray fins are the most expensive sea products globally, and their demand has led to sharp declines in the abundance of many species. As a result, half of the species targeted for fins are threatened.

Other threats directly or indirectly related to human activities include pollution, climate change, and loss of habitat and food, among others. For all these reasons, the conservation statuses of sharks and rays are among the worst in vertebrates. In fact, in 2021, 36% of shark and ray species are considered threatened by the International Union for Conservation of Nature (IUCN). However, understanding how many species of sharks and rays exist, which part of the ocean they inhabit, and the state of their populations is particularly difficult; among fish, they have proportionally more species with insufficient data to attribute a conservation status. In addition, their timid nature combined with high mobility and low population density complicate monitoring efforts by specialists. Therefore, fisheries data are often the only source of information, although insufficient, to assess the conservation statuses of sharks and rays. In European waters, characterised by high fishing effort, sharks and rays have poor conservation statuses, especially in the Mediterranean. Pelagic species have been particularly affected by overfishing; since 1970, their abundance decreased 71%. This serious depletion catalysed the risk of global extinction to the point where 3/4 of pelagic species are now threatened.

In Portugal, 117 Elasmobranch and Chimaera species are known, representing 89% of the known European species and 9% of the world species. This great diversity results in part from the variety of environments in Portuguese waters, with important differences between the Mainland and the archipelagos of Madeira and Azores.

The European fleet, which includes the Portuguese fleet, can be found in all oceans and records important catches of rays, mainly *Raja* sp., and pelagic sharks, especially blue shark, shortfin mako, and porbeagle. However, it is in the Atlantic Ocean that the highest catches of sharks take place; 88% of world catches of pelagic sharks, mainly blue shark and shortfin mako, are made by European longliners operating in the North Atlantic that provide the majority of shark and ray fins that the European Union (EU) exports to China. Both Portugal and Spain have been increasing shark and ray catches; Spain now occupies the second position in the world ranking and Portugal the 12th.

Since official fishery records for this group began in 1986, Elasmobranch catches have declined by 60% in reported weight. This decrease seems to be more related with declines in both shark and ray species abundance than to implemented fishery restriction measures. Rays, mainly *Raja* sp., constitute the majority of elasmobranch landings in Portugal. However, 3/4 of the sharks and rays total weight of landings is currently composed of only four species: thornback ray, blonde ray, lesser spotted dogfish, and blue shark. There are important differences between the Portuguese mainland and the Archipelagos, namely in terms of the most landed ecological groups. It is in the fishing ports of the mainland that 92% of Elasmobranch landings occur, particularly rays; in the Azores, pelagic sharks are the most landed species while in Madeira deep-sea sharks have historically occupied the first place in reported landings.

Despite the difficulty in understanding which fishing gears are involved in catching sharks and rays, due to the artisanal and polyvalent nature of Portuguese fisheries, it is known that lines and hooks have a high impact on both pelagic and deep-sea species. These species are mainly caught as bycatch, but in the case of surface longliners targeting swordfish between the Mainland and the Azores, the blue shark already corresponds to most of the landings and should therefore be considered a target species of this fishery. Currently, the number of blue shark individuals caught is three times that of swordfish, 91% of which are immature individuals (i.e., animals not yet of reproductive age). For the shortfin mako, in particular, 86% of catches are of immature individuals. This species is popular for its meat and fins, and it can partly replace the demand for swordfish, as it is often marketed as such. Currently, it is a globally threatened species due to weak management measures by fisheries authorities and by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Since January 1st, 2021, landing and trading of shortfin mako from the North Atlantic stock caught in international waters is prohibited due to its inclusion on the Annex II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the negative Non-Detrimental Finding (NDF).

The black scabbardfish fishery, an important fishery in both Madeira and Portuguese mainland, uses lines and hooks like that of swordfish, but, in this case, the fishing gear is placed on the seabed. In this fishery, deep-sea sharks correspond to 16% of the total catches that end up discarded at sea, most already dead. Deep-sea species, in addition to playing a very important role in deep-sea habitats, are especially vulnerable to fisheries, given their

THE DECREASE OF PORTUGUESE LANDINGS SINCE 1986 SEEMS TO BE MORE RELATED TO THE DECLINE OF SHARKS AND RAYS ABUNDANCE THAN TO THE IMPLEMENTED MEASURES OF FISHING RESTRICTIONS

great longevity, late reproductive maturation, very low population growth rates, and living in habitats historically characterized by little disturbance. For several decades, the deep-sea longline fleet in Portugal was the second with the greatest impact on sharks, especially demersal and deep-sea sharks, after the polyvalent fleet. However, due to the difficulty in placing observers on board, there is still little information on the level of bycatch in this fishery in Portugal; the same goes for trammel nets and gillnets, purse seine, and beach seine.

Evidence for sharks and rays overfishing in Portugal is considerable: i) 43% of the species in Portugal are threatened; ii) 11 species are 'Critically Endangered'; iii) 75% of the fished species have declining populations; and iv) 25% of the total landings by weight of sharks and rays over the last 30 years correspond to currently threatened species. Fishery data have many limitations and allow only a partial picture of the reality of elasmobranch fisheries; because it is often not possible to have reliable information at the species level, the associated fishing gear and real catches are also not known. As so, illegal, unreported, and unregulated (IUU) fishing is suspected to be quite high for sharks and rays.

The trade and consumption of sharks and rays is based on different products, but their fins, liver, and meat are the items with the greatest commercial value. In Portugal, most shark fins and meat are for international trade, and exports have been increasing to Europe, mainly to Spain. In fact, the Iberian Peninsula countries are the main European producers and exporters of sharks and rays. In the last decade, Portugal has increased the number of frozen products imported, especially blue shark, coming from outside the EU.

COMMERCE AND CONSUMPTION OF SHARKS AND RAYS IS BASED IN DIFFERENT BY-PRODUCTS, BUT FINS, LIVER AND MEAT ARE THE MAIN PRODUCTS AND WITH BIGGER COMMERCIAL VALUE

However, there is a substantial difference between Portuguese national and international trade data with Spain, both on frozen and fresh meat, which hinders the understanding of the real amounts entering the trading circuits. More in-depth studies are therefore needed in the Iberian Peninsula. The analysis of the consumption of sharks and rays in Portugal also needs further studies, as so far it has only been possible to analyse consumption data for *Raja* sp. rays. Estimates for the last eight years indicate that the consumption of rays has been increasing. Two trends in the last 30 years support the hypothesis that the consumption of rays in Portugal is boosting imports: the average price per kilo increased about 40% in this period, despite the decrease in 58% of reported catches. The increased consumption of sharks and rays, especially in Europe and South America, may have implications for human health due to the high levels of heavy metals detected in the tissues of blue shark and some tropical species. The values detected are higher than those recommended by the EU, and therefore regular consumption of these species is not recommended.

International and national protection and management policies for elasmobranchs have only recently started to be formalised at the European level. Management measures have been introduced sporadically into national legislation without any integrated management plan. Despite some improvements over the last 20 years, related to catch bans, retention, and definition of total admissible catches (TACs) and quotas for some species, this group is still of low priority in international and national policies when compared to other fishes. Most shark and ray stocks are poor in data, have no catch limits defined based on biomass trend values, and fishing mortality values are unknown. This lack of knowledge often results in poor management measures and, consequently, in stocks' overexploitation.

The complex nature of these fisheries, which occur in both national and international waters, complicates the establishment of fishery catch limits based on science, and the implementation of bycatch mitigation measures is residual or practically non-existent. For years, TACs for some elasmobranch stocks, particularly those of deep-sea species, were fixed at zero, with the obligation of immediate release at sea. The reason for the implementation of this measure was their poor conservation statuses and the assumption that discards did not increase fishing mortality rates. It is now known that the survival of these animals after release is highly dependent on fishers' practices, the species concerned, and the fishing gear involved. The prohibition of on-board retention and consequent landing does not, by itself, allow the recovery of species as the accidental catch still occurs, as demonstrated by the poor conservation status of many species. Portugal currently has no integrated plan for the protection and management of elasmobranchs, and although there is a framework at the European level based on the United Nations Food and Agriculture Organisation (FAO) International Plan of Action for the Conservation and Management of Sharks and Rays, it is urgent and necessary to develop and implement a plan of action at the national level.

To reverse and recover shark and ray populations and prevent their extinction, the establishment of Marine Protected Areas (MPAs) and/or sanctuaries could be promising for demersal and deep-sea species. However, for pelagic species, an approach is needed that includes not only the establishment of MPAs covering essential habitats and ecological corridors but also spatial and temporal restriction measures. Increasing monitoring and control of high-risk fisheries and implementing bycatch mitigation measures needs to be extended to all fisheries in general. Currently, there are innovative approaches other than onboard observers that can, and should, be implemented in Portuguese artisanal and polyvalent fisheries. Restricting fishing, and even banning it, may also help to reduce pressure on elasmobranch species in some cases, but it must be accompanied by adequate control, monitoring, and surveillance. The implementation of measures to minimise bycatch, already duly tested in efficacy studies, must move forward quickly. Such is the case with the ban on the use of steel wire leads, currently in force in the Azores' Exclusive Economic Zone (EEZ), and which should be extended to the entire Portuguese longline fleet, especially the one targeting pelagic species.

ANP|WWF's seven main recommendations to protect the Guardians of the Ocean, based on the scientific data collected, are presented on a timescale, and detailed to the different stakeholders, including authorities, researchers, fishermen, consumers, and distributors. In general terms, these are: (1) the development and implementation of a National Plan of Action for the Management and Conservation of Sharks and Rays in Portugal; (2) the promotion of significant improvements in the protection and recovery of stocks of endangered target and non-target species; (3) the adoption of measures to minimise bycatch and promote best practices on board; (4) the substantial improvement in the quality of scientific data regarding shark and ray species; (5) the implementation of trade prohibitions/restrictions, including stricter regulation, transparency, and product traceability; (6) better monitoring and surveillance of fisheries; and (7) definition of MPAs/sanctuaries with total fishing bans, focusing on areas special rich in species and/or populations, and essential habitats for sharks and rays. Only an integrated approach to threats and concerted, pragmatic, and courageous initiatives can reverse the decline of sharks and rays in Portugal, the true Guardians of the Ocean.

1. SHARKS AND RAYS GUARDIANS OF THE OCEAN

Sharks, rays, and chimaeras are cartilaginous fish species (Chondrichthyes) **the oldest living group of vertebrates** with jaws. They diverged from a common ancestor of bone vertebrates and **have lived in the ocean for 420 million years**[1], having survived five mass extinctions. They are distinguished from bony fish mainly because they have a skeleton mostly composed of cartilage. These fish are divided into two classes: Elasmobranchii (sharks and rays, known as Elasmobranchs), consisting of 13 orders; and Holocephali, of which only one order is known, the Chimaeriformes (known as Chimaeras)[2].

Chondrichthyes present a wide variety of unusual and unique characteristics among vertebrates: bioluminescence, saw or hammer-shaped heads, stingers, and even the generation of electrical discharges. The whale shark (*Rhincodon typus*) has the largest known egg (16 cm), the frilled shark (*Chlamydoselachus anguineus*) has the longest gestation period (31 months)[3], and the Greenland shark (*Somniosus microcephalus*) holds the record for longevity among vertebrates, taking 156 years to reach maturity and living more than 400 years[4].

Currently, more than 1,200 species of sharks, rays, and chimaeras are known worldwide, with approximately one new species being discovered every month. According to the most recent world species list (2016), there are 649 species of rays, 510 species of sharks, and 48 species of chimaeras[5]. The distribution of these species in the ocean results from a combination of oceanographic factors (temperature, depth, and currents), and ecological (prey and habitats), and reproductive characteristics (for example, migrations for reproduction). Six global biodiversity hotspots are identified for elasmobranchs, the largest of which, with 324 species, is located in Australia[6]. In European waters, the areas with the greatest diversity of shark and ray species are the Portuguese mainland coast, Macaronesia (Madeira and the Azores), and the western Mediterranean[7].

Elasmobranchs **inhabit a wide variety of habitats, from coastal to deep-sea areas, and can live near the bottom, and be more sedentary, or at the surface, performing large migrations in open water** (Fig. 1). However, many species can occupy different ocean habitats and exhibit mixed behaviours. For simplification, and because of their distinct characteristics, we classify them as demersal, pelagic, and deep-sea Elasmobranchs and Chimaeras[8].

MORE THAN 1200 SPECIES OF SHARKS, RAYS AND CHIMERAS ARE KNOWN WORLDWIDE

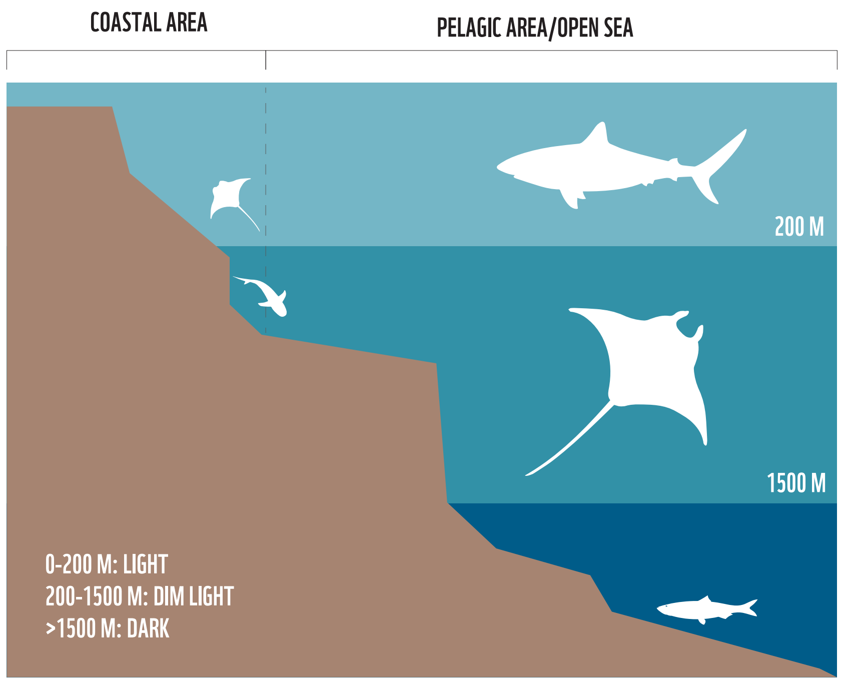
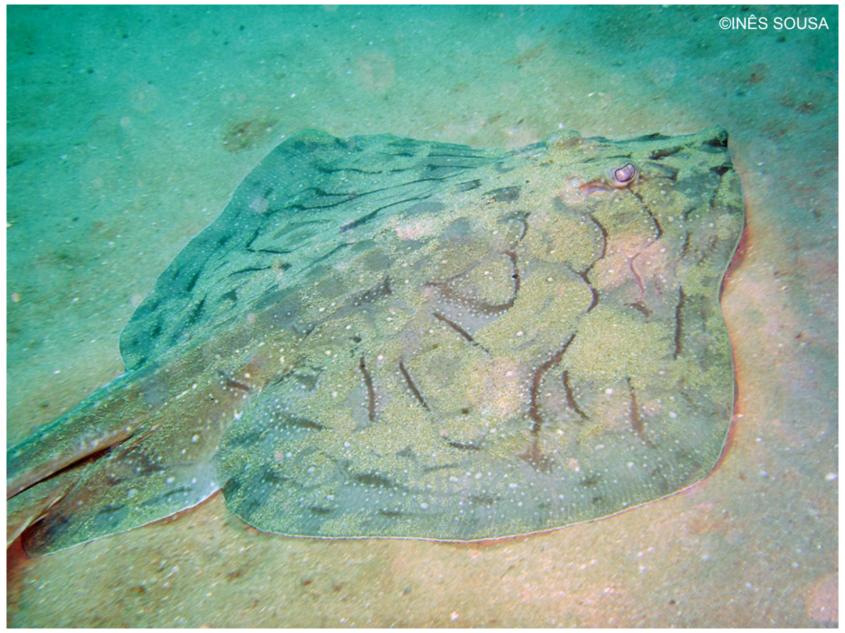


Figure 1. The different ocean areas, as a function of depth and distance from the coast.

- **Demersal sharks:** More than 90% of elasmobranch species occupy demersal ecosystems on the continental shelf and slope, living associated with the seabed of coastal areas.
- **Pelagic sharks:** Inhabit open waters and usually swim closer to the surface of both tropical and temperate oceans. Many are migratory species, travelling great distances, normally at the sea surface. Iconic species include the blue shark (*Prionace glauca*), which is one of the most far-ranging, abundant, fast-growing sharks, producing the greatest number of offspring among Elasmobranchs and being one of the most captured and traded species worldwide[8]. Another iconic pelagic shark is the oceanic whitetip (*Carcharhinus longimanus*), targeted for its fins and with a global status of 'Critically Endangered', given that some populations in the Pacific and Atlantic have decreased by 98% since 2000[9].
- **Deep-sea sharks:** Inhabit the water column down to more than 2,000 meters and have morphological characteristics that allow them to live in such environments. Due to their great sensitivity to habitat disturbance, deep-sea sharks are one of the ecological groups most exposed to overexploitation[7].
- **Rays:** Appear in fossil records about 200 million years later than the first sharks, and currently inhabit both coastal areas and the open sea. One of the most iconic species is the giant manta ray (*Manta birostris*), which can occasionally be spotted not only in the Azores archipelago but also off the Algarve coast; its conservation status is 'Endangered'[10].
- **Chimaeras:** Differ from sharks and rays because of their bare skin, single external branchial cleft, and breathing mainly through the nostrils (Fig. 2). In front of the anterior dorsal fin, they have a strong fin spine associated with a venom gland[11]. Chimaeras live close to the seabed at great depths and feed on invertebrates[12].



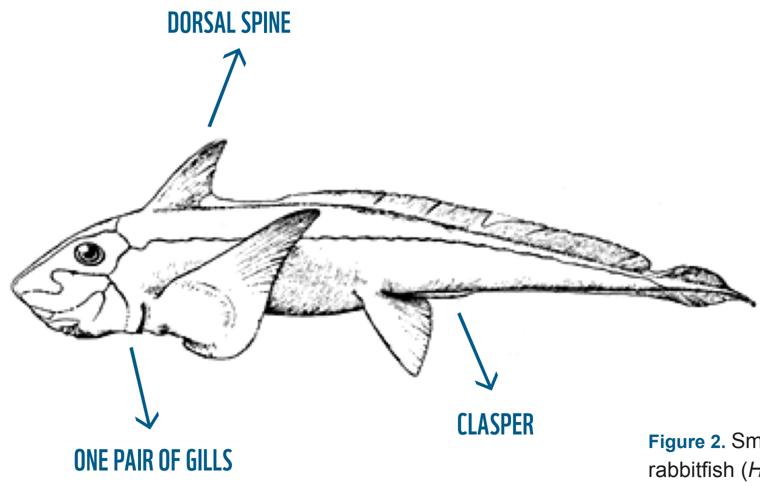


Figure 2. Smalleyed rabbitfish (*Hydrolagus affinis*) and main characteristics of Chimaeras. Source: Adapted from Sanches (1986).

Sharks and rays belong to one of the most cosmopolitan and diverse classes in the animal kingdom. They feed on a wide variety of prey and therefore their ecological roles can be very diverse. Although all sharks and rays are predators, differences in size, shape, and habitat use between species place them at different levels of the food chain and provide them with widely variable ecological roles. It is therefore difficult to generalise the ecological role of sharks and rays in marine ecosystems. It is necessary to contextualise regarding species, age, and location, which is why there is some inconsistency and lack of consensus in the scientific literature. That being said, these species can have the role of top predators in the food chain (e.g., the Greenland shark and some species of rays within the Rajidae family), but also the role of mesopredators (in middle of the food chain), as for example torpedo rays (*Torpedo torpedo*). The importance of sharks and rays as key species and regulators of ecosystems is well-grounded in ecological theory, reinforced by numerous examples of terrestrial ecosystems. **Some are often key species that structure marine communities**, both in the areas where they occur and at larger scales, when they migrate between the deep sea and the surface, **influencing ocean biodiversity and functioning**[13]. Among their numerous roles, sharks and rays:

- **Promote balance in food chains.** Large adult sharks (> 3 m), such as some reef sharks, can control the abundance and distribution of a wide variety of marine species that have very few natural predators, such as smaller elasmobranchs, marine mammals, and sea turtles[14].

- **Promote the conservation of key marine ecosystems, being important agents for climate regulation.** In seagrass habitats, some studies have suggested that the removal of tiger sharks led to increased populations of green turtles (whose main predator is this shark) that were left to feed too long in one place (a phenomenon known as excessive herbivory), which, in turn, decreased seagrass areas. In areas with healthy tiger shark populations, they control the number of turtles in the area and maintain the structure of seagrass areas and their ecosystem services, such as important carbon reservoirs and nursery grounds for commercial fish species[14].

- **Connect habitats and ecosystems, promoting the growth of phytoplankton.** Some species, such as the giant manta ray, transfer essential nutrients from the bottom of the sea to shallow areas[13].

- **Increase habitat and food availability for other species.** The common eagle ray (*Myliobatis aquila*) excavates sediments as it feeds, creating microhabitats and facilitating other species' access to food[15]. The uneaten parts of their prey will serve as food for other marine animals, and even dead they still support entire communities of 'scavengers of the deep'. As they currently occupy ecological niches that were previously occupied by predators that are now extinct, they have likely influenced the diversification and distribution of species we see today[16].

- **Indirectly benefit fishing communities.** For centuries, fishers have explored the yet little-known relationship between schools of tuna and whale sharks. Industrial fishers still look for signs of the presence of this shark and other species of marine megafauna, as they are good indicators of tuna schools. A recent study in the Azores used tuna pole and line fishing data to understand how the presence of whale sharks could influence fishers' incomes. Generally, the results showed differences between schools with and without whale sharks. Schools associated with whale sharks were more diverse and with smaller specimens than schools without whale sharks[17]. These results show that whale shark behaviour influences the aggregation of other species, including tuna.

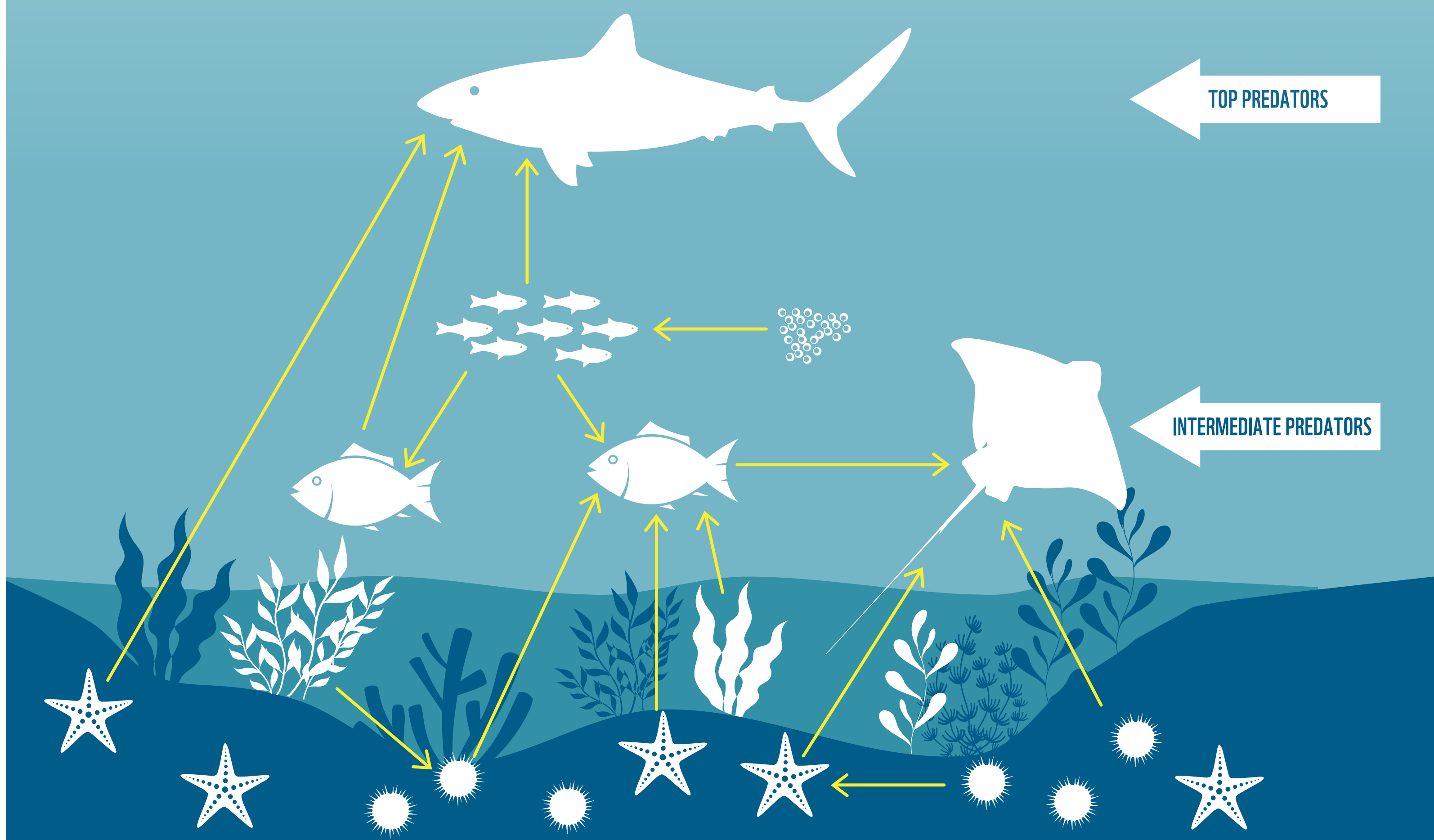
TOP PREDATORS AND MARINE MEGAFAUNA (SUCH AS WHALES AND DOLPHINS) HAVE A CONTROL POPULATION EFFECT IN SPECIES THAT ARE BELOW IN THE FOOD CHAIN AND ARE FUNDAMENTAL TO STRUCTURE THE MARINE COMMUNITIES

For all these reasons, there is an urgent need to recognise the importance and key roles that sharks and rays have in marine ecosystems. Their reputation as villains reduces sharks to a negative role which doesn't correspond to reality: they are true *Guardians of the Ocean*.

Most sharks and rays have a reproduction strategy known as K-strategy[iii], and one of the most extreme among vertebrates: each female generates few offspring; pregnancies are long and far apart (for example, the shortfin mako, *Isurus oxyrinchus*, only produces offspring every three years); and juveniles take a long time to reach adulthood, representing a high maternal investment[18]. Many species have low population growth, are intrinsically vulnerable to high fishing mortality, and require many years without catches to recover depleted populations[19].

iii Opposite to R strategy (more offspring, few maternal investment and rapid growth), common in the majority of bony fish.

Figure 3. Role of sharks and rays in the food chain. Source: Adapted from FindRayShark.



Why are they in crisis?

The biological characteristics of sharks and rays – late maturity, long gestation, and low population growth rates – **make them particularly susceptible to overfishing[18].** But although overfishing is considered the main threat to the conservation of these animals it not the only one: they also face threats resulting directly or indirectly from other human activities, such as pollution, mining, loss of habitat and food, and climate change, among others.

Overfishing

The capture and consumption of sharks and rays has existed for hundreds of years. Traditionally, fishing took place in coastal waters, and it was limited by their low economic value. However, since the end of World War II, **the increased effort and expansion of fishing areas, associated with the growth of the world's population, have intensified the demand for sharks and rays,** particularly in China, USA, Central America, and Indonesia[20]. Since the early 1980s, official data on shark and ray catches reported to the United Nations Food and Agriculture Organisation (FAO) have tripled, reaching their peak in 2003 with 869,000 t, representing 86 million animals and an estimated income of US$800 million[18]. Since then, there has been a general global decreasing trend by 21%; in 2018, landings[iv] were approximately 680,000 t (Fig. 4). **Actual catches can nevertheless be three to four times higher** than those reported, as most species are unregulated, often misidentified, unrecorded, aggregated into generic groups, or discarded at sea, all resulting in a lack of reliable catch information[18]. The capture of Elasmobranchs occurs in almost all types of fisheries and, although there are no official targeted fisheries for sharks or rays, pelagic sharks represent 43% of the total shark catches worldwide[21]. In some fishing gears, **bycatch mortality often exceeds targeted fishing mortality**, a fact that is particularly evident in large bony fish fisheries such as tuna or swordfish.

In this report, we consider as bycatch: (i) non-target species with illegal sizes; (ii) species for which the catch limit (quota) has been exceeded; and (iii) species with a ban on retention due to their risk of extinction. Bycatch that cannot be landed for legal reasons are often discarded at sea. Many die due to physical trauma, either by interaction with fishing gears or stress due to handling. Bycatch species without landing restrictions but with commercial value are, for the Portuguese case, usually landed in auction fishing centres and then sold[22].

iv fresh weight reported in fishing harbours.

v fish first sale place.

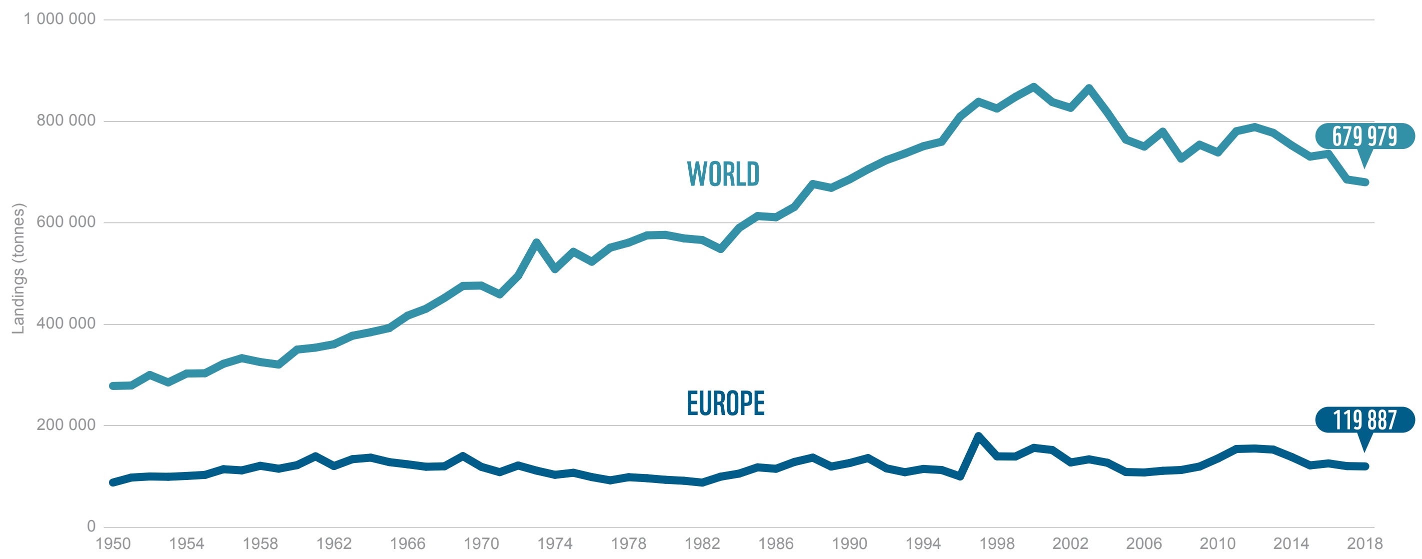


Figure 4. Worldwide and European' catches of sharks, rays and chimeras (in tons) between 1950 and 2018. Source: FAO Global Capture Statistics 1950-2018.

Bycatch, with its adverse ecological, economic, and social effects, is particularly difficult to quantify and relatively poorly documented for sharks and rays. However, **it is considered one of the greatest threat to their survival.** In the late 1980s, estimates indicated that around 12 million elasmobranchs (approximately 300,000 t) per year were captured and then discarded at sea[23].

