Sardine, anchovy, sardinella, mackerel

Scomber colias, Engraulis encrasicolus, Trachurus trachurus, Sardina pilchardus, Ethmalosa fimbriata, Trachurus trecae, Sardinella spp.

Morocco: Eastern Central Atlantic

Purse seines

Report ID 27810

January 9, 2023

Seafood Watch Standard used in this assessment: Fisheries Standard v4

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental 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. 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.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

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, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides 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 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 small pelagic fisheries occurring in Morocco (FAO area 34). It covers the Moroccan purse seiners operating in coastal areas off Nortwest Africa targeting the following species: European pilchard (*Sardina pilchardus*), European anchovy (*Engraulis encrasicolus*), and Atlantic chub mackerel (*Scomber colias*).

In Northwest Africa, pelagic stocks are assessed internationally by the Fishery Committee for the Eastern Central Atlantic (FAO/CECAF) Working Group on the assessment of small pelagic fish off Northwest Africa (sub-group North); and by the National Institute for Fisheries Research (INRH) in Morocco. These fisheries are regulated by the Moroccan Fisheries Department (MPM) in Moroccan and Western Sahara waters.

Criterion 1: Impacts on the Species Under Assessment

The most recent stock assessment for European pilchard in the area indicates that biomass is above the target reference points. However, it is considered a key forage species, and neither the target reference points used by the FAO/CECAF Working Group nor the harvest strategy seem to consider the fluctuating nature of the species.

In the case of European anchovy, the available fishery data is not considered good enough to evaluate the status of the stock. This short-lived species is highly variable, and the current biomass of the stock is unknown, although fishing mortality on the stock is below the target reference point.

In the case of Atlantic chub mackerel, the biomass of the stock is above the target reference point but fishing mortality is considered to be too high.

Criterion 2: Impacts on Other Species

Observer or other data regarding the catch composition of the fisheries is limited, but the available info on these and similar fisheries suggests minimal impacts on bycatch species. No bait is used in purse seine fisheries.

Criterion 3: Management Effectiveness

3.1 - Management Strategy And Implementation

A number of technical measures have been implemented in Morocco for the management of the small pelagics fishery, including effort limits and total allowable catches (TACs). But, TACs are combined for all small pelagics rather than being species-specific, and exactly how they are set or how responsive they are to changes in stock productivity is unclear. There are also no regional agreements to limit total catches between the states, nor on the partitioning of TACs advised by the FAO Working Group for the subregion into national quotas. Reference points have been determined for sardine and chub mackerel, but not for anchovy (see Criterion 1). Both sardine stocks and chub mackerel are above their respective target reference points, and fishing mortality on the sardine stocks is below the reference point. But, fishing

mortality of chub mackerel appears too high, and without regional agreements, it is unclear how the countries can work together to reduce fishing mortality.

In summary, there are measures in place to manage the fisheries, and the main target stocks of European pilchard are not overfished or experiencing overfishing, but the lack of regional management, stock-specific harvest control rules, and effective implementation is a weakness. Thus, management of the Moroccan fisheries is considered moderately effective.

3.2 - Bycatch Strategy

Catch composition in the fisheries is not well documented, but data and analyses from nascent observer programs do suggest that there are no major bycatch issues (see Criterion 2). Nonetheless, Morocco does have specific measures in place to reduce bycatch species. The lack of major concern based on the information available for the Moroccan fishery allows for a score of moderately effective.

3.3 - Scientific Data Collection and Analysis

Although the assessment routine conducted by the FAO/CECAF Working Group on Small Pelagic Fish is considered relatively robust, a number of improvements have been recommended by the group, particularly around better regional coordination. Stock assessments are made available, but the lag between the FAO/CECAF Working Group meetings and the publication of the report is considerable (though a summary is made available on a shorter timeframe), which makes it challenging to understand recent data collection and analysis (and results). Interactions with ETP species are collected by INRH observers, but the level of coverage is unknown and no data are made publicly available. This factor receives a moderately effective score.

3.4 - Enforcement of and Compliance with Management Regulations

In Morocco, enforcement and surveillance have been improved significantly in recent years. A Monitoring, Control and Surveillance (MCS) system is in place that offers some data to assess its effectiveness, and it has been legally reinforced by the implementation of Law 15-12 against illegal, unreported, and unregulated fishing (IUU). A recent independent report on MCS for the country has presented quite satisfactory results in the 12 different criteria evaluated. A score of highly effective is awarded.

3.5 - Stakeholder Inclusion

Stakeholder inclusion and the decision-making process have become more robust in Morocco in recent years, but no official evidence/public record (e.g., meeting reports, memorandums) on the operation of the different management commissions (e.g., FNPA) in Morocco has been found. Thus, despite the existence of legal frameworks and committees to ensure the participation of critical stakeholders in the management decisions, the lack of evidence of its functioning led to score this factor as moderately effective.

Criterion 4: Impacts on the Habitat and Ecosystem

There are no particular concerns with the impact of these fisheries on seafloor habitats, but similar fisheries are known to occasionally contact the seafloor. The INRH, which is in charge of collecting fishery data and assessing the state of the stocks in these countries, has committed to introducing new complementary approaches to fisheries, including improving the knowledge of the structure and functioning of ecosystems, to support an EBFM approach in these countries. But, there is no indication that the protection of ecosystem functioning and accounting for each species' ecological role have yet to be considered when setting the catch limits and other measures.

Sardine is considered a key forage species in this fishery. In these cases, additional precaution in setting catch limits is necessary to protect the role of the species in the ecosytem. The Lenfest Forage Fish Task Force (LFFTF) recommendations for forage fisheries followed by the SFW standard indicates that, in fisheries with an intermediate level of information (fisheries in which population abundance, status, and trends are monitored; environmental drivers of forage fish productivity are identified; and there is some monitoring and enforcement in the fishery), such as the Moroccan fishery, the application of a "hockey stick" harvest control rule with minimum biomass (B_{LIM}) ≥ 40% B_0 and fishing (F) not to exceed 50% of the natural mortality rate or 50% of the level that achieves MSY (F_{MSY}) is recommended. Because the fishery does not have reference points and/or a harvest strategy that is in line with the LFFTF recommendations, this factor is scored a high concern.

Overall

The overall ratings are yellow for all fisheries.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Atlantic chub mackerel | West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.236	2.236	3.000	2.828	**Good Alternative (2.552)**	13,740 (MT) 2018
Atlantic chub mackerel | West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C	2.236	2.236	3.000	2.828	**Good Alternative (2.552)**	74,763 (MT) 2018
Atlantic chub mackerel | West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.236	2.236	3.000	2.828	**Good Alternative (2.552)**	68,953 (MT) 2018
European anchovy | Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	3.413	2.236	3.000	2.828	**Good Alternative (2.837)**	19,962 (MT) 2018
European anchovy | Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	3.413	2.236	3.000	2.828	**Good Alternative (2.837)**	2,506 (MT) 2018
European pilchard | West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.644	2.236	3.000	2.828	**Good Alternative (2.661)**	434,499 (MT) 2018
European pilchard | Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.644	2.236	3.000	2.828	**Good Alternative (2.661)**	20,096 (MT) 2018
European pilchard | West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco	2.644	2.236	3.000	2.828	**Good Alternative (2.661)**	0 (MT) 2018

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

This assessment provides ratings for European pilchard (*Sardina pilchardus*), European anchovy (*Engraulis encrasicolus*), and Atlantic chub mackerel (*Scomber colias*) caught by Moroccan coastal purse seiners operating in the eastern central Atlantic Ocean (FAO area 34).

Species Overview

European pilchard/Sardine commune (*Sardina pilchardus*) is a small pelagic species (up to 25 cm) found at depths between 25 and 100 m (FAO 2021a). It is a schooling migratory species that is distributed in coastal areas in the eastern North Atlantic Ocean and the North Sea to Senegal (the southern limit is found near 15° N.). This species is also found in the Mediterranean, the Sea of Marmara, and the Black Sea. The species supports important fisheries in FAO areas 27, 34, and 37 (FAO 2021a). In the area covered by this assessment, it is the main target species, representing nearly half of the pelagic catch (FAO/CECAF 2020).

European anchovy/Anchois (*Engraulis encrasicolus*) is a pelagic species that forms large schools. It is mainly marine and coastal but also euryhaline, tolerating salinities of 5 to 41‰ (parts per thousand), and in some areas it enters lagoons, estuaries, or lakes, especially in the warmer months during the spawning season (FAO 2021d). It has been recorded to 400 m depth off West Africa (FAO 2021d). European anchovy is found in the eastern Atlantic Ocean, from Norway to South Africa. It also occurs around several Atlantic Islands, including the Canary Islands, the Azores, Madeira, and St. Helena. In the western Indian Ocean, it is present in Mauritius, the Seychelles, and upwelling areas around Somalia {Toues et al., 2015b}.

Atlantic chub mackerel/Maquereau Espagnol Atlantique (*Scomber colias*) is a coastal pelagic species, and to a lesser extent epipelagic to mesopelagic over the continental slope (Collette et al., 2011). The species schools by size and may form schools with *Sarda* species, other bonitos, jacks, and clupeids (Collette et al., 2011). It is found in the eastern Atlantic Ocean from northern France through the Mediterranean Sea and to Angola to the south. This species is widespread and abundant, and it is targeted by many fisheries, mainly in the eastern Atlantic Ocean portion of its range (Collette et al., 2011).

