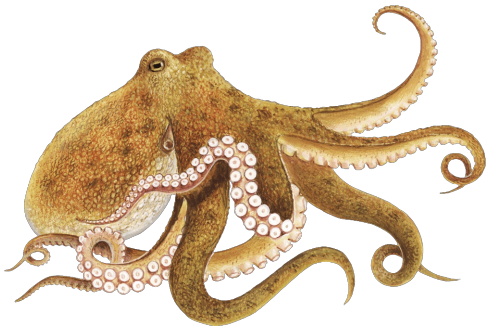
Common octopus

Octopus vulgaris



Eastern Central and Northeast Atlantic

Bottom trawls, Traps (unspecified), Pots, Jig

Seafood Watch Consulting Researcher

March 1, 2021

Disclaimer

Seafood Watch strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture.Scientific review, however, does not constitute an endorsement of the Seafood Watch program or its recommendations on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this report.

Seafood Watch Standard used in this assessment: Fisheries Standard v3

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Watch Assessment. Each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." This ethic is operationalized in the Seafood Watch standards, available on our website here. In producing the assessments, Seafood Watch seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Watch assessments in any way they find useful.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught, farmed or managed.

Avoid/Red: Take a pass on these for now; they're overfished, lack strong management or are caught or farmed in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

The following Seafood Watch report provides recommendations for the main common octopus (*Octopus vulgaris*) fisheries occurring in the Northeast Atlantic (Spain and Portugal) and the Eastern Central Atlantic (Morocco, Mauritania, and Senegal). The common octopus (*sensu stricto*) is found in the Northeast Atlantic and the Mediterranean. It is common along the French, Spanish, and Portuguese coasts but it is especially abundant on the Sahara Bank, off West Africa between 26 and 19°N, extending farther south and west to the Cape Verde Islands, and as far as the equator (Adam, 1983)(Jereb et al., 2014)(Jereb et al., 2015). It is a benthic cephalopod species distributed on rocky, sandy, and muddy bottoms from the coastline to the edge of the continental shelf (Mangold 1983) (Jereb et al., 2014 and 2015). It is a short-lived species whose spawning and recruitment are extremely dependent on the seasonal and interannual variability of environmental conditions (Sobrino et al. 2002) (Otero et al. 2008) (Sonderblohm et al. 2014). (Lourenço et al., 2014). The species is targeted and caught as bycatch by both the coastal and offshore fleets, using a wide range of fishing gears, including trawls, pots, traps, and jigs. The common octopus has a low inherent vulnerability to fishing pressure due to its high fecundity, low age at maturity, and rapid growth rate (Wood 2014). Moreover, ecosystem perturbations caused by intensive fishing are leading to changes in the trophic structure of the ecosystem, favoring short-living opportunistic species, such as octopus (Boyle et al., 2005).

In European waters, no comprehensive stock assessments have been undertaken for common octopus, although due to its high social and economic value, the International Council for the Exploration of the Sea (ICES) has undertaken some assessment exercises to understand the state of the stock. The ICES Working Group on Cephalopod Fisheries (WGCEPH) subdivides the stock into three areas: VIIIc (North of Spain), IXa-North (Portugal) and XIa-South (Gulf of Cádiz, which includes the South of Portugal and Spain), although genetic studies to support this stock subdivision are scarce (Cabranes et al., 2008)(ICES 2019). The fisheries in Europe are regulated by the European Union through the Common Fisheries Policy (CFP). However, this fishery is excluded from quota regulations under the CFP, with the national and local (in the particular case of Spain) governments being directly responsible for the management of the fishery (Pita et al., 2015).

In Morocco, Mauritania, and Senegal fish and cephalopod stocks are assessed internationally by the Fishery Committee for the Eastern Central Atlantic (FAO/CECAF) Working Group on the Assessment of Demersal Resources–Subgroup North; and by local scientific institutes: the National Institute for Fisheries Research (INRH) in Morocco; the Mauritanian Institute of Oceanographic Research and Fisheries (IMROP) in Mauritania; and the Senegalese Centre for Oceanographic Research (CRODT). Three main fishing grounds are found along the northwest African coast, more or less coinciding with the distribution zones of the three octopus stocks of the subregion. From north to south these are i) the zone between Cape Bojador (26°N) and Cape Blanc (21°N) (Moroccan stock); ii) the zone between Cape Blanc (21°N) and the mouth of the Senegal River (16°N) (Mauritanian stock), and iii) the zone between the mouth of the Senegal River (16°N) and the border with Guinea-Bissau (12°N) (Senegalese stock) (FAO/CECAF 2018). The fisheries in Morocco, Mauritania, and Senegal are regulated by the Moroccan Fisheries Department (MPM), the Fisheries and Maritime Economy Department (FMEM), and the Maritime Fisheries Department (DPM) respectively.

Octopus resources have been and continue to be under pressure for some time and the situation is not improving. Common octopus in the Sahara bank and surroundings areas, including the Iberian peninsula, is targeted by a very large fishing fleet. For example, in 2016, in Mauritania alone, more than 35,000 fishers and 7,500 artisanal boats were reported (SIPA 2016), whereas, in the Algarve (south of Portugal), there are more than 700 boats targeting the resource, which would correspond to around 500,000 traps deployed, although this number seems to be underestimated (Carlos Sonderblohm pers. comm.). Moreover, demand for octopus is rising in several markets, which puts further pressure on the resource (FAO 2019a). The resource situation is approaching a very serious state.

The combination of individual criteria results in an overall rating of "Good Alternative" for the Spanish, Portuguese, and pot and trap fisheries and the Senegalese pot fishery and "Avoid" for the trawl fishery in all the countries. Even though the Spanish and Portuguese pot-caught octopus is the preferred alternative, identifying the capture method may be difficult, and information for consumers needs to be improved.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Common octopus | Eastern Central Atlantic | Bottom trawls | Mauritania	1.916	1.000	1.000	1.732	**(1.350)**
Common octopus | Eastern Central Atlantic | Jig | Mauritania	1.916	5.000	1.000	3.873	**(2.468)**
Common octopus | Eastern Central Atlantic | Pots | Mauritania	1.916	5.000	1.000	3.000	**(2.315)**
Common octopus | Eastern Central Atlantic | Bottom trawls | Morocco	1.000	1.000	1.000	1.732	**(1.147)**
Common octopus | Eastern Central Atlantic | Jig | Morocco	1.000	5.000	1.000	3.873	**(2.098)**
Common octopus | Eastern Central Atlantic | Pots | Morocco	1.000	5.000	1.000	3.000	**(1.968)**
Common octopus | Northeast Atlantic | Bottom trawls | Portugal	2.644	1.000	3.000	1.732	**(1.925)**
Common octopus | Northeast Atlantic | Pots | Portugal	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**
Common octopus | Northeast Atlantic | Traps (unspecified) | Portugal	2.644	2.644	3.000	2.449	**Good Alternative (2.677)**
Common octopus | Eastern Central Atlantic | Bottom trawls | Senegal	2.644	1.000	1.000	1.732	**(1.463)**
Common octopus | Eastern Central Atlantic | Jig | Senegal	2.644	5.000	1.000	3.873	**Good Alternative (2.675)**
Common octopus | Eastern Central Atlantic | Pots | Senegal	2.644	5.000	1.000	3.000	**Good Alternative (2.510)**
Common octopus | Northeast Atlantic | Bottom trawls | Spain	2.644	1.000	3.000	1.732	**(1.925)**
Common octopus | Northeast Atlantic | Pots | Spain	2.644	5.000	3.000	3.000	**Good Alternative (3.303)**
Common octopus | Northeast Atlantic | Traps (unspecified) | Spain	2.644	2.644	3.000	2.449	**Good Alternative (2.677)**

Summary

Common octopus caught using trawls in Spain, Portugal, Morocco, Mauritania, and Senegal are rated 'Avoid' due to concerns regarding bycatch of at-risk species and impacts on the marine ecosystem. There are also concerns regarding the management of octopus fisheries in western Africa, resulting in Avoid ratings for pot and jig fisheries in Morocco and Mauritania.

Common octopus caught using pots and traps in Spain and Portugal are rated as Good Alternatives, as these are selective gears that have minimal bycatch concerns and a moderate impact on the marine ecosystem.

Common octopus caught using pots and jigs in Senegal are also rated as Good Alternatives. The octopus population is healthier in Senegal than in other western African countries, and while there are concerns with management these selective gears have minimal impact on other species and a moderate to low impact on the marine ecosystem.

Eco-Certification Information

The western Asturias octopus trap fishery is certified as sustainable according to the Marine Stewardship Council standards.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

Best Choice/Green = Final Score >3.2, and no Red Criteria, and no Critical scores

Good Alternative/Yellow = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

The following Seafood Watch report provides recommendations for the common octopus (*O. vulgaris*) fisheries occurring in the North East and Eastern Central Atlantic (FAO areas 27 and 34). Common octopus is caught in that area as a target species and as bycatch in industrial and coastal trawl fisheries targeting mixed finfish and crustaceans along the five countries assessed: Spain, Portugal, Morocco, Mauritania, and Senegal.

The species is also target by several artisanal fisheries, using a wide range of gears, including traps, pots, and jigs. Catch data by gear is unavailable for these countries, but based on the available information (scientific reports, government reports, etc.) and expert's opinion, the main artisanal fisheries catching common octopus in the area are considered to be: the trap and pot fisheries in Spain and Portugal and the pot and jig fisheries in Morocco, Mauritania, and Senegal (jigs and traps are locally used in Spain, Portugal, and the African countries respectively, but it is considered that these gears represent a very low percentage of the total catch and they have not been assessed in this report).

In total, fourteen fisheries, including the industrial trawl fisheries and the artisanal fisheries listed above, are assessed in this report.

Table 1 Ratings by country contained within the current Seafood Watch assessment.

Country	Fisheries
Spain	Traps
	Pots
	Bottom trawls
Portugal	Traps
	Pots
	Bottom trawls
Morocco	Pots
	Bottom trawls
	Jigs
Mauritania	Pots
	Bottom trawls
	Jigs
Senegal	Pots
	Bottom trawls
	Jigs

Species Overview

The commercial importance of cephalopod species as a fishery resource has increased over recent decades, in many cases due to the decrease of fish stocks as a consequence of overfishing and the good prices that these species fetch (Caddy and Rodhouse 1998)(FAO 2011)(Jereb et al., 2014)(Sauer et al., 2019). Cephalopod landings are dominated by the squid fisheries, which represents nearly 80% of the worldwide cephalopod catches. Total reported global production of octopuses has doubled between 1980 (179,042 MT) and 2018 (377,358 MT) and it represents around 10% of the cephalopod catch (Sauer et al., 2019).

In the Northeast and Central Atlantic, Mediterranean and Black Sea, common octopus (*Octopus vulgaris*) is a commercially important resource for coastal and offshore fisheries (Jereb et al., 2015) (Pita et al., 2015)(ICES 2018c)(Bañon et al., 2018)(Sauer et al., 2019). Although other octopus species are present in the area, such as: horned octopus (*Eledone cirrhosa*) or musky octopus (*Eledone moschata*); common octopus (*Octopus vulgaris*) is the species which fetches the highest domestic and exporting prices (Jereb et al., 2015)(FAO GLOBEFISH 2019a) and therefore, is the most heavily exploited octopus in a wide range of countries in the area, including Spain, Portugal, Morocco, Mauritania and Senegal. The species is caught as a target species and as bycatch by the offshore, coastal and artisanal fleets in this region, using a wide range of fishing gears, including trawls, pots and traps and jigs; showing large fluctuations in landings that can reach up to 50 % between consecutive years (Lourenço et al., 2014).

The common octopus (*Octopus vulgaris* Cuvier, 1797), is found in the Northeast Atlantic and the Mediterranean, western Atlantic (Caribbean Sea and northern South America), South Africa, India, and East Asia (Norman et al., 2014)(Jereb et al., 2015). However, the number of taxa/species/subspecies within the general *O. vulgaris* species is unresolved and several types have been described (see figure below). The common octopus *sensu stricto* is distributed in the Northeast and Central Atlantic and the Mediterranean. It is common along the French, Spanish, and Portuguese coasts but it is especially abundant on the Sahara Bank, off West Africa between 26 and 19°N, extending farther south and west to the Cape Verde Islands, and as far as the Equator (Adam, 1983)(Jereb et al., 2014)(Jereb et al., 2015). It is a benthic cephalopod species distributed on rocky, sandy, and muddy bottoms from the coastline to the edge of the continental shelf (Mangold 1983) (Jereb et al., 2014 and 2015). It is a short-lived species that is extremely dependent on the seasonal and interannual variability of environmental conditions. Studies conducted along the south Atlantic Iberian (Spain and Portugal) coast have revealed that increased rainfall and high sea surface temperature during early life stages affect recruitment (Sobrino et al. 2002) (Otero et al. 2008) (Sonderblhom et al. 2014) (Lourenço et al., 2014). The common octopus has a low inherent vulnerability to fishing pressure due to its high fecundity, low age at maturity, and rapid growth rate (Wood 2014).

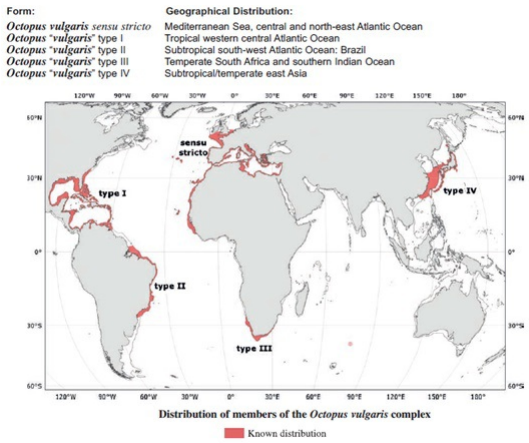

Figure 1: Distribution of the *Octopus vulgaris* species complex.

As global demand for octopus increases, efforts to develop aquaculture production of common octopus have increased. So far, the technology turned out to be difficult and expensive, and no-one

has succeeded on an industrial scale; but some developments have been achieved in recent years in Spain (FAO Globefish 2019b).

Production Statistics

According to the FAO landing data, between 2013 and 2017, landings of octopuses in the five countries included in this report, namely Spain, Portugal, Morocco, Mauritania and Senegal remained more or less constant (with some variability among years) at around 110,000 MT per year. In the last 20 years landings have ranged from 64,146MT (min) to 156,118MT (max) (annual average of ~100,000MT).

European production of octopuses for 2018 was 28,562 MT, which was primarily common octopus, with some horned and musky octopus from the western and central Mediterranean Sea and the Atlantic coasts of Spain and Portugal. The largest producers were Italy (9,161 MT), Spain (6,799 MT) and Portugal (6,236 MT), followed by Greece (3,190 MT) and France (2,314 MT).

Landings of octopus in north Africa are reported as "common octopus" and "octopuses nei" in the FAO landing datasets. In 2018, 92,780 MT were landed in the entire continent, the vast majority of which was common octopus (with a small proportion of other species) harvested mainly from off the northwest coast of Africa. The three countries which reported the highest catches were: Morocco (40,620 MT), Mauritania (29,216 MT) and Senegal (11,236 MT).

Table 2 Octopus landing data by country (FAO landing data 2019)

Country	2014	2015	2016	2017	2018
North Africa					
Mauritania	20,798	33,249	30,425	39,013	29,216
Morocco	49,237	64,963	55,319	52,969	40,620
Senegal	4,060	4,433	5,932	6,075	11,236
Total	82,339	110,805	99,910	107,419	92,872
Europe					
Portugal	11,095	7,757	9,845	5,970	6,236
Spain	3,637	4,087	3,537	3,778	6,069
Total Europe	26,547	28,370	32,499	27,680	28,562
Grand total (only the selected countries included)	**108,886**	**139,175**	**132,409**	**135,099**	**121,434**

Although more up to date data is not available in the FAO database yet, it is expected from national reports that landings of common octopus in the five countries decreased for 2019 (FAO Globefish 2019a)(FAO Globefish 2019b).

Importance to the US/North American market.

Imports of octopus (in Kilos) to the United States from the selected countries are shown in the table below. Imports from Spain doubled between 2014 and 2018, from 4,641 to 8,668 MT. Imports from Portugal decreased in the same period from 1,121 to 402 MT. Imports from the North African countries have been variable. It is important, however, to emphasize that Spain imports high volumes of octopus from these countries (including Portugal) which are subsequently exported to international markets, such as the United States. Therefore, they are reported as Spanish imports although the octopus originates from other countries (see the specific section below). In 2018, total exports to the U.S. from the area assessed was estimated at 9,216 MT, corresponding to a value of $119 million.

Table 3 Imports of octopus (in Kilos) to the United States (NMFS 2019)

Country	2014	2015	2016	2017	2018
Spain	4,641	5,903	7,789	8,925	8,668
Portugal	1,121	793	243	337	402
Morocco	167	400	149	172	55
Mauritania	18	44	20	89	89
Senegal	16	0	10	1	0
Total	**5,965,509**	**7,142,110**	**8,214,068**	**9,527,172**	**9,215,675**

Common and market names.

The only commercial name used in the U.S. for *Octopus vulgaris* is common octopus. No other commercial names have been reported.

Primary product forms

Octopus is available in seafood markets or specialty grocery stores in a myriad of forms. Live, fresh, dried, frozen, cured, salted, and brined octopus are all available to the public. However, common octopus imported from the northeast and central Atlantic is primarily sold frozen. Other products identified in U.S. supermarkets are whole cooked octopus and canned octopus in sauce (olive oil, soybean sauce, garlic sauce, etc.).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

COMMON OCTOPUS			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Eastern Central Atlantic | Bottom trawls | Mauritania	3.670: Low Concern	1.000: High Concern	Red (1.916)
Eastern Central Atlantic | Jig | Mauritania	3.670: Low Concern	1.000: High Concern	Red (1.916)
Eastern Central Atlantic | Pots | Mauritania	3.670: Low Concern	1.000: High Concern	Red (1.916)
Eastern Central Atlantic | Bottom trawls | Morocco	1.000: High Concern	1.000: High Concern	Red (1.000)
Eastern Central Atlantic | Jig | Morocco	1.000: High Concern	1.000: High Concern	Red (1.000)
Eastern Central Atlantic | Pots | Morocco	1.000: High Concern	1.000: High Concern	Red (1.000)
Northeast Atlantic | Bottom trawls | Portugal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Atlantic | Pots | Portugal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Atlantic | Traps (unspecified) | Portugal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Eastern Central Atlantic | Bottom trawls | Senegal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Eastern Central Atlantic | Jig | Senegal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Eastern Central Atlantic | Pots | Senegal	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Atlantic | Bottom trawls | Spain	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Atlantic | Pots | Spain	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Atlantic | Traps (unspecified) | Spain	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Common octopus

Factor 1.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Pots | Mauritania

Low Concern
The most recent CECAF assessment report available for the Mauritanian stock is from the FAO/CECAF Working Group held in 2017 in Tenerife (Spain) (FAO/CECAF 2018). In this assessment, this stock (Cape Blanc stock) is listed as **fully fished**.

Catches from the industrial fishery, both foreign and national, as well as the artisanal fishery from 1999 to 2008 and abundance indices from scientific surveys were used by the group to assess the state of the stock (FAO/CECAF 2018. The Schaefer dynamic production model provided a good fit with the data series used (FAO/CECAF 2018). Results of the model showed that current biomass is equal to the target biomass B0.1 (Bcur /B0.1 = 100%) and slightly above the limit biomass (Bcur/BMSY = 110%)(FAO/CECAF 2018).

A stock assessment is available. The Mauritanian stock was assessed as **fully exploited** by the FAO/CECAF working group (see table above). The biomass is estimated to be above the target reference point. However, as octopus abundance fluctuates with environmental conditions and no estimates of uncertainty are given in the CECAF assessment, a '**low concern**' score is assigned.
Justification:
Abundance indices of scientific surveys for common octopus in Mauritania have increased from 2002. In 2016, they were 8Kg/30 min (FAO/CECAF 2018). For the period 2000-2016, the octopus CPUE for the commercial fishery show a large variability with an increasing trend for certain cephalopod fleets and a stabilization for others (FAO/CECAF 2018).

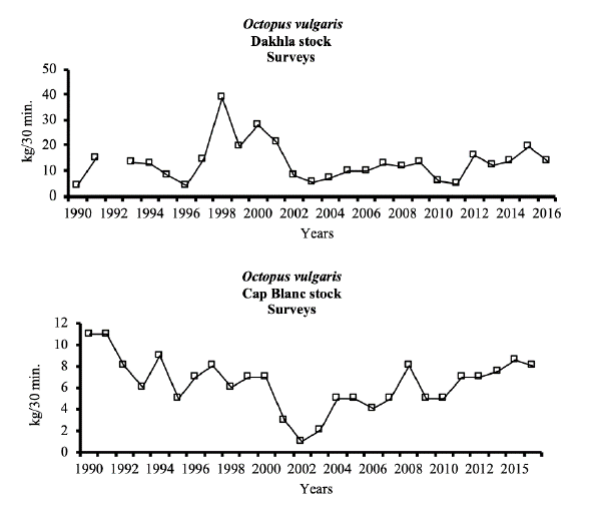

Figure 2: Indices of abundance (kg/30min) of *Octopus vulgaris* off Morocco and Mauritania obtained from the trawl surveys (FAO/CECAF 2018)

Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Pots | Morocco

High Concern
Cephalopod species are characterized by short-life cycles and variable growth rates influenced by environmental variability which makes them both potentially susceptible to overfishing but also capable of rapid recovery (Pierce & Guerra 1994)(Sobrino et al. 2002)(Pierce et al. 2008)(Caballero Alfonso et al., 2009)(Rodhouse 2010).

A Schaefer dynamic production model is used by the FAO/CECAF working group (see justification section) to assess the state of the stock and fisheries of common octopus in the area (FAO/CECAF 2018). The Working Group used two different series of abundance indices: the CPUEs of the Moroccan deep-sea cephalopod fishery and the abundance indices of the trawling surveys (FAO/CECAF 2018). The results indicate that the current biomass was 66% the target biomass B0.1 (Bcur/B0.1 = 66%) and below the limit biomass BMSY (Bcur/BMSY = 73%); the Dakhla octopus stock was therefore considered as **overexploited** as indicated in previous assessments (see table in the justification section) (FAO/CECAF 2018).

A stock assessment is available. The FAO/CECAF working group assessed the Moroccan stock as overfished. Current biomass is below the limit biomass. Therefore, a '**high concern**' score is assigned.
Justification:
The Fishery Committee for the Eastern Central Atlantic (FAO/CECAF) Working Group on the Assessment of Demersal Resources–Subgroup North is responsible for assessing fisheries resources in Northwest Africa. Common octopus is regularly assessed by the Working Group on demersal resources in the northern zone, which last met in Tenerife (Spain) in 2017 (FAO/CECAF 2018). Three octopus stocks have been identified in the area, which are separately assessed by the working group. From north to south these are: i) the stock situated in the zone between Cape Bojador (26°N) and Cape Blanc (21°N) (Moroccan stock); ii) the stock located in the zone between Cape Blanc (21°N) and the mouth of the Senegal River (16°N) (Mauritanian stock); and iii) the stock situated in the zone between the mouth of the Senegal River (16°N) and the border with Guinea-Bissau (12°N) (FAO/CECAF 2018).

A Schaefer dynamic production model is used to assess the state of the stock and fisheries of common octopus in the area (FAO/CECAF 2018). The Working Group uses BMSY and FMSY as limit reference points and B0.1 and F0.1 as target reference points (FAO 2006).

Results of the most recent assessments for the three North-Western African stocks are shown in the table below (FAO/CECAF 2018 for the Morocco and Mauritania stocks and FAO/CECAF 2016 for the Senegal-Gambia stock).

Table 4: Indicators on the state of the stock and fishery of common octopus. FAO/CECAF working group. Figures for Morocco and Mauritania based on data from 2016 (FAO/CECAF 2018). Figures for Senegal based on data from 2013 (FAO/CECAF 2016).

Country (stock)/Abundance index	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	F_{cur}/F_{SYcur}
Morocco (Dakhla stock)/Surveys	66%	73%	142%	128%	101%
Mauritania (Cape Blanc stock)/CPUE Mauritanian cephalopod freezer trawls	100%	110%	114%	103%	115%
Senegal (Senegal-Gambia stock)/Senegalese industrial freezer trawlers	115%	127%	93%	84%	115%

From 2013 to 2016, Morocco carried out 8 scientific surveys to assess and monitor the cephalopods along the Atlantic coast of Morocco between Cape Boujdour (26°N) and Cape Blanc (20°50'N). The average yield over the last five years is 15 kg/fishing day (Figure 5.3.3d).

Eastern Central Atlantic | Bottom trawls | Senegal
Eastern Central Atlantic | Jig | Senegal
Eastern Central Atlantic | Pots | Senegal

Moderate Concern
In Senegal, although 10 national scientific surveys were carried out in the area between 2014 and 2016, none of them specifically targeted octopus. Thus, no scientific survey results were presented to the FAO/CECAF Working Group in 2017 and only CPUEs from the Senegalese industrial cephalopod fleet were used as abundance indices for the stock assessment model. However, the model was a poor fit, the results were considered unreliable and no stock assessment was undertaken by the group(FAO/CECAF 2018c).

In 2013, results of the stock assessment carried out by the FAO/CECAF group indicated that current biomass was above the target biomass B0.1 (Bcur /B0.1 = 115%) and the limit biomass (Bcur/BMSY = 127%) and that the stock was shifting from overexploited to fully exploited (FAO/CECAF 2016).

At national level, the last stock assessment report for common octopus in Senegalese waters was carried out by the CRODT under the 'Sustainable Management of Fisheries in Senegal (ADuPeS)' project (Meissa et al. 2016). CPUE data from the artisanal and the industrial fleet was used to feed several stock assessment models (GLM, age-structured model, etc). The results of the national assessment show that the stock was slightly below the target reference biomass (Bcurrent/BMSY=93%) (Meissa et al. 2016). The current biomass of the octopus stock represented 34% of the virgin biomass and 68% of the biomass at the beginning of the data series (Meissa et al. 2016).

There is a quantitative stock assessment that is no more than 10 years old and the biomass is above a limit reference point (but below the target reference point in the case of the national assessment). Some concerns were expressed about the data used by the CRODT for this last assessment stock, therefore a '**moderate concern**' score is assigned.
Justification:
Over the past four years, the CPUEs of the Senegalese industrial fleet ranged between 39 kg/sea day and 189 kg/sea day. The CPUEs of the Senegalese artisanal fishery are low but have increased in recent years from 2 kg/trip in 2013/2014 to 3/4 kg/trip in 2015/2016.

However, it seems that Senegalese artisanal fishery landings have increased in recent years. The reason is that traps and pots are increasingly used by artisanal canoes which currently land an average of 70/80 kg per trip (every 2 days) (Mamadou Niang pers. comm.).

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Bottom trawls | Spain
Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
Common octopus is a short-lived species, with a lifecycle of around 12 –14 months characterized by non-overlapping generations, with only one or two cohorts present in the fishery at any time, and a very rapid growth with high fecundity rates (Pierce and Guerra, 1994) (Sonderblohm et al., 2014). Cephalopod populations are well known to exhibit wide fluctuations in abundance. Recruitment success in common octopus is largely associated with the environmental oceanographic conditions, mainly due to the presence of a planktonic larval stage particularly sensitive to environmental factors (Sobrino et al. 2002) (Pierce et al., 2010) (Sonderblohm et al. 2014) (Lourenco et al., 2014) (Sonderblohm et al., 2016). Studies carried out in the Gulf of Cádiz (South Spain) indicate that there may be a relationship between the amount of rainfall in the previous year, the wind strength causing upwellings, the surface sea temperature in April, and the abundance of this species in the following year (Sobrino et al. 2002) (Torres et al. 2013) (ICES 2018c).

In European waters, cephalopod populations/stocks are not assessed on a regular basis and there are no TACs or quotas for these resources (ICES 2018c). The ICES Working Group on Cephalopod Fisheries and Life History (WGCEPH) is in the process of improving the knowledge and understanding of these fisheries in European waters with the objective of assessing the resource in coming years (ICES 2018c). Recent work undertaken by the group, has demonstrated the value of production models that include environmental predictors (effectively allowing environmental carrying capacity to vary between years) as well as the utility of empirical statistical models employing environmental predictors and survey-based recruitment indices and more work is being done in this area (ICES 2018c). For the Gulf of Cadiz, for example, researchers from the Spanish Oceanographic Institute (IOE) have recently published results for a model developed to forecast landings between consecutive years with some degree of confidence (89.7% of deviance) combining several hydrographic and oceanographic parameters with landings statistics (Sobrino et al., 2020).

