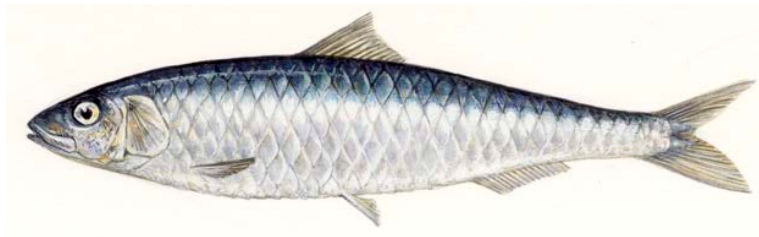


and



**Atlantic sardine and European anchovy**  
*Sardina pilchardus and Engraulis encrasicolus*



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**Mediterranean and Black Seas**  
Pelagic Trawl and Purse seine

February 28, 2014

Blue Ocean Institute Seafood Analysts

**Disclaimer**

Seafood Watch and Blue Ocean Institute strive to ensure that all our Seafood Reports and recommendations contained therein are accurate and reflect the most up-to-date evidence available at the time of publication. All our reports are peer-reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science or aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch program or of Blue Ocean Institute or their recommendations on the part of the reviewing scientists. Seafood Watch and Blue Ocean Institute are solely responsible for the conclusions reached in this report. We always welcome additional or updated data that can be used for the next revision. Seafood Watch and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation and other funders.

## Final Seafood Recommendation

Species/ Fishery	Impacts on Species Under Assessment	Impacts on other Species	Management Effectiveness	Impacts on Habitat and Ecosystem	Overall Recommendation
European anchovy Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.41)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>
Atlantic sardine Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Red (1.41)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>
European anchovy Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Yellow (2.45)	Yellow (3.16)	<b>Good Alternative/Yellow (2.440)</b>
Atlantic sardine Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Yellow (2.45)	Yellow (3.16)	<b>Avoid/Red (2.195)</b>
European anchovy Gulf of Lion – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.41)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.022)</b>
Atlantic sardine Gulf of Lion – Pelagic Trawl & Purse Seine, Unassociated	Red (1.41)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>
European anchovy Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
Atlantic sardine Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Red (2.16)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.022)</b>
European anchovy Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
Atlantic sardine Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>

European anchovy Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
Atlantic sardine Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
European anchovy Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
Atlantic sardine Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
European anchovy Ligurian Sea & North Tyrrhenian Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
European anchovy Black Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Yellow (2.64)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>

**Scoring note** – 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 between 3.2 and 5, **and** no Red Criteria, **and** no Critical scores

● **Good Alternative/Yellow** = Final score between 2.2 and 3.199, **and** Management factors 3.1 (management of retained species) and 3.2 (management of bycatch species) are not scored as very high concern, **and** no more than one Red Criterion, **and** no Critical scores

■ **Avoid/Red** = Final Score between 0 and 2.199, **or** Management factor 3.1 or 3.2 is scored as very high concern, **or** two or more Red Criteria, **or** one or more Critical scores.

## **Summary**

European anchovy and Atlantic sardine are small, schooling species, found throughout the eastern Atlantic Ocean and its associated seas. This report is for European anchovy and Atlantic Sardine caught in small pelagic fisheries in the Mediterranean region, including the Black Sea.

The abundance of European anchovy relative to abundance conservation goals is largely unknown throughout the region. The abundance level of sardine is also uncertain in many areas, but some populations are depleted. Fishing levels on anchovy and sardine are above sustainable levels in several areas. While anchovy and sardine are the primary target species in the small pelagic fisheries in the Mediterranean, other small pelagic fishes are caught as well (e.g., mackerels, horse mackerels, Spanish sardine, and sprat). Fishing levels on chub mackerel in these fisheries are thought to be high and the fisheries may sometimes catch threatened and endangered dolphins.

European anchovy and Atlantic sardine fisheries are managed in international waters by the General Fisheries Commission for the Mediterranean but also by individual countries. Management is currently relatively poor, except in the Adriatic Sea where a management plan has just been introduced.

The purse seines and pelagic trawls used to capture European Anchovy and Atlantic sardine fish at or near the water surface and therefore have little impact on bottom habitats. However, because European Anchovy and Atlantic Sardines are an important prey species in pelagic food webs, there are concerns about the effects of these fisheries on the food web and overall ecosystem.

Anchovy in the Adriatic Sea is rated "yellow" or "good alternative", but all other anchovy and sardine fisheries in the region are rated "red" or "avoid" due to poor management and/or rampant overfishing.

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## Introduction

### **Scope of the analysis and ensuing recommendation**

This report is on the Mediterranean and Black Seas small pelagic fisheries for European anchovy (*Engraulis encrasicolus*) and Atlantic Sardine (*Sardina pilchardus*) in FAO region 37.

### **Overview of the species and management bodies**

European anchovy are a small pelagic species found in the eastern Atlantic and Mediterranean, Black, and Azov Seas (Whitehead 1984). Atlantic Sardine are found in the eastern Atlantic Ocean from the North Sea into the Mediterranean and Black Seas, as well as along the north coast of Africa to Senegal. These species are found in large schools along the coast and in the Mediterranean and Black Seas are primarily targeted by purse seine fisheries but also by pelagic trawlers. Environmental changes, including those caused by the Mediterranean Oscillation Index (WeMOi), appear to impact the survival, spawning activity and growth of these species, and hence their overall population abundance (Guisande 2001) (Catalan et al. 2006) (Ganias 2009) (Solari et al. 2010) (Martin et al. 2012) (Bonanno et al. 2013).

Within the Mediterranean basin there are many sub-populations of European anchovy and sardine (Traina et al. 2011) (WGSASPS 2012) (Kristoffersen and Magoulas 2008). The General Fisheries Commission for the Mediterranean (GFCM) manages both species in the Mediterranean and Black Sea. Individual countries manage these species in their respective waters.



**Figure 1: Geographical sub-areas within the Mediterranean Basin (Image by the General Fisheries Commission for the Mediterranean).** In this report we evaluate Anchovy and sardine fisheries in the Alboran Sea (Areas 1-3), Northern Spain (Area 6), Gulf of Lion (Area 7), Ligurian and North Tyrrhenian Sea (Area 9), Strait of Sicily/South Sicily (Area 16), Adriatic Sea (Areas 17-18), Ionian Sea (Areas 20-21), Aegean Sea (Area 22), and the Black Sea (Area 29).