Production Statistics

Landings of pelagic species in 2019 by Morocco in FAO area 34 are shown in Table 1 (FAO/CECAF 2020). Pelagic fisheries in the subregion (including Morocco, Mauritania, Senegal, The Gambia, and the Canary Islands) landed an average of 2,466,000 mt of pelagic species per year in that year. Morocco and Mauritania together represented 84.8% of the total catch in the region, with an average of 2,090,000 mt per year. In 2019, European pilchard dominated the coastal purse seine catch in Morocco (INRH 2020).

Table 1. Landings of pelagic species by Morocco in FAO area 34 in 2019. Data from (FAO/CECAF 2020). Species in blue are rated in this assessment.

Species	2019 Landings (mt)	2019 Landings (%)
European pilchard	643,250	82.1
Atlantic chub mackerel	109,362	14.0
European anchovy	19,590	2.5
Atlantic horse mackerel	6,694	0.9
Sardinella spp.	4,325	0.6
Total	**783,221**	**100**

The ratings in this present Seafood Watch assessment follow the zoning in place in Moroccan Atlantic waters.

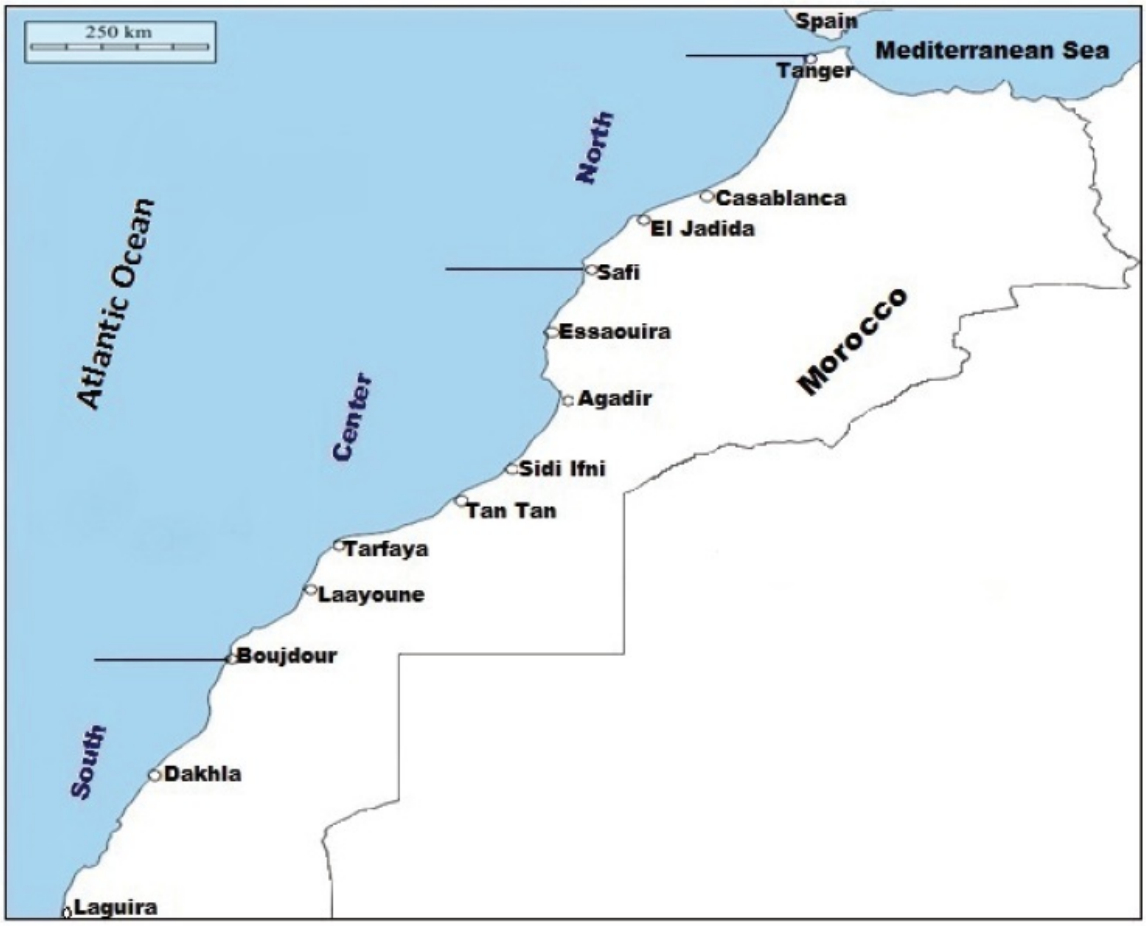

Figure 1: Map illustrating the Moroccan Atlantic coast with three fishing areas: the North area (between Tanger and Safi), the Center area (between Safi and Boujdour), and the South area (between Boujdour and Laguira). From (Essekhyr et al 2019).

Importance to the US/North American market.

Pelagic species imported into the United States from Morocco for the period 2016–20 are shown in Figure

2 (NOAA 2021). In the case of edible pelagic fish, the species imported included sardinella, sardine/European pilchard, European anchovy, and Atlantic chub mackerel. No other species are reported. The main imports corresponded to sardine/European pilchard, which increased during the period from a minimum of 5,422 mt in 2016 to a maximum of 10,642 mt in 2020. Imports of sardinella followed in importance, although they decreased during the same period. Imports from other species were low. In 2020, total exports of pelagic species from the area assessed to the United States were estimated at 14,051 mt, corresponding to a value of USD 75.5 million (NOAA 2021).

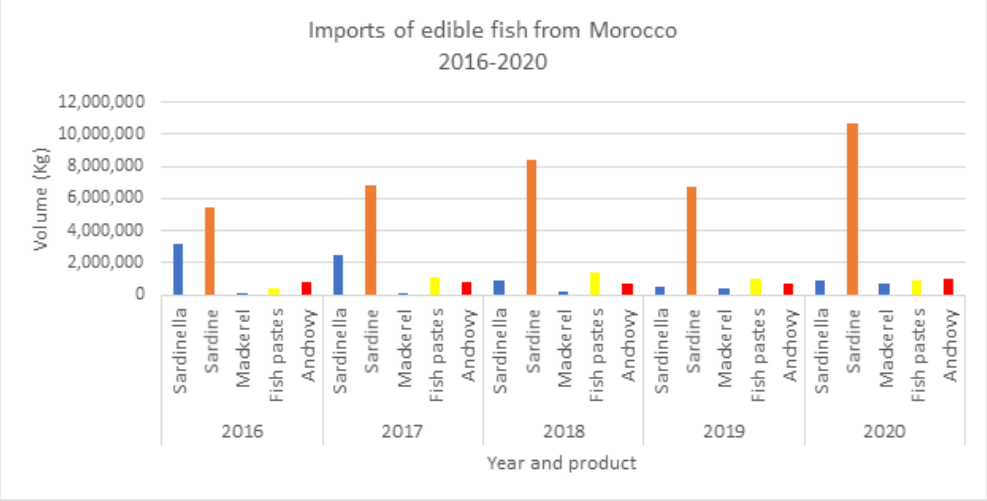

Figure 2: United States imports from Morocco of edible fish products, Data from (NOAA 2021).

In the case of non-edible fish, the imports of fish oil into the United States from Morocco were variable between 2016 and 2020, reaching a maximum of 353 mt in 2018. But, the import of fish meal increased during the same period, peaking at 1,141 mt in 2020 (Figure 3) (NOAA 2021).

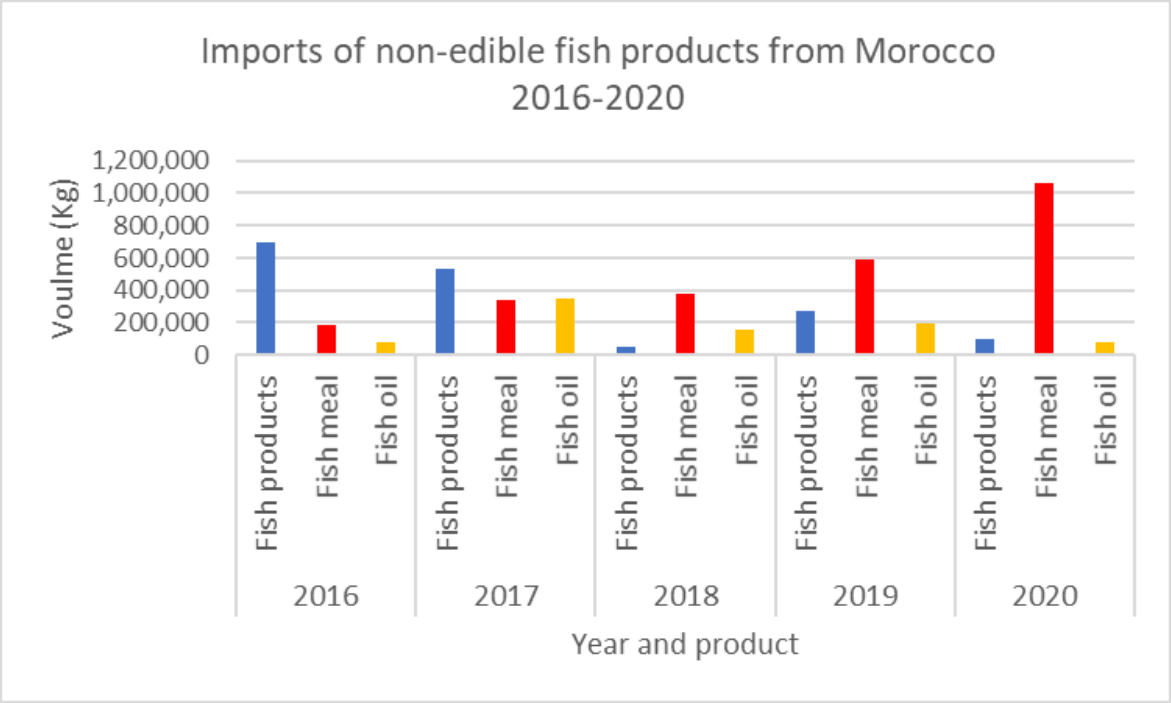

Figure 3: United States imports from Morocco of non-edible fish products. Data from (NOAA 2021).

