Ecological risk assessment for the impact of the Senegal-based tuna pole-and-line fishery on species used as live bait

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Eastern Atlantic P&L Tuna FIP

Contents

1 Introduction

This report presents the results of a Level 2 Risk Assessment (ERA) of 19 bait species in the context of the Senegal-based tuna pole-and-line (P&L) Fishery Improvement Project (FIP). The P&L fleet is based in Dakar and consists of a combination of EU- and Senegal-flagged vessels that target tunas (mainly skipjack with some juvenile yellowfin and bigeye) using live bait. The live bait is fished by Dakar-based pirogues under contract to the P&L vessels, using seines owned by the P&L owners.

The Terms of Reference (ToR) for this consultancy lists the following 19 bait species:

- Round sardinella (*Sardinella aurita)*
- Flat sardinella (*S. maderensis)*
- Sardine (*Sardina pilchardus)*
- Anchovy (*Engraulis encrasicolus)*
- Horse mackerel (*Trachurus trachurus* and *T. trecae)*
- Chub mackerel (*Scomber colias*)
- Mullet (*Mugil* spp.)
- Atlantic bumper or bumpfish (*Chloroscombrus chrysurus*)
- Grunt or bigeye grunt (*Brachydeuterus auritus*)
- False scad (*Caranx rhonchos)*
- Sar or Senegal seabream (*Diplodus bellottii*)[1]
- Thiékem or lesser African threadfin (*Galeoides decadactylus*)
- Demi-bec or ballyhoo halfbeak (*Hemiramphus brasiliensis*)
- Drépane or African sicklefish (*Drepane africana*)
- Vomer or African moonfish (*Selene dorsalis*)
- Black seabream (*Spondyliosoma cantharus*)[2]
- Bonga shad (*Ethmalosa fimbriata*)
- Silver-biddy or Guinean striped mojarra *(Gerres nigri*)[3]
- Barracuda (*Sphyraena sphyraena*)

In the absence of formal information available on the consumption of live bait by the fishery, this list was compiled in the context of the FIP based on sampling of pirogue seine catches and discussions with pirogue and P&L vessel owners (e.g. Fall and Guèye (2019) and Fall and Diatta (2014)), as well as observer reports from the EU component of the P&L fleet. The data obtained remain uncertain, however, and this study is intended to help target further FIP activities around this issue.

The following sections in this report explore the general background of the live bait fishery, with particular attention to the information needed to complete the ERA, including gear use, spatial and temporal footprint and selectivity. Further detail on the methodology is presented in Section 3.1. The ERA results by bait species are shown in Section 1.1.

[1] Referred to as *Diplodus senegalensis in ToR;* this species name is no longer in use

[2] Referred to as *Cantharus cantharus* in ToR; this species name is no longer in use.

[3] Referred to as *Gerres octatis* in ToR; however, *Gerres nigri* according to Fishbase.

2 Bait fishery background

2.1 General

Bait fishing for P&L tuna vessels was introduced off the coast of Dakar in the early 1950s. The bait is captured prior to or during fishing trips by P&L vessels by the vessels themselves, or in the majority of cases, by artisanal boats which operate under contract with the P&L vessels. The bait fish mainly consist of small coastal pelagic fish including clupeids, engraulids and carangids. The preferred bait species are sardines and sardinellas, although anchovies, mackerels and horse mackerel are also used. Although listed in the ToR for this study, mullet and Atlantic bumpfish are not considered a desired bait species (Fall and Guèye, 2019; Gascoigne et al., 2019).

According to an analysis carried out by Gascoigne et al. (2019) estimates of annual bait use by the fishery range from 445t (based on pirogue owner interviews) to 1,357t (based on observer data), corresponding to *ca*. 4% of tuna landings, although this could be an underestimate (Fall and Guèye, 2019).

2.2 Fishing gear

The bait is typically caught with a small 16mm mesh purse seine (*bolinche*) deployed from the P&L vessel itself or from an artisanal vessel (pirogue), although beach seines are reportedly also used (Fall and Diatta, 2014; Gascoigne et al., 2019). The gear is regulated through the *Arrêté* 7225 of 30 March 2018. The activity is legal for pirogues as long as the pirogues use gear belonging to the P&L company and operate under a valid subcontracting agreement. Several pirogues share one purse seine which is provided by the tuna company and which also provides money for fuel and supplies (Gascoigne et al., 2019). The purse seines are deployed in waters of 10 to 40m depth (Fall and Guèye, 2019), or in more shallow waters in the case of beach seines. For the purpose of this analysis and in the absence of detailed gear dimensions, the assumption was made that the gear overlaps fully with the water column at up to 40m depth.

2.3 Spatial footprint

The bait fishery takes place along the Senegalese coast, with the exception of a small restricted area[4] to the south of Dakar. According to Fall and Guèye (2019), the main fishing location is the Baie de Hann (e.g. off Rufisque, Bargny, Hann, Thiaroye) although when catch rates fall, fishers may go further south to Djiffère, in the region of Fatick (Figure 1).

Figure 1. The main live bait fishing area in the Baie de Hann (left) and extended fishing area out to Djiffère (right). From Fall and Guèye (2019)**.**

[4] defined by the low-tide mark and the line connecting two points: Point 1 : 14° 40'08''N, 17° 25'02''W ; Point 2 : 14° 44'18''N , 17° 21'00''W (Fall and Guèye, 2019)

2.4 Seasonality

According to Fall and Guèye (2019), the ideal live bait fishing period is between April and June when the waters off the coast of Senegal warm up; however, fishing takes place throughout the year. There is some variability in which species are caught when; however other than some anecdotal references, the information by species is too limited to be taken into account here.

Table 1 shows the amount of live bait fished by trimester by the EU P&L companies in 2015, demonstrating that – at least for that year – there was no real seasonal peak in live bait fishing. As the data are limited on seasonality in the fishery, year-round catches are assumed for this analysis.

Table 1. Amount of live bait (in tonnes) by trimester caught by EU pole-and-line vessels in 2015. From Fall and Guèye (2019)**.**

Trimester	Live bait (t)
T1	93.9
T2	120.2
T3	110.8
T4	128.9
Total	453.8

2.5 Selectivity

As part of their field study, Fall and Guèye (2019) sampled boxes of live bait destined for use in the P&L fishery. Although the samples were small (Figure 2), the results provide some indication of the likely mix of species and sizes caught by the gear. The results are summarized in Table 2. Note that the majority of vessels (21) mainly catch juveniles (>75%). According to Fall and Guèye (2019) the three other pirogues will also catch adult fishes although juveniles still make up a significant portion of the catch (2 at 50 – 75%; 1 at < 50%).