Many historically captured species are now seriously threatened and at risk of disappearing from the ocean. Such is the case of the angel shark (*Squatina squatina*), once common in European waters, but highly sought after for consumption and with high commercial value. This slow-growing species has been fished at unsustainable levels and it is currently one of the most endangered shark species globally, existing mainly in the seas of the Canary Islands where it is highly protected[7].

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Finning

The removal of shark fins is known internationally as finning. By definition, finning is the process of removing the fins and discarding the rest of the animal's body at sea[24]. Shark and ray fins are one of the most expensive seafood items, and the existence of a global market for shark-based products is one of the main causes of the sharp decline of most targeted species; indeed, more than half of the species targeted for fins are at risk[20]. Fins can cost between 50 to 150 € per kilo[24] and some, like the dorsal fin of the whale shark, 10,000 to 20,000 € per fin[25]. In Asia, populations of this species are seriously threatened and their inclusion in Appendix II of CITES has been approved, meaning their trade is prohibited. East and Southeast Asian countries, such as China, Taiwan, Malaysia, and Japan, are the major consumers of shark fins and Hong Kong is a true global hub importing 50 to 70% of the fins traded worldwide[20]. The finning industry has suffered some restrictions imposed by European legislation because it generates huge waste and contradicts all the principles of animal welfare and ethics, questioning the survival of many species. Prior to the changes to finning regulations, and assuming the bodies of all sharks caught for finning purposes were discarded, 20 to 73 million animals must have been discarded annually[18], which represents about 200,000 t. Since 2013, the entire body of the animal must be landed and only then can fins be removed. However, finning still occurs illegally in Portugal and it is still legal to export and import shark fins in the European Union.

Recreational fishing

Recreational fishing is practised differently from commercial fishing. The objective is to capture iconic, heavy, and large specimens, which are sometimes returned to the sea (a practice known as catch and release) because they cannot be landed at commercial fishing harbours or sold, unlike specimens caught by commercial fisheries. **These catches are not reported and, therefore, do not enter official statistics.** For catches retained and landed, the overall estimates in 2014 were 900,000 t, of which around 50,000 t (5 to 6%) corresponded to elasmobranchs[26]. Most recreational fishing catches (70%) originate in Asia, North America, and Europe, but it is in Oceania and South America that this activity has the greatest expression.

Illegal, unreported, and unregulated fishing

Although there are few studies on illegal, unreported, and unregulated fishing of elasmobranchs, that of pelagic species is estimated to represent 7% of total catches[27]. Illegal fishing does not respect national and international measures to reduce bycatch, nor the species life cycle (minimum sizes or seasonal closures), fishing effort monitoring, or catch limits. It takes many forms, from the use of unauthorized nets to catching individuals of banned sizes or ages, to species whose fishery is prohibited due to their poor conservation statuses. Progress has been made in some geographical areas: in the Northeast Atlantic, estimates of illegal fishery have decreased from 12% in the early 1990s to 9% in 2003. The main factor for controlling illegal fishing is related to governance indicators[28], meaning it is not dependent on geographical areas, fishing gears, or species, but rather on appropriate surveillance, monitoring, and legislation.

'Stop Ghost Gear' 2020[vi]

- **Between 500,000 and 1 million tonnes of ghost gear end up lost at sea each year.**
- **5.7% of all nets, 8.6% of traps and pots, and 29% of lines are globally lost every year.**
- **They cause damage to important marine habitats, from corals to seagrasses, and because they act as an alternative substrate, they also cause excessive sediment accumulation and habitat changes.**
- **There is no scientific information regarding the impact of this type of pollution on sharks and rays.**

Pollution

Due to their broad distribution and because they often occupy middle and top positions in the food chain, **elasmobranchs are indicators of ecosystem health**, accumulating large amounts of heavy metals and other persistent organic pollutants[29], which can be detrimental to their survival. Other forms of pollution such as lost gear (or ghost gear) may also impact elasmobranchs but there is little information. These end-of-life fishing gears, intentionally discarded or lost at sea, continue to fulfil their role of catching fish that, in turn, attract more animals in an endless cycle of high mortality.

Climate Change

Little is known about the impacts of climate change on the physiology of sharks and rays. Sea temperature and climatic events, such as rain, can influence the distribution and abundance of prey, affecting the distribution of some species. Decreased pH and/or increased average seawater temperature can have effects on early life stages and on the health and survival of juveniles. Tropical species residing in reefs and estuaries are at the highest risk, and the effects of climate change are most evident in these habitats[30]. A recent study with the epaulette shark (*Hemiscyllium ocellatum*), an inhabitant of coral reef areas that can withstand drastic changes in dissolved oxygen levels, showed that embryos exposed to an increase in temperature are unable to adapt and hatch 25 days earlier than usual. Newly hatched individuals weigh significantly less and have a lower metabolic rate, which has negative consequences on their resilience and survival[31]. **In the context of climate change and habitat loss, many vulnerable species**, which generate few offspring, have late maturity, and are specific to certain environments and conditions, **will be unable to adapt to the new environment and thus may become extinct.**

vi wwf.org.ph/resource-center/story-archives-2020/ghost-gear-report/

Conservation Status

Much has been written about the sharp global decline in biodiversity and abundance of populations in general. The WWF Living Planet Report[vii] has estimated that 68% of the abundance of mammal, bird, fish, amphibia, and reptile populations was lost in the last 50 years. The situation is not different for Elasmobranchs and Chimaeras, but it is less known to the general public.

The IUCN Red List assesses the conservation status of 1,186 species of sharks, rays, and chimaeras. In 2020, the conservation status of 420 species was updated in relation to 2014: **172 ray species, 140 shark species, and four chimaera species are now considered threatened**[viii], which represents more than 25% of all species known worldwide (Fig. 5). Since the last update, **sharks, rays, and chimaeras are rapidly starting to be considered the most endangered of all known vertebrates on the planet** and, among fish, they are already the most endangered.

In the last six years, the number of species under threat has increased by 53% and four species have been reported as probably extinct. These include the lost shark (*Carcharhinus obsoletus*) which, despite only having been recognised as a species in 2019, is considered as probably 'Extinct in the Wild'[32].

In March 2021, a new update of the status of some shark and ray species by the IUCN classified 36% of species

vii WWF 2020, Living Planet Report 2020: https://livingplanet.panda.org/pt-br/

viii Classification according to UICN.

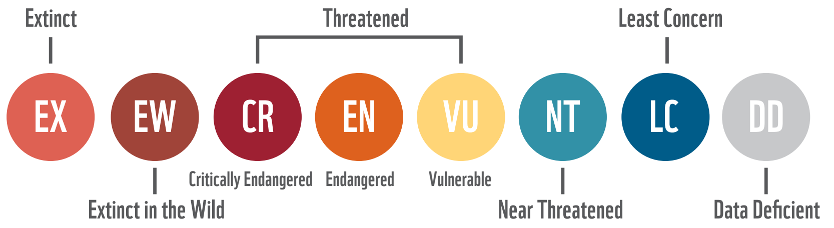
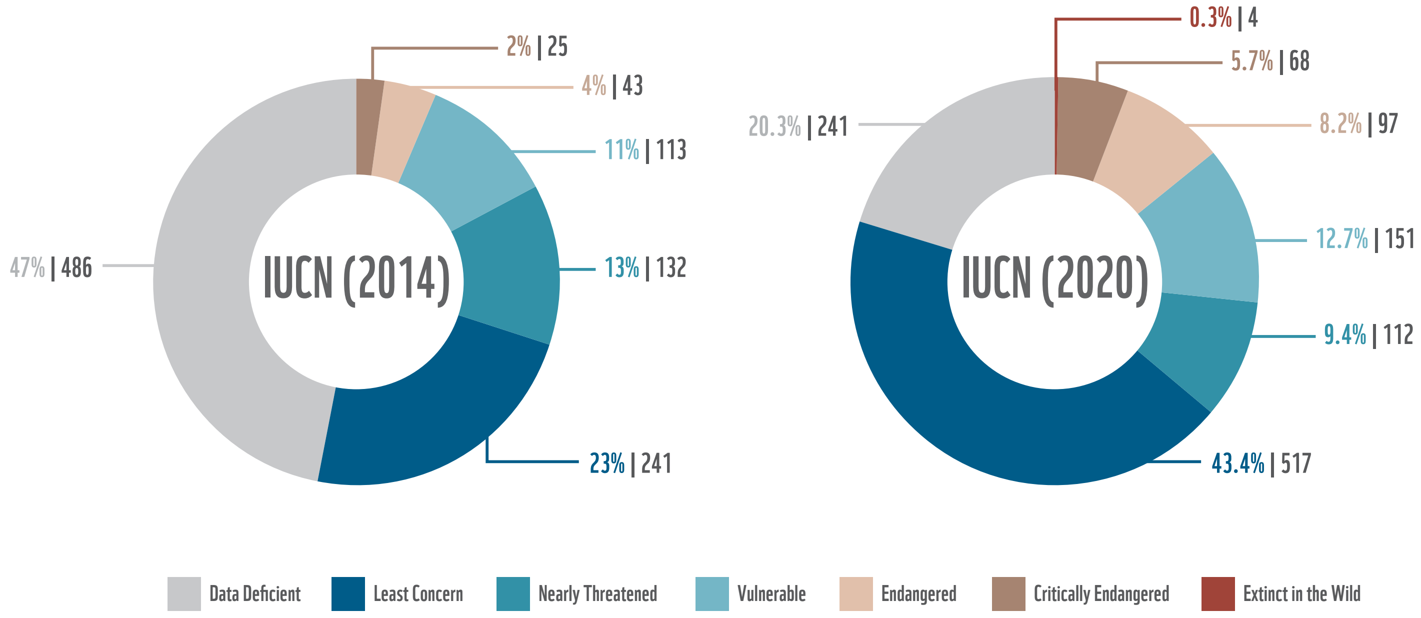


Figure 5. Global conservation status of shark, ray and chimera species in terms of percentage and number for 2014 and 2020. Source: IUCN Red List.

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as threatened, totalling 355 species: 76 'Critically Endangered', 112 'Endangered', and 167 'Vulnerable'. Since the last update in 2020, eight of the nine species moved to the 'Critically Endangered' category are rays, and one species of java stingray (*Urolophus javanicus*) is likely 'Extinct in the Wild'.

'Critically Endangered' species include five of the eight species of hammerhead sharks (*Sphyrna* sp.), seven of the 22 species of angel shark (*Squatina* sp.), the iconic giant manta (*Manta birostris*)[33], and eight other species of rays such as the common eagle ray (*Myliobatis aquila)* and the bull ray (*Aetomylaeus bovinus*). Additionally, since the last update:

- The number of 'Critically Endangered' species has almost tripled
- The number of 'Endangered' species has more than doubled
- The number of 'Vulnerable' species increased by more than 30%
- The species classified as 'Least Concern' more than doubled, likely due to the 50% decrease in 'Data Deficient' species.

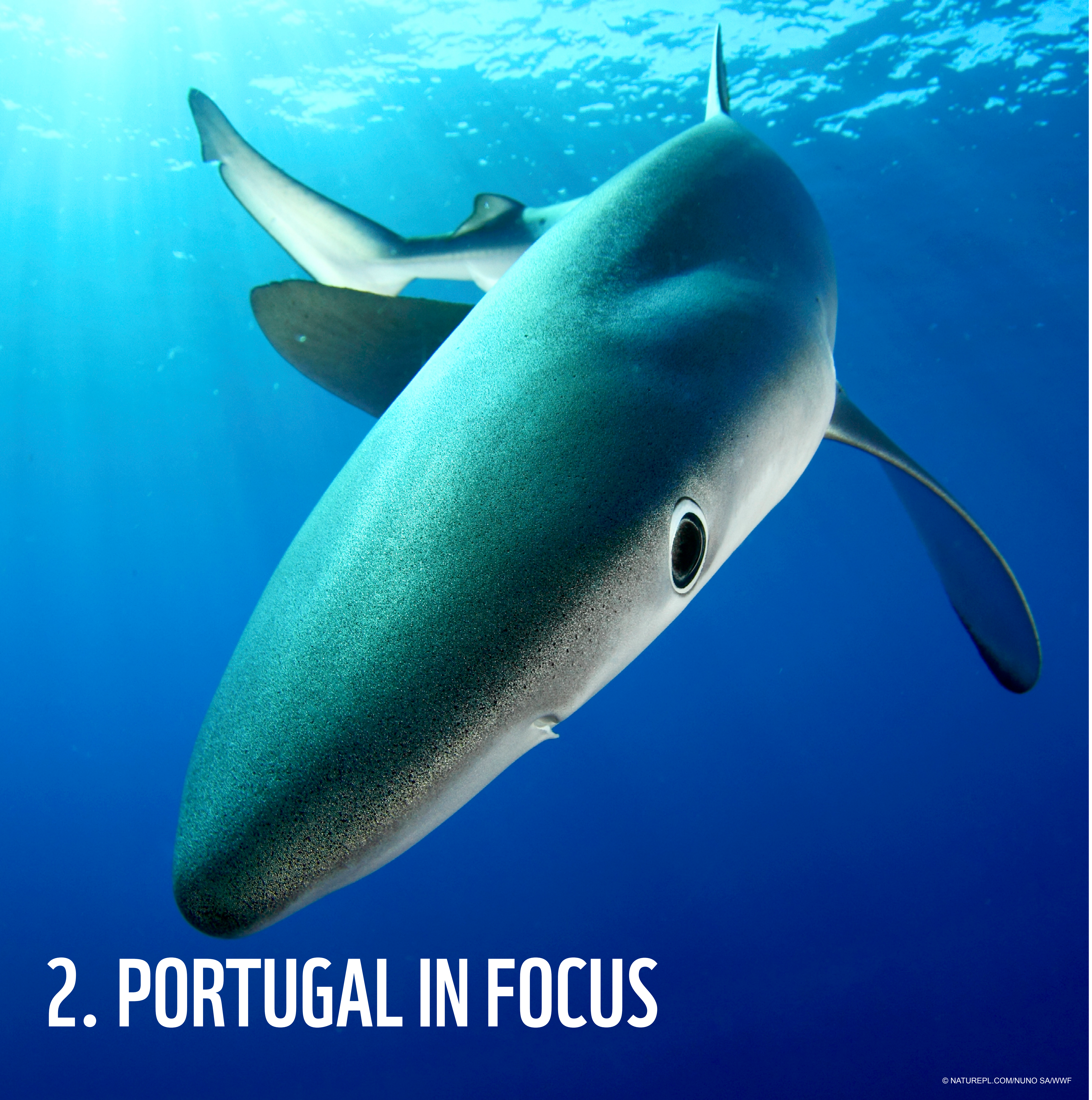
In Europe, and according to the 2015 European Red List of Marine Fishes, the conservation statuses of known shark, ray, and chimaera species (132 species) is even worse than at the global level. At the European level about 40% of species are threatened (between 32.1% and 52.7%) and 52 species show populations declines[7]. The situation is particularly worrying in the Mediterranean Sea. At the regional level, and according to IUCN data for 2016, the Mediterranean Sea is considered an extinction risk hotspot, with at least half of the species at high risk of extinction (53 to 71% of threatened species)[34]. In the Northeast Atlantic, according to 2008 data, 35.3% of the 116 species are threatened[35] but these values need to be updated.

THE CONSERVATION STATUS OF SHARKS, RAYS AND CHIMERAS IS THE WORST AMONG ALL VERTEBRATES, WITH 36% OF THE SPECIES THREATENED

Recently, the first global census of pelagic shark and ray species (31 species) was published. It considered the Living Planet Index (WWF) and the Red List Index (IUCN) data as well as fishery catch data. The results are very disturbing: **since 1970, the abundance of pelagic sharks and rays has decreased 71%, with an 18-fold increase in relative fishing effort.** This serious depletion in the abundance of pelagic sharks and rays increased the risk of global extinction to the point that 3/4 of the species in this ecological group are threatened. It is in the Indian Ocean that the larger species, with late maturation, show the most drastic reductions; these were also the first species whose abundance was affected. Overfishing is identified as the main cause of the decline and high extinction risk for the species included in this census. Despite the major improvements in the commitments for conservation in recent decades, there are relatively few countries with specific catch limits for oceanic sharks or demonstrating improvements in populations or proving that the capture of species comes from sustainable fisheries. Obligations under international wildlife treaties to prohibit retention on-board or restrict international trade of endangered species are late and have not yet been effectively implemented[36].

A WORLD WITHOUT SHARKS?

In 2010, it was estimated that the global catch of sharks could amount to 97 million animals per year, but figures are estimated to range from 63 to 273 million. According to estimates, more sharks are being removed from the ocean than those that grow and breed annually[27].
At this pace, and without a drastic reduction in mortality levels, we are jeopardising entire marine ecosystems. An ocean with fewer sharks is an ill, dying ocean. It would be a huge failure for humanity to lose these species, with unpredictable consequences for the ocean[11]. From the loss of very important habitats to the decrease of important stocks of commercial species and changes in fishery locations, effects on biodiversity, and decreases in ocean productivity, among other effects which are still little known[37]. If Elasmobranch species disappear, it will be difficult for other species to replace their key role in the ocean and even in fishing communities. It is therefore necessary to drastically reduce shark mortality and recover populations; but for that to happen, an integrated approach to the various threats they face is necessary.



2. PORTUGAL IN FOCUS

In Portugal, information on Chimaeras - species, habitats, and levels of exploitation by fisheries - is scarce. As there is no evidence of catches by commercial fisheries, according to official data, and being species of low commercial value, the information presented herein will be predominantly related to sharks and rays. If certain reference data also include Chimaeras, this will be indicated in the text. Considering Elasmobranchs alone, it is also important to note that there are many more studies dedicated to sharks than to rays.

The notion that there are no sharks in Portuguese waters is quite common. Rays are also little known, except for perhaps the iconic giant manta and the rays for consumption. Chimaeras, being even less familiar, are usually only known to specialists. Still, **89% of the species known in European waters and 9% of species known worldwide are present in Portuguese waters.**

The great diversity of habitats that exist in Portuguese waters, especially between the islands and the mainland, allows the existence of a high number of species of many different families and ecological groups. Currently, **117 species of sharks, rays, and chimaeras are described in Portugal:** 71 species of sharks from 21 families, 39 species of rays from 11 families, and seven species of chimaeras from two families. The Rajidae family of rays has the greatest species diversity in Portuguese waters (18 species), especially in mainland waters. In the mainland, 59 species of sharks, 34 of rays, and five of chimaeras are known, in Azores 61 species are confirmed (39 sharks, 17 rays, and five chimaeras) and in Madeira 77 species (50 sharks, 23 rays, and four chimaeras), of which three are exclusive to Macaronesia[38].

See Annex 4 for a list of the shark, ray, and chimaera species described for Portugal.

Commercial Fishery of Elasmobranchs

The EU fleet is estimated to capture 42,500 t of rays (*Raja* sp.) and 42,000 t of pelagic sharks, of which 60% correspond to blue shark, but also include porbeagle (*Lamna nasus*) and shortfin mako. Longliners operating in the Atlantic Ocean catch 88% of the pelagic sharks captured by the EU fleet, 68% of which as bycatch. Longliners also provide most of the fins that the EU exports to China. Official catches of deep-sea sharks by the EU fleet have been decreasing, probably due to the establishment of catch limits and restrictions on certain fishing gears at depths below 200 m, but also due to declines in the abundance of these species[39].

Globally, and according to FAO data, Indonesia is the country that captures the most sharks[20] and, in the last decade, Spain has occupied the second position in the world ranking[40,41] (Fig. 6). Between 2000 and 2010, Portugal contributed 2% to the world's catch of sharks and rays, occupying the 16th position among the 40 countries with the highest shark catches[20]. Data for the period between 2010 and 2018 indicate that **Portugal now ranks 12th, with 2.2% of global catches.** In the EU, Portugal is the third country with the most reported catches since 2000, after Spain and France[41].

The Portuguese fishing fleet carries out most of its activity in the Northeast Atlantic, encompassing fleets from the Mainland, Madeira, and the Azores. Fishing takes place in coastal areas, open sea, and deep ocean, both in the Exclusive Economic Zones (EEZs) of European countries and in international waters governed by different Regional Fisheries Management Organisations (RFMOs)[ix]. All fish landed in Portugal must be sold for the first time at an auction centre, where landed species/groups of species and quantities are recorded.

Looking at the evolution of commercial fisheries in Portugal, existing official data for sharks and rays (recorded since 1986 for the mainland and 1992 for Madeira and the Azores) indicate that the **Portuguese fleet catches an average of 4,340 t of sharks and rays per year.** The minimum value was recorded in 2019 (2,100 t) and the maximum

in 1988 (5,915 t). Most (92%) of shark and ray landings in Portugal occur in mainland fishing harbours, namely Sesimbra, Peniche, Nazaré, Figueira da Foz, and Matosinhos. Only 7% and 1% of the official reported weight for sharks and rays is landed in the Azores and Madeira, respectively (Fig. 7)[42].

As is happening globally, over the past 30 years, official landings by the Portuguese fleet have decreased by 60%, even with the expansion of fishing areas. At first glance, this reduction could be due to the implementation of fishery management measures. However, a study that addressed the causes of shark and ray declines by modelling the evolution of landings in 126 countries concluded that recent improvements in international/national fisheries management were not yet sufficient to explain such declines. The countries with the greatest declines in landings are mostly coastal countries, with high fishery pressure and shark and ray exports, such as Pakistan, Sri Lanka, and Thailand[43]. Therefore, **the declines in shark and ray landings are more related to the high fishing pressure** and the characteristics of the ecosystem **and less so to the implemented management measures.**

The species of sharks and rays caught by commercial fisheries in Portugal in the last 30 years **correspond to about half of the shark and ray species known to inhabit Portuguese waters:** 58 taxa[42] (species[x] or groups of species), which correspond to a total of 62 species of different ecological groups. Of these, **seven species correspond to 3/4 of all shark and ray landings by weight in the last 30 years.**

Since the onset of official records, rays have been the most landed group by weight (seven species of *Raja* sp.), followed by deep-sea sharks (five species). Regarding pelagic species, the blue shark has been the second most landed species in the last 30 years, and

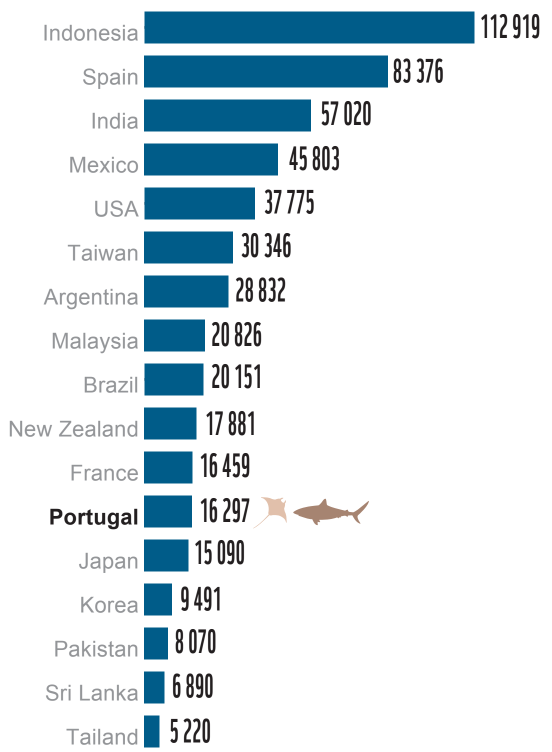


Figure 6. Annual world capture in average of sharks and rays (tons) for the most relevant countries between 2010 and 2018. Source: FAO Global Capture Production 1950-2018.

ix For more information about RFMOs (Regional Fishing Management Organizations) check Governance and Policies section.

x Common names from: www.dgrm.mm.gov.pt/documents/20143/43770/LISTA+DE+ESP%C3%89CIES_15032019.pdf/e9c697a3-de56-0ba8-3188-025c7bf1ee5e

LANDINGS IN PORTUGAL

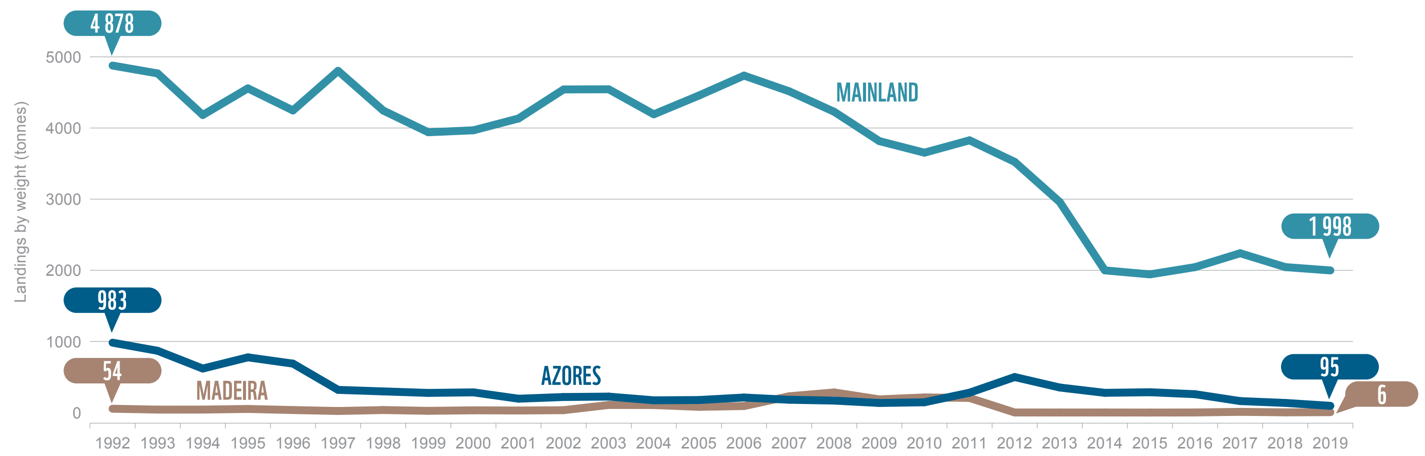


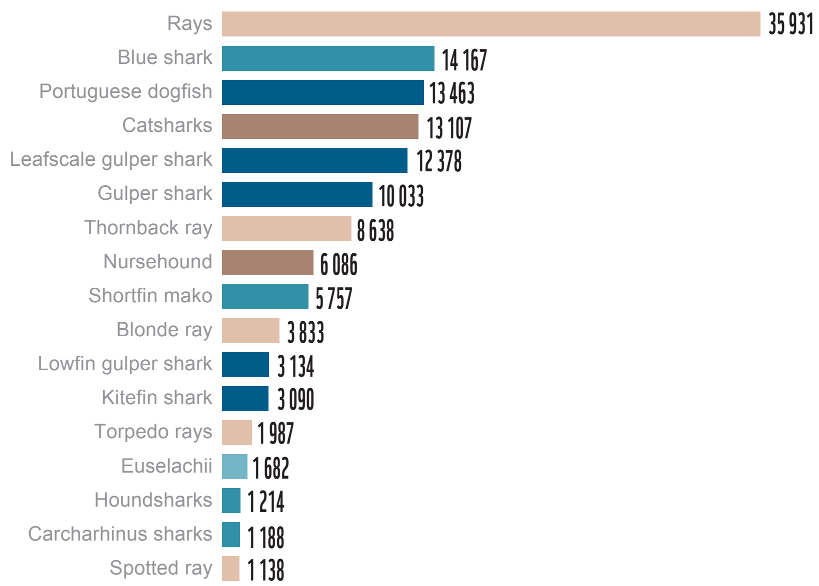
Figure 7. Sharks and Rays landings by weight (tons) in national harbours of the Mainland, Azores and Madeira archipelagos, between 1992 and 2019.

the shortfin mako also has relevant landings. The lesser-spotted dogfish (*Scyliorhinus canicula*), a coastal shark, also represents a significant part of shark and ray landings by weight[42,44] (Fig. 8). Table 1 summarises the main biological characteristics of six species corresponding to 38% of the shark and ray total landings by weight in the last 30 years.

Over time, significant differences in species and average landed values allow the distinction of three periods: between 1986-1996, 1997-2013, and from 2014 onwards. Since 2014, the group of deep-sea species represents only 3% of the total landings by weight, with 55% corresponding to rays[42].

Figure 8. Global analysis of the cumulative quantity of all landings (tons) between 1986 and 2019 in national harbours (left) and analysis of landings weight by ecological group (right). The name *Euselachii* corresponds to a generic term to designate Elasmobranchs. Source: DGRM data 1986-2019.

TOTAL LANDINGS IN WEIGHT (TONNES) 1986-2019



ECOLOGICAL GROUP (WEIGHT PROPORTION)

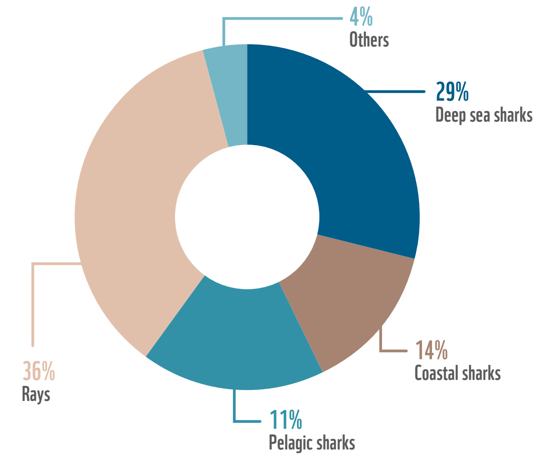
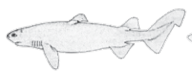


Table 1. Ecological and life cycle characteristics of important sharks and rays species landed by the Portuguese fleet. Leafscale gulper shark, Kitefin shark and Gulper shark belong to the group of deep-sea sharks, blue shark and shortfin mako to the pelagic sharks and the Thornback ray to the group of rays. Source: IUCN, Moreno et al. 2020 and Sanches 1986.