### **Production Statistics**

European anchovy are one of the most commercially important small pelagic species in the Mediterranean (Leonart and Maynou 2003). Around 5% or 563,000 t (1,241,000,000 lbs.) of worldwide anchovy catches come from the Mediterranean and Black Seas (EIO 2012). Catches in this region have varied from 260,627 t to 765,827 t (574,500,000-1,688,000,000 lbs) since 2001 (FAO 2013a). Within the Mediterranean Sea, the highest catches occur in the North and Central Adriatic Sea (by Italy, Croatia, and Slovenia), with catches in excess of 40,000 t (Casey et al. 2012). High catches also occur in the Aegean Sea off eastern Greece (14,000-24,000 t) and Northern Spain (8,000-10,000 t). Lower catches occur in the Alboran Sea, the Gulf of Lion, the Strait of Sicily, the Ligurian and North Tyrrhenian Seas, and the Ionian Sea (Casey et al. 2012). In the Black Sea, Turkey accounts for the majority of European anchovy catches, with catches ranging from 138,569 t to 385,000 t between 2000 and 2011, followed by Georgia, with catches ranging from 927 t to 39,857 t (FAO 2013a).

Atlantic Sardine are also an important resource in the Mediterranean (FAO 2013b). Catches increased dramatically during the 1990's, peaking in 2001, and then subsequently declined. In recent years (2009-2011), the countries catching the most Atlantic Sardine in the Mediterranean/Black Sea region have been Croatia (30,000-46,000 t), Turkey (28,000-35,000 t), and Algeria (31,000-55,000 t). Other important countries catching sardine include Tunisia (15,000-20,000 t), Spain (15,000-20,000 t) and Italy (~15,000 t) (FAO 2013a).

### **Importance to the US/North American market**

Import statistics for the United States do not break anchovy imports out by species. The United States is one of the top importers of prepared and preserved anchovies (EIO 2012). In 2012, the US imported 3,313 t (7,304,000 lbs) of canned "anchovies" and 994 t (2,191,000 lbs) of pickled or salted "anchovies" (NMFS 2013). Import information specific to the Mediterranean and Black Sea is not available. During 2012, the US imported 694 t of anchovy from Italy, 247 t from Spain, 50 t from Turkey, and very small amounts from France and Greece (NMFS 2013). However, it is unclear if all of the imported "anchovy" from these countries was caught in the Mediterranean and Black Seas.

During 2012, nearly 33,000 t of sardine were imported into the US. Most of this was canned sardine (NMFS 2013). The US imported 400 t of Atlantic Sardine from Spain, as well as small amounts from Croatia, France, Italy, Slovenia, and Turkey.

### **Common and market names**

European anchovy is the accepted common name. Atlantic Sardine are also known as European pilchard.

### **Primary product forms**

European anchovy and Atlantic Sardine are found frozen, fresh, prepared and preserved and salted (EIO 2012).

## Analysis

### Scoring Guide

- All scores result in a zero to five final score for the criterion and the overall final rank. A zero score indicates poor performance, while a score of five indicates high performance.
- The full Seafood Watch Fisheries Criteria that the following scores relate to are available on our website at <http://www.seafoodwatch.org>

### **Criterion 1: Fishery's impact on the species under assessment**

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown. The final Criterion 1 Score is determined by taking the geometric mean of the abundance and fishing mortality scores.*

#### Criterion 1 Summary

<b>ATLANTIC SARDINE</b>				
Region / Method	Inherent Vulnerability	Abundance	Fishing Mortality	Criterion 1 Score
Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Medium	3.00:Moderate Concern	1.00:High Concern	<b>Red (1.732)</b>
Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Medium	3.00:Moderate Concern	2.33:Moderate Concern	<b>Yellow (2.644)</b>
Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Medium	3.00:Moderate Concern	2.33:Moderate Concern	<b>Yellow (2.644)</b>
Gulf of Lion – Pelagic Trawl & Purse Seine, Unassociated	Medium	2.00:High Concern	1.00:High Concern	<b>Red (1.414)</b>
Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Medium	3.00:Moderate Concern	1.00:High Concern	<b>Red (1.732)</b>
Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Medium	2.00:High Concern	2.33:Moderate Concern	<b>Red (2.159)</b>
Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Medium	2.00:High Concern	1.00:High Concern	<b>Red (1.414)</b>

<b>EUROPEAN ANCHOVY</b>				
Region / Method	Inherent Vulnerability	Abundance	Fishing Mortality	Criterion 1 Score
Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	2.33:Moderate Concern	<b>Yellow (2.644)</b>
Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	2.33:Moderate Concern	<b>Yellow (2.644)</b>



Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	1.00:High Concern	Red (1.732)
Black Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	1.00:High Concern	Red (1.732)
Gulf of Lion – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Ligurian Sea & North Tyrrhenian Sea – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	1.00:High Concern	Red (1.732)
Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	1.00:High Concern	Red (1.732)
Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Low	3.00:Moderate Concern	1.00:High Concern	Red (1.732)

There are a number of populations of European anchovy and sardine within the Mediterranean and Black Seas. The abundance of European anchovy relative to sustainable abundance targets or conservation goals is largely unknown. Some Atlantic sardine populations are considered depleted so their population status in some areas is of higher concern than European anchovy. For both species fishing levels on several populations are too high and unsustainable.

### Justification of Ranking

#### ATLANTIC SARDINE

##### Factor 1.1 - Inherent Vulnerability to Fishing

##### *Scoring Guidelines*

- Low = FishBase vulnerability score for species 0-35 OR species exhibits life history characteristics that make it resilient to fishing, e.g., early maturing (<5 years), short lived (< 10 years), small maximum size, and low on food chain.
- Medium = FishBase vulnerability score for species 36-55 OR life history characteristics that make it neither particularly vulnerable or resilient to fishing, e.g. moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain.
- High = FishBase vulnerability score for species 56-100 OR life history characteristics that make it particularly vulnerable to fishing, e.g. long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator.

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g. schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

### Medium

FishBase has assigned a medium vulnerability score of 36 out of 100 for Atlantic sardine (Froese and Pauly 2013). Atlantic sardine grow quickly reaching sexual maturity between 11 and 16 cm (4-6 in) or by 1 year of age. The maximum reported age of Atlantic sardine is over six years (Santojanni et al. 2005) (Silva et al. 2008) (Bigot and Ross 2009) (Bellido et al. 2009) (Giannoulaki et al. 2009) (Quintanilla et al. 2009) (Omar and Hachem 2009). Atlantic sardine are broadcast spawners producing between 50,000 to 490,000 eggs (McEvoy and McEvoy 1992) (Froese and Pauly 2013). Atlantic sardine are an intermediate species in the food web (Froese and Pauly 2013).

## Factor 1.2 – Abundance

### *Scoring Guidelines*

- 5 (Very Low Concern) = Strong evidence that population is above target abundance level (e.g. biomass at maximum sustainable yield, BMSY) or near virgin biomass
- 4 (Low Concern) = Population may be below target abundance level, but it is considered not overfished.
- 3 (Moderate Concern) = Abundance level is unknown and species has a low or medium inherent vulnerability to fishing
- 2 (High Concern) = Population is overfished, depleted, or a species of concern OR Abundance is unknown and species has a high inherent vulnerability to fishing.
- 1 (Very High Concern) = Population is listed as threatened or endangered.