Common and market names.

Commercial names for these species (when directed for human consumption) in U.S. markets or specialty grocery stores include sardine, anchovy, and mackerel.

Primary product forms

Pelagic species are destined either for reduction into fishmeal and fish oil (indirect human consumption, IHC) or for food products (direct human consumption, DHC). The main markets for fishmeal are the manufacturers of feeds for aquaculture, pigs, and poultry.

The main products identified for human consumption in U.S. markets are canned or pot anchovy fillets in olive oil and anchovy paste; and canned sardines or chub mackerel in water/brine, olive oil, and different sauces (tomato, mustard, etc.). Other species have not been found. In many cases, the origin of the product is difficult to find in the product description, so it is unclear if these products come from the area of this assessment (Morocco) or from other sourcing countries.

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

ATLANTIC CHUB MACKEREL			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)

EUROPEAN ANCHOVY			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

EUROPEAN PILCHARD			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

For a fishery on a native stock to receive a high score for Criterion 1 (i.e., 3.67 Low Concern or 5.00 Very Low Concern in Factor 1.1 Abundance, and 5.00 Low Concern in Factor 1.2 Fishing Mortality), the stock must be performing well relative to reference points appropriate for the species, based on a recent assessment.

Age of assessment

The Fishery Committee for the Eastern Central Atlantic (FAO/CECAF) Working Group on the Assessment of Small Pelagic Fish is responsible for assessing pelagic fisheries off Northwest Africa. The group met most recently in September 2022, in Dakar. In 2020, they did not meet; in 2021, they met remotely. The full 2021 report is not yet publicly available, but a summary is (FAO/CECAF 2021). Data in the most recent full assessment report are through 2018, and those for the most recent summary report are through 2019.

Appropriateness of reference points

The FAO Working Group defines limit reference points (LRP) and target reference points (TRP) in terms of stock biomass or fishing mortality. Per the Working Group's latest summary report, the "more conservative $F_{0.1}$ and $B_{0.1}$ have been selected as target reference points rather than the more traditional F_{MSY} and B_{MSY}, due to the inconsistencies of some data sets, and in line with the precautionary approach" (FAO/CECAF 2021).

- Target reference points: $B_{CUR}/B_{0.1}$ and $F_{CUR}/F_{0.1}$
- Limit reference points: B_{CUR}/B_{MSY} and F_{CUR}/F_{MSY}

where

- $F_{0.1}$ is the fishing mortality rate at which the slope of the yield-per-recruit curve is only 1/10th the slope of the curve at its origin, or 90 percent of F_{MSY};
- F_{MSY} is the value of F (and of other characteristics of the stock) where the long-term total yield is maximum;
- $B_{0.1}$ is the value of biomass corresponding to $F_{0.1}$; and
- B_{MSY} is the value of biomass corresponding to F_{MSY}.

The Working Group also adopted three assessment categories (FAO/CECAF 2021):

- Not fully exploited: The stock is in good condition and fishing pressure can be increased without affecting the 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 in terms of biomass or/and fishing mortality. Fishing pressure should be reduced to allow the stock to grow.

These reference points would meet the requirements for appropriateness for all species in this assessment except sardine, because that species has been determined to be a key forage species (see below). The assessment categories are not used in scoring in this assessment if more quantitative outputs are available.

Table 2. Stock assessment results from the latest full reports from the Fishery Committee for the Eastern Central Atlantic Working Group on the Assessment of Small Pelagic Fish (FAO/CECAF 2020).

Species—Stock	2020 Catch in kmt (2016–20 avg.)	Assessment year/most recent data	Limit B_{CUR}/B_{MSY} (%)	Target $B_{CUR}/B_{0.1}$ (%)	Limit F_{CUR}/F_{MSY} (%)	Target $F_{CUR}/F_{0.1}$ (%)	ICES status
Atlantic chub mackerel (*Scomber colias*)—Mackerel stocks combined	381 (439)	2019/2018 2020/2019*	118** —	107** 109	114** —	126** 102	Fully exploited
European anchovy (*Engraulis encrasicolus*)—Assessed as a single stock (Zone North + Zone A+B)	50 (29)	2019/2018 2020/2019*	Not determined		Not determined	69 76	Fully exploited
European pilchard (*Sardina pilchardus*)—Central (Zone A+B) stock	389 (439)	2019/2018 2020/2019*	159 —	145 141	45 —	50 54	Not fully exploited
European pilchard (*Sardina pilchardus*)—South (Zone C) stock	824 (795)	2019/2018 2020/2019*	151 —	137 130	57 —	64 70	Not fully exploited
Sardinella (*Sardinella aurita*)—Single stock	197 (350)	2019/2018 2020/2019*	Not determined		Not determined	— 147	Overexploited
Sardinella (*Sardinella maderensis*)—Single stock	336 (219)	2019/2018 2020/2019*	Not determined		Not determined		Overexploited

* Results from the summary document of the group's latest meeting in 2021 (relative to $B_{0.1}$ and $F_{0.1}$

only); not yet validated by the Scientific Sub-Committee (FAO/CECAF 2021).

** Results from the "global model fit" shown for Atlantic horse mackerel (see species account for more information).

Determination of key forage species

The reference points in Table 2 (static reference points with stationary parameters such as unfished biomass and static B_0) are not considered to be appropriate for key forage species, because those species' dynamic productivity shifts in response to environmental conditions. Such species are defined by 1) exhibiting high connectance to other organisms in the ecosystem; and 2) channeling a large amount of energy from lower trophic levels to higher trophic levels. Although all the species targeted by these fisheries could be considered forage species, the limited ecosystem studies conducted suggest that sardines and other clupeids play an outsize role {Morissette et al. 2010}{Essekhyr et al. 2019}. As part of the Fishery Improvement Project for the Moroccan fishery, (Guénette, S. 2018) found sardines to show high connectance (and to be "key low trophic level" species under the Marine Stewardship Standard). Thus, sardines are considered key forage species in this Seafood Watch assessment. In these cases, Seafood Watch considers forage stock biomass and fishing mortality to be highly uncertain, which moderates very low concern and low concern scores for Factor 1.1 Abundance and Factor 1.2 Fishing Mortality. Regardless of whether a species is considered a forage species, if fishing mortality exceeds F_{MSY}, it is assigned a score of high concern (see the Scoring Guidelines below).

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.*

Atlantic chub mackerel

Factor 1.1 - Abundance

West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Very Low Concern

The most recent published stock assessment for the Central (Zone A+B) and Zone C stocks of Atlantic chub mackerel used data through 2018 (FAO/CECAF 2020). Biomass at the time was above the limit and target reference points (in both of the models run). The summary of the latest stock assessment (with data through 2019) also concludes that biomass is above the target reference point (FAO/CECAF 2021). Because a recent stock assessment (i.e., with data <5 years old) found biomass to be above the target reference point, a score of very low concern is given.

Justification:

Two possible stocks of chub mackerel are present in the area: stock north, between Cape Bojador and northern Morocco, and the southern stock between Cape Bojador and southern Senegal. But, because of the lack of new information on migration and possible trade between the two mackerel stocks, the Working Group carries out a joint assessment of the two stocks in its regional distribution area {FAO/CECAF 2019}. Recently, the Nansen project has been launched in order to undertake identity studies of stocks of several small pelagic species present at the regional level, which include the chub mackerel, although results are not yet available (FAO/CECAF 2020).

Factor 1.2 - Fishing Mortality

West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone

High Concern

Fishing mortality in both the Central (Zone A+B) and South (Zone C) stocks was found to be over the target and limit reference points in the latest published assessment (FAO/CECAF 2020), and remains over the target reference point in the summary of the latest assessment (FAO/CECAF 2021). Therefore, fishing mortality for the stock is scored a high concern.

Justification:

In the Moroccan Zone north (Tangier-Cap Cantin) and center (Cape Cantin-Cape Bojador A+B), chub mackerel is exploited according to its availability by the Moroccan coastal purse seiners, which target mainly sardine (FAO/CECAF 2020).