COMMON NAME	LEAFSCALE GULPER SHARK	KITEFIN SHARK	GULPER SHARK	BLUE SHARK	SHORTFIN MAKO	THORNBACK RAY
ILUSTRATION ©FAO						
SCIENTIFIC NAME	***Centrophorus squamosus***	***Dalatias licha***	***Centrophorus granulosus***	***Prionace glauca***	***Isurus oxyrinchus***	***Raja clavata***
HABITAT	Depth ocorrence zones between 240 to 4 000 m	Depth ocorrence zones between 40 and 1 800 m	Depth ocorrence zones between 150 and 1 440 m	Cosmopolitan of open sea from the surface until 1 000 m	Cosmopolitan of open sea from the surface until 500 m	Coastal water between 10 and 60 m depth
COMERCIAL VALUE	Historically was commercially exploited for its liver	Historically was commercially exploited for its liver	Historically was commercially exploited for its liver	Fins and meat	Fins and meat	Meat
EUROPEAN CONSERVATION STATUS	Endangered; population declines	Endangered; population declines	Critically Endangered; strong populations declines	Near Threatened; 2,3% annual reduction rates	Dados Deficient; Vulnerable at the sub-atlântic population level	Near Threathened; stable population
CURIOSITIES	Lives until 70 years old	High fishing pressure between the 70s and 90s for squalene extraction	Despite a global species, portuguese coast is the main distribution area	The most captured shark species	The fastest of all sharks	The most captured ray species in Portugal and the most common in the Portuguese coast
FISHING CAPTURES	High bycatch rates in the Azores (15 t/year in bottom longliners)	High captures of bottom longliners in Azores and Madeira	High bycatch rates in bottom trawlers	Longliners, trammel and gillnets, purse seiners	Large and Small scale fleet; longliners, purse seine and gillnets	Trawlers, polyvalent fleet with trammel and gillnets
RESTRICTIONS	On-board retention ban except for small scale bottom longliners until 7 tonnes	On-board retention ban except for small scale bottom longliners until 7 tonnes	On-board retention ban except for small scale bottom longliners until 7 tonnes	CMS Apendix II	CITES Apendix II	Minimum size for capture is 52 cm and season fishing closures are between May and June
REPRODUCTIVE FEATURES	Aplacental viviparity; young numbers 2-10; few information but late maturation at 110 cm	Aplacental viviparity; 3-16 youngs; maturation at 17 yrs with 80-170 cm; few information	Aplacental viviparity; 3-12 youngs; maturation at 5 yrs with 120 cm; few information	Viviparous; around 35 youngs; gestation lasts 9-12 months; female maturation at 220 cm	Aplacental viviparity; 10-18 youngs; female maturation at 195 cm, around 10 yrs; gestation period of 15-18 months; reproduces every 3 years	Ovoviparity; maturation with 45-50 cm at 5 yrs; around 135 egg cases per female; reproduction is not every year

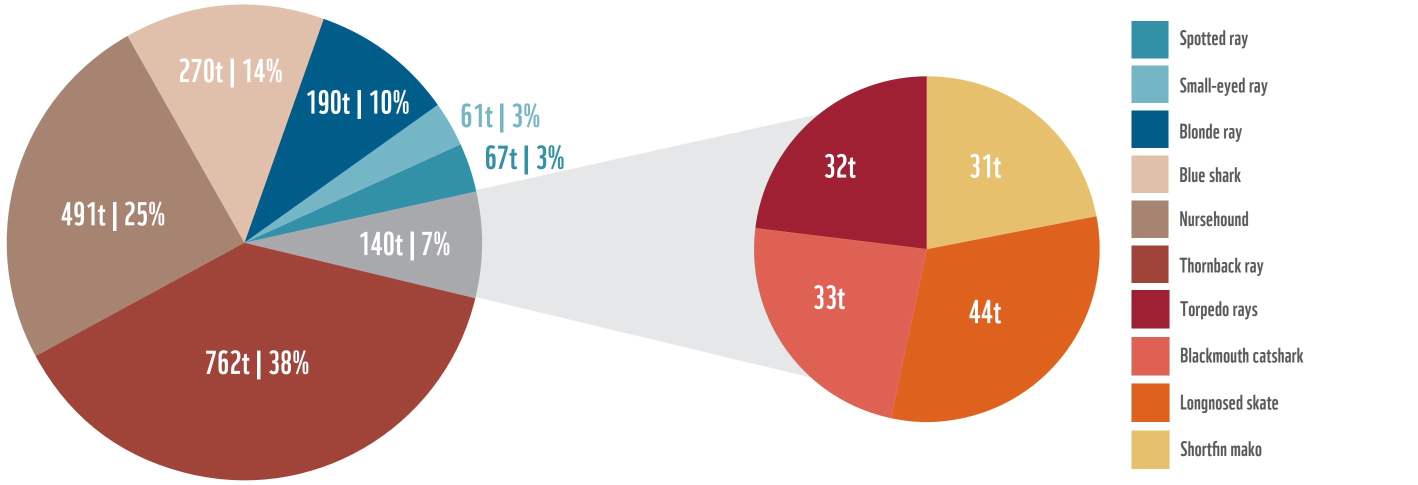


Figure 9. Average landings in weight (tons) and relative percentage of the 10 most captured species by the national fleet between 2017 and 2019. Data from DGRM 2017-2019.

Between 2017 and 2019, according to official data from the Directorate-General for Natural Resources, Safety, and Maritime Services (DGRM, Portuguese acronym), the 10 most fished Elasmobranch species accounted for 91% of total landings by weight (Fig. 9). In 2019, four species, the thornback ray (*Raja clavata*), the lesser-spotted dogfish, the blue shark, and the blonde ray (*Raja brachyura*), corresponded to 3/4 of the total Elasmobranch national landings by weight.

See Annex 4 for detailed information on the most currently fished species by the Portuguese fleet.

The unique characteristics of the Azores and Madeira archipelagos, which include their remote geographic location, the artisanal nature of fisheries, and the small size of the resident population, contribute to a reduced level of Elasmobranch landings[45] and **explain the differences observed between the mainland and the islands regarding the type of species most commonly landed.**

The fishing fleet of the Autonomous Region of the Azores is an artisanal fleet made up mostly of vessels under 9 m long, which has decreased in recent decades but still represents 63% of the Azorean fleet. In addition, 85% of this fleet uses lines and hooks while the remaining fleet essentially uses gillnets, purse seines, and lift nets to catch small pelagic species[46].

According to official data on landings between 1992 and 2019 in the Azores, 25 shark and ray species or groups of species were fished and landed, representing an average of 332 t per year. The historical maximum catch in fresh weight was recorded in 1992 (983 t) and the minimum in 2019 (95 t), meaning there was a reduction of about 90% of Elasmobranch landings during this period. Contrary to the landings data from the Mainland, where rays are predominant, **pelagic sharks are the main ecological group landed, concerning weight, in the Azores**. The most important pelagic species fished are blue

IN 2019, FOUR SPECIES (THORNBACK RAY, NURSEHOUND, BLUE SHARK AND BLONDE RAY) REPRESENTED 3/4 OF THE TOTAL WEIGHT OF ELASMOBRANCHS NATIONAL LANDINGS shark, shortfin mako, "reef" sharks (*Carcharhinus* sp.), and tope shark (*Galeorhinus galeus*). Deep-sea sharks, such as the kitefin shark (*Dalathias licha*) and lowfin gulper shark (*Centrophorus lusitanicus*), and rays, such as the thornback ray, are also important species in the Azores Elasmobranch fisheries (Fig. 10). The kitefin shark was one of the few elasmobranch species targeted by fisheries for the extraction of liver oil, and the main deep-sea species landed in this archipelago. However, due to inadequate management and overexploitation, this fishery was abandoned in 1998[47].

In Madeira, like in the Azores, the narrow area of continental shelf and the existence of steep slopes contributed largely to the early appearance of deep-sea fish catches.

There are few studies dedicated to Elasmobranch fisheries in Madeira. Official data shows that 15 species were landed in the last 30 years, almost all deep-sea sharks (Fig. 11). The leafscale gulper shark (*Centrophorus squamosus*), a threatened species according to the IUCN, represents 88% of the total Elasmobranch catch by weight declared in Madeira fishing auction centres. The introduction of European legislation to restrict fisheries, reduction of TACs[xi], and an on-board retention ban for some deep-sea species, such as the leafscale gulper shark, is visible in Madeira's official statistics. Landings fell by 99%, from 206 t in 2011 to just 1.7 t the following year. If these species are caught incidentally, they must now be immediately released (thus not appearing in official landing records); however, they are unlikely to survive due to the high-pressure differences they are subject when they come to surface, as these damage their internal organs.

THERE ARE FEW DEDICATED STUDIES ABOUT THE ELASMOBRANKIS FISHERIES IN MADEIRA. THE OFFICIAL DATA REGISTERS ONLY 15 SPECIES LANDED OVER THE LAST 30 YEARS, ALMOST ALL OF DEEP WATER SHARKS

LANDINGS IN AZORES (TONNES) BETWEEN 1992 AND 2019

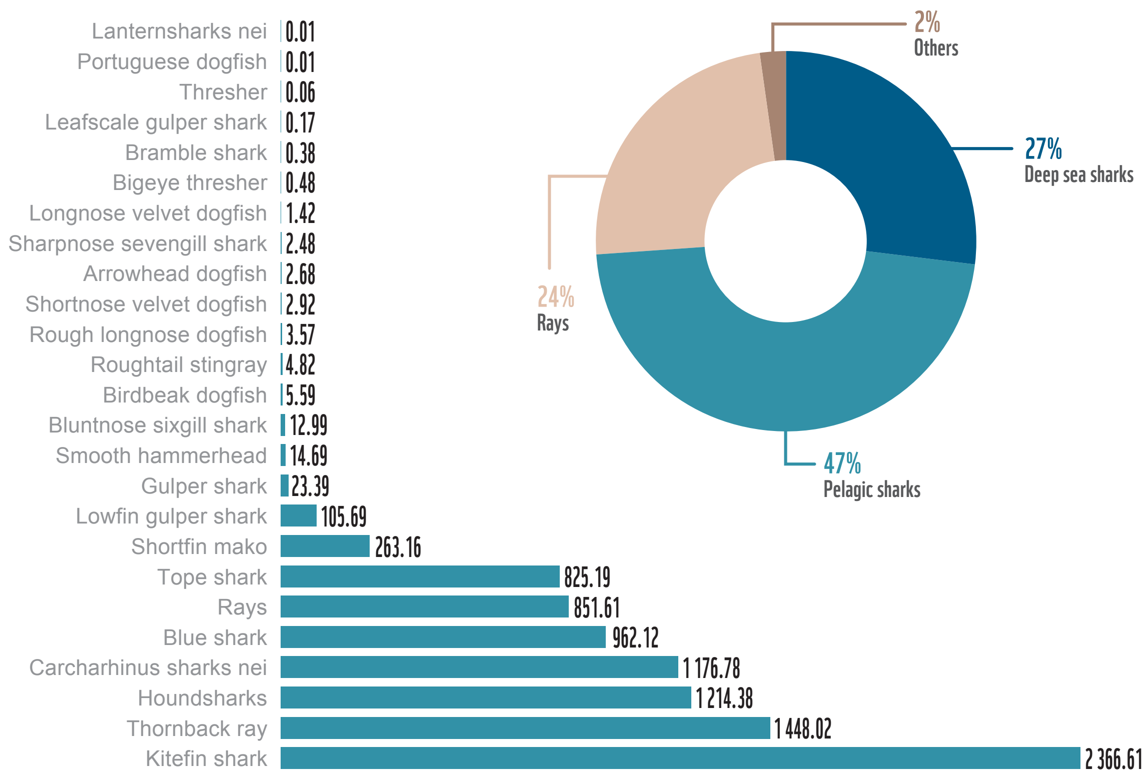


Figure 10. Landings by weight (tonnes) in the Azores between 1992 and 2019 (left) and analysis by ecological group (right). Data from DGRM 1992-2019 for the Azores.

LANDINGS IN MADEIRA BETWEEN 1992 AND 2019

Figure 11. Landings by weight (tonnes) of sharks and rays in Madeira harbours between 1992 and 2019 (linear graph) and global analysis by ecological group (circular graph). Source: DGRM 1992-2019 data for Madeira.

It is difficult to understand which fishing gears are involved in catching sharks and rays. Almost 90% of the national fishing fleet consists of artisanal vessels less than 12 m long that catch several species of fish and use different fishing gears (polyvalent fleet), from nets, gillnets, trammel nets, and trawls, to traps, lines, and hooks, among others.

At each departure to sea, a polyvalent vessel can operate more than one gear; as so, it is currently impossible to associate the quantities and species landed on a given sea trip with the respective gear that caught them. **The polyvalent fleet[xii] records 68% of all reported shark and ray landings by weight, and the trawl fleet 16%[42].**

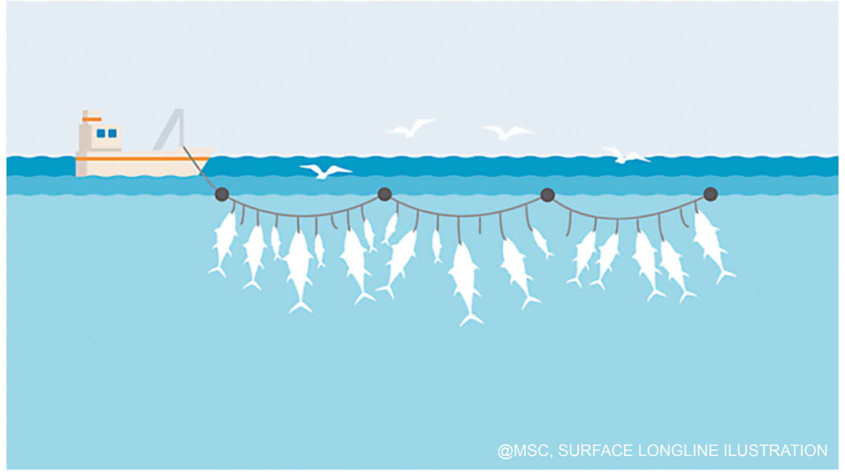
In Portugal, in general terms, there are no fisheries targeting exclusively Elasmobranchs. However, shark and ray bycatch occur in almost all types of fishing gear, from lines and hooks to different nets (gillnet, purse seine) and trawls, both in small artisanal fishing boats and in large-scale industrial boats, operating in territorial and international waters. Generally speaking, we can say that hook and line fishing gear have more impact on pelagic and deep-sea species and nets on coastal species.

xi Total Allowable Catch, which corresponds to the maximum limit of annually fish catches (in weight or quantities) for a given species or group of related species

xii Licensed to transport and use different fishing gears

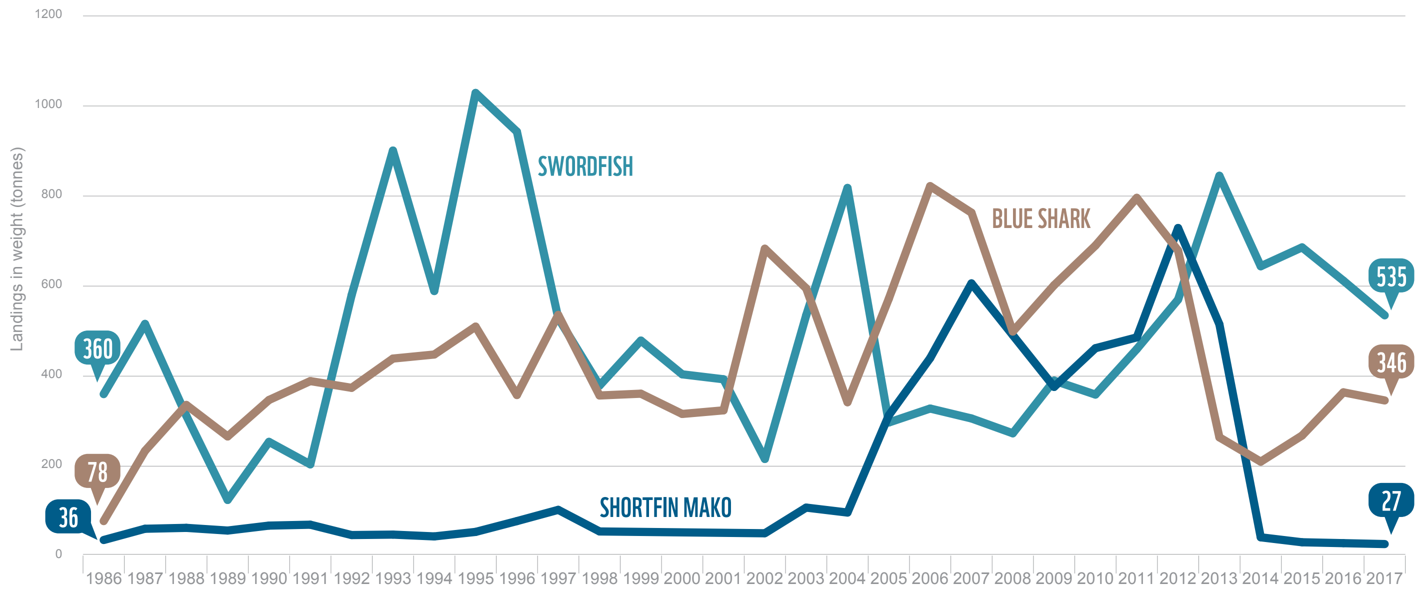
Lines and Hooks

Fisheries targeting pelagic species usually involve vessels using a surface or pelagic longline, which is a device suspended near the surface, formed by a line or cable of variable length, from which other strings, usually made of monofilament, are suspended and where the hooks are placed. Although targeting large migrating pelagic species such as swordfish (*Xiphias gladius*) and tunas (*Thunnus* sp.), this is a multispecies fishery. Pelagic sharks, mainly blue shark, are becoming a target of these fisheries, especially in certain areas or seasons and depending on the swordfish quota. From 2004 onwards, landings of shortfin mako, a species targeted for the quality of its meat, rose sharply to a maximum of 729 t landed in 2012 but thereafter reported catches declined sharply[42] (Fig. 12). This phenomenon may suggest that **the shortfin mako is increasingly targeted when swordfish decreases and may even replace part of its demand in the markets.** The increase of the average price per kilo of these pelagic species may also reflect the increase in their commercial interest, which peaked in 2001.



Although in the Azores the swordfish fishery was only introduced in 1987, it is estimated that 11,000 t of blue shark and shortfin mako have been caught since then, mostly as bycatch; **currently, and by weight, blue shark catches are three times more than swordfish**[45]. Data from onboard observers between 2015 and 2018 indicate that this is a very selective fishery, in which 96% of the individuals are blue shark and swordfish (73.5% and 22.4%, respectively) and where the shortfin mako represents 1.4% of the catches. However, 91% of blue shark catches are of immature individuals, who have not yet produced offspring[48]. Recent (2019-2020) and not yet published data, from the Institute for Nature Conservation and Forests (ICNF, portuguese acronym), reveal that the overwhelming majority of shortfin mako catches also correspond to immature individuals.

Figure 12. Evolution of landings (in tons) in national harbours of the main species caught by the surface longliners since 1986. Source: Alves et al. 2020.



Despite the small number of Portuguese longliners fishing in the Azorean EEZ, the official landing values do not reflect the catches that occur in this important geographical area due to illegal fishing and landings in other countries. The Spanish longline fleet, for example, accounts for 16% of the total catches in the Azores EEZ (Fig. 13) but only 20% of the catches corresponds to swordfish[45].

The swordfish fishery has a strong seasonality and uses several fishing grounds throughout the year. In autumn, the fishery is especially targeted to swordfish in an area closer to the Mainland; during winter and spring, the fishing fleet gradually shifts westwards towards the Azorean EEZ, where blue shark catches triple (January to May). This pattern is accompanied by a gradual increase in the use of steel wires[48], instead of the monofilament ones, to increase shark catches.

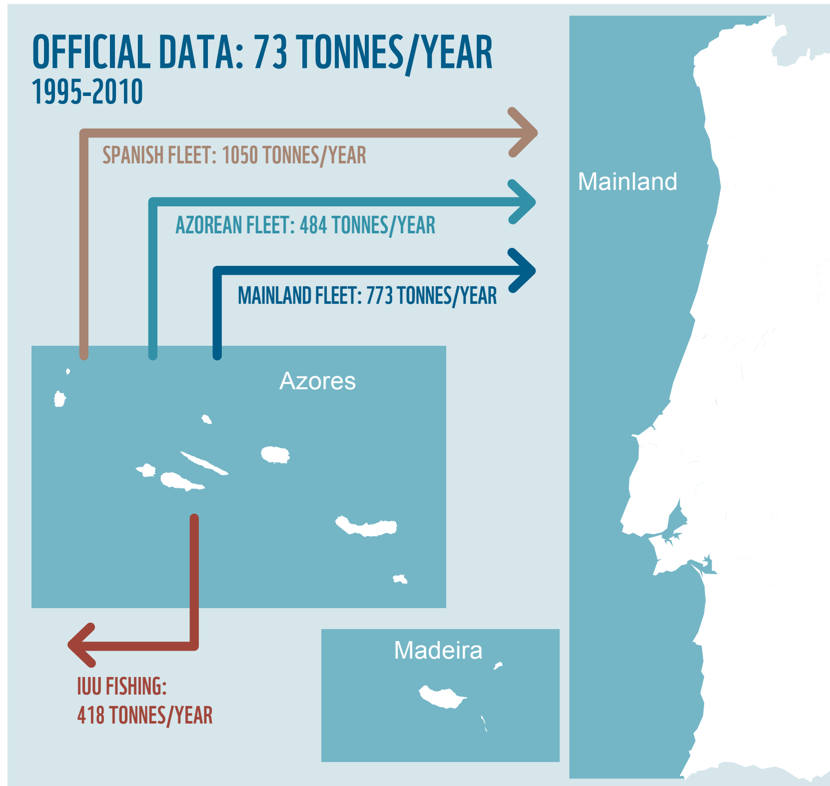
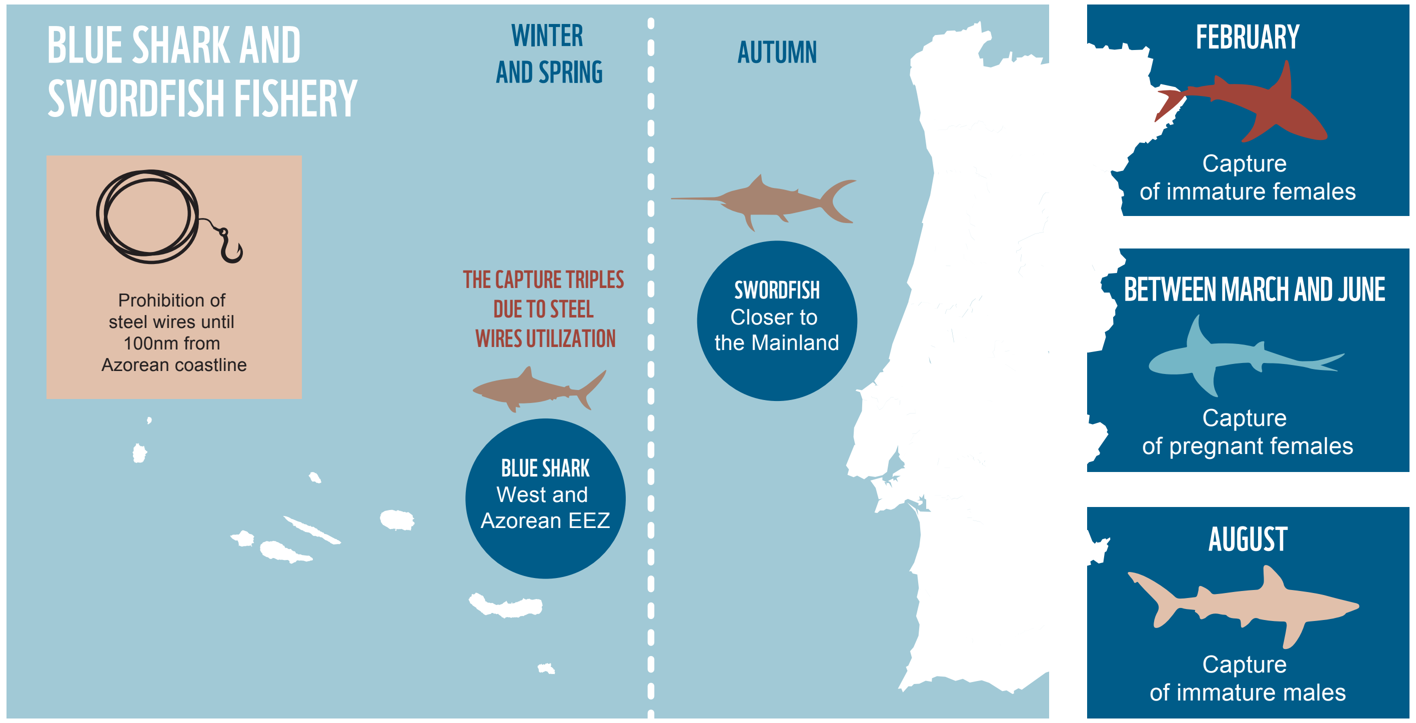


Figure 13. Elasmobranch catches that probably do not enter the Azorean official statistics, originating from illegal fishing, from landings by the national fleet in non-national harbours and from the Spanish fleet landing in non-national harbours. Catch values correspond to average annual values in tons for the period 1995-2010. Source: Adapted from Pham et al. 2013.



At the end of 2018, the use of steel wires was prohibited in an area up to 100 nautical miles away from the Azores coast[xiii].

For blue shark, in February there are more catches of immature females, and between March and June of pregnant females. In August, catches show proportionally more immature males, evidencing the complex migration patterns of this species[48].

The high catch of pregnant blue shark females, especially between March and June in Azorean waters seems to show the existence of important maternity and nursery areas and that the introduction of time restrictions could be an important management measure.

Catches of shortfin mako also have a strong seasonal pattern and most individuals captured are immature males. Catches per unit of effort (CPUE) are especially high between May and June (14 individuals per 1,000 hooks) and December (four individuals per 1,000 hooks)[48].

Another pelagic species, considered threatened but representing important catches by longliners, is the bigeye thresher (*Alopias superciliosus*). For this species, the seasonal catch pattern seems to accompany the increase in sea surface temperature, showing higher catches between May and October, with a maximum in August (one to two individuals per 1,000 hooks). There are also more irregular catches of other similarly threatened species such as the longfin mako (*Isurus paucus*), porbeagle (*Lamna nasus*), thresher (*Alopias vulpinus*), and smooth hammerhead (*Sphyrna zygaena*) sharks. It should be noted that, except for the longfin mako, under EU regulations and due to the poor conservation status of these species, their catch and retention on board is prohibited and therefore the majority are discarded at sea. The survival rate is especially low for the longfin mako, porbeagle, and smooth hammerhead sharks[48].

As of December 30, 2019, the Regional Government of the Azores established measures for the management of demersal species, choosing to set an upper catch limit for some shark species. Targeted catch, as well as bycatch, of the shortfin mako in Azorean EEZ areas has been prohibited. Target catch of tope shark, a 'Critically Endangered' species, and of blue shark is also prohibited and these two species can only be caught as bycatch with a maximum annual limit of 50 and 35 t, respectively[xiv].

BETWEEN 1997 AND 2000 IT WAS ESTIMATED THAT FOR EVERY 1000 HOOKS, 11 CAPTURED DEEP SEA SHARKS OF 10 DIFFERENT SPECIES, REPRESENTING 16% OF THE TOTAL DISCARDS OF BOTTOM LONGLINE, THE EQUIVALENT TO 135 TONNES OF DEEP SEA SHARKS REJECTED AT SEA EVERY YEAR

In Portuguese waters, the fishing of deep-sea species is internationally recognised as one of the oldest fisheries targeting sharks. It started in Madeira in the 17th century when artisanal boats targeted deep-sea sharks. Discovered as a bycatch of deep-sea shark fisheries, the black scabbardfish became itself the target species. In fact, in Madeira, the black scabbardfish fishery is one of the most relevant, given the high level of captured Elasmobranchs.

The Portuguese fleet targeting black scabbardfish uses hooks and lines like the surface longliners, but in this case these are placed close to the seabed - deep-sea longlines. These devices are placed from 800 to 1,450 m deep and can comprise 840 to 10,000 hooks, depending on the size of the boat and fishing areas. Fishing takes place in mainland waters (Sesimbra, Peniche, and Figueira da Foz harbours), in the Azores (from Ponta Delgada, Praia da Vitória, and Horta harbours), and in Madeira (from Funchal harbour)[49].

Currently, the deep-sea longline is the most important fishery in the Azores in terms of value, number of boats, and jobs. Together with handline[xv], it represents 42% of the value by weight and 76% of the total economic value generated by fisheries in the Azores[50]. However, the impact on deep-sea shark species is very high, with 25 different species known in this area[51]. Between 1997 and 2000, it was estimated that for every 1,000 hooks, 11 caught deep-sea sharks of 10 different species, representing 16% of the total discards of deep-sea longline; this is equivalent to 135 t of deep-sea sharks discarded at sea per year[52].

Bycatch associated with deep-sea longlines mainly consists of deep-sea species with poor conservation status, such as the blue skate (*Dipturus intermedius*), kitefin shark, gulper shark (*Centrophorus granulosus*), leafscale gulper shark, and Greenland shark[53]. In Madeira, despite the 68% reduction in the number of vessels between 1988 and 2007, the number of hooks doubled, and the Madeiran fleet has gradually explored new fishing areas and spent more time at sea[54].

Although there is little information on deep-sea sharks, these species are believed to be top predators in their habitats, contributing to the balance and health of deep-sea environments by

xiii Ordinance (PT) No 116/2018 on fishing with lines and hooks in Azorean waters: https://jo.azores.gov.pt/#/ato/2def0a38-8100-4a03-bf1b-4000aeb30b09

xiv Ordinance (PT) No 92/2019 on establishing maximum fishing limits for certain targeted and bycatch species: https://jo.azores.gov.pt/#/ato/225a7982-d864-471d-9b3f-09f648ef3e89

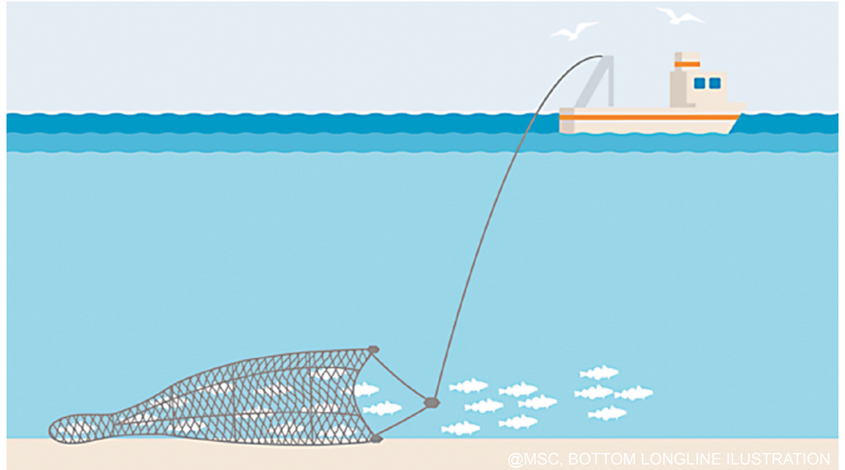
xv A fishing gear with a maximum of sixty hooks, operated by the fishermen's hand targeting demersal, deep-sea, pelagic species, squids and octopus.

exerting population control of many other species further down the food chain. These species usually live below 500 to 1,000 m, in environments characterised by low temperatures, high pressures, and absence of light. Generally, they have high longevity, late maturation, slow growth, and produce fewer offspring than shallower species, having adapted over millions of years to living in environments with little disturbance and scarce food[51]. They are, therefore, extremely vulnerable to fisheries exploitation, even at very low catch levels. Until 2002, deep-sea fisheries were not regulated, but with the introduction of specific EU regulations, retention bans were established, and 17 species are currently regulated and with capture restrictions[xvi].

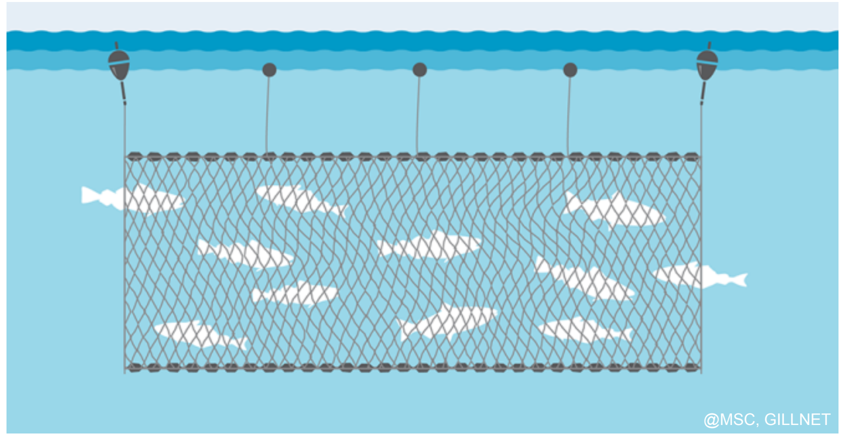
As of 2016, Portuguese longliners can land a maximum of 7 t of deep-sea species, but higher levels of catch are believed to continue and to be discarded at sea because no additional measures have been introduced to minimise bycatch[55].

In mainland waters, the presence of underwater canyons near the shore provides fisheries with easy access to deep-sea habitats. Boats use trawl nets as well as lines and hooks and work mainly from Sesimbra and Peniche harbours. **Catch of deep-sea sharks from longliners operating from the Mainland can be equivalent to a quarter of the total weight of shark and ray landings**, especially when gears are placed between 800 and 1 600 m. Since 2000, there has been a reduction of about 60% in landings of deep-sea sharks in Sesimbra and of about 30% in Peniche[56].