There is no formal stock assessment for common octopus in Spain and Portugal, so neither total allowable catches (TACs) nor stock reference points have been set. Survey abundance indices for octopus show wide year to year fluctuations (probably due to changing environmental conditions) but no clear trends are evident (ICES 2018c). Species is not highly vulnerable (the PSA results in a moderate score for all the fisheries). Therefore, stock status is assessed as "**moderate concern**".
Justification:
Despite the enormous importance of this fishery along the Iberian coast (Spain and Portugal), there are several biological, socioeconomic and institutional aspects that remain largely unknown (ICES 2018c). In 2017, fishery-independent information was supplied to the ICES cephalopod working group from different surveys carried out annually in Iberian waters (Portugal and Spain): SP-NGPS "DEMERSALES" carried out in 8.c and 9.a north, PGFS in 9.a-centre by Portugal and the south Spanish groundfish survey (ARSA/SPGFS) carried out in November and March each year in the Gulf of Cadiz (South Spain). These surveys collect data on the distribution and relative abundance (in number and weight) of all demersal species in the area, as well as to estimate biological parameters of the main commercial species (ICES 2018c). The estimated yields (kg/hour) of common octopus in Spanish DEMERSALES survey in the north during 2000-2017 have oscillated over time, reaching maximum values in 2012 with 2.5 kg/h but dropping to minimum values of 0.15 kg/h in 2015. In the ARSA survey in the south, strong fluctuations are evident, with a peak in 2013 of 6.9 kg/h and a minimum of around 1 kg/h seen in six years in the series, most recently in 2014. In both series, an increase is detected in 2016, followed by a new decrease in 2017 (ICES 2018c). The information from the Portuguese survey is not relevant for common octopus, with values lower than 0.5 kg/hour (ICES 2018c) (see figure 2 below). Therefore, survey abundance indices for octopus show wide year to year fluctuations but no clear trends are evident (ICES 2018c). However, there are some indications of a decline in octopus biomass index in north of Spain and an increase off western Portugal (ICES 2018c).

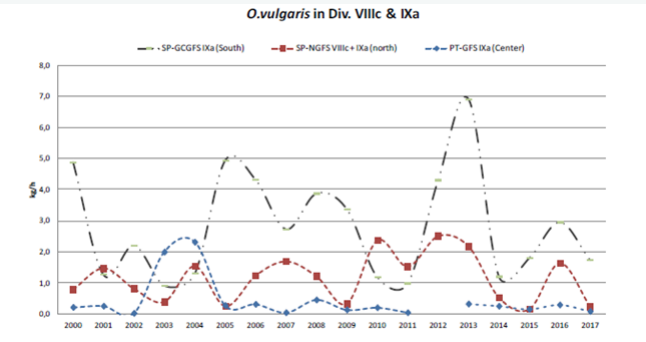

Figure 3: Common octopus abundances in ICES surveys for Divisions VIIIc and IXa (ICES 2019)

PSA analysis

The Productivity-Susceptibility Analysis (PSA) is a semi-quantitative assessment tool that relies on the life history characteristics of a stock, and it is used to assess the susceptibility of the stock to the fishery in question. For invertebrate species, Seafood Watch uses a PSA to assess their inherent vulnerability.

The productivity score for common octopus has been calculated based on the following information: "Octopus vulgaris can live up to 20 months (Dolman et al., 2000) and usually matures between 5 and 12 months (Cuccu et al., 2013). The common octopus undergoes seasonal migrations (Case 1999) (Tsangridis et al. 2002), moving to coastal waters at the beginning of the year (Quetglas et al. 1998) and congregating in shallow waters to spawn. For the Gulf of Cadiz, the breeding season extends from February to October, with spawning peaks in April–May and August (Silva et al. 2002). The total number of eggs laid by a female varies from 100,000 to 500,000 (Case 1999). The assigned (TL) values of common octopus in the areas north and south of Boujador (Morocco) are respectively 3.35 and 2.67 (Idrissi et al., 2016)" resulting in a productivity score of for common octopus is 1.50. Its migratory behavior and spawning spikes impart a certain level of vulnerability, but its high fecundity, low age at maturity, relatively short lifespan, and rapid growth rate cause *O. vulgaris* to be considered a naturally resilient organism.

The susceptibility score for the assessed fisheries results in a value of 2.81, medium vulnerability for all the fisheries. This is based on the following information: the stock is distributed along the coastal waters from Ireland to the North to Senegal to equator to the south and it is extensively fished along all the distribution area by several fleets. Therefore, the area overlap, which considers all fisheries in the area, is scored as high (>30%). The vertical overlap is also considered as high, as a wide range of depths are fished by the different gears used for targeting octopus. The selectivity of the fishery is considered moderate for all fisheries, as the species is targeted and is not likely to escape the gear. Finally, the post-capture mortality is considered high for all the fisheries (in the case of pot, trap and jig fisheries, although the species could be released alive when catch by these gears, it is not clear that it is happening in more of the 66% of the cases).

The final PSA categories are therefore, medium vulnerability, for all assessed fisheries.

PRODUCTIVITY ANALYSIS		
CRITERIA		**SCORE**
Average age at maturity	1 year (Case 1999) (Tsangridis et al. 2002)	1
Average maximum age	1 – 2 years (Case 1999) (Tsangridis et al. 2002)	1
Fecundity	Between 100,000 to 500,000 (Case 1999)	1
Reproductive strategy	Demersal or pelagic egg mass	2
Trophic level	2.67 – 3.35 (Idrissi et al., 2016)	2
Density dependence	No dispensatory or compensatory dynamics at low population levels	2
Habitat quality	Moderately altered	2
Productivity score		1.57
SUSCEPTIBILITY ANALYSIS		
CRITERIA		**SCORE**
Areal overlap (availability)	> 30% overlap	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery	Species is targeted, or is incidentally encountered and is not likely to escape the gear	2
Post-capture mortality (PCM)	Retained species or majority dead when released	3
Susceptibility score		**2.32**
PSA score		**2.81**
PSA category		**Medium vulnerability**

Factor 1.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Pots | Mauritania

High Concern
The most recent quantitative stock assessment for the common octopus stock in Mauritania was published by the FAO/CECAF in 2018 using catch series for the industrial and the artisanal fleet only for the period from 1999 to 2008 due to the heterogeneity of the data (FAO/CECAF 2018). The results of the assessment indicated that the current fishing mortality was 142% the target fishing mortality F0.1 (Fcur/F0.1 = 114%) and above the limit fishing mortality FMSY (Fcur/FMSY = 103%). Therefore, although fishing mortality has decreased in recent years in Mauritania, it is considered that **overfishing** is still occurring.

A stock assessment has been undertaken and it indicates that fishing mortality from all sources is above a sustainable level. Therefore, based on the SFW criteria, a '**high concern**' score is given.

Justification:

In Mauritania, common octopus is the main target species of both the artisanal and the industrial cephalopod fleets. Landings of the Mauritanian freezer trawlers have fluctuated between 2000 and 2016. Over the last five years they have stabilized at around 9,000 MT (FAO/CECAF 2018). Catches by the Mauritanian ice trawlers (coastal fleet) have declined since 1993 due to a reduction in the number of vessels.

However, the catches of the cephalopod artisanal fishery have been favored by government policies, showing a rising trend since 2002. Between 2010 and 2016, quantities landed by the artisanal fleet tripled from 6,900 MT to 23,000 MT (FAO/CECAF 2018).

Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Pots | Morocco

High Concern

The Fishery Committee for the Eastern Central Atlantic (FAO/CECAF) Working Group on the Assessment of Demersal Resources–Subgroup North is in charge of assessing fisheries resources in the Northwest Africa (FAO/CECAF 2018).

The most recent quantitative stock assessment for the common octopus stock in Moroccan waters was published by the FAO/CECAF in 2018 using catch series from 2001 to 2016 (FAO/CECAF 2018). That assessment found that the current fishing mortality was 142% of the target fishing mortality F0.1 (Fcur/F0.1 = 142%) and above the limit fishing mortality FMSY (Fcur/FMSY = 128%); overfishing is occurring for the Dakhla octopus stock (see table 1 in the abundance justification section) (FAO/CECAF 2018).

Common octopus catches have been variable in the country (see figure in the justification section). A stock assessment has been undertaken and it indicates that fishing mortality from all sources is above a sustainable level. Therefore, based on the SFW criteria, a '**high concern**' score is given.

Justification:

In Morocco, the octopus fishery is conducted by a heterogeneous fleet, ranging from small boats to bottom trawlers; which use multiple fishing gears: the passive gears (pots, jigs and traps) and active gears (bottom trawls) (FAO/CECAF 2018).

Octopus catches in Morocco show a general decreasing trend from 1991 with some peaks (a maximum of 107,000 MT correspond to the year 2000, whereas a minimum of 18,000 MT to year 2004). Since 2011 catches increase from 20,800 MT to a maximum of 49,287 MT in 201,5 and decreased again in recent years. Catches of the three segments artisanal, coastal and deep-sea have experienced the same trends over the last four years (FAO/CECFA 2018).

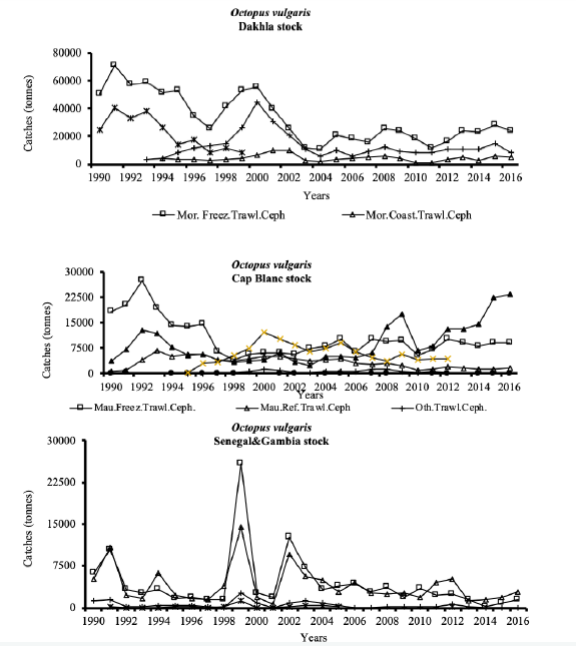

Figure 4: Catch in tonnes of *Octopus vulgaris* by stock and fleet in the CECAF northern sub-region (FAO/CECAF 2018)

Eastern Central Atlantic | Bottom trawls | Senegal
Eastern Central Atlantic | Jig | Senegal
Eastern Central Atlantic | Pots | Senegal

Moderate Concern

The most recent quantitative stock assessment for the common octopus stock in Senegal was published by the FAO/CECAF in 2016 (FAO CECAF 2016). The results of the assessment indicated that the current fishing mortality was below the target fishing mortality F0.1 (Fcur/F0.1 = 93%) and (Fcur/FMSY = 84%).

In recent years, it is thought that fishing mortality has risen due to the increasing use of pots and traps in this fishery (Mamadou Niang pers. comm.). Therefore, while F is below FMSY expert opinion suggests that effort has increased since the most recent assessment increasing the level of uncertainty, therefore a '**moderate concern**' score is given.

Justification:

Landings of common octopus in Senegal-Gambia stock for the period 1990-2012 averaged 9,000 MT with a maximum peak of 44,000 MT in 1999. Due to the improvement of catches of the artisanal fleet, catches increased between 2009 (5,076 MT) and 2012 (8,640 MT) and decreased again until 2015. Landings in 2016 were 4,466 MT, 3,000 MT of which corresponded to the artisanal fleet (FAO/CECAF 2018).

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Bottom trawls | Spain

Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
Cephalopod species are characterized by short-life cycles and variable growth rates influenced by environmental variability (Sobrino 2002)(Pierce et al. 2008)(Caballero Alfonso et al., 2009) (Rodhouse 2010) which makes them both potentially susceptible to overfishing but also capable of rapid recovery (Pierce & Guerra 1994). There is no formal stock assessment for common octopus in Europe, so neither TACs nor reference points (FMSY) have been set.

In 2013, ICES concluded in the Workshop on the Necessity for Crangon and Cephalopod Management (WKCCM) that there does not appear to be a negative effect of octopus fisheries on the octopus populations at the current fishing pressure (ICES 2013). Fishing effort has decreased in recent years for some gears (trawling) whereas it has increased for others (trap fishery in the south of Portugal), and it still exerts a high impact on most species in the area and fishing is considered the main source of mortality for common octopus during the adult phase of the species (Pierce et al., 2010)(Torres et al., 2013)(Sonderblohm et al., 2016). The stock shows large fluctuations due to environmental conditions but after environmentally controlled recruitment, population dynamics is largely fishery driven, resulting in strong seasonality in the landings. Underreporting has decreased in recent years due to increase control pressure by the authorities, although it is still an important issue in both countries (Coll et al. 2014)(ICES 2016)(Villasante et al 2016)(Bañón et al., 2018). Therefore, it is considered that the impact of the current level of mortality on the stock is unknown and fishing mortality is assessed as "**moderate concern**" in both countries.
Justification:
Landings of octopuses in the area comprise three species, common octopus (*Octopus vulgaris*), horned octopus (*Eledone cirrhosa*) and musky octopus (*Eledone moschata*). Average cephalopod annual landings into European ICES countries during 2000–2017 were 18,771 t. On average 88% of all octopus landings in Europe were caught in the Iberian peninsula (Portugal (63%) and Spain (27%)) (ICES 2018c).

In the North of Spain (Division VIIIC and Subdivision IXa north), the artisanal fleet accounts for more than 98% of common octopus landings mostly from traps (ICES 2016). In Portuguese waters (Subdivision IXa-centre), a large percentage of the catch comes from the polyvalent (artisanal) fleet (91–97%), which uses a range of gears which includes gillnets, trammel nets, traps, pots and hooks. Despite the bottom trawl fleet in Portugal (which is subdivided in two components depending on the main target species, either crustaceans or fin-fish) are not targeting cephalopods, has been indicated that during high abundance seasons, a significant part of the trawler fleet has switched to targeting octopus (Fonseca et al., 2008). In the Gulf of Cadiz (Subdivision IXa south), the bottom-trawl fleet traditionally accounted for around 60%, whereas the remaining 40% is taken by the artisanal fleet using mainly clay pots and hand jigs. In the last two years the proportion of catches attributed to the artisanal fleet increased to 72%, due possibly to tighter official control of landings (ICES 2016.

Landing data for Spain and Portugal for the most recent years (2013 to 2017), although variable, seems to show a downward trend (see figure in the justification section), which can be attributed to a mix of reasons: environmental conditions, decreasing fishing effort, etc. (Lourenco et al., 2014) (ICES 2018c) (Bañón et al., 2016) (Bañón et al., 2018).

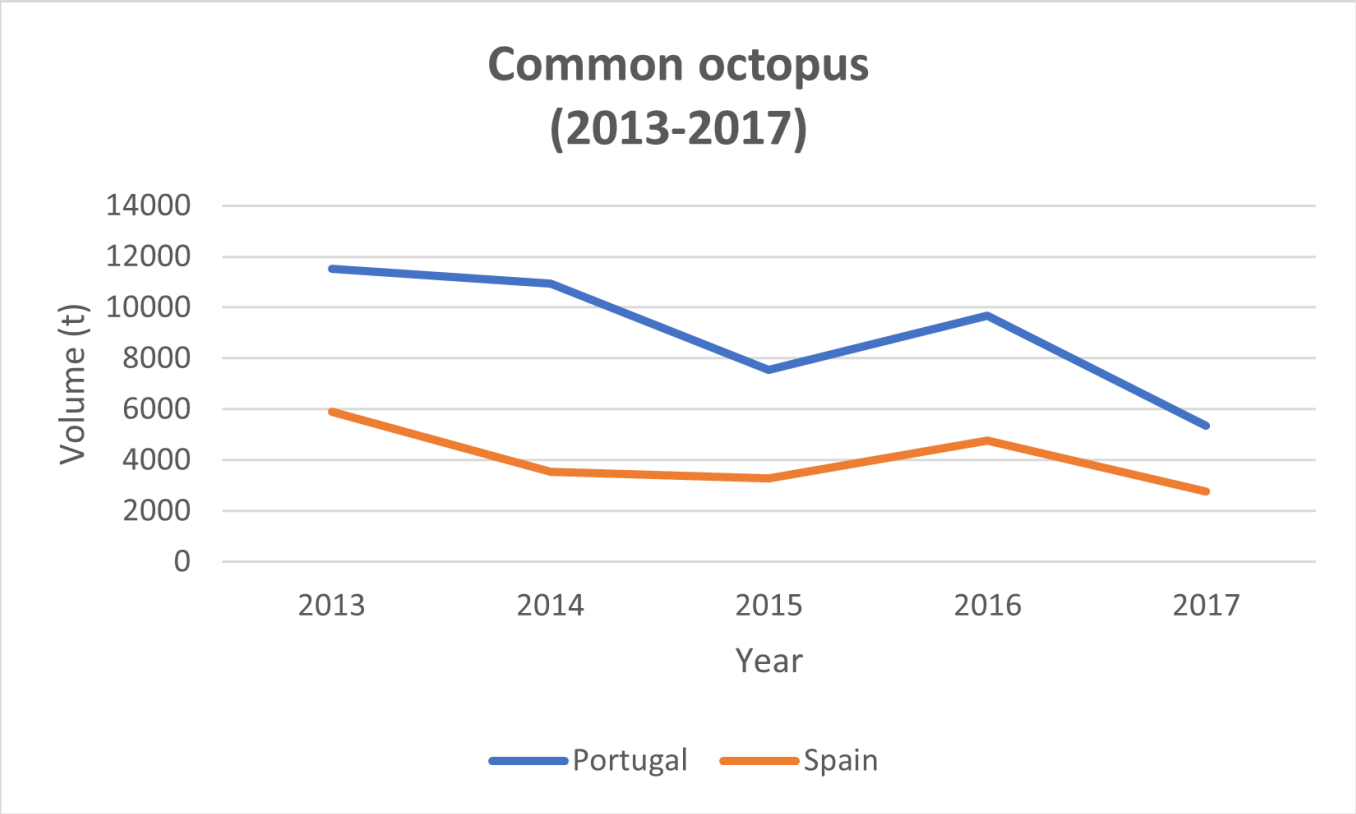

Figure 5: Landings (t) of common octopus in Spain and Portugal between 2013 and 2017 (ICES 2018)

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

COMMON OCTOPUS			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Eastern Central Atlantic | Bottom trawls | Mauritania	1.000	1.000: < 100%	Red (1.000)
Eastern Central Atlantic | Jig | Mauritania	5.000	1.000: < 100%	Green (5.000)
Eastern Central Atlantic | Pots | Mauritania	5.000	1.000: < 100%	Green (5.000)
Eastern Central Atlantic | Bottom trawls | Morocco	1.000	1.000: < 100%	Red (1.000)
Eastern Central Atlantic | Jig | Morocco	5.000	1.000: < 100%	Green (5.000)
Eastern Central Atlantic | Pots | Morocco	5.000	1.000: < 100%	Green (5.000)
Northeast Atlantic | Bottom trawls | Portugal	1.000	1.000: < 100%	Red (1.000)
Northeast Atlantic | Pots | Portugal	5.000	1.000: < 100%	Green (5.000)
Northeast Atlantic | Traps (unspecified) | Portugal	2.644	1.000: < 100%	Yellow (2.644)
Eastern Central Atlantic | Bottom trawls | Senegal	1.000	1.000: < 100%	Red (1.000)
Eastern Central Atlantic | Jig | Senegal	5.000	1.000: < 100%	Green (5.000)
Eastern Central Atlantic | Pots | Senegal	5.000	1.000: < 100%	Green (5.000)
Northeast Atlantic | Bottom trawls | Spain	1.000	1.000: < 100%	Red (1.000)
Northeast Atlantic | Pots | Spain	5.000	1.000: < 100%	Green (5.000)
Northeast Atlantic | Traps (unspecified) | Spain	2.644	1.000: < 100%	Yellow (2.644)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

EASTERN CENTRAL ATLANTIC | BOTTOM TRAWLS | MAURITANIA			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Skates (unspecified)	1.000: High Concern	1.000: High Concern	Red (1.000)
Mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Common octopus	3.670: Low Concern	1.000: High Concern	Red (1.916)
White grouper	3.670: Low Concern	1.000: High Concern	Red (1.916)
Bluespotted seabream	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Senegalese hake	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
European squid	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Common cuttlefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Red pandora	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

EASTERN CENTRAL ATLANTIC | BOTTOM TRAWLS | MOROCCO			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common cuttlefish	1.000: High Concern	1.000: High Concern	Red (1.000)

EASTERN CENTRAL ATLANTIC | BOTTOM TRAWLS | MOROCCO

SUB SCORE: 1.000 | DISCARD RATE: 1.000 | **SCORE: 1.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	1.000: High Concern	1.000: High Concern	Red (1.000)
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Skates (unspecified)	1.000: High Concern	1.000: High Concern	Red (1.000)
Mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
European hake	3.670: Low Concern	1.000: High Concern	Red (1.916)
Axillary seabream	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
European squid	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

EASTERN CENTRAL ATLANTIC | BOTTOM TRAWLS | SENEGAL

SUB SCORE: 1.000 | DISCARD RATE: 1.000 | **SCORE: 1.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Skates (unspecified)	1.000: High Concern	1.000: High Concern	Red (1.000)
Mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
White grouper	3.670: Low Concern	1.000: High Concern	Red (1.916)
Bluespotted seabream	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Senegalese hake	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Common cuttlefish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Red pandora	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

EASTERN CENTRAL ATLANTIC | JIG | MAURITANIA

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	3.670: Low Concern	1.000: High Concern	Red (1.916)

EASTERN CENTRAL ATLANTIC | JIG | MOROCCO

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	1.000: High Concern	1.000: High Concern	Red (1.000)

EASTERN CENTRAL ATLANTIC | JIG | SENEGAL

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

EASTERN CENTRAL ATLANTIC | POTS | MAURITANIA

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	3.670: Low Concern	1.000: High Concern	Red (1.916)

EASTERN CENTRAL ATLANTIC | POTS | MOROCCO

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	1.000: High Concern	1.000: High Concern	Red (1.000)

EASTERN CENTRAL ATLANTIC | POTS | SENEGAL

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHEAST ATLANTIC | BOTTOM TRAWLS | PORTUGAL

SUB SCORE: 1.000	DISCARD RATE: 1.000	SCORE: 1.000

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Skates (unspecified)	1.000: High Concern	1.000: High Concern	Red (1.000)
Loggerhead turtle	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Mammals	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
European hake	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Bib Pouting	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Atlantic mackerel	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Blue whiting	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
European horse mackerel	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST ATLANTIC | BOTTOM TRAWLS | SPAIN

SUB SCORE: 1.000	DISCARD RATE: 1.000	SCORE: 1.000

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Skates (unspecified)	1.000: High Concern	1.000: High Concern	Red (1.000)
Loggerhead turtle	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Mammals	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
European hake	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Bib Pouting	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Atlantic mackerel	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Blue whiting	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
European horse mackerel	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST ATLANTIC | POTS | PORTUGAL

SUB SCORE: 5.000	DISCARD RATE: 1.000	SCORE: 5.000

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHEAST ATLANTIC | POTS | SPAIN

SUB SCORE: 5.000	DISCARD RATE: 1.000	SCORE: 5.000

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHEAST ATLANTIC | TRAPS (UNSPECIFIED) | PORTUGAL

SUB SCORE: 2.644	DISCARD RATE: 1.000	SCORE: 2.644

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Snails	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Starfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

NORTHEAST ATLANTIC | TRAPS (UNSPECIFIED) | SPAIN			
SUB SCORE: 2.644	DISCARD RATE: 1.000		SCORE: 2.644
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Common octopus	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Snails	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Starfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

The most complete catch profiles for the Spanish and Portuguese trawl fisheries were found in (Campos et al. 2007) and (Costa et al., 2008) who defined the fleet components in the Portuguese bottom trawl fisheries (see figures below). These reports were cross-checked with other reports, such as (Fonseca et al. 2008) who studied the fleet dynamics and landings composition of the Portuguese cephalopod trawl fishery; the EU project IBERMIX (DG FISH/2004/03-33), a project commissioned by the European Commission to identify and categorize mixed-species fisheries operating in the Atlantic Iberian peninsula waters; the demersal discard atlas for the South Western Waters (Rochet et al., 2014) and (Bueno-Pardo et al., 2017); to create the bycatch species tables for the Spanish and Portuguese trawl fisheries. Based on the information shown in those reports and the SFW unknown bycatch matrix, six species or group of species are included as bycatch in the common octopus trawl fishery: European horse mackerel (*Trachurus trachurus*), Atlantic Mackerel (*Scomber scombrus*), Blue whiting (*Micromesistius poutassou*), Pouting (*Trisopterus luscus*), Chub mackerel (*Scomber japonicus*), Demersal Elasmobranchs (Skates and Sharks), Turtles (loggerhead turtle) and Marine Mammals (common dolphin).

Species	MIX	CRU	CEP	HOM	BWT	SHR	Landings (t)	% of total landings	Landings (10^3 Euros)	% of total value
T. trachurus	17.8	0.1	0.5	74.7	6.9	0.0	17231	39.70	24042	27.42
P. longirostris	0.1	28.4	0.5	0.0	0.3	70.7	1028	2.37	14574	16.62
Octopodidae	37.1	4.1	23.3	32.8	1.0	1.6	1641	3.78	5198	5.93
S. scombrus	42.8	0.2	1.3	50.5	5.1	0.1	2854	6.58	1488	1.70
M. poutassou	21.0	2.6	0.2	32.3	43.7	0.2	5207	12.00	2422	2.76
T. luscus	47.8	0.0	4.8	46.0	1.4	0.0	2189	5.04	2988	3.41
M. merluccius	35.5	9.4	2.0	44.4	4.5	4.2	1855	4.27	6888	7.86
S. japonicus	48.3	0.0	0.1	42.2	9.4	0.0	2768	6.38	825	0.94
N. norvegicus	0.1	76.3	0.5	0.1	3.7	19.3	447	1.03	7874	8.98
S. officinalis	18.3	0.0	68.5	12.7	0.5	0.0	175	0.40	654	0.75
Total (10 species)							35395	81.55	66953	76.37
Total (31 species)							43403	100.00	87677	100.00

Figure 21: Landings composition for the main species in each landing profiles in the Portuguese trawl fisheries. The different landing profiles, are named after their main target species. MIX: mixed of targeted species, including horse mackerel, Chub mackerel, Atlantic mackerel, blue whiting; CRU: Norway lobster; CEP: cephalopods; BWT: blue whiting; HOM: horse mackerel; SHR: rose shrimp. Octopodidae are mainly caught in MIX (37.1%), CEP (23.3%) and HOM (32.8%) trawls. Species included in this assessment are those which surpass 5% of the total catch (Campos et al., 2007)

The most recent catch profile for the Spanish trap fishery is shown in (Bañon et al., 2018) who analyzed the octopus fishery in Galicia. During that project, 135 species and 35 species groups (e.g. Asteroidea spp., Gobidae spp.) were caught in the sampled traps. In terms of biomass, mollusks were the most captured taxon (78.8%), followed by crustaceans (9.3%), echinoderms (7.7%), and fishes (4.2%) (Bañón et al., 2018). Common octopus was the main species representing 70.4% of the catch. Nassarius spp. represented 7.9% of the total catch. Henslow swimming crab (*Polybius henslowi*) and velvet crab (*Necora puber*) were the main crustacean species accounting for 4.8% and 3.2% of the total biomass, respectively. Starfish (7.5%) were the most prominent echinoderms and the European conger (*Conger conger*) (2.1%) and the comber (*Serranus cabrilla*) (0.8%) the main fish species caught (Bañón et al., 2018). The complete catch profile is shown in the table below. It is important to highlight that in Galicia (North of Spain), velvet crab and common prawn (*Palaemon serratus)* are targeted with the same fishing gear, but to avoid the bycatch of these species, the octopus fishery is only permitted during daytime (whereas velvet crab and common prawn are targeted during nighttime). This catch profile has been applied to the Spanish trap fishery. Therefore, Nassarius spp. and Asteroidea are the only species/group of species that represent a percentage higher than 5% of the catch and it is the only species assessed for these fisheries.

Scientific name	Rías Baixas	Ártabro Gulf	Cantabrian Sea	Total Galicia	Discards
Octopus vulgaris	67.7	71.5	77.7	70.4	26.6
Nassarius spp.	9.5	5.1	5.7	7.9	100
Charonia lampas	0.3	0.9	0.8	0.5	56.8
Rest (# sp.)	<0.1(22)	<0.1(18)	<0.1(8)	<0.1(25)	
Total Mollusca	77.7	77.5	84.3	78.8	34.2
Polybius henslowi	4.5	5.6	4.7	4.8	94.7
Necora puber	2.8	3.9	3.4	3.2	47.7
Paguridae	0.3	0.2	0.1	0.2	100
Palaemon spp.	0.3	0.1	<0.1	0.2	1.1
Atelecyclus spp.	0.3	<0.1	<0.1	0.2	99.6
Scyllarus arctus	0.1	0.4	0.1	0.1	57.7
Galatheoidea	0.1	0.2	0.1	0.1	99.1
Homarus gammarus	0.1	0.3	<0.1	0.1	49.7
Cancer pagurus	0.1	0.2	<0.1	0.1	82.6
Maja brachydactyla	0.1	0.1	<0.1	0.1	96.9
Rest (# sp.)	0.1(13)	<0.1(11)	0.1(7)	0.1(13)	
Total Crustacean	8.9	11.0	8.7	9.3	75.7
Asteroidea	9.0	6.6	3.5	7.5	99.8
Ophiuroidea	0.3	<0.1		0.2	100
Holothuroidea	<0.1	<0.1	<0.1	<0.1	100
Echinoidea	<0.1	<0.1	<0.1	<0.1	100
Total Echinoderm	9.4	6.7	3.5	7.7	99.8
Conger conger	2.0	3.0	0.9	2.1	60.5
Serranus cabrilla	0.4	0.8	2.0	0.8	75.3
Trisopterus luscus	0.6	0.1	<0.1	0.4	14.4
Gaidropsarus vulgaris	0.4	0.3	0.1	0.3	25.2
Coris julis	0.1	0.1	0.1	0.1	40.4
Parablennius gattorugine	0.1	<0.1	<0.1	0.1	100
Labrus mixtus	<0.1	0.1	0.1	0.1	56.3
Rest (# sp.)	0.3 (61)	0.2 (60)	<0.1(23)	0.3(68)	
Total Pisces	4.0	4.8	3.5	4.2	56.7

Figure 22: Main species by taxonomic groups caught in octopus traps in percentages of biomass of total catch. It is also shown the fraction discarded in relation to the total catch of each species or species group. Data from surveyed traps in Galicia from 1999 to 2015 (Banon et al., 2018).