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

**2.00**

### High Concern

There are many populations of Atlantic sardine in the Mediterranean Sea and populations are assessed individually. Sardines have natural fluctuations in abundance levels, which can be related to climate changes (Sabates et al. 2006).

In the North Spanish Mediterranean, the abundance of sardines declined from 3902 million fish to 1210 million fish between 2003 and 2006 (Tugores et al. 2010). Abundance for this population is considered

low and there is a risk of population collapse (Casey et al. 2012). In the Gulf of Lion (French waters), the abundance level of adult sardines was very low from 2008-2011, increasing in 2012; however it is uncertain if this trend will continue (GFCM 2013b). This population is also considered to be at risk of collapse.

In the Strait of Sicily, abundance of sardine has increased slightly in recent years, but the current abundance is only at 48% of the target abundance level, i.e., the biomass needed to produce the maximum sustainable yield (BMSY). Although this population is not considered overfished by managers (GFCM 2012c) (GFCM 2013b) (Casey et al. 2012), because abundance is below 50% of the target level, we consider this population depleted/overfished.

We have awarded a high concern score for these regions due to the low population sizes.

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**3.00**

**Moderate Concern**

In the northern and central Adriatic Sea, abundance of sardine has increased greatly in recent years and is now above both the limit and precautionary abundance reference levels/goals (GFCM 2012c). However, it has been recommended that these abundance reference levels/goals be revised (GFCM 2013c). The abundance of sardine in the southern Adriatic Sea relative to sustainable reference levels/goals is unknown (GFCM 2012b). It has been recommended that these two areas be assessed as a single population. We therefore consider the abundance level of sardine for the entire Adriatic Sea to be uncertain. In the Aegean Sea, abundance of sardine has fluctuated since 2003. The abundance level of sardine relative to sustainable abundance targets/goals is uncertain (Cardinale et al. 2012). No formal assessments have been conducted for sardine in the Alboran Sea so the population status is unknown (GFCM 2013b). The status of sardine in the Ionian Sea is also unknown (Casey et al. 2012) We have awarded a moderate concern score for these regions because the abundance of sardine relative to sustainable abundance targets is unknown and sardine have a medium vulnerability to fishing.

### **Factor 1.3 - Fishing Mortality**

#### *Scoring Guidelines*

- 5 (Very Low Concern) = Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY) OR fishery does not target species and its contribution to the mortality of species is negligible ( $\leq 5\%$  of a sustainable level of fishing mortality)

- 3.67 (Low Concern) = Probable (>50% chance) that fishing mortality is at or below a sustainable level, but some uncertainty OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught)
- 2.33 (Moderate Concern) = Fishing mortality is fluctuating around sustainable levels OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery, and if species is depleted, reasonable management is in place.
- 1 (High Concern) = Overfishing is occurring, but management is in place to curtail overfishing OR fishing mortality is unknown, species is depleted and no management is in place
- 0 = (Critical) = Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**

**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

**1.00**

**High Concern**

Fishing levels with regard to the fishing mortality at maximum sustainable yield (FMSY) have not been determined for sardine populations. However, for the majority of sardine populations in the Mediterranean Sea, scientists and managers have recommended a maximum sustainable exploitation rate (fishing mortality/fishing mortality + natural mortality) of 0.4 (Casey et al. 2012)(GFCM 2012c). If exploitation rates are above this level, this indicates that fishing levels are unsustainable or that overfishing is occurring.

In the northern Adriatic Sea, fishing levels on Atlantic sardine are above the recommended sustainable level, which means overfishing is occurring (GFCM 2012c). In the southern Adriatic Sea, no formal assessment has been conducted so the fishing level on sardine is unknown (Casey et al. 2012) (GFCM 2012b) (GFCM 2013b). In the Ionian Sea, fishing levels on sardine are also above the recommended sustainable level (Casey et al. 2012). In the Gulf of Lion, the sardine population is considered fully exploited, meaning there is no room for any increase in the fishing level/catches. However, because the population is close to collapse it has been recommended the fishing levels be reduced or the fishery closed (Casey et al. 2012) (GFCM 2013b). In northern Spain, the exploitation rate (fishing mortality/fishing mortality + natural mortality) is 0.78, which is above the maximum recommended sustainable exploitation level of 0.4; thus overfishing is currently occurring (Casey et al. 2012). We have awarded a high concern score for these regions because fishing mortality rates are too high.

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

2.33

**Moderate Concern**

In the Strait of Sicily, the sardine population is considered sustainably fished, though current fishing levels are slightly above (105%) the fishing mortality at maximum sustainable yield (FMSY)(GFCM 2013b). The population in the Aegean Sea is also considered to be sustainably fished based on long term catches and is right around the recommended exploitation rate (fishing mortality/total mortality) of 0.4 (Cardinale et al. 2012). Fishing levels with regard to the fishing mortality at maximum sustainable yield (FMSY) however are uncertain. In the Alboran Sea, fishing levels on sardine are uncertain but may range from fully exploited to overexploited (GFCM 2012c). We have awarded a moderate concern score for these regions because fishing mortality levels are either around sustainable levels or uncertain.

**EUROPEAN ANCHOVY****Factor 1.1 - Inherent Vulnerability to Fishing***Scoring Guidelines*

- Low = FishBase vulnerability score for species 0-35 OR species exhibits life history characteristics that make it resilient to fishing, e.g., early maturing (<5 years), short lived (< 10 years), small maximum size, and low on food chain.
- Medium = FishBase vulnerability score for species 36-55 OR life history characteristics that make it neither particularly vulnerable or resilient to fishing, e.g. moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain.
- High = FishBase vulnerability score for species 56-100 OR life history characteristics that make is particularly vulnerable to fishing, e.g. long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator.

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g. schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

### Low

European Anchovy have a FishBase vulnerability score of 14 out of 100 (Froese and Pauly 2013), which is considered a low vulnerability to fishing. They reach sexual maturity early in life at around 1 year of age and 10-13 cm (4-5 in) in length, and live to around 4 years of age (Giraldez and Abad 1995)(Perterra and Lleonart 1996)(Uriate et al. 1996)(Somarakis and Nikolioudakis 2007)(Somarakis et al. 2004)(Froese and Pauly 2013). European Anchovy are broadcast spawners, releasing their eggs into the water column. They spawn multiple times a year, producing around 13,000 to 500,000 eggs (Whitehead et al. 1988) (Froese and Pauly 2013). Anchovies are an important food source for many species.