In the south zone (Cap Bojador-Cap Blanc), chub mackerel is fished by Moroccan coastal purse seiners as well as by Moroccan trawlers. In 2018, Russian and European pelagic trawlers continued to fish in Zone C north of Cape Blanc under the Morocco-Russia and Morocco-EU bilateral fisheries agreements (FAO/CECAF 2020).

In the Mauritanian zone, south of Cap Blanc, Russian-style pelagic trawlers from several countries (Russia, Ukraine, Poland, and Lithuania, among others) or European (Dutch type), working under a fisheries agreement, chartered or free licenses, exploit mackerel seasonally and/or incidentally. In 2017, 48 trawlers visited the area.

Concerning the artisanal and coastal pelagic (PAC) fishery, it is currently subdivided into three sub-segments according to the size of the boat (purse seiners <26 m, between 26 and 40 m, and between 40 and 60 m). The coastal purse seiner fleet that started its activities in 2015 has increased every year and it now has at least 78 fishing units (FAO/CECAF 2020).

For the subregion, the trend in total mackerel catches since the 1990s has an increasing trend, from 210,000 mt caught in 1997 to a maximum of 418,500 mt caught in 2018. This is mainly related to the increase in mackerel catches of 94% in the northern part (Tangier-Cap Bojador) and their stability in the southern part (Cape Bojador-Gambia) (FAO/CECAF 2020).

In terms of fleets, about 19% of the 2018 catch was made by Moroccan purse seiners operating north of Cape Bojador, 34% was by national and foreign fleets fishing in Zone C north of Cape Blanc, and 46% was by coastal and industrial fleets operational in Mauritania (FAO/CECAF 2020).

According to the most recent stock assessment, the actual fishing mortality is above 26% of the target level ($F_{0.1}$) (see Table 2 in the Criterion 2 Summary). This is partly due to the increasing trend of catches in recent years. But, catches per unit effort (CPUE) have improved over the past 3 years, although changes in fishing strategies have occurred (FAO/CECAF 2020).

European anchovy

Factor 1.1 - Abundance

Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North

Moderate Concern

The most recent published stock assessment of the European anchovy stock (Zones North and Central [Zone A+B]) used data through 2018 (FAO/CECAF 2020). At that time, and in the following stock assessment (FAO/CECAF 2021), the available fishery data were considered not good enough to evaluate the status of the anchovy stock. This short-lived species is highly variable, and it is considered that previous assessments do not reflect the current state of the stock. Therefore, the current biomass of the stock is unknown. But, the International Union for the Conservation of Nature (IUCN) rated the species as "Least Concern" (Tous et al., 2015a), which allows for a score here of moderate concern.

Factor 1.2 - Fishing Mortality

Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North

Low Concern
Fishing mortality in the European anchovy stock was found to be below the target reference point (no limit reference point has been defined) in the latest published assessment (FAO/CECAF 2020), and it remains below the target reference point in the summary of the latest assessment (FAO/CECAF 2021). Therefore, a score of low concern is given.

Justification:
In the northwestern African region, anchovies are fished mainly in the North (Zone A+B) of Morocco and in Mauritania. In Morocco, they are targeted by a fleet of Moroccan purse seiners and a fleet of Spanish purse seiners under the Morocco-EU fisheries agreement since December 2014 (FAO/CECAF 2020). In Mauritania, this species is not targeted by the industrial pelagic fishery, although the exploitation of the species is encouraged by the government and an experimental fishery was carried out in 2018 (FAO/CECAF 2018).

European pilchard

Factor 1.1 - Abundance

Eastern Central Atlantic | Purse seines | Morocco | Zone North

Moderate Concern
No biomass reference points have been determined for the North zone stock of European pilchard (FAO/CECAF 2020). The species is considered a "Least Concern" by the IUCN (Tous et al 2015), which allows for a score for abundance in this report of moderate concern. European anchovy is considered a key forage species in the ecosystem, further supporting a score of moderate concern.

West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderate Concern
The most recent published stock assessment for the Zone A+B (Central) stock of European pilchard used data through 2018 (FAO/CECAF 2020). Biomass at the time was above the limit and target reference points. The summary of the latest stock assessment (with data through 2019) also concludes that biomass is above the target reference point (FAO/CECAF 2021). But, European pilchard is considered a key forage species in the western coast off Africa Bay of Biscay ecosystem, and neither the target reference points used by the FAO/CECAF Working Group nor the harvest strategy seem to consider the fluctuating nature of the species. Therefore, a moderate concern score is awarded for abundance.

Justification:
The European pilchard is widely distributed in the northeast and eastern central Atlantic Ocean, as well as the Mediterranean Sea and Black Sea (e.g., Spanakis et al. 1989; Tinti et al. 2002; Atarhouch et al. 2005; Chlaida et al. 2006). Three sardine stocks are distinguished by the FAO Working Group on Small Pelagic Fish in Northwest Africa: the northern stock (35°45'–32° N.), the central A+B stock (32°–26° N.), and the southern stock C (from 26° N. to the south of the species' distribution). The recent work of Shukhgalter 2013 supports the distinction of these stock units (FAO/CECAF 2020). The European pilchard southern stock unit covers the sardine population occurring in the south waters of Morocco from Cap Blanc to the southern limit of the species' extent (FAO/CECAF 2020).

West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco

Moderate Concern
The most recent published stock assessment for the Zone C stock of European pilchard used data through 2018 (FAO/CECAF 2020). Biomass at the time was above the limit and target reference points. The summary of the latest stock assessment (with data through 2019) also concludes that biomass is above the target reference point (FAO/CECAF 2021). But, European pilchard is considered a key forage species in the Bay of Biscay ecosystem, and neither the target reference points used by the FAO/CECAF Working Group nor the harvest strategy seem to consider the fluctuating nature of the species. Therefore, a moderate concern score is awarded for abundance.

Justification:
The European pilchard is widely distributed in the northeast and eastern central Atlantic Ocean, as well as the Mediterranean Sea and Black Sea (e.g., Spanakis et al. 1989; Tinti et al. 2002; Atarhouch et al. 2005; Chlaida et al. 2006). Three sardine stocks are distinguished by the FAO Working Group on Small Pelagic Fish in Northwest Africa: the northern stock (35°45'–32° N.), the central A+B stock (32°–26° N.), and the southern stock C (from 26° N. to the south of the species' distribution). The recent work of Shukhgalter 2013 supports the distinction of these stock units (FAO/CECAF 2020). The European pilchard southern stock unit covers the sardine population occurring in the south waters of Morocco from Cap Blanc to the southern limit of the species' extent (FAO/CECAF 2020).

Factor 1.2 - Fishing Mortality

Eastern Central Atlantic | Purse seines | Morocco | Zone North

Moderate Concern
The North zone stock of European pilchard has not been assessed, so it is considered unknown relative to sustainable levels. Thus, a moderate concern score is awarded.

West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderate Concern
Fishing mortality in the Zone A+B European pilchard stock was found to be below the limit and target reference points in the latest published assessment (FAO/CECAF 2020), andit remains

below the target reference point in the summary of the latest assessment (FAO/CECAF 2021). But, because the reference points do not seem to explicitly take into account the fluctuating nature of the species, a score of moderate concern is given.

West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco

Moderate Concern

Fishing mortality in the Zone C European pilchard stock was found to be below the limit and target reference points in the latest published assessment (FAO/CECAF 2020), and it remains below the target reference point in the summary of the latest assessment (FAO/CECAF 2021). But, because the reference points do not seem to explicitly take into account the fluctuating nature of the species, a score of moderate concern is given.

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.

ATLANTIC CHUB MACKEREL			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.236	1.000: < 100%	Yellow (2.236)
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C	2.236	1.000: < 100%	Yellow (2.236)
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.236	1.000: < 100%	Yellow (2.236)

EUROPEAN ANCHOVY			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.236	1.000: < 100%	Yellow (2.236)
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.236	1.000: < 100%	Yellow (2.236)

EUROPEAN PILCHARD			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	2.236	1.000: < 100%	Yellow (2.236)
Eastern Central Atlantic | Purse seines | Morocco | Zone North	2.236	1.000: < 100%	Yellow (2.236)
West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco	2.236	1.000: < 100%	Yellow (2.236)

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 | PURSE SEINES | MOROCCO | CENTRAL ZONE			
SUB SCORE: 2.236	DISCARD RATE: 1.000	**SCORE: 2.236**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Atlantic chub mackerel	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
European pilchard	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
European anchovy	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Seabirds	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

EASTERN CENTRAL ATLANTIC | PURSE SEINES | MOROCCO | ZONE C			
SUB SCORE: 2.236	DISCARD RATE: 1.000	**SCORE: 2.236**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Atlantic chub mackerel	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
European pilchard	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Seabirds	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

EASTERN CENTRAL ATLANTIC | PURSE SEINES | MOROCCO | ZONE NORTH			
SUB SCORE: 2.236	DISCARD RATE: 1.000		**SCORE: 2.236**
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Atlantic chub mackerel	5.000: Very Low Concern	1.000: High Concern	Yellow (2.236)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
European pilchard	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
European anchovy	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Seabirds	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

The Criterion 2 score for the stock for which you want a recommendation is the lowest score of *all the other* main species caught with it (including both target and nontarget retained and discarded species), multiplied by the discard + bait use rate. A species is a main species if it meets any of the following conditions ("catch" here includes landings plus discards):

- It is a common component of the catch (as guidance, >5% of the catch in most cases), or
- It is overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern, where catch occurs regularly and may significantly contribute to the conservation concern (i.e., more than a negligible and/or sporadic level of catch). As guidance, mortality of the species caused by this fishery is >5% of a sustainable level, or
- The fishery under assessment is one of the main sources of fishing mortality for the species, including bait species if known (as guidance, approximately 20% or more of total fishing mortality), and
- In fisheries that use bait, the bait species should be treated as a bycatch species if it meets the main species criteria outlined above. If the species used as bait are unknown but together account for greater than 5% of the catch and no other main species have been identified, then add "unknown finfish," with abundance and fishing mortality both scored as moderate concern.