Saldanha 2001 investigated the bycatch of the octopus trap fishery in the south of Portugal based on 20 fishing surveys. The recorded by-catch accounted for 8% in weight of the total catch and 49% in number. During that study, 18 species belonging to 4 phyla were recorded: Chordata (fishes); Echinodermata, Arthropoda, and Mollusca. The most representative group was fishes, of which Lusitanian toadfish (*Halobatrachus didactylus*), Senegal Seabream (*Diplodus bellotii*), and Small red scorpionfish (*Scorpaena notata*) were the most significant species, but many of them represented a percentage higher than 5% of the total catch. Most of the by-catch was discarded (78%), the rest was consumed by the crew (not commercialized). However, no information is given about the percentage of invertebrates caught. Therefore, the previous catch profile from Bañón et al., 2018 has been also used for the Portuguese trap fishery.

To characterize the Moroccan and the Mauritanian trawl fisheries, qualitative data from (Balguerias et al. 2000) and (Guenette et al. 2001), and from the IMROP assessment for the commercial stocks present in Mauritanian waters was used respectively (FAO/COPACE 2005). For the Senegalese trawl fishery, a complete bycatch profile was not found but the information used for the Moroccan and the Mauritanian trawl fisheries has been cross-checked with the most recent FAO/CECAF report (FAO/CECAF 2018) and other anecdotal evidence and a profile (very similar to the

Mauritanian one) has been created. In these cases, the species included as bycatch has been:

- Moroccan trawl fishery: European (White) Hake, Axillary Seabream (*Pagellus acarne*), Common Cuttlefish, European Squid (*Loligo vulgaris*), Demersal Elasmobranchs (Skates and Sharks), Turtles (loggerhead turtle) and Marine Mammals;
- Mauritanian trawl fishery: Bluespotted Seabream (*Pagrus caeruleostictus*), Red Pandora (*Pagellus bellottii*), Senegalese Hake (*Merluccius senegalensis*), Common Cuttlefish, European Squid, Demersal Elasmobranchs (Skates and Sharks); Turtles (loggerhead turtle) and Marine Mammals;
- Senegalese trawl fishery: Bluespotted Seabream, Red Pandora, Senegalese Hake, Common Cuttlefish, Demersal Elasmobranchs (Skates and Sharks); Turtles (loggerhead turtle) and Marine Mammals.

Jigs and pots are considered highly selective gears with very low bycatch. In these fisheries, no bait is used either. So, it is considered that no other species apart from octopus are caught.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

Atlantic mackerel

Factor 2.1 - Abundance

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Very Low Concern
Northeast Atlantic mackerel is a widely distributed species, assessed by the ICES as a single stock in European waters (ICES 2019c). There is a long-term management strategy for Northeast Atlantic (NEA) mackerel agreed by three coastal states involved in the mackerel fishery (Norway, the EU, and the Faroes), however, Iceland has not reached an agreement with these other states and also harvests significant volumes of mackerel (Anon. 2017). The spawning-stock biomass (SSB) is estimated to have increased since 2007, reaching a maximum in 2014, and has been declining since then. It has, however, remained above MSY Btrigger since 2008. There has been a succession of large year classes since 2001, with year classes since 2011 estimated to be above average (ICES 2019h).

There is a reliable quantitative stock assessment, and biomass is estimated to be above an appropriate target reference point. Therefore abundance is considered as "**very low concern**".
Justification:
Figure 12 provides a summary of the stock assessment for Atlantic mackerel in subareas I-VIII and XIV, and in Division IXa. The unshaded catches prior to 2000 are the ones that have been down-weighted in the assessment because of the considerable underreporting suspected to have taken place in this period. The recruitment value for 2018 is estimated using the recruitment survey (IBTS) and a model (RCT3), and the recruitment value for 2019 is the geometric mean of the recruitments from 1990 to 2017. Confidence intervals (95%) are included in the recruitment, fishing mortality, and spawning-stock biomass plots (ICES 2019h).

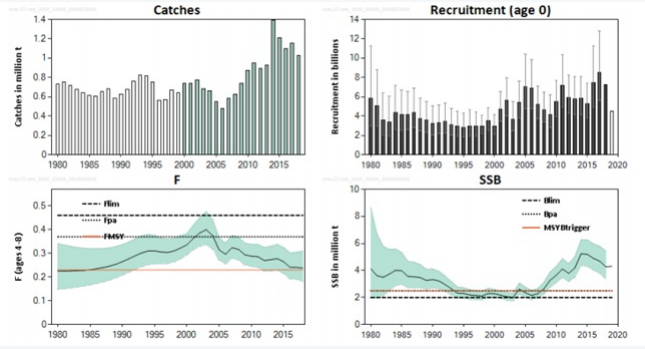

Figure 6: Summary of the stock assessment for Atlantic mackerel in subareas I-VIII and XIV, and in Division IXa. The unshaded catches prior to 2000 are the ones that have been down-weighted in the assessment because of the considerable underreporting suspected to have taken place in this period. The recruitment value for 2018 is estimated using the recruitment survey (IBTS) and a model (RCT3), and the recruitment value for 2019 is the geometric mean of the recruitments from 1990 to 2017. Confidence intervals (95%) are included in the recruitment, fishing mortality, and spawning-stock biomass plots (ICES 2019h).

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Low Concern
Traditionally, the fishing areas with higher catches of mackerel have been in the northern North Sea, around the Shetland Islands, and off the west coasts of Scotland and Ireland (ICES 2019c). The southern fishery off Spain's northern coast (Division 8c) has also accounted for significant catches although the catch from Division 9a (west coast of Spain and Portugal, where the common octopus mainly occurs) only represents a very small fraction of the total catch (ICES 2019h). Mackerel in the southern component are taken in a mixture of purse-seine, demersal trawl, line, and gillnet fisheries.

The current management plan aims for a fishing mortality in the range 0.20—0.22. The current fishing mortality has declined since mid-2000 from levels between Fpa (0.37) and Flim (0.46) to levels just above FMSY in 2018 (ICES 2019h). The total declared quotas for 2015 to 2019 all exceed the TAC advised by ICES. Total removals of mackerel are expected to be approximately 835,000 MT in 2019, exceeding the ICES advice for 2019 by about 65,000 MT (ICES 2019h).

Fishing mortality has decreased in recent years but it is still above FMSY. Total catch exceeds ICES advice, indicating that overfishing is taking place. Fishing mortality in Division 9a represents a small fraction of the total catch (mackerel catches from ICES areas 8c and 9a represented 3.3% of the total catch in European waters in 2018 (ICES 2019h)). Therefore, it is considered that the fishery assessed is not a substantial contributor and fishing mortality is therefore ranked as "**low concern**."

Axillary seabream

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Morocco

Moderate Concern

This species is a widely distributed species along the northern and eastern Atlantic coasts from Norway to Senegal and around the Macaronesia Islands and the Mediterranean Sea. The Axillary Seabream occupies a variety of habitats, especially seagrass beds and sand, from the surface to 500 m depth (commonly occurring between 40 and 100 m) (Russell et al., 2014). This is a hermaphrodite and an omnivorous species which feeds on mollusks and crustaceans (FAO/CECAF 2018).

Axillary seabream is assessed on the FishBase website as having medium resilience (minimum population doubling time 1.4 to 4.4 years (K = 0.17–0.23; tm = 2–3; tmax = 7; fec = 85,000)) and moderate vulnerability (43 of 100) (Fishbase 2014).

The abundance indices observed for this species in the scientific surveys carried out in the south of Boujdour show a downward trend from 2002 to 2012, before increasing in 2015 to a peak of 22.6 kg/30 mn. They fell in 2016 to a value of 2.9 kg/30 mn (FAO/CECAF 2018).

The FAO/CECAF Working Group on the Assessment of Demersal Resources–Subgroup North assessed the axillary seabream stock in Moroccan waters in 2017 using a Schaefer dynamic production and an LCA model (FAO 2018a). The Schaefer model did not provide a satisfactory fit with the series of data used, and no conclusion was drawn on the state of the stock using this model (FAO/CECAF 2018). Therefore, a PSA has been undertaken using the Fishbase website for the productivity analysis and the default scores for the susceptibility analysis. The species has a medium vulnerability.

Although the stock was assessed in 2017, the results were not satisfactory, and no conclusion was given by the FAO/CECAF Working Group. The species is not highly vulnerable. Therefore, abundance is considered "**moderate concern**".

Justification:

PRODUCTIVITY ANALYSIS		
CRITERIA		**SCORE**
Average age at maturity	1-2 years	1
Average maximum age	9 years	1
Fecundity	20,000 to 780,000	1
Average Maximum Size	37.0	1
Average Size Maturity	13-19	1
Reproductive Strategy	Broadcast spawner	1
Trophic level	>3.25	3
Habitat quality	Moderately altered	2
Productivity score		1.37
SUSCEPTIBILITY ANALYSIS		
CRITERIA		**SCORE**
Areal overlap (availability)	> 30% overlap	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery	Species is targeted, or is incidentally encountered and is not likely to escape the gear	2
Post-capture mortality (PCM)	Retained species or majority dead when released	3
Susceptibility score		**2.32**
PSA score		**2.70**
PSA category		**Medium vulnerability**

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Morocco

Moderate Concern

The axillary seabream is exploited by the deep-sea trawler fleet, the coastal fleet (longliners and trawlers) and the artisanal fleet in the area. From 2007 to 2012, the coastal fleet landed nearly nine times more that the deep-sea fleet, but after 2012 both fleets have recorded similar volumes. A sharp decline in catches of this species was observed in 2012 (569 MT, the lowest catch since 1990), followed by a gradual rise to 1,598 MT in 2016 (FAO/CECAF 2018).

The CPUE of the sea bream landed by deep-sea fleet reached a maximum 77 kg/fishing day in 2001 before falling to around 4 kg/fishing day in 2013 and increasing to 16 kg/day in 2016 (FAO/CECAF 2018).

The stock was assessed by the FAO/CECAF Working Group in 2017. The results of the LCA and Y/R models indicate that the stock is fully exploited (Fcurr/F0.1=110%) and (Fcurr/FMSY=99%). However, the stock assessment was not conclusive. The fishery is a substantial contributor for fishing mortality of the species. Fishing mortality is therefore considered "**moderate concern**".

Bib Pouting

Factor 2.1 - Abundance

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderate Concern
Pouting is a species from the Gadidae family and distributes along the continental shelf from 30 and 100 m depth from Scotland and Norway to Morocco and the western part of the Mediterranean Sea (Svetovidov, 1986). It is a benthopelagic, oceanodromous gregarious fish. Immature fish often occur in large schools. It mostly lives on the outer shelf, but moves inshore to depths of 50 m or less for spawning. This species feeds on benthic crustaceans but also on small fish, molluscs, and polychaetes (Svetovidov 1986).

There is a not a reliable quantitative stock assessment for this species in European waters. Therefore, a PSA has been undertaken using data from the Fishbase website for the productivity analysis (see justifications section) and default scores for the susceptibility analysis as the information found for the species is scarce.

The species is not highly vulnerable and no stock assessments are available. Therefore, biomass is ranked as "**moderate concern**."
Justification:

PRODUCTIVITY ANALYSIS		
CRITERIA		**SCORE**
Average age at maturity	1-2 years	1
Average maximum age	5 years	1
Fecundity	200,000 to 800,000	1
Average Maximum Size	46.0	1
Average Size Maturity	21.6	1
Reproductive Strategy	Broadcast spawner	1
Trophic level	>3.25	3
Habitat quality	Moderately altered	2
Productivity score		**1.37**
SUSCEPTIBILITY ANALYSIS		
CRITERIA		**SCORE**
Areal overlap (availability)	> 30% overlap	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery	Species is targeted, or is incidentally encountered and is not likely to escape the gear	2
Post-capture mortality (PCM)	Retained species or majority dead when released	3
Susceptibility score		**2.32**
PSA score		**2.70**
PSA category		**Medium vulnerability**

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderate Concern
This is a commercial species. The species is caught as bycatch in France, Spain, Portugal, and Morocco (Di Natale et al., 2011). In 2017, 8,949 MT were declared, Portugal and Spain represented 42% of the total catch (FAO landing data 2019). In Portugal, this species is mainly caught by the artisanal fishery (gillnets and hooks) representing 70% of the landings, and 75% are landed in the harbors of the North of Portugal (Chaves & Cardador 2004). No information for Spain has been found although the species is landed along the coast.

The species is mainly caught by gillnet and hook fisheries. Fishing mortality from the trawl fishery is unknown. Therefore, fishing mortality is ranked as "**moderate concern**."

Blue whiting

Factor 2.1 - Abundance

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Very Low Concern
Blue whiting is a small pelagic gadoid that is widely distributed in the eastern part of the North Atlantic. The highest concentrations are found along the edge of the continental shelf in areas west of the British Isles and on the Rockall Bank plateau where it occurs in large schools at depths ranging between 300 and 600 meters (ICES 2019c).

A long-term management plan was agreed on by the European Union, the Faroe Islands, Iceland, and Norway in 2016 to manage the stock (ICES 2019). ICES evaluated the strategy and found it to be precautionary (ICES 2016a). In 2017, the biological reference points of the stock were re-evaluated in the ICES Workshop on Blue Whiting Long Term Management Strategy Evaluation (WKBWMSE). The group agreed to keep Blim (1.50 million t) and Bpa (corresponding to MSY Btrigger =2.25 million t) unchanged (ICES 2019c). Spawning-stock biomass (SSB) increased from 2010 (2.71 million MT) to 2018 (6.32 million MT), followed by a decline to 2020 (4.32 million MT). SSB has been above Bpa (2.25 million tonnes) since 1997 (ICES 2019c). Recruitment has been low during the last three years. This low recruitment in combination with low 2016–2017 year classes will result in a decrease in stock size in the following years (ICES 2019b). However, SSB is still estimated to remain well above MSY Btrigger, which is the target reference point stated in the management strategy (Bmgt).

There is a reliable quantitative stock assessment. The lower recruitment in combination with a high F in recent years have resulted in a decline in SSB. However, biomass is estimated to be above the target reference point (BMSY). Therefore, abundance is assessed as "**very low concern**."
Justification:

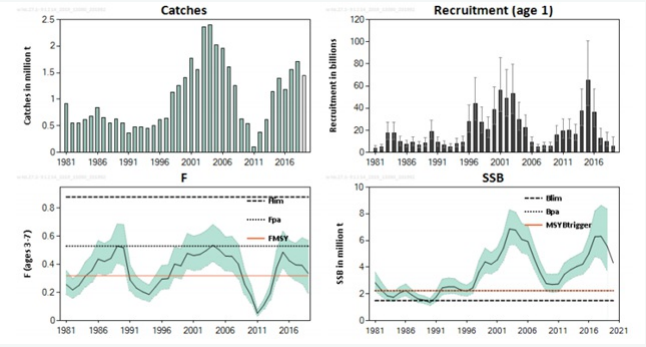

Figure 7: Summary of the stock assessment for blue whiting in subareas I-IX, XII, and XIV. . Catches for 2019 (not shaded) are preliminary. For this stock, F_{MGT} = F_{MSY} and SSB_{MGT} = B_{pa}; therefore, the horizontal lines representing these points in the graph would overlap. Confidence intervals (95%) are included in the recruitment, F, and SSB plots (ICES 2019c).

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Low Concern
A long-term management plan to manage the stock was agreed on by the European Union, the Faroe Islands, Iceland, and Norway in 2016 (Anon 2016). In 2017, the biological reference points of the stock were re-evaluated and the fishing mortality limit and target points were revised: Flim (0.88), Fpa (0.53) and FMSY (0.32) (ICES 2019c).

The multinational fleet currently targeting blue whiting consists of several types of vessels from 16 countries. The bulk of the catch is caught with large pelagic trawlers (ICES 2019c). The main blue whiting fisheries occurred west of Scotland, around the Porcupine Bank, and south of the Faroe Islands. In 2018, the total catch in 2018 was 1711 kt (ICES 2019c). Most of the catches (88%) are taken in the first two quarters of the year and the largest part of this west of the British Isles and east, south and west of the Faroes. Large blue whiting dominated the catch (ICES 2019b). Spanish catches are around 2% of the international catches. The total catch from Portugal is less than half a percent of the total international catches (ICES 2019c).

Fishing mortality increased from a historical low in 2011 (0.052) to above FMSY since 2014 (0.488 in 2015) (ICES 2019b) and decreased since then (0.335 in 2019), but is still estimated to be above FMSY (but below Fpa and Flim) (ICES 2019a). The recent low recruitment scenario will result in a reduction in fishing opportunities when the 2016–2018 year classes are fully selected in the fishery.

There is a reliable quantitative stock assessment, and F is estimated to be above FMSY but below Fpa and Flim. The bottom trawl fishery along the coast of Spain and Portugal represents a small portion of the total catch of the species. Therefore, as the fishery is not a substantial contributor to the mortality of this species, fishing mortality is considered a "**low concern**."

Bluespotted seabream

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

Very Low Concern
Bluespotted seabream is relatively widespread along the east Atlantic coast from Portugal to Angola, including the Canary Islands and Sao Tome (Russell 2014). The species is assessed on the FishBase website as having moderate to high vulnerability (46 of 100) (Fishbase 2014).

The abundance index of the Mauritanian industrial fleet shows a steady rise over the last four years with a reduction in 2014 and an increase in 2016. The CPUE of the Senegalese ice canoes show a downward trend until 2008, then it went up in 2009 and 2010 and declined again until 2013 (FAO/CECAF 2018). The abundance index series estimated by scientific surveys in Mauritania show some fluctuations, with a decreasing trend between 2010 and 2014, after which they fluctuated and reached 0.22 kg/30 mn in 2016 (FAO/CECAF 2018).

In 2017, the group assessed the stocks and concluded that the stock is fully exploited. The current biomass is higher than the target biomass. Therefore, the stock is over the target reference point, and abundance is considered as "**very low concern**."
Justification:

Stock/abundance index	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	F_{cur}/F_{SYcur}
Pagrus caeruleostictus (Mauritania and Senegal) / indices Al-Awam surveys	116%	127%	114%	102%	141%

$B_{cur}/B_{0.1}$: Relationship between the estimated biomass for the last year and the biomass corresponding to $F_{0.1}$.
F_{cur}/F_{SYcur}: Relationship between the observed fishing mortality coefficient during the last year of the series and that which would produce a sustainable yield at the current biomass level.
F_{cur}/F_{MSY}: Relationship between the observed fishing mortality coefficient during the last year of the series and that which would produce a maximum sustainable yield over the long term.
$F_{cur}/F_{0.1}$: Relationship between the observed fishing mortality coefficient during the last year of the series and $F_{0.1}$.

Figure 8: Indicators on the state of the stock and fishery of bluespotted seabream (*Sparus caeruleostictus*) in Mauritania and Senegal (FAO/CECAF 2018).

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
This species is a component of commercial, recreational, and artisanal fisheries in parts of its range and is highly valued (Russell 2014). The species is caught by Mauritanian and Senegalese trawlers. Total landings tend to fluctuate, but there was a downward trend from 2010 to 2015 and an increase in 2016. The industrial catches of this species remain quite stable in Mauritania, while catches of the artisanal fishery have increased since 2009 from 2,167 to 7,778 MT in 2016. However, in Senegal, the catch level has been rather stable since 1995 at around 4,000 MT per year (FAO/CECAF 2018).

The FAO/CECAF Working Group concluded that current fishing mortality is slightly above F0.1 (FAO/CECAF 2018). The fishery is a substantial contributor to fishing mortality of the species. Therefore, fishing mortality is ranked "**high concern**."

Common cuttlefish

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania

Very Low Concern
In 2017, the FAO/CECAF Working Group assessed these stocks and concluded that the current biomass of the Cape Blanc stock is higher than the target biomass B0.1 (FAO/CECAF 2018). The group considered that the improvement in the state of the stock was due to a decline in fishing effort of cephalopod trawlers due to two main reasons: the introduction of a 4-month/year closure in cephalopod trawler fishing; and the departure of European cephalopod fleet (FAO/CECAF 2018). Therefore, the stock is over the target reference point and abundance is considered as "**very low concern**."

Eastern Central Atlantic | Bottom trawls | Morocco

High Concern
Common cuttlefish*, Sepia officinalis,* is generally found in the eastern North Atlantic and in the Mediterranean Sea. Populations have also been recorded along the west coast of Africa. The common cuttlefish is an active predator, feeding on mollusks, young fish, and crabs. During spring and summer, males and females migrate to warmer water to spawn. The eggs are attached to objects on the seafloor such as shells and seaweeds. Young cuttlefish reach maturity at 14–18 months of age, and the average life span is 1–2 years (Encyclopedia of Life 2014).

During the 2003 meeting of the FAO/CECAF Working Group three administrative stocks were adopted for cuttlefish: Morocco (Dakhla stock (26 °N-21 °N)), Mauritania (Cape Blanc stock (21 °N-16 °N)) and Senegal-Gambia (Senegal-Gambia stock (16 °N-12 °N)) although the stock structure is unclear (FAO/CECAF 2018).

In 2017, the group assessed these stocks and concluded that the current biomass of the Dakhla Sepia spp. stock was overexploited (Bcur/B0.1 = 33% and Bcur/BMSY = 37%) coming from a fully exploited status in 2013 (FAO/CECAF 2018). Therefore, the stock is below a limit reference point and abundance is considered as "**high concern**."

Justification:

Stock/abundance index	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	$F_{cur}/F_{SY_{cur}}$
Sepia spp. Dakhla stock) / Moroccan cephalopod freezer trawlers	33%	37%	310%	279%	171%
Sepia spp. Cap Blanc stock / Mauritanian cephalopod freezer trawlers	151%	167%	31%	28%	83%
Sepia spp. Senegal-Gambia / CPUE artisanal fleet	N/A	N/A	N/A	N/A	N/A

$B_{cur}/B_{0.1}$: Relationship between the estimated biomass for the last year of the series and the biomass corresponding to $F_{0.1}$.
$F_{cur}/F_{SY_{cur}}$: Relationship between the observed fishing mortality coefficient during the last year of the series and the coefficient that would provide a sustainable yield at the current biomass level.
F_{cur}/F_{MSY}: Relationship between the observed fishing mortality coefficient during the last year of the series and the coefficient that would give a maximum sustainable yield over the long term.
$F_{cur}/F_{0.1}$: Relationship between the observed fishing mortality during the last year of the series and $F_{0.1}$.

Figure 9: Indicators on the state of the stock and fishery of cuttlefish (*Sepia spp.*) in Morrocan, Mauritanian, Senegalese, and Gambian waters (FAO/CECAF 2018).

Eastern Central Atlantic | Bottom trawls | Senegal

Low Concern
Sepia officinalis is found in the eastern North Atlantic from Norway to Senegal, and in the Mediterranean Sea (FAO 2019c). The common cuttlefish is an active predator, feeding on mollusks, young fish, and crabs. During spring and summer, males and females migrate to warmer water to spawn. The eggs are attached to objects on the seafloor such as shells and seaweeds. Young cuttlefish reach maturity at 14–18 months of age, and the average life span is 1–2 years (Encyclopedia of Life 2014). Stock inherent vulnerability is low (inherent vulnerability was calculated using the Seafood Watch guidelines for invertebrates. Due to its high fecundity, low age at maturity, relatively short lifespan, and rapid growth rate, Sepia spp. are considered naturally resilient organisms).

The CPUEs of the artisanal fishery in Senegal in recent years indicate a decline compared with previous years. Those of the industrial fishery have remained stable over the whole period. However, a drastic fall in CPUEs was observed in The Gambia in 2013-2014 (FAO/CECAF 2018). No scientific abundance indices are available.

In 2017, the group assessed these stocks using total annual landings for the period 1990-2012 and the CPUEs of the Senegalese industrial cephalopod fleet, but it was found that the model is a poor fit with the data used and the results were considered unreliable (FAO/CECAF 2018). In 2013, the group assessed the stock and concluded that the current biomass of the Senegalese stock was higher than the target biomass B0.1 (Bcurr/B0.1=117%)(FAO/CECAF 2018).

A quantitative stock assessment that is no more than 10 years old is available and the stock was estimated to be above a target reference point but does not meet all the requirements for very low concern. Therefore, abundance is ranked "**low concern**."

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania

Low Concern
The FAO/CECAF Working Group concluded in the 2017 assessment that fishing effort of the previous year is less than that corresponding to F0.1 (FAO/CECAF 2018). Therefore, fishing mortality is ranked "**low concern**."

Eastern Central Atlantic | Bottom trawls | Morocco

High Concern
The FAO/CECAF Working Group concluded that fishing effort in 2017 was far greater than that which would produce the B0.1 biomass (Fcur/F0.1 = 310% and Fcur/FMSY = 279%, respectively) (FAO/CECAF 2018). The Working Group concluded this could be due to the fishing strategies adopted by the cephalopod trawler fleets subject to a quota for octopus fishing, which in order to distribute their octopus quota over the whole year to prolong their activities, redirect their effort to other species of high commercial value, like the cuttlefish (FAO/CECAF 2018). In Morocco, the stock is not subject to a quota system but is governed by the same management measures applied to the octopus fishery. The group therefore recommended a reduction in fishing mortality of this species and the limitation of catches to the 2011 level (18,000 MT).

Overfishing is occurring. Management that is reasonably expected to curtail overfishing is not effective. Therefore, fishing mortality is ranked "**high concern**."
Justification:
In Morocco, the species is both catch by the cephalopod freezer fleet and by the artisanal fishery. Catches of cuttlefish in 2015 and 2016 were 27,300 and 25,500 MT respectively (FAO/CECAF 2018).

Eastern Central Atlantic | Bottom trawls | Senegal

Moderate Concern
The total catch of cuttlefish of the Senegal-Gambia stock has a decreasing trend from a maximum of 13,800 MT in 1991 to a minimum of 2,500 MT in 2009. Since then, there was an increase in catches to 4,300 MT in 2014 (FAO/CECAF 2018). In the Senegal-Gambia zone, the CPUEs of Senegalese industrial trawlers generally declined over the period 1990-2016 (FAO/CECAF 2018).

As indicated above, it was not possible to assess the stock in 2017. However, in 2013, the group assessed the stock and concluded that the current fishing mortality of the Senegalese stock was lower than the target fishing mortality F0.1 (Fcurr/F0.1=37%)(FAO/CECAF 2018).CPUEs have decreased in recent years.

It is considered that fishing mortality was adequate in 2013. No most updated information is available. CPUEs have declined in recent years. Therefore, fishing mortality is ranked "**moderate concern**."

European hake

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Morocco

Low Concern
In Morocco, the white hake has a large bathymetric distribution which extends from the coast to depths of 1 000 m. It's a species which lives near the bottom during the day but moves away during the night to look for food. Adult white hake generally prey on fish (young hake, anchovies, sardines and other gadoid species) and squid, while the young feed on crustaceans (in particular Euphausiides and Amphipods) (FAO/CECAF 2018).

The FAO/CECAF Working Group on the Assessment of Demersal Resources–Subgroup North assessed the European hake stock in Moroccan waters in 2017 (FAO/CECAF 2018). The Schaefer dynamic production model was used to assess the state of the stock of white hake. The results of the assessments indicate that the white hake stock is fully exploited in terms of biomass (Bcurr/B0.1=88%) and (Bcurr/BMSY=97%) (see figure below) (FAO/CECAF 2018).

There is a quantitative stock assessment and the stock is listed by the FAO/CECAF Working Group as fully-fished (the biomass is above a limit reference point, and at least 75% of the target reference point). Therefore, abundance is considered "**low concern**'.
Justification:
The FAO/CECAF Working Group on the Assessment of Demersal Resources in the Northern Area of CECAF was held in Tenerife, Spain, from 6 to 15 June 2017. The main objective of the group is to contribute to the improvement of the management of demersal resources in northwest Africa through the assessment of the state of stocks and fisheries to ensure sustainable use of these resources for the benefit of coastal countries (FAO 2018b). The results of the analyses are presented in four subgroups: shrimp, cephalopods, hake, and other demersal fish. A total of 26 stocks and groups of species were analyzed by the group in 2017. The Working Group used the Biological Reference Points (BRPs) adopted by CECAF;

- Target reference points: B0.1 and F0.1;
- Limit reference points: BMSY and FMSY.

The Bcur/BMSY and Fcur/FMSY reports were used to assess the current situation with respect to the limit reference points while the Bcur/B0.1 and Fcur/F0.1 reports were used to assess the situation relative to the target reference points. A detailed explanation of these reference points is given in the FAO report (FAO, 2006).