Figure 2. Arrival of boxes of live bait destined for use in the P&L fishery and sampling by Fall and Guèye (2019)

Table 2. Summary of species identified in field sampling, with average individual weight estimated from data shown in Fall and Guèye (2019)**.**

Species	Average individual weight (g)
Sardinella aurita	8.7
Sardinella maderensis	10
Brachydeuterus auritus	3.8
Diplodus senegalensis	6.7
Chloroscombrus chrysurus	18.2
Galeoides decadactylus	5
Hemiramphus brasiliensis	30
Drepane africana	40
Selene dorsalis	10

3 Ecological risk assessment

3.1 Methodology

A Level 2 Ecological Risk Assessment (ERA) was carried out for each of the bait species, consisting of a Productivity Susceptibility Analysis (PSA). The PSA method selected for this FIP is in line with the MSC PSA requirements for Secondary Species (performance indicator 2.2.1) as given in Annex PF of the MSC Fisheries Certification Procedures (FCPv2.1). The procedural requirements are not repeated here; however the analysis consists of two components: a productivity analysis which takes into account the biological and reproductive attributes of the species (Table 3) and a susceptibility analysis which considers the impact of the fishery on the species (Table 4). It is important to bear in mind that the scope of the PSA is limited to the FIP fishery alone; i.e. it does not take into account any other pressures, from other fisheries or otherwise[5]. The results of the PSA need to be seen in that context.

Once the productivity and susceptibility risk scores are determined, an overall PSA risk score is calculated and converted into an MSC-PSA derived scoring indicator of <60 (indicating an overall fail for that species), 60 – 79 (a conditional pass) or ≥80 (an unconditional pass). Scores are calculated automatically using the MSC RBF Worksheet v2.1, available here.

Table 3. PSA productivity attributes and scores for vertebrates (adapted from Table PF4 in MCS FCPv2.1)

Productivity attribute	High productivity (Low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)
Average age at maturity	<5 years	5-15 years	>15 years
Average maximum age	<10 years	10-25 years	>25 years
Fecundity	>20,000 eggs per year	100-20,000 eggs per year	<100 eggs per year
Average maximum size	<100 cm	100-300 cm	>300 cm
Average size at maturity	<40 cm	40-200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic Level	<2.75	2.75-3.25	>3.25

Table 4. PSA susceptibility attributes and scores for vertebrates (adapted from Table PF5 in MCS FCPv2.1)

Susceptibility attribute	High susceptibility (Low risk, score = 1)	Medium susceptibility (medium risk, score = 2)	Low susceptibility (high risk, score = 3)
Areal overlap (availability) Overlap of the fishing effort with a species	<10% overlap	10-30% overlap	>30% overlap
Encounterability The position of the stock/species within the water column relative to the fishing gear, and the	Low overlap with fishing gear (low encounterability)	Medium overlap with fishing gear	High overlap with fishing gear (high encounterability)

[5] MSC FCPv2.1 PF4.4.3 : *When scoring PI 2.2.1, if the UoA has main species with catches at 10% or more of the total catch by weight of the UoA, all MSC UoAs having a catch of the same species that is 10% or more of the total catch of the UoAs shall be identified and listed separately*. Given that there are no other MSC fisheries impacting on these species, this cumulative impact requirement is not triggered here.

Susceptibility attribute	High susceptibility (Low risk, score = 1)	Medium susceptibility (medium risk, score = 2)	Low susceptibility (high risk, score = 3)
position of the stock/species within the habitat relative to the position of the gear			
Selectivity of gear type Potential of the gear to retain species	a - Individuals < size at maturity are rarely caught b - Individuals < size at maturity can escape or avoid gear	a - Individuals < size at maturity are regularly caught b - Individuals < half the size at maturity can escape or avoid gear	a - Individuals < size at maturity are frequently caught b - Individuals < half the size at maturity are retained by gear
Post-capture mortality (PCM) The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released post-capture and survival	Evidence of some released post-capture and survival	Retained species or majority dead when released. Default score for retained species

3.2 Constraints

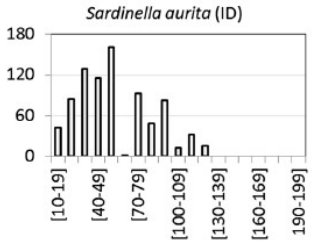
For the purpose of this study, it is assumed that all activities associated with the FIP fishery are compliant with Senegalese regulations, in particular with *Décret 2016-1804 du 22/11/2016 portant application de la Loi 2015-18 du 13/07/2015 portant Code de la pêche maritime sénégalaise* and the *Arrêté 007225 du 30 mars 2018.*

This was a desk-based study and no stakeholder interviews were carried out. In many cases, information specific to the study area was lacking, in which case inferences from other areas were made, as referenced throughout the analysis. In line with the precautionary approach, where information was lacking, a higher risk score was awarded to that attribute.

3.3 Results

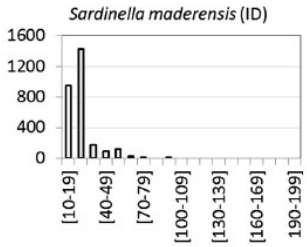
3.3.1 Round sardinella (*Sardinella aurita*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Size at first sexual maturity (L_{50}) ranges between 21 and 26cm total length for Senegal (Baali et al., 2017), corresponding to an average age at maturity of less than 5 years (likely between 1 and 2 years based on growth curve by Baali et al. (2015) for south Moroccan waters).	1
Average maximum age	According to Baali et al. (2015) the age of *S. aurita* does not exceed 5 years.	1
Fecundity	Absolute fecundity for *S. aurita* in Senegalese waters ranged from 35,604 to 260,260 oocytes with an average of 110,794 ± 7,582 oocytes per female (Ndiaye et al., 2018).	1
Average maximum size	Diouf et al. (2010) reports maximum length of 40cm.	1
Average size at maturity	Size at first sexual maturity (L_{50}) ranges between 21 and 26cm total length for Senegal (Baali et al., 2017).	1
Reproductive strategy	Broadcast spawner (Ganias et al., 2014)	1
Trophic level	3.4 ± 0.5 se (Fishbase)	3
Productivity risk score		1.29
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	*S. aurita* undertakes extensive north/south seasonal migrations throughout the West African region. In the absence of data on the stock identity for this species in the region, the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa considers a single stock unit ranging from south of Senegal to Morocco's northern border for stock assessment purposes (FAO, 2019a). On that basis alone, the fishery's footprint, which is limited to the coastline between Dakar and Djiffère (Section 2.3), could be considered to overlap with less than 10% of the stock distribution, corresponding to a risk score of 1. The shallow areas along the coast are, however, important spawning and nursery grounds for all clupeid species present in the area, with greater abundance of *S. aurita* closer to the coast in waters accessible to the fishery (Figure 3 and Sarré et al. (2018) and references therein). There is therefore a high likelihood of overlap between the live bait fishery, which operates between 10 to 40m depth or in more shallow waters in the case of beach seines (Section 2.2), and spawning aggregations and juveniles of the species. This, combined with the uncertainties surrounding stock identity reported by the FAO working group, means a more precautionary risk score of 2 is awarded.	2
Encounterability	Acoustic surveys carried out along the Senegalese coastline by Sarré et al. (2018) indicate a typical distribution from 10 m down to 120 m, with the highest concentrations around the 50 m isobath.	3