The Moroccan coastal pelagic purse seine fishery lands a number of different species (European pilchard, Atlantic chub mackerel, European anchovy, Atlantic horse mackerel, and sardinellas; see Table 1 in the Introduction). Per the filters above, European pilchard and Atlantic chub mackerel account for >5% of the catch of the Moroccan landings. Of the remaining species that compose >1% of the catch, European anchovy is not currently a species of concern (see Criterion 1), nor is Atlantic horse mackerel (*Trachurus trachurus*) (B_{CUR}/B_{MSY} = 91%, F_{2019}/F_{MSY} = 61%), although fishing mortality was too high a few years ago (FAO/CECAF 2020)(FAO/CECAF 2021).

Finfish bycatch

No observer data for the coastal purse seine fleet were available for this Seafood Watch assessment, though there are limited observer programs in place (see Criterion 3.2). But, the Institute National de la Recherche Halieutique (INRH) provided some information from an unspecified source that indicates that bycatch species caught in the Moroccan coastal purse seine fleet vary with region (Figure 4) (INRH 2020). Species include Atlantic bonito/bonite à dos rayé (*Sarda sarda*) (IUCN "Least Concern"(Collette and Fernandes 2015)), bluefish/tassergal (*Pomatomus saltatrix*) (IUCN "Vulnerable" (Carpenter et al., 2015)), and striped mullet/flathead grey mullet/mulet à grosse tête (*Mugil cephalus*) (IUCN "Least Concern" (Lalèyè, P. 2010)(Lalèyè, P. 2010){Camara et al. 2019}. Other species include bogue (*Boops boops*) (IUCN "Least Concern" (Pollard et al 2014)), black seabream/dorade grise (*Spondyliosoma cantharus*) (IUCN "Least Concern" (Russell et al 2014)), salema/karanteen/saupe (*Sarpa salpa*) (IUCN "Least Concern" {Russell et al. 2014b}), and leaping African mullet/mulet sauteur d'Afrique (*Mugil capurrii*) (IUCN "Leasty Concern" {Camara et al. 2015}(INRH 2020)). Analyses of observer data for the trawl fleets conducted for the fishery improvement project (FIP) have led to the conclusion (in that project) that there are no major bycatch concerns in the fishery (Gascoigne, J. 2017). A 3% bycatch limit has been set in Morocco for the small pelagic fishery (except for bogue, which is set at 10%), which suggests that these species may be caught in relatively low numbers {MAPM 2015}.

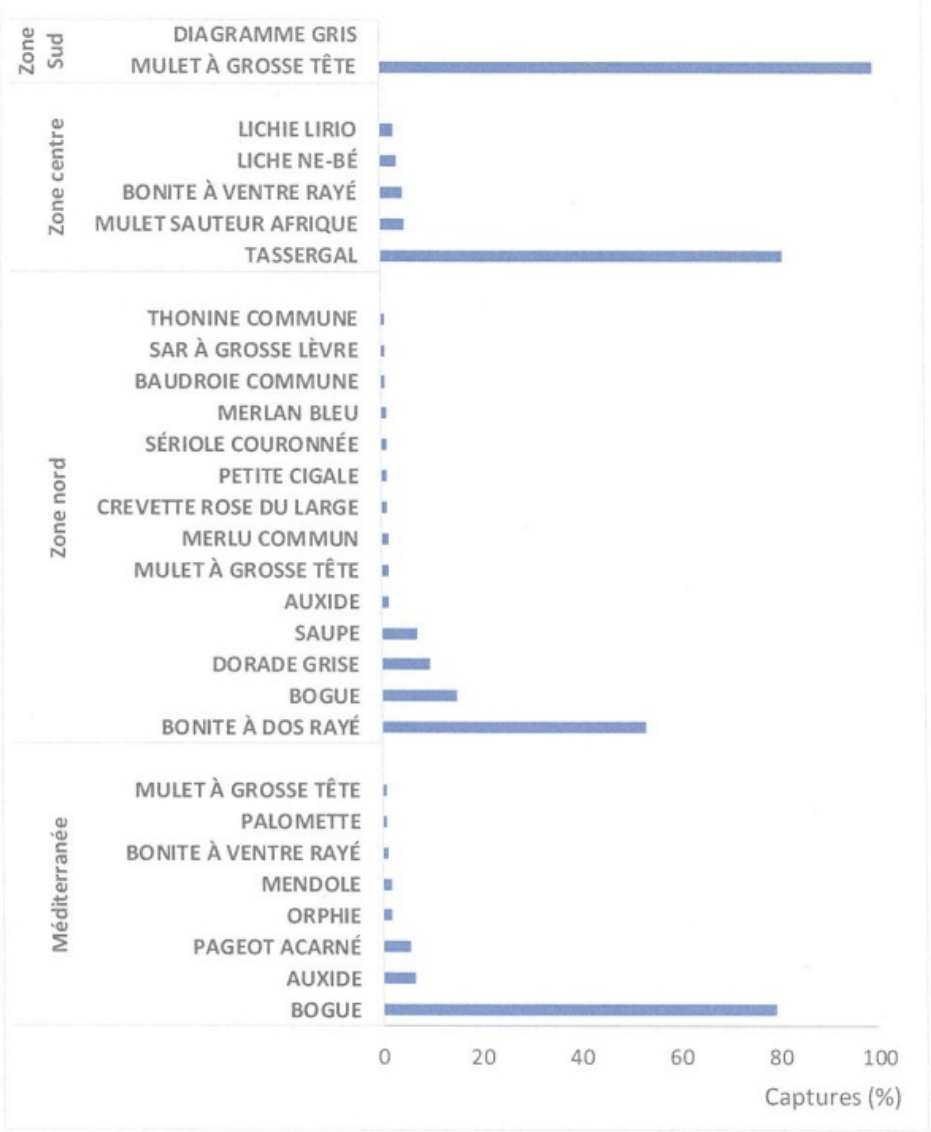

Figure 4: The main bycatch species landed in 2019 by Moroccan coastal purse seiners in the different regions (INRH 2020). Note that Mediterranean fisheries are not included in this Seafood Watch assessment.

Endangered, Threatened, and Protected (ETP) species

Specific information about the catch of ETP species in purse seine fisheries in the area is scarce. But, recent analysis of ETP interactions documented under the Moroccan sardine and anchovy fishery improvement projects indicated potential and occasional interactions with marine mammals, such as common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), and Atlantic humpback dolphin (*Sousa teuszii*) {Gascoine, J. 2017}(Gascoigne, J. & Key Traceability 2020). No interaction with seabirds has been reported in these fisheries, but observer coverage is quite limited and seabird interactions have been documented in the Portuguese purse seine fishery (as reported in (Gascoigne et al., 2021)). No bait is used in purse seine fisheries.

Criterion 2 species selection

Although the available data suggest minimal impacts on bycatch species, the lack of multiyear fishery-specific data (observer or otherwise) precludes an accurate representation of bycatch volumes relative to target catch. A finfish group has been included in this assessment to account for this uncertainty. In addition, marine mammals and seabirds are also included as main species.

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

Finfish

Factor 2.1 - Abundance

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

Moderate Concern

Except for bluefish, which is considered "Vulnerable," all the small pelagic and larger species documented as caught (and not considered in Criterion 1) are considered "Least Concern" or, in some cases, "Data Deficient" under the IUCN (see Criterion 2 Summary). A score of moderate concern balances the belief that there is no particular concern with the recognition that actual impacts are not well understood.

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

Moderate Concern

The impacts from the fisheries relative to the sustainable fishing levels are not well understood. A score of moderate concern is given until improved information on the catch composition and fishing levels are available.

Justification:

The Unknown Bycatch Matrix in the Seafood Watch Wild Fisheries Standard v4 indicates a score of 3 for forage fish and 4 for finfish (both out of 5) for pelagic purse seine fisheries, based on studies of similar fisheries around the world.

Marine mammals

Factor 2.1 - Abundance

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

High Concern

Using the Seafood Watch guidance for unknown species, abundance for marine mammals is scored a high concern.

Justification:

A number of species of small cetaceans can be found in West African waters, including common

dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), harbor porpoise (*Phocoena phocoena*), small-toothed whales (Ziphiidae), and the endemic Atlantic humpback dolphin (*Sousa teuszii*) (CMS 2021). An isolated subpopulation of Mediterranean monk seal (*Monachus monachus*) also exists at the border of Mauritania and Western Sahara (González, L.M. & Fernández de Larrinoa, P. 2012){Karamanlidis, A. & Dendrinos, P. 2015}. Various threats, including direct and accidental catch, coastal development, pollution, and habitat degradation, have caused West African marine mammal populations to decline rapidly (CMS 2021).