Deep-sea trawl nets used in cold-water shrimp fisheries between 100 and 600 m deep have reported levels of bycatch of sharks and rays between 20% and 94%[22]. **In shrimp trawlers from the south coast of Portugal, 15.5% of the total catches are sharks and rays species**, mainly the lesser spotted dogfish, a species not commonly sold,



@MSC, BOTTOM LONGLINE ILUSTRATION



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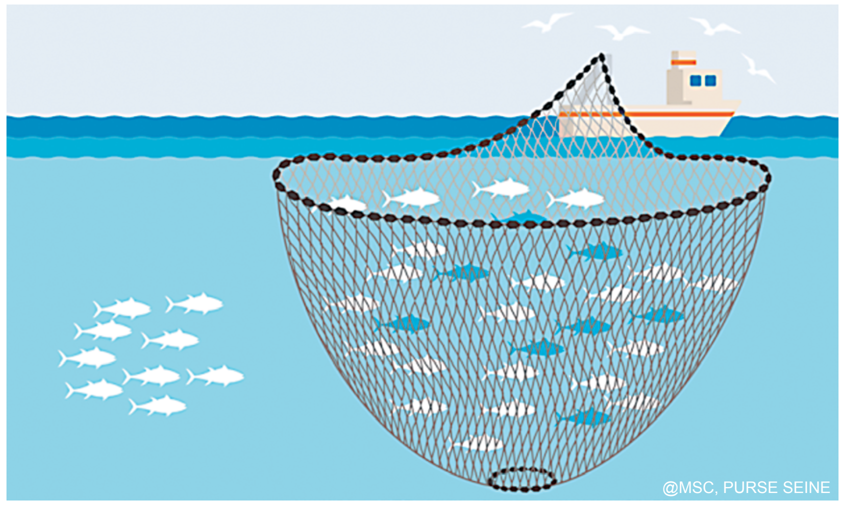

@MSC, PURSE SEINE

and deep-sea sharks, such as immature male smooth lantern shark (*Etmopterus pusillus*), velvet belly lantern shark (*Etmopterus spinax*), and blackmouth catshark (*Galeus melastomus*). Most of these animals are discarded already dead, as they do not survive the pressure differences that occur during capture nor during continuous trawling for several hours[57].

The fishery for coastal species is mainly carried out with gillnets and trammel nets, used by the polyvalent fleet to catch hake, monkfish, and sole, among other species. Several species of rays appear on reported landings, such as the cuckoo ray (*Leucoraja naevus*), spotted ray (*Raja montagui*), blonde ray, thornback ray, and undulate ray (*Raja undulata*)[58].

The Portuguese purse seine fleet, targeting small pelagic animals, also records landings of thornback ray, blue shark, and common eagle ray, the latter being globally 'Critically Endangered' at a global level and with evidence of population declines in European waters and considered 'Vulnerable', according to the IUCN in this region.

Beach seine is a traditional Portuguese fishing gear that takes place in Mainland coastal areas and targets small pelagic fish, such as sardines, Atlantic chub mackerel, and Atlantic horse mackerel[59]. However, it can occasionally catch sharks such as the smooth-hound (*Mustelus mustelus*) and blue shark, some rays, such as the common eagle ray, thornback ray, small-eyed ray (*Raja microocellata*), and undulate ray, all with commercial value, and the lesser spotted dogfish and torpedo rays. Shark and ray catches in this type of gear seem to have a strong seasonality that may be related to sea temperature, time of year, and other factors that influence the distribution of these species in the coastal areas.

xvi European Regulation (EU) 2018/2025 fixing for 2019/2020 the fishing opportunities for Union fishing vessels for certain deep-sea fishing stocks.

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Data limitations on elasmobranch fisheries[19, 60]

- Poor identification of species and aggregation in generic groups often make identification of shark and ray catches at the species level difficult.
- Bycatch is not incorporated into official statistics, especially those from artisanal fleets. For boats less than 10 m long, there is no obligation to keep a record of bycatch, discards, or fishing gears used.
- Does not consider the influence of changes in fishing effort, legislation, or consumer preferences.
- Does not include recreational fishing.
- The illegal, unreported, and unregulated fishery is especially high for elasmobranchs but it is not considered in official data.
- Catches of the national fleet can be landed at non-national harbours, often in Spain, and therefore do not enter official national landing statistics.
- Catches from the Portuguese EEZ by non-Portuguese vessels are not considered in the official national data.
- Onboard observer programmes and collaboration with vessel captains are often the only means available to obtain estimates of bycatch and discards.
- When species are prohibited from being caught, they disappear from official records, and if there are similar species (of the same genus) without prohibitions they can be mistakenly identified and continue to be landed.
- The analysis of deep-sea species fishing catches became particularly difficult since 2007, after the implementation of catch limits, and species landed have been clustered into that of lowfin gulper shark species, which was not under a retention ban at that time.

Evidence of overfishing in Portugal

- 43% of the Elasmobranch species in Portugal are under threat (Fig. 14), which corresponds to 50 species.
- Of the 62 Elasmobranch species fished in Portugal, 30 are now threatened (25 shark species - 14 pelagic and 11 deep-sea - and five ray species) (Fig. 14).
- 1/4 of the total landings by weight of the Portuguese fleet consists of currently threatened species (Fig. 15).
- *Centrophorus* species, such as leafscale gulper shark and gulper shark, were the main species captured until 2004, which may explain the current poor conservation status of these deep-sea species (Fig. 16).
- Catch of shortfin mako increased dramatically since 2004, representing 16% of the Portuguese fleet's landings in terms of endangered species (Fig. 16).
- Seven of the species caught are now 'Critically Endangered': oceanic whitetip shark, tope shark, hammerhead, angel sharks (*Squatina* sp.), and common eagle ray (*Myliobatis aquila*).
- According to the IUCN, 3/4 of the species of sharks and rays fished in Portugal have their populations decreasing.
- Of the fished species, 26% of rays and 58% of sharks are threatened.
- Endangered fished shark species are both pelagic (14 species) and deep-sea (11 species), and endangered fished ray species are mainly coastal (four species).
- The decline in landings is three times higher than that recorded worldwide.

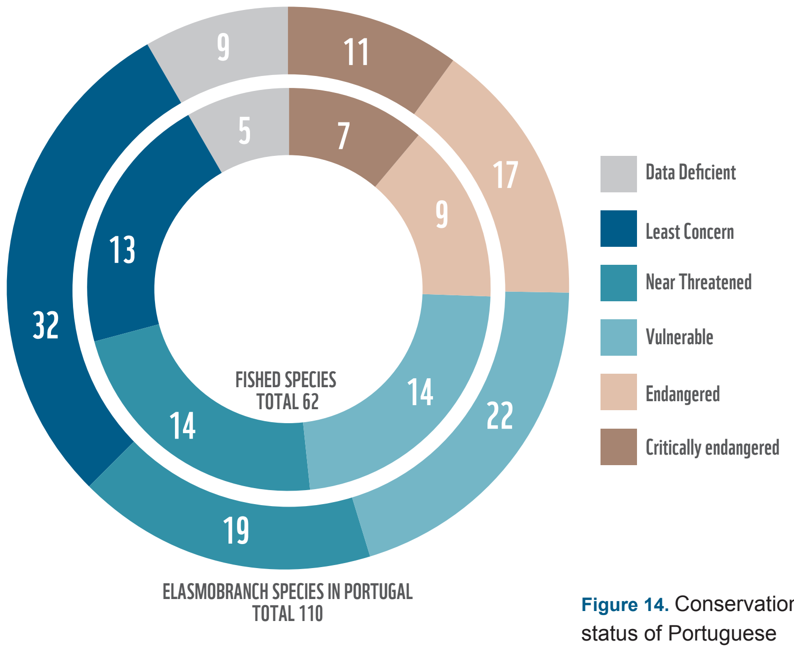


Figure 14. Conservation status of Portuguese Elasmobranch species (outer ring) and of the species landed by fisheries in Portugal (inner ring). DGRM data 1986-2019 and IUCN Red List (2020).

In conclusion, and based only on official landing data, there are strong indications of overfishing of sharks and rays in Portugal. As most species are sensitive to high fishing mortality, many of the shark and ray stocks initially captured and landed by the Portuguese fleet are now subject to restrictions; these include deep-sea species and, more recently, the shortfin mako. **Currently, threatened species represent a significant part of shark and ray landings in Portugal**, suggesting that overfishing may have led to the poor conservation status of shark and ray species.

It is estimated that, in 2019, 380,273 sharks and rays were landed by the Portuguese fleet. This estimate, made only for this report, refers to the Atlantic area and was based on official landings data for commercial fisheries and average weights for the different ecological groups (deep-sea, pelagic, and coastal sharks)[27]. This estimate is quite conservative, as it was not possible to accurately estimate bycatch, discards, and associated mortality, total landings in foreign harbours, and illegal fishing at a national level, mainly due to lack of information and because catch levels are quite variable depending on the fishing gear used. In any case, and based on the overall estimates of Elasmobranch landings, the actual values can be three to four times higher than the landing numbers[27], and Portugal's contribution represents 2% of global catches[41], **with the total number of sharks and rays caught annually in Portugal reaching possibly 1.5 million animals.**

BASED ON OFFICIAL LANDING DATA THERE IS STRONG EVIDENCE OF OVERFISHING OF SHARKS AND RAYS IN PORTUGAL

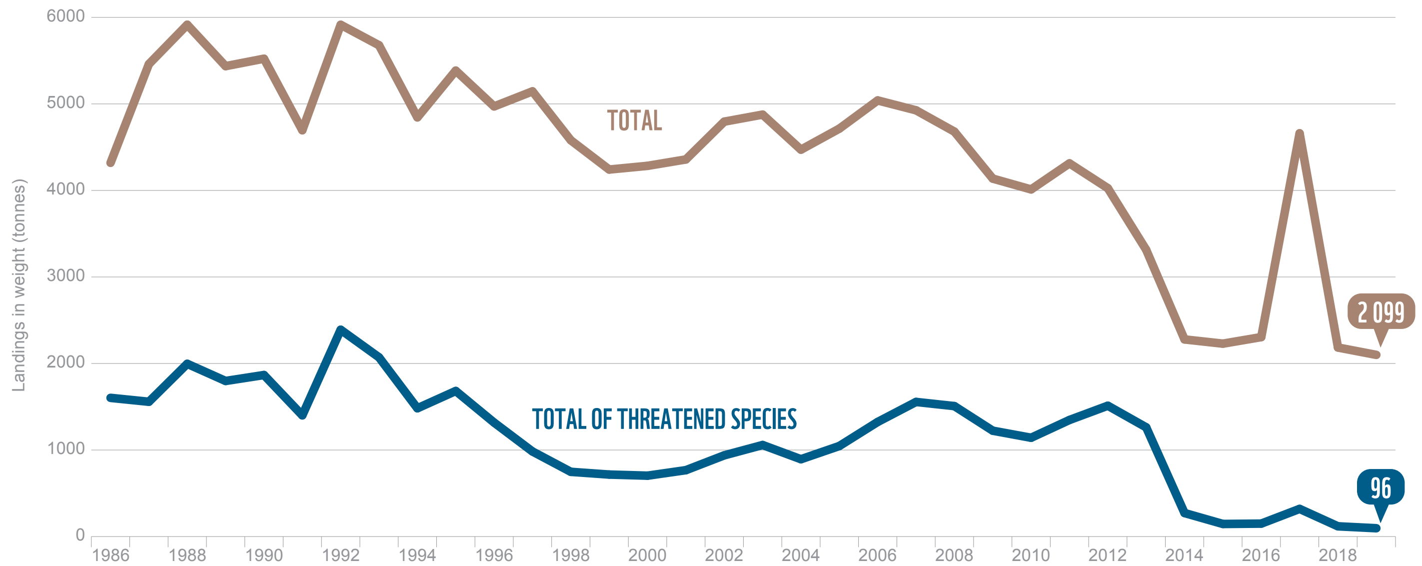


Figure 15. Evolution of the national fleet sharks and rays landings in weight (tons) and the corresponding amount of currently threatened species that have been landed in the last 30 years.

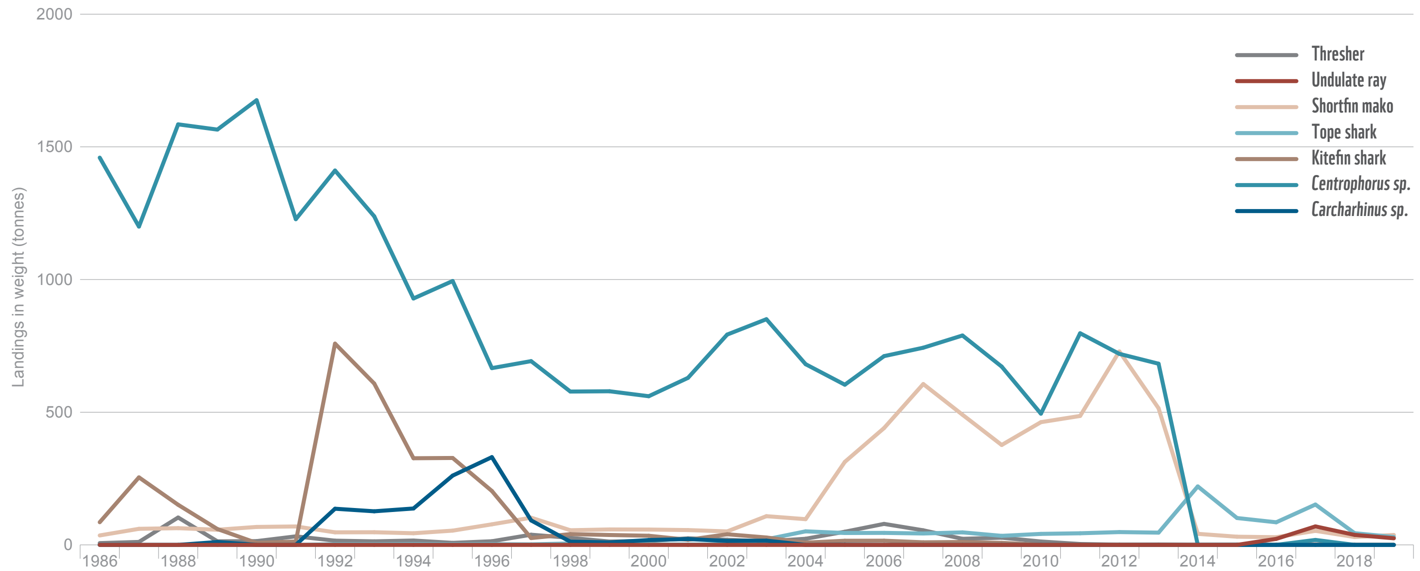
Recreational fishing

The lack of published data on recreational fishing in Portugal does not allow for a clear understanding as to whether this activity is having an impact on shark and ray species. From the scarce information available for Portugal, and according to preliminary data from the research being developed under the Sportfish and Pescardata[xvii] projects, there have been no shark catches in angler fishing but some catches of blue shark have been recorded in boat fishing. In principle, most are released back into the sea alive, after the traditional photograph. There is also the occasional marking, according to information gathered from the Portuguese Association for the Study and Conservation of Elasmobranchs (*Associação Portuguesa para o Estudo e Conservação de Elasmobrânquios*, APECE), which actively promotes the catch and release practice since 1997. There's a catch limit of 10 kg per practitioner in onboard recreational fishing, excluding the heaviest specimen caught[xviii].

xvii https://pescardata.pt/o-projecto/

xviii www.dgrm.mm.gov.pt/especies

Figure 16. Evolution of threatened species landings in Portugal in terms of weight (tons) according to the current IUCN classification, over the last 30 years. The seven species correspond to 92% of the landings total weight of threatened fished species.



Trade and Consumption

The market for shark and ray products is very diverse. It is based on their fins, meat, and liver and, with lower commercial value, on their skin, skeleton, teeth, and jaws. Oil and squalene are extracted from the liver to be used in the cosmetic industry (moisturisers), pharmaceutical industry (coadjuvant in vaccines), in nutraceuticals (food supplements), and in animal feed[61]. The most targeted species vary according to the product to be obtained: deep-sea sharks, such as kitefin shark, are sought for their liver while pelagic species, such as blue shark and shortfin mako, and rays (*Raja* sp.) are sought for their meat and fins.

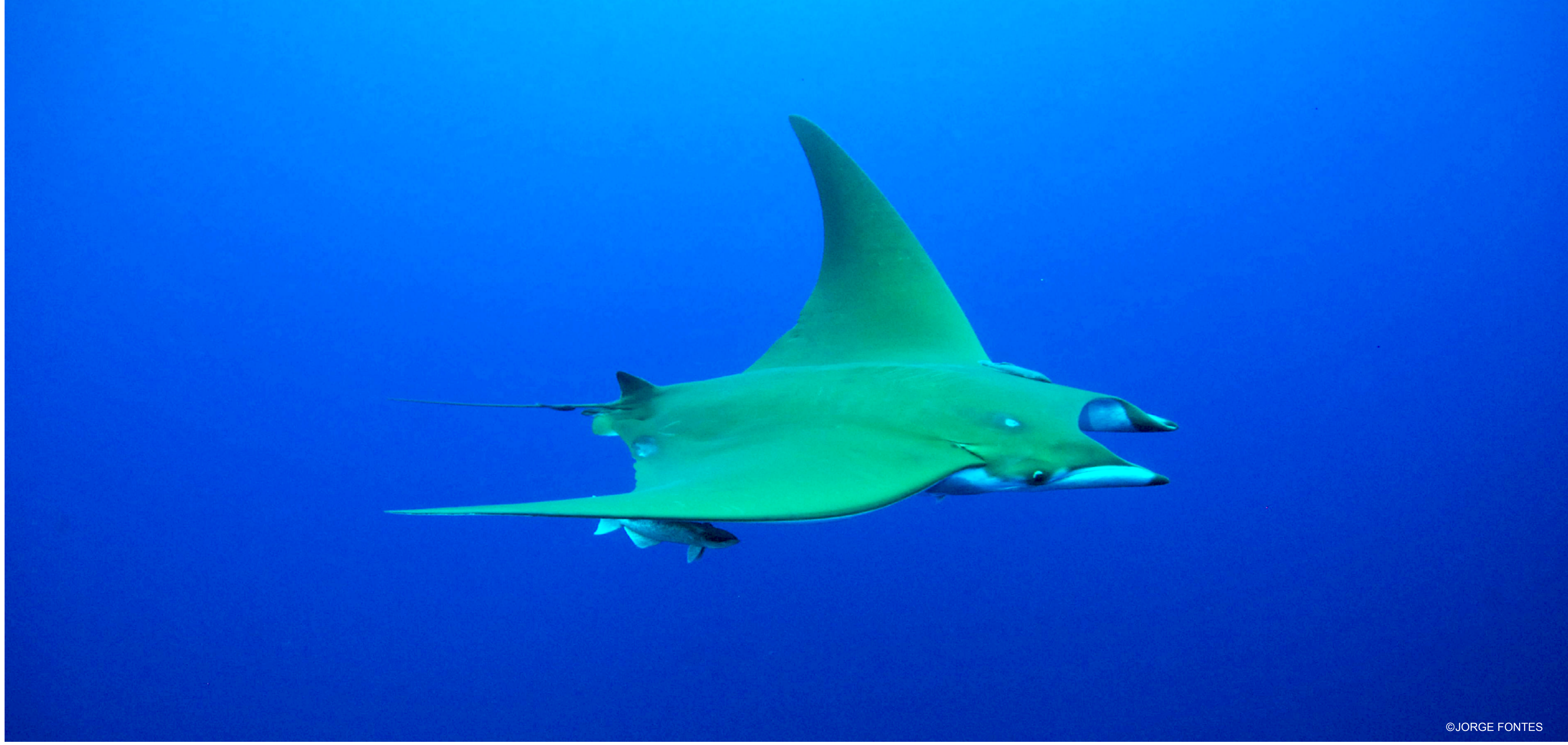
European countries play a very important role in the global trade of shark products, from their catch, processing, and trade to their consumption. The forms of consumption vary from country to country: in France, head, skin, and bowel are removed before filleting; in Germany, parts of the belly and back are smoked; in Portugal they are consumed fresh-cut.

Despite the recognised importance of rays in the fins market, as evidenced by the high prices of some species such as guitarfish (*Rhinobatos* sp.), official statistics do not distinguish between shark and ray fins, and both are classified under the category of shark fins. The global shark fin market has not changed significantly and, despite the 81% reduction in fin imports recorded in Beijing, between 2011 and 2014, in Shanghai, Hong Kong, Macau, and Thailand this market continues to expand[62].

The common perception is that much of the fin trade comes from sharks caught in international waters where fishery management rules are more difficult to implement. But a recent study contradicts this idea, as many of the fins found in Asian, North American, and South American markets come from sharks caught in coastal areas, particularly in the EEZs of only a few countries such as Australia, Indonesia, Brazil, Mexico and Japan[63]. This evidence is important because it can facilitate the control of the shark fin trade.

In this report, we use the designation "meat" and not "fish" for shark and ray products. The latter, despite being scientifically more correct, does not reflect the great biological differences between bony fish and cartilaginous fish. Like the most commonly found trade name "whale and dolphin meat", the term "shark and ray meat" will be used here when referring to products used for direct human consumption.

Figure 17. Seizure of 83 shark fins in Sesimbra harbour on January 6, 2021, since they were removed while still onboard and the rest of the body was probably discarded at sea. Source: Lusa.



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In Portugal, contrary to what one might think, there is fin trade. Some anecdotal evidence has shown that at least in some cases fin trade does not originate from landed carcasses but from finning.

National Statistics Institute (*Instituto Nacional de Estatística*, INE) data from 2012 (year at which official trade recording of shark products began) indicate that exports largely outweigh imports. This confirms that in Portugal it is not usual to consume fins and that the removal of fins occurs to supply the international trade. Imports account for only 9% of trade by weight and originate outside the EU in the form of frozen products, while exports are destined for EU countries. In recent years, the volume of exports of frozen and fresh fins has increased in Portugal, especially since 2017, replacing the traditional dry products traded in previous years (Fig. 18).

Although the value of fins is around 11 times that of the meat[64], **it is the shark and ray meat market that has experienced the greatest expansion worldwide.** Since 2000, and with the combination of increased demand (mainly in Europe and South America) and regulations to restrict finning[xix] (intended to avoid discards on board and avoid wasting meat), the shark meat market has increased by 42%, globally moving around 700 million euros annually[20].

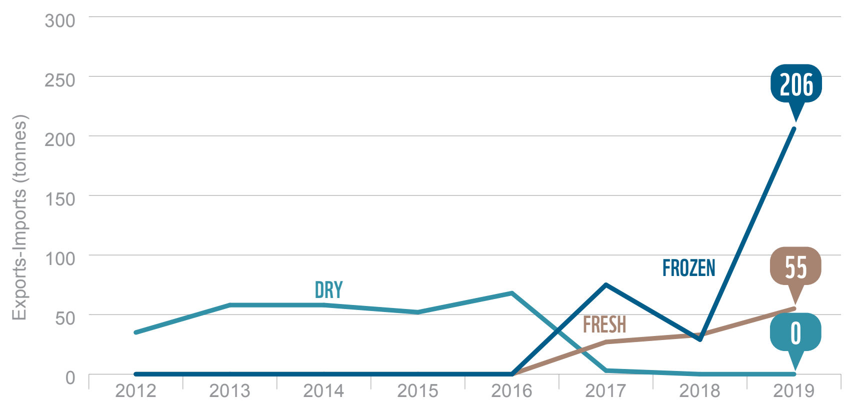
European countries play a very important role in the trade of shark and ray meat. In 2005, for example, they imported 56% of Elasmobranch meat from around the world, and accounted for 32% of world exports[20]. **Spain, France, Portugal, and Italy are among the top 10 exporting and importing countries, both of fresh and frozen shark and ray meat.** In the last decade, in terms of value, Spain was the world's largest exporter of frozen meat (24% of global value), France the largest exporter of fresh meat (19% of global value), and Italy the largest importer of fresh meat (39% of global value). Since 2017, Portugal has been the country with the largest import of frozen shark and ray meat at the European level (9%). Brazil, Colombia, Uruguay, Hong Kong, and Japan have also emerged in the market of frozen shark and ray meat and have increased the value of their EU imports[65].

Between 2000 and 2011, Portugal exported an average of 5,624 t of shark and ray meat and imported 2,037 t, annually[20]. Since then, the country has increased its contribution by 5% to world exports and doubled its imports. In the last 10 years, Portugal has globally become the sixth largest exporter and eight largest importer of shark and ray meat by weight, according to the United Nations (UN) commercial trade data (Fig. 19).

The fresh shark and ray trade is predominantly for EU countries but frozen trade supplies both EU and non-EU markets. The most valued species for shark meat consumption are now threatened according to the IUCN.

xix Prohibition to remove fins on board and obligation to land the specimen with naturally attached fins.

Figure 18. Portuguese net exports, to the European Union, of dry, fresh and frozen fins by weight (tonnes), between 2012 and 2019. Source: INE Database 2012-2019.



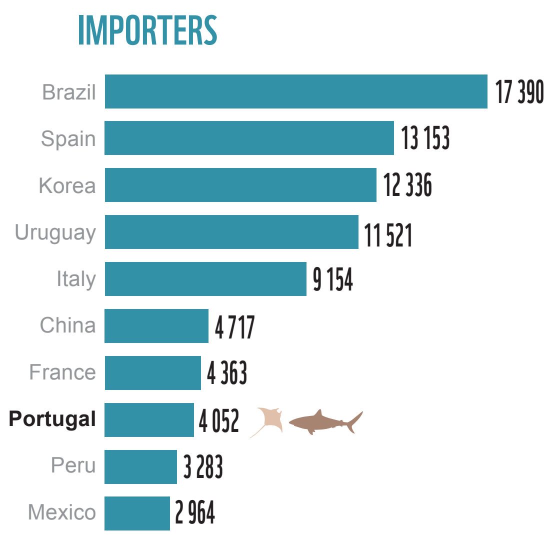
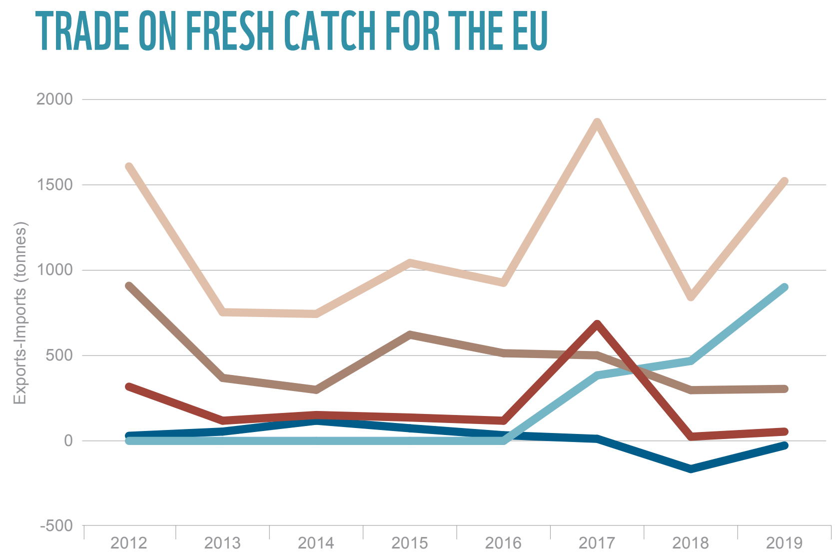


Figure 19. Most important countries in the shark and ray meat trade between 2008 and 2018. Importing countries (left) and exporting countries (right). Annual average values in tons. Source: UN Comtrade 2008-2018 data.

Such is the case of tope shark, porbeagle, and picked dogfish (*Squalus acanthias*). In Portugal, the porbeagle, which is 'Critically Endangered' in Europe, records important exports as fresh meat (35% of the total weight of exports since 2012, on average), despite the considerable 66% decrease in landings between 2012 and 2019. **Blue shark is currently the main commercialised species, having accounted for 51% of total exports by weight of sharks and rays fresh meat in 2019** to EU countries alone, and 76% of total imports by weight in frozen form from both EU and non-EU countries. The Portuguese commercial balance for the shark and ray frozen meat segment was negative in 2019, mainly due to the high imports of frozen blue shark. Since 2017, imports from the EU have almost tripled while those from outside the EU more than doubled, with 58% of imports of blue shark coming from non-EU countries (Fig. 20). The identification of species that enter commercial circuits presents some problems. On the one hand, there are important differences regarding the fresh and frozen meat segments. In the case of fresh meat exports, 26% of the total weight is not identified at the species level and for frozen meat this figure rises to 69%. These differences may explain why the variation in the total value of Portuguese net exports in the frozen meat segment does not follow the dramatic increase in imports of blue shark. On the other hand, it is no longer possible to distinguish the picked dogfish from the lesser spotted dogfish, although the picked dogfish is a threatened species. Surprisingly, INE data have no record of shortfin mako exports or imports, and therefore it is not possible to perceive the amount of shortfin mako that enters the commercial circuits. However, it is thought to be quite high.



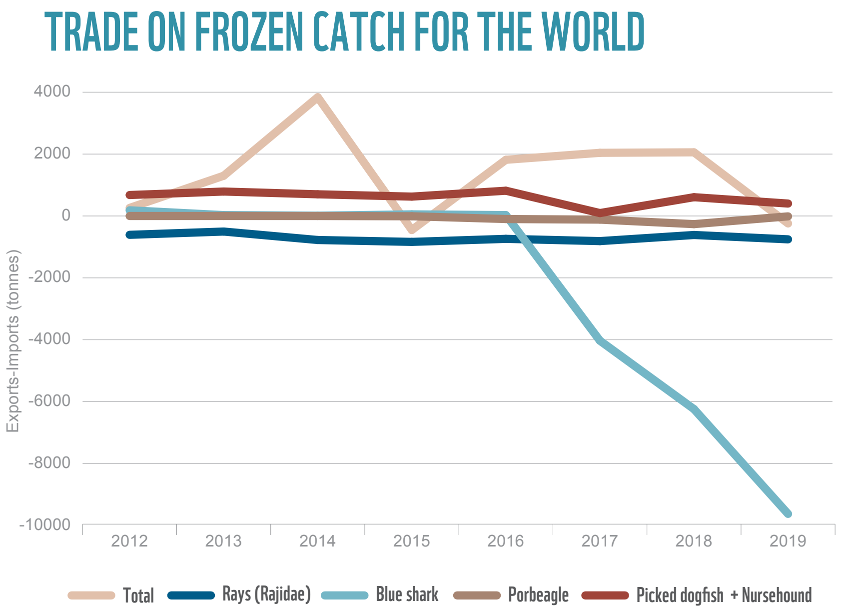


Figure 20. Evolution of trade in fresh (top) and frozen (bottom) Elasmobranch meat in Portugal for the species distinguished in the official data and the total value, which includes all sharks and rays. Data represents the difference between Exports and Imports. Source: INE 2012-2019.

According to the report sent to the European Commission (EC) in 2013[xx], resulting from the Member States obligation to report all shark landings from boats authorized to sell fins (in Portugal, 47 boats), more than 3/4 of the weight of sharks and rays declared and landed by the Portuguese fleet in 2013 was in foreign fishing harbours: 49% in Vigo, Spain and 31% in Montevideo, Uruguay. The landed species were mainly blue shark, shortfin mako, and picked dogfish, which accounted for 92% of the total landings declared to the EC that year. This emphasises even more the fact that the official national landings data does not represent the total number of animals landed by the Portuguese fleet. It would be very important for Portugal to continue to report data collected from fishing vessel logbooks of the pelagic fleet, although apparently it only did so in 2013.