## Factor 1.2 – Abundance

### *Scoring Guidelines*

- 5 (Very Low Concern) = Strong evidence that population is above target abundance level (e.g. biomass at maximum sustainable yield, BMSY) or near virgin biomass
- 4 (Low Concern) = Population may be below target abundance level, but it is considered not overfished.
- 3 (Moderate Concern) = Abundance level is unknown and species has a low or medium inherent vulnerability to fishing
- 2 (High Concern) = Population is overfished, depleted, or a species of concern OR Abundance is unknown and species has a high inherent vulnerability to fishing.
- 1 (Very High Concern) = Population is listed as threatened or endangered.

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

**3.00**

### **Moderate Concern**

There are several different populations of European anchovy in the Mediterranean Sea (Traina et al. 2011) (WGSASPS 2012) (Kristoffersen and Magoulas 2008) and population assessments are conducted for each individual population. Population abundances of European anchovy in the Mediterranean Sea

range from low to moderate, and for some populations abundance is unknown (see detailed rationale section below). Climate changes may affect population sizes from year to year (Martin et al. 2012).

In the Black Sea, there have been large declines in European anchovy abundance over time, but since 2007 the abundance of sexually mature fish has remained stable around 600,000-700,000 t. Recruitment (i.e. the amount of new fish entering the population) has varied between 2002 and 2011 (Daskalov et al. 2012).

No European anchovy populations have been declared overfished or depleted, but for the majority of populations, abundance conservation goals have not been determined, making it difficult to evaluate whether abundances are at healthy or unhealthy levels (Casey et al. 2012)(GFCM 2012c)(GFCM 2011b). We therefore consider abundance levels to be uncertain throughout this region. Since European anchovy has a low vulnerability to fishing, this factor is rated 'moderate concern'. (Palomera et al. 2008)(Casey et al. 2012)

#### **Detailed Rationale:**

Within the Mediterranean Sea, the European anchovy population in Northern Spain is considered to have a low abundance. Abundance declined between 2003 and 2006, from 3486 million fish to 1456 million fish (Tugores et al. 2010). Declines in abundance in this region were also observed during the 1990's (Giraldez et al. 2006) (Palomera et al. 2008) (Casey et al. 2012). The population in the Gulf of Lion (French waters) is also at a low abundance, though abundance is thought to have remained stable since 2005 (Casey et al. 2012) (GFCM 2011b) (GFCM 2012c) (GFCM 2013b). In the Gulf of Lion, the age/size structure of European anchovy is skewed toward younger/smaller individuals; as well, reduced mean length at age, a distortion of the sex-ratio, reduced growth rate, and reduced size-at first maturity have all been observed (Casey et al. 2012)(GFCM 2012c). Neither of these populations are considered overfished, but no abundance conservation goals have been established.

In the Strait of Sicily, the current abundance of European anchovy is at 56% of the target abundance level or the biomass needed to produce the maximum sustainable yield/catch (BMSY). This is considered a low abundance. However abundance is still slightly above the limit abundance reference point, so the population is not considered overfished, but the population is overexploited and this could lead to population declines in the future (GFCM 2012c).

In the Northern and Central Adriatic Sea (north Italy, Croatia, and Slovenia), abundance is considered to be at a medium abundance level and is above both the limit/overfished abundance reference point and the precautionary abundance reference point/goal (GFCM 2012c). However, it has been recommended that these abundance reference points/goals be revised (GFCM 2013b). In the Southern Adriatic Sea (south Italy, Montenegro, and Albania), the abundance of European anchovy is uncertain (Casey et al. 2012) (GFCM 2013b). It has been recommended that these two areas be assessed as a single population. We therefore consider the abundance of anchovy for the entire area unknown.

Abundance is also uncertain for other populations in the Mediterranean. In the Ionian Sea (western Greek waters), abundance has generally decreased since 2002, but there was a slight increase from 2006-2008 (Casey et al. 2012). In the Aegean Sea (eastern Greek waters), although a large amount of uncertainty surrounded the results, abundance appears to have increased from 2006 to 2008 (Cardinale et al. 2012). Information on the abundance of European anchovy in the Ligurian and North Tyrrhenian Seas (northwestern Italy) is not available (Casey et al. 2012). In the Alboran Sea (south Spain, Morocco, and Algeria), managers are currently working towards a population assessment of European anchovy, but as of 2012, there was not enough information to complete a formal assessment. Abundance for this population is unknown (GFCM 2013b) (Casey et al. 2012).

### Factor 1.3 - Fishing Mortality

#### *Scoring Guidelines*

- 5 (Very Low Concern) = Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY) OR fishery does not target species and its contribution to the mortality of species is negligible ( $\leq 5\%$  of a sustainable level of fishing mortality)
- 3.67 (Low Concern) = Probable ( $>50\%$  chance) that fishing mortality is at or below a sustainable level, but some uncertainty OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught)
- 2.33 (Moderate Concern) = Fishing mortality is fluctuating around sustainable levels OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery, and if species is depleted, reasonable management is in place.
- 1 (High Concern) = Overfishing is occurring, but management is in place to curtail overfishing OR fishing mortality is unknown, species is depleted and no management is in place
- 0 = (Critical) = Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Black Sea, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

1.00

High Concern



For the majority of European anchovy populations in the Mediterranean Sea and in the Black Sea, scientists and managers have recommended a maximum sustainable exploitation rate (fishing mortality/fishing mortality + natural mortality) of 0.4 (Casey et al. 2012)(GFCM 2012c). If exploitation rates are above this level, this indicates that fishing levels are unsustainable or that overfishing is occurring. Fishing exploitation levels are currently considered to be greater than the recommended level of 0.4 for several populations in the Mediterranean Sea, including the North Alboran Sea, Northern Spain, Ligurian and North Tyrrhenian Seas, and the Strait of Sicily (Casey et al. 2012)(GFCM 2013b). Therefore, overfishing is considered to be occurring on these populations. European Anchovy are also undergoing overfishing in the Black Sea, where the current exploitation rate is around 0.54 (Daskalov et al. 2012). We have therefore awarded a high concern score for these regions.

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**  
**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**2.33**

**Moderate Concern**

Fishing levels with regard to the fishing mortality at maximum sustainable yield (FMSY) have not been determined. However, for the majority of European anchovy populations in the Mediterranean Sea and in the Black Sea, scientists and managers have recommended a maximum sustainable exploitation rate (fishing mortality/fishing mortality + natural mortality) of 0.4 (Casey et al. 2012)(GFCM 2012c). If exploitation rates are above this level, this indicates that fishing levels are unsustainable or that overfishing is occurring.