	 **Figure 3. Histogram of the bottom depth distribution of *S. aurita* based on an acoustic small pelagic assessment survey covering the Senegambia led in 2004, 2005, and 2007. From** Sarré et al. (2018)**.** The fishery operates between 10 to 40m depth or in more shallow waters in the case of beach seines (Section 2.2). The vertical overlap with the fishing gear is determined as high, given that the bulk of the distribution is in waters < 50m.	
Selectivity of gear type	The average weight for *S. aurita* based on sampling of landed catch by Fall and Guèye (2019) was 8.7g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		2.33
PSA risk score		2.66
MSC-PSA derived scoring indicator		≥80

3.3.2 Flat sardinella (*S. maderensis*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Size at first sexual maturity (L_{50}) ranges between 20 and 27cm total length for Senegal (Baali et al., 2017) corresponding to an average age at maturity of less than 5 years (likely between 1 and 2 years based on growth curve by Amednah et al. (2018) for Mauritanian waters).	1
Average maximum age	Between 4.5 and 5.5 years for females and males respectively, based on study in Mauritanian waters by Amednah et al. (2018).	1
Fecundity	Likely to be similar to other *Sardinella* species, such as *S. aurita* above; > 20,000 eggs per year.	1
Average maximum size	*ca*. 40 cm (Amednah et al., 2018)	1
Average size at maturity	Size at first sexual maturity (L_{50}) ranges between 20 and 27cm total length for Senegal (Baali et al., 2017).	1
Reproductive strategy	Broadcast spawner (Ganias et al., 2014)	1
Trophic level	3.2 ± 0.38 se (Fishbase)	3
Productivity risk score		1.29
b. Susceptibility		

Attribute	Rationale	Score
Areal Overlap	This species is distributed from the southern Mediterranean to Angola. In the absence of data on the stock identity for this species, the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa considers a single stock unit ranging from south of Senegal to Morocco's northern border for stock assessment purposes (FAO, 2019a). On that basis alone, the fishery's footprint, which is limited to the coastline between Dakar and Djiffère (Section 2.3), could be considered to overlap with less than 10% of the stock distribution, corresponding to a risk score of 1. The shallow areas along the coast are, however, important spawning and nursery grounds for all clupeid species present in the area (Sarré et al. (2018) and references therein). *S. maderensis* in particular may be found far inshore (Sarré et al., 2018). There is therefore a high likelihood of overlap between the live bait fishery, which operates between 10 to 40m depth or in more shallow waters in the case of beach seines (Section 2.2), and spawning aggregations and juveniles of the species. This, combined with the uncertainties surrounding stock identity reported by the FAO working group, means a more precautionary risk score of 2 is awarded.	2
Encounterability	Similar to *S. aurita*, this species has a depth distribution of up to 120m depth. In contrast with *S. aurita*, however, *S. maderensis* occurs further inshore at depths of less than 10m (Sarré et al., 2018).  **Figure 4. Histogram of the bottom depth distribution of *S. maderensis* based on an acoustic small pelagic assessment survey covering the Senegambia led in 2004, 2005, and 2007. From** Sarré et al. (2018)**.** The fishery operates between 10 to 40m depth or in more shallow waters in the case of beach seines (Section 2.2). The vertical overlap with the fishing gear is determined as high, given that the bulk of the distribution is in waters < 50m.	3
Selectivity of gear type	The average weight for *S. maderensis* based on sampling of landed catch by Fall and Guèye (2019) was 10g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		2.33
PSA risk score		2.66
MSC-PSA derived scoring indicator		≥80

3.3.3 Sardine (*Sardina pilchardus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Along the Moroccan coast, sardines can breed for the first time during its first year of life. In its range, sardine can reach its first sexual maturity at the length between 8 and 20 cm corresponding to the individual's age groups between 0 to 2 years (Abderrazik et al., 2016).	1
Average maximum age	The longevity of sardine in the Atlantic is higher than in the Mediterranean; in the Atlantic, longevity is 8 years, which corresponds to asymptotic lengths of 25.5 cm in the Bay of Biscay (Guerault 1980) and 24 cm in the east Atlantic (COPACE 1978) (all cited in Dahel et al. (2016)).	1
Fecundity	Amenzoui et al. (2006) estimated the mean values of batch fecundity for this species off the Moroccan Atlantic coast at 23 150 (±1301) oocytes for a mean size of 19.5 (±0.49) cm.	1
Average maximum size	In the Atlantic, longevity is 8 years, which corresponds to asymptotic lengths of 25.5 cm in the Bay of Biscay (Guerault 1980) and 24 cm in the east Atlantic (Copace 1978) (all cited in Dahel et al. (2016)).	1
Average size at maturity	Based on samples collected from the north (English Channel to southern France), south (northern Morocco to Mauritania), east (Azores and Madeira), and west (western Mediterranean), sardine were found to attain sexual maturity at a total length of 10.9 - 16.8 cm (Silva et al., 2006). In Moroccan waters, size at first sexual maturity averaged at 17.6 cm and 19.8 cm for males and females respectively (Abderrazik et al., 2016).	1
Reproductive strategy	Broadcast spawner (Ganias et al., 2014).	1
Trophic level	3.1 ± 0.1 se (Fishbase)	2
Productivity risk score		1.14
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Sardine stocks along the west African coast are distinguished into three stocks: the northern stock (35°45'-32°N), the central A+B stock (32°N-26°N), and the southern stock C. The latter extends from 26°N to the southern extent of the species distribution (FAO, 2019a) which, according to Fishbase, is in Senegal, at the level of the Bay de Gorée. The fishery therefore operates at the very edge of the species' range. *S. pilchardus* is also not considered a key species in the landings of small pelagics in Senegal (Sarré et al., 2018). On that basis, an areal overlap of < 10% is determined.	1
Encounterability	There are no depth distribution data for *S. pilchardus* off the Senegal coast; however according to Fishbase its general depth range is between 10 and 100m. The fishery operates between 0 and 40m depth and may therefore overlap with nearly half of this vertical distribution, leading to a high risk score.	3
Selectivity of gear type	*S. pilchardus* was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5	3

	clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.01
MSC-PSA derived scoring indicator		≥80