Thus, and although we only have data from landings in foreign fishing harbours for 2013, we can understand why the export values largely exceed the values declared for national landings, and confirm the existence of direct landings, particularly of pelagic species in foreign harbours, mostly in Spain.

Portugal and Spain are a European hub in the shark trade and record important commercial trades.

- In terms of weight, in 2018, 73% more shark meat was exported when compared to 2013, and imports of frozen shark products from Spain almost doubled.
- Virtually all imports and exports of fresh meat are carried out with Spain.
- 71% of total exports and 35% of total imports with Europe, regarding frozen meat, are carried out with Spain.

These data show the important commercial trade that exists on the Iberian Peninsula concerning sharks and rays, especially in fresh meat form.

It should be noted that the data analysed for exports and imports to/from Portugal are mainly based on INE's national statistics. As this data is somewhat limited[xxi], namely regarding the lack of information concerning shortfin mako, the UN-Comtrade database was used to address these limitations and specifically analyse the trade with Spain. Due to the significant differences found between the two databases, the actual values of transactions between the two countries could not be confirmed. The values of the UN-Comtrade database, on fresh shark meat, are 53% higher than those recorded by INE, while these are 55% higher than that of the UN-Comtrade on frozen meat (Fig. 21). Concerning the evolution of the trade balance (net exports), INE's data show a two-fold increase on the volumes of frozen meat transacted since 2012 while the UN-Comtrade data do not show significant variations in this segment for the same period. In relation to fresh meat, the trend is the same in both databases, with a decrease of about 46% in net exports in the last four years. In any case, we can say that the commercial balance with Spain is positive, with exports largely surpassing imports, both on the frozen and fresh meat segments.

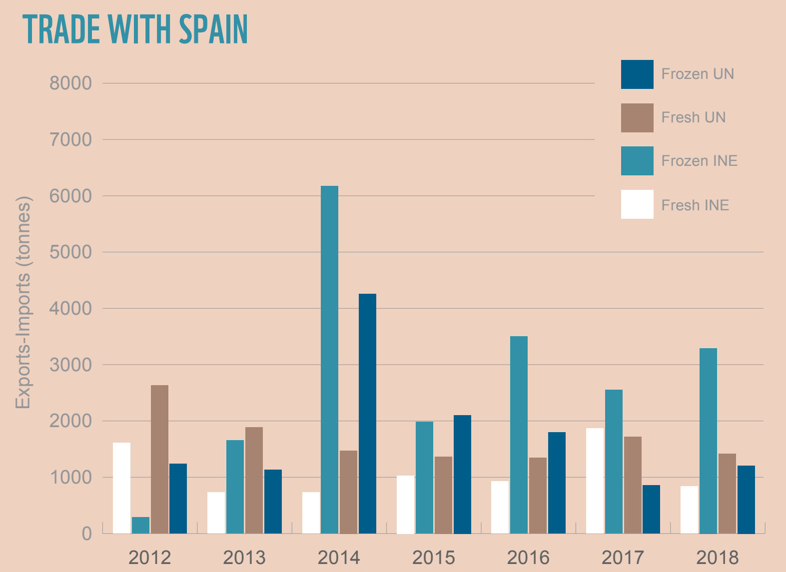


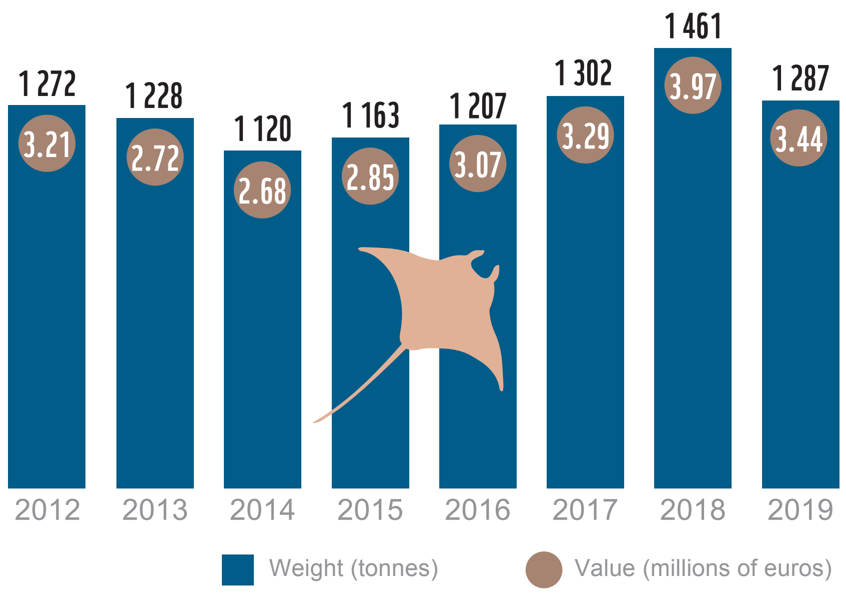
Figure 21. Comparative analysis of the trade balance (net exports) between Portugal and Spain from two official databases. Source: UNComtrade and INE data from 2012 and 2019.

xx https://ec.europa.eu/fisheries/marine_species/wild_species/sharks/member-states-reports/

xxi INE Data doesn't represent the totality of national exports and imports: i) statistical information about transactions made by Portugal and other Member States only refers to registered companies in Portugal and volume of transactions above 350 000€ for imports and 250 000€ for exports; ii) direct landings in international fishing harbours

Figure 22. Evolution of consumption estimates in value (euros) and weight (tonnes) since 2012 for rays (Raja sp.) Source: INE 2012-2019 data and DGRM 2012-2019 data.

FORMULA 3:
ESTIMATED CONSUMPTION = (LANDINGS-EXPORTS)+IMPORTS



The differences observed in the volumes traded between the INE and UN-Comtrade databases emphasise the difficulty of analysing trade data for sharks and rays and show the importance of cross-referencing different databases to obtain a more complete picture of the trade reality for these species. It is possible that, at the national level, the data are underrepresenting fresh meat trade, and that, regarding frozen meat, the values recorded may vary even more, showing the difficulty of tracking and real accounting the volumes traded, especially when they are already processed. Therefore, more in-depth studies on the shark and ray trade in Portugal and in the Iberian Peninsula are needed, as these countries record important catches of elasmobranchs.

Analysing the level of consumption of sharks and rays at a national level is particularly difficult. In addition to there being few studies dedicated to the topic, the current trade registration mechanisms lack detailed data and species are sometimes poorly identified or aggregated into generic groups. Also, if there is no correspondence between species, units, and type of processing, at the level of landings, exports, and imports, it is very difficult to make estimates of consumption per species. Fortunately, the INE data from 2012 began to distinguish rays within the Rajidae family from other species and, based on the landings data of the seven species of this family, it was possible to estimate the consumption of rays by weight and value, according to the formula presented in Figure 22. Nevertheless, it was necessary to adjust the values for inflation, to be comparable to 2019 prices, and use the Consumer Price Index for unprocessed foods[66] as a deflator. The values obtained should be assessed as a preliminary approach. Although there are only trade data from the last eight years, the consumption of rays in Portugal (by weight and value) may have been increasing, with a maximum in 2018, when more than 1,400 t of rays were consumed, corresponding to 4 million euros (Fig. 22).

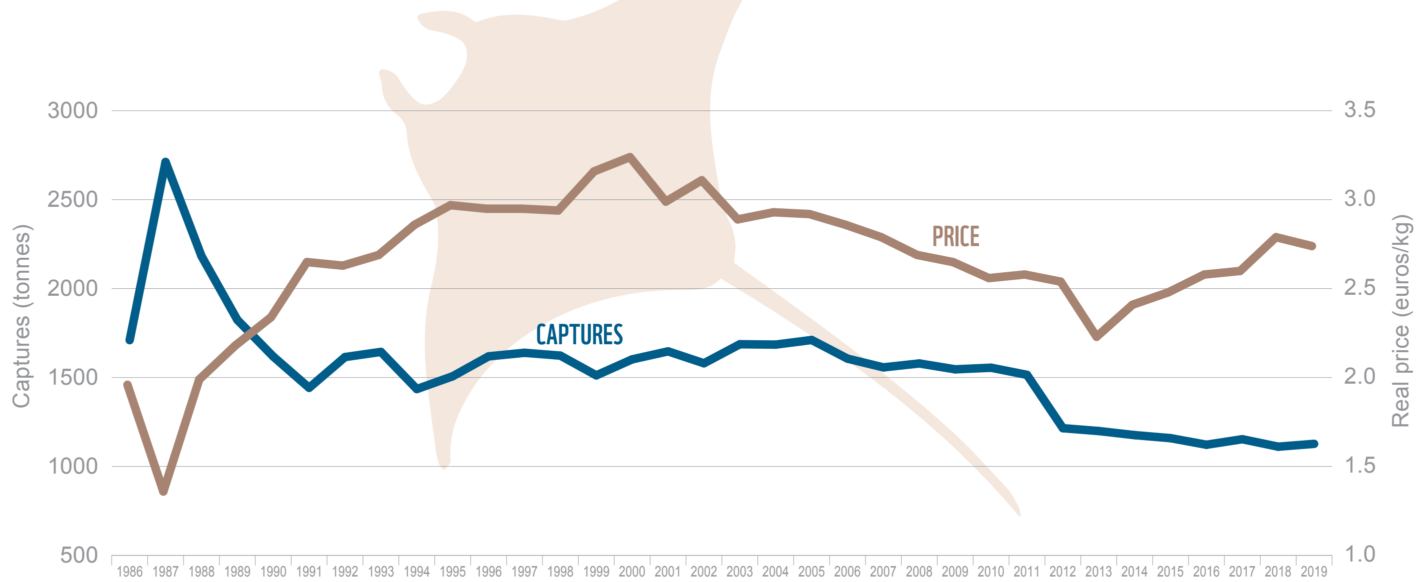
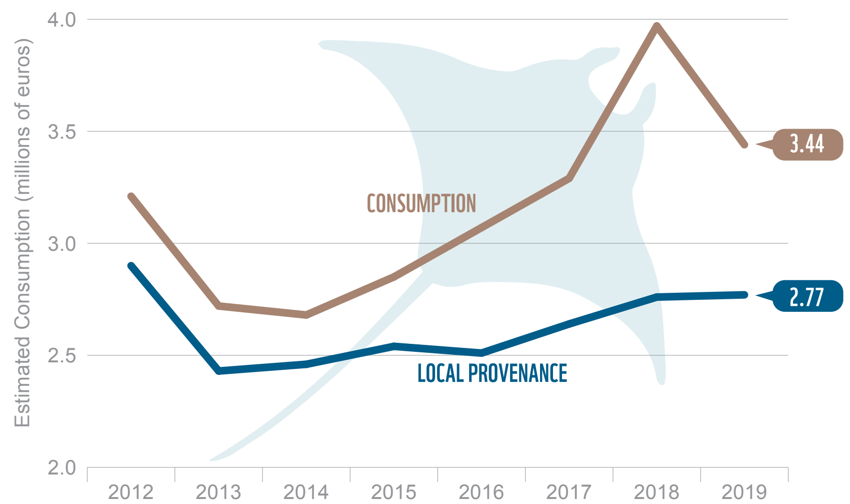


Figure 23. Evolution of ray (Raja sp.) landings by weight (tonnes) and average price (€/Kg) since 1986. Source: DGRM data 1986-2019.

It is also visible that, **since 1986, the price per kilo of *Raja* sp.** (real price, adjusted for inflation), **sold at fishing auction centres increased about 40% on average.** Despite the difference in value in the different auctions, in 2019 rays were worth 2.74 €/kg, a value 26% higher than the average first price of all species of sharks and rays sold. Based on the estimated average consumption of rays between 2012 and 2019, the annual consumption per capita in Portugal is 122 g of rays[xxii]. Considering an average weight of 12.2 kg per ray (based on the information obtained for three of the species consumed - *Raja clavata, Raja brachyura,* and *Raja microocellata* - in Fishbase.se), per 100 inhabitants one ray specimen is consumed (Fig. 23).

Additionally, the consumption of rays is mostly of local origin (Fig. 24), caught by the national fleet. However, since 2014, there has been an increase in foreign provenance with a maximum peak in 2018, suggesting that increased consumption and lower catches have driven an increase in imports. These data, especially those of imports and the increase in the price per kilo sold at auction centres, indicate that the Portuguese are increasingly favouring the consumption of rays.

Figure 24. Evolution of rays consumption estimates in value (millions of euros) from national landings (local origin) to satisfy national consumption. Source: INE 2012-2019 data.

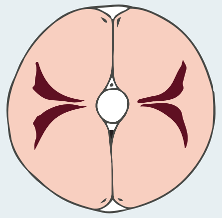


xxii INE 2019, Based in Portugal's resident population.

In Portugal, there is little data to indicate the occurrence of purposeful errors in the identification of commercial species, which is considered fraud and is illegal. However, anecdotal information indicates that certain pelagic shark species, such as shortfin mako (*Isurus oxyrinchus*), may be identified as swordfish (*Xiphias gladius*), which has a higher commercial value. In such cases, it is important to know how to distinguish one from the other when purchasing. Similarly, unconfirmed reports point to the landing of swordfish designated as blue shark when the swordfish quota was exceeded. What occurs most often is the use of common names that do not include the shark designation or that designate several different species under the same name. An example of this is the use of the Portuguese name "cação" [tope] to refer either to tope shark (*Galeorhinus galeus*), smooth-hound (*Mustelus mustelus*), starry smooth-hound (*Mustelus asterias*), or picked dogfish (*Squalus acanthias*), and the name "tintureira" [blue shark], which is not normally associated by Portuguese consumers with sharks. **When species are poorly identified and designated by generic names, endangered species may be more easily traded and consumed.** Sharks are distinguished from swordfish by the "blood line" (dark red muscle), which appears as a spot close to the vertebrae; on swordfish, this red muscle is shaped like a "V". Additionally, shark vertebrae are smaller and the meat emanates a characteristic odour of ammonia that, in swordfish, is much less notorious.

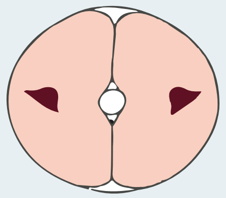

Shortfin mako
Isurus oxyrinchus
©PABLO DUFFLOCQ

SWORDFISH OR SHARK?



SWORDFISH

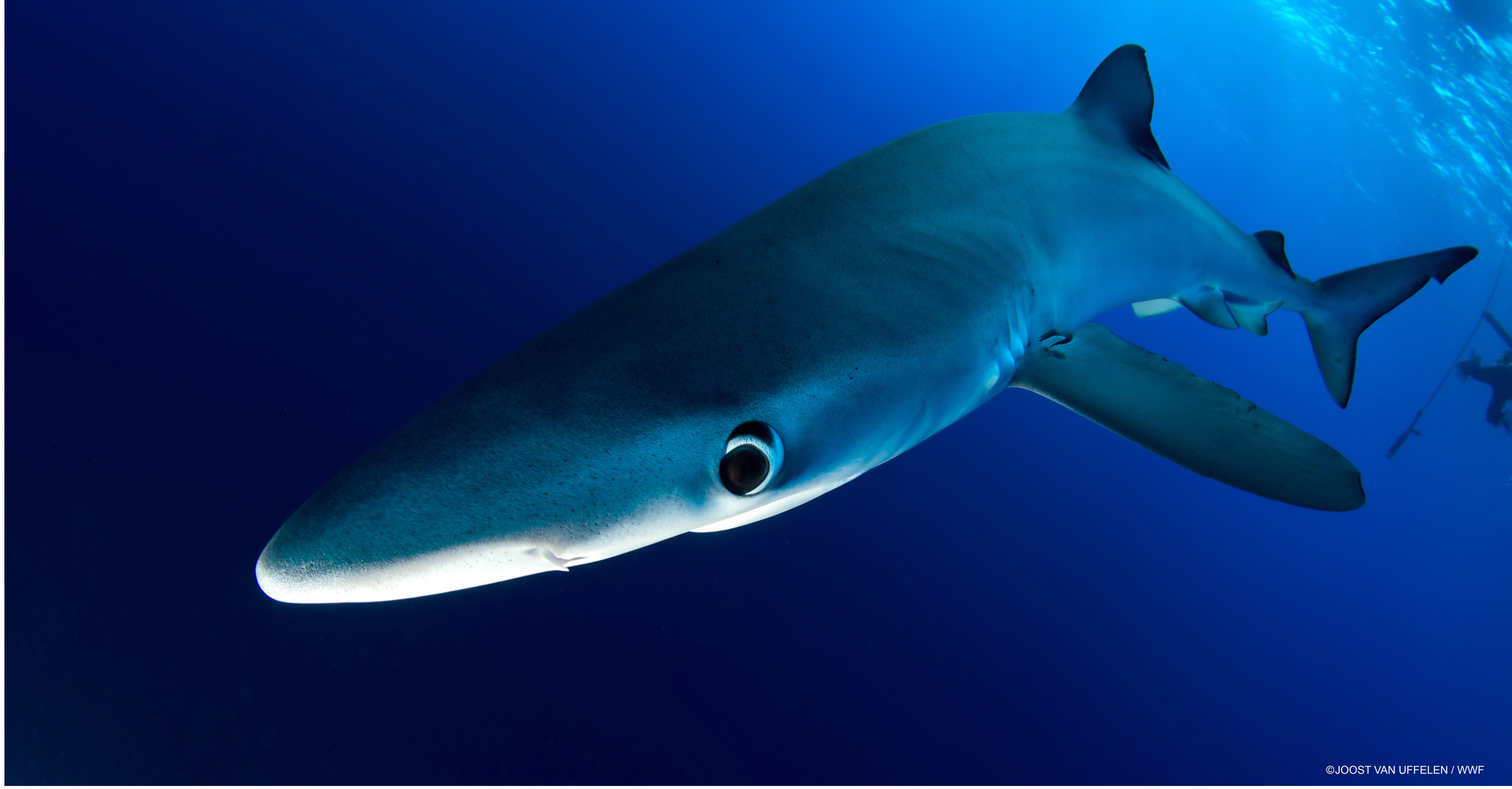
Red V shapped muscle
-
Bigger vertebrae
-
Lighter flesh, softer scent



SHARK

Red stain muscle
-
Smaller vertebrae
-
Darker flesh, amoniac scented

©WildAid 2018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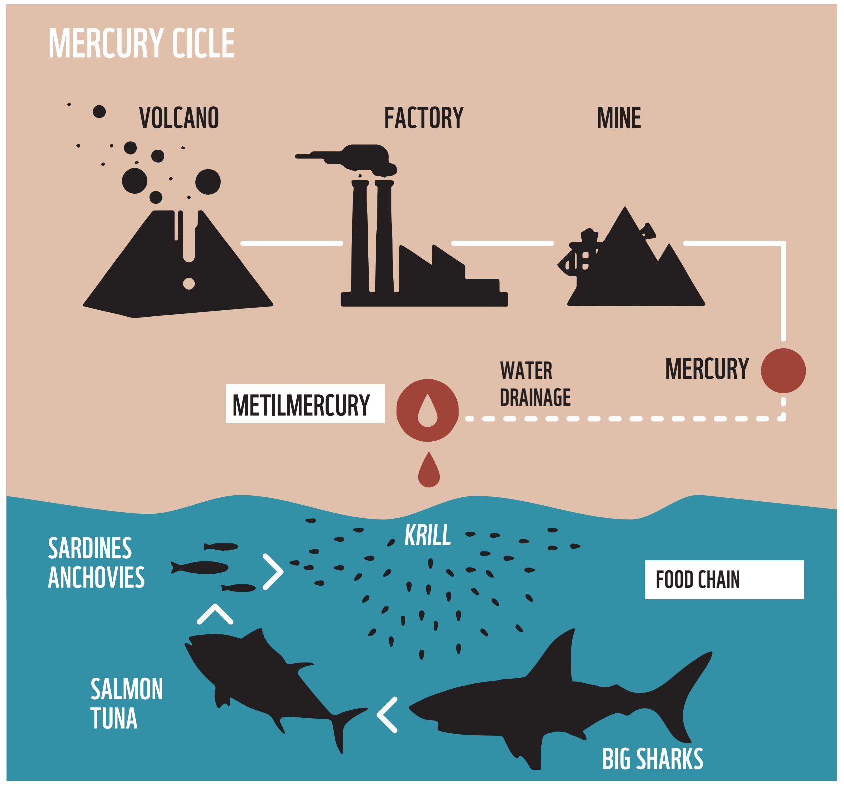
Implications of ocean pollution on shark meat consumption

Marine ecosystems are constantly being loaded with persistent organic pollutants (POPs) and heavy metals, such as arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), and mercury (Hg). Due to their high toxicity and persistence in the environment, **these compounds accumulate along the food chain, with increasing concentrations from the base to the top**, a phenomenon known as 'bioaccumulation'. These compounds negatively affect the health of specimens, causing damage to their DNA and inhibition of enzymes, which are reflected in their ability to swim, feed, and reproduce. Sharks, being at the top of the food chain, are known to accumulate large amounts of heavy metals and, although some of these metals are essential for their physiological processes (iron and zinc), others are not so beneficial (Hg and Pb). Analysis carried out on blue shark, tiger shark (*Galeocerdo cuvier*), and Caribbean reef shark (*Carcharhinus perezi*) revealed that the levels of some POPs, and especially heavy metals, such as Hg, are especially high. When it comes to human consumption, **the levels detected are higher than those allowed by the EU, and therefore the regular consumption of these species can have implications for human health and their consumption is discouraged**[29,67].



3. Governance and Policies

The management of fisheries in the EU is regulated by the European Commission, specifically by DG MARE which, under the Common Fisheries Policy (CFP), establishes the framework regulation of fisheries and fishery resources in the waters under the jurisdiction of the Member States and in which the European fleet operates, including international waters and third country waters[68]. The management of fisheries aims to: i) ensure high long-term fishing yields by setting total allowed catches (TACs) for each fishery that are allocated among Member States (quotas) according to scientific advice; ii) minimise or even end by-catches and discards; and iii) include consultations[xxiii] with stakeholders.

The definition of rules is based on scientific data and advice from i) the Scientific, Technical, and Economic Committee for Fisheries (STECF), a non-permanent group of experts in various areas, reporting directly to the European Commission, and ii) the International Council for the Exploration of the Sea (ICES), an independent intergovernmental body for the marine ecosystem research on the North Atlantic, providing advice to several governments and regional fisheries management organisations (RFMOs), including the EU[69].

The EU participates scientifically and politically in the RFMOs, international organisations including the countries with fishing interests in a specific area, usually in international waters (e.g., NAFO - Northwest Atlantic Fisheries Organisation) or highly migratory species, especially tuna (e.g., ICCAT - International Commission for the Conservation of Atlantic Tunas - and IOTC - Indian Ocean Tuna Commission). RFMOs have management powers to define i) catch limits and fishing effort and ii) technical measures and fishing control obligations, which are binding on their members[69].

The EU participates in two RFMOs with a purely advisory status (WECAFC - Western Central Atlantic Fishery Commission - and CECAF - Fishery Committee for the Eastern Central Atlantic) (Fig. 25).

The EU includes three of the countries that fish the most sharks worldwide: Spain, France, and Portugal. Together, **EU Member States account for the second highest level of shark catches recorded worldwide (around 18% in 2018[xxiv])**, caught in European, international, and third country waters. Considering the global impact that EU Member States have on shark and ray populations, there is responsibility to develop and implement appropriate fisheries management.

xxiii This consultations are made through Advisory Councils, which can have a thematic (offshore fishing, aquaculture) or geographic scope (South Atlantic, Baltic Sea) and different sectorial representatives.

xxiv Reported catches to FAO in 2018. FAO FishStat: Capture Production 1950-2018.

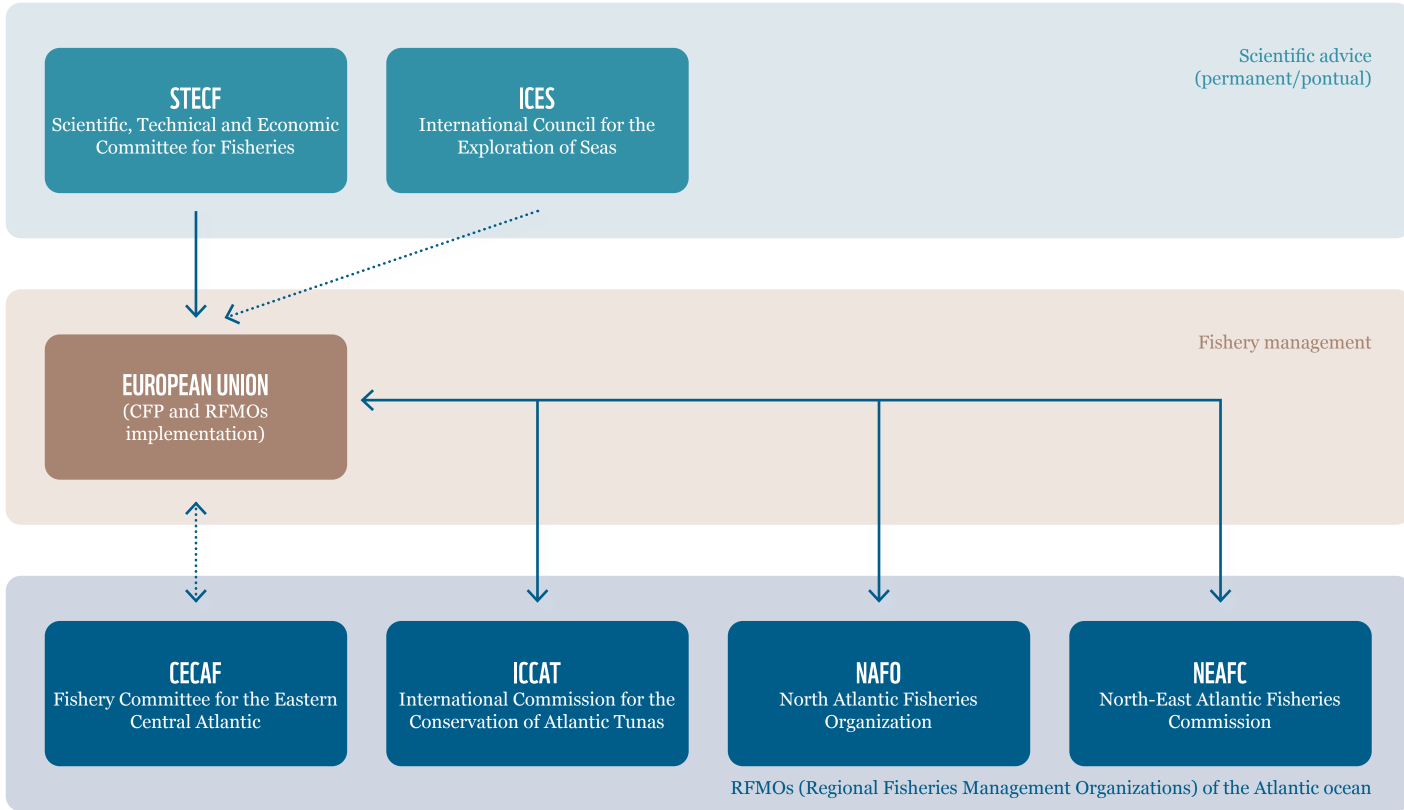


Figure 25. Main entities that contribute to the governance of Elasmobranchs in the Atlantic Ocean, especially North Atlantic.

In this sense, several international and regional instruments relevant to the conservation of sharks and rays have been ratified at a Member State level, Portugal included (Table 2). The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an important instrument for regulating international trade of aquatic species. Signatory countries, Portugal included, are required to implement and comply with CITES requirements concerning listed species that are exploited and managed commercially. Some of these requirements are scientific studies dedicated to species, designated Non-Detriment Findings (NDFs), which attest whether a given species' international trade is damaging it and whether it can continue or not. Each country also must assign distinct administrative and scientific authorities to make such decisions for commercially exploited and managed aquatic species[70].

The management of commercial stocks of sharks and rays is still a low priority for EU and national authorities, especially in comparison with other top marine predators, such as dolphins and whales. The management measures in force relevant to Elasmobranchs (Table 3) have been gradually integrated into EU regulations. They are mainly based on the definition of catch limits and on board retention bans and many are only included when the populations of the species are in sharp decline and threatened; thus, management is not based on the precautionary principle, nor are its measures enough to recover populations. Despite some important advances, particularly in recent years, with special emphasis on deep-sea

Table 2. Conventions relevant to Portugal for the management of Elasmobranchs [71,72,73]

CONVENTION	OBJECTIVES	INSTRUMENTS INCLUDED
UNCLOS (United Nations Convention on the Law of the Sea or Constitution for the Oceans)	Definition of maritime zones with variable jurisdictions (territorial sea, contiguous area, EEZ, continental shelf, and open sea) and of principles and norms for fisheries regulation and marine resources conservation.	**UNFSA** (Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks): to establish cooperation principles between Member States for the conservation and management of the stocks of highly migratory fish in different jurisdiction areas (inside and outside their EEZ) according to precautionary approach and to the best scientific information available. **UNCLOS IA**: Together with the IUCN, it aims to fill important gaps in the governance of marine biodiversity conservation, especially in areas outside national jurisdiction.
CMS (Convention on Migratory Species or Bonn Convention)	Sets measures to protect migratory species in their distribution area and habitats.	**Annex I** (22 species – e.g., *Squatina* sp., *Cetorhinus maximus, Carcharodon carcharias, Manta birostris*): there is a retention ban for these species; conservation measures must be taken to restore these species habitats, to minimise migratory route obstacles, and to control the introduction of exotic species. **Annex II** (36 species - e.g., *Rhincodon typus, Isurus oxyrinchus, Isurus paucus, Lamna nasus, Squalus acanthias* -Northern hemisphere populations- and *Manta birostris*): does not provide any specific protection but requires global or regional agreements for species protection.
CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)	To ensure that international trade does not threaten the survival of species or the maintenance of biodiversity.	**Annex I:** endangered species with trade restrictions (20 Elasmobranch species); **Annex II:** species under threat if no commercial restrictions are implemented (*Cetorhinus maximus, Carcharodon carcharias, Isurus oxyrinchus, Isurus paucus, Lamna nasus* and those in genera *Manta, Mobula, Alopias,* and *Sphyrna*).

and some pelagic species, **there is still a lack of an integrated European management to be implemented by Member States and measures that focus on minimising bycatch and monitoring and controlling fishing effort.**

In 1999, FAO drafted the International Plan of Action for Conservation and Management of Sharks (IPOA), providing for the first time a framework for the management of sharks and rays in and out of EU waters. About 10 years later, the EU adopted its own Plan of Action applicable to targeted commercial fisheries, bycatch, and targeted and bycatch recreational fisheries for all species of sharks, rays, and chimaeras in community waters. The Plan of Action describes what already exists and what still needs to be done, emphasising the need for collaboration between countries, particularly concerning data collection and data sharing[74]. Its implementation involves drafting a national plan, suited to the local specificities and fisheries of each Member State, based on solid scientific evidence and on consultation of stakeholders, whose main objectives are:

- to expand knowledge on the fisheries of shark, ray, and chimaera species and their role in the ecosystem;
- to ensure that targeted shark fisheries are sustainable and that bycatches are properly regulated;
- to encourage a coherent approach between internal and external EU policy[75].

However, the IPOA serves only as advice, and there is no penalty for its non-compliance. Currently, few countries have implemented it: in Europe, it has only been applied by the United Kingdom. Given the EU's commitment to sustainable fisheries, reflected in the

THE MANAGEMENT OF COMMERCIAL STOCKS OF SHARKS AND RAIAS IS STILL A LOW PRIORITY TO THE EUROPEAN AND NATIONAL AUTHORITIES

Table 3. Timeline of the main management measures in force in Europe and relevant to Portugal.
EU = European Union, FAO = Food and Agriculture Organization of the United Nations,
ICCAT = International Commission for the Conservation of Atlantic Tunas, NAFO = North Atlantic Fisheries Organization.