For the North and Central Adriatic Sea, there appears to be a dispute among scientists/managers as to whether fishing levels are sustainable or not. The General Fisheries Commission for the Mediterranean (GFCM), the regional management body, considers fishing mortality on this population to be right around the recommended level and thus sustainable (GFCM 2012c)(GFCM 2013b). However, the Scientific, Technical, and Economic Committee for Fisheries (STECF) of the European Union suggested that there were flaws in the GFCM's assessment and that it is likely that overfishing is occurring (Casey et al. 2012). In the Gulf of Lion, the population is being fished at the maximum sustainable level, meaning there is no room for any increase in catches (Casey et al. 2012) (GFCM 2013b). In the Aegean Sea, the last population assessment in 2008 indicated that the exploitation rate was just below the recommended level and therefore the population was being sustainably fished at the time (Cardinale et al. 2012). Fishing mortality/exploitation rates are uncertain for Ionian Sea population. We have awarded a moderate concern score for these regions because the fishing levels either uncertain or fluctuating around sustainable levels.

## **Criterion 2: Impacts on other retained and bycatch species**

All retained and primary bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch.

### **Criterion 2 Summary**

<b>Atlantic sardine</b>				
<b>Region / Method</b>	<b>Lowest Scoring of Other Species</b>	<b>Lowest Species Subscore</b>	<b>Discard Rate Modifying Score ((Discards+Bait)/Retained Catch)</b>	<b>Criterion 2 Score</b>
<b>Adriatic Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Aegean Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel & European Anchovy	1.732	1.00 (<20%)	Red (1.732)
<b>Gulf of Lion, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Ionian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Strait of Sicily, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel & European Anchovy	1.732	1.00 (<20%)	Red (1.732)
<b>Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel & European Anchovy	1.732	1.00 (<20%)	Red (1.732)

<b>European Anchovy</b>				
<b>Region / Method</b>	<b>Lowest Scoring of Other Species</b>	<b>Lowest Species Subscore</b>	<b>Discard Rate Modifying Score ((Discards+Bait)/Retained Catch)</b>	<b>Criterion 2 Score</b>
<b>Adriatic Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel & Atlantic Sardine	1.732	1.00 (<20%)	Red (1.732)

<b>Aegean Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Gulf of Lion, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Sardine	1.414	1.00 (<20%)	Red (1.414)
<b>Ionian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel & Atlantic Sardine	1.732	1.00 (<20%)	Red (1.732)
<b>Strait of Sicily, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Sardine	1.414	1.00 (<20%)	Red (1.414)
<b>Ligurian Sea &amp; North Tyrrhenian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Atlantic Chub Mackerel	1.732	1.00 (<20%)	Red (1.732)
<b>Black Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	Mediterranean horse mackerel	2.644	1.00(20%)	Yellow (2.644)

European anchovy and Atlantic sardine are the main target species in the Mediterranean small pelagic fisheries. However, several other species of lower commercial importance can be caught, with the composition of species varying slightly among areas. In all areas, the majority of the species caught are retained, so discards (fish thrown back to sea) are low.

In the Aegean and Ionian Sea purse seine fisheries, five species make up over 97% of the marketable catch: European anchovy, Atlantic sardine, Spanish sardine, bogue, and chub mackerel in the Aegean Sea and picarel in the Ionian Sea. In these regions, European anchovy and sardine make up around 39% and 29% of the catch, respectively (Tsagarakis et al. 2012). In the Ionian Sea, chub mackerel was also included in the assessment because it was reported to occasionally be caught and there is some concern about the status of chub mackerel in the Mediterranean. In other areas within the Mediterranean Sea, commonly reported bycatch includes Atlantic mackerel, Chub mackerel, horse mackerels (*Trachurus* spp.), and Spanish sardine (GFCM 2008) (GFCM 2011) (Santoganni et al. 2005) (Casey et al. 2012). As well, in the Alboran Sea and northern Spanish Mediterranean, Atlantic saury and bullet tuna were reported in the bycatch {GFCM 2008}. Sprat was reported as a common bycatch species in the Adriatic Sea and the Gulf of Lion (since 2008) {GFCM 2011}{Santoganni et al. 2005}{Casey et al. 2012}. The small pelagic fisheries in the Mediterranean Sea have the greatest impact on Atlantic chub mackerel and in some areas Atlantic sardine, because there is concern about their abundance and fishing levels are unsustainable. There is also some concern about incidental catches of the endangered short-beaked

common dolphin in the Mediterranean Sea fisheries. In the Black Sea, the only common bycatch species in the anchovy fisheries is the Mediterranean horse mackerel {Sahin et al. 2008}. There is also the potential for incidental catches of short-beaked common dolphins in the Black Sea; in the Black Sea this species is considered vulnerable.

### **Justification of Ranking**

*Only the lowest scoring species are listed in the text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix B. See criterion 1 for scoring guidelines.*

## **ATLANTIC CHUB MACKEREL**

### **Factor 2.1 - Inherent Vulnerability to Fishing**

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Medium**

Chub mackerel have a medium vulnerability to fishing score of 46 out of 100 according to FishBase (Froese and Pauly 2013). They reach sexual maturity at a length of 18 cm and around 2 to 3 years of age (Froese and Pauly 2013) (Cengiz 2012). Females spawn several batches of eggs a year with an average annual fecundity rate of 100,000 to 400,000 eggs (Collete and Nauen 1983). Chub mackerel have a maximum reported age of 18 years and maximum size of 30 cm fork length (Collette and Nauen 1983) (Hernandez and Ortega 2000). Within the food chain, Atlantic chub mackerel are an intermediate species (Froese and Pauly 2013).

### **Factor 2.2 – Abundance**

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated****3.00****Moderate Concern**

The International Union for Conservation of Nature (IUCN) considers Atlantic chub mackerel a species of 'Least Concern' globally. However, in the IUCN assessment, they note that chub mackerel are 'Near Threatened' in the Mediterranean (Collette et al. 2011b). No other assessments for this species have been conducted in the Mediterranean region. Due to the lack of information on their status in this region, we have awarded a moderate concern score.

**Factor 2.3 - Fishing Mortality****Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated****Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated****Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated****Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated****Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated****Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated****Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated****Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated****1.00****High Concern**

No comprehensive population assessment of Atlantic chub mackerel in the Mediterranean Sea has been conducted. However, a study that estimated fishing mortality levels of Atlantic chub mackerel in the Aegean Sea suggested fishing levels were high and that overfishing was likely occurring (Cengiz 2012). The International Union for Conservation of Nature has also identified that current fishing exploitation levels of Atlantic chub mackerel in the Mediterranean are "intense" and that catches since the 1980's have been declining (Collette et al. 2011b). We have awarded a high concern score because fishing mortality rates are unknown but may be high, the status of the population is unknown and there are no management measures in place.