The three assessment categories adopted by the CECAF scientific Working Groups include:

- **Non-fully exploited**: The stock is in good condition and fishing pressure can be increased without affecting sustainability. All increases must be seen in the context of the general environmental situation;
- **Fully exploited**: The fishery operates within the limits of sustainability. Current fishing pressure seems sustainable and can be maintained;
- **Overexploited**: The fishery is in an undesired state both in terms of biomass and fishing mortality. Fishing pressure should be reduced to allow the stock to grow.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Very Low Concern
The EU multiannual plan (MAP) for stocks in the Western Waters and adjacent waters applies to the Southern hake stock (ICES VIIIc and IXa Sub-divisions) (EU 2019). The target fishing mortality of the MAP, in line with the ranges of FMSY, shall be achieved by 2020 (ICES 2019e). In accordance with the MAP, catches higher than those corresponding to FMSY can only be taken providing SSB is greater than MSY Btrigger, and one of the following conditions is met: a) if it is necessary for the achievement of objectives of mixed fisheries; b) if it is necessary to avoid serious harm to a stock caused by intra- or inter-species stock dynamics; c) in order to limit variations in fishing opportunities between consecutive years to not more than 20%. ICES considers that the FMSY range for this stock used in the MAP is precautionary (ICES 2019d).

In the 2019 advice for European hake, ICES highlighted that the spawning-stock biomass (SSB) has increased since 1998 and has been above MSY Btrigger, Bpa, and Blim since 2007. In 2019, the stock is in a healthy status (17,430 t) above Bpa (MSY Btrigger = 11.100 t). Since 2010, recruitment (R) has been close to the historical average (ICES 2019e).

A management plan is in place for the stock. Stock status is assessed by ICES. In 2019, the biomass of southern hake was above BMSY. Therefore, abundance is ranked as "**very low concern**".
Justification:

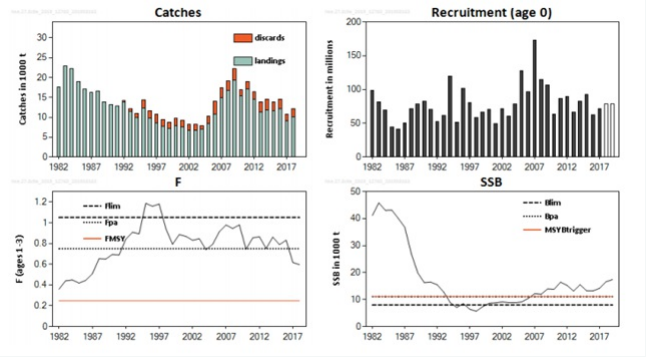

Figure 10: Summary of the stock assessment for European hake in divisions VIIIc and IXa, Southern stock. Assumed recruitment values are unshaded (ICES 2019d).

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Morocco

High Concern
The European hake is one of the main commercial fish resources found in the North Atlantic coast of Morocco. The species is managed among Senegalese hake (*Merluccius senegalensis*), and the tropical African hake (*Merluccius polli*) under a hake management plan which became effective at the end of 2014. The management plan includes fishing closures by area, restricted areas for artisanal fleets, and other technical measures (minimum mesh size, etc.) (FAO/CECAF 2018).

The species is mainly exploited in Morocco by a national fleet, composed of artisanal trawlers, longliners, and small boats. The catch per unit of effort (CPUE) of the coastal Moroccan fleet reached a peak in 2008 with 96 kg/day, then fell to 44 kg/day in 2015 and increased slightly to 59 kg/day in 2016. The total catch of the species in 2016 was 5,379 MT. European hake accounts for 12 percent of all demersal species caught in the zone (FAO/CECAF 2018).

The most recent assessment undertaken by the FAO/CECAF working group indicated that the stock was slightly overexploited in terms of fishing mortality, with catches exceeding the sustainable production of the stock. The current fishing mortality is slightly higher than the target fishing mortality F0.1 (Fcurr/F0.1=126%) and the fishing mortality that would correspond to the sustainable biomass (Fcurr/FMSY=114%). In 2018, the group recommended reducing the current fishing mortality of coastal trawlers targeting juveniles in order to minimize the proportions of juveniles caught.

The stock is currently experiencing overfishing. The fishery is a substantial contributor to the mortality of the species. Therefore, abundance is considered "**high concern**".

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Hake is caught by a multigear fleet (otter trawlers, pair trawlers, gillnetters, longliners, and artisanal) in Spanish and Portuguese waters. In the trawl fleet, hake is caught together with megrim, anglerfish, blue whiting, horse mackerel, mackerel, and crustaceans. Overall landings increased from 9,171 t in 2017 to 10,183 t in 2018. Spanish and Portuguese official landings were 6,441t and 1,489 t respectively (ICES 2019e). Non-reported landings in 2018 increased from 763t in 2017 to 2,193 t. Total catches were 12,125 t in 2018, higher than the 10,847 observed in 2017. The TAC for 2018 was 9,258 which means total catches overpass the advised TAC (ICES 2019e). Fishing mortality (F) is decreasing although it remains above FMSY (0.25), but below Fpa (0.75) and Flim (1.05) (ICES 2019d).

Trawl fisheries contribute around 30% of the total fishing mortality of European hake in the area. Like octopus, European hake is caught in both the crustacean and the fish trawl fisheries. In 2019, the stock continues to be overexploited (F 2018=0.60), well above FMSY, although inside precautionary limits (Fpa). Therefore, the mixed trawl fishery in the area is considered to have a high impact on the fishing mortality for this species, and this section is assessed as "**high concern**."

European horse mackerel

Factor 2.1 - Abundance

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Very Low Concern
In the Northeast Atlantic, European horse mackerel is divided into three stocks: the northeastern Atlantic horse mackerel in the Norwegian sea, northern North Sea, west and south of the British Isles, western English Channel, and west of France; the southern horse mackerel around the Iberian peninsula; and the North Sea horse mackerel, restricted to the central and southern parts of the North Sea and eastern English Channel (Smith-Vaniz et al., 2015).

In 2018, a management plan was proposed for the European horse mackerel stock in Iberian waters with a Harvest Control Rule defined by FMSY at 0.11, Fbycatch at 0.01, MSY Btrigger at 181 kt and Blim at 103 kt and with a ±15% catch constraint (ICES 2018b). ICES evaluated the long-term management strategy and considered to be precautionary; and, it was found that when the HCR is applied, the stock is maintained at levels that can lead to catches around MSY (ICES 2019f). SSB has been above MSY Btrigger over the whole time-series, with a continuous and steep increase in the last few years (increase from 410 thousand MT in 2013 to 888 thousand MT in 2018) (ICES 2019g)), and is currently at its highest level (ICES 2019f). Recruitment (R) in 2011–2017 has been above the time-series average (ICES 2019g).

Horse mackerel's stock status scores "**very low concern**" because current SSB (SSB2018=888,000 MT) is well above the target reference point (MSYBtrigger= 181,000 MT).
Justification:

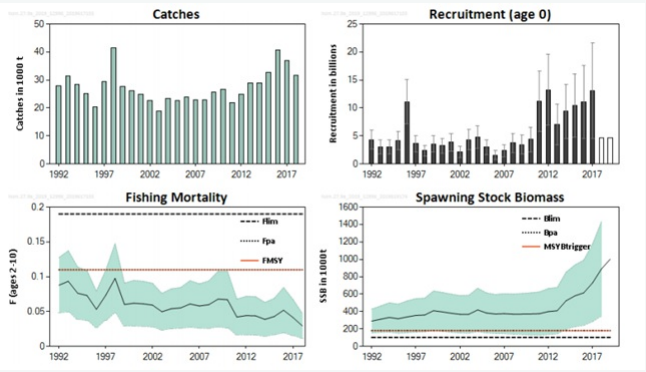

Figure 11: Summary of the stock assessment (weights in thousand tonnes) for horse mackerel (*Trachurus trachurus*) in Division IXa. Confidence intervals (95%) are displayed for recruitment, fishing mortality (F), and spawning–stock biomass (SSB). Unshaded recruitment is geometric mean over 1992–2017 (ICES 2019f).

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Low Concern
The southern horse mackerel is targeted by six fleets, the Spanish and Portuguese bottom trawl, purse-seine and artisanal fleets. Horse mackerel is mainly targeted in the Portuguese bottom trawl demersal fish fleet (64% of the Portuguese catches in 2018), while in Spain, main catches are from the Purse-seine fleet (71%) (ICES 2019g).

Management of southern horse mackerel, blue jack mackerel (*T. picturatus*), and Mediterranean horse mackerel (*T. mediterraneus*) is done under a combined TAC, which prevents effective control of the single-species exploitation rates and could lead to overexploitation of any of the species (ICES 2019g). However, estimates indicate that in 2018, less than 10% of the catch consisted of the other two species (blue jack mackerel and Mediterranean horse mackerel). In 2019, ICES advised on the basis of the MSY approach that catches should be no more than 116,871 MT in 2020 (ICES 2019g)

Fishing mortality has been below FMSY over the whole time-series. In the last published assessment, ICES considered that fishing pressure on the stock (F2018=0.029) was well below FMSY (=Fpa=0.11) and Flim (0.19) (ICES 2019f).

The bottom trawl demersal fish fleet catch represents 64% of the total catch in Portugal (in Spain the catch is less important). However, current fishing mortality is well below FMSY. Therefore fishing mortality for this species is scored "**low concern**."

European squid

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco

Moderate Concern
The European squid (*Loligo vulgaris*) is one of the most common loliginid species in the northeastern Atlantic and the Mediterranean Sea. It is a neritic and semi-pelagic species distributed between the North Sea and the British Isles (55°N) and the north African coast (20°N), including the Mediterranean Sea (Guerra, A. & Rocha, F. 1994). The life span of *L. vulgaris* is estimated at about 1 year. *L. vulgaris* spawn throughout the year, but the period of more intensive spawning extends from December to April. The estimated number of oocytes in mature female *L. vulgaris* varied from 782 to 21,885 and showed a slight positive correlation with the length of the mantle (Guerra, A. & Rocha, F. 1994).

In Morocco, the squid CPUEs show major fluctuations, yet indicate a more significant upward trend in recent years for the deep-sea and artisanal segments. Also in recent years, a considerable improvement in the CPUEs is observed in Mauritania particularly for the Mauritanian freezer trawlers and the Spanish trawlers (2012). The CPUEs for Senegal and The Gambia have remained low (FAO/CECAF 2018). With respect to the scientific surveys, in Morocco, the abundance indices (annual yields) show the same trend as the CPUEs of the commercial fishery. Whereas, in Mauritania, annual abundance indices are highly variable. No information is given for the Senegal-Gambia stock (FAO/CECAF 2018).

In 2017, the FAO/CECAF group tried to assess these stocks but the model was a poor fit with the data used and the results were considered unreliable for all the stocks (FAO/CECAF 2018).

No reference points were set for this stock and a reliable stock assessment was not undertaken due to the inconsistency of the data. The species has a medium vulnerability to fishing pressure. Abundance indices are variable. Therefore, based on the SFW criteria, a PSA analysis has been undertaken and abundance is considered as "**moderate concern**."
Justification:
The inherent vulnerability was calculated using the Seafood Watch guidelines for invertebrates. In this case, the life history attributes selected from the table are average age at maturity <1 year, average maximum age 1 year, reproductive strategy "demersal egg layer," trophic level >3.25, and density dependence "no depensatory or compensatory dynamics demonstrated." Default scores are used for the susceptibility score. Therefore, inherent vulnerability is "medium."

PRODUCTIVITY ANALYSIS		
CRITERIA		**SCORE**
Average age at maturity	<1 year (Moreno et al., 2004)	1
Average maximum age	1 year (Guerra & Rocha 1994)	1
Fecundity	782 – 21,885 eggs (Guerra & Rocha 1994)	2
Reproductive Strategy	Demersal egg layer (Guerra & Rocha 1994	2
Trophic level	>3.25 (DCSMM 2019)	3
Density dependence	No depensatory or compensatory dynamics demonstrated	2
Habitat quality	Moderately altered	2
Productivity score		1.85
SUSCEPTIBILITY ANALYSIS		
CRITERIA		**SCORE**
Areal overlap (availability)	> 30% overlap	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery	Species is targeted, or is incidentally encountered and is not likely to escape the gear	2
Post-capture mortality (PCM)	Retained species or majority dead when released	3
Susceptibility score		**2.32**
PSA score		**2.97**
PSA category		**Medium vulnerability**

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco

Moderate Concern
In Morocco, squid catch by the deep-sea, coastal, and artisanal fleets showed large fluctuations from one year to the next (FAO/CECAF 2018). Catches of the deep-sea segment showed an upward trend from 775 MT in 2007 to 6,900 MT in 2013, decreasing in 2014 and 2015 and increasing sharply in 2016, doubling the production recorded in 2015 (10,560 MT) (FAO/CECASF 2018). For the coastal and artisanal fleets, segments, the average annual catch was 1,000 and 2,000 MT respectively (FAO/CECAF 2018).

In Mauritania, most of these squid catches were from Mauritanian freezer trawlers and Spanish cephalopod trawlers showing an increasing trend from 2006 until 2016 (2,920 MT). Squid catches in Senegal were lower with an annual average of 132 MT (FAO/CECAF 2018).

In 2017, the stocks were not assessed due to the poor fit of the data used. The main squid catches are undertaken by the Moroccan fleet (10,560 MT in 2016). The effect of the current fishing mortality on the stock is unknown and the fishery is a substantial contributor to fishing mortality of the species. Therefore, fishing mortality is ranked "**moderate concern**."

Loggerhead turtle

Factor 2.1 - Abundance

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderate Concern
Sea turtles are threatened worldwide by many human activities, from direct exploitation to the indirect effects of climate change. The global population of the Loggerhead Turtle (*Caretta caretta*) comprises 10 subpopulations that vary widely in population size, geographic range, and population trends (Wallace et al. 2010) (Wallace et al., 2011). The IUCN assesses the loggerhead turtle as vulnerable on a global scale (Casale & Tucker 2017). The Mediterranean subpopulation is considered as 'least concern', thanks to decades of intense conservation programs, especially at nesting sites (Casale 2015). The available long-term series of nest counts (used as an index of population abundance) show an overall increase over the past three generations. Moreover, both geographic distribution and population size are relatively large (Casale 2015). However, the Northeast Atlantic subpopulation which is distributed along the African coast until the western part of the Mediterranean, is assessed as 'endangered' due to strong reductions in the population (Marco et al. 2012).

The Mediterranean subpopulation of loggerhead turtle is assessed as 'least concern'. However, this "Least Concern" status it is considered by the IUCN as entirely conservation-dependent (Casale 2015). The Northeast Atlantic population is considered as 'endangered' (Casale & Marco 2015). This last population is found further south (Cabo Verde; Guinea; Mauritania; Sierra Leone) (Casale & Marco 2015). Therefore, it is considered that the individuals caught by fishing trawlers operating in the area of the Gulf of Cadiz would belong to the Mediterranean population. Therefore, this section is considered "**moderate concern**."

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Fisheries bycatch, coastal development, pollution and pathogens and climate change are considered the greatest threats to loggerheads (Casale et al. 2017). In 2007 and 2008, the Chelonia Association evaluated the incidental catch of loggerhead turtles in bottom trawlers, and concluded that about 5,000 turtles are caught annually in the Gulf of Cádiz and the Spanish Mediterranean (Biton 2009). The average number of turtles caught by trawlers in the Gulf of Cádiz (South Spain), where the octopus fishery is being assessed, was assessed between 1 and 3 individuals—by vessel and trip—lower than in the Mediterranean Sea due to the lower number of turtles in this area (Biton et al., 2009). Although TEDs (turtle excluder devices) are effective in reducing turtle captures (Biton et al., 2009)(Luchetti et al., 2019), there is no legal obligation to use these devices in the trawl fishery.

Individual fisheries contribution is unknown, but bottom trawls could be one of the main sources of mortality in the Mediterranean area (Tomas et al., 2008)(Alvarez de Quevedo et al., 2009) (Casale 2011)(Lucchetti et al., 2017). It is probable that fishing mortality from all sources is above a sustainable level. Therefore, fishing mortality is assessed "**high concern**".

Mammals

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
A number of species of small cetaceans can be found in West African waters, common dolphin, stripped dolphin (*Stenella coeruleoalba*), harbor porpoise, small toothed whales (Ziphiidae) and the endemic Atlantic humpback dolphin (*Sousa teuszii*) (CMS 2020). According to the CMS various threats, including direct and accidental catch, coastal development, pollution and habitat degradation, have caused West African marine mammal populations to decline rapidly (CMS 2020).

(Pompa et al. 2011) identified global key conservation sites for marine and freshwater mammal species based on their geographic ranges. Regions especially rich in marine species were found along the coasts of North and South America, Africa, Asia, and Australia. In Northwestern Africa, 25 species were identified; 7 of them endemic or with a small range. The size of the marine mammal populations in the area and the optimum sustainable population (OSP) have not been calculated, so it is not possible to determine whether current populations are at a sustainable level. However, vulnerable and endemic species are found in the area, and the conservation status of the Northwestern Africa ecoregion was estimated by (Pompa et al. 2011) as critically endangered. The Atlantic humpback dolphin is also listed as critically endangered in the IUCN red list (Collins et al., 2017). Using the Seafood Watch guidance for unknown species, abundance for these species is assessed as "**high concern**."

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderate Concern
The Iberian (Spain and Portugal) mainland coast is rich in cetacean species, with at least 13 species present in the area. The principal species reported in the area are common dolphins, harbor porpoises, bottlenose dolphins, and striped dolphins. Some sources indicate that common dolphins were captured in large amounts off mainland Portugal during the late 19th and 20th centuries. Other species are also commonly reported as bycatch, such as harbor porpoises, bottlenose dolphins, and striped dolphins (Brito et al. 2009). The size of these populations in the area and the optimum sustainable population (OSP) have not been calculated, so it is not possible to determine whether the current population is at a sustainable level. Common dolphins (*Delphinus delphis*), harbor porpoises (*Phocoena phocoena*), bottlenose dolphins (*Tursiops truncatus*) and striped dolphins (*Stenella coeruleoalba*) are not considered to be endangered or threatened species; all these species are assessed as least concern by the IUCN (Hammond et al., 2008a)((Hammond et al., 2008b)(Wells et al., 2019)(Braulik 2019).

As these are highly vulnerable species, abundance for these species is assessed as "**moderate concern**".

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

Moderate Concern
Several species such as Mediterranean monk seal, common dolphin, harbor porpoise, or bottlenose dolphin occur in Northwest African waters and Southern Europe (Pompa et al. 2011). Historical whaling data suggest that in the 18th to the early 20th centuries, Northwest African waters constituted an important area for humpback whales and sperm whales. Recent data from scientific surveys confirm that the area still plays an important role for these species, blue whales, and several species of dolphins and pilot whales (IMROP 2013).

Incidental capture in fishing activities threatens whales, dolphins, and porpoises worldwide. Marine mammals in particular provide some of the best-known cases of population and species extinction through overexploitation. Incidental capture of small cetaceans in particular presents one of the greatest threats worldwide to the conservation of cetacean species (Zollett 2005).

The impact of trawling on marine mammals is not well documented although, in some areas of the world, associations between cetacean species and trawlers have been documented (Leatherwood 1075)(Zollett 2005). Trawling activities can attract healthy animals since they represent an easy-to-access, concentrated food source. Marine mammals can become entangled by trawl gear when swimming to forage around the vessels, although the risk differs widely between species. Pilot whales and common dolphins in the Atlantic seem to be particularly susceptible to being caught in bottom trawls (NOAA fisheries 2020).

(Leatherwood 1975) observed three feeding patterns of bottlenose dolphins associated with shrimp trawlers, including animals foraging behind working boats by eating organisms stirred up from trawlers, fish that bypass the net or fish stuck in the mesh; animals feeding on discarded fish or those that escaped the net; and animals preying on fish attracted to non-working trawlers (Zollett 2005). The consumption and sale of Atlantic humpback dolphin has been reported from Mauritania, Senegal and other countries in the area. It is unclear if it is as a result of the bycatch of the species is directly targeted (Collins et al., 2017). (Leeney et al. 2015) reported that in Guinea-Bissau for example, 42% of fishermen stated that they had accidentally caught a dolphin.

Some marine mammals may be caught in bottom trawl fisheries in the area, although gillnets, driftnets and pelagic trawls have the main impact on marine mammals. Based on the unknown bycatch matrix, fishing mortality is assessed as "**moderate concern**".

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Under the Council Regulation (EC) 812/2004 (EU, 2004), the European countries are forced to report any bycatch of marine mammals in European waters. ICES uses this data to assess the impact of European fisheries on marine mammals. In 2016, although several species were reported as bycatch in bottom trawl fisheries, including common dolphins, harbor porpoises, and bottlenose dolphins, many of these incidents occurred in ICES division IXa. However, observer monitoring under the European Data Collection Framework (DCF) is not always sufficient and in some years Spain has not provided bycatch data to ICES (ICES 2016b).

The LIFE+ MarPro project (Vingada and Eira, 2018) provided estimates of accidental mortality in fisheries obtained from surveys, observers onboard fishing vessels, electronic monitoring systems, or through voluntary declarations from fishermen and stranding analyses, for the first time in Portugal. The bottom-trawler fleet captured caught an average of 437 cetaceans per year. It contributes to the removal of 0.92% of the common dolphin population and 1% of the Bottlenose dolphin population. For all species with catches, PBR values are below the 1.7% limit. No information has been found for Spain.

In 2016, ICES considered that based on bycatch rate and total fishing effort, total annual removals of common dolphins in European fisheries may exceed the 1.7% limit established by ASCOBANS but these estimates were based on incomplete data (ICES 2016b).

Using the Seafood Watch guidance for unknown species (as available data are inconclusive), fishing mortality for these species is assessed as "**high concern**".

Red pandora

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

Very Low Concern
Red Pandora is widespread and is one of the most abundant sparid species on the West African coast (Russell & carpenter 2014). It is a significant component of the multi-species coastal demersal fisheries in the Eastern Central Atlantic. Abundance indices in Mauritania fluctuate over the years with a spectacular increase in abundance in 2016 (FAO/CECAF 2018).

In 2017, the FAO/CECAF group assessed the stocks using a wide range of models (Schaefer dynamic production model, the LCA analytical model, and the yield per recruit model) and that the stock is fully exploited. The current biomass is higher than that corresponding to the biomass B0.1. Therefore, the stock is over the target reference point and abundance is considered as "**very low concern**."
Justification:

Stock	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	F_{cur}/F_{SYcur}
Pagellus bellottii (Mauritania, Senegal and The Gambia) / CPUE of Senegalese icebox canoes	113%	124%	82%	74%	98%

$B_{cur}/B_{0.1}$: Relationship between the estimated biomass for the last year and the biomass corresponding to $F_{0.1}$.
F_{cur}/F_{MSY}: Relationship between the observed fishing mortality coefficient during the last year of the series and that which would produce a maximum sustainable yield over the long term.
$F_{cur}/F_{0.1}$: Relationship between the observed fishing mortality coefficient during the last year of the series and $F_{0.1}$.
F_{cur}/F_{SYcur}: Relationship between the observed fishing mortality coefficient during the last year of the series and that which would produce a sustainable yield at the current biomass level.

Figure 12: Indicators on the state of the stock and fishery of red pandora (*Pagellus bellottii*) in Mauritania, Senegal, and The Gambia (FAO/CECAF 2018).

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

Low Concern
Between 1990 and 2016, the largest catches of Red Pandora in the northern CECAF region were recorded in Senegal with an annual average of 5,664 MT compared to 2,217 MT for Mauritania. The FAO/CECAF Working Group concluded that the current fishing effort is lower than the target mortality (F0.1). Therefore, fishing mortality is ranked "**low concern**."

Sea turtles

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Six sea turtle species occur in the West Africa region: the loggerhead, green, hawksbill, olive ridley, Kemp's ridley, and leatherback (IMROP 2013). Due to their typically vulnerable life cycle, characterized by a slow growth rate, late maturity, and low fecundity, turtles are highly susceptible to fishing mortality (Casale et al. 2011).

Sea turtles are threatened worldwide by many human activities, from direct exploitation to the indirect effects of climate change. The global population of the Loggerhead Turtle (*Caretta caretta*) comprises 10 subpopulations that vary widely in population size, geographic range, and population trends (Wallace et al. 2010) (Wallace et al., 2011). The IUCN assesses the loggerhead turtle as vulnerable on a global scale (Casale & Tucker 2017). The Northeast Atlantic subpopulation which is distributed along the African coast until the western part of the Mediterranean is assessed as 'endangered' due to strong reductions in the population (Marco et al. 2012). Mauritania is likely the northernmost nesting area on the African Atlantic coast for loggerhead sea turtle (Caretta caretta). It is unknown if this population is the same that breeds in the Cape Verde archipelago. This species breeds between Belawkh and Tiwilit (IMROP 2013).

The green sea turtle (*Chelonia mydas*) is the most common in Mauritania (90% of individuals observed). There is a high proportion of immature individuals in the marine protected area of Nouakchott, indicating the existence of one or more nursery areas. Large adults of both sexes feed on seagrass beds in Arguin (area of the island Tidra). Some females carry out long migrations between their nesting sites in the Bijagos Archipelago (Guinea Bissau) and the Banc d'Arguin (Mauritania) (IMROP 2013). The green turtle is classified as endangered at the global level (Seminoff 2004). Degradation of nesting habitats, fishing-induced mortality, boat collisions, and pollution are considered the greatest threats (Casale et al. 2007) (Casale et al. 2011).

Sea turtles are threatened worldwide by many human activities, from direct exploitation to the indirect effects of climate change. There is no specific information about sea turtle abundance in the area. Following the "unknown species" criteria from Seafood Watch, these species are evaluated as "**high concern.**"

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Current data and assessments of trawl fisheries are almost non-existent for the region. Mid-water factory trawls in Mauritania incidentally catch at least 50 sea turtles per year, including leatherbacks, loggerheads, and hawksbills (Zeeberg et al. 2006). A number of incidental threats impact green turtles around the world. These threats affect both terrestrial and marine environments and include bycatch in marine fisheries and habitat degradation at nesting beaches and feeding areas. Mortality associated with entanglement in marine fisheries is the primary incidental threat; the responsible fishing techniques include drift netting, shrimp trawling, dynamite fishing, and long-lining (Seminoff 2004). Information for Morocco and Senegal is not available.

There is no specific information about the impacts of the bottom trawl fishery on sea turtles in the region. Therefore, the fishery's contribution to sea turtle mortality is unknown. Using the unknown bycatch matrix, fishing mortality is evaluated as "**high concern**."

Senegalese hake

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

Very Low Concern
Merluccius senegalensis and *M. polli* are fished and marketed under the same name, black hake, and they are therefore assessed by the FAO/CECAF Working Group as a single stock (Merluccius spp.). In 2017, several assessment models, including a Schaefer dynamic production model, a Bayesian dynamic model, and a CMSY model, were used by the working group to carry out the assessment. Although the results differ among them, the group concluded that the black hake stock was not fully exploited, with current biomass greater than the sustainable biomass BMSY (Bcurr/BMSY = 126-163%) and the target biomass B0.1 (Bcurr/B0.1 = 115-148%)(see table below) (FAO 2018).

There is a reliable quantitative stock assessment, current black hake biomass exceeded biomass required to produce maximum sustainable yield (FAO 2018), therefore this section is scored as "**very low concern**".
Justification:

Model	Stock/abundance index	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	F_{cur}/F_{SYcur}
Biodyn Schaefer	*Black hake* (sub-region/CPUE 2015 (*cf.* 1st test)	148%	163%	114%	103%	280%
Biodyn Schaefer	*Black hake* (sub-region/average CPUE 2015-2016)	115%	126%	137%	124%	168%
Biodyn Schaefer	*Black hake* (sub-region/ 2016 (*cf.* 3rd test)	135%	148%	129%	116%	226%
Bayesian Fox	*Black hake* (sub-region/average CPUE 2015-2016)	139%	153%	113%	102%	154%
CMSY	*Black hake* (sub-region/average CPUE 2015-2016	82%	95%	137%	125%	N/A
LCA/Y/R	*Black hake* (sub-region/average CPUE 2015-2016)	N/A	N/A	313%	281%	N/A

$B_{cur}/B_{0.1}$: Ratio between the estimated biomass for the last year and the biomass corresponding to $F_{0.1}$.
$F_{cur}/F_{0.1}$: Ratio between the observed fishing mortality coefficient during the last year of the series and $F_{0.1}$
B_{cur}/B_{MSY}: Ratio between the estimated biomass for the last year and the biomass coefficient corresponding to F_{MSY}.
F_{cur}/F_{MSY}: Ratio between the observed fishing mortality coefficient during the last year of the series and the coefficient giving maximum long-term sustainable yield.
F_{cur}/F_{SYcur}: Ratio between the observed fishing mortality coefficient during the last year of the series and the coefficient that would give a sustainable yield at current biomass levels.

Figure 13: Indicators on the state of the stock and fishery of black hake (*Merluccius senegalensis* and *M. polli*) (FAO 2018).