Year	Measures
1999	Adoption of the International Plan of Action for Sharks and Rays
2002	Introduction of fishing restrictions to deep sea species[xxv]
2003	Finning regulation that defines a special and limited authorization to a fixed proportion of 5% fin/shark[xxvi]
2006	TAC reduction for deep sea sharks; Retention ban of white shark and basking shark
2007	Fishery restrictions for shortfin mako and porbeable; Reduction of quotas for porbeagle and TACs for rays
2008	Reduction of TAC for deep sea sharks; Angel sharks and three ray species protection measures ; reduction of TAC for porbeagle and picked dogfish
2009	Defibition of the European Plan of Action for Sharks and Rays; Quota definitions for rays based in the scientific advice for NAFO area; Protection measures for Bigeye thresher; Retention ban for porbeagle and picked dogfish
2010	Protection of *Alopiidae* in IOTC; Reduction of TACs for deep sea sharks and four new species inclusion; Fishing limits for *Rhinobatidae* and tope shark
2011	Reduction of TAC for rays
2012	Public consultation and prososal for finning regulamentation revision; Zero TAC for deep sea sharks
2013	New finning regulation to land sharks with naturally attached fins[xxvii]; Fishing landing obligation plan for demersal fisheries
2015	Undulate ray is no longer in the prohibited species list; Landing obligation progressive application for all TAC species[xxviii]
2016	New restrictions on deep sea fishing[xxix] and exceptions for Portugal[xxx]
2017	10% TAC increase for rays
2018	Fishing restrictions for some shark species[xxxi]
2019	Shortfin mako inclusion in Appendix II of CITES
2020	Emission of negative NDF for shorfin mako (prohibition of trade in the EU from the atlantic north stock)

FAO EU ICCAT NAFO

xxv Regulation (EC) No 2347/2002 establishing specific conditions and requisites for fishing for deep-sea stocks.

xxvi Regulation (EC) No 1185/2003 on the removal of sharks fins on board vessels.

xxvii Regulation (EU) No 605/2013 amending Regulation (EC) No 1185/2003 on the removal of sharks fins on board vessels.

xxviii Regulation (EU) No 2019/1241 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures.

xxix Regulation (EU) 2016/2336 and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic.

xxx Council Regulation (EU) 2016/2285 of 12 December 2016 fixing for 2017 and 2018 the fishing opportunities for Union fishing vessels for certain deep-sea fish stocks; Council Regulation (EU) 2018/2025 of 17 December 2018 fixing for 2019 and 2020 the fishing opportunities for Union fishing vessels for certain deep-sea fish stocks.

xxxi Council Regulation (EU) 2020/123 of 27 January 2020 fixing for 2020 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters.

current CFP, and its international weight, **the EU must take a leading role in the development of integrated and binding policies for the sustainable exploitation of sharks and rays.**

The management of fisheries implemented under the CFP[xxxii] is complemented by Portuguese legislation[76]. Shark and ray fishing is subject to the legal regime of professional commercial fisheries and to the authorisation, registration, and licensing of vessels[xxxiii]. Since 2018/2019, it is mandatory to land all catches of sharks and rays, including bycatch, which are subject to TACs[xxxiv]. However, the many exceptions[xxxv] do not allow the effective application of this measure.

Although there are virtually **no measures in force at national level to minimise bycatch, those few relevant to sharks and rays relate to fishing effort management, such as catch limits, seasonal closures, and minimum catch sizes for some species**, ban of some fishing gears, and retention bans for some species. Specifically:

- Time restrictions and minimum sizes for rays (family Rajidae)[xxxvi]: minimum sizes of 52 cm (Rajidae) and 72 cm (undulate ray)[xxxvii] and seasonal closures between May and June and May and July, respectively.

- Rules and bans on the use of certain fishing gears: i) on the mainland and applicable to rays, ≥ 70 mm mesh size for trawl nets and ≥ 100 mm mesh size for gillnets; ii) in the Azores and Madeira, ban on the use of trawl nets and gillnets in deep-sea waters[xxxviii]; iii) ban on the use of steel wires in longliners operating in Azorean waters[xxxix].

- Retention bans of certain species such as the bigeye thresher (*Alopias superciliosus*), hammerhead sharks (i.e., the entire Sphyrnidae family, except *Sphyrna tiburo*), oceanic whitetip shark, and silky shark (*Carcharhinus falciformis*), although there are some exceptions to retention bans[xl].

- Licensing, control, and monitoring of the fishing effort scheme applicable to deep-sea species fisheries in the Northeast Atlantic[xli]: restrictions on targeted deep-sea shark fisheries and a seven-tonne limit (between 2017 and 2020) for Portuguese artisanal fisheries using deep-sea longline targeting black scabbardfish, as well as establishing mandatory data collection on deep-sea sharks.

- Establishment of retention bans and catch limits for certain species: shortfin mako, blue shark, tope, and thornback ray applicable to the Azores EEZ[xlii].

For more details on prohibited species, management measures, and scientific advice, see Annexes 6, 7, and 8.

xxxii Decree-Law (PT) No 10/2017 on control regime under Common Fisheries Policy: https://data.dre.pt/eli/dec-lei/10/2017/01/10/p/dre/pt/html

xxxiii Decree-Law (PT) Nº 73/2020 on licensing, register and authorization of commercial fishing activity: https://data.dre.pt/eli/dec-lei/73/2020/09/23/p/dre

xxxiv Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures.

xxxv Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy.

xxxvi Ordinance (PT) No 315/2011 on temporal restrictions for Rajidae: https://data.dre.pt/eli/port/315/2011/p/cons/20160321/pt/html; Ordinance (PT) No 170/2014 on minimum sizes for Rajidae: https://data.dre.pt/eli/port/170/2014/08/22/p/dre/pt/html

xxxvii Ordinance (PT) No 4/2019 on management measures for undulate ray (Raja undulata): https://data.dre.pt/eli/port/4/2019/01/03/p/dre/pt/html

xxxviii Regulation (EU) 2019/1241.

xxxix Ordinance (PT) No 116/2018.

xl Council Regulation (EU) 2020/123; Regulation (EU) 2019/1241; Council Regulation (EU) 2018/2025.

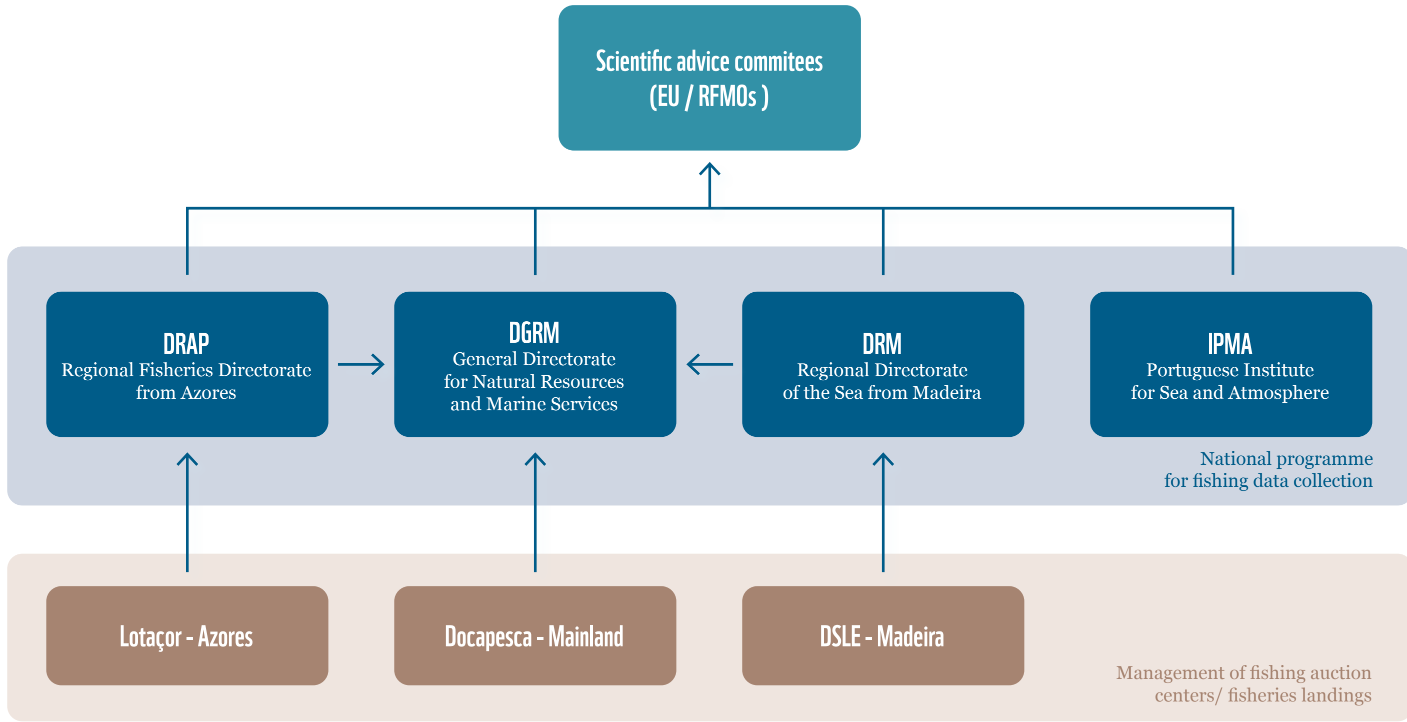


Figure 26. Portuguese main entities and their competences related to the management of Elasmobranchs.

At national level, DGRM implements EU regulations for fisheries, also defining the measures to be applied for national fisheries that are not EU-regulated. Official national landings data are compiled by the institutions managing fishing landing harbours (i.e., auction centres): Docapesca, Lotaçor, and DSLE (*Direção de Serviços de Lotas e Entrepostos*), located in the mainland, Azores, and Madeira, respectively. These data are communicated to DGRM which, in turn, reports them to INE, to the EU, and to fishery management bodies (Fig. 26).

The Portuguese Institute for Sea and Atmosphere (*Instituto Português do Mar e da Atmosfera*, IPMA) is the national public body responsible for the assessment of commercial fishery stocks and may also provide scientific advice when requested by the government. Elements of IPMA, of Madeira and the Azores, and national experts are also part of working groups in scientific advisory committees such as ICCAT, ICES, and STECF. Currently, five species of rays are considered as commercial stocks in Portugal and reported to ICES for scientific advice: thornback ray, blonde ray, spotted ray, cuckoo ray, and undulate ray.

The ICNF acts indirectly in the management of species by assessing their conservation status covered by international conventions of biodiversity conservation, having focal point functions, as in the case of CITES, being later responsible for reporting their implementation in the national territory. In this context, as a CITES national administrative authority, and after the inclusion of the shortfin mako in CITES Appendix II in 2019, it was necessary to issue a positive NDF for the introduction into the EU of mako individuals caught in international waters. In December 2020, due to the lack of measures to increase stocks of shortfin mako in the Atlantic Ocean, the EU's scientific analysis group decided to issue a negative opinion on placing specimens of this species from the North Atlantic Ocean on the EU market. This measure, made official by ICNF, was celebrated by many EU conservation organisations and entered into force on December 31, 2020[77]. In theory, **the catch, retention on board, landing, transport, and marketing of shortfin mako from North Atlantic international waters is now prohibited across the EU.**

xli Ordinance (PT) No 10/2021 on fisheries of deep-sea species listed in Annex I of the Regulation (UE) 2016/2336: https://data.dre.pt/eli/port/10/2021/01/08/p/dre

xlii Ordinance (PT) No 92/2019 amended by Ordinance (PT) Nº 113/2020 on establishing additional restrictions: https://jo.azores.gov.pt/#/ato/a3e009fe-3b30-429a-8747-8213777135d9

4. CONCLUSIONS

With more than a hundred species of sharks, rays, and chimaeras described, corresponding to 89% of those known in European waters and 9% of those known worldwide, **Portuguese waters are home to a very rich fauna of elasmobranchs.** These species are important to ensure the ocean's health and productivity, having a high ecological value and playing important and varied roles in marine ecosystems. These magnificent animals have been wrongly called villains or killers of the sea, words that do not make them justice, as **they are true Guardians of the Ocean.**

In Portugal, commercial fishing has a high impact on elasmobranchs, both in terms of the number of species caught and quantities landed. Although they are mainly caught as bycatch while targeting other species of greater commercial value, in some fisheries, such as surface longline, blue shark is already targeted by the fishery. The polyvalent and trawling fleets from the mainland have the highest catch of Elasmobranchs, but are the most difficult to monitor, especially the polyvalent fleet, which is mostly artisanal. **There are important differences between Mainland and Island fisheries**; in the mainland, rays are the main ecological group landed, while in the Azores and Madeira pelagic sharks and deep-sea sharks are the main landed group, respectively. These differences must be understood and integrated regionally in the management of fisheries if we are to ensure their long-term protection.

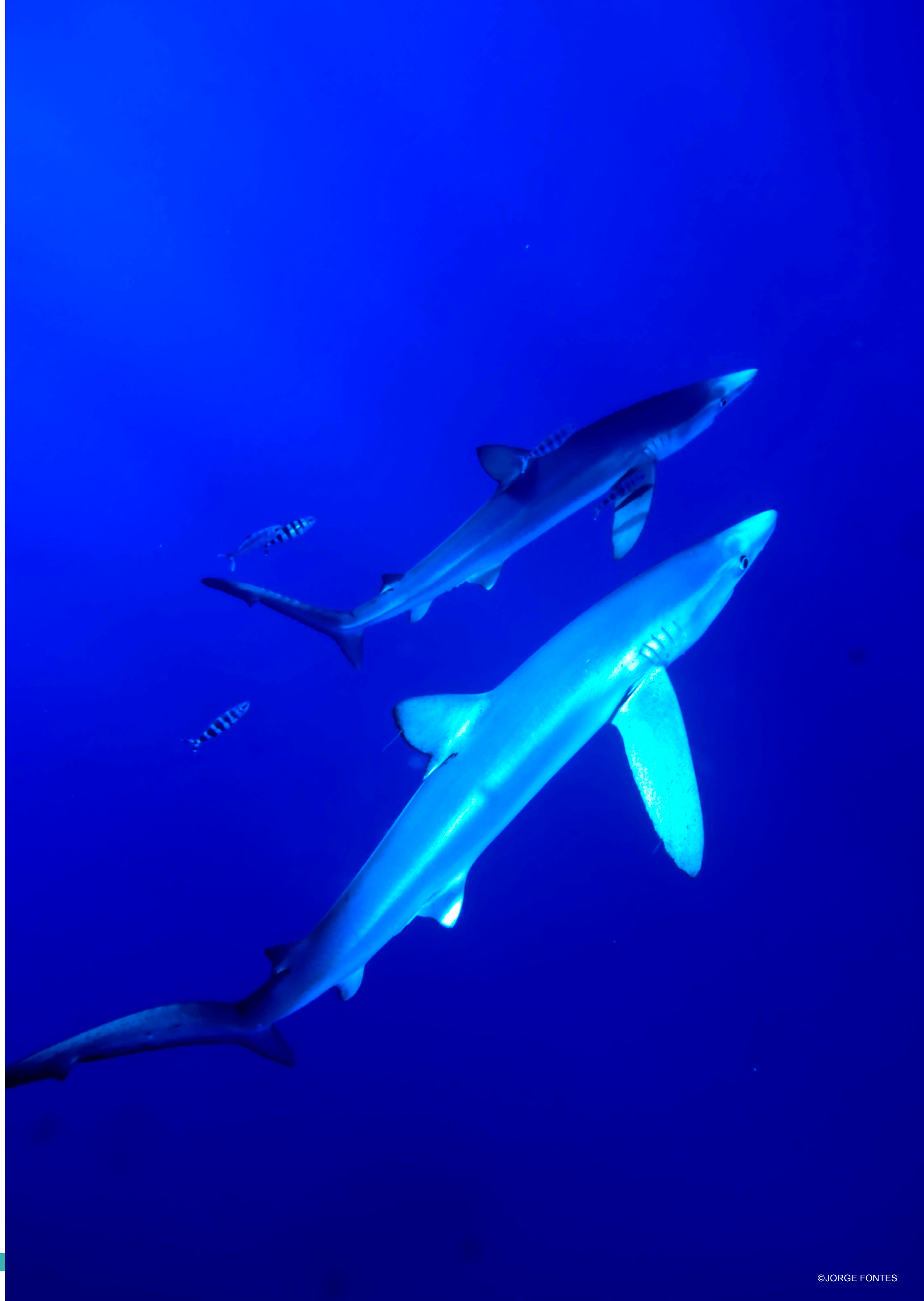
Globally, despite the difficulty of realising how many of these animals die due to targeted fishery and bycatch, fishery impacts are known to be very high and are rapidly bringing many species of elasmobranchs to the brink of extinction. Portugal is no exception, with 3% of the species under threat and populations declining, mounting evidence suggests that Elasmobranch fisheries in Portugal are not currently sustainable.

Although species protection and fisheries management of Elasmobranchs are a low priority for policy makers, demand for shark and ray-based products is on the rise, with their meat being consumed in both European and South American countries, and their fins being sold to Asian markets. This results in the worst possible combination: species that are highly valued for their fins, biologically vulnerable to intensive exploration due to their life cycle characteristics, and whose fishery is poorly regulated and underreported. The high demand for shark and ray products, without consideration of the sustainability of fisheries in the long term, the weak regulation of markets, low transparency, and poor traceability, as well as the illegal trade of endangered species, all contribute to undermine the conservation and protection efforts of the most vulnerable species.

SHARKS AND RAYS ARE REAL GUARDIANS OF THE OCEAN BUT THEY ARE IN PERIL. IT IS URGENT TO ADOPT CONSERVATION AND MANAGEMENT MEASURES TO SAFEGUARD A BETTER FUTURE FOR THIS SPECIES, THE OCEAN AND THE PEOPLE

To reverse population declines and prevent extinctions, it is necessary to drastically reduce fishing mortality to levels that allow the recovery of shark and ray populations. This requires a change in approach: from the top-down, through international and regional policy instruments, applying species protection measures and implementing sanctuaries and/or marine protected areas; to the bottom-up, at fisheries level, with particular focus on minimising bycatch in pelagic and deep-sea fisheries. It is necessary to quickly implement bycatch mitigation measures, already studied and with proven effectiveness, as is the case with the ban on steel wires in the longline fleet. Furthermore, strengthening surveillance and control mechanisms for fisheries and improving knowledge of species in general is key to prevent extinctions and recover populations.

The consumption of Elasmobranchs in



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Portugal, although little studied, seems to focus more on rays than on sharks. Trade data shows that sharks do not play a role in national food security, and poor control records are allowing the trade of endangered species and unsustainable fisheries to feed the growing demand in international markets.

Until recently, the management of these fisheries was characterised by a lack of regulation or very weak legislation, which has allowed the severe depletion of many shark and ray populations.

Urgent action is needed at both micro and macro scales to reduce the high bycatch and the unsustainable demand for fins, and now also for meat. The survival of Elasmobranch populations cannot be ensured without protection and management measures based on scientific advice, or without sufficient information about these species. Restricting international trade through CITES and other instruments may help, but implementation has been delayed and usually only occurs when species are already seriously threatened. **It is also necessary to promote awareness on the consumption of shark and ray products. An integrated approach is urgently needed, as well as the establishment of protection measures, sanctuaries, and catch bans to reverse the decline and possible disappearance of sharks and rays from the ocean.**

PORTUGAL CURRENTLY DOES NOT HAVE A NATIONAL PLAN OF ACTION FOR SHARKS AND RAYS, WHICH RESULTS IN THE ABSENCE OF PROPER AND COORDINATED EFFORTS OF CONSERVATION. THE CREATION AND IMPLEMENTATION OF A NATIONAL PLAN OF ACTION FOR SHARKS AND RAYS IS AN URGENT AND ESSENTIAL STEP FOR AN EFFECTIVE MANAGEMENT OF THESE SPECIES

EU Member States have a very important role in the catch and trade of sharks and rays and associated products, and they are finally taking a leading role in the application of international treaties for the protection of these species. The 2009 European Plan of Action for Sharks and Rays, although only prepared 10 years after the international plan developed by FAO, allowed setting the stage for significant improvements in the management of Elasmobranchs. The EU must now move forward with the rapid implementation of its Plan of Action and actively collaborate with other countries, strengthening regulations related to finning, monitoring, control, and surveillance, and providing special protection for shark and ray species under the 'protected' or 'threatened' status.

Currently, Portugal does not have a Plan of Action for Sharks and Rays, resulting in an absence of adequate and coordinated conservation efforts. **The development and implementation of a Plan of Action for Sharks and Rays is an urgent and essential step for the effective management of these species** to counter the usual practice of loose measures being introduced in a pattern with already predictable consequences: there is a sharp decline in the number of individuals of a species; there is a on board retention ban (which is mostly bycatch); the collection of fisheries data on this species (the only source of data for monitoring these species) is no longer available because catch (and landing) is now banned; the species is eventually landed under another non-prohibited species designation or discarded at sea.

Urgent, courageous, and pragmatic changes are needed to ensure the protection of elasmobranch populations and an integrated approach to fisheries, trade, and policies. **Portugal must set an example, at European and international levels, of its commitment to protect the Guardians of the Ocean. This is essential to guarantee a better future for the ocean itself and, ultimately, for the Portuguese people who depend on it so much.**

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What can we do?

Conservation measures for sharks and rays

There is an urgent need to implement management measures at different scales, both nationally and internationally. These measures may involve the strict regulation and management of fisheries, such as defining temporary fishing closures at specific times and zones and the establishment of marine protected areas and sanctuaries for sharks and rays. It is also necessary to change the way fisheries are carried out, be it structural modifications to improve the selectivity of fishing gears and the promotion of best practices on board, to minimise the impact of bycatches and increase the survival of individuals discarded at sea[78].

As sharks and rays are more frequently found in areas of the ocean with specific oceanographic characteristics and exhibit different behaviours in terms of swimming and position in the water column, studies targeting the behaviour of these species and studies on how they interact with fishing grounds and gears[79] are urgent.

Marine Protected Areas

Marine protected areas (MPAs) are designated areas in marine ecosystems that can have various levels of protection. These range from a total ban on extractive human activities (full protection), commonly applied to reduce the impacts of fishing as it promotes a faster recovery of stocks, to allowing certain activities while imposing some restrictions. In the Pacific Ocean, MPAs covering areas and shark species associated with coral reefs need to increase their current size by at least five times and to include bans on fishing activities. **In the Atlantic Ocean**, which has lower population densities than the Pacific, **there is also evidence that MPAs should be increased by 1.6 to 2.6 times and include bans on human activities to decrease shark and ray fishing mortality**[80].

Since 2009, 15 countries with Atlantic, Indian, or Pacific coasts have established shark sanctuaries, which comprise areas where targeted commercial shark fishing is banned, and have laws that prohibit the catch, trade, or sale of shark and ray products. These areas typically cover the entire EEZ of coastal countries and currently represent more than 3% of the ocean, similar to the global area occupied by MPAs[81]. Shark catch, trade, and abundance data can be used to assess the effectiveness of these sanctuaries and evidence the need to have baseline data for these areas[82]. **Sanctuaries show a smaller decline in shark and ray populations, and records demonstrate a reduced number of sharks sold on the market compared to other marine areas.** However, sanctuaries do not solve the bycatch, pollution, and habitat destruction problems on their own and complementary measures are needed[82].

The ecological and economic benefits of these spatial protection measures are recognised for many reef and demersal species. But for highly migratory fish, such as pelagic sharks, it is still necessary to know the species' migration routes and aggregation behaviours and include these areas in spatial protection measures. Knowing these features for each species provides an important opportunity, although often overlooked, to safeguard and even recover stocks of pelagic species. The existence of new remote monitoring tools, both for species and for fishing fleets, offers a way to improve spatial management, especially in areas that are difficult to monitor[83].

Although studies dedicated to MPAs are scarce in Portugal, the Gulf Stream in the Atlantic and the areas around the Azores archipelago are known to be critical habitats for sharks, and there is evidence of blue shark nursery grounds. On the Portuguese mainland, there is also evidence of blue shark nursery grounds, and the underwater canyons between the Tagus estuary, Cape Espichel and the Sado estuary seem to be important areas for the feeding and growth of these ocean migrants. It is also known that the shortfin mako is more susceptible to fishing during summer and autumn months, when it moves to areas where the Gulf Stream and the Labrador Current converge[84]. This type of information allows defining important marine areas and critical times of the year for the life cycle of shark and ray species, which must be implemented as species protection and fisheries management measures.

Sustainable fisheries

Sustainable shark fishing has been achieved only in some countries and for some relatively small and highly productive species, given that, globally speaking, 91% of shark catches are currently unsustainable[85]. Determining the sustainability of shark and ray fisheries requires an assessment of their impacts on the ecosystem, which are often overlooked in fisheries stock assessments[86]. However, for sharks, as for other predators, this assessment is extremely important as the sharp declines of these species can cause cascading effects on marine food chains, impacting other fisheries. In Portugal, shark and ray fisheries occur mainly as bycatch and do not have contribute to the national food security since both meat and fins are mainly exported. Fins have a low nutritional value and are usually consumed as a delicacy in Southeast Asian countries. Additionally, excessive consumption of shark meat is discouraged due to the high concentration of heavy metals in their muscles and liver[29,67]. **Given the EU's central role in the shark and ray markets, it is crucial to implement management measures to monitor and control their fisheries and minimise bycatches**[87]. The implementation of a ban on the use of steel wires on both surface and deep-sea longliners is a simple but effective measure, which greatly reduces the bycatch of sharks without prejudice to the catch of target species. In Brazil, in the last decade, shark meat trading increased rapidly as the national and foreign fleets began to target sharks. Brazil is actually one of the emerging countries in shark meat consumption, and although markets have not previously sold this product, its low value and government incentives have pushed shark meat into national distribution chains[88]. Improving the control of the trade of these species is key, especially in a market where the transparency and traceability of products is still a major problem. In the United States, for example, a bill has been discussed to eliminate shark fin sales (Shark Fin Sales Elimination Act). If passed, this bill could also pressure Europe to adopt a more rigid stance in the shark and ray trade, especially of their fins. The environmental and economic value of live sharks and rays, for example in marine life observation tourism, is also increasingly recognised as far exceeding the sale value of these species in the markets, often in at least two orders of magnitude[85].

DATA FROM CAPTURES, TRADE AND ABUNDANCE OF SHARKS CAN BE USED TO EVALUATE THE EFFECTIVENESS OF SANCTUARY ZONES AND DEMONSTRATE THE NEED TO HAVE REFERENCE DATA FOR THESE AREAS


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Minimisation of bycatches

Bycatch is considered a major problem in shark and ray fisheries management, especially in longline fisheries where shark catches are higher than those of the target species[91]. It is therefore vital to adopt measures to minimise bycatch with particular emphasis on this fishery.

Although studies to minimise bycatches in trawl nets are scarce in Portugal, the placement of a rigid grid combined with an escape area, a mechanism commonly known as TED (turtle excluder device) is being tested, which may also reduce bycatch of sharks and rays. In a deep-sea longline fishery, when placing the hooks further away from the seabed the number of shark bycatches can be reduced by 16 to 33%[57].

Other scientific studies have shown that shark catch rates are higher when using steel wires on longlines, instead of the usual monofilament nylon line[92]. When sharks are caught by steel wires, they remain trapped for many hours until the device is retracted, and the hooks may have been (or still are) attached to the body causing injury, increased stress, or even death[93]. The use of nylon wires leads to a decrease in bycatch as sharks can free themselves from the wires, increasing their survival rate. Also, using monofilament nylon wires increases catches of the targeted species, such as swordfish and tuna[94], and fishers only use steel wires when wanting to catch sharks, thereby transforming the fishery into a targeted sharks one.

The use of steel wires in the longline fleet fishery in the Azorean EEZ has recently been banned, as a measure to reduce bycatch and this could, and should, be extended to the entire fleet.

Fisheries independent monitoring and surveillance

Many institutions, from non-governmental organisations (NGOs) to research centres, are calling for greater accountability and transparency of fishing fleets and for the implementation of more effective tools to monitor fisheries.

This type of monitoring is usually done using onboard observers, especially in fisheries where there is a high risk of bycatch. With 40 million fishing boats operating in the ocean (87,000 in European waters alone) and an especially harsh and dangerous working environments, the percentage of fisheries covered by this type of monitoring is insufficient, often less than 1%.

Additionally, observers who are at sea for long periods are exposed to the use of heavy machinery in particularly rough seas, to the hostility of crews, due to the tension between observers' data and fishermen's livelihoods, and are often alone and unsupported. As such, reports of accidents, injuries, intimidation, abuse, and unexplained deaths have been reported in some monitoring programs around the world[89].

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In the last two decades, alternative monitoring systems have emerged using electronic surveillance with cameras, motion sensors, and general positioning systems (GPS), which do not require onboard observers and allow real catch documentation and more detailed information on fishing effort estimates. Remote electronic monitoring (REM) is a powerful tool to ensure fisheries sustainability and it has great potential to significantly increase the percentage coverage of monitoring programmes by improving catch records, location of fishing activities, and identification of the gears in use. Indirectly, **REM can encourage the adoption of best practices on board and reduce illegal fishing and discards, while improving screening, transparency, and market access.** Used together with onboard observers, it can serve as an alternative support and registration system, reducing the risk of abuse to observers and promoting improved transparency of fishing fleets[90]. In Portugal, this type of surveillance can be important for monitoring artisanal and polyvalent fisheries.

However, fishery managers and the industry have been very reluctant to embrace this type of monitoring, claiming intrusion on their privacy, thus slowing down its implementation. In Europe, for instance, REM programmes are still in the testing phase.

It is necessary to take more pragmatic and courageous approaches to the conservation of sharks and rays and drastically reduce their mortality due to fisheries. There is an urgent need to change behaviours and implement effective protection measures for these species, to prevent one of the greatest environmental crises that the ocean is facing, i.e., the loss of its guardians.

OVER THE LAST TWO DECADES, ALTERNATIVE SYSTEMS OF MONITORING HAVE EMERGED, USING ELECTRONIC SURVEILLANCE WITH CAMERAS, ACTIVITY SENSORS AND GPS, THAT DON'T REQUIRE ON BOARD OBSERVERS AND ALLOW FOR A MORE DETAILED DOCUMENTATION OF CAPTURES AND ESTIMATES OF THE FISHING EFFORT

5. RECOMMENDATIONS

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Seven general recommendations for the conservation and management of Elasmobranchs are presented in this section, and detailed recommendations, by stakeholder and priority level, based on short (< 1 year), medium (1-3 years), and long term (> 3 years) implementation periods are also presented in a colour-coded scale: <1 year, 1-3 years, and >3 years.

General recommendations

1. To develop, adopt and implement a Plan of Action for the Management and Conservation of Sharks and Rays in Portugal.
2. To promote the effective protection and recovery of stocks of threatened species, both targeted and non-targeted by fisheries (bycatch), through CITES and national legislation (DGRM) that includes protection and management measures based on the best available knowledge and the precautionary principle.
3. To adopt measures to minimise bycatch and discards, and best practices on board to improve the survival of individuals discarded at sea.
4. To improve the quality of fisheries scientific data regarding Elasmobranch species in Portuguese waters.
5. To ban the catch, trade, and consumption of threatened species, and define stricter regulations for shark and ray products for all species traded.
6. To improve the monitoring and surveillance of Elasmobranch fisheries, including artisanal and polyvalent fisheries.
7. To define marine protected/sanctuary areas with a total fishing ban, considering the species and essential habitats for sharks and rays.