**MEDITERRANEAN HORSE MACKEREL****Factor 2.1 - Inherent Vulnerability to Fishing****Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated****Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated****Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated****Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated****Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated****Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated****Black Sea, Pelagic Trawl & Purse Seine, Unassociated**

## Medium

Mediterranean horse mackerel have a medium FishBase vulnerability score of 46 out of 100 (Froese and Pauly 2013). Mediterranean horse mackerel reach a maximum length of 60 cm (FL) (Bauchot 1997) and 12 years of age and mature around 20 cm (Froese and Pauly 2013). Spawning occurs multiple times during a season and the average fecundity per spawning event has been reported to range from 9,433 to 10,839 eggs. This species is an intermediate to top-level species within the food chain. For European horse mackerel, FishBase assigned a moderate-high vulnerability score of 56 out of 100 (Froese and Pauly 2013). However, this species reaches sexual maturity early in life, between 3-4 years of age (21-30 cm in length), lives to around 10 years of age, and grows to a maximum length of 70 cm. They are broadcast spawners with a fecundity range of 12,700 to 344,700 eggs (Froese and Pauly 2013). They are also intermediate to top levels species within the food chain. Taking into account the FishBase vulnerability scores and the life history information for these species, we have scored vulnerability as medium.

## Factor 2.2 - Abundance

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

Black Sea, Pelagic Trawl & Purse Seine, Unassociated

**3.00**

**Moderate Concern**

An assessment of Mediterranean horse mackerel has been conducted in the Black Sea but is considered preliminary. The Black Sea assessment did estimate a recent increase in the population of recruits (i.e. new fish entering the population), but a decrease in abundance of sexually mature fish (Bernal 2012). No assessments in the remainder of the Mediterranean Sea have been conducted for horse mackerel species. We have awarded a moderate concern score because of their medium vulnerability to fishing and lack of information on population sizes.

## Factor 2.3 - Fishing Mortality

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

Black Sea, Pelagic Trawl & Purse Seine, Unassociated

**2.33****Moderate Concern**

Mediterranean horse mackerel have been assessed in the Black Sea, but the assessment is considered unreliable and preliminary and therefore the fishing level is uncertain (GFCM 2013b). Catches in the Black Sea have ranged from 9,633 t in 2004 to 20,842 t in 2008 (2004-2010) (Bernal 2012). No other assessments have been conducted for either horse mackerel species in the Mediterranean region, so fishing levels are unknown (Turan 2004) (Casey et al. 2012). We have therefore awarded a moderate concern score.

**ALL SPECIES****Factor 2.4 - Discard Rate**

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

**1.00****< 20%**

The two main target species in the Mediterranean small pelagic fisheries are European anchovy and sardine. However, other small pelagic species are also caught and at times can make up a substantial proportion of the total catch. The composition of species varies among areas, but other species caught include horse mackerels (*Trachurus* spp.), Atlantic mackerel, chub mackerel, Spanish sardine, bullet tuna, Atlantic saury, and sprat (GFCM 2008) (GFCM 2011b) (Casey et al. 2012). Discards of these species (those thrown back to sea) varies among areas. On average 4.6% of the total catch (weight) in the Aegean Sea is discarded and only 2.2% is discarded in the Ionian Sea. Sardine and mackerel are not typically discarded but during the fall recruitment season, large amounts of small European anchovy are discarded. The discarding rates for the other species (bogue, picarel and Spanish sardine) vary in this region from 0-100%, depending on the market (Tsagarakis et al. 2012). However, in the Adriatic Sea, discard ratios (discards/total retained catch) appear to be higher, ranging from 2% to 15% for pelagic trawls and midwater trawls. Similarly, discard ratios in the western Mediterranean have been estimated to range from 13% to 15% (Santojanni et al. 2005) (Kelleher 2005). In the north eastern Black Sea, discard ratios in the small pelagic purse seine fishery have been estimated to be very low, around 1% (Sahin et al. 2008).

## **Criterion 3: Management effectiveness**

*Management is separated into management of retained species and management of non-retained species/bycatch. The final score for this criterion is the geometric mean of the two scores.*

### **Criterion 3 Summary**

<b>Region / Method</b>	<b>Management of Retained Species</b>	<b>Management of Non-Retained Species</b>	<b>Criterion 3 Score</b>
<b>Adriatic Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	3.00: Moderate Concern	2.00: High Concern	Yellow(2.449)
<b>Aegean Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Black Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Gulf of Lion, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Ionian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Ligurian Sea &amp; North Tyrrhenian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Strait of Sicily, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)
<b>Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated</b>	1.00: Very High Concern	2.00: High Concern	Red(1.414)

The General Fisheries Commission for the Mediterranean, which manages European Anchovy and Atlantic Sardine in international waters of the Mediterranean and Black Sea, has implemented very few management measures for these two target species or other species caught in the small pelagic fisheries. Some individual countries have implemented measures such as minimum size limits, fishing effort restrictions, and gear restrictions. Unfortunately, measures to date have been unable to rebuild populations with low abundances or adequately control fishing levels. However, a new management plan was recently implemented for the Adriatic Sea population, which should help sustain these populations, and thus management is rated more highly for the Adriatic Sea. There is limited monitoring of bycatch species, like marine mammals, in these fisheries.

### **Justification of Ranking**

#### **Factor 3.1: Management of Fishing Impacts on Retained Species**

##### *Scoring Guidelines*

*Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective', 'moderately effective', or 'highly*



*effective*'.

- 5 (Very Low Concern) = Rated as 'highly effective' for all seven subfactors considered
- 4 (Low Concern) = Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective'.
- 3 (Moderate Concern) = All subfactors rated at least 'moderately effective'.
- 2 (High Concern) = At minimum meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective'.
- 1 (Very High Concern) = Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective'
- 0 (Critical) = No management exists when a clear need for management exists (i.e., fishery catches threatened, endangered, or high concern species) OR there is a high level of Illegal, Unregulated, and Unreported Fishing occurring.