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
In the past, black hake was exploited by several national and foreign fleets in the area. Recent changes in the agreements between the EU and these countries have affected this fishery. Although most of the catch is currently taken by Spanish fresh hake trawlers, these species constitute a significant part of the bycatch of cephalopod boats, shrimpers, and pelagic trawlers (FAO/CECAF 2018). Catches of black hake reached a maximum of 15,890 MT in 2002 and have been declining gradually until 2013 (4,790 MT). In recent years, total catches increased significantly to 16,970 MT in 2016. Catches in Mauritania represented 83% of the total production of the CECAF zone for the period 2000–2012 but have increased in Morocco since 2014 (reaching a percentage of 70% of the total catch) (FAO/CECAF 2018).

In the most recent assessment, several assessment models were used by the group to evaluate the stock. The Schaefer dynamic production model indicated that the current effort (2016) is above the optimum effort FMSY and the target effort F0.1. Overall, the different dynamic models used indicate excess fishing mortality comparative to that of the past year.

There is a reliable quantitative stock assessment, current fishing effort is above the optimum effort FMSY and the target effort F0.1. (FAO/CECAF 2018) and the fishery is a substantial contributor to fishing mortality for the species. Fishing mortality is therefore ranked as '**high concern**'.

Sharks

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Due to their typically vulnerable life cycle, characterized by slow growth rates, late maturity, and low fecundity, elasmobranch species are highly susceptible to fishing mortality (Field et al., 2009)(Dulvy et al., 2014)(Quetglas et al., 2016).

(Balguerias et al. 2000) carried out a study on the changes produced in the faunistic communities in Morocco in response to fishing. Several families of chondroichthyes (sharks and rays) were described as present in the area: Carcharhinidae, Dasyatidae, Gymnuridae, Leptochariidae, Mobulidae, Myliobatidae, Rajidae, Rhinobatidae, Scyliorhinidae, Squalidae, Squatinidae, Torpedinidae and Triakidae (Balguerias et al., 2000). Some of the species belonging to these families are Thornback ray (*Raja clavata*), cuckoo ray (*Leucoraja naevus*), undulate skate (*R. undulata*), common skate (*Dipturus batis-complex*), small-spotted catshark (*Scyliorhinus canicula*), spiny dogfish (*Squalus acanthias*), nursehound (*Scyliorhinus stellaris*), Common Smoothhound (*Mustelus mustelus*), tope (*Galeorhinus galeus*) and blackmouth Catshark (*Galeus melastomus*), which are all present also in waters of Mauritania and Senegal. Thornback ray, undulate ray and common skate are classified as Near Threatened, endangered, and critically endangered (Ellis 2016)(Coelho et al., 2009)(Dulvy et al., 2015) respectively. Nursehound, spiny dogfish, and tope are classified as near threatened and vulnerable (Ellis et al., 2009)(Walker et al., 2006)(Fordham et al., 2016)respectively.

(Balguerias et al. 2000) used results from surveys carried out on the bank in 1942, 1962, 1974, and 1990. The data suggested some changes in the community. Within the elasmobranchs (Chondrichthyes), all families but one (Scyliorhinidae) experienced a severe decline in relative abundance. Also, the total number of families and species represented in the surveys decreased from 1942 to 1990 (from 13 families and 29 species in 1942 to only 6 families and 6 species in 1990) (Balguerias et al. 2000).

In a survey carried out by (Gascuel et al. 2007) in Mauritanian waters, total demersal biomass has been reduced by 75% on the Mauritanian continental shelf over the past 25 years due to overfishing. In the same survey, common smoothhound (*Mustelus mustelus*) showed a strong biomass decrease but only in the deepest strata.

No information about this group has been found for Senegal.

Skates and rays and demersal sharks are not assessed by the FAO/CECAF Working Group or by any of the national agencies (INRH, IMROP, CRODT), and no reference points have been set for these species. Moreover, the available information for these species in the area is scarce. There is no evidence therefore to suggest that shark stocks are either above or below reference points. Shark and skates stocks' inherent vulnerability is high. Therefore, this section is assessed "**high concern"** for all the areas.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Due to their typically vulnerable life cycle, characterized by slow growth rates, late maturity, and low fecundity, elasmobranch species are highly susceptible to fishing mortality (Field et al., 2009)(Dulvy et al., 2014)(Quetglas et al., 2016).

Skates found in Iberian waters include thornback ray (*Raja clavata*), cuckoo ray (*Leucoraja naevus*), the less frequent blonde ray (*Raja brachyura*), small-eyed ray (*R. microocellata*), brown ray (R. miraletus), spotted ray (*R. montagui*), undulate ray (*R. undulata*), shagreen ray (*Leucoraja fullonica*), common skate (*Dipturus batis-complex*), long-nosed skate (*D. oxyrinchus*), sandy ray (*Leucoraja circularis*) and white skate (*Rostroraja alba*). Thornback ray and Cuckoo ray (*L. naevus*) are the most commercially important skate species in this ecoregion and are normally found in Portuguese fish markets (Ictioterm 2013)(ICES 2018d). The small-spotted catshark *(Scyliorhinus canicula*), spiny dogfish (*Squalus acanthias*), nursehound (*Scyliorhinus stellaris*), tope (*Galeorhinus galeus*) and blackmouth Catshark (*Galeus melastomus*) are also present in the area and caught by the fishery. Thornback ray, undulate ray and common skate are classified as Near Threatened, endangered and critically endangered (Ellis 2016)(Coelho et al., 2009)(Dulvy et al., 2015) respectively. Nursehound, spiny dogfish and tope are classified as near threatened and vulnerable (Ellis et al., 2009)(Walker et al., 2006)(Fordham et al., 2016) respectively.

Due to depletion of species within this group, stock status scores as "**high concern**."

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Several species of demersal elasmobranchs are described in the area and it is known that globally deep-sea and coastal trawl fisheries had the largest total annual ray bycatch (Oliver et al., 2015).

(Dulvy et al. (2008) found that globally, three-quarters (16 of 21) of oceanic pelagic sharks and rays have an elevated risk of extinction due to overfishing. It seems that some fisheries in the area specifically target skates and demersal elasmobranchs. Based on the unknown bycatch matrix, fishing mortality is considered as "**high concern**" for all these fisheries.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Demersal elasmobranchs in this region are caught in mixed target and non-target fisheries. Most catches of elasmobranchs in the Bay of Biscay (North of Spain) are from trawler fleets operating in Divisions VIIIa, b, d and IXa. Elasmobranch catches from western Iberian waters (ICES Division IXa) are mainly from the Portuguese polyvalent fleet and, in particular, from the "métiers" using nets or trammel nets. In Portugal, trawlers may account for 5% of the total skate landings, being only observed in certain landing ports (ICES 2018d). The skate species composition of landings varies along the coast. Thornback ray is the main species landed, but blonde ray, cuckoo ray, and spotted ray are also caught (ICES 2018d). In these countries, chondrichthyes in general are marketed fresh only at large sizes and/or if the fish quota established them to be commercialized.

An EU TAC for skates (Rajiformes) in the area was first established in 2009, and it was reduced by 60% until 2014 and increased slightly in 2015 and 2016 (ICES 2018d). The catch of some species such as common skate and undulate ray are prohibited and cannot be targeted, although a small TAC of undulate ray was given to Portugal in order to monitor the species (Portaria n.º 4/2019).

Skate and ray fisheries are currently managed under a common TAC, although this complex comprises species that have different vulnerabilities to exploitation. However, TACs alone cannot adequately manage these stocks because catches may still be taken in mixed fisheries and discarded, even after the TAC is exhausted. Therefore, ICES recommends that management measures such as closed areas/seasons to protect spawning/nursery grounds or effort restrictions may better protect demersal elasmobranchs (STECF 2013) (ICES 2013e). The contribution of this fishery to the mortality of protected skates and demersal sharks is unknown, the fishery is not the main source of mortality for these species but it is probable (>50% chance) or suspected that fishing mortality from all sources (including commercial, recreational, subsistence, and ghost fishing, if applicable) is above a sustainable level. Therefore, fishing mortality is considered a "**high concern**."

Skates (unspecified)

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Due to their typically vulnerable life cycle, characterized by slow growth rates, late maturity, and low fecundity, elasmobranch species are highly susceptible to fishing mortality (Field et al., 2009)(Dulvy et al., 2014)(Quetglas et al., 2016).

(Balguerias et al. 2000) carried out a study on the changes produced in the faunistic communities in Morocco in response to fishing. Several families of chondroichthyes (sharks and rays) were described as present in the area: Carcharhinidae, Dasyatidae, Gymnuridae, Leptochariidae, Mobulidae, Myliobatidae, Rajidae, Rhinobatidae, Scyliorhinidae, Squalidae, Squatinidae, Torpedinidae and Triakidae (Balguerias et al., 2000). Some of the species belonging to these families are Thornback ray (*Raja clavata*), cuckoo ray (*Leucoraja naevus*), undulate skate (*R. undulata*), common skate (*Dipturus batis-complex*), small-spotted catshark (*Scyliorhinus canicula*), spiny dogfish (*Squalus acanthias*), nursehound (*Scyliorhinus stellaris*), Common Smoothhound (*Mustelus mustelus*), tope (*Galeorhinus galeus*) and blackmouth Catshark (*Galeus melastomus*), which are all present also in waters of Mauritania and Senegal. Thornback ray, undulate ray and common skate are classified as Near Threatened, endangered, and critically endangered (Ellis 2016)(Coelho et al., 2009)(Dulvy et al., 2015) respectively. Nursehound, spiny dogfish, and tope are classified as near threatened and vulnerable (Ellis et al., 2009)(Walker et al., 2006)(Fordham et al., 2016)respectively.

(Balguerias et al. 2000) used results from surveys carried out on the bank in 1942, 1962, 1974, and 1990. The data suggested some changes in the community. Within the elasmobranchs (Chondrichthyes), all families but one (Scyliorhinidae) experienced a severe decline in relative abundance. Also, the total number of families and species represented in the surveys decreased from 1942 to 1990 (from 13 families and 29 species in 1942 to only 6 families and 6 species in 1990) (Balguerias et al. 2000).

In a survey carried out by (Gascuel et al. 2007) in Mauritanian waters, total demersal biomass has been reduced by 75% on the Mauritanian continental shelf over the past 25 years due to overfishing. In the same survey, common smoothhound (*Mustelus mustelus*) showed a strong biomass decrease but only in the deepest strata.

No information about this group has been found for Senegal.

Skates and rays and demersal sharks are not assessed by the FAO/CECAF Working Group or by any of the national agencies (INRH, IMROP, CRODT), and no reference points have been set for these species. Moreover, the available information for these species in the area is scarce. There is no evidence therefore to suggest that shark stocks are either above or below reference points. Shark and skates stocks' inherent vulnerability is high. Therefore, this section is assessed "**high concern"** for all the areas.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Due to their typically vulnerable life cycle, characterized by slow growth rates, late maturity, and low fecundity, elasmobranch species are highly susceptible to fishing mortality (Field et al., 2009)(Dulvy et al., 2014)(Quetglas et al., 2016).

Skates found in Iberian waters include thornback ray (*Raja clavata*), cuckoo ray (*Leucoraja naevus*), the less frequent blonde ray (*Raja brachyura*), small-eyed ray (*R. microocellata*), brown ray (R. miraletus), spotted ray (*R. montagui*), undulate ray (*R. undulata*), shagreen ray (*Leucoraja fullonica*), common skate (*Dipturus batis-complex*), long-nosed skate (*D. oxyrinchus*), sandy ray (*Leucoraja circularis*) and white skate (*Rostroraja alba*). Thornback ray and Cuckoo ray (*L. naevus*) are the most commercially important skate species in this ecoregion and are normally found in Portuguese fish markets (Ictioterm 2013)(ICES 2018d). The small-spotted catshark *(Scyliorhinus canicula*), spiny dogfish (*Squalus acanthias*), nursehound (*Scyliorhinus stellaris*), tope (*Galeorhinus galeus*) and blackmouth Catshark (*Galeus melastomus*) are also present in the area and caught by the fishery. Thornback ray, undulate ray and common skate are classified as Near Threatened, endangered and critically endangered (Ellis 2016)(Coelho et al., 2009)(Dulvy et al., 2015) respectively. Nursehound, spiny dogfish and tope are classified as near threatened and vulnerable (Ellis et al., 2009)(Walker et al., 2006)(Fordham et al., 2016) respectively.

Due to depletion of species within this group, stock status scores as "**high concern**."

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
Several species of demersal elasmobranchs are described in the area and it is known that globally deep-sea and coastal trawl fisheries had the largest total annual ray bycatch (Oliver et al., 2015).

(Dulvy et al. (2008) found that globally, three-quarters (16 of 21) of oceanic pelagic sharks and rays have an elevated risk of extinction due to overfishing. It seems that some fisheries in the area specifically target skates and demersal elasmobranchs. Based on the unknown bycatch matrix, fishing mortality is considered as "**high concern**" for all these fisheries.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

High Concern
Demersal elasmobranchs in this region are caught in mixed target and non-target fisheries. Most catches of elasmobranchs in the Bay of Biscay (North of Spain) are from trawler fleets operating in Divisions VIIIa, b, d and IXa. Elasmobranch catches from western Iberian waters (ICES Division IXa) are mainly from the Portuguese polyvalent fleet and, in particular, from the "métiers" using nets or trammel nets. In Portugal, trawlers may account for 5% of the total skate landings, being only observed in certain landing ports (ICES 2018d). The skate species composition of landings varies along the coast. Thornback ray is the main species landed, but blonde ray, cuckoo ray, and spotted ray are also caught (ICES 2018d). In these countries, chondrichthyes in general are marketed fresh only at large sizes and/or if the fish quota established them to be commercialized.

An EU TAC for skates (Rajiformes) in the area was first established in 2009, and it was reduced by 60% until 2014 and increased slightly in 2015 and 2016 (ICES 2018d). The catch of some species such as common skate and undulate ray are prohibited and cannot be targeted, although a small TAC of undulate ray was given to Portugal in order to monitor the species (Portaria n.º 4/2019).

Skate and ray fisheries are currently managed under a common TAC, although this complex comprises species that have different vulnerabilities to exploitation. However, TACs alone cannot adequately manage these stocks because catches may still be taken in mixed fisheries and discarded, even after the TAC is exhausted. Therefore, ICES recommends that management measures such as closed areas/seasons to protect spawning/nursery grounds or effort restrictions may better protect demersal elasmobranchs (STECF 2013) (ICES 2013e). The contribution of this fishery to the mortality of protected skates and demersal sharks is unknown, the fishery is not the main source of mortality for these species but it is probable (>50% chance) or suspected that fishing mortality from all sources (including commercial, recreational, subsistence, and ghost fishing, if applicable) is above a sustainable level. Therefore, fishing mortality is considered a "**high concern**."

Snails

Factor 2.1 - Abundance

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
A PSA has been used to assess the vulnerability of Nassarius spp. and is mainly based on the information provided by Tallmark 1980 who studied the population dynamics of *Nassarius reticulatus* on the Swedish west coast. The nassa mud snail is a species abundant on shallow sandy bottoms and in rock pools with gravel along the European coasts. The species becomes sexually mature when it is nearly 4 years old and reaches a maximum age of 15 years in Swedish waters (Tallmark 1980). Fecundity is high: 6,000 eggs female-' year-'; females spawned every year (Tallmark 1980). The egg capsules of this species are laid singly, or in rows or scattered irregularly in masses, attached to some substrates, such as stones, shells or algae (Levour undated). Information on the trophic level for the species has not been found, but it seems that the species main food sources are particulate organic matter (POM) and polychaetes (Kwan et al., 2017). No depensatory or compensatory dynamics demonstrated or likely. Areal and vertical overlap is considered high for the species. Selectivity and post-capture mortality are considered medium (Species is incidentally encountered and is not likely to escape the gear and evidence of some individuals released and survive post-capture).

The species is not high highly vulnerable and there is no stock assessment, no reference points, and/or no evidence to suggest that stock is either above or below reference points. Abundance is ranked "**moderate concern**".
Justification:

PRODUCTIVITY ANALYSIS		
CRITERIA		**SCORE**
Average age at maturity	4 years (Tallmark 1980)	1
Average maximum age	15 years (Tallmark 1980)	2
Fecundity	6,000 (Tallmark 1980)	2
Reproductive strategy	Demersal egg layer or brooder (Levour undated)	2
Trophic level	<2.75	1
Density dependence	No dispensatory or compensatory dynamics at low populations	2
Habitat quality	Moderately altered	2
Productivity score		1.71
SUSCEPTIBILITY ANALYSIS		
CRITERIA		**SCORE**
Areal overlap (availability)	> 30% overlap	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery	Species is targeted, or is incidentally encountered and is not likely to escape the gear	2
Post-capture mortality (PCM)	Evidence of some (33-66%) individuals released and survive post-capture	2
Susceptibility score		**1.87**
PSA score		**2.54**
PSA category		**Low vulnerability**

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
Fishing mortality for this species is unknown, but the species is mainly released alive. Based on the SFW criteria, it is ranked "**moderate concern**".

Starfish

Factor 2.1 - Abundance

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
Bañon et al., 2018 indicated that in the trap fishery 7.5% of the catch was composed by the group Asteroidea, but no information about the exact species has been found (in the south of Portugal, *Astropecten grancianus* has been reported as common bycatch in the octopus traps). Therefore, this group is assessed under the common denomination "benthic invertebrates". No highly vulnerable starfish are present in the area. Therefore, using the SFW standard a "**moderate concern**" for abundance is assigned to this group.

Factor 2.2 - Fishing Mortality

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

Low Concern
Benthic invertebrates (starfish) caught by trap fisheries are mainly released alive. Based on the Unknown Bycatch Matrices, fishing mortality for benthic invertebrates is ranked as "**low concern**".

White grouper

Factor 2.1 - Abundance

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

Low Concern
White grouper, or thiof, is a coastal demersal species belonging to the Serranid family. Its bathymetric distribution ranges between 20 and 200 m in depth, but it is mainly fished at depths of between 30 and 60 m. The species is found on the rocky bottoms of the continental shelf (FAO/CECAF 2018). In 2017, several assessment models, including a Schaefer dynamic production model and a Length Classes Analysis (LCA) were used by the working group to carry out the assessment. The results from the model indicated that the stock was overexploited with an improvement in biomass compared to the situation in 2012. The current biomass is below that corresponding to the biomass B0.1. (FAO/CECAF 2018).

There is a reliable quantitative stock assessment, current white grouper biomass is >75% of the target biomass. Therefore this section is scored as "**low concern"**.
Justification:

Stock/abundance index	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	F_{cur}/F_{SYcur}
Epinephelus aeneus (Mauritania, Senegal and The Gambia)/CPUE Abundance indices obtained during scientific surveys in Mauritania with the R/V *Al Awam*	85%	93%	144%	130%	122%

$B_{cur}/B_{0.1}$: Ratio between the estimated biomass for the last year of the series and the biomass corresponding to $F_{0.1}$.
F_{cur}/F_{SYcur}: Ratio between the observed fishing mortality during the last year of the series and the coefficient which would give a sustainable yield at the current biomass level.
F_{cur}/F_{MSY}: Ratio between the observed fishing mortality during the last year of the series and the coefficient which would give a maximum sustainable yield over the long term.
$F_{cur}/F_{0.1}$: Ratio between the observed fishing mortality during the last year of the series and $F_{0.1}$.

Figure 14: Indicators on the state of the stock and fishery of white grouper (*Epinephelus aeneus*) (FAO/CECAF 2018).

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Senegal

High Concern
The white grouper is targeted by the artisanal and industrial fleets of Mauritania, Senegal and The Gambia. In Mauritania, the national cephalopod trawlers and pelagic trawlers only take this species as bycatch. The total effort of ice and freezer trawlers of the Senegalese industrial fishery and the ice canoes of the Senegalese artisanal fishery shows an overall decreasing trend in recent years (FAO/CECAF 2018). The total catches of thiof in the three countries increased from 2013-2016, with an annual average catch of 4,845 MT. This increase is mainly due to the increase in artisanal fishery catches of Mauritania and The Gambia. Mauritania has the largest proportion of catches with an average of 2,779 MT over the period 2013-2016, followed by Senegal with an average of 1,364 MT and The Gambia with an average of 702 MT. In the most recent assessment, it was considered that the current fishing effort is higher than that which would produce a sustainable yield at the current biomass level.

There is a reliable quantitative stock assessment, current fishing effort is above the optimum effort FMSY and the target effort F0.1. (FAO/CECAF 2018). The fishery is a substantial contributor to fishing mortality of the species. Fishing mortality is therefore ranked as '**high concern**'.

Factor 2.3 - Discard Rate/Landings

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Bottom trawls | Senegal

< 100%
The industrial cephalopod fishery in Morocco is associated with higher rates of discarding (Belhabib et al. 2013). The discard rate in the Moroccan *O. vulgaris* fishery was estimated at 45% by Kelleher (2005). Balguerias (1997) estimated that, in the 1970s, 66% of the industrial cephalopod fleet catches were discarded and, in the 1980s, discards represented 46% of the retained catch. Haddad (1994) estimated that 30% of the catch was discarded in the 1990s, and Rojo-Diaz and Pitcher (2005) estimated that 45% was discarded in the 2000s.

The *O. vulgaris* trawl fishery in Mauritania has 60% bycatch, primarily juveniles of other species (Pechecops & CFFA 2006). Bycatch in the Mauritanian trawl fishery is around 60%.

No information has been found for the Senegalese trawl fishery but discard rates are expected to be similar to the previous two.

Discard rates in the North West African trawl fisheries are <100%.

Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Jig | Senegal

< 100%
The gear most commonly used in the area to catch octopus is the "turlutte", a multi-hooked hand-jig device very similar to the "potera" (jig) used in the Mediterranean and elsewhere to catch octopus and other cephalopods. Jigs are considered an environmentally friendly gear, with very low bycatch. In the common octopus fishery, no bait is used. So, it is considered that no other species apart from octopus are caught. Therefore, the discard rate in this fishery is lower than 100%.
Justification:

Figure 15: A typical turlutte (jig) used in Senegal to fish octopus. (PHOTO: Juan Vilata)

Eastern Central Atlantic | Pots | Mauritania
Eastern Central Atlantic | Pots | Morocco
Northeast Atlantic | Pots | Portugal
Eastern Central Atlantic | Pots | Senegal
Northeast Atlantic | Pots | Spain

< 100%
The vase-like pots used to catch octopus are passive capture gears without any net or other devices to retain the species caught. Therefore, discard rate in this fishery is lower than 100%.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

< 100%
Several studies on the selectivity of fishing gear and the bycatch and discards in the Iberian Peninsula (Spain and Portugal) have been published in recent years. Finfish bottom trawls targeting hake, horse mackerel, monkfish, and megrim were reported to have discard rates of 30%–60%, primarily of target species that are undersized, with some non-commercial bycatch (European Commission 2011). Other studies report discard rates as high as 62% or 72% for the Southcoast trawl fishery (Borges et al. 2001)(Costa et al. 2008). However, (Coll et al. 2014) estimated historical total discards for the Spanish trawl fishery in the Gulf of Cádiz and concluded that total discard rates in the area had decreased in recent years, reaching less than 20% in 2010.

Since 2015, a landing obligation for TAC species has been gradually implemented by the CFP which has decreased discards in European fisheries. The landing obligation requires all catches of regulated commercial species on-board to be landed and counted against quota. By 2019 all species subject to TAC limits and Minimum Conservation Reference Sizes in the Mediterranean are subject to the landing obligation (EC 2020).

The discard rate in the Spanish and Portuguese trawl fisheries is considered to be **<100%.**

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

< 100%
Discarding in artisanal fisheries is not particularly well documented, though gear types such as traps, pots, and other small-scale gear tend to have no or very low levels of bycatch because they are non-lethal capture methods. Traps used for the octopus fishery are highly selective, targeting common octopus, spiny lobster, and some bony fishes (Xunta de Galicia 2006). Undersize or non-commercial catches can usually be released alive, so catches of non-commercial species or others such as berried lobsters can be returned to the sea (European Commission 2011). Along the Galician coast, the main artisanal fishing gear to catch octopus is the baited trap (Bañón et al., 2018). Baits usually consist of fatty fish such as sardine (*Sardina pilchardus*), mackerel (*Scomber scombrus*) or horse mackerel (*Trachurus trachurus*), but also many other secondary species such as bogue (*Boops boops*) or Atlantic chub mackerel (*Scomber colias*), among others (Xunta de Galicia 2006) (Bañón et al., 2018). Artificial baits have also been used since at least 2010. In 2015, manufactured baits were the most common occurring in 26% of the sampled traps (Bañón et al., 2018). This bait, known locally as "membrillo," is more expensive than the natural bait used in the area. However, advantages lie in its storability, durability, and lightweight, making it a good substitute for natural bait (Xunta de Galicia 2006).

The trap fishery is thought to have low discard rates. The amount of bait used, although unknown, is significant. The use of artificial and manufactured baits have increased in the fishery in recent years. The discard rate in this fishery is assessed as lower than **100%**.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Eastern Central Atlantic | Bottom trawls | Mauritania	Ineffective	Ineffective				Red (1.000)
Eastern Central Atlantic | Bottom trawls | Morocco	Ineffective	Ineffective				Red (1.000)
Eastern Central Atlantic | Bottom trawls | Senegal	Ineffective	Ineffective				Red (1.000)
Eastern Central Atlantic | Jig | Mauritania	Ineffective	Highly effective				Red (1.000)
Eastern Central Atlantic | Jig | Morocco	Ineffective	Highly effective				Red (1.000)
Eastern Central Atlantic | Jig | Senegal	Ineffective	Highly effective				Red (1.000)
Eastern Central Atlantic | Pots | Mauritania	Ineffective	Moderately Effective				Red (1.000)
Eastern Central Atlantic | Pots | Morocco	Ineffective	Moderately Effective				Red (1.000)
Eastern Central Atlantic | Pots | Senegal	Ineffective	Moderately Effective				Red (1.000)
Northeast Atlantic | Bottom trawls | Portugal	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Atlantic | Bottom trawls | Spain	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Atlantic | Pots | Portugal	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Atlantic | Pots | Spain	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Atlantic | Traps (unspecified) | Portugal	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Atlantic | Traps (unspecified) | Spain	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of

compliance.

Factor 3.5 - Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Pots | Mauritania

Ineffective
Fisheries in Mauritania are regulated by the Ministry of Fisheries and Maritime Economy (MPEM). The Institut Mauritanien de Recherche Océanographique et des Pêches (IMROP) analyses the data and provides scientific advice. At a regional level, stock assessments are carried out by FAO/CECAF working group (FAO/CECAF 2019).

In 2006, Mauritania, with support from various nations and development projects, established a fisheries management system and adopted its first management plan, which focused on octopus fisheries. In 2012, a comprehensive new fisheries protocol entered into force on a provisional basis. Due to the importance of the common octopus resource to local fisheries and in order to reduce the effort on the resource, the government decided to reserve octopus fishing for national segments and to limit the access to the fishery (Agnew et al., 2010) (FAO/CECAF 2018). Since 2003, the industrial fishing licenses for the Mauritanian octopus industrial fishery have been frozen in the country. Thus, no new licenses for the trawl fishery have been issued and the units that left the fleet have not been replaced (FAO/CECAF 2019). The European cephalopod fleet which used to work in the country has been also left out from the EU-Mauritania fisheries agreement since 2012 (FAO/CECAF 2018). However, the coastal and artisanal fishery has been favored by the different fisheries policies, and the number of coastal and artisanal boats has increased considerably. The artisanal fleet, which mostly targets octopus, has grown in the last decade from 4,000 canoes in 2007 up to 7,500 in 2016 (FAO/CECAF 2019.).

Management measures currently in force in the Cape Blanc fishery are (FAO/CECAF 2019): a 2-month closed season in autumn (since 1996) and spring (since 2008); minimum 70 mm stretched trawl mesh for the demersal trawler fleet except for shrimp trawlers where a mesh size of 50 mm is allowed; fishing zones (established since 2006) to preserve the coastal zone and limit conflicts between the different fleet segments; trawling is also banned in waters of depths less than 20 m; a minimum landing weight for octopus (eviscerated) of 500 g.

A national strategy for responsible management and the sustainable development of the fishing sector and the maritime economy (law n° 017-2015of 29/07/2015) was adopted by the Ministry of Fisheries and Maritime Economy for the period 2015-2019. This new strategy recommends a change in fisheries management, by abandoning a system focused on controlling fishing effort to favor approaches based on catch control through the use of quotas. To this effect, it provides for two operating schemes in the country: National and Foreign (Marti 2018). These quotas are distributed by segment (deep-sea, coastal, and artisanal), under the advice from the National Council for the Fisheries Development and Management (CCNADP): deep-sea, coastal, and artisanal. The strategy highlighted the importance of the octopus fishery for the artisanal fleet and introduced individual quotas for industrial cephalopod vessels and global quotas for the artisanal cephalopod fishery (FAO/CECAF 2019).

In Mauritania, compliance is monitored by the Ministry of fisheries with support from the Mauritanian Coast Guard. Catches and effort data are declared by the vessel captains and extracted from the daily fishing logbooks (Evans 2018). In addition, the artisanal fleet is monitored by the Directorate of Artisanal and Coastal Fisheries. There is also monitoring by the IMROP of catches during landings at certain sites and controls conducted by the Delegation for Fisheries Monitoring and Control at Sea (DSPCM) (Ould Taleb Sidi et al., 2010) (Evans 2018). However, the enforcement and monitoring system is very poorly applied to artisanal and coastal fishing, with many vessels undoubtedly conducting illegal fishing (Evans 2018). Better collaboration among countries is necessary to improve monitoring and increase transparency (FAO 2016) (Evans 2018). Domestic catches of all species in Mauritania were estimated to be three times as high as official landings data reported by Mauritania to the FAO (Gascuel et al., 2007)(Belhabib et al. 2013). Illegal catches also affect marine protected areas, such as the Banc d'Arguin National Park.