3.3.4 Anchovy (*Engraulis encrasicolus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	This species reaches sexual maturity from its first year of life (ICES, 2017)	1
Average maximum age	Maximum reported age is 5 years according to Fishbase.	1
Fecundity	For the Bay of Biscay, Motos (1996) estimated annual realised fecundity between 110,000 eggs (10 g female) and 350,000 eggs (40 g female) assuming a 2.5 month spawning season. This range is well above of the annual fecundity range of 20,000 to 175,000 eggs, given by Cendrero et al. (1981) (cited in Motos (1996)) but nevertheless indicates a low risk score.	1
Average maximum size	To 20 cm standard length, but usually about 12 to 15 cm; those in tropical waters are smaller than those in northern waters (FAO, 2020).	1
Average size at maturity	Length at maturity ranges from 9 to 14cm (FAO, 2020).	1
Reproductive strategy	Broadcast spawner (Ganias et al., 2014).	1
Trophic level	3.1 ± 0.36 se (Fishbase).	3
Productivity risk score		1.29
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	In the absence of studies on the stock identity of this species, the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa considers anchovy in the region between the southern border of Senegal and the northern Atlantic border of Morocco and including the Canary Islands as a single stock for assessment purposes (CECAF, 2018). The fishery therefore overlaps with only the southern limit of this distribution, indicating a low areal overlap.	1
Encounterability	There are no depth distribution data for *E. encrasicolus* off the Senegal coast; however according to FAO (2020) and Fishbase, this is a mainly marine, pelagic, coastal species, forming large schools but recorded down to 400 m depth off West Africa. The fishery operates between 0 and 40m depth and therefore overlaps with up to 10% of this vertical distribution, leading to a low risk score.	1

Selectivity of gear type	*E. encrasicolus* was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.20
PSA risk score		1.76
MSC-PSA derived scoring indicator		≥80

3.3.5 Horse mackerel (*Trachurus trachurus* and *T. trecae*)

The risk scoring for horse mackerel is for the most part based on *T. trecae*, which is likely to provide a more precautionary outcome considering its life history traits and which may be the more representative horse mackerel species found off the coast of Senegal (see for example Sarré et al. (2018)). Where species-specific information was lacking, the information was supplemented with data on *T. trachurus*, as indicated in the table below.

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Age at maturity assumed to be similar for *T. trachurus* and *trecae*. Abaunza et al. (2003) reports range of age at maturity between 1 and 3 years for *T. trachurus.*	1
Average maximum age	A maximum age of 40 years has been reported for *T. trachurus*; however it is not clear how robust this estimate is (ICES, 2020). Other observations of mackerel over 20 years of age have been made (e.g. Olafsdottir et al. (2016)) although this was in the Northeast Atlantic. In the absence of species-specific data for the area under assessment, a precautionary score of 3 is awarded.	3
Fecundity	The minimum absolute fecundity of an individual of *T. trecae* at 32-42 cm length is 151,000 eggs, the maximum is about 773,000 eggs (FAO, 1978).	1
Average maximum size	North of Cape Blanc, the size of the Cunene horse mackerel's population structure (*T. trecae*) varies between 13 and 43 cm, the dominant 35 cm mode. South of Cape Blanc, the structure shows a range of sizes between 17 and 45 cm (FAO, 2019a)	1
Average size at maturity	According to Fishbase, the size at maturity for *T. trecae* is ~ 24cm.	1
Reproductive strategy	Broadcast spawner (Murua and Saborido-Rey, 2003).	1
Trophic level	3.5 ±0.38 se (Fishbase).	3
Productivity risk score		1.57
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	In the absence of studies on the stock identity of this species, the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa considers both species of horse mackerel in the	1

	region between the southern border of Senegal and the northern Atlantic border of Morocco and including the Canary Islands as a single stock for assessment purposes (CECAF, 2018). The fishery therefore overlaps with only the southern limit of this distribution, indicating a low areal overlap.	
Encounterability	The Cunene horse mackerel (*T. trecae*) is more coastal than the Atlantic horse mackerel. The bulk of its concentration is in depths of less than 100 metres, while *T. trachurus* spreads from the coast to more than 300 metres and prefers the deepest areas of the continental shelf (depths of 100 metres plus) (FAO, 2001). According to FAO (1978), however, the depth range for *T. trecae* in the eastern Central Atlantic is 30 – 250m. Based on this information, and considering the lack of depth distribution data for the area under assessment, a precautionary risk score of 2 is awarded.	2
Selectivity of gear type	*Trachurus* spp. was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.43
PSA risk score		2.12
MSC-PSA derived scoring indicator		≥80

3.3.6 Chub mackerel (*Scomber colias*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Sexual maturity is reached at *ca*. 1 year of age (based on study in Madeiran waters by Vasconcelos et al. (2012)).	1
Average maximum age	Studies cited by Velasco et al. (2011) suggest this is a moderately long-lived species with longevity of up to 7 years.	1
Fecundity	Batch fecundity in a Moroccan study was estimated as 18,452–131,642, with a mean of 60,022 oocytes (Techetach et al., 2019).	1
Average maximum size	Fishbase reports maximum length at *ca*. 35 cm.	1
Average size at maturity	Fishbase reports size at maturity at *ca*. 21 cm.	1
Reproductive strategy	Broadcast spawner (Murua and Saborido-Rey, 2003).	1
Trophic level	3.9 ± 0.63 se (Fishbase).	3
Productivity risk score		1.29
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	The fishery overlaps with the *S. colias* stock south between Cape Boujdour (also known as Cape Bojador) and southern Senegal (FAO, 2019a). The species is distributed over the continental shelf, at	1

	depths down to 250-300 m (Collette 1986, Uriarte et al. 2001, Villamor et al. 2004 – all cited in Velasco et al. (2011)). The degree of overlap with the fishery is low, at less than 10%.	
Encounterability	Similar to most scombrids, mackerels are highly migratory species over the continental shelf, being mainly distributed at depths down to 250-300 m (Collette 1986, Uriarte et al. 2001, Villamor et al. 2004 – all cited in Velasco et al. (2011)). Overlap with the gear (up to 40m depth max.) is low.	1
Selectivity of gear type	*Scomber* spp. was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.20
PSA risk score		1.76
MSC-PSA derived scoring indicator		≥80

3.3.7 Mullet (*Mugil* spp.)

This species is also referred to locally as 'guiss'; based on the ToR this is assumed to be *Mugil cephalus*.