Factor 3.1: Management of fishing impacts on retained species								
Region / Method	Strategy	Recovery of Species of Concern	Research	Following Scientific Advice	Enforcement of Regulations	Track Record	Stakeholder Inclusion	Factor 3.1 Score
Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	3.00: Moderate Concern
Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Black Sea, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Ligurian Sea, Pelagic Trawl &	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High

Purse Seine, Unassociated								Concern
Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern
Spain Mediterranean, Pelagic Trawl Purse Seine, Unassociated	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	1.00: Very High Concern

### Subfactor 3.1.1 - 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. To achieve a highly effective rating, there must be appropriate management goals and evidence that the measures in place have been successful at maintaining/rebuilding species.*

#### Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

##### Moderately Effective

In international waters of the Mediterranean and Black Seas, management regulations for small pelagic fisheries that catch European anchovy, sardine, and other species are established by the General Fisheries Commission for the Mediterranean (GFCM). Individual countries are expected to implement these regulations and are responsible for the management of the fisheries in their respective waters. To date, the GFCM has adopted few regulations pertaining to the small pelagic fisheries. In 2006, they established a regulation to develop a fishing effort program for pelagic trawl and purse seine fisheries targeting European anchovy, Atlantic sardine, and other small pelagic species (GFCM 2012a), but this does not appear to have been developed yet. However, individual countries have implemented their own management regulations to regulate their small pelagic fisheries. For instance, in Italy, fishing is not allowed on the weekends and there is a closed season for pelagic trawlers in August, but not for purse seiners (Cardinale et al. 2012). Recently (2013), the General Fisheries Commission for the Mediterranean did adopt a regulation to develop a multi-annual management plan for European anchovy and sardine in the Adriatic Sea, which includes the countries of Italy, Croatia, Slovenia, Montenegro, and Albania. The plan is to include fishing mortality and abundance goals/targets, monitoring recommendations as well as the directive to determine management measures based on the status of the population, required size limits for both species, and area closures to protect fish during their first year of life (GFCM 2013a). It remains to be seen how successful this new management strategy will be, but given the new efforts to sustain anchovy and sardine populations in this region, we consider the management strategy of the Adriatic Sea fisheries moderately effective.

**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Black Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**  
**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated**  
**Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated**  
**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

### **Ineffective**

In international waters of the Mediterranean and Black Seas, management regulations for small pelagic fisheries that catch European anchovy, sardine, and other species are established by the General Fisheries Commission for the Mediterranean (GFCM). Individual countries are expected to implement these regulations and are responsible for the management of the fisheries in their respective waters. To date, the GFCM has adopted few regulations pertaining to the small pelagic fisheries. In 2006, they established a regulation to develop a fishing effort program for pelagic trawl and purse seine fisheries targeting European anchovy, Atlantic sardine, and other small pelagic species (GFCM 2012a), but this does not appear to have been developed yet. However, individual countries have implemented their own management regulations to regulate their small pelagic fisheries. In northern Spain, a two month closure to protect European anchovies and sardine during the December-January recruitment period has been in place since 1993 (Palomera et al. 2008). There is also a minimum size limit of 11 cm for anchovy and sardine, gear and mesh size restrictions, vessel size limit restrictions, and no fishing on weekends (GFCM 2011b). In the Gulf of Lion (French waters), there are fishing effort limitations (no fishing on weekends or during certain hours) and limits on vessel size and power; however a few of the regulations are not followed (GFCM 2011b). In Italy, fishing is not allowed on the weekends and there is a closed season for pelagic trawlers in August, but not for purse seiners (Cardinale et al. 2012). In the Aegean and Ionian Seas (Greek waters) there are regulations on how far from shore purse seine fishermen must operate, gear and mesh size restrictions, vessel size limits, a closed period from mid-December until the end of February, and a minimum size limit of 11 cm for sardines and 9 cm for European anchovy (Casey et al. 2012).

In the Black Sea, Georgia has an annual catch limit of 60,000 t (132,300,000 lbs.) for European anchovy. This catch limit was instituted in 2007 and will last ten years (Ozturk et al. 2011). However, Turkey accounts for the majority of the catches in the Black Sea region, and they have not adopted an annual catch limit for anchovy.

To date management measures have not been able to control fishing levels on many anchovy and sardine populations and in some areas this has led to species declines and depletions. As well, there are no regulations in place for other pelagic species that are sometime caught in these fisheries. Scientists have recommended that catch limits be established to control fishing levels, rather than solely relying on regulations that control fishing effort, and that management plans be adopted (Casey et al. 2012). While we recognize the new management plan in the Adriatic Sea (and therefore rate

management in this region moderately effective), because of the lack of adequate regulations to control fishing on anchovy and sardine throughout the rest of the Mediterranean and Black Seas, we have awarded an ineffective score for all other regions.

### **Subfactor 3.1.2 - Recovery of Species of Concern**

*Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success. To achieve a highly effective rating, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/ endangered species.*

#### **Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**

##### **Moderately Effective**

European anchovy and Atlantic sardine populations are currently thought to be at healthy abundance levels in the northern and central Adriatic Sea, but there is some uncertainty as to whether the abundance reference points for this population are appropriate. There is also uncertainty with regard to their abundance in the southern Adriatic Sea. As well, fishing levels on sardine are above sustainable levels. A new fishery management plan was recently established for these species in the Adriatic Sea, which should help to sustain these populations (GFCM 2013a). However, there is also concern about the abundance and fishing levels on chub mackerel in the Mediterranean (Collette et al. 2011b) and no specific management measures are in place for this species. It is unclear how much chub mackerel may be caught in the Adriatic Sea fisheries. Because it is unclear if a recovery strategy is needed for chub mackerel, we have awarded a moderately effective score.

#### **Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**

#### **Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**

#### **Black Sea, Pelagic Trawl & Purse Seine, Unassociated**

#### **Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

#### **Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated**

#### **Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated**

##### **Moderately Effective**

Sardine and anchovy populations in these regions are not considered overfished, though for several population the current population status is uncertain. As well, in the Strait of Sicily, abundance is slightly below 50% of the biomass at maximum sustainable yield, and thus by our criteria this population is overfished; but fishing levels in the Strait of Sicily are currently around sustainable levels (GFCM 2012c) (Casey et al. 2012). There is also concern about the abundance and fishing mortality of chub mackerel in the Mediterranean Sea (Collette et al. 2011b) and no specific management measures for this species have been established. Because it is unclear if recovery strategies are needed or not in these regions, we

have rated this factor moderately effective.

**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

**Ineffective**

In the Gulf of Lion the sardine population is considered collapsed or depleted and in north Spain the sardine population is also considered at risk of collapse (GFCM 2012b)(GFCM 2012c)(GFCM 2013c)(Casey et al. 2012). In the Gulf of Lion, targeting of sardine no longer occurs due to the very low abundance and it has been recommended that fishing levels are not increased until the species recovers (GFCM 2012c)(GFCM 2013c). In north Spain it has been recommended that fishing be decreased to the lowest possible levels (GFCM 2012b). However, no catch limits have been established for these populations to control fishing levels and rebuilding plans are not in place. As well, there is concern about the abundance level and fishing mortality of chub mackerel in the Mediterranean and measures have not been established for this species. Due to the lack of adequate management measures to rebuild sardine populations in these regions, we have awarded an ineffective score.