The Mauritanian government introduced a number of measures to protect the octopus resources. Cephalopod trawl licenses have been frozen in the country and the European cephalopod vessels ceased fishing in Mauritanian waters from 2012. It has resulted in the stock moving from overexploited to fully exploited. However, several other species caught as a bycatch in the trawl fishery are overfished. Management effectiveness is unknown, and it is likely that the fishery is having serious negative impacts on retained populations. Therefore, the management strategy section scores "**ineffective**" for the Mauritanian trawl fishery.

Although some managements are in place for the artisanal fleet, there is no restriction on the number of boats or pots used for fishing octopus (FAO/CECAF 2018). Enforcement is inadequate and the underreported catch in the artisanal fishery seems to be important. It is considered that the fishery lacks management measures (effort controls) that are reasonably expected to be effective. The management strategy section also scores "**ineffective**" for the Mauritanian pot and jigs fisheries.

Justification:
Mauritania is not a traditional fishing nation but fast-growing fisheries have developed over the past decades. Octopus exploitation began in the late 1960s in northern Mauritania. Due to the high commercial value of the species, there was a rapid development of the industrial fishery, and the artisanal fleet later on (FAO/CECAF 2018). Three national segments have been targeting cephalopods (octopus, cuttlefish, and squid) in the country: industrial trawlers, inshore fishing, and small-scale boats (Paz Marti 2018)(FAO/CECAF 2018). To reduce the effort on octopus, Mauritania decided to reserve octopus fishing for national segments and to limit their access. Thus, the European cephalopod vessels ceased fishing in Mauritanian waters from July 2012 (Paz Marti 2018)(FAO/CECAF 2018). This situation led to a significant reduction in the effort of the industrial fishery targeting octopus in Mauritania. Thus, the total number of cephalopod vessels (national and foreign) operating in Mauritanian waters fell from 193 in 2003 to 130 vessels in 2016, although only half of the national fleet seems to be active. Cephalopods fisheries still represent 70% of the industrial fisheries in the country(FAO/CECAF 2018)

The artisanal fishery is composed of small wooden, aluminum, or plastic units, generally less than 16 meters in length. The number of coastal and artisanal boats has increased considerably in recent years due to the new government policies. It is estimated that currently more than 4,500 coastal boats are working in the country and the number of artisanal boats and fishermen is largely unknown (Paz Marti 2018)(FAO/CECAF 2018). Cephalopods (mainly octopus) fisheries represent 4% of the artisanal segment (IMROP 2014)(FAO/CECAF 2018). Around 50% of the octopus was caught by the small-scale fleet in 2013 (10,000 MT)(FAO/CECAF 2018).

Eastern Central Atlantic | Bottom trawls | Morocco

Ineffective
In Morocco, fisheries are regulated by the Fisheries Department, under the Ministry of Agriculture and Fisheries (DPM 2019).

Due to the overexploitation of the resource, a management plan was established for the octopus fishery in 2001, which was revised in 2011, and again in 2014 (DPM 2019). The management of the fishery is based on the total allowable catch (TAC) per season, together with several measures aimed at limiting fishing pressure (fishing licenses, spatial measures, prohibited fishing grounds, biological rest period, and other technical measures (mesh size, marketable size, etc.)) (FAO/CECAF 2018). The TAC is determined before each fishing season based on results of the stock abundance survey carried out yearly by the INRH (National Fisheries Research Institute) and shared according to a distribution key per segment: 63% for industrial trawlers, 26% for artisanal fishing, and 11% for coastal fishing. The global quota per segment is then distributed into individual quotas for the deep-sea and artisanal fleets (FAO/CECAF 2018). The management plan for the octopus fishery also set a management unit for this fishery (UA). In that area, the offshore fleet is authorized to work beyond 10 nautical miles from the coast except at the resumption of the winter fishing season where it must operate beyond 12 miles nautical for a period of one to two months (INRH 2018). A minimum market size of 500 gr is also in place for the octopus (FAO/CECAF 2018).

In 2018, motivated by the fall of octopus biomass at zone C (south of Cap Boujdour), the authorities banned the use of GOV (large opening vertical opening) trawls (Ministerial Decision No. 11/18). Moreover, trawling was permanently prohibited within four bounded polygons in the southern area to protect rocky areas (Les.Eco.ma 2019)(Bougharioun M. pers. comm).

The monitoring and enforcement system in the country was reinforced under the Halieutis plan (MPM 2020). The control coordination support unit (UACC) coordinates monitoring and surveillance in EEZ waters to check compliance with fisheries regulations. Control and surveillance plans are established by different departments. Fisheries activities are monitored at three levels (Pramod 2019) (MPM 2020). At the water level, the Moroccan navy and the coast guard patrol the EEZ waters to fight against IUU. The National Center for the Monitoring of Fishing Vessels (CNSNP) uses a VMS system (compulsory for the offshore and coastal fleet) for real-time tracking of fishing vessels and to protect fishery zones (cephalopod fishing area, monk seal protection area, prohibited fishing areas, allowed distances to the coast) and collect reliable scientific data. Logbooks are also used to record fishing operations and freezer cephalopod and shrimp vessels are obligated to take onboard scientific observers (Pramod 2019)(MDM 2020). Moreover, fisheries delegations of the department of maritime fisheries present along the Moroccan coast, control fishing activities at the ports, implementing the control policies established by the Department. Control and enforcement agents monitor landings and first sale auctions (Pramod 2019)(MDM 2020). Finally, through the catch certification system, fishing and post-harvest activities are supervised for seafood traceability from ship to export through intermediate processing operations for some products, although it does not apply to all products and fleet types (Pramod 2019). In the cephalopod fishery, a commission is responsible for distributing the total quota between the coastal and artisanal segments, by season and vessel. Any violation of this quota is sanctioned by the suspension of the fishing license and the seizure of the boat involved in the case of the artisanal fleet and the suspension of the current season's quota for the coastal and deep-sea segment (Pramod 2019).

In 2019, the quota assigned for the first fishing season, which runs from January 5 to March 31, was 18,000 MT, assigned as follows: 11,340 MT for the offshore trawl fleet, 1,980 MT for the coastal fleet, and 4,680 MT for the Dakhla artisanal fleet. In addition, a total quota of 1,500 MT was granted to the zone of Aftissat, Boujdour center, and Sidi l'Ghazi (Les.Eco.ma 2019).

In the trawl fishery, a number of management measures have been introduced by the authorities in order to reduce the impact on the octopus population and habitats. However, the stock remains overfished (FAO/CECAF 2018) as well as several of the species caught as a bycatch in the trawl fishery. Estimated domestic catches suggest that, in the data supplied by the Moroccan authorities to FAO, over 41.5% of total catches are unreported (Belhabib et al. 2013). Illegal cephalopod fishing is one of the main illegal domestic fishing activities, and it is mainly practiced along the Saharan coastline. Recent reports (Anon 2015) (Cherii 2019) (Anon 2019) suggest that there are still significant problems with under-reporting illegal and unreported catches in both pelagic and demersal fisheries in the country (Pramod 2019).

Management effectiveness is unknown and it is likely that the fishery is having serious negative impacts on retained populations. Therefore, the management strategy section scores "ineffective" for the Moroccan trawl fishery.

Justification:
In the Moroccan Atlantic area the cephalopod fishery started in the early 60s, due to the increase in abundance of these species in the area which substituted the sparid fishery (the reason for this is unclear: overexploitation of the former species, climate change affecting the environment or adaptation of fishing techniques to fishing for cephalopods, although it seems that ecosystem perturbations caused by intensive fishing generally are leading to changes in the trophic structure in favor of the short-living opportunistic species in many areas (Boyle and Rodhouse, 2005))At the beginning, the species was mainly exploited by a deep-sea foreign fleet but from the 70s and 80s, a national fleet was developed (FAO/CECAF 2018).

At present, this fishery is conducted by a heterogeneous fleet, ranging from small artisanal boats using passive gears (pots, jigs, and traps) to bottom trawlers (FAO/CECAF 2018). Common octopus is caught with other cephalopod species, such as cuttlefish (Sepia officinalis and S. orbignyana) and squid (Loligo vulgaris); and other finfish species such as sparids and flatfishes.

The fleet is currently divided in three segments: freezer trawling fleet, composed of 226 vessels, which only operates within the management unit of the octopus fishery between Boujdour (26°N)-Lagouira (20°50'N). The activity of the offshore cephalopod fleet is mainly concentrated on the sandy or muddy bottoms north of Dakhla. (FAO/CECAF 2018). A fresh fish coastal fleet, of 150 units, which undertakes short trips (up to 10 fishing days) and use ice boxes to preserve the fish products (FAO/CECAF 2018). And finally, an artisanal fleet composed of wooden boats equipped with outboard motors that use passive gears (mainly pots and jigs) to catch octopus. Presently, there are about 13,584 boats of which 3,084 are within the management unit (FAO/CECAF 2018).

Eastern Central Atlantic | Bottom trawls | Senegal
Eastern Central Atlantic | Jig | Senegal
Eastern Central Atlantic | Pots | Senegal

Ineffective
Fishing constitutes an essential segment of the economic and social development of Senegal. It contributes significantly to the growth objectives of the national economy, in particular to reducing the deficit in the trade balance, creating jobs, and meeting the food needs of the population. The Ministry of Fisheries and Maritime Economy (MPEM) responsible for fisheries management in Senegalese waters, based on the Fisheries Maritime Code implemented in 2015 (Law nr. 2015-18 of 13 July 2015) and on the Letter of Sectoral Policy for the Development of Fisheries and Aquaculture (LPSDPA).

Stemming from the local co-management initiatives initiated in the country by the World Bank's GIRMAC project in 2005 (Peiro Crespo et al., 2017), a collaborative process was initiated by the Senegalese government to implement a management plan for the octopus fishery at a national level, which was first established in 2016 (Decree n° 2016-90). Under this management plan, the octopus fishery is managed on the basis of quotas established by the government with the advice of the Oceanographic Research Center of Dakar-Thiaroye (CRODT), for both the industrial and the artisanal fleet. A number of technical measures were also introduced for both the industrial and the artisanal fisheries. For the industrial fishery, some of the measures already in place were: a seasonal closure, a minimum mesh size for cephalopod-fish trawlers (fixed at 70 mm), and a minimum landing weight (350g for whole octopus and 300g for eviscerated octopus. Coastal demersal licenses have been also frozen in the country since 2006 (MPEM 2016). For the artisanal fishery, the management measures included in the management plan are: the implementation of spawning and juveniles season closures, improve enforcement, and limit the number of pirogues by stopping registration (in place since 2015). A system of Individual Transfers Quotas (ITQ) was also introduced which will be managed by the Local Artisanal Fishing Councils (CPLA - Conseil Local de Pêche Artisanal) established by the government to be part of the framework structure for fisheries consultation at the local level (Peiro Crespo et al., 2017). Octopus clay pots were also deployed in coastal fishing grounds to improve octopus recruitment as part of an EU-funded project under the Sustainable Fisheries Partnership Agreement (SFPA) (Carlos Sonderblohm pers. comm.).

In Senegal, compliance is monitored by the Department of Surveillance and Protection of Fisheries (DPSP). Several measures are in place to enforce compliance in industrial fisheries: the use of VMS for all trawlers working in Senegalese waters is compulsory, inspections of industrial and artisanal fisheries are carried out, transshipments at sea are monitored, etc. However, enforcement and compliance in the country are poor (Peiro Crespo et al., 2017) (Pramod 2019)(Doumbouya et al., 2017) despite Senegal's new legislation in place since 2015, which improved MCS (Doumbouya et al., 2017): of the nine coastal stations situated along the coast, only five have radars and some of them are not operative the DSDP has less than 100 contract staff to conduct inspection along the entire Senegalese coast (Pramod 2019); and the observer program is not effective because the number of observers is too short and they are poorly paid (Pramod 2019) and very few are deployed on Senegalese vessels (Gueye 2016). Total IUU catches in the country were estimated at 4.2 million metric tons between 2000 and 2011 (Belhabib et al. 2014). Official catch figures may show important variations depending on the source of information (for instance, comparing official data from DPM and data from CRODT researchers such as Meissa et al. 2016) and there are many discrepancies between the declared catches and declared exports, with exports exceeding catches in some years (Ndiaye et al. 2009), which reflect the deficiencies of the system collecting catch and export statistics in Senegal (Chavance et al. 2007)(Masumbuko et al. 2011)(Kelleher et al. 2012)(Belhabib 2014).

A management plan has been developed in the country, but it is unclear if it is already in place, as a three-year transitional phase was foreseen by the plan to implement it. Monitoring and enforcement in the trawl fishery are not effective and it is thought that compliance is poor. Several species caught as a bycatch in the octopus trawl fishery are overexploited. IUU catches in the country are large.

Management effectiveness is unknown, and it is likely that the fishery is having serious negative impacts on retained populations. Therefore, the management strategy section scores "**ineffective**" for the trawl fishery.

Senegal has the largest coastal fleet in North-Western Africa, which works legally and illegally in Senegalese and EEZ waters of other countries. Illegal, unreported, and unregulated (IUU) fishing is therefore a serious concern in the country (Belhabib 2014) (Belhabib 2015)(Doumbaya et al., 2017). Although some management measures are in place for the artisanal fleet, there is no restriction on the number of boats or pots used for fishing octopus (FAO/CECAF 2018). Enforcement is inadequate and the underreported catch in the artisanal fishery seems to be

important. Therefore, it is considered that the fishery lacks management measures (effort controls) that are reasonably expected to be effective. The management strategy section also scores "**ineffective**" for the Senegalese artisanal fishery.

Justification:
In Senegal, cephalopods are targeted by both the coastal industrial fishery and the artisanal fishery. The industrial fishery is composed of trawlers that target both coastal demersal fish species and cephalopods. The number of trawlers operating in the country has decreased from 172 in 2000 to 25 in 2016 (FAO/CECAF 2018). The artisanal fleet is made up of wooden motorized canoes ("pirogues") of varying size depending on the requirement of the fishery (i.e. larger pirogues are used for longer fishing trips, whilst smaller ones can be used in daily trips such as in the case of the octopus fishery) (Camara 2008). The gear most commonly used is the jig ("turlutte"). In 2012, the number of artisanal jiggers targeting octopus in the country was estimated at 2,010 units (FAO/CECAF 2018). Catches of octopus in Senegal are split between the industrial and the artisanal fleet. The latter has been steadily acquiring relevance during the past years over the former, and currently represents the largest share of the catch (Peiro Crespo et al., 2017).

Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Pots | Morocco

Ineffective
In Morocco, fisheries are regulated by the Fisheries Department, under the Ministry of Agriculture and Fisheries (DPM 2019). Due to the overexploitation of the resource, a management plan was established for the octopus fishery in 2001, which was revised in 2011, and again in 2014 (DPM 2019). The management of the fishery is based on the total allowable catch (TAC) per season, together with several measures aimed at limiting fishing pressure (fishing licenses, spatial measures, prohibited fishing grounds, biological rest period, and other technical measures (mesh size, marketable size, etc.) (FAO/CECAF 2018).

The management plan for the octopus fishery also set a management unit for this fishery (UA) in the area between Boujdour (26 ° N) and Lagouira (20 ° 50'N), subdivided into three sub-units (SU) to better control and regulate the activity of the artisanal fleet (INRH 2018). In that area, the artisanal fishery is only allowed to operate within a 3 to 8-mile band from the coast (FAO/CECAF 2018). Two biological rest periods are set per year, one in spring to protect the spawning process and another one in autumn to protect recruitment (FAO/CECAF 2018). The duration of the octopus season is adapted based on the indicators of the fisheries data collected by the INRH on a weekly basis and time closures are extended if the recruitment or the reproduction are not sufficiently progressed (Faraj 2009)(MDM 2019)(Les.Eco.ma 2019). The use of baited traps for the artisanal fleet targeting octopus is also prohibited, and the number of jigs and pots per boat is set at three and 300 respectively (Les.Eco.ma 2019)(Bougharioun M. pers. comm.).

In the case of the artisanal fishery, a restructuring fund was created in 2004 to reduce the number of artisanal and coastal vessels, limiting their number to 3,000 artisanal boats and 100 coastal trawlers. The number of artisanal boats has kept reducing from the end of the 90s due to the inventory and regulations that entered into force for this sector (FAO/CECAF 2018). In 1998, (Barreira et al. 1998) reported approximately 12,000 pateras, the majority of them operating illegally (over the quota announced by the government), a number which has remained stable since then (Belhabib et a., 2013) (Undercurrents 2019). It is thought that currently there are still more than 13,000 small boats, many of which are neither registered nor licensed. This illustrates that the Moroccan government needs to improve its fisheries monitoring system to include small-scale fishing and unregulated fishing.

Management effectiveness is unknown and it is likely that the fishery is having a serious negative impact on the target stock. Therefore, the management strategy section also scores as "ineffective" for the artisanal pot and jig fisheries.

Northeast Atlantic | Bottom trawls | Portugal

Moderately Effective
Fisheries in Portugal are regulated by the Directorate-General for Natural Resources, Safety and Maritime Services (Direcção-Geral de Recursos Naturais, Segurança e Serviços marítimos, DGRM).

The octopus trawl fishery in Portugal is governed by three regulations: Portaria 1102-E/2000, which regulates fishing with trawl (republished by Portaria No. 349/2013 and updated by Portaria No. 122-A / 2015; Portaria n .º 124-A / 2016 and Portaria No. 66/2017); Portaria 27/2001 (updated by Portaria 402/2002), which establishes the minimum landing size for most of the fish, crustacean, and mollusk species caught in Portuguese waters; Portaria 1423-B/2003, which changes the Portaria 1102-E/2000 to introduce the licensing for the mesh sizes of 55 mm and 70 mm in the crustacean trawl fishery. Finally, Ordinance n.º 349/2013 regulates minimum catch of octopus according to codend mesh size (in 65-69 mm codend mesh size trawls at least 70% in weight of the total catch needs to be octopus (Carlos Sonderblohm pers. comm.)). Some closed areas/seasons for trawling have been also established in the country (for example trawling is not permitted in the country within 6 nm off the coast). Since 2015, Commission delegated Regulation (EU) 2015/2439) also established a discard plan for certain demersal fisheries in the country (South-Western waters).

As indicated in the Spanish trawl fishery, neither TACs nor reference points have been set for cephalopod fisheries in European waters. However, the recent increase in the commercial importance of cephalopods resources has meant that, although the stocks are not presently subject to quota management, there is a need for specific management of this resource (Pierce et al., 2019).

Management measures are in place but no appropriate management/conservation targets have been defined for the stock in consideration, the fishery does not meet all the standards of 'highly effective' management. Therefore, this section is considered "moderately effective."

Northeast Atlantic | Bottom trawls | Spain

Moderately Effective
European fisheries are managed under the Common Fisheries Policy (CFP)(Regulation (EU) No 1380/2013). The principal aim of fisheries management under that regulation is to ensure high long-term fishing yields (maximum sustainable yield) for all European stocks by 2020 (European Commission 2020a). In European waters, some of the stocks are managed under EU regulations (through Total Allowable Catches (TACs), effort limits, and other technical measures) while others are subject only to national legislation. Neither TACs nor reference points have been set for cephalopod fisheries in European waters, being the national government's responsibility for the management of the resources. Management measures in these fisheries are mainly centered on effort restrictions (IBERMIX project 2004) (Pita et al., 2015) (Silva et al., 2015)(ICES 2018c).

In Spanish waters, two different regulations apply to fishing activities: Central Administration regulations in external waters (CA) and the Regional Administration regulation in internal waters (RA) (ICES 2013). Bottom-trawl activity is only regulated by the central administration, the Secretary-General for Fisheries under the Ministry of Agriculture, Fisheries and Food, which in 1993 established a Royal Decree 632/1993 that contained regulations to control vessel characteristics, limit fishing to areas outside 6 mi of coastline, and limit weekly fishing effort (STECF 2008) (ICES 2013).

Since 2004, consecutive Fishing Plans have been established in the Gulf of Cádiz (Spanish South coast, the main area where the octopus trawl occurs) with the aim to regulate the activity of the bottom-trawl fleet in the area (order APM/453/2018 is the most recent regulation). These plans regulate fishing effort through licenses, permitted days per week (5), minimum mesh size (55mm); and two fishing closures: one in autumn (between September 16 and October 31) for the entire trawl fleet, and another one in spring (between May 1 and June 15) specifically for the octopus trawl fishery. These closures are mainly aimed to protect recruitment peaks for fish and octopus, reducing the landing of immature specimens (STECF 2008)(ICES 2013) (APM/453/2018).

Since 2014, a landing obligation has been gradually implemented in European waters under the CFP to end the wasteful practice of discarding (see more in the bycatch section). Commission delegated Regulation (EU) 2015/2439 established a discard plan for certain demersal fisheries in South-Western waters, which cover Spain and Portugal, among other countries.

Lastly, the new CFP has revised its management structure, backing regionalization, and more extensive stakeholder consultation (European Commission 2020a).

Stocks in European waters are assessed by the International Council for the Exploration of the Sea – ICES, which offers advice on TACs to the European Commission. However, as in other multispecies fisheries, the level of knowledge regarding the state of the stocks exploited by this fishery is highly variable. Some of the stocks (mainly fish species) are currently assessed by the ICES; while others have no formal assessment due to insufficient data, or to low priority (Silva et al., 2015). Cephalopod biology (short lifespan, variable growth rates, and a weak relationship between stock size and juvenile recruitment) makes them unsuited to traditional stock assessment. In EU waters, cephalopods stocks are considered data poor: stocks are poorly defined, few catches are identified to the species level, and fishery monitoring is inadequate.

Management of cephalopod fisheries is scarce (except for some small scale fisheries), for example, no specific effort or catch controls are in place in the industrial fisheries (Pierce et al., 2019). During the recent Cephs&Chefs project, researchers highlighted the need for better monitoring of EU cephalopod stocks in order to implement an Integrated Ecosystem Assessment and Ecosystem-Based Management for these resources (Pierce et al., 2019). However, it would imply a substantial increase in data requirements: an adequate stock definition, monthly data collection for annual for undertaken annual assessments, reliable species ID, and reliable catch, effort, and biological data by species and fishing area; which would allow formulating management measures available in the event that populations reach unexpected low levels that jeopardize sustainability (Pierce et al., 2019). Management measures in cephalopod small scale and large scale fisheries could include catch quotas, closed areas and seasons, deployed flexibly to account for variable abundance, and protect both spawners and recruitment. Market-based solutions (e.g. fishery certification or catch shares) could also promote sustainability (Pierce et al., 2019).

Management measures (such as effort restrictions and a discard ban) that are expected to be effective are in place, but no appropriate management/conservation targets have been defined. Therefore, this section is considered "moderately effective."

Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal

Moderately Effective
The octopus trap and pot fishery is regulated in Portuguese waters by the Ministerial ordinance n. 1102-D/2000. The current legislation focuses on fishing effort, defining the number of licenses in operation, minimum mesh size depending on gear, maximum number of traps for the artisanal fleet (a maximum of non-baited traps per vessel is limited at 3000 for all sizes and the number of baited-traps are regulated by size: 750 for vessels under 9m; 1000 traps for vessels between 9 and 12 m; and 1250 traps for vessels over 12 m). A minimum landing weight of 750 gr has also been set for the species. The use of alive green crab (*Carcinus maenas*) as bait in octopus traps was also prohibited by Ministerial ordinance n. 054/2010 in order to reduce fishing effort (it seems that this bait last longer than other baits and it permitted the use of a higher number of traps per vessels).

Due to the importance of the octopus fishery in the Algarve (Portuguese South coast), a number of specific regulations are also in place for the fishery in the area. Ministerial ordinance n. 230/2012 set a number of restrictions for octopus fishery in that area: vessels greater than 9m can fish only > 1 nautical mile in order to protect juveniles and the reproductive portion, except from March 1st to September 30th between Pedrógão (39° 55' 04' N) and Guadiana (7° 23' 48' W) when fishing operations can happen > 0.5 nautical mile from the shoreline. Vessels lower than 9 m length can operate > 0.25 nautical miles from the shoreline for the same period.

A co-management process ("Tertulias do polvo") started in the Algarve under the EcoFishman project (Sonderblohm et al. 2017). During these meetings between researchers and stakeholders, it was noted that there is a need for limiting fishing effort in the country and several management measures were suggested. Based on it, the catch, retention and landing of common octopus during the weekends was prohibited by Legal order n. 1127-B/2019 both for artisanal and recreational fishermen (trawl vessels can catch it but they cannot land it during the weekends either).

The main goal of the previous process was the implementation of a management plan for the Portuguese small scale octopus fishery. However, after several meetings, management measures agreed by the stakeholders, were not approved by the government. The need for limiting effort has been highlighted by stakeholders but the national management strategy doesn't effectively address this problem (the number of pots/traps set by vessel are difficult to control). Several studies indicated that between 13% and 25% of the catch in artisanal fisheries in the country went unreported (CIIMAR 2011)(Leitão et al., 2014).

Management measures are in place but no appropriate management/conservation targets have been defined for the stock in consideration. The fishery does not meet all the standards of 'highly effective' management. Management strategy/implementation is therefore ranked as "**moderately effective**".

Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderately Effective
The common octopus fishery has substantial importance in Southern European countries due to its considerable social and economic value. Small-scale fisheries are increasingly economically dependent on this resource, which in many cases is used as a revenue resource to complement other traditional target species (Lourenco et al., 2014) (Pita et al., 2015)(Bañón et al., 2018).

In European waters, the octopus fishery is excluded from quota regulations under the Common Fisheries Policy, being the national governments responsible for the management of the fishery (Pita et al., 2015). In Spain, the small-scale octopus fishery (such as all shellfish fisheries in the country) is managed at the autonomous community level. Since 2010, periodic management plans have been approved in Galician waters (North-western Spain)(the most recent regulation is DOG 101 2020/5/27). A management plan is also in place in Asturias (ICES subarea 8c) (BOPA Resolution December 4, 2018). Current management strategies set in those management plans focus on controlling fishing effort, via measures such as limiting licenses, the number of traps used by vessel, fishing days, and daily vessel quotas. The plans also regulate minimum landing sizes (1kg), discarding, and distances to the coast at which traps can be set. The current management plans also include programs to monitor fleet activity through monitoring onboard fishing vessels and periodic controls in fish markets (Gepeto project 2014)(Macho & Rios 2019).

In the Gulf of Cadiz (South Spain), a number of specific management measures for the octopus fishery are shown in annex III of the Order AAA/1406/2016. A draft management plan was later developed by the government in collaboration with stakeholders, but it seems that this plan was later rejected by the fishing sector (AI 2016)(LaVanguardia 2016). Since 2017, two 1.5 month temporal closures are established in the Gulf of Cadiz, from May 1st - June 15th and from September 15th - October 30th (AI 2016). In Asturias, the temporal closure is unique, of 3 months (February 1st – May 1st) for the fishery outside the management plan, and extended to 5 months (July 13th – December 15th) for the octopus fishery under the management plan. In 2020 in Galicia, it lasts from May 29th to July 1st (DOG 101 2020/5/27)

Major problems with the implementation of these management plans are the control and monitoring of catch quotas and minimum landing size; and compliance with area and time restrictions (DOG 2013)(Gepeto project 2014) (Macho & Rios 2019). During the Gepeto project, funded by the EU, the octopus management plan in Galicia was evaluated. The review noted that clear long-term objectives should be set and continuous monitoring would be necessary to allow the introduction of new measures agreed by the authorities and the fishing sector (Gepeto project 2014). Similarly, when the octopus fishery was certified by the MSC in Asturias, the experts considered that short- and long-term management objectives were not clearly spelled out in the management plan (Macho & Rios 2019).

Finally, although transparency and participation are being enhanced by the new EU fisheries policies. Fishermen's involvement in fishery resource management in Spanish waters is still inadequate. For example, the octopus management plan in Galician waters (North of Spain) involved consultation with District Fishermen's associations from Coruna, Lugo, and Pontevedra (DOG 2013). However, when the management plan was approved by the authorities, 65% of the fishermen rejected the plan due to disagreements with the management measures implemented (El Pais 2013). A similar situation happened in the Gulf of Cadiz (AI 2016)(LaVanguardia 2016). Illegal, unreported, and unregulated (IUU) fishing is also a concern in the Spanish octopus fishery due to the level of unreported landings (Otero et al., 2005)(Villasante et al., 2010)(Villasante et al. 2015)(Bañón et al. 2018) (see specific sections).

Management measures (effort restrictions, minimum landing size, restricted areas, etc.) which are expected to be effective are in place, but no appropriate management/conservation targets

have been defined for the species. Management strategy/implementation is therefore ranked as "**moderately effective**".

Factor 3.2 - Bycatch Strategy

Eastern Central Atlantic | Bottom trawls | Mauritania

Ineffective
Management measures currently in force in Mauritania include a closed season, technical measures (mesh size), fishing zones, to preserve the coastal zone, a trawling ban in waters of depths less than 20 m. Bycatch of unmanaged species or species of concern, such as demersal elasmobranchs, sea turtles, or marine mammals is unknown and information about specific management measures applied to the Mauritanian trawl fishery to reduce the impact on these species has not been found.