Authorities

- To start developing a Plan of Action for the Management and Conservation of Sharks and Rays that includes the specificities of the national fleet, in both the Mainland and the Islands, to be drafted until March 2022 with subsequent implementation.
- To establish strong restrictions and bans on target fishing and/or bycatch of endangered species and/or those with insufficient information.
- To adopt measures to reduce bycatch and discards in the multiannual fishery plans, with special priority for deep-sea species due to their low probability of survival upon release.
- To establish appropriate management measures always based on science and the precautionary principle – total allowed catches (TACs), minimum sizes, time and spatial restrictions, protection of breeding and immature individuals, etc., at the species level and prioritizing the most heavily fished species: thornback ray, lesser spotted dogfish, blue shark, blonde ray, small-eyed ray, spotted ray, shortfin mako, longnose skate, blackmouth catshark, and torpedo rays.
- To fund collaborative research with stakeholders and test measures to minimise bycatch, with priority for fishing gears with greater interactions with Elasmobranchs.
- To ban the use of steel wires in the entire national longline fleet.
- To establish temporal restrictions on the surface longline fishery between March and June, in the Azores EEZ, for the protection of blue shark nurseries.
- To conduct scientific surveys and evaluations of Elasmobranch main stocks exploited and caught by the national fleet to support the definition of TACs based on CPUE and the definition/update of conservation status.
- To establish, encourage, and monitor best practices on board to reduce catches and increase the survival rate of sharks and rays discarded at sea, including the correct handling of animals and respect the temporal and spatial restrictions on fisheries.
- To ensure the long-term retention ban and trade of shortfin mako in Portuguese and international EEZ waters, due to the high vulnerability of this species.
- To impose a total ban, strict control, and punitive mechanisms for the entry into international trade circuits of products based on threatened shark and ray species.
- To assess the effectiveness of current management measures, especially retention bans and immediate release obligation by increasing onboard monitoring.
- To collaborate with the Spanish government in the implementation of common measures for the Portuguese and Spanish fleets with the highest elasmobranch catches.
- To distinguish between ray and shark fins in the export and import databases and to start identification at the species level.
- To improve species identification at fishing auction centres, providing stakeholders with identification guides and mechanisms.
- To promote the reporting of all Elasmobranch catches from the Portuguese EEZ, even if not landed in national auction centres.
- To promote the harmonisation, at the European level, of the information to be included on shark and ray-based product labels, as well as the inclusion of the terms "shark" and "ray".

- To promote mechanisms for the traceability and transparency of supply and distribution chains for shark and ray-based products.
- To provide species in the Annex II of CITES a threatened status to regulate their catch and trade.
- To support the inclusion of deep-sea species in the main international conventions' annexes.
- To promote the assessment of 'Data Deficient' species to support the definition of their IUCN conservation status.
- To include sharks and rays as priority species in the designation of marine protected areas, which should cover their feeding, reproduction, nursery, and migration areas over sufficiently large areas.
- To create a national database for recreational fisheries, with information at the species level for quantities and catch locations.
- To promote a study on the operability and effectiveness of the finning ban and fin trade, and on the reduction of the meat trade.
- To promote an operational and effectiveness study to establish sanctuaries/marine protected areas for sharks and rays in the Portuguese EEZ.
- To promote the harmonisation and the regular information exchange between the DGRM and INE databases, and of these with international databases, with inclusion of information at the species level, reducing the use of generic groups.

- To promote the definition and development of scientific criteria to assess the sustainability of elasmobranch fisheries, aiming for lower impact and higher selectivity.
- To create working groups with different stakeholders (authorities, fishermen, researchers, environmental NGOs, etc.) to promote data sharing, strengthen monitoring, control, and surveillance, and to support the implementation of the best available techniques on board.

Research Centres and Universities

- To carry out collaborative research with stakeholders that includes testing, implementation, and assessment of the effectiveness of measures to minimise bycatch.
- To study fishery interactions with gillnets and trammel nets, beach seine, purse seine, and trawling.
- To provide, on a compulsory basis, CPUE data (e.g., number of fish per 1,000 hooks), which is essential for proper stock assessments.
- To study and test monitoring alternatives for small-scale fisheries (e.g., mobile phone applications, onboard cameras).
- To create good practice guides and release protocols for discards.
- To develop a study on the mortality rates of the different species with on-board retention bans.
- To identify habitats and critical times for the life cycle of species, with special priority for areas that overlap with human activities, aiming to establish sanctuaries and/or MPAs.
- To use local ecological knowledge to obtain information on ´Data Deficient´ species.
- To increase research on indicators of commercial stocks sustainability with special priority for those with the highest catches and those belonging to ICES categories 4, 5, and 6.

- To collaborate with auction centres and management entities to train and assist workers in the identification of landed sharks and rays at a species level.
- To establish a network of independent onboard observers in collaboration with the authorities, prepared to monitor the capture of shark and ray species.
- To study individual species behaviours and interactions with the fisheries.
- To carry out research on the international trade, supply chains, and national consumption levels of shark and ray products.

- To assess the impact of recreational fishing and catch and release practices on elasmobranch survival.
- To carry out studies applied to Portuguese Chimaera species and the impact of fisheries on their populations.

Commercial and recreational fisheries

- To collaborate and implement good practices onboard to reduce bycatch and discard-associated mortality.
- To collaborate in the selection and testing of fishing gear modifications to decrease the catch of sharks and rays.
- To collect information on all catches from commercial fisheries of elasmobranchs, including bycatch and discards, locations, and fishing gears in use.
- To voluntarily adopt monitoring and surveillance systems to improve fisheries transparency.
- To accept not fishing at specific times of the year or in places with high catches of sharks and rays and to do not modify fishing gears to increase catches of these species.

- To collect end-of-life fishing gears and bring them to shore, respecting the principles of the circular economy.
- To be available and committed to integrate elasmobranch fishery management working groups.
- To adopt catch and release practices in recreational fisheries, especially for large and immature specimens.

- To implement logbooks in recreational fisheries documenting all catches that can then be included in a national database.

Consumers and distributors (HORECA)

- To mandatorily provide more detailed information on shark and ray products, including the designation of "shark" or "ray" on sale products.
- To require detailed information on species, sources, and fishing gears used, and not selling endangered species or species obtained in international waters or using destructive gear, such as trawling.
- To never support and/or consume shark fin and/or meat from endangered species, not proven to come from low-impact fisheries.
- To not consume shark and ray products due to their high ecological value and human health risks on account of their high levels of potential contamination by persistent organic pollutants and heavy metals.
- To look for credible, science-based sources of information about sharks and rays.
- To participate in initiatives to mobilise citizens for the conservation of sharks and rays that promote behavioural changes, including online petitions.
- To check the labels of cosmetic products and food supplements, purchasing only those that do not contain "liver oil" or "squalene".
- To avoid excessive consumption of swordfish and tuna, and to obtain proof, either visually or from the supplier, that it is not shark meat.

- To require shark and ray products on the market to come from proven sustainable, transparent, and traceable fisheries and avoid frozen shark and ray products.
- To demand the adoption of genetic identification methods (DNA) by suppliers and distributors, along the entire value chain, to fight food and market fraud of prohibited and threatened species.

References

1 Inoue, J. G.; Miya, M.; Lam, K.; Tay, B.; Danks, J.A. et al. 2010.v Evolutionary Origin and Phylogeny of the Modern Holocephalans (Chondrichthyes: Chimaeriformes): A Mitogenomic Perspective. Molecular Biology and Evolution: 27(11), pp. 2576-2586.

2 Fricke, R.; Eschmeyer, W. N.; Van der Laan, R. 2020. Eschmeyer's Catalog of fishes: Genera, Species References. (Online version accessed on 07/01/2021: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp).

3 Kyne, P.; Simpfendorfer, C. L. 2010. Sharks and Their Relatives ll, Biodiversity, Adaptive Physiology, and Conservation. Taylor & Francis. 746 pp.

4 Nielsen J.; Hedeholm, R.; Heinemeier, J.; Bushnell P.J., Christianson, J.S. et al. 2016. Eye lens radiocarbon reveals centuries of longevity in the Greenland shark (Somniosus microcephalus). Science:353-6300, pp. 702-704.

5 Weigman, S. 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology:88, pp. 837-1037.

6 Lucifora, L.O.; García, V.B.; Worm, B. 2011. Global diversity hotspots and conservation priorities for sharks. PLoS One: 6(5)-e19356.

7 Nieto, A.; Ralph, G.M.; Comeros-Raynal, M.T.; Kemp, J.; García Criado, M. et al. 2015. European Red List of marine fishes. Luxembourg: Publications Office of the European Union. 88 pp.

8 WWF Shark and Ray Initiative 2020. (Website accessed on 10/08/2020: https://sharks.panda.org/conservation-focus/sharks-and-rays).

9 Rigby, C.L.; Barreto, R.; Carlson, J.; Fernando, D.; Fordham, S.; et al. 2019. Carcharhinus longimanus: The IUCN Red List of Threatened Species e.T39374A2911619.

10 Marshall, A.; Barreto, R.; Carlson, J.; Fernando, D.; Fordham, S. et al. 2020. Mobula birostris. The IUCN Red List of Threatened Species 2020: e.T198921A68632946.

11 Sanches, J. 1986. Nomenclatura e diagnose dos principais peixes marinhos de Portugal (Ciclóstomos, Seláceos e Holocéfalos). Instituto Nacional de Investigação das Pescas – Publicações Avulsas:9, pp. 43-128.

12 Barreiros, J.P.; Gadig O.B. 2011. Catálogo Ilustrado dos Tubarões e Raias dos Açores. Instituto Açoriano de Cultura. 198 pp.

13 Chin, A.; Bierwagen, S. 2018. The ecological roles of sharks and rays in marine environments. Report to the World Wide Fund for Nature, 41 pp.

14 Heupel, M.; Knip, D.M.; Simpfendorfer, C.A.; Dulvy, N.K. 2014. Sizing up the ecological role of sharks as predators. Mar. Ecol. Prog.: 495, pp. 291-298.

15 O'Shea, O.R.; Thums, M.; van Keulen, M.; Meekan, M. 2012. Bioturbation by stingrays at Ningaloo Reef, Western Australia. Marine and Freshwater Research 63, pp. 189-197.

16 Compagno, L.J.V. 1990. Alternative life-history styles of cartilaginous fishes in time and space. Environmental Biology of Fishes: 28, pp. 33-75.

17 Fontes, J.; McGintyc, N.; Machete M.; Afonso, P. 2020. Whale shark-tuna associations, insights from a small pole-and-line fishery from the mid-north Atlantic. Fisheries Research: 229, 9 pp.

18 Dulvy, N.K.; Fowler, S.L.; Musick, J.A.; Cavanagh, R.D.; Kyne, P.M.; et al. 2014. Extinction risk and conservation of the world's sharks and rays. eLife: 3 - e00590.

19 Dulvy, N.K.N.; Simpfendorfer, C.A.; Davidson, L.N.K.; Fordham, S.V.; Brautigam, A. et al. 2017. Challenges and priorities in shark and ray conservation. Curr. Biol: 27, pp 565-572.

20 Dent, F.; Clarke, S.C. 2015. State of the global market for shark products, FAO Fisheries and Aquaculture Technical Paper: 590, 196 pp.

21 Birkmanis, C.; Partridge, J.; Simmons, L.; Heupel, M.; Sequeira, A. 2020. Shark conservation hindered by lack of habitat protection. Global Ecology and Conservation: 21 - e00862.

22 FAO. 2010. Report of the technical consultation to develop international guidelines on bycatch management and reduction of discards. FAO Fisheries and Aquaculture Report: 957, 41 pp.

23 Kelleher, K .2005. Discards in the world's marine fisheries. An update. FAO Fisheries Technical Paper: 470. 131 pp.

24 Correia, J.P.S. 2009. Pesca comercial de tubarões e raias em Portugal. Dissertação de Doutoramento em Biologia. Universidade de Aveiro. 402 pp.

25 Sharksider e IFLScience (Websites accessed on 22/01/2021: www.sharksider.com/ and www.iflscience.com/plants-and-animals/true-price-shark-fin-soup/).

26 Freire, K.M.F.; Belhabib, D.; Espedido, J.C.; Hood, L.; Kleisner, K.M. et al. 2020. Estimating Global Catches of Marine Recreational Fisheries. Front. Mar. Sci.: 7-12.

27 Worm, B.; Davis, B.; Kettemer, L.; Ward-Paige, C.; Chapman, D. et al. 2013. Global catches, exploitation rates and rebuilding options for sharks. Mar. Policy: 40, pp. 194-204.

28 Agnew, D.J.; Pearce, J.; Pramod, G.; Peatman, T.; Watson, R. et al. 2009. Estimating the Worldwide Extent of Illegal Fishing. PLoS ONE: 4(2) - e4570.

29 Alves, L., Nunes, M., Lemos, M., Novais, S. 2016. Blue sharks (Prionace glauca) as bioindicators of pollution and health in the Atlantic Ocean: Contamination levels and biochemical stress responses. Science of the Total Environment: 563-564, pp. 282-292.

30 Rosa, R.; Baptista, M.; Lopes, V.M.; Pegado, M.R.; Paula, J.R., et al. 2014. Early-life exposure to climate change impairs tropical shark survival. Proc. R. Soc. B 281: 20141738.

31 Wheeler, C.R.; Rummer, J.L.; Bailey, B.; Lockwood, J.; Vance, S.; et al. 2021. Future thermal regimes for epaulette sharks (Hemiscyllium ocellatum): growth and metabolic performance cease to be optimal. Scientific Reports: 11(454).

32 IUCN. 2020 (Website accessed on 15/12/2020 www.iucn.org/news/species/202012/european-bison-recovering-31-species-declared-extinct-iucn-red-list.)

33 WWF 2021. Shark Recovery Initiative.

34 Dulvy, N.K.; Allen, D.J.; Ralph, G.M.; Walls, R.H.L. 2016. The conservation status of Sharks, Rays and Chimaeras in the Mediterranean Sea. IUCN.

35 Gibson, C.; Valenti, S.V.; Fordham, S.V.; Fowler, S.L. 2008. The Conservation of Northeast Atlantic Chondrichthyans: Report of the IUCN Shark Specialist Group Northeast Atlantic Red List Workshop. IUCN Species Survival Commission Shark Specialist Group. 76 pp.

36 Pacoureau, N.; Rigby, C.; Kyne, P.; Sherley. R.; Winker, H., et al. 2021. Half a century of global decline in oceanic sharks and rays. Nature: 589, pp. 567-571.

37 Ferretti, F.; Worm, B.; Britten, G.L.; Heithaus, M.R.; Lotze H.L. 2010. Patterns and ecosystem consequences of shark declines in the ocean. Ecology Letters:13, pp. 1055-1071.

38 Costa, M.J. 2018. Peixes de Portugal. 1ª Ed. Edições Afrontamento. 468 pp.

39 EC Sharks fisheries (Website accessed on 27/11/2020: https://ec.europa.eu/fisheries/marine_species/wild_species/sharks/sharks_fisheries_en).

40 Okes, N.; Sant, G. 2019. An overview of major shark traders, catchers and species. TRAFFIC, Cambridge, UK.

41 Lack, M.; Sant, G. 2009. Trends in Global Shark Catch and Recent Developments in Management. TRAFFIC International.

42 Alves, L.; Correia, J.; Lemosa, M.; Novais, S.; Cabral, H. 2020. Assessment of trends in the Portuguese elasmobranch commercial landings over three decades (1986-2017). Fisheries Research:230-105648.

43 Davidson, L. N. K.; Krawchuk, M. A.; Dulvy, N. K. 2016. Why have global shark and ray landings declined: Improved management or overfishing? Fish and Fisheries: 17(2), pp. 438-458.

44 Correia, J.; Morgado, F.; Erzini, K.; Soares, A.M.V. 2016. Elasmobranch landings in the Portuguese commercial fishery from 1986 to 2009. Arquipelago - Life and Marine Sciences:33, pp. 81-109.

45 Pham, C.; Canha, A.; Diogo, H.; Pereira, J.; Prieto, R.; et al. 2013. Total marine fisheries catch for the Azores 1950–2010, ICES J. Mar. Sci.: 70, pp. 564-577.

46 DGRM. 2019. Frota de Pesca Portuguesa. 2019 Annual Report (Website accessed on 24/10/2020: www.dgrm.mm.gov.pt/documents/20143/46307/PT-RELAT%C3%93RIO+FROTA_2019.pdf/15bd50d8-01f8-a41d-0947-07137efa485b).

47 Torres, P.; Cunha, R.; Rodrigues, A. 2016. The elasmobranch fisheries of the Azores. Mar. Policy: 73, pp. 108-118.

48 Vandeperre, F.; Parra, H.; Machete, M. 2020. A pesca com palangre de superfície nos Açores. Relatório do projeto COSTA (Consolidating Sea Turtle conservation in the Azores). Direção Geral das Pescas dos Açores. 10 pp.

49 Ramos, H.; Silva, E.; Gonçalves, L. 2013. Reduction of deep-sea sharks' by-catches in the Portuguese long-line black scabbard fishery. Final Report to the European Commission MARE/2011/06 (SI2.602201).

50 Carvalho, N.; Edwards-Jones, G.; Isidro, E. 2011. Defining scale in fisheries: small versus large-scale fishing operations in the Azores. Fisheries Research: 109, pp. 360-369.

51 Fauconnet, L.; Ribeiro, A.; Catarino, D.; Giacomello, E.; Das, D., et al. 2020. Guia dos Tubarões de Profundidade dos Açores. Publicações científicas Okeanos: 2, 48 pp.

52 ICES. 2001. Report of the working group on biology and assessment of deep-sea fisheries resources. ICES CM 2001/ACFM: 23, 41pp.

53 DiscardLess. 2019. Discardless mitigation Strategies in the Azores Case Study – Deliverable 7.6. European Commission, pp. 12-23 (Report available on: www.discardless.eu/deliverables/entry/synthesis-of-discards-mitigation-strategies-by-case-study).

54 Bordalo-Machado P.; Fernandes, A.C.; Figueiredo, I.; Moura, O.; Reis, S.; Pestana, G.; et al. 2009. The black scabbardfish (Aphanopus carbo Lowe, 1839) fisheries from the Portuguese mainland and Madeira Island. Scientia Marina: 73, pp. 63-76.

55 ICES. 2018. Report of the Working Group on Elasmobranch Fishes (WGEF). ICES CM 2018/ACOM: 16, 1306 pp.

56 NAFO. 2002. Deep-water Sharks Fisheries from off the Portuguese Continental Coast. Scientific Council Meeting NAFO SCR Doc. 02/125.

57 Coelho, R.; Erzini, K. 2008. Effects of fishing methods on deep water shark species caught as by-catch off southern Portugal. Hydrobiologia: 606, pp. 187-193.

58 Moura, T.; Fernandes, A.; Figueiredo, I.; Alpoim, R.; Azevedo, M. 2015. Results from the pilot study on the Portuguese trammel nets fishery targeting anglerfish in ICES Division IXa. Working Document to ICES-Working Group on Elasmobranch Fishes (WGEF), 7 pp.

59 Teixeira, C.; Silva, P.; Gamito, R.; Amoroso, S.; Lopes N. et al. 2020. Which are the best environmental conditions for catching the beach-seine target species? A Portuguese case study. Fisheries Oceanography: 29, pp. 276-289.

60 Leitão, F.; Baptista, V.; Erzini, K.; Iritani, D.; Zeller, D. 2014. Reconstruction of mainland Portugal Fisheries catches 1950-2010. Fisheries Centre - The University of British Columbia: 08, 30 pp.

61 Shiffman, D.S.; Bittick, S.J.; Cashion, M.S.; Colla, S.R.; Coristine, L.E.; et al. 2020. Inaccurate and Biased Global Media Coverage Underlies Public Misunderstanding of Shark Conservation - Threats and Solutions iScience: 23 (6).

62 Vallianos, C.; Sherry, J.; Hofford, A.; Baker, J. 2018. Sharks In Crisis: Evidence of positive behavioural change in China as new threats Emerge. Wild Aid Report. 28 pp.

63 Houtan, K.; Gagné, T.; Reygondeau, G.; Tanaka, K.; Palumbi, S. et al. 2020. Coastal sharks supply the global shark fin trade. Biology Letters: 10 (16).

64 Ferretti, F.; Jacoby, D.M.P.; Pfleger, M.O.; White, T.D.; Dent, F. et al. 2020. Shark fin trade bans and sustainable shark fisheries. Conservation letters: 13(3).

65 Atlas of Economic Complexity. 2020. (as it was on 15/12/2020: https://atlas.cid.harvard.edu/).

66 Goulart, P.; Veiga, F.J.; Grilo, C. 2018. The evolution of fisheries in Portugal: A methodological reappraisal with insights from economics. Fisheries Research: 199, pp. 76-80.

67 Oliver, N.; Shipley, O.N.; Cheng-Shiuan, C.; Fisher, N.; Sternlicht, J. et al. 2021. Metal concentrations in coastal sharks from The Bahamas with a focus on the Caribbean Reef shark. Nature Scientific Reports: 11 (218).

68 European Commission - CFP Fishing Rules. 2020. (Website accessed on 12/11/2020: https://ec.europa.eu/fisheries/cfp/fishing_rules_pt).

69 Moreno, A.; Silva, A.; Melo, A.; Pereira, B.; Silva, C. et al. 2020. Estado dos stocks e aconselhamento científico para a sua gestão em 2019. Annual report on the status of fishing resources exploited by the mainland's national fleet. IPMA, Departamento do Mar e dos Recursos Marinhos, Divisão de Modelação e Gestão dos Recursos da Pesca. 133 pp.

70 Nakamura, J.N.; Kuemlangan, B. 2020. Implementing the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) through national fisheries legal frameworks: a study and a guide. FAO Legal Guide: 4. 146 pp.

71 UNCLOS. 2020. (Website accessed on 10/12/2020: www.un.org/Depts/los/convention_agreements/texts/unclos/annex1.htm).

72 CMS. 2020. (Website accessed on 10/12/2020: www.cms.int/sites/default/files/basic_page_documents/appendices_cop13_e_0.pdf).

73 CITES. 2020. (Website accessed on 10/12/2020: https://cites.org/eng/app/appendices.php).

74 Murua, H.F.; Abascal, J.; Amande, J.; Ariz, P.; Bach, P.; et al. 2013. Provision of scientific advice for the purpose of the implementation of the EUPOA sharks. European Commission - Studies for Carrying out the Common Fisheries Policy: MARE/2010/11 - LOT 2.

75 EC Fisheries. 2020. Website accessed on 15/12/2020: https://ec.europa.eu/fisheries/marine_species/wild_species/sharks/sharks_action_plan).

76 DGRM. 2020. (Website accessed on 17/12/2020: www.dgrm.mm.gov.pt/pesca_cpt_especies).

77 ICNF. 2021. (Website accessed on 09/01/2021: www.icnf.pt/imprensa/tubaraoanequimisurusoxyrinchus).

78 Bräutigam, A.; Callow, M.; Campbell, I.R.; Camhi, M.D.; Cornish, A.S. et al. 2015. Global Priorities for Conserving Sharks and Rays: A 2015-2025 Strategy. Global Sharks and Rays Initiative. 15 pp.

79 COFREPECHE; Ifremer; SCAPECHE. 2014. Reduction of gear impact and discards in deep sea fisheries. DG Mare: Contract MARE/2011/07 – Studies on the common fisheries policy Lot 1. 202 pp.

80 Dwyer, R.; Krueck, N.; Udyawer, V.; Heupel, M.; Chapman, D. 2020. Individual and Population Benefits of Marine Reserves for Reef Sharks. Current Biology: 30(3), pp. 480-489.

81 Ward-Paige, C.; Worm, B. 2017. Global evaluation of shark sanctuaries. Global Environmental Change: 47, pp. 174-189.

82 Ward-Paige, C. 2017. A global overview of shark sanctuary regulations and their impact on shark fisheries. Marine Policy: 82, pp. 87-97.

83 Boerder, K.; Schiller, L.; Worm, B. 2019. Not all who wander are lost: Improving spatial protection for large pelagic fishes. Marine Policy: 105, pp. 80-90.

84 Queiroz, N.; Humphries, N.E.; Couto, A. Marisa Vedor, M.; Costa, I. et al. 2019. Global spatial risk assessment of sharks under the footprint of fisheries. Nature: 572 (7770), pp. 461-466.

85 Simpfendorfer, C. A.; Dulvy, N. K. 2017. Bright spots of sustainable shark fishing. Current Biology: 27(3), pp. 97-98.

86 Ferretti, F.; Jacoby, D.M.P.; Pfleger, M.O.; White, T.D.; Dent, F. et al. 2020. Shark fin trade bans and sustainable shark fisheries. Conservation letters. Vol 13:3.

87 Mitcheson, Y. S.; Andersson, A. A.; Hofford, A.; Law, C. S.; Hau, L. C., et al. 2018. Out of control means off the menu: The case for ceasing consumption of luxury products from highly vulnerable species when international trade cannot be adequately controlled; shark fin as a case study. Marine Policy: 98, pp. 115-120.

88 Bornatowski, H.; Braga, R. R.; Barreto, R. P. 2018. Elasmobranchs Consumption in Brazil: Impacts and Consequences. In Book: Rossi-Santos, M. & Finkl, C. 2018. Advances in Marine Vertebrate Research in Latin America. Coastal Research Library: 22, pp. 251-262.

89 Course, G.P.; Pierre, J.; Howell, B.K. 2020. What's in the Net? Using camera technology to monitor, and support mitigation of wildlife bycatch in fisheries. WWF. 53 pp.

90 van Helmond, A. T. M.; Mortensen, L. O.; Plet-Hansen, K. S.; Ulrich, C.; Needle, C. L. et al. 2020. Electronic monitoring in fisheries: Lessons from global experiences and future opportunities. Fish and Fisheries: 21(1), pp. 162-189.

91. Barker, M.J.; Schluessel, V. 2005. Managing global shark fisheries: suggestions for prioritizing management strategies. Aquatic Conservation: Marine and Freshwater Ecosystems: 15, pp. 325-347.

92. Ward, P.; Lawerence, E.; Darbyshire, R.; Hindmarsh, S. 2008. Large-scale experiment shows that nylon leaders reduce shark bycatch and benefit pelagic longline fishers. Fisheries Research: 90, pp. 100-108.

93. Campana, S.E.; Joyce, W.; Manning, M.J. 2009. Bycatch and discard mortality in commercially caught blue sharks Prionace glauca assessed using archival satellite pop-up tags. Marine Ecology Progress Series: 387, pp. 241-253.

94. Gilman, E.; Clarke, S.; Brothers, N.; Alfaro-Shigueto, J.; Mandelman, J.; et al. 2007. Shark depredation and unwanted bycatch in pelagic longline fisheries: industry practices and attitudes and shark avoidance strategies. Western Pacific Regional Fishery Management Council, Honolulu, HI, USA.

Annex 1 Ocean Conservation Projects

OCEAN CONSERVATION FUND (OCEANÁRIO DE LISBOA AND OCEANO AZUL FOUNDATION) - 'RAYS AND SHARKS. FROM DARKNESS TO THE LIGHT OF SCIENCE'		
FINDRAYSHARK: APPLICATION OF INNOVATIVE TECHNOLOGIES IN THE CONSERVATION OF RAYS AND SHARKS	MARE – Centro de Ciências do Mar e do Ambiente *(Marine and Environmental Sciences Centre)*	1. To analyse the occurrence, abundance, and size of sharks and rays with two non-invasive complementary methods in Berlengas and Faial Island, through baited remote underwater stereo-video systems (BRUVS) and metabarcoding of environmental DNA; 2. To propose initiatives considering the local conditions, species in question, and different stakeholders; 3. To increase environmental awareness by organizing activities for different target groups.
ISLANDSHARK: OCEANIC ISLANDS AS ESSENTIAL HABITATS FOR MIGRATORY SHARKS	University of the Azores & OMA (Sea Observatory of the Azores - Observatório do Mar dos Açores)	1. To identify essential habitats in the Azores, using non-invasive techniques for two selected species of sharks: smooth hammerhead (*Sphyrna zygaena*) and tope shark (*Galeorhinus galeus*); 2. To obtain relevant ecological information for key marine species using complementary approaches regarding individual behaviour, aggregations, ocean migrations, and long-term population dynamics.
SHARK ATTRACT: CONSERVATION OF SHARKS AND RAYS THROUGH AWARENESS-RAISING TO FISHING COMMUNITIES AND SOCIETY	MARE – Centro de Ciências do Mar e do Ambiente *(Marine and Environmental Sciences Centre)*	1. To analyse fishery patterns and trends and to identify the main fishing gears and areas with greatest shark and ray mortality; 2. To promote changes in fisher's behaviours and fishing methods; 3. To promote awareness among fishers and the general public about the threats and needs for conservation.

Annex 2 Other relevant projects in Portugal

OTHER RELEVANT PROJECTS IN PORTUGAL	
TO MONITOR THE NORTH ATLANTIC IN SEARCH OF OVERLAP BETWEEN FISHERIES AND SHARK CONCENTRATION AREAS	To quantify the geographic and temporal overlap between shark activity areas (hotspots) and commercial fisheries. To deepen the knowledge on smooth hammerhead (*Sphyrna zygaena*) migration patterns and habitat use (in terms of deep-sea and temperature).
MANTA CATALOG AZORES	To deepen our knowledge on Mobulidae rays (giant manta ray species) found in the Azores and in the East Atlantic, concerning their population composition and migration patterns in the Azores waters. To create the world's first database for the photo-identification of sicklefin devil ray (*Mobula tarapacana*).
SOS TUBAPROF	To assess the sustainability of deep-sea sharks unwanted catches and inclusion of stakeholders (fishers, scientists, etc.) to collect data on deep-sea sharks. To assess the abundances of these species and study measures to alleviate the impacts of fishing interactions with deep-sea sharks.
TO REDUCE DEEP-SEA SHARKS' BYCATCH IN PORTUGUESE BLACK SCABBARDFISH LONGLINE FISHERY.	To assess the distribution of deep-sea shark species and spatial overlap with black scabbardfish (*Aphanopus carbo*) by collecting scientific data from onboard observers. To test mitigation measures in longline fishing gears targeting black scabbardfish, in mainland Portugal, Madeira, and Azores waters.
'FLY WITH BULL RAYS', FROM IMAR (INSTITUTE OF MARINE RESEARCH, AZORES)	To monitor the duckbill eagle ray population, through photo-identification of individuals, to increase knowledge in their areas of geographic occurrence (the Mediterranean, Macaronesia (except for the Azores, where it does not occur), West African coast, and part of the East African coast (up to Mozambique)), namely actual distribution, abundance, behaviours, and life characteristics.
SHARK TAG: MIGRATIONS AND HABITAT USE BY SMOOTH HAMMERHEAD.	To deepen the knowledge on smooth hammerhead (*Sphyrna zygaena*) migration patterns and habitat use (in terms of deep-sea and temperature). To integrate results with population dynamics and genetics.

Annex 3 International projects of interest

INTERNATIONAL PROJECTS OF INTEREST		
IMPROVEMENT OF INDEPENDENT FISHERIES DATA FOR THE MANAGEMENT OF ATLANTIC SHORTFIN MAKO	Pew Charitable Trusts - Lenfest Ocean Program	To test the application of new genetic and marking and recapture methods to be used to estimate the abundance of shortfin mako in the Atlantic Ocean independently of fishery data.
ANGEL SHARK PROJECT: CANARY ISLANDS	University of Las Palmas de Gran Canaria, Alexander Koenig Zoological Research Museum & Zoological Society of London	To collect scientific information on the 'Critically Endangered' angelshark (*Squatina squatina*) in the Canary Islands, namely, data on conservation status and essential habitats. To include stakeholders to improve awareness and propose conservation initiatives.
GLOBAL SHARK AND RAY INITIATIVE	WWF	Collaboration between the WWF, TRAFFIC, WCS, Shark Trust, and Shark Advocates International, with technical advice by IUCN Shark Group Specialists to define global priorities for the conservation of sharks and rays and political influence for management and conservation.
PROJECT AWARE	Shark League	Collaboration between Shark Advocates International, Shark Trust, and Ecology Action Centre to mobilise the adoption of safeguards for Atlantic and Mediterranean shark and ray species in RFMOs (regional fisheries management organizations) such as ICCAT, NAFO, and GFCM.