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	2 – 5 years, depending on location according to Elaine et al. (2016)	1
Average maximum age	Theoretical longevity estimated at up to 57.6 years based on data presented by Aguirre et al. (1999) although longevity between 10 and 30 years appears more common. Precautionary score of 3 is awarded.	3
Fecundity	Fecundity of between 2 and 6 million oocytes reported for Mauritania and Senegal (Elaine et al., 2016).	1
Average maximum size	Between 40 and 70 cm based on data reported by Aguirre et al. (1999); Fishbase reports a maximum length of 100 cm. A precautionary score of 2 is awarded.	2
Average size at maturity	In a study off the North coast of Senegal (Ndour et al., 2013), males reached sexual maturity from size 39 cm fork length (FL) while the sexual maturity of females is reached at 42 cm FL. For both sexes, the estimated L50 was 40 cm LF. Average size at maturity is therefore likely to be above 40cm total length, leading to a medium risk score.	2
Reproductive strategy	Broadcast spawner (Albieri et al., 2010).	1
Trophic level	2.5 ± 0.17 se (Fishbase).	1
Productivity risk score		1.57
b. Susceptibility		
Attribute	**Rationale**	**Score**

Areal Overlap	This species is cosmopolitan in coastal waters of the tropical, subtropical and temperate zones of all seas; in the eastern Atlantic, it occurs from the Bay of Biscay to South Africa (Fishbase). There is no stock assessment for this species and distinct stocks along the west African coast have not been identified. Genetic diversity in *M. cephalus* sampled between Senegal and Angola was not shown to be significant (Whitfield et al., 2012). On that basis, the overlap between the fishery and this species is considered small, at less than 10%.	1
Encounterability	According to Fishbase, the species' depth range is 0 - 120 m although it usually occurs between 0 - 10 m. Overlap with the gear (up to 40m depth max.) is medium.	2
Selectivity of gear type	*Mugil* spp. was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.43
PSA risk score		2.12
MSC-PSA derived scoring indicator		≥80

3.3.8 Atlantic bumper (*Chloroscombrus chrysurus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Age at sexual maturity was estimated at 2.9 years by De Queiroz et al. (2018).	1
Average maximum age	Theoretical longevity estimated at *ca*. 9 years by De Queiroz et al. (2018) and 6.12 years by Sossoukpe et al. (2017).	1
Fecundity	No data found for *C. chrysurus*, but based on biology of other Carangids, highly likely to be above 20,000 eggs per year (see for example Honebrink (2000)).	1
Average maximum size	Total length ranged from 2.5 to 26.4 cm in De Queiroz et al. (2018) and was estimated at 28.35 cm in Sossoukpe et al. (2017). Fishbase reports a maximum length of 65 cm.	1
Average size at maturity	The size at first maturity was estimated at 15.5 ± 2.8 cm by De Queiroz et al. (2018).	1
Reproductive strategy	Broadcast spawner (Souza and Júnior, 2008).	1
Trophic level	3.5 ± 0.2 se (Fishbase).	3
Productivity risk score		1.29
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	There is no stock assessment for this species and distinct stocks along the west African coast have not been identified. According to	1

	Edwards et al. (2001), the species occurs along the coast of West Africa from Mauritania to Angola. It also occurs in the subtropical and tropical western Atlantic. On that basis, the overlap between the fishery and this species is considered small, at less than 10%.	
Encounterability	Fishbase reports a depth range of 0 - 110 m; however, Ssentongo and Njock (1987) mention the species occurs along the continental shelf at depths of 10–50 m, as well as in estuaries and the mangrove fringed lagoons and brackish water areas. On that basis, overlap with the gear (up to 40m depth max.) is considered as high.	3
Selectivity of gear type	The average weight for *C. chrysurus* based on sampling of landed catch by Fall and Guèye (2019) was 18.2g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.09
MSC-PSA derived scoring indicator		≥80

3.3.9 Bigeye grunt (*Brachydeuterus auritus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	For Ghanaian waters, Amponsah et al. (2017) reports age at first maturity at 1.34 years.	1
Average maximum age	Amponsah et al. (2016) reports a longevity of 4 years for this species.	1
Fecundity	Mean fecundity of 32, 344 ± 1,889 eggs reported by Adebiyi (2012) for Nigerian waters.	1
Average maximum size	30 cm according to Fishbase.	1
Average size at maturity	Samb (2003) reports length at first maturity 14.4 – 14.8 cm for Senegalese waters.	1
Reproductive strategy	Broadcast spawner (Blaber, 1997).	1
Trophic level	3.0 ± 0.44 (Fishbase).	3
Productivity risk score		
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Globally, this species' distribution ranges from Mauritania to Angola (Amponsah et al., 2017). FAO CECAF has identified 3 stocks for this species in the Côte d'Ivoire-Ghana-Togo-Benin region, Nigeria-Cameroon-Equatorial Guinea region and Congo-Angola region (FAO, 2019b). According to a Morocco – Ghana survey carried out by Chrzan (1961) (in Samb (2003)), high abundances were	2

	encountered between in Sierra Leone, Liberia, Ivory Coast and Ghana. Nevertheless, the species is present in Senegal as well, from where it migrates seasonally to Mauritania and vice versa. There are thought to be two important nursery areas along Cap vert in Senegal (Samb, 2003) which overlaps with where the live bait fishery operates. From Senegal, the species extends southwards to Guinea-Bissau. Samb (2003) hypothesizes that this may be a separate stock from the Côte d'Ivoire-Ghana-Togo-Benin stock. On that basis, although the aerial overlap with the fishery is likely to be low, the presence of nursery areas along the Senegalese coast suggests a precautionary score of 2 may be appropriate.	
Encounterability	This species is encountered in dephs from 10 to 100 m but is most commonly found between 30 and 80 m (Adebiyi, 2013 in Sylla et al. (2016)). On that basis, overlap with the gear (up to 40m depth max.) is considered as medium.	2
Selectivity of gear type	The average weight for *C. chrysurus* based on sampling of landed catch by Fall and Guèye (2019) was 3.8. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.88
PSA risk score		2.27
MSC-PSA derived scoring indicator		≥80

3.3.10 False scad (*Caranx rhonchus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Maturity reached during the second year (Overko, 1979).	1
Average maximum age	More than 5 years (Overko, 1979); likely to be less than 10 but since this is unknown, a precautionary score of medium risk is awarded.	2
Fecundity	Likely to be high since this species is a broadcast spawner; ~100,000 eggs according to data available here: https://figshare.com/articles/Koutsidi_Moukas_Tzanatos_23_traits_by_235_species_xls/8020247/1.	1
Average maximum size	At least 60 cm (Smith-Vaniz et al., 2015); Fishbase suggests 60 cm although this estimate is uncertain.	1
Average size at maturity	Approx. 20 cm according to Fishbase; 23 cm in Mauritania (Smith-Vaniz et al., 2015); 16 cm in Tunisia (Sley et al., 2015).	1
Reproductive strategy	Broadcast spawner with pelagic eggs (Fishbase).	1
Trophic level	3.6 ± 0.59 se (Fishbase).	3
Productivity risk score		1.43
b. Susceptibility		
Attribute	**Rationale**	**Score**