Species of concern are assumed to be caught in trawl fisheries in the country. For example, scientists monitored Dutch industrial freezer-trawler fisheries off Mauritania between 2001 and 2004. Onboard observers recorded bycatch from more than 1,400 trawl sets and used observed numbers to extrapolate total bycatch for the freezer-trawler fleet. The estimated annual bycatch of 70 to 720 dolphins between those years (Zeeberg, Corten, and de Graaf (2006). A number of projects have worked in the area in order to reduce the impact on protected species, such as the project to improve the conservation status of marine turtles in West Africa (2008-2012) (Diallo & Dossa 2013). However, information on specific management measures implemented on trawl fisheries to reduce the impact on these species is not available.

Species of concern are caught in the fishery and management measures are insufficient given the potential impacts of the fishery. Therefore, the bycatch strategy is ranked "**ineffective**."

Eastern Central Atlantic | Bottom trawls | Morocco

Ineffective
As indicated in the management strategy, cephalopod fisheries in Morocco are managed through a total allowable catch (TAC) per season, together with several technical measures aimed at limiting fishing pressure and reducing the impact on the stock and other species (Fishing licenses, distance to the coast, biological rest period, mesh size, marketable size, etc.) (FAO/CECAF 2018). A cephalopod management unit has also been established to the South of the Atlantic coast where only artisanal vessels are permitted to catch this species. Moreover, in December 2018, the Moroccan department of fisheries banned the use of large vertical opening trawls to reduce the impact of the fishery on bycatch species.

Bycatch of species of concern, such as demersal elasmobranchs, sea turtles, or marine mammals is possible. For example, The Convention on Migratory Species (CMS) reports that despite the near-total lack of data on marine mammal bycatch in the West of Africa, "it is assumed that the true extent of fisheries-related mortality in the area is substantial" (CMS 2008) and information about specific management measures applied to the Moroccan trawl fishery to reduce the impact on these species is not available.

Species of concern are caught in this fishery and management measures are insufficient given the potential impacts of the fishery. Therefore, the bycatch strategy for the country is ranked "ineffective."

Eastern Central Atlantic | Bottom trawls | Senegal

Ineffective
As indicated above, a series of technical management measures, such as minimum mesh size, or by-catch limits are implemented in trawl fisheries in Senegal (for example in the hake fishery a 7% limit for cephalopods and crustaceans and a 15%limit for other deep demersal fish are in place). However, compliance and enforcement in trawl fisheries in the country are inadequate. Bycatch of unmanaged species or species of concern, such as demersal elasmobranchs, sea turtles, or marine mammals is unknown and information about specific management measures applied to the Senegalese trawl fishery to reduce the impact on these species has not been found.

Species of concern are caught in this fishery and management measures are insufficient given the potential impacts of the fishery. Therefore, the bycatch strategy is ranked "**ineffective**."

Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Jig | Senegal

Highly effective
A jig is a type of grapnel (or grappling hook), which is attached to a fishing line. The hooks used in the octopus fishery are not baited and there's virtually no bycatch. Richardson et al., 2019 predicted a 29% gear loss for line fisheries. However, the impact of these lost gears on bycatch species is thought to be low. Therefore, a "**highly effective**" score is assigned.

Eastern Central Atlantic | Pots | Mauritania
Eastern Central Atlantic | Pots | Morocco
Eastern Central Atlantic | Pots | Senegal

Moderately Effective
The vase-like pots used to catch octopus are passive capture gears without any net or other devices to retain the species caught. Pots are considered an environmentally friendly fishing gear, with limited or low impact on bycatch and habitat. The global loss of traps and pots in these fisheries has been estimated at 19%. Loss of pots and traps per vessel is higher for traps fishing over soft, mixed, and unknown bottom types, in comparison with hard bottom types and increases with depth (Richardson et al., 2019). Lines used in loss pots can get entangled and there is not a comprehensive strategy to address ghost fishing in this fishery. Therefore, a "**moderately effective**" score is assigned to this fishing gear for the bycatch strategy.

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderately Effective
The reform of the Common Fisheries Policy (CFP) (Regulation (EU) No 1380/2013) aimed at gradually eliminating the practice of discarding in European waters and European vessels fishing in the high seas through the introduction of the landing obligation for all commercial fisheries (species under TACs, or under minimum sizes) (EC 2020). Under the landing obligation, all catches have to be kept on board, landed, and counted against the quotas. Undersized fish cannot be marketed for direct human consumption purposes whilst prohibited species (e.g. some species of sharks) cannot be retained on board and must be returned to the sea (EC 2020). Details of the implementation will be included in multiannual plans or in specific discard plans when no multiannual plan is in place. These details include the species covered, provisions on catch documentation, minimum conservation reference sizes, and exemptions ((for fish that may survive after returning them to the sea, and a specific de minimis discard allowance under certain conditions) (EC 2020).

Commission delegated Regulation (EU) 2015/2439 established a discard plan for certain demersal fisheries in South-Western waters (ICES subareas 8 and 9, which includes the Portuguese

and Spanish coast where the octopus fishery occurs) for the period 2016-2018; and delegated regulation (EU) 2018/2033 established a new discard plan in the same area for the period 2019-2021. Some of the bycatch species caught in the octopus fishery in Portugal and Spain are species under TACs and are affected by these regulations. However, a number of de minimis exemptions apply to several of the species caught in the trawl fishery, such as sole, European hake, or horse mackerel (Commission delegated regulation (EU) 2018/2033). Technical measures, such as minimum mesh size, distance to the coast, closed periods, etc. are also in place in the fishery to reduce the number of bycatch species caught in the fishery.

For elasmobranch species (skates, rays, and demersal sharks), Council Regulation (EU) 2019/124 prohibitions for EU vessels to fish for, to retain on board, to transship or to land several species including thornback ray, undulate ray, starry ray, common skate or tope shark, among others. When accidentally caught, species referred to in paragraph 1 of the (EU) 2019/124 shall not be harmed. Specimens shall promptly be released.

The Portuguese government has also adopted some national legislation: Portaria no. 170/2014, established a minimum landing size of 520 mm (total length) for specimens of the genus Leucoraja or Raja, covering all of the continental Portuguese EEZ; and Portaria no. 315/2011 (updated by Portaria no. 47/2016) prohibits the catch, retention onboard, and landing of any skate species belonging to Rajiformes during the months of May and June, which covers part of the spawning period. For each fishing trip during these two months vessels are permitted to retain on board and to land a maximum of 5% bycatch, in weight, of the Rajiformes species (ICES 2018d).

Under the Council Regulation (EC) 812/2004 (EU, 2004), the European countries are forced to report any bycatch of marine mammals in European waters, fisheries with a high level of bycatch are obliged to implement pingers and other mitigation measures.

The new bycatch management measures introduced by the EU have reduced the level of discarding in European waters. Therefore, it is considered that the fishery has a precautionary strategy to minimize the impacts of the fishery on bycatch species and there is evidence that the strategy is being implemented successfully. However, the effectiveness of these bycatch management measures has not been proved for all the bycatch species (demersal sharks, sea turtle). Therefore, and bycatch management strategy is ranked "**moderately effective**".

Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Pots | Spain

Moderately Effective
The vase-like pots used to catch octopus are passive capture gears without any net or other devices to retain the species caught. Pots are considered an environmentally friendly fishing gear, with limited or low impact on bycatch and habitat. The global loss of traps and pots in these fisheries has been estimated at 19% (Richardson et al., 2019). For the Gulf of Cadiz, Sobrino et al. (2011) have estimated pots losses of around 9,000 units per month. Loss of pots and traps per vessel is higher for traps fishing over soft, mixed, and unknown bottom types, in comparison with hard bottom types and increases with depth (Richardson et al., 2019). Lines used in loss pots can get entangled and there is not a comprehensive strategy to address ghost fishing in this fishery. Therefore, a moderately effective score is assigned to this fishing gear for the bycatch strategy.

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

Moderately Effective
As indicated in the management strategy section, a series of management measures have been implemented in Spain to limit the impact of pots and traps on resources, such as the prohibition of the use of pots (Galician waters), minimum mesh size in traps, limitation in the number of traps per vessel, permitted areas, etc. Traps are considered an environmentally friendly fishing gear, with limited or low impact on bycatch and habitat. However, the global loss of traps and pots in these fisheries has been estimated at 19% (Richardson et al., 2019). In Algarve, there have been an estimated more than 50 thousand octopus traps to be lost every year (Erzini, 2007). Loss of pots and traps per vessel is higher for traps fishing over soft, mixed, and unknown bottom types, in comparison with hard bottom types and increases with depth (Richardson et al., 2019). Erzini et al., 2008, investigated the catch of lost octopus traps in Portugal. The lost gear caught six species: common octopus, European conger, Mediterranean moray (*Muraena Helena*), red scorpionfish (*Scorpaena notata*), comber (*Serranus cabrilla*), and *P. phycis*. Catch rates were generally low and highly variable. Most octopuses were caught in the first two weeks after trap deployment, and few catches were observed thereafter. For other fishes, namely small red scorpionfish, occasional catches were recorded up to three months after deployment (Erzini et al., 2008).

The rate of bycatch in trap fisheries is low but there is not a comprehensive strategy to address ghost fishing in this fishery. Therefore, a "**moderately effective**" score is assigned to this fishing gear for the bycatch strategy.

Factor 3.3 - Scientific Research And Monitoring

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Bottom trawls | Spain
Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderately Effective
Using the best available scientific advice to define management measures is one of the Common Fisheries Policy's (CFP) principles of good policy making. According to the CFP, fisheries management based on the best available scientific advice requires harmonized, reliable, and accurate data collection. The EU Data Collection Framework (DCF; Council Regulation (EC) 199/2008; EC Regulation 665/2008; Decision 2008/949/EC) establishes a framework for the collection of economic, biological and transversal data by the Member States, including data on fleets and their fishing activities, catches, including discards and survey information on fish stocks and on the potential environmental impact of fishing activities on the marine ecosystem, needed for scientific advice (Regulation (EU) No 1380/2013) (ICES 2019e).

In Portugal, the IPMA (formerly IPIMAR) is responsible for discard sampling from ICES Division IXa under the Data Collection Framework. Biological data collection started in the 1990s and has allowed the identification of fishing gears, fishing effort, and cephalopod discards in the Portuguese cephalopod fishery. In Spain, the IEO (Spanish Oceanographic Institute) is responsible for monitoring discards monthly, by sea area and gear, of the entire Spanish fleet except for the Basque fleet, which is covered by AZTI-Tecnalia (ICES 2018c). Since 2002, under the respective national sampling programs of the DCF, the discard sampling program has been conducted in different "métiers" (homogeneous subdivisions, either of a fishery by vessel type or of a fleet by voyage type) for all species covered by the regulation, including cephalopod species. Data on the distribution and relative abundance (in number and weight) of all demersal species in the area (including cephalopods) is also collected in both Spain and Portugal through the cephalopod working group from different surveys: SP-NGPS "DEMERSALES" survey carried out annually in Iberian waters and through the south Spanish groundfish survey (ARSA/SPGFS) (ICES 2018c).

Several scientific advisory bodies work in European waters: The International Council for the Exploration of the Sea (ICES) is an intergovernmental body founded in 1902 to conduct and coordinate research into the marine ecosystems of the North Atlantic. The ICES provides advice to numerous governments and regional fisheries management organizations, including the EU. It publishes annual advice by fish species and region on its website. The Scientific, Technical and Economic Committee for Fisheries (STECF) was set up in 1993 to advise the Commission on Fisheries Management. The STECF analyses Member States data collection annual report and reports directly to the European Commission. The Commission's Joint Research Centre complements the advisory bodies' work by supporting the coordination and management of the Scientific, Technical and Economic Committee for Fisheries and the implementation of the data collection regulations. It also conducts studies on fisheries management issues relevant to the implementation of the Common Fisheries Policy (European Commission 2020c).

In European waters, cephalopod populations/stocks are not assessed on a regular basis and there are no TACs or quotas for these resources (ICES 2018c). ICES does not issue advice on cephalopod stocks. However, strong efforts have been made in recent years by the members of the ICES Working Group on Cephalopod Fisheries and Life History (WGCEPH) to assess cephalopod fisheries in ICES areas (ICES 2018c). WGCEPH is in the process of improving the knowledge and understanding of these fisheries in European waters with the objective of better assessing the resource in the coming years (ICES 2018c). Several stock assessment exercises for common octopus undertaken by the WGCEPH, have demonstrated the value of production models that include environmental predictors (effectively allowing environmental carrying capacity to vary between years) as well as the utility of empirical statistical models employing environmental predictors and survey-based recruitment indices (ICES 2018c).

Although several scientific bodies advise the European Commission about fisheries management, there is not yet a reliable assessment for this species. The principal problem in assessing octopus stocks in European waters is obtaining accurate information on fishing effort and catches. In general, fisheries statistics in the EU seem to underestimate the contribution of the artisanal fisheries, mainly because not all catches tend to pass through monitored markets and other misreported issues, and fleets are not under strict control. These deficiencies are usually accompanied by a lack of fundamental data such as effort which, in conjunction with the particular biological traits of these species, hampers the application of traditional population dynamics models for assessment and management purposes (Rodhouse et al., 2014) (Bañón et al., 2018).

Some data related to stock abundance and health are collected and analyzed which is used to monitor and maintain the stock (including monitoring of bycatch) using appropriate data-limited management strategies. Therefore, scientific research and monitoring are considered "**moderately effective**."

Factor 3.4 - Enforcement Of Management Regulations

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Bottom trawls | Spain
Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderately Effective
In European waters, there is a control system to enforce EU CFP rules (COUNCIL REGULATION (EC) No 1224/2009). It was designed to ensure compliance with the TACs and combat illegal fishing; to collect fisheries data for managing fishing opportunities; to ensure harmonized application of rules and sanctions across the EU, and improve traceability throughout the supply chain (European Commission 2020d).

In 2017, the European Commission published its evaluation of the fisheries control regulation in European waters. The report showed that Member States have generally been compliant with the main obligations set by the regulation (EC 2020). The necessary instruments and procedures for ensuring monitoring and inspection of fishing activities throughout the EU have been set, improving the surveillance and tracking of fishing vessels in EU and international waters, as well as the collection and transmission of reliable data (EC 2017). In European waters, Vessel Monitoring Systems (VMS) and Electronic Reporting Systems (ERS) are used throughout the fishing fleets for vessels above 12 meters, improving monitoring, control, and reliability of catch data (EC 2017). However, the report concluded that its full implementation lacks behind in many member states, highlighting both a number of shortcomings in the implementation and deficiencies in the current regulation, mainly concerning sanctions and point system, follow up of infringements, data exchange and sharing between the Member States, traceability, control of weighing practices, and monitoring and catch reporting tools for vessels below 12 meters (European Commission 2017). Based on these results, the Commission decided to propose and implement a number of changes to the control regulation, as well as targeted amendments to the regulation on illegal, unregulated, and unreported fishing, in order to modernize, strengthen and simplify the EU fisheries control system and to increase the level playing field in fisheries controls (European Commission 2018).

As indicated previously, total removals of common octopus in Galicia, were notably higher than officially reported values. The Illegal, Unreported and Unregulated (IUU) catches were estimated to range between 14% to 50% of total reported catches, while the volume of recreational fishers harvesting octopus and selling to restaurants is important (Otero et al., 2005) (Villasante et al., 2010)(Villasante et al. 2015)(Bañón et al., 2018). However, it seems that better control and monitoring programs with more sustainable fishers' practices have contributed to a substantial reduction of IUU practices in recent years (Bañón et al., 2018)(Silva et al., 2019). A similar level of underreporting is expected in other areas in Spain.

In Portugal, efforts to conserve the biodiversity of coastal marine ecosystems are constrained by political uncertainty and bureaucracy (Leitão et al., 2014). The majority of the octopus catches come from artisanal fleets, where there is a substantial overcapacity deployed. The existence of black-market landings of underweight octopus (recruits) is well known. For the pot and trap fishery, the current legislation defines the number of licenses in operation, the minimum landing weight, and the maximum number of traps and pots by vessel (effort limitation) for artisanal fleets but, in many cases, this maximum number of traps by vessel is not respected (CIIMAR 2011). The maximum number of traps/pots per boat has been recognized in the national legislation as one of the most unsuccessful policies implemented in the fishery (ordinance nº230/2012) (Carlos Sonderblohm pers. comm.). In Portugal, between 1950 and 2010, discards contributed the most to unreported catches, accounting for 7.6 million t of total catches (i.e., 35%), while unreported landings amounted to around 2.9 million t (13%). Finfish accounted for 94% (115,000 MT/yr) of unreported catches, followed by cephalopods (2,400 MT/yr) and crustaceans (1,800 MT/yr) (Leitão et al.2014). It represents around 20% of the catch of these species.

The EU has implemented several measures in recent years to improve data collection and enforcement in European waters. As a consequence of greater pressure by the fishing control agencies, IUU fishing in coastal fisheries has decreased in recent years, but fishing effort and underreporting is not adequately controlled yet by the management agencies

Enforcement and monitoring are in place to ensure goals are successfully met, although effectiveness is uncertain, Therefore, enforcement of management regulations is considered as "**moderately effective**".

Justification:
The current fisheries control system in European waters is made up of four pillars: the Control Regulation (Council Regulation (EC) No 1224/2009), establishing an EU-wide system for control, inspection, and enforcement for ensuring compliance with rules of the Common Fisheries Policy: the IUU Regulation (Council Regulation (EC) No 1005/2008) establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing; the EFCA Regulation (Council Regulation (EC) No 768/2005), establishing a Community Fisheries Control Agency; and the SMEF Regulation (Regulation (EU) 2017/2403), on the sustainable management of external fishing fleets (EP 2018).

The 2017 review of the control regulation undertaken by the European Commission highlighted a number of issues. In particular, the traceability of fishery products across the Member States was considered a concern. Even though a significant improvement has been observed in recent years and post landing control increased, the reliability and quality of data there are still issues with control at first sales and during transport (European Commission 2017). Control authorities consider that the current framework for the control of weighing and transport is giving room for misreporting catch data. Also, the paper-based traceability system mandated by the Control Regulation was not considered effective (European Commission 2017). The specific rules applying to vessels less than 12 meters were considered not fully suitable as the rigidity of some provisions imposed an unjustified burden on the small scale fisheries. The control of the activities of vessels below 10 meters, which are exempt from keeping a logbook, is not properly implemented by the Member States (e.g. control by sampling at the time of landing) either (EC 2017).

In the 2018 proposal, the Commission indicated that the absence of catch reporting obligations for vessels less than 10 meters' length led to incomplete and unreliable data for that segment (data collection for those vessels was based on sampling plans) and required reporting of catches for all fishing vessels without regard to their size, simplifying the rules and improving compliance and controls. In the case of vessels less than 12 meters' length, the obligations pertaining to the completion and submission of the logbook should be simplified, requiring masters to submit the information contained in the logbook before arrival at port (European Commission 2018).

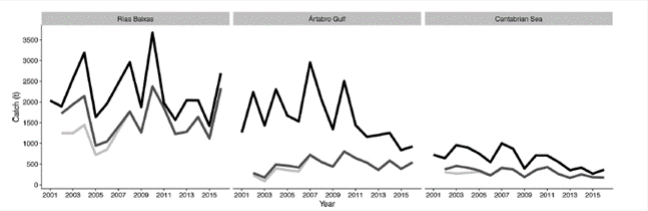

Figure 16: Time series plots of expected catches (black line) and official records (dark and light grey lines) for the artisanal fleet targeting common octopus. Estimated catches were calculated using the annual yield and the number of deployed traps. Note that these two lines converge presumably because of the improvement of the official registration system (Banon et al., 2018).

Factor 3.5 - Stakeholder Inclusion

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Bottom trawls | Spain
Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderately Effective
The European Commission identified the lack of stakeholder involvement as one of the major weaknesses of the Common Fisheries Policy (CFP), recognizing that this fact clearly undermined its legitimacy. The creation of the Advisory Councils (ACs) (latterly called regional advisory councils (RACs)), was one pillar of the reform of the Common Fisheries Policy of 2002. They aimed to allow greater participation of the stakeholders of the fishing industry, in relation to the resources management in European waters in order to enhance transparency and participation. The South Western RAC (CCR.S) covers the Atlantic area from the point of Brittany in the north to the Straits of Gibraltar in the south, as well as the ultraperipheric regions of Madeira, the Azores, and the Canary Islands. The CCR.S gathers two-thirds of its representatives from the fishing sector (fishermen, shipowners, organizations of producers, transformers, wholesale fish merchants, and organizations of markets) of five Member States (Portugal, Spain, France, Belgium, and The Netherlands). One-third comprises member organizations from civil society (e.g., aquaculture, consumer and environmental NGOs, "women of sailors", and recreational fishing) (CCR.S 2014). The AC members meet regularly to give advice on fishing opportunities, management plans, socio-economic aspects of management, and other issues (CCS 2020). Specifically, the traditional fisheries (TRAD) group within the CCR.S deals with topics specific to artisanal or small-scale fisheries (CCS 2020).

Recent projects funded by the European Commission such as the EcoFishMan, GEPETO, or FarFish have aimed to integrate fisheries knowledge and increase stakeholder involvement in fisheries management in order to develop new integrated fisheries management system in Europe(EcoFishMan 2014). For example, under the GEPETO project in 2016, a meeting was held which included small-scale fishermen associations, NGOs, managers, and scientific bodies from Galicia, Cantabria, Asturias, Andalucia, the Bask Country, and Portugal in order to evaluate and improve the management of the octopus fishery.

In the Algarve (South of Portugal), the Centre of Marine Sciences (CCMAR), supported by the Ministry of Fisheries (DGRM), scheduled seven meetings with local fishermen beginning April 2014. Based on the results of the EcoFishMan project, they were interested in involving stakeholders to develop a management plan for the octopus trap and pot fishery, to avoid traditional disputes between regional fishing groups (Sonderblohm, pers comm.). Since 2015, a series of meetings with stakeholders ('Tertulias do polvo') were undertaken in the south of Portugal which brought together researchers, fishers, and managers and resulted in a 'green book' with a series of recommendations to improve the management of the octopus fishery (Sonderblohm et al., 2017). Several management measures were recommended, including closed Season (CS), fishing Schedule or Weekend stops (FS), Maximum Allowable Number of Traps or Gears (MAXGEAR), Bait Selection, Minimum allowable distance from the coastline (MINDIST), Maximum Allowable Catch (MAC), Increase Minimum Landing Weight (MLW), etc (Sonderblohm et al., 2017). However, only one of the recommended measures, the prohibition of the catch, retention, and landing of common octopus during the weekends have been implemented so far. Other measures, such as the implementation of a two months closure was rejected by the government. This initiative focused on the octopus pot and trap fishery due to its small scale nature and high social and economic importance in the Algarve region (Sonderblohm et al., 2017). The introduction of co-management is at present being discussed at the national level, within the revision of the Decreto-Lei 278/87 (Borges & Revenga 2020).

Similar initiatives have been undertaken in Spain for the Galician octopus fishery under the GEPETO and the GAP2 projects in order to integrate fishers' knowledge into management (Pita et al., 2014). A series of MSC assessments and pre-assessments have also been undertaken in several areas of the country (Asturias, Galicia) which have increased the interest of the fishing industry in managing the octopus fishery. However, although a series of workshops have been undertaken, it seems that no specific actions have been taken and no overall initiatives have been carried out to implement co-management plans in the country.

Transparency and participation are being enhanced by the new EU fisheries policies. However, according to several reports, the effectiveness of stakeholder involvement becomes constrained – or even reversed – by the realities of stakeholder representation procedures. Unresolved problems regarding representation create legitimacy issues which ultimately reduce AC's opportunities to contribute to a more progressive and sustainable environmental governance (Linke & Jeftoft 2015). For example, during the GEPETO project, managers complain that their regulations are routinely ignored, while fishermen argued that these regulations are implemented without their participation (information is provided by the managers to the fishermen associations but this is not adequate and their input is not adequately taken into consideration by the managers (Javier Garcia Galdo pers. comm.)). In Portugal, although a great effort was done to improve stakeholder participation in the management of the octopus fishery, this activity was only undertaken in the Algarve and the implementation of the measures suggested collided with the traditional top-down management approach in place in the country.

The management process includes some stakeholder input but transparency and participation need to be improved. Therefore, stakeholder inclusion in the Spanish and Portuguese octopus fishery is considered "**moderately effective.**"

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

GUIDING PRINCIPLES

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Eastern Central Atlantic | Bottom trawls | Mauritania	1	0	Moderate Concern	Red (1.732)
Eastern Central Atlantic | Bottom trawls | Morocco	1	0	Moderate Concern	Red (1.732)
Eastern Central Atlantic | Bottom trawls | Senegal	1	0	Moderate Concern	Red (1.732)
Eastern Central Atlantic | Jig | Mauritania	5	0	Moderate Concern	Green (3.873)
Eastern Central Atlantic | Jig | Morocco	5	0	Moderate Concern	Green (3.873)
Eastern Central Atlantic | Jig | Senegal	5	0	Moderate Concern	Green (3.873)
Eastern Central Atlantic | Pots | Mauritania	3	0	Moderate Concern	Yellow (3.000)
Eastern Central Atlantic | Pots | Morocco	3	0	Moderate Concern	Yellow (3.000)
Eastern Central Atlantic | Pots | Senegal	3	0	Moderate Concern	Yellow (3.000)
Northeast Atlantic | Bottom trawls | Portugal	1	0	Moderate Concern	Red (1.732)
Northeast Atlantic | Bottom trawls | Spain	1	0	Moderate Concern	Red (1.732)
Northeast Atlantic | Pots | Portugal	3	0	Moderate Concern	Yellow (3.000)
Northeast Atlantic | Pots | Spain	3	0	Moderate Concern	Yellow (3.000)
Northeast Atlantic | Traps (unspecified) | Portugal	2	0	Moderate Concern	Yellow (2.449)
Northeast Atlantic | Traps (unspecified) | Spain	2	0	Moderate Concern	Yellow (2.449)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Bottom trawls | Morocco
Northeast Atlantic | Bottom trawls | Portugal
Eastern Central Atlantic | Bottom trawls | Senegal
Northeast Atlantic | Bottom trawls | Spain

1
The important role of cephalopods in the Gulf of Cádiz ((northeastern Atlantic, Spain, and Portugal) has been suggested by several studies (Silva et al., 1998, 2011) (Vila et al., 2010) (Torres et al., 2013). These species hold an important trophic position as top-down structuring groups in the marine food web (Vila et al., 2010) (Torres, 2013), and may be influenced by environmental factors and fishery exploitation (Sobrino et al., 2002) (Sonderblohm et al., 2016). Cephalopods are, in fact, important groups in marine ecosystems and can proliferate in highly exploited areas (Piatkowski et al., 2001) (Boyle and Rodhouse, 2005) (Coll et al., 2013c) (Torres et al., 2013). The Gulf of Cádiz is a notably stressed ecosystem, displaying characteristics of a heavily exploited area (Torres et al. 2013).

Commercial trawl fisheries for common octopus in the area most often employ shallow bottom trawls that catch octopus among other species, including cuttlefish, squid, and several species of fish (Silva et al., 1998) (Sobrino et al., 2002) (Pita et al., 2015). The impact of bottom trawling on the habitat is well documented (Oceana 2008)(Hinz et al., 2009)(Rossi 2013). All the components involved in trawling (doors, chain, weights, etc) have the capability to affect the seabed, destroying benthic ecosystems; doors, chains, weights, and net can go various depths into the seabed (up to 30 cm) depending on the sediment and the technique used (Oceana 2008). Chronic bottom trawling reduces habitat complexity, species richness, and biomass, and increases the presence of opportunistic species by altering the species composition (Morgan & Chuenpagdee 2003)(Hinz et al. 2009). Homogenization of habitats risks loss of ecological function and natural heritage values reducing resilience, thereby predisposing the system to sudden and dramatic change (Hiscock et al. 2006). Bottom trawling also resuspends sediment, lowers the nutritive quality of sediment, and reduces primary and microbial production. Turbidity impedes the normal functioning of benthic organisms' feeding and respiratory structures, resulting in hypoxia or anoxia (Morgan & Chuenpagdee 2003).

Although some areas have been protected in all the countries to reduce fishing impact and protect vulnerable habitats, the area and level of protection is limited and there is the potential for the gear to contact sensitive habitat. According to the SFW criteria, if bottom trawling occurs on muddy areas, where the octopus trawl fishery mainly is carried out, the impact on the habitat is considered moderate. However, as there is a potential impact for the gear to contact sensitive habitat, a score of "1" is given for all the trawl fisheries for fishery impact on the habitat.

Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Jig | Senegal

5
The gear most commonly used in the area to catch octopus is the "turlutte", a multi-hooked hand-jig device which does not come in contact with the bottom. This fishing method is considered environmentally responsible because there's virtually no catch of unwanted marine life or habitat impacts (SFW 2018). Based on the SFW standard, this the impact on the substrate is scored as "5" (no impact on the seabed).