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 sizes 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. But, vulnerable and endemic species are found in the area, and the conservation status of the Northwestern Africa ecoregion was considered "Critically Endangered" (Pompa et al., 2011). The Atlantic humpback dolphin is also listed as "Critically Endangered" and the Mediterranean monk seal as "Endangered" on the IUCN Red List (Collins et al., 2017){Karamanlidis, A. & Dendrinos, P. 2015}.

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

Low Concern
The available information for the small pelagic purse seine fishery suggests minimal interactions with these species. Per the Seafood Watch Standard for Wild Capture Fisheries (v4), fishing mortality of mammals in purse seines in the Northwest Atlantic is a low concern.

Justification:
Several species of marine mammals, 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 also constituted an important area for humpback whale and sperm whale. Recent studies and anecdotal evidence confirm that this upwelling zone still plays an important role for these species, blue whales, and several species of dolphins and pilot whales (Baines, M.E. & Reichelt, M. 2014)(AMI 2021).

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, E.A. 2005)(Zollett, E. A. 2008). Adverse fishing interactions are considered one of the probable causes for the lack of recovery of the Cabo Blanco monk seal population after commercial sealing ended in the region.

Currently, illegal industrial and artisanal fishing is one of the main threats to the survival of the colony, mainly for sub-adult seals (González, L.M. & Fernández de Larrinoa, P. 2012). Migrant fishers have been also implicated in the captures of Atlantic humpback dolphin in areas adjacent to the Banc d'Arguin in Mauritania (Campredon, P. & Cuq, F. 2001)(Collins et al., 2017).

Recent analysis of ETP interactions documented under the Moroccan sardine and anchovy fishery improvement projects (FIPs) indicates that no interactions with marine mammals, sea turtles, or seabirds were recorded in the purse seine fishery in the area (Gascoigne, J. 2017)(Gascoigne, J. & Key Traceability 2020).

Seabirds

Factor 2.1 - Abundance

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

Moderate Concern

According to (Gascoigne et al., 2021), the most common seabird species in the coastal area nearest the fisheries were common tern (*Sterna hirundo*), storm petrel (*Hydrobates pelagicus*), and northern gannet (*Morus bassanus*). All are assessed as "Least Concern" by the IUCN (BirdLife International 2018)(BirdLife International 2019)(BirdLife International 2021), so a moderate concern score is awarded.

Factor 2.2 - Fishing Mortality

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone C

Low Concern

Per the Seafood Watch Standard for Wild Capture Fisheries (v4), fishing mortality of seabirds in purse seines in the Northwest Atlantic is a low concern.

Factor 2.3 - Discard Rate/Landings

West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Zone N and Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North
West Africa Zone A+B Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone
Eastern Central Atlantic | Purse seines | Morocco | Zone North
West Africa Zone C Stock | Eastern Central Atlantic | Purse seines | Morocco

< 100%

The fisheries for small pelagics generally have low discard rates because the schools tend to be monospecific and the fish tend to be of a similar size (Kelleher, K. 2005). The ratio of bait + discards to landings is considered to be lower than 100%.

Justification:

The fisheries for small pelagics generally have low discard rates because the schools tend to be monospecific and the fish tend to be of a similar size (Kelleher, K. 2005). This same author indicates that purse seine fisheries contribute over 350,000 tonnes to the global discard estimate and have a weighted discard rate of 1.6% (Kelleher, K. 2005). According to INRH observer reports, the discard rate in the small pelagic fishery in the Moroccan Atlantic coast was 0.9% in 2017 and 6.6% in 2018 (Gascoigne, J. & Key Traceability 2020). In purse seine fisheries, no bait is used.

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	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Eastern Central Atlantic | Purse seines | Morocco | Central Zone	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Moderately Effective	**Yellow (3.000)**
Eastern Central Atlantic | Purse seines | Morocco | Zone C	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Moderately Effective	**Yellow (3.000)**
Eastern Central Atlantic | Purse seines | Morocco | Zone North	Moderately Effective	Moderately Effective	Moderately Effective	Highly 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 | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderately Effective

A number of technical measures have been implemented in Morocco for the management of the small pelagics fishery, including effort limits and total allowable catches (TACs) (see Justification) (Gascoigne, J. 2017)(Evans, T. 2018). But, TACs are combined for all small pelagics rather than being species-specific, and exactly how they are set or how responsive they are to changes in stock productivity is unclear. There are also no regional agreements to limit total catches between the states, nor on the partitioning of TACs advised by the FAO Working Group for the subregion into national quotas (Braham and Corten 2015). Reference points have been determined for sardine and chub mackerel, but not for anchovy (see Criterion 1). Both sardine stocks and chub mackerel are above their respective target reference points, and fishing mortality on the sardine stocks is below the reference point. But, fishing mortality of chub mackerel appears too high, and without regional agreements, it is unclear how the countries can work together to reduce fishing mortality.

In summary, there are measures in place to manage the fisheries, and the main target stocks of European pilchard are not overfished or experiencing overfishing, but the lack of regional management, stock-specific harvest control rules, and effective implementation is a weakness. Thus, management of the Moroccan fisheries is considered moderately effective.

Justification:

Fisheries in Morocco are regulated by the Marine Fishery Division (MFD) of the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests (MPM). Beside the MFD exists the Office National des Pêches (ONP), which is placed under the supervision of the MPM and is in charge of the trade and marketing of fishery products. The Institute National de la Recherche Halieutique (INRH) is responsible for developing fisheries research in the country to provide scientific advice to the government. Also, there is an Ad Hoc Comité de Coordination pour la pêcherie de sardine (comité conserve) in charge to liaison between government, scientists, and industry representatives for the management and development of the industry (Gascoigne, J. 2017).

In Morocco, the Halieutis Strategic Plan (2010) is the national framework for fishery management currently in place, which was first launched in 2009 and updated by 2020 (MAPM 2010)(MAPM 2020). This plan sets out three key strategic areas for the sector: sustainability, performance ,and competitiveness, with mission statements, objectives, and actions associated with each. For sustainability, the objectives are to ensure the long-term protection of vulnerable and overfished species, to create a climate for sustainable investment, and to ensure that operators feel responsible for respecting principles of sustainable fishing. The small pelagic fisheries are included as 1 of the 16 components of this plan (MAPM 2010).

In particular for the small pelagic fishery, in Morocco, two main management zones have been established: Zone A+B and Zone C (FAO/CECAF 2020). A management plan for the small pelagic fisheries in Zone C has been implemented since 2010 (Order No 3279-10). This plan is based in setting a TAC (all species combined), bycatch limits and species restrictions, spatial zoning, and closed areas. Also, in 2014, this management plan for Zone C was extended to Zone North (Saadia-Cap Bojador) (Order No. 4196-14) but it uses limits on effort rather than a TAC (Daly, J. 2019). Other provisions have been introduced to ensure the sustainability of these resources: (i) a management plan for the rest of the fishing zones (Mediterranean, North and Centre Atlantic (l'arrêté n° 1515–2017 and l'arrêté n° 4196–2014); (ii) the limitation of the trips for pelagic trawlers operating at the southern of Cape Bojador zone (Zone C); (iii) annual limitations for small pelagic catches (2,000t/yr) for seiners operating in Zone C; (iv) renewal of the establishment of the reserve area of 24–25° N. over 15 nm, for 5 years, and the establishment of an additional closure zone between the 22° N. and 23° N. parallels over 15 nm during the May–June period of each year (Gascoigne, J. 2017). Thus, all the small pelagic fisheries in Morocco are managed under a management plan, based on the establishment of management units, zoning, spatio-temporal closure to protect juveniles and spawners, a quota system and catch trip catch limits in certain zones, and catch limits for bycatch species (FAO/CECAF 2018).

The small pelagics TAC in Morocco is 1M mt/year, which includes five designated groups of target species (décret n°230-2008):

1. sardine (*Sardina pilchardus*)
2. sardinella (*Sardinella aurita* and *S. madeirensis*)
3. horse mackerel (*Trachurus trachurus*, *T. track*, *T. ronchus*, and *T. picturatus*)
4. anchovy (*Engraulis encrasicolus*)
5. mackerel (*Scomber scombrus* and *S. colias*)

According to (Gascoigne, J. 2017), the fundamental basis for decision-making about the TAC used in Morocco for Zone C is to find an appropriate balance between biological and socio-economic factors. Decision makers use a rule of thumb that the TAC should not exceed one-third of the annual biomass estimate (for all small pelagic species). The TAC is responsive to changes in stock productivity and/or biomass; for example, in 2018, the TAC allocated to Zone C (1,000,000 mt) was reduced by 15%. But, there is uncertainty regarding implementation of this management measure, because no formal indications of how this decision rule is applied are available.