Areal Overlap	Distribution of the species is from Morocco to Angola in the Atlantic, and along the African coast of the western Mediterranean (Fishbase) and may extend to the eastern Mediterranean (Smith-Vaniz et al., 2015). There is some morphometric evidence for different stocks in north Mauritania vs south Senegal (Overko, 1979), but the species is also somewhat migratory. Spawning occurs in shallow waters, with juveniles inhabiting inshore shallow water south of 19ºN (Overko, 1979). The combination of inshore spawning behaviour combined with the possibility of separate stocks between Mauritania and Senegal leads to a precautionary risk score of 2.	2
Encounterability	Coastal schooling species with a depth range of occurrence between 15-200 m (Overko, 1979). According to Fishbase, this species is pelagic but often occurs close to the bottom; usually at depths of *ca*. 30-50m but can move close to the surface and spawn in shallow water. Precautionary score of 2 is given	2
Selectivity of gear type	*Caranx* spp. were not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.88
PSA risk score		2.36
MSC-PSA derived scoring indicator		≥80

3.3.11 Senegal seabream (*Diplodus bellottii*)

There are multiple species of *Diplodus* with overlapping ranges in the Northeast Atlantic, and the taxonomy of the genus is confused. *D. senegalensis* has been renamed *D. bellottii*, and appears to be the most common species in Senegal, but other species including the closely related *D. sargus* may also be present. *D. sargus* is a widespread and commercially important species in southern Europe, and as such there is much more information available on its biology than for *D. bellottii*. Information on both species has been consulted for this ERA, although *D. bellottii* is prioritised where possible. The scores should apply to both species since they are closely related.

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Estimated at *ca*. 4 years for *D. sargus* in Tunisia; estimates for *D. sargus* from other areas have been lower (Mouine et al., 2007). No age information could be found for *D. bellottii*.	1
Average maximum age	Estimated at *ca*. 12 years for *D. sargus* (Pollard et al., 2014). No age information could be found for *D. bellottii*.	2
Fecundity	In the range 35-550,000 eggs per female per spawn according to two studies on *D. sargus* in Egypt and Spain (Fishbase). No information for *D. bellottii* which is smaller but even factoring this in, is likely to produce >20,000 eggs / year for an average sized female, assuming similar biology to *D. sargus*.	1
Average maximum size	Estimated at *ca*. 30 cm for *D. bellottii* and 45 cm for *D. sargus* (Fishbase).	1

Average size at maturity	14 cm for *D. bellottii* in Senegal (Ndiaye, 2015); 20-22 cm for *D. sargus* in Tunisia (Mouine et al., 2007).	1
Reproductive strategy	Both species are partial protandrous hermaphrodites and broadcast spawners in spawning aggregations (Mouine et al., 2007; Ndiaye, 2015).	1
Trophic level	3.6 ± 0.50 se (Fishbase)	3
Productivity risk score		1.43
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Sea breams of the genus *Diplodus* are mostly littoral fishes with a preference for rocky algae reefs and sea grass beds (Summerer et al., 2001). *D. bellottii* is distributed from southern Spain to Senegal, and around the Canary Islands and Cape Verde (Summerer et al., 2001), entering the Mediterranean but only as far as Gibraltar (Fishbase). In the absence of any other information on stock identity, the overlap with this fishery is likely to be small.	1
Encounterability	This is a demersal species, living along the Senegalese coast on rocky and sandy bottoms at depths of up to 100m, although it is most usual between 30 and 50m (Ndiaye, 2015). *Diplodus* spp. juveniles often live in coastal lagoons and estuaries, while the adults are found over rocky areas further offshore (Roques et al., 2007; Pollard et al., 2014). Based on the depth distribution of the species, a medium vertical overlap is assumed.	2
Selectivity of gear type	The average weight for *D. senegalensis (bellottii)* based on sampling of landed catch by Fall and Guèye (2019) was 6.7g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.43
PSA risk score		2.02
MSC-PSA derived scoring indicator		≥80

3.3.12 Lesser African threadfin (*Galeoides decadactylus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Estimated at *ca*. one year (Carpenter, Camara, et al., 2015).	1
Average maximum age	Estimated at *ca*. 4 years (Carpenter, Camara, et al., 2015).	1
Fecundity	Fecundity as the number of ripe eggs in the female fish prior to the next spawning estimated between 214,957 and 307,391 by Ezekiel et al. (2013) in Nigerian waters.	1
Average maximum size	Reported as 50 cm by Fishbase.	1

Average size at maturity	Reported as *ca*. 12 cm by Fishbase.	1
Reproductive strategy	The spawning behaviour of this species is unknown but according to Carpenter, Camara, et al. (2015), the family (Polynemidae) is characterised by pelagic eggs, so it is highly likely that this species is a broadcast spawner.	1
Trophic level	3.6 ± 0.67 se (Fishbase).	3
Productivity risk score		1.29
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	The species is distributed from Mauritania to Angola according to Fishbase. Although the stock structure is unknown, the IUCN rates this species as 'near-threatened' based on evidence of overfishing leading to local depletion in some areas (e.g. Guinea), suggesting that stocks may be on a smaller scale than the overall species distribution. This may be a consequence of the species being 'semi-diadramous' – i.e. migrating into estuaries and rivers to spawn. On that basis, a score of 2 is given for precaution.	2
Encounterability	This is a demersal species living mainly in shallow waters, down to *ca*. 70m, particularly in bays, estuaries and other brackish water habitats (Fishbase). On this basis, a high degree of vertical overlap is assumed.	3
Selectivity of gear type	The average weight for this species based on sampling of landed catch by Fall and Guèye (2019) was 5g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		2.33
PSA risk score		2.66
MSC-PSA derived scoring indicator		≥80

3.3.13 Ballyhoo halfbeak (*Hemiramphus brasiliensis*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	This species reaches maturity in its first year (McBride and Thurman, 2003; Collette et al., 2015).	1
Average maximum age	Collette et al. (2015) reports a longevity of up to 4 years.	1
Fecundity	*H. brasiliensis* spawn frequently, even daily, for at least a few months of the year. Annual individual fecundity of *H. brasiliensis* ranges from 169,000 to 346,809 eggs per year (McBride and Thurman, 2003).	1
Average maximum size	McBride and Thurman (2003) report a maximum body size for *H. brasiliensis* of 31.3 cm FL.	1

Average size at maturity	*Ca*. 20 cm (according to Fishbase and McBride and Thurman (2003)).	1
Reproductive strategy	Spawn in surface waters, hence broadcast spawner (Collette et al., 2015).	1
Trophic level	2.3 ± 0.1 se, according to FishBase.	1
Productivity risk score		1.00
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	The ballyhoo halfbeak has a widespread distribution range in the eastern and western Atlantic. The western Atlantic includes from Massachusetts USA to the Gulf of Mexico, all the way to Brazil, including the Caribbean Sea. The eastern Atlantic includes the Cape Verde islands, Senegal to Angola (Fishbase). In the absence of information on stock structure, the overlap between the fishery and the species' distribution is assumed to be low.	1
Encounterability	Inshore species that has a depth range of 0 - 5 m and usually 0 – 2 m (Fishbase). There is no depth refuge from this fishery, leading to a high risk score.	3
Selectivity of gear type	The average weight for this species based on sampling of landed catch by Fall and Guèye (2019) was 30g. Based on data presented in McBride and Thurman (2003) and the information presented in Section 2.5, it is likely that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		1.93
MSC-PSA derived scoring indicator		≥80