Eastern Central Atlantic | Pots | Mauritania
Eastern Central Atlantic | Pots | Morocco
Northeast Atlantic | Pots | Portugal
Eastern Central Atlantic | Pots | Senegal
Northeast Atlantic | Pots | Spain

3
The fishing gear known as "alcatruz" in Spain and Portugal or pots is an entrapment device used specifically for the common octopus fishery. This type of fishing gear consists of a vase-like pot, and its effectiveness is based on the octopus' behavior: territorial, "hermit-like." The common octopus voluntarily enters the pot seeking shelter and can leave it at any moment. The pots are normally checked every 2 to 5 days. The pots are made of plastic or clay and they are normally rigged to long lines containing 50–70 pots (Sobrino et al. 2011). This is a passive, lightweight fishing gear that has a low impact on the habitat when the fishery is undertaken on rocky, sandy, or muddy bottoms, where the common octopus fishery normally occurs. There is not a score specified in the SFW criteria for this particular gear.. However, as the impact of the pots on the substrate is considered to be lower than the impact of a trap gear (which is heavier), a score of "3" is assigned for all the pot fisheries.

Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Traps (unspecified) | Spain

2
Trapping is a passive way to catch fish, shellfish, crustaceans, and cephalopods. Traps are designed so the entrance becomes a non-return device, allowing the target species to enter the trap but making it impossible to leave. Different materials are used for building the trap: iron (frame), netting wire, etc. Traps are normally baited with pieces of low-value fish such as sardine or mackerel. Traps are the only gear permitted in Galicia (North of Spain), where an artificial bait, known as "membrillo," has been also introduced (Bañón et al., 2018). In Portugal, the use of live baits (green crab) has been forbidden to reduce fishing effort (Ministerial ordinance n. 054/2010).

Traps in Spain and Portugal are deployed over mud, sand, and rocky bottoms. Therefore, a score of "2" is given for the Spanish and Portuguese trap fisheries.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Pots | Mauritania

0
The Mauritanian legislation regulates the fishing intensity and protects marine habitats through limits on the number of licenses, bycatch limits, fishing area restrictions, and the creation of marine protected areas, such as the Banc d'Arguin National Park and the Cap Blanc satellite reserve. These two MPA represent 3.7% of the total marine area in the country. However, information about vulnerable marine ecosystems (VME) present in the area and management measures particularly defined to protect benthic habitats in the country is very scarce. Moreover, compliance with management measures is not correctly monitored, resulting in significant illegal, unreported, and unregulated (IUU) fishing in some protected areas (Belhabib et al. 2013).

In 2016, FAO organized a Technical Workshop on Deep-sea Fisheries and Vulnerable Marine Ecosystems for the CECAF area. Deep-sea fisheries in EEZs and Marine Areas Beyond National Jurisdiction (ABNJ) were characterized and currently available information on benthic habitats were reviewed (FAO 2016). In the particular case of Mauritania, a presentation on deep-sea fisheries and VMEs was given by the IMROP. Deep-sea fishing in waters deeper than 200 m can threaten biodiversity by damaging VMEs and many deep-sea stocks through overfishing. The absence of a management plan for this fishery, which is characterized by high biomass, low reproduction rates, slow-growth, and long-lived species, increases this threat (FAO 2016).

No effective controls on fishing intensity are in place and few efforts exist to limit the spatial extent of fishing. Therefore, mitigation of gear impacts for the Mauritanian fisheries is ranked as "**0.**"

Justification:

Figure 17: Map of the Banc d'Arguin National Park marine protected area in Mauritania (Panorama solutions 2020)

Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Pots | Morocco

0

The Moroccan legislation regulates the fishing intensity and protects marine habitats through limits on the number of licenses, gear restrictions (for example the use of traps and GOVs has been recently prohibited in some areas of the country and a total closure south of 26 ° 00'N to all bottom trawling activity was implemented by Order n ° 4195-14), bycatch limits, time and area restrictions, and the creation of marine protected areas (Ministerial Decision No. 11/18)(Les.Eco.ma 2019)(Boughariou M. pers. comm). Single management measures to protect fisheries resources, such as the creation of artificial reefs or the protection of rocky habitat have also been implemented in the country. However, the number of protected areas in Atlantic waters is very low (only the Dakhla national park has been designed in Western Sahara) (MAPATLAS 2020). Information about vulnerable marine ecosystems (VME) present on the Atlantic coast and management measures particularly defined to protect benthic habitats is very scarce. Moreover, compliance with these measures is not correctly monitored. So, some fishermen have argued that illegal octopus fishing is taking place in protected areas and during time closures. This poses questions about the real protection of these measures in the country (Lavieeco 2007) (Belhabib et al. 2013).

No effective controls on fishing intensity are in place and few efforts exist to limit the spatial extent of fishing. Therefore, mitigation of gear impacts for the Moroccan fisheries is ranked as "**0.**"

Eastern Central Atlantic | Bottom trawls | Senegal
Eastern Central Atlantic | Jig | Senegal
Eastern Central Atlantic | Pots | Senegal

0

The Senegalese government regulates the fishing intensity and protects marine habitats. Several MPAs have been declared in the country, such as the Kayar or the Joal MPAs. Specific measures to enhance the octopus population and protect the ecosystem, have been implemented in the country. For example, under the Sustainable Fisheries Partnership Agreement (SFPA) between the European Union (EU) and the Republic of Senegal, 15,000 octopus clay pots were submerged this year in Senegalese local waters to form artificial reefs and habitat for octopus to reproduce (European Commission 2020b). Spatial limitations and by-catch limits are also set for industrial fisheries. However, the marine protected areas only represent 0.69% of the total marine area in the country (MPATLAS 2020). Compliance with management measures is not correctly monitored and IUU is extensively spread throughout the country (Belhabib et al. 2014a) (Belhabib et al. 2014b)(Belhabib et al. 2015)(Peiro Crespo et al., 2017)(Pramod 2019).

No effective controls on fishing intensity are in place and few efforts exist to limit the spatial extent of fishing. Therefore, mitigation of gear impacts for the Senegalese fisheries is ranked as "**0.**"

Northeast Atlantic | Bottom trawls | Portugal

0

The Algarve, off the southern coast of Portugal, is one of the most important fishing areas of the country. Recent studies show that of all species captured by this fishing gear, around 70% are discarded due to low or lack of commercial importance, low gear selectivity, and fishing legislation. Direct observations revealed a heavily trawled bottom, with strong parallel marks caused by the doors of the trawl nets (Borges & O'Dor 2010). The Portuguese government has recently issued (June 2014) a decree prohibiting all deep-sea fishing—except for longlining—in an area spanning 2,280,000 km2, to promote sustainable fisheries and the conservation of deep-sea ecosystems. This decree will also contribute to building up the information database on Vulnerable Marine Ecosystems (VMEs) by establishing a requirement to collect samples of accidentally captured corals and sponges (Oceana 2014). However, this protection does not include shallow areas, where the octopus fishery is normally undertaken.

Trawling is allowed outside of 6 nm and the prohibition of trawling within this limit was enhanced through the use of artificial reefs in sensitive coastal areas. There are also time and area closures to bottom trawling, and some management measures have been introduced to reduce bycatch (Machado 2005). However, incursions of trawls in the octopus fishing grounds are regularly reported in Portugal (Carlos Sonderblohm pers. comm.).

The Portuguese authorities have made much progress in reformulating the legal and strategic planning framework for nature and biodiversity management. New management tools have been implemented and new sources of finance mobilized, both domestically and from the EU. The monitoring of species has been strengthened (MPAATLAS 2020b). A series of management measures to reduce the impact of the trawl fishery on the habitat, including seasonal closures for mechanized vessels, depth restrictions, closed areas, etc. However, despite these efforts, habitat deterioration is a concern and the extent of marine protected areas in the country is still low (2.5%) (MPAATLAS 2020b). Therefore, it is considered that mitigation of gear impacts in this fishery is not adequate and no extra points are given in this section.

Justification:

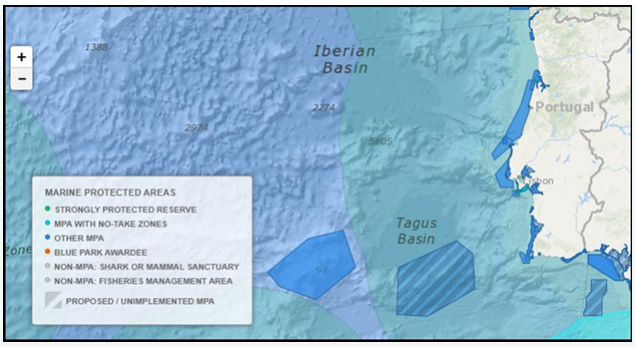

Figure 18: A map of marine protected areas in Portugal (MPAATLAS 2020)

Northeast Atlantic | Bottom trawls | Spain

0

The Gulf of Cadiz marine ecosystem (Spanish South coast ICES IXa South) connects the Atlantic Ocean with the westernmost part of the Mediterranean Sea. This area is an important fishing ground with a high diversity and high productivity of exploited species (Sobrino et al., 1994)(Sobrino et al., 1994)(Silva et al., 2002)(Jiménez et al., 2004)(Torres et al., 2013)(Silva & Acosta 2014). On a spatial scale, the diverse nature of the substrata over the Gulf of Cadiz shelf leads to the coexistence of different fisheries. For example, the rocky bottoms in the eastern area (Cadiz coast) favor the artisanal fisheries targeting sea breams (mainly Pagrus spp., Dentex spp. and Pagellus spp.); whereas sandy, muddy, and gravel bottoms in the western area (Huelva coast) are exploited mainly by trawl and gillnet fisheries which capture hake, wedgesole (*Dicologlossa cuneata*), crustaceans and cephalopods, among others (Ramos et al., 1996). The exploitation of fisheries is therefore intensive in the area, with all fleets exerting high impacts on most living groups of the ecosystem, which makes the Gulf of Cádiz a notably stressed ecosystem, which displays characteristics of a heavily exploited area (Torres et al. 2013). In 2009, mixed species low selectivity trawlers represented 33% of the catch in the area, purse seiners (54%), and artisanal boats (13%) (Sobrino et al., 1994)(Silva et al., 2002)(Jiménez et al., 2004)(Torres et al., 2013)(Silva & Acosta 2014)

A series of measures have been implemented by the EU and Spanish government to reduce the impact of trawl fishing on habitats and species. Trawling is only allowed outside of the 6 nm line to the coast and the prohibition of trawling within this limit was enhanced through the use of artificial reefs in sensitive coastal areas. There are also area closures such as bottom trawl closed areas, military areas, and marine protected areas (e.g., Gulf of Cádiz, Doñana National Park) (Ramos et al. 1996)(Paz Marti et al., 2018). Marine protected areas (MPAs) in particular in Spain have considerably expanded in recent years as a result of the Law of the Protection of Marine Environment (41/2010) which moved MPA expansion from a paradigm of designating fishery reserves, that focuses mostly on maintaining the natural repopulation of fish stocks, to one designating marine protected areas, that focus on preserving entire marine ecosystems and fostering ecological corridors (MPAATLAS 2020). The declaration of MPAs in 2010 and the subsequent development of the Network of Marine Protected Areas of Spain (NMPAs) spurred actions to make the network representative by including areas from all of Spain's marine sub-regions (i.e. East Atlantic, Bay of Biscay, and Iberian Coast, the Macaronesian Islands Atlantic and the Mediterranean region). Spain estimates that MPAs covered 8.4% of territorial waters by the end of 2014 (MPATLAS 2020) (protected areas in the country are shown in the figure below). In the life + Indemares project, 10 new marine SCIs were also proposed to the European Commission, and 39 new marine SPAs have been designated by the Spanish Government, mostly large areas that add nearly 70,000 Km2 to the Natura 2000 network in Spain (SEO2015). Recently Spain committed to declaring nine new protected habitats by 2024 (Lamoncloa.gob 2020). Under the EU legislation (Council Directive 92/43/EEC of 21 May 1992) on the conservation of natural habitats and of wild fauna and flora in Europe (Natura 2000) a series of vulnerable marine habitats, such as seagrass beds are also protected.

Fishing intensity is controlled in the area, the number of marine protected areas has increased in recent years and some vulnerable habitats are protected by law. Trawling areas are also well defined. However, the level of protection does not reach the 20% level necessary to consider that a substantial proportion of all representative habitats are protected from all bottom contact and expansion of the fishery's footprint into untrawled areas is not possible. Therefore, mitigation of gear impacts is ranked as "**0**"

Justification:

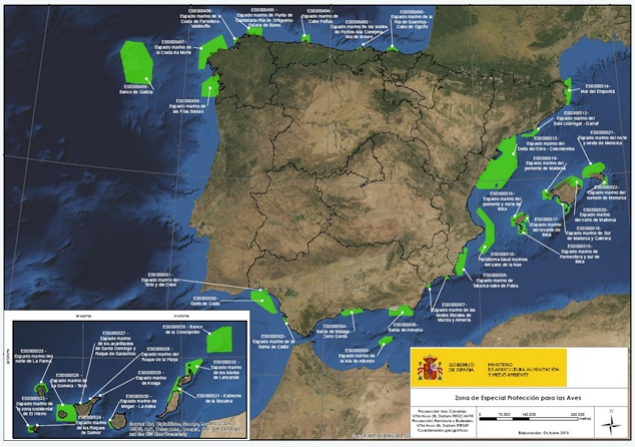

Figure 19: A map of marine protected areas in Spanish waters (Red Natura 2020).

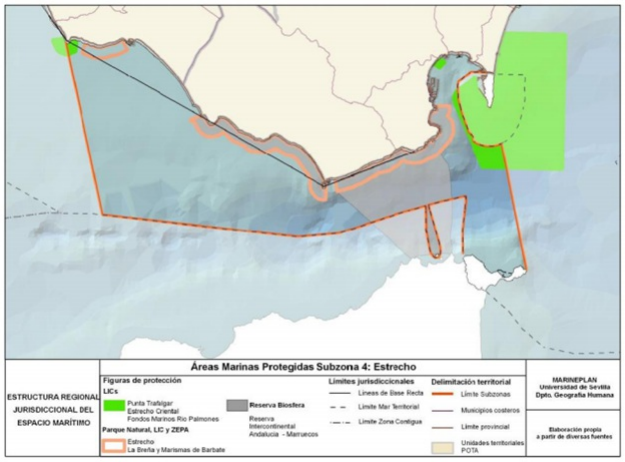

Figure 20: Protected marine areas in the area of the Strait of Gibraltar (Paz Marti 2018).

Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal

0
The Portuguese fishing legislation regulates fishing intensity in the pot/trap fishery and protects marine habitats through limits on the number of pots/traps permitted by vessel, limits on the number of licenses, time and area restrictions, and the declaration of marine protected areas. However, it is well known that some vessels normally exceed the maximum number of pots/traps permitted and IUU (undeclared catch) is important in artisanal fisheries in the country (many fishermen from the South of Portugal admit to use at least the double of the maximum number of traps permitted (Sondreblohm 2015)). Therefore, it is considered that some efforts exist to limit the spatial extent of fishing, but controls on fishing intensity are not effective enough and mitigation of gear impacts for the Portuguese pot/trap fishery is assessed "**0.**"

Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

0
The management plans in place for the octopus fisheries in Spain regulates fishing intensity in the pot/trap fishery, limits on the number of pots/traps permitted by vessel, limits on the number of licenses, time and area restrictions, etc. The Spanish legislation also protects marine habitats through the declaration of marine protected areas (see map above). In Galician waters, the use of pots is banned, and in the Gulf of Cádiz, fishing using pots and traps is also prohibited at the mouth of the Guadalquivir River and between the Strait of Gibraltar and longitude 6°12 ´W.

The number of traps used by each vessel is controlled using an identification number, and new measures such as the use of chips have also been proposed. However, it is well known that some vessels normally exceed the maximum number of pots/traps permitted and IUU fishing is also regularly reported in these countries ((Xunta de Galicia 2006)(Otero et al., 2005)(Villasante et al., 2010)(CIIMAR 2011) (Villasante et al. 2015)(Bañón et al. 2018)). Therefore, although some measures exist to reduce the impact of pot/traps on the habitat, no effective controls on fishing intensity are in place and few effective efforts exist to limit the spatial extent of fishing. Therefore, mitigation of gear impacts for the Spanish trap/pot fishery is assessed "**0**".

Factor 4.3 - Ecosystem-based Fisheries Management

Eastern Central Atlantic | Bottom trawls | Mauritania
Eastern Central Atlantic | Jig | Mauritania
Eastern Central Atlantic | Pots | Mauritania

Moderate Concern
Since 1988, the scientific activities of the IMROP, in charge of collecting fishery data and assessing the state of the stocks in the country, have been organized within five-year plans (largely inspired by the national fisheries strategy) and broken down into programs (IMROP 2019). Between 2008 and 2012 three 5-year programs were in place in the country: the 'aquatic ecosystems and uses' program, the 'fisheries and environment resources' program, and the 'fisheries operating systems and management' program (IMROP 2019); programs which included the objective of developing new complementary approaches to fisheries research in the country, improving the knowledge of the structure and functioning of ecosystems, to support an EBFM in the country (IMROP 2019). However, this information has not been recently updated by the IMROP and it is unclear if or how these programs have evolved over time.

The new national strategy for responsible management and the sustainable development of the fishing sector adopted by the Minister of Fisheries and Maritime Economy (law n° 017-2015 of 29/07/2015) for the period 2015-2019 include among its objectives the protection of the resources, ecosystems, and habitats through sustainable exploitation of the fisheries resources.

Several studies related to the EBFM have also been undertaken in the country. For example, in 2017, (Gascuel et al. 2007) investigated changes in the demersal community structure in Mauritania using Biomass Trophic Spectra representations. The study shows that the demersal biomass has been reduced by 75% on the Mauritanian continental shelf over the past 25 years, corresponding to a biomass loss of around 20,000 MT per year. Also in 2014, (Guenette et al., 2014) assessed the usefulness of MPAs to the trophic functioning of the ecosystem by modeling the effects of Mauritanian Banc d'Arguin.

The FAO/CECAF meeting on deep-sea fisheries and vulnerable habitats considered that Mauritania is likely a well-studied continental area. Several surveys have been undertaken by the Spanish IEO in the area and a biodiversity inventory is going to be published (Ramos et al., in press). Other studies on benthos developed within the framework of the EcoAfrik project (IEO – University of Vigo), detailed bathymetry information, and environmental and faunal information for three important slope habitats: the giant barrier of the deep coral mountains, which extend for more than 500 km to the south of the Timiris cape, the canyons of the northern area in front of the Banc d'Arguin and the underwater mountains of the Wolofs, which were discovered to the south of Nouakchott during the Mauritanian surveys. On these hard bottoms, important communities of benthos such as sponges, corals, gorgonians, hydrozoans, bryozoans, and some species of ophiurides have been discovered (FAO/CECAF 2016b).

The demersal Mauritanian fishery was also selected as a case study in the recent FarFish project which aimed to provide knowledge, tools, and methods to support responsible, sustainable and profitable EU fisheries outside European waters, compatible with Maximum Sustainable Yield. In the particular case of Mauritania, the project aimed to solve the overfishing by engaging stakeholders in the process of evaluating existing management tools and stock assessment methods and formulating new management tools and RFMS-based management plan recommendations (FarFIsh 2020).

Therefore, although the understanding of the ecosystem in the area is improving and marine habitats are being mapped through different research projects, it is unclear if the results of these studies and projects are being used by the government for management purposes. The FAO/CECAF Working Group, which assesses stocks and fisheries in Northwestern Africa, still assesses

and offers advice to governments in the area based on a single stock basis and no steps towards EBFM have been taken yet (FAO/CECAF 2018c).

The concept of the precautionary approach to fisheries management is included in the Mauritanian law. However, there is not any evidence that the current research and the management strategies in place are really improving ecosystem-based fisheries management (EBFM). The impact of the fisheries on the ecosystem is possible but some spatial management measures are in place to protect the ecosystem. However, a scientific assessment and stronger management of ecosystem impacts are necessary. Therefore, EBFM scores "**moderate concern."**

Eastern Central Atlantic | Bottom trawls | Morocco
Eastern Central Atlantic | Jig | Morocco
Eastern Central Atlantic | Pots | Morocco

Moderate Concern
The Moroccan fishing industry went through a development phase in the 1970s and the 1980s in which enhancing national harvesting capacity and boosting production and incomes were the major objectives. Morocco became more concerned with the sustainability of its fishing sector when valuable fisheries, such as the cephalopods fishery, began to experience resource depletion in the 1990s (Faraj 2009). Illegal fishing practices (Boudinar 2007), foreign fishing pressure, lack of control and surveillance (Kaczynski, V.M. 1989), fish habitat loss (Menioui, M. 2007), and high discard rates have led to the overexploitation of demersal resources (Belhabib et al. 2013). Heavy trawling activity led to shifting stocks (Balguerias et al. 2000) and declining stock abundance (Faraj, A & Bez, N. 2007).

With this growing concern about the long-term economic viability of fishing activities, a range of legislative and regulating measures were implemented: ban on catch and trade of threatened species, control and limitation of access to fisheries to face the problem of overcapacity, ban on destructive fishing gear, TACs, etc. An exploitation area (UA) area for the octopus fishery has been also created in the country. But these measures, based on a "Target Resources-Oriented Management" (TROM) approach, were essentially implemented to cope with the fishing overcapacity, spatial fleets interaction, and growth overexploitation issues, even though elements of multispecies interactions and environmental forcing were somewhat taken into account in the management (Faraj 2009).

In 2009, the Halieutis Plan was launched by the Moroccan government. The main objective is to preserve fish stocks and marine ecosystems to achieve healthy marine waters by 2020 and to strengthen Morocco's position as the worldwide supplier of quality marine products. The plan is based on three main axes: ecological, social, and economic sustainability. The plan consists of 16 strategic projects that cover several issues (e.g., scientific improvement and knowledge transfer, set up of TACs to manage fisheries, aquaculture development, and improvement of fisheries infrastructures). To achieve the plan's goals, five tools were created: the national committee for fisheries (governance); a fund for the adjustment of the fishing effort (financing); the National Aquaculture Development Agency (promotion and development) and the observatory on employment for the fishing sector (proactive management).

Several marine areas in Morocco and Western Sahara were studied by the Spanish IEO during the European project LIFE-INDEMARES20 and other bilateral surveys for deep-sea exploration and the study of ecosystems. Vulnerable areas, including coral reefs, gorgonian forests, and large sponge fields were identified and mapped (FAO/CECAF 2016b). However, not all of the vulnerable habitats are currently protected. Moreover, the FAO/CECAF Working Group which assess stocks and fisheries in Northwestern Africa still assess and offers advice to governments in the area based on a single stock basis and no steps towards EBFM have been taken neither by the group nor by the national INRH (FAO/CECAF 2018c).

Some spatial management or other policies to protect ecosystem functioning and account for capture species' ecological role are in place, but a scientific assessment and management of ecosystem impacts are not yet underway. EBFM therefore scores "**moderate concern."**

Eastern Central Atlantic | Bottom trawls | Senegal
Eastern Central Atlantic | Jig | Senegal
Eastern Central Atlantic | Pots | Senegal

Moderate Concern
Fishing constitutes an essential segment of the economic and social development of Senegal. The fisheries administration is responsible for implementing the sectoral policy of the Ministry of Fisheries and Maritime Economy (MPEM) based on the law establishing the Fisheries Maritime Code and on the Letter of Sectoral Policy for the Development of Fisheries and Aquaculture (LPSDPA). Article 4 of the law indicates that: "the management of fishery resources is a prerogative of the State which defines, for this purpose, a policy aimed at protecting, conserving and planning their sustainable use in order to preserve the marine ecosystem. The State implements a precautionary approach in the management of resources fisheries." Therefore, fisheries' sustainability and the precautionary approach are enshrined in the fisheries regulation.

Single management measures to protect the octopus resource and the ecosystem, have been implemented in the country. For example, Under the Sustainable Fisheries Partnership Agreement (SFPA) between the European Union (EU) and the Republic of Senegal, 15,000 octopus clay pots were submerged this year in Senegalese local waters to form artificial reefs and habitat for octopus to reproduce (European Commission 2020b). Spatial limitations and by-catch limits are also set for industrial fisheries. However, the marine protected areas only represent 0.69% of the total marine area in the country (MPATLAS 2020).

The recent DemerstEm project, under the Program for Improved Regional Fisheries Governance in Western Africa (PESCAO) funded by the EU for the period 2018-2023, also aims at improving knowledge of the state of shared stocks in Western Africa, focused on demersal fish stocks. This project proposes to broaden the purely mono-specific management vision through 3 working areas: define essential habitats to propose spatial solutions for fisheries management; monitor artisanal and industrial coastal fishing fleets to identify innovative solutions for fisheries management, and to develop the ecosystem approach to fisheries to go beyond the mono-specific approach and taking into account interactions within the ecosystem (PESCAO 2020).

Therefore, although it is unclear if the results of these studies and projects are being used by the government for management purposes, some research is currently being undertaken in order to better understand the marine ecosystem in Senegal.

The FAO/CECAF Working Group, which assesses stocks and fisheries in Northwestern Africa, still assesses and offers advice to governments in the area based on a single stock basis and no steps towards EBFM have been taken yet (FAO/CECAF 2018c).

The concept of the precautionary approach to fisheries management is included in the Senegalese law. However, there is no evidence that the current research and the management strategies in place are really improving ecosystem-based fisheries management (EBFM). The impact of the fisheries on the ecosystem is possible but some spatial management measures are in place to protect the ecosystem. However, a scientific assessment and stronger management of ecosystem impacts are necessary. Therefore, EBFM scores "**moderate concern."**

Northeast Atlantic | Bottom trawls | Portugal
Northeast Atlantic | Bottom trawls | Spain

Moderate Concern
The EU has embraced the concept (if not the mechanisms to achieve) integrated ecosystem assessment (IEA) for fisheries, coupled with an integrated ecosystem-based approach to management, to be delivered through maritime spatial planning (ICES 2019). The CFP is increasingly resorting to multi-annual plans which often combine different management tools (fishing effort restrictions, TACs, and other specific rules) to assess several stocks. These multi-annual plans are then a mechanism aimed to implement the ecosystem-based approach to fisheries management (European Commission 2020f). Since several years ago, ICES also provides advice in European waters by ecoregion (the Bay of Biscay and Iberian Coast, North Sea, Celtic Sea, etc.), taking into consideration mixed-fisheries and their interactions with the ecosystem (ICEA advice 2020).

The Marine Strategy Framework Directive (MSFD), by setting the goal of Good Environmental Status (GES) in European seas, requires an overall assessment of ocean health, which is being delivered through a series of indicators. The Directive requires them to assess the quality status of the marine environment, determine good environmental status, set appropriate environmental targets and draw up adequate monitoring programs and implement measures to achieve the Directive's key goal of securing the 'good environmental status' of all EU marine waters by 2020. Over the past 6 years, the EU Member States have been developing marine strategies to comply with the MSFD. In their programs of measures, the Member States have at least partially addressed a number of pressures: the introduction of non-indigenous species, commercial fisheries, nutrient input, pressures on seabed habitats, hydrographical changes, contaminants, and marine litter (ICES 2019)

However, progress towards IEA in European waters has been limited due to logistic and budgetary challenges and the widespread perception that this objective of securing the 'good environmental status' of all EU marine waters by 2020 is unachievable (ICES 2019). Mixed-fisheries advice given by ICES is based on the single-stock assessments combined with knowledge of the species composition in the catches (ICES 2020b), falling short of being a real EBM. In particular, in order to implement an Integrated Ecosystem Assessment and Ecosystem-Based Management for cephalopod stocks, better data collection would be necessary, including adequate data on species identification, stock definition, fisheries data on effort and catches and biological data to underpin adequate stock assessments, as these resources are especially challenging to assess due to their special biological characteristics (Pierce et al., 2019).

This is a gear with a high impact on the ecosystem and habitat. It is considered that although some policies have been implemented in European waters (Spain and Portugal) to protect ecosystem functioning, trophic cascades or other detrimental food web impacts resulting from the trawl fishery are possible. Better data is necessary to understand the ecological role of the species and the impact of the fisheries on the ecosystem and stronger policies are needed to fully protect the ecological role of the target species. Therefore, this section is ranked as '**moderate concern**'.

Northeast Atlantic | Pots | Portugal
Northeast Atlantic | Traps (unspecified) | Portugal
Northeast Atlantic | Pots | Spain
Northeast Atlantic | Traps (unspecified) | Spain

Moderate Concern
The theory behind ecosystem-based management (EBM) and ecosystem-based fisheries management (EBFM) is now well developed in European waters. However, the implementation of EBFM exemplified by fisheries management is still largely based on single-species assessments or mixed fisheries interactions but still ignores the wider ecosystem context and impact. The reason for the lack or slow implementation of EBM and specifically EBFM is a lack of a coherent strategy (Molmann et al., 2013)(ICES 2019). The role of cephalopods in the ecosystem as prey and predator is largely unknown, despite being part of the diet of various predator species (e.g., cetaceans, seabirds, and large epipelagic fish) and their importance tends to be underestimated if the emphasis is given to biomass rather than energy flows, due to their high P/B (Production per biomass) ratio.

The high sensitivity of cephalopods to environmental changes means they can be useful indicators, and some countries have shown interest in including cephalopods as trophic descriptors (4th descriptor of the Good Environmental Status (GES) criteria) under the EU Marine Strategy Framework Directive (MSFD), although more research is necessary to understand and assess the changes of cephalopod abundance due to environmental changes (ICES 2013)(ICES 20018c)(Pierce et al., 2019). Therefore, as better research and a coherent strategy are necessary to implement an EBFM in the area, this issue is ranked as 'moderate concern'.

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Appendix B: Review Schedule

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