Regional

On a regional level, concerted management actions are still lacking. There is no agreement on the limitation of total catches between the total states, nor on the partitioning of TACs advised by the FAO Working Group for the subregion into national quotas (Braham and Corten 2015). According to Braham and Corten, two regional organizations have been established to help improve coordination between member states:

- The Central East Atlantic Fisheries Commission (CECAF/COPACE) was established in 1967, with the broad goal of giving advice designed to promote coordination across

member states in terms of research, education, training, data collection and analysis, and the establishment of the scientific basis for regulatory measures for the rational utilization of fishery resources in the region (FAO 34) (FAO 1967). The FAO/CECAF Working Group on the Assessment of Small Pelagic Fish off Northwest Africa comprises a group of scientists from the region who cooperate on stock assessments for small pelagics under the framework of CECAF (FAO/CECAF 2020).

- The Subregional Fisheries Commission (SRFC) was established in 1985 and its purpose was "to ensure harmonization of national policies of Member States on the preservation, conservation and exploitation of fisheries resources and strengthen cooperation for the well-being of the populations" (http://spcsrp.org/en/presentation). But, Morocco is not a member of the SRFC, thus complicating the implementation of FAO Working Group advice (Braham and Corten 2015).

Thus, management at the regional level is advisory only, with the implementation of recommendations left to the member states. Experts, civil society organizations, and NGOs (CFFA, APRAPAM, CONIPAS, CAOPA and REJOPRAO) have been advocating for the creation of a regional fisheries management organization (RFMO) in the area for the management of the shared resources, particularly for the pelagic stocks, some of which (e.g., sardinella) are a staple food for the populations of the region (CFFA-CAPE 2020). Because of the increased global demand for fishmeal, fishmeal factories are multiplying in the area (for example, in Mauritania, the number of legal fishmeal plants increased from 6 in 2010 to 29 in 2015 (CFFA-CAPE 2017)), and some resources are deteriorating due to the absence of sustainable and concerted management (but these are of stocks that are more typically caught in fisheries south of those in Morocco).

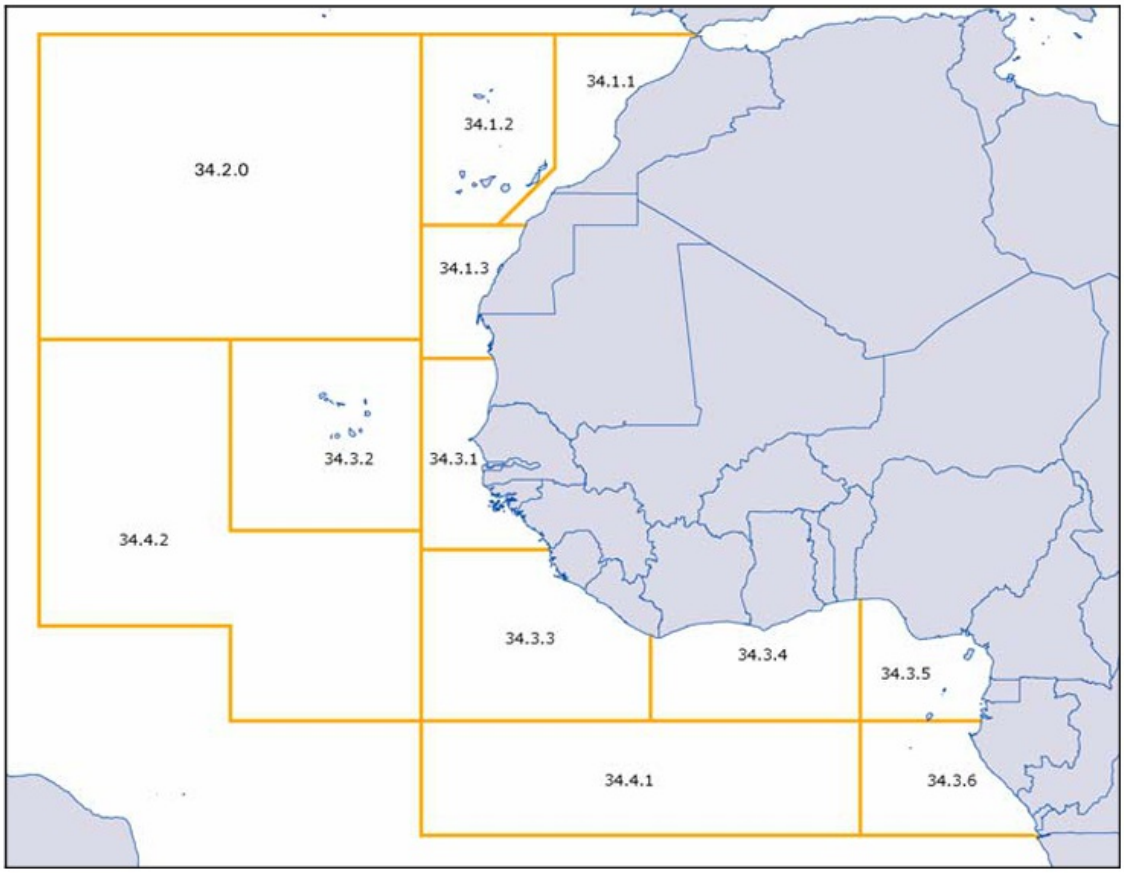

Figure 5: The CECAF area and its statistical divisions.

Factor 3.2 - Bycatch Strategy

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderately Effective

Catch composition in the fisheries is not well documented, but data and analyses from nascent observer programs do suggest that there are no major bycatch issues (see Criterion 2). Nonetheless, Morocco does have specific measures in place to reduce bycatch species. The lack of major concern based on the information available for the Moroccan fishery allows for a score of moderately effective.

Justification:

According to the evolution of the Moroccan fishery in the different fishing zones, lists of authorized bycatch have been published and constantly updated. These lists are separated according to vessel class, and their weight is limited to a maximum percentage per fishing trip (Arrêté n° 3049 - 2019). The percentage of bycatch permitted by fishing vessel class ranges from 2% by volume by

haul for RSW purse seiners and pelagic trawlers to 5% by volume per trip for coastal purse seiners (except *Mugil* spp., for which bycatch is limited to 2% per year and 5% per trip [July to December]) (Arrêté n° 3049 - 2019).

There are also regulations in place to protect endangered species:

- ban on fishing for hammerhead sharks (*Sphyrna* spp.), except bonnethead shark (*S. tiburo*), oceanic whitetip shark (*Carcharhinus longimanus*), and bigeye thresher shark (*Alopias superciliosus*), from 2017 for a period of 5 years {Arrêté n° 1517-2017};
- ban on fishing for porbeagle (*Lamna nasus*) and silky shark (*Carcharhinus falciformis*) for a period of 5 years (Arrêté n°2095 - 2020);
- ban on fishing of marine mammals and sea turtles for 10 years from 2019 {Arrêté n°2271 - 2019};
- area closures in place to protect juvenile sardine inside 15 miles in the Bay of Dakhla (24–25° N.);
- area closures to protect different resources (e.g., marine mammals, cephalopods, crustaceans) (Arrêté n°2818 - 2016).

Factor 3.3 - Scientific Data Collection and Analysis

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderately Effective
Although the assessment routine conducted by the FAO/CECAF Working Group on Small Pelagic Fish is considered relatively robust, a number of improvements have been recommended by the group, particularly around better regional coordination. Stock assessments are made available, but the lag between the FAO/CECAF Working Group meetings and the publication of the report is considerable (though a summary is made available on a shorter timeframe), which makes it challenging to understand recent data collection and analysis (and results). Interactions with ETP species are collected by INRH observers, but the level of coverage is unknown and no data are made publicly available. This factor receives a moderately effective score.

Justification:
The Institute National de la Recherche Halieutique (INRH) is responsible for developing fisheries research to provide scientific advice for Morocco. Since 2001, stock assessments are conducted at the regional level by the FAO Working Group on the Assessment of Small Pelagic Fish of Northwest Africa, which comprises 23 scientists from 5 countries that play an active role in Northwest African pelagic fisheries, including INRH. This FAO WG is part of the Fishery Committee for The Eastern Central Atlantic (CECAF), the fisheries management body for the broader area (FAO area 34) (FAO/CECAF 2020).

The FAO Working Group, in collaboration with INRH (and the equivalent in other countries),

oversees the assessment of the following pelagic species: sardine (*Sardina pilchardus*), sardinella (*Sardinella aurita* and *Sardinella maderensis*), horse mackerel (*Trachurus trecae*, *Trachurus trachurus*, and *Caranx rhonchus*), chub mackerel (*Scomber colias*), anchovy (*Engraulis encrasicolus*), and bonga (*Ethmalosa fimbriata*) between the southern border of Senegal and the northern Atlantic border of Morocco (FAO area 34). A national biological sampling program for landings at Moroccan ports has been implemented with different levels of effectiveness. For each of these, standardized information is collected and analyzed on a yearly basis by species, reporting data on stock identity, fisheries, abundance indices, sampling intensity, biological data, assessment (reference points), projections, and management recommendations (FAO/CECAF 2020).

Moreover, acoustic campaigns are also carried out periodically through the EAF-Nansen Program since 1975, implemented under the FAO Fisheries and Aquaculture Department's Marine and Inland Fisheries Branch (FIAF) and supported by the Norwegian Institute of Marine Research (IMR) as part of the project "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries." The survey time series registered by the EAF-Nansen Program has been used as the backbone of the Working Group's assessment. To this end, joint surveys have been carried out between the R/V Dr. Fridtjof Nansen and the national research vessels of both countries (Al-Amir of Morocco, Al Awam of Mauritania). The data generated from this survey provides essential fisheries-independent data for the assessments of these resources and are therefore of vital importance to the Working Group (FAO/CECAF 2020).