3.3.14 African sicklefish (*Drepane africana*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	No data available but most likely <5 years, given that the maximum age is about 8 years.	1
Average maximum age	8 years (Carpenter et al., 2015b).	1
Fecundity	No information could be found for this or congeneric species. Most likely a broadcast spawner and so with high fecundity, but a score of medium risk is given for precaution.	2
Average maximum size	Maximum length *ca*. 45cm according to Fishbase; 40cm according to Carpenter et al. (2015b).	1
Average size at maturity	12.5 – 14 cm (Carpenter et al., 2015b)	1

Reproductive strategy	No information could be found for this or congeneric species. Most likely a broadcast spawner but a score of medium risk given for precaution.	2
Trophic level	3.1 ± 0.41 se (Fishbase).	3
Productivity risk score		1.57
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Species distribution is from Senegal to Angola, including Cape Verde, with centre of distribution in the Gulf of Guinea (Nigeria) (Carpenter et al., 2015b). Stock structure is unknown, but spatial overlap with this fishery, which operates on the edge of its range, is likely to be low.	1
Encounterability	Coastal species that migrates into bays and estuaries before starting to reproduce. Recorded up to 75m depth but usually shallower than ~50m (Fishbase), so a high vertical overlap with this fishery.	3
Selectivity of gear type	The average weight for this species based on sampling of landed catch by Fall and Guèye (2019) was 40g. Although these are not likely to be juveniles based on length-weight data reported by Fishbase, the information presented in Section 2.5 together with the species' life inshore spawning behaviour, indicates it is likely that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.28
MSC-PSA derived scoring indicator		≥80

3.3.15 African moonfish (*Selene dorsalis*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	No data availalble; however, a small carangid is probably not very long-lived. A score of medium risk is given for precaution.	2
Average maximum age	No data availalble; however, a small carangid is probably not very long-lived. A score of medium risk is given for precaution.	2
Fecundity	No data availalble; most likely broadcast spawners so probably a high number of eggs, but score of medium risk is given for precaution.	2
Average maximum size	Reported at *ca*. 40cm (Fishbase) or 30cm (Arra et al., 2018).	1
Average size at maturity	Reported as *ca*. 20cm in Cote d'Ivoire (Arra et al., 2018).	1
Reproductive strategy	Little is known about the species' spawning behaviour, but the congeneric *S. vomer* spawns offshore so it is assumed that this species is also likely to be a broadcast spawner.	1

	(https://reefs.com/magazine/aquarium-fish-reconsidering-the-lookdown-selene-vomer/).	
Trophic level	4.1 ± 0.69 se (Fishbase).	3
Productivity risk score		1.71
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Distribution of the species is from Senegal to Namibia, including Cape Verde (Smith-Vaniz and Carpenter, 2015). Stock structure is unknown, but spatial overlap with this fishery is likely to be low.	1
Encounterability	Coastal species, recorded to 100m but usually in waters shallower than 60m (Fishbase). Juveniles most likely to be found in bays and estuaries. Vertical overlap with this fishery could be high.	3
Selectivity of gear type	The average weight for this species based on sampling of landed catch by Fall and Guèye (2019) was 10g. The information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.38
MSC-PSA derived scoring indicator		≥80

3.3.16 Black seabream (*Spondyliosoma cantharus*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	Approximately 2 years in females, 3 years in males, because the species is a protogynous hermaphrodite (Russell et al., 2014).	1
Average maximum age	The species is thought to live up to *ca*. 15 years (Russell et al., 2014).	2
Fecundity	Average of approximately 300,000 eggs per female (Russell et al., 2014)	1
Average maximum size	*Ca*. 60cm according to Fishbase.	1
Average size at maturity	*Ca*. 20cm according to Fishbase. The species also changes sex from female to male at ~24-25cm, and may change back to female at >40cm (Russell et al., 2014).	1
Reproductive strategy	Demersal egg layer (Russell et al., 2014)	2
Trophic level	3.3 ± 0.2 se according to Fishbase	3
Productivity risk score		1.57
b. Susceptibility		
Attribute	**Rationale**	**Score**

Areal Overlap	The species is widely distributed in the northeast and central-east Atlantic, from Scotland to West Africa (Fishbase, Russell et al. (2014)). Stock structure is unknown, but spatial overlap with this fishery, which is at the edge of its range, is likely to be low.	1
Encounterability	Distributed down to 300m depth, so there is a significant depth refuge from this fishery, which operates only at up to 40m depth (Section 2.2).	1
Selectivity of gear type	*Scomber* spp. was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.20
PSA risk score		1.98
MSC-PSA derived scoring indicator		≥80

3.3.17 Bonga shad (*Ethmalosa fimbriata*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	According to Panfili et al. (2004), length at maturity is between 15 and 20 cm, which corresponds to fish that are 2-3 years of age.	1
Average maximum age	Panfili et al. (2004) found a maximum age of 5 years in samples, but since the samples were only from estuaries, this could be an underestimate; in any case, however, it is likely to be <10 years.	1
Fecundity	100,000-150,000 eggs per female, depending on size and location (Panfili et al., 2004).	1
Average maximum size	According to sampling in Senegal (2010-16), the maximum size in the catch is *ca*. 40cm (COPACE, 2018).	1
Average size at maturity	Length at maturity is reported on Fishbase at 17cm; according to Panfili et al. (2004) it is in the range 15 to 20 cm in West Africa, depending on sex and environmental conditions.	1
Reproductive strategy	Broadcast spawners.	1
Trophic level	2.5 ± 0.20 se (Fishbase).	1
Productivity risk score		1.00
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	The species is distributed from Mauritania to Angola. COPACE assumes a single stock in Mauritania and Senegal/Gambia, although there may be some sub-stocks in this area (COPACE, 2018). On this basis, the overlap with this fishery is most likely <30% but may not be <10%.	2

Encounterability	According to Fishbase, this species usually occurs between 0 and 50m depth in shallow, inshore coastal and estuarine waters, sometimes also rivers. Vertical overlap with the fishery which operates at up to 40m depth (Section 2.2) is likely to be high.	3
Selectivity of gear type	This species was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		2.33
PSA risk score		2.53
MSC-PSA derived scoring indicator		≥80