Annex 4 Main species of sharks, rays, and chimaeras that occur in Portugal

IUCN Red List Categories and Criteria: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated; n.a.= not available/non defined. Sources: IUCN (2021), Alves et al. 2020, Adapted from Costa (2018).

SCIENTIFIC NAME	COMMON NAME	SHARK / RAY	PT DISTRIBUTION	HABITAT	GLOBAL IUCN (2021)	CONVENTIONS	FISHED SPECIES
Aetomylaeus bovinus	Bull ray	ray	Mainland and Madeira	coastal	CR		
Alopias superciliosus	Bigeye thresher	shark	Mainland, Azores, and Madeira	pelagic	VU	CITES (Annex II)	X
Alopias vulpinus	Thresher	shark	Mainland and Madeira	pelagic	VU	CMS and CITES (Annex II) and UNCLOS (Annex I)	X
AmblyrRaja radiata	Starry ray	ray	Mainland	pelagic and deep-sea	VU		X
Apristurus laurussonii	Iceland catshark	shark	Azores and Madeira	deep-sea	LC		
BathyRaja pallida	n.a.	ray	Azores	deep-sea	LC		
BathyRaja richardsoni	n.a.	ray	Azores	deep-sea	LC		
Bathytoshia lata (Dasyatis pastinaca)	Roughtail stingray, Common eagle ray	ray	Mainland, Azores, and Madeira	coastal	LC		X
Carcharodon carcharias	Great white shark	shark	Mainland, Azores, and Madeira	n.a.	VU	CITES (Annex II)	
Carcharhinus brevipinna	Spinner shark	shark	Mainland	coastal	VU		X
Carcharhinus falciformis	Silky shark	shark	Mainland and Madeira	pelagic	VU	CITES (Annex II)	X
Carcharhinus galapagensis	Galapagos shark	shark	Azores	pelagic	LC		X
Carcharhinus limbatus	Blacktip shark	shark	Mainland and Madeira	coastal and pelagic	NT		X
Carcharhinus longimanus	Oceanic whitetip shark	shark	Mainland, Azores, and Madeira	pelagic	CR	CITES (Annex II)	X
Carcharhinus obscurus	Dusky shark	shark	Mainland and Madeira	pelagic	EN		X
Carcharhinus plumbeus	Sandbar shark	shark	Mainland	pelagic	VU	UNCLOS (Annex I)	X
Centrophorus granulosus	Gulper shark	shark	Mainland, Azores, and Madeira	deep-sea	EN		X
Centrophorus lusitanicus	Lowfin gulper shark	shark	Mainland and Azores	deep-sea	VU		X
Centrophorus machiquensis	Gulper shark	shark	Madeira	deep-sea	NE		
Centrophorus squamosus	Leafscale gulper shark	shark	Mainland, Azores, and Madeira	deep-sea	EN		X
Centrophorus uyato	n.a.	shark	Madeira	pelagic and deep-sea	EN		
Centroscyllium fabricii	n.a.	shark	Mainland and Azores	deep-sea	LC		X
Centroscymnus coelolepis	Portuguese dogfish	shark	Mainland, Azores, and Madeira	deep-sea	NT		X
Centroscymnus crepidater	Longnose velvet dogfish	shark	Mainland, Azores, and Madeira	deep-sea	NT		X
Centroscymnus owstonii	Shortnose velvet dogfish	shark	Mainland, Azores, and Madeira	deep-sea	VU		X
Cetorhinus maximus	Basking shark	shark	Mainland, Azores, and Madeira	pelagic	EN	CMS (Annex I and II) CITES (Annex II)	X
Chimaera opalescens	n.a.	Opal chimaera	Mainland, Azores and Madeira	n.a.	NE		
Chimaera monstrosa	Rabbit fish	Opal chimaera	Mainland, Azores, and Madeira	coastal and deep-sea	VU		
Chlamydoselachus anguineus	Frilled shark	shark	Mainland, Azores, and Madeira	deep-sea	LC		
Dalatias licha	Kitefin shark	shark	Mainland, Azores, and Madeira	deep-sea	VU		X
Dasyatis pastinaca	Common stingray, Common eagle ray	ray	Mainland, Azores, and Madeira	coastal	DD		X
Deania calcea	Birdbeak dogfish	shark	Mainland, Azores, and Madeira	deep-sea	NT		X
Deania hystricosa	Rough longnose dogfish	shark	Mainland and Madeira	deep-sea	DD		X
Deania profundorum	Arrowhead dogfish	shark	Mainland, Azores, and Madeira	deep-sea	NT		X

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SCIENTIFIC NAME	COMMON NAME	SHARK / RAY	PT DISTRIBUTION	HABITAT	GLOBAL IUCN (2021)	CONVENTIONS	FISHED SPECIES
Dipturus intermedius	Blue skate	ray	Mainland, Azores and Madeira	deep-sea	CR		
Dipturus oxyrinchus	Longnosed skate	ray	Mainland, Azores and Madeira	deep-sea	NT		X
Echinorhinus brucus	Bramble shark	shark	Mainland, Azores	deep-sea	EN		X
Etmopterus princeps	Great lanternshark	shark	Mainland, Azores and Madeira	deep-sea	LC		X
Etmopterus pusillus	Smooth lanternshark, velvet belly lanternshark	shark	Mainland, Azores and Madeira	deep-sea	LC		X
Etmopterus spinax	Velvet belly lanternshark, Velvet belly	shark	Mainland, Azores and Madeira	deep-sea	LC		X
Galeocerdo cuvier	Tiger shark	shark	Azores and Madeira	pelagic	NT		
Galeorhinus galeus	Tope shark, Tope	shark	Mainland, Azores and Madeira	pelagic	CR	CMS (Annex II)	X
Galeus atlanticus	n.a.	shark	Mainland	demersal	NT		
Galeus murinus	Mouse catshark	shark	Mainland and Azores	demersal	LC		
Galeus melastomus	Blackmouth catshark, Tope	shark	Mainland and Madeira	demersal	LC		X
Glaucostegus cemiculus	Blackchin guitarfish	ray	Mainland	pelagic	CR		
Gymnura altavela	Spiny butterfly ray,	ray	Mainland and Madeira	coastal	EN		X
Gymnura hirundo	Madeira butterfly ray	ray	Madeira	n.a.	NE		
Heptranchias perlo	Sharpnose sevengill shark	shark	Mainland, Azores and Madeira	deep-sea	NT		X
Hexanchus griseus	Bluntnose sixgill shark	shark	Mainland, Azores and Madeira	deep-sea	NT		X
Hexanchus nakamurai	Bigeyed sixgill shark	shark	Mainland	pelagic and deep-sea	NT		
Hydrolagus affinis	Smalleyed rabbitfish	Opal chimaera	Mainland, Azores, and Madeira	deep-sea	LC		
Hydrolagus lusitanicus	n.a.	Opal chimaera	Mainland	deep-sea	LC		
Hydrolagus mirabilis	n.a.	Opal chimaera	Mainland	deep-sea	LC		
Hydrolagus pallidus	Opal chimaera	Opal chimaera	Azores and Madeira	deep-sea	LC		
Isurus oxyrinchus	Shortfin mako	shark	Mainland, Azores, and Madeira	pelagic	EN	CMS and CITES (Annex II), UNCLOS (Annex I)	X
Isurus paucus	Longfin mako	shark	Mainland and Azores	pelagic	EN		
Lamna nasus	Porbeagle	shark	Mainland, Azores, and Madeira	pelagic	VU	CMS and CITES (Annex II)	X
LeucoRaja circularis	Sandy ray	ray	Mainland	deep-sea	EN		
LeucoRaja fullonica	Starry ray	ray	Mainland, Azores, and Madeira	deep-sea	VU		
LeucoRaja naevus	Cuckoo ray	ray	Mainland	deep-sea	LC		X
Mitsukurina owstoni	Goblin shark	shark	Mainland and Madeira	deep-sea	LC		
Mobula birostris	Giant manta, Giant manta ray	ray	Mainland, Azores, and Madeira	pelagic	EN	CITES (Annex II)	
Mobula mobular	Giant manta ray, Common stingray	ray	Mainland, Azores, and Madeira	pelagic	EN	CITES (Annex II)	
Mobula tarapacana	Chilean devil ray, Sicklefin devil ray	ray	Mainland, Azores, and Madeira	pelagic	EN	CITES (Annex II)	
Mustelus asterias	Starry smooth-hound	shark	Mainland and Madeira	pelagic	NT		
Mustelus sp.	Smooth-hound	shark	Mainland and Madeira	coastal and deep-sea	VU		

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SCIENTIFIC NAME	COMMON NAME	SHARK / RAY	PT DISTRIBUTION	HABITAT	GLOBAL IUCN (2021)	CONVENTIONS	FISHED SPECIES
Mustelus punctulatus	Blackspotted smooth-hound	shark	Mainland	coastal	VU		
Myliobatis aquila	Common eagle ray	ray	Mainland, Azores, and Madeira	coastal	CR		X
NeoRaja iberica	Iberian pygmy skate	ray	Mainland	deep-sea	LC		
Odontaspis ferox	Smalltooth sand tiger	shark	Azores and Madeira	n.a.	VU		
Odontaspis noronhai	Bigeye sand tiger	shark	Madeira	pelagic and deep-sea	LC		
Oxynotus centrina	Angular roughshark	shark	Mainland and Madeira	n.a.	VU		
Oxynotus paradoxus	Sailfin roughshark	shark	Mainland, Azores, and Madeira	deep-sea	DD		
Prionace glauca	Blue shark	shark	Mainland, Azores, and Madeira	pelagic	NT	CMS (Annex II)	X
Pristis sp.	Common sawfish, Sword-fish	shark	Mainland and Madeira	n.a.	CR	CITES (Annex I)	
Pseudocarcharias kamoharai	Crocodile shark	shark	Mainland	pelagic	LC		X
Pseudotriakis microdon	False catshark	shark	Mainland, Azores, and Madeira	deep-sea	LC		
Pteroplatytrygon violacea	Common stingray	ray	Mainland, Azores, and Madeira	pelagic	LC		
Raja asterias	Mediterranean starry ray	ray	Mainland	coastal and deep-sea	NT		X
Raja bigelowi	Bigelow's ray	ray	Mainland and Azores	n.a.	LC		X
Raja brachyura	Blonde ray	ray	Mainland, Azores, and Madeira	coastal and deep-sea	NT		X
Raja clavata	Thornback ray	ray	Mainland, Azores and Madeira	coastal and deep-sea	NT		X
Raja maderensis	Madeiran ray	ray	Mainland and Madeira	deep-sea	VU		
Raja microocellata	Small-eyed ray	ray	Mainland	coastal and deep-sea	NT		X
Raja miraletus	Brown ray	ray	Mainland and Madeira	demersal, coastal, and deep-sea	LC		X
Raja montagui	Spotted ray	ray	Mainland	demersal	LC		X
Raja undulata	Undulate ray	ray	Mainland	demersal, coastal	EN		X
Rajella fyllae	Round ray	ray	Mainland	deep-sea	LC		
Rhincodon typus	Whale shark	shark	Mainland, Azores, and Madeira	pelagic and deep-sea	EN	CITES (Annex II)	
Rhinobatos rhinobatos	Common guitarfish	ray	Mainland	coastal	EN		X
Rhinoptera marginata	Lusitanian cownose ray	ray	Mainland	pelagic	NT		
Rostroraja alba	White skate	ray	Mainland and Madeira	pelagic and deep-sea	EN		
Scyliorhinus canicula	Lesser spotted dogfish	shark	Mainland and Azores	demersal, coastal	LC		X
Scyliorhinus stellaris	Nursehound	shark	Mainland	demersal, coastal	NT		X
Scymnodalatias garricki	Azores dogfish.	shark	Azores	deep-sea	DD		
Scymnodon ringens	Knifetooth dogfish	shark	Mainland and Madeira	deep-sea	VU		X
Somniosus microcephalus	Greenland shark	shark	Mainland, Azores, and Madeira	deep-sea	VU		X
Somniosus rostratus	Little sleeper shark	shark	Mainland, Azores, and Madeira	deep-sea	LC		
Sphyrna lewini	Scalloped hammerhead	shark	Mainland and Madeira	pelagic	CR	CITES (Annex II)	X
Sphyrna mokarran	Great hammerhead	shark	Mainland	pelagic	CR	CITES (Annex II)	X

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SCIENTIFIC NAME	COMMON NAME	SHARK / RAY	PT DISTRIBUTION	HABITAT	GLOBAL IUCN (2021)	CONVENTIONS	FISHED SPECIES
Sphyrna zygaena	Smooth hammerhead	shark	Mainland, Azores, and Madeira	pelagic	VU	CMS and CITES (Annex II), UN-CLOS (Annex I)	X
Squaliolus laticaudus	Spined pygmy shark	shark	Azores and Madeira	deep-sea	LC		
Squalus acanthias	Picked dogfish	shark	Mainland, Azores, and Madeira	demersal, deep-sea	VU	CMS (Annex II)	X
Squalus blainvillei	Longnose spurdog	shark	Mainland	demersal, deep-sea	DD		
Squalus megalops	Shortnose spurdog	shark	Mainland	demersal, deep-sea	LC		
Squatina aculeata	Sawback angelshark	shark	Mainland	demersal coastal	CR		X
Squatina squatina.	Angelshark	shark	Mainland	demersal coastal	CR		X
Taeniura grabata	Round stingray	ray	Azores and Madeira	pelagic	DD		
Torpedo torpedo	Common torpedo	ray	Mainland and Madeira	coastal	DD		X
Torpedo marmorata	Marbled electric ray	ray	Mainland and Madeira	coastal	DD		X
Torpedo nobiliana	Electric ray, Great torpe-do ray	ray	Mainland, Azores, and Madeira	coastal	DD		X
Zameus squamulosus	Velvet dogfish, Knifetooth dogfish	shark	Mainland, Azores and Madeira	pelagic and deep-sea	LC		

Anexo 5 Species with fishing restrictions in European and International waters

COMMON NAME	SCIENTIFIC NAME	PROHIBITION	ALL AREAS	EUROPE UNION	ICES EU WATERS	ICES INTERNATIONAL WATERS	RFMO
Alfred manta	*Mobula alfredi*			X			
Angelshark	*Squatina* sp.			X			
Basking shark	*Cetorhinus maximus*		X				
Bigeye thresher	*Alopias superciliosus*						ICCAT
Birdbeak dogfish	*Deania calcea*				1, 2a; 4 and 14	1 and 14	
Birdbeak dogfish	*Deania calcea*				5 to 10	5 to 10; 12	CECAF
Black dogfish	*Centroscyllium fabricii*				X	X	CECAF
Black roughscale catshark	*Apristurus* sp.				X	X	CECAF
Blue skate	*Dipturus batis*				2a, 3-4, 6-9		
Bluntnose sixgill shark	*Hexanchus griseus*				5 to 10	5 to 10; 12	CECAF
Blurred lanternshark	*Etmopterus bigelowi*						SEAFO
Chilean devil ray	*Mobula tarapacana*			X			
Common guitarfish	*Rhinobatos*	only in the Mediterranean					
Common sawfish	*Pristis*			X			
Deep-sea sharks	*superorder Selachi-morpha*						SEAFO
Devil fish	*Mobula mobular*			X			
Dwarf sawfish	*Pristis clavata*			X			
Frilled shark	*Chlamydoselachus anguinues*				5 to 10	5 to 10; 12	CECAF
Ghost catshark	*Apristurus manis*						SEAFO
Giant manta	*Mobula birostris*			X			
Great lanternshark	*Etmopterus princeps*				5 to 10	5 to 10 and 12	CECAF
Great lanternshark	*Etmopterus princeps*				1, 2a, 4 and 14	1 and 14	
Great lanternshark	*Etmopterus princeps*						SEAFO
Great white shark	*Carcharodon carch-arias*		X				
Greenland shark	*Somniosus micro-cephalus*				5 to 10	5 to 10; 12	CECAF
Guitarfish	*Rhinobatidae*				1 to 10; 12		
Gulper shark	*Centrophorus* sp.				5 to 10	5 to 10 and 12	CECAF
Hammerhead sharks	*Sphyrnidae family ex-cept for Sphyrna tiburo*						ICCAT
Houting	*Coregonus oxyrinchus*						
Kitefin shark	*Dalatias licha*				5 to 10	5 to 10 and 12	CECAF
Kitefin shark	*Dalatias licha*			X	1, 2a, 4 and 14	1 and 14	
Knifetooth dogfish	*Scymnodon ringens*				X		
Leafscale gulper shark	*Centrophorus squa-mosus*			X	1, 2a, 4 and 14	1 and 14	
Lesser devil ray	*Mobula hypostoma*			X			
Lesser Guinean devil ray	*Mobula rochebrunei*			X			
Longcomb sawfish	*Pristis zijsron*			X			
Longhorned mobula	*Mobula eregoodoo-tenkee*			X			
Longnose velvet dogfish	*Centroscymnus crepi-dater*				5 to 10	5 to 10; 12	CECAF
Manta and Ray	*Manta* sp. and *Mobula* sp.						IATTC
Mouse catshark	*Galeus murinus*				5 to 10	5 to 10 and 12	CECAF
Munk's devil ray	*Mobula munkiana*			X			
Norwegian skate	*Dipturus nidarosiensis*				6ab and 7		
Oceanic whitetip shark	*Carcharhinus longima-nus*						ICCAT, IOTC, IATTC
Picked dogfish	*Squalus acanthias*				ICES 2 to ICES 10		
Pointed sawfish	*Anoxypristis cuspidate*			X			
Porbeagle	*Lamna nasus*		X				
Portuguese dogfish	*Centroscymnus coe-lolepis*			X	2a and 4	1 and 14	CECAF
Rays	*Rajidae*						SEAFO
Shortfin devil ray	*Mobula kuhlii*			X			
Short-tail lanternshark	*Etmopterus brachyurus*						SEAFO
Silky shark	*Carcharhinus falci-formis*						ICCAT
Smalltooth sawfish	*Pristis pectinata*			X			
Smooth lanternshark	*Etmopterus pusillus*				1, 2a, 4 to 8, 12 and 14		
Smoothtail mobula	*Mobula thurstoni*			X			
Spinetail mobula	*Mobula japanica*			X			
Starry ray	*Raja radiata*				2a, 3a, 7d and 4		
Thornback ray	*Raja clavata*				3a		
Thresher	*Alopidae family*						IOTC
Thresher	*Alopias* sp.						ICCAT

COMMON NAME	SCIENTIFIC NAME	PROHIBITION	ALL AREAS	EUROPE UNION	ICES EU WATERS	ICES INTERNATIONAL WATERS	RFMO
Tope shark	*Galeorhinus galeus*	only applicable to longline fishery			1-2, 4-8, 12 and 14	1, 5-8, 12 and 14	
Undulate ray	*Raja undulata*				quota for 8 and 9		
Velvet belly	*Etmopterus spinax*				5 to 10	5 to 10 and 12	CECAF
Velvet dogfish	*Scymnodon squamulosus*						SEAFO
Whale shark	*Rhincodon typus*		X				
White skate	*Raja alba*				6 to 9		

Prohibited to fish, keep on board, discard or land, store, sell, display or put up for sale

Prohibited to fish, keep on board, discard or land and immediate mandatory release without injuries

Prohibited except in cases where TACs are applied for bycatches in black scabbardfish longline fisheries

Prohibited targeted fishing

Annex 6 Scientific information for the main Atlantic stocks status

ICES/ RFMO	SPECIES (COMMON NAME)	SCIENTIFIC NAME	ASSESSMENT PERIODICITY	2012 ICES STOCK CATEGORY	SCIENTIFIC INFORMATION	FISHING PRESSURE TREND	BIOMASS TREND	RECRUITMENT	ADVISE ON CATCHES (T) 2019	REFERENCE
ICES	Blackmouth catshark	*Galeus melastomus*	Biennial	3	NA	S	I	U	156	PA
ICES	Blonde ray	*Raja brachyura*	Biennial	3	NA	S	I	U	212	PA
ICCAT	Blue shark	*Prionace glauca*	Triennial	2	F/FMSY; B/ Btrigger	U	U	U	39,102	MSY
ICCAT	Blue shark	*Prionace glauca*	Triennial	2	F/FMSY; B/ Btrigger	U	U	U	28,923	MSY
IOTC	Blue shark	*Prionace glauca*	Biennial	2	F/FMSY; B/ Btrigger	U	D	U	29,924	MSY
ICES	Blue skate	*Dipturus batis*	-	6	NA	-	-	-	-	-
ICES	Cuckoo ray	*Leucoraja naevus*	Biennial	3	NA	S	I	U	70	PA
ICES	Kitefin shark	*Dalatias licha*	Quadrennial	6	NA	U	U	U	-	-
ICES	Leafscale gulper shark	*Centrophorus squamosus*	Quadrennial	6	NA	U	U	U	-	-
ICES	Nursehound	*Scyliorhinus stellaris*	Biennial	3	NA	S	I	U	1,178	PA
ICES	Portuguese dogfish	*Centrocymnus coelolepis*	Quadrennial	6	NA	U	U	U	-	-
ICCAT	Shortfin mako	*Isurus oxyrinchus*	Triennial	2	F/FMSY; B/ Btrigger	U	D	U	500	MSY
ICCAT	Shortfin mako	*Isurus oxyrinchus*	Triennial	2	F/FMSY; B/ Btrigger	U	S	U	2,001	MSY
IOTC	Shortfin Mako	*Isurus oxyrinchus*	Annual	5	NA	U	U	U	-	-
ICES	Smooth-hounds nei	*Mustelus* sp.	Quadrennial	3	NA	S	I	U	3,855	PA
ICES	Spotted ray	*Raja montagui*	Biennial	3	NA	S	U	U	108	PA
ICES	Starry ray	*Amblyraja radiata*	-	-	Blim	D	I	I	4,060	-
ICES	Thornback ray	*Raja clavata*	Biennial	3	NA	S	I	U	1,431	PA
ICES	Tope shark	*Galeorhinus galeus*	-	5	NA	S	U	U	376	PA
ICES	Undulate ray	*Raja undulata*	Annual	6	NA	S	U	U	31	PA
ICES	White skate	*Rostroraja alba*	-	6	NA	-	-	-	0	PA

Key: NA: not assessed U: unknown S: stable I: increasing D: decreasing –: does not exist PA: precautionary approach
MSY: Maximum sustainable yield

> F_{MSY} ; 2018 Biomass > $B_{triggern}$ around the referentialn < F_{MSY}; 2018 Biomass < $B_{trigger}$
Source: IPMA, 2018; Moreno et al. 2019.

NOTES

ICES Categories (ICES, 2012):

Category 1: data-rich stocks (quantitative assessments). This category includes stock with full quantitative assessments.

Category 2: stocks with analytical assessments and predictions that are only treated qualitatively. This category includes stocks with quantitative assessments and predictions that, for a variety of reasons, are merely indicative of trends in fishing mortality, recruitment, and biomass.

Category 3: stocks for which survey-based assessments indicate trends of biomass/abundance. This category includes stocks for which survey indices (or other indicators of stock size such as reliable fishery-dependent indices; e.g., LPUE, CPUE, and mean length in the catch) are available, providing reliable indications of trends in stock metrics such as mortality, recruitment, and biomass.

Category 4: Stocks for which reliable catch data are available. This category includes stocks for which a time series of catch can be used to approximate MSY.

Category 5: Data-poor stocks. This category includes stocks for which only landings data are available. In these cases, ICES recommends a reduction in catches unless there is additional information indicating that the stock's exploitation level is adequate.

Category 6: stocks with insignificant landing data and stocks caught in small quantities as bycatch. This category includes stocks where landings are not significant when compared to discards. It also includes stocks that form part of stock complexes and that are primarily made up of bycatch species in fisheries targeting other target species.

Annex 7 Scientific advice measures for the main population stocks exploited in the Atlantic

Anexo 7 Scientific advice measures for the main population stocks exploited in the Atlantic

ICES/ RFMO	SPECIES (COMMON)	SCIENTIFIC NAME	STOCK STATUS	MANAGEMENT MEASURES	TAC EU / PT 2018 (TONS)	COMMENTS
ICES	Blackmouth catshark	*Galeus melastomus*		Included in the EU's list of deep-sea sharks in 2010 and excluded in 2014. Species with a retention ban by longliners in some areas.		Landings in generic commercial categories and possible mixing with species *Galeus atlanticus* (mainland Portugal). Discard levels are high and variable (depending on the fleet) and are not fully quantified.
ICES	Leafscale gulper shark	*Centrophorus squamosus*	There are no landing time series for the entire stock distribution area. Deep-sea shark landings (mostly leafscale gulper shark and Portuguese dogfish) peaked between 2001 and 2004, and have declined since then in response to the potential reduction in abundance and restrictive management measures adopted by the EU for this species.	2018 TAC for bycatches and exclusive for black scabbardfish.	10	Prohibited species on some ICES zones of EU waters.
ICES	Nursehound	*Scyliorhinus stellaris*	The stock status indicator (biomass index, estimated based on catches from four campaigns that took place in the stock distribution area) revealed the species has been increasing since 2003.	No European regulation.		Discard levels are high and variable (depending on the fleet) and are not fully quantified. It is assumed that this species, when returned to the sea, has a high survival capacity (around 70% in some *metiers*).
ICES	Tope shark	*Galeorhinus galeus*	Estimated landings for this species have been stable since 2010. Information on the abundance or exploitation of this resource in the ICES zone is limited.	There is no TAC assigned in the ICES area.		Species with a retention ban by longliners.
ICES	Cuckoo ray	*Leucoraja naevus*	The stock biomass indicator shows an increasing trend over the time series.	A shared quota of 366 t in ICES zones 8 and 9 with other Rajidae, although it must be declared separately.	4,326/1,330	Due to problems with the identification of ray species reported in official statistics, IPMA developed a specific method to estimate the weight landed at species level in mainland Portugal.
ICES	Undulate ray	*Raja undulata*	Campaign and catch data were insufficient to assess the state of the undulate ray stock in Iberian waters.	Only allowed to fish in ICES zones 8 and 9, with a maximum limit of 3 and 4 t, respectively.	48	There is a fisheries monitoring programme on this stock since 2016.
ICES	Thornback ray	*Raja clavata*	Growing trend since 1999. The level observed in 2017 represents the historic maximum.	Quota of 366 t for Rajidae in ICES zones 8 and 9 and 660 t in NAFO zone.	4,326/1,330	Due to problems with the identification of ray species reported in official statistics, IPMA developed a specific method to estimate the weight landed at species level in mainland Portugal.

ICES/ RFMO	SPECIES (COMMON)	SCIENTIFIC NAME	STOCK STATUS	MANAGEMENT MEASURES	TAC EU / PT 2018 (TONS)	COMMENTS
ICES	Spotted ray	*Raja montagui*	Levels higher than those observed in 2005-2012, but with a downward trend in the last two years (2016-2017).	Quota of 366 t for Rajidae in ICES zones 8 and 9 and 660 t in NAFO zone.	4,326/1,330	Due to problems with the identification of ray species reported in official statistics, IPMA developed a specific method to estimate the weight landed at species level in mainland Portugal.
ICES	Blue skate	*Dipturus batis*	Since 2009, the inclusion of *Dipturus batis* and *Dipturus intermedius* species complex in the list of prohibited species means that no information is available on the dynamics of the stock: specific composition, catches, or landings. For this ecoregion, there is currently no robust indicator of stock status.	Ban on catch, retention, transhipment, and landing of *Dipturus batis* species complex.		No advice was requested.
ICES	Blonde ray	*Raja brachyura*	The stock biomass indicator, resulting from the CPUE of the Portuguese polyvalent fleet segment, shows an increasing trend over the time series. The maximum level observed was in 2017.	Quota of 366 t for Rajidae in ICES zones 8 and 9 and 660 t in NAFO zone.	4,326/1,330	Due to problems with the identification of ray species reported in official statistics, IPMA developed a specific method to estimate the weight landed at species level in mainland Portugal.
ICES	White skate	*Rostroraja alba*	Disappeared from most historical areas of occurrence in ICES areas. There are few recent validated records of the presence of white skate in ICES areas, these being from the English Channel, Irish, and Portuguese waters.	EU ban on catching, retention, transhipment, and landing		
ICES	Starry ray	*Amblyraja radiata*	In 2018, the stock biomass was above B_{lim} (> 95 %) and has been gradually increasing since 1990. Recruitment in 2017 was above average and fishing mortality is currently low.	No management plans or objectives are defined, and there is no scientific advice. The general objectives of the NAFO Convention have been applied. A quota of 366 t for Rajidae in ICES zones 8 and 9 and 660 t in NAFO zone.	4,408/660	
ICES	Smooth-hound	*Mustelus* sp.		Species landed in mainland Portugal without EU regulation.		
ICCAT	Blue shark North Atlantic	*Prionace glauca*	The last assessment (2015) showed that the stock was not overfished (B> B_{MSY}) nor in overfishing (F <F_{MSY}); some uncertainty in the data.	Quota for Portugal of 5363 t.	39,102 (2016-2018) / 5,363	In 2016 and 2017, the catch values exceeded the established TACs. In 2012, an Ecological Risk Analysis (ERA) was carried out, which showed intermediate vulnerability.
ICCAT	Blue shark South Atlantic	*Prionace glauca*	The last assessment (2015) showed that the stock can be overfished (B_{actual}> B_{MSY}) and in overfishing (F_{actual} > F_{MSY}); some uncertainty in the data.	There are no management measures in place.	28,923	In 2012, an ERA was carried out for ICCAT sharks that showed the blue shark has intermediate vulnerability.

ICES/ RFMO	SPECIES (COMMON)	SCIENTIFIC NAME	STOCK STATUS	MANAGEMENT MEASURES	TAC EU / PT 2018 (TONS)	COMMENTS
ICCAT	Shortfin mako North Atlantic	*Isurus oxyrinchus*	Last assessment (2017): very high probability (90%) of the stock being overfished (B_{actual} < B_{MSY}) and in overfishing (F_{actual} > F_{MSY}). There is high probability that the stock is overexploited; projections for this stock are very pessimistic.	Since 2018, ICCAT requires that all catches be returned to the sea unless the animals caught are already dead when captured and the vessels have onboard observers. Alternatively, the catch of this species may be allowed if a minimum catch size of 180 cm is established for males and 210 cm for females (furcal length). Overall TAC for the EU fleet of 288 t.	288	
ICCAT	Shortfin mako South Atlantic	*Isurus oxyrinchus*	Last assessment (2017): 33% probability of the stock being overfished (B_{actual} < B_{MSY}) and 42% of it being in overfishing (F_{actual} > F_{MSY}).	There are no management measures in place.		In 2012, the ICCAT carried out an ERA for sharks and found that the shortfin mako was among the most vulnerable shark species.
IOTC	Blue shark	*Prionace glauca*	Last assessment (2017): the stock is within the reference points (B_{actual} > B_{MSY} and F_{actual} < F_{MSY}) with a 73% probability. Current high catches may result in short-term biomass declines.	There is no TAC defined		Reported catches, although very uncertain, are around 30 000 t, and estimated actual ones are around 50 000 t: much higher than the MSY value (30 000 t). High risk of stock biomass going into very short-term decline.
IOTC	Shortfin Mako	*Isurus oxyrinchus*	Unknown. The IOTC plans the first analytical stock assessment in 2020.	There is no TAC defined		In 2012, the IOCT carried out an ERA for sharks and found that the shortfin mako was among the most vulnerable shark species.

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