In addition, the Pelagic Freezer-Trawler Association (PFA) has run a self-sampling program since 2015. This program expanded the ongoing monitoring programs onboard pelagic freezer-trawlers by the specialized crew of the vessels. Information is provided on the spatial and temporal evolution of the fishery, species and length compositions, and ambient fishing conditions (temperature and depth). The self-sampling is carried out by the vessel quality managers onboard the vessels, who have a long experience in assessing the quality of fish, and by the skippers/officers with respect to the haul information. All data are recorded in standardized Excel worksheets, which are sent by skippers by the end of each fishing trip. The data are checked and added to the database, and standardized trip reports (using *RMarkdow*n) are generated and published on the PFA website (Pastoors, M.A. 2020).

The indices B_{CUR}/B_{MSY} and F_{CUR}/F_{MSY} are used by the FAO/CECAF Working Group as limit reference points, whereas the indices $B_{CUR}/B_{0.1}$ and $F_{CUR}/F_{0.1}$ are chosen as target reference points for management recommendations (FAO/CECAF 2020). Although the scientific advice seems to be generally robust, the Working Group indicated in its most recent report a number of recommendations to improve it, such as: relaunch coordinated regional surveys between national research vessels in the region to estimate abundance of (sardine) stocks for the entire area of distribution of the species in the region, strengthen sampling for some species and areas, ensure recruitment surveys throughout the area, and improve stock identity studies (*Sardinella*) (FAO/CECAF 2020). Therefore, a number of improvements are necessary in this area to improve how stock data are collected and stock assessments are conducted for the relevant species in the area.

In the case of ETP species, the INRH has a program of putting scientific observers onboard small

pelagic vessels (seiners and pelagic trawlers) to evaluate rates of discards and interactions with ETP species (Gascoigne, J. & Key Traceability 2020). But, none of these data were available during this Seafood Watch assessment, and observer coverage of the coastal purse seine fleet is not known.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Highly effective

In Morocco, enforcement and surveillance have been improved significantly in recent years. A Monitoring, Control and Surveillance (MCS) system is in place that offers some data to assess its effectiveness, and it has been legally reinforced by the implementation of Law 15-12 against illegal, unreported, and unregulated fishing (IUU). A recent independent report on MCS for the country (Pramod, G. 2019) has presented quite satisfactory results in the 12 different criteria evaluated. Gascoigne (2017) also notes that there seems to be a strong enforcement system in place (Gascoigne, J. 2017). A score of highly effective is awarded.

Justification:

The monitoring and enforcement system in Morocco was reinforced under the Halieutis Plan update (MAPM 2020). The control coordination support unit (UACC) coordinates monitoring and surveillance in exclusive economic zone (EEZ) waters at three levels. First is the control and monitoring of landings by a catch certification procedure (MPM 2021). For this purpose, DPMA counts on 18 sea fishing delegations across the national coast as regional representations. They oversee control of fishing activities at the ports, through monitoring landings during first sale auctions by checking logbooks and landings declarations. Second, a traceability system for seafood products has been implemented with the support of several international projects to fight against IUU practices (MPM 2021). Third, a vessel monitoring system (VMS) exists to monitor the entire fishing fleet, except the artisanal vessels. The National Center, [for] the Monitoring of Fishing Vessels (CNSNP) uses the VMS system (compulsory for the offshore and coastal fleet) for real-time tracking of fishing vessels to protect fishery zones (fishing zones, monk seal protection area, prohibited fishing areas, allowed distances to the coast) and to collect reliable scientific data. Moreover, an innovative system of identification of national artisanal fishing boats by radio frequency (RFID) has been implemented in recent years (2017) as part of the national strategy to fight IUU. Results of the performance of the Haleutis Plan are reported on a yearly basis by the publication of the Rapport d'activité of the Marine Fisheries department, available online (MPM 2021).

Factor 3.5 - Stakeholder Inclusion

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Moderately Effective

Stakeholder inclusion and the decision-making process have become more robust in Morocco in recent years, but no official evidence/public record (e.g., meeting reports, memorandums) on the operation of the different management commissions (e.g., FNPA) in Morocco has been found. Thus, despite the existence of legal frameworks and committees to ensure the participation of critical stakeholders in the management decisions, the lack of evidence of its functioning led to score this factor as moderately effective.

Justification:

In Morocco, the Comité de Coordination pour la pêcherie de sardine (comité conserve) is the national mechanism in charge to liaison between government, scientists, and industry representatives for the management and development of the small pelagic industry (MAPM 2020). Management decisions such as TACs and other regulations are discussed and agreed upon between the stakeholders in this forum (MAPM 2020). But, the DPMA legal framework emphasizes that the decision-making process can be sped up in cases where urgent action may be required (e.g., to introduce time-area closures in areas where there have been large catches of juveniles) in response to scientific advice {Gascoigne 2019}.

Although information about the participation of stakeholders at the regional level is scarce, it seems that within the Central East Atlantic Fisheries Commission (CECAF/COPACE), stakeholder participation is promoted; for example, as indicated in the Factor 3.3, the Pelagic Freezer-Trawler Association (PFA) has conducted a self-sampling program since 2015 (FAO/CECAF 2020).

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	FORAGE SPECIES?	SCORE
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Central Zone	Score: 4	Score: 0	High Concern	Yes	**Red (2.828)**
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone C	Score: 4	Score: 0	High Concern	Yes	**Red (2.828)**
West Africa Stock | Eastern Central Atlantic | Purse seines | Morocco | Zone North	Score: 4	Score: 0	High Concern	Yes	**Red (2.828)**

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 - Physical Impact of Fishing Gear on the Habitat/Substrate

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Score: 4

The target species (European pilchard, European anchovy, Atlantic chub mackerel, and Atlantic horse mackerel) are pelagic fish that are commonly caught by purse seine at or near the surface at depths between 0 and 50 m (Ould Taleb Sidi et al., 2010). Although these species are targeted in midwater and the gears do not generally make contact with the seabed (Gascoigne, J. & Key Traceability 2020), similar fisheries are known to occasionally contact the seafloor, generally based on observer data showing the bycatch of demersal species. An absence of public observer data precludes the conclusion that the Moroccan fishery never contacts the seafloor (a score of 5), so a score of 4 is given.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

Score: 0

As indicated in Factor 4.1, purse seines that capture small pelagic species rarely come in contact with the bottom, and according to the Seafood Watch standard (v4), mitigation techniques are not required.

Factor 4.3 - Ecosystem-based Fisheries Management

Eastern Central Atlantic | Purse seines | Morocco | Zone North
Eastern Central Atlantic | Purse seines | Morocco | Zone C
Eastern Central Atlantic | Purse seines | Morocco | Central Zone

High Concern

As described in Criterion 3.1, all the small pelagic fisheries in Morocco are managed under a management plan, based on the establishment of management units, zoning, spatio-temporal closure to protect juveniles and spawners, a quota system and catch trip catch limits in certain zones, and catch limits for bycatch species (FAO/CECAF 2018). In addition, Morocco has implemented marine protected areas over some 0.7% of its EEZ. These include marine protected areas, national parks, and other designations that allow different levels of extraction and activity (UNEP-WCMC 2022). The INRH, which is in charge of collecting fishery data and assessing the state of the stocks in these countries, has also committed to introducing new complementary approaches to fisheries, including improving the knowledge of the structure and functioning of

ecosystems, to support an EBFM approach in these countries (see objective 6 in (INRH 2021)). But, there is no indication that the protection of ecosystem functioning and accounting for each species' ecological role have yet to be considered when setting the catch limits and other measures.

Sardine is considered a key forage species in this fishery (see Criterion 1). In these cases, additional precaution in setting catch limits is necessary to protect the role of the species in the ecosytem. The Lenfest Forage Fish Task Force (LFFTF) recommendations for forage fisheries followed by the SFW standard indicates that, in fisheries with an intermediate level of information (fisheries in which population abundance, status, and trends are monitored; environmental drivers of forage fish productivity are identified; and there is some monitoring and enforcement in the fishery), such as the Moroccan fishery, the application of a "hockey stick" harvest control rule with minimum biomass (B_{LIM}) ≥ 40% B_0 and fishing (F) not to exceed 50% of the natural mortality rate or 50% of the level that achieves MSY (F_{MSY}) is recommended {Pikitch et al. 2012}. Because the fishery does not have reference points and/or a harvest strategy that is in line with the LFFTF recommendations, this factor is scored a high concern.

Justification:
Extensive research has been conducted over the years on the dynamics of the Canary Current Large Marine Ecosystem (CCLME) to understand the role of pelagic fish stocks in the area and their response to fisheries and environmental variations, and to improve the knowledge about the marine components (species, VMS, etc.) (Gascoigne, J. & Key Traceability 2020)(Corten et al., 2017). For example, marine areas and vulnerable areas, including coral reefs, gorgonian forests, and large sponge fields, were identified and mapped by the Spanish IEO under the European project LIFE-INDEMARES20. 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 important slope habitats (FAO/CECAF 2016b).

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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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