3.3.18 Guinean striped mojarra (*Gerres nigri*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	No data available. Given the information on maximum age below, the risk score cannot be higher than 2.	2
Average maximum age	No information found for *G. nigri*, but *G. equulus* (Japan; Iqbal et al. (2006)) was found to be aged up to 10, with most specimens aged 5 or less; for *G. oyena* (Japan; Kanak and Tachihara (2006)) the average maximum for males was found to be 6 and females 8; for *G. filamentosus* (Egypt; El-Nasr (2017)) the maximum age was found to be 8. Biology of *G. nigri* assumed to be the same as these congenerics.	1
Fecundity	Not directly reported but since they are multiple broadcast spawners, likely to be >20,000 eggs per year.	1
Average maximum size	Maximum reported length given as 20cm (Carpenter et al., 2015c).	1
Average size at maturity	Not reported but given the above, certainly less than 40cm.	1
Reproductive strategy	Not directly reported for *G. nigri*, but species in the genus *Gerres* appear to be multiple broadcast spawners (e.g. Cyrus and Blaber (1984))	1
Trophic level	3.2 ± 0.51 se (Fishbase)	3
Productivity risk score		1.43
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	*G. nigri* is an inshore species, which is thought to depend on estuaries at least for some of its life cycle. There is some debate about whether it is a strictly estuarine species, although other species in the genus are known to move in and out of estuaries seasonally (Carpenter et al., 2015c; Cyrus and Blaber, 1984). It is distributed from Senegal to Congo and perhaps further south. The overlap with this fishery is most likely small.	1

Encounterability	Since *G. nigri* is an inshore, shallow water species and Fishbase reports it occurs up to 60m depth. The vertical overlap with the gear is high.	3
Selectivity of gear type	This species was not present in the samples collected by Fall and Guèye (2019); however, the information presented in Section 2.5 clearly indicates that individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	3
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.18
MSC-PSA derived scoring indicator		≥80

3.3.19 Barracuda (*Sphyraena sphyraena*)

a. Productivity		
Attribute	**Rationale**	**Score**
Average age at maturity	The species attains sexual maturity at 3–4 years of age 1–2 years of age in females and 1-2 years of age in males (de Sylva, 1963 in Kadison et al. (2010).	1
Average maximum age	14 years (De Sylva, 1963).	2
Fecundity	Average fecundity ranged from 46,778 to 103,453 eggs in a study by Allam et al. (2004).	1
Average maximum size	200 cm (Fishbase).	2
Average size at maturity	46 – 58 cm (Kadison et al., 2010).	2
Reproductive strategy	Broadcast spawner	1
Trophic level	4.5 ± 0.6 se (Fishbase)	3
Productivity risk score		1.71
b. Susceptibility		
Attribute	**Rationale**	**Score**
Areal Overlap	Ubiquitous species, found in all tropical and subtropical waters except the East Pacific; range spans approximately 32,000 km and more than 4/5th of the earth's circumference, indicating that this species has bridged nearly every major marine biogeographic barrier in tropical oceans over the course of recent evolutionary history (Daly-Engel et al. (2012) and references therein). On this basis, likely aerial overlap with this species is less than 10%.	1
Encounterability	Depth range 1 - 100 m, usually 3 - 30 m (Quéro, 1990; Gasparini and Floeter, 2001) so high vertical overlap with the fishery.	3
Selectivity of gear type	Juveniles of this species are usually found in mangrove swamps or estuaries of rivers. Although it was not present in the samples collected by Fall and Guèye (2019); the information presented in Section 2.5 together with its life history clearly indicates that	3

	individuals < size at maturity are frequently caught (a) and individuals < half the size at maturity are retained by gear (b).	
Post capture mortality	Although the fish are maintained alive, they are ultimately used as bait. Post-capture mortality is high.	3
Susceptibility risk score		1.65
PSA risk score		2.38
MSC-PSA derived scoring indicator		≥80

3.4 Overview

Not a single species received a high PSA risk score in this assessment. Despite the low selectivity of the live bait fishery, its small spatial footprint, combined with the high to medium productivity of the species considered, leads to an overall low risk score. An overview of the PSA results for each species is given as follows:

Scientific name	Common name	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
Sardinella aurita	Round sardinella	1	1	1	1	1	1	3	1.29	2	3	3	3	2.33	2.66	82	Low	≥80
Sardinella maderensis	Flat sardinella	1	1	1	1	1	1	3	1.29	2	3	3	3	2.33	2.66	82	Low	≥80
Sardina pilchardus	Sardine	1	1	1	1	1	1	2	1.14	1	3	3	3	1.65	2.01	95	Low	≥80
Engraulis encrasicolus	Anchovy	1	1	1	1	1	1	3	1.29	1	1	3	3	1.20	1.76	99	Low	≥80
Trachurus spp.	Horse mackerel	1	3	1	1	1	1	3	1.57	1	2	3	3	1.43	2.12	94	Low	≥80
Scomber colias	Chub mackerel	1	1	1	1	1	1	3	1.29	1	1	3	3	1.20	1.76	99	Low	≥80
Mugil cephalus	Grey mullet	1	3	1	2	2	1	1	1.57	1	2	3	3	1.43	2.12	94	Low	≥80
Chloroscombrus chrysurus	Atlantic bumper	1	1	1	1	1	1	3	1.29	1	3	3	3	1.65	2.09	94	Low	≥80
Brachydeuterus auritus	Bigeye grunt	1	1	1	1	1	1	3	1.29	2	2	3	3	1.88	2.27	91	Low	≥80
Caranx rhonchos	False scad	1	2	1	1	1	1	3	1.43	2	2	3	3	1.88	2.36	89	Low	≥80
Diplodus bellottii	Senegal seabream	1	2	1	1	1	1	3	1.43	1	2	3	3	1.43	2.02	95	Low	≥80
Galeoides decadactylus	Lesser African threadfin	1	1	1	1	1	1	3	1.29	2	3	3	3	2.33	2.66	82	Low	≥80
Hemiramphus brasiliensis	Ballyhoo halfbeak	1	1	1	1	1	1	1	1.00	1	3	3	3	1.65	1.93	97	Low	≥80
Drepane africana	African sicklefish	1	1	2	1	1	2	3	1.57	1	3	3	3	1.65	2.28	91	Low	≥80
Selene dorsalis	African moonfish	2	2	2	1	1	1	3	1.71	1	3	3	3	1.65	2.38	89	Low	≥80
Spondyliosoma cantharus	Black seabream	1	2	1	1	1	2	3	1.57	1	1	3	3	1.20	1.98	96	Low	≥80
Ethmalosa fimbriata	Bonga shad	1	1	1	1	1	1	1	1.00	2	3	3	3	2.33	2.53	85	Low	≥80
Gerres nigri	Guinean striped mojarra	2	1	1	1	1	1	3	1.43	1	3	3	3	1.65	2.18	92	Low	≥80
Sphyraena sphyraena	Barracuda	1	2	1	2	2	1	3	1.71	1	3	3	3	1.65	2.38	89	Low	≥80

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