**Subfactor 3.1.3 - Scientific Research and Monitoring**

*Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species. To achieve a highly effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.*

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Black Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**

**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated**

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

**Moderately Effective**

The major European anchovy and sardine populations in the Mediterranean basin are assessed regularly by the General Fisheries Commission for the Mediterranean (GFCM) (GFCM 2008)(GFCM 2011b)(GFCM 2012c). In the majority of European Union member states, assessments are also conducted by Expert Working Groups of the Scientific, Technical and Economic Committee for Fisheries (STECF). Catch and effort information is collected and acoustic surveys and Daily Egg Production Method (DEPM) are used in some areas to estimate abundance. However, for some populations there is not sufficient data to conduct population assessments or determine population status. In addition, for other

retained species, data is not regularly collected and population assessments are not conducted (Casey et al. 2012). We have therefore awarded a moderately effective score.

#### **Subfactor 3.1.4 - Management Record of Following Scientific Advice**

*Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels). A highly effective rating is given if managers nearly always follow scientific advice.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Moderately Effective**

The small pelagic working group in charge of assessing European anchovy and sardine populations in the Mediterranean basin and the Scientific Advisory Committee provide management advice to the General Fisheries Commission for the Mediterranean (GFCM) (GFCM 2012d)(GFCM 2013b). This advice is provided for each assessed population. Scientific advice for fisheries/populations of the European Union is also provided by the Scientific, Technical, and Economic Committee for Fisheries (STECF) (Casey et al. 2012). For most populations it has been recommended that fishing levels be reduced or kept at current levels. However, no catch limits have been put into place. It also been recommended that management plans be created for each population and that they take into account the multi-species nature of the fishery when appropriate (Casey et al. 2012). Recently, a management plan was adopted for the Adriatic Sea and managers will now consider the state of the both the Anchovy and sardine populations when setting regulations (GFCM 2013a). However, management plans have not yet been developed for other populations. Since managers appear to only sometimes follow scientific advice, we have awarded a moderately effective score.

#### **Subfactor 3.1.5 - Enforcement of Management Regulations**

*Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations. To achieve a highly effective rating, there must be regular enforcement of regulations and verification of compliance.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

### **Moderately Effective**

The General Fisheries Commission for the Mediterranean, has a compliance committee that is tasked with reviewing compliance and implementation of adopted measures, enforcement of regulations, and monitoring illegal, unreported and unregulated (IUU) fishing (GFCM 2012a). Current measures adopted by the GFCM related to ensuring compliance and enforcement of regulations include, requiring that vessel monitoring systems are installed, that countries provide a list of any vessels engaged in IUU fishing, and that they implement inspections and rules at vessels landing sites (ports) for foreign vessels. However, a performance review of the GFCM conducted during 2009 and 2010 indicated that compliance and enforcement within the organization could be improved (GFCM 2011a). There are many member countries that have not implemented or only partially implemented several of the adopted regulations. The GFCM is working on addressing these instances of non-compliance (GFCM 2013a). We have therefore awarded a moderately effective score.

### **Subfactor 3.1.6 – Management Track Record**

*Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels. A highly effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.*

Adriatic Sea, Purse Seine, Unassociated

### **Moderately Effective**

Anchovy and sardine are not thought to be overfished in the Adriatic Sea, though there is some uncertainty regarding their abundance level. Fishing levels on sardine have been above sustainable levels (Casey et al. 2012, GFCM 2013a). However, a new management plan was recently implemented for the Adriatic Sea anchovy and sardine fisheries, which should help to sustain to these species. Therefore the track record for the Adriatic Sea is considered moderately effective.

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Ineffective**

Sardine population in the Gulf of Lion and North Spain are considered depleted. To date, measures enacted by managers have not been able to adequately control fishing levels or rebuild depleted populations in these regions (Casey et al. 2012)(GFCM 2013a).

Populations of European anchovy and Atlantic sardine in other areas are currently not considered depleted, but fishing levels on several European anchovy and Atlantic sardine populations are too high. Continued high fishing is likely to lead to the depletion of more population in the future. Because the current management system has been ineffective at control fishing levels and there have been no new management efforts to ensure the sustainability of sardine and anchovy populations (with the exception of the Adriatic Sea region)(Casey et al. 2012), we have the rated the track record ineffective for all areas other than the Adriatic Sea.

#### **Subfactor 3.1.7 - 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 and includes stakeholder input.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Moderately Effective**

A performance review of the General Fisheries Commission for the Mediterranean found that cooperation with both member countries and non-member countries could be improved, and that there



was a need to improve assistance to developing nations (GFCM 2011a). Representatives from governmental and non-governmental organizations are invited to participate in the commission meetings on proposed management regulations (GFCM 2013a). However, overall stakeholder inclusion in the management process appears limited.

### Factor 3.2: Management of Fishing Impacts on Bycatch Species

#### Scoring Guidelines

Four subfactors are evaluated: Management Strategy, Scientific Research/Monitoring, Following of Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective', 'moderately effective', or 'highly effective'. Unless reason exists to rank Scientific Research/Monitoring, Following of Scientific Advice, and Enforcement of Regulations differently, these ranks are the same as in 3.1.

- 5 (Very Low Concern) = Rated as 'highly effective' for all four subfactors considered
- 4 (Low Concern) = Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective'.
- 3 (Moderate Concern) = All subfactors rates at least 'moderately effective'.
- 2 (High Concern) = At minimum meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective'.
- 1 (Very High Concern) = Management exists, but Management Strategy rated 'ineffective'
- 0 (Critical) = No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substantially impacted by the fishery.

Factor 3.2: Management of fishing impacts on bycatch species					
Region / Method	Strategy	Research	Following of Scientific Advice	Enforcement of Regulation	Factor 3.2 Score
Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Black Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern

Ligurian Sea, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern
Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective	2.00: High Concern

### Subfactor 3.2.1 - Management Strategy and Implementation

*Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures. To achieve a highly effective rating the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g. catch limits, use of proven mitigation measures, etc.).*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### Moderately Effective

In the European anchovy pelagic fisheries in the Mediterranean, most species are retained. Discards (fish thrown back to sea) are typically low. However, bycatch of some marine mammals, primarily dolphins, is reported to occur. The General Fisheries Commission for the Mediterranean (GFCM) recently (2012) adopted a regulation that bans the use of some gillnet gear, requires that all marine mammals be released alive and unharmed when possible, and that countries collect data on bycatch interactions with mammals and submit this data to the GFCM (GFCM 2012d). Because there has been limited data collection of dolphin catches in these fisheries to this point, and it uncertain if additional measures are need to reduce dolphin catches, we have awarded a moderately effective score.

### Subfactor 3.2.2 - Scientific Research and Monitoring

*Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species. To achieve a highly effective rating, assessments must be conducted to determine the impact of the fishery on*

*species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Ineffective**

There has been limited monitoring of discards (fish thrown back to sea) in the small pelagic fisheries that catch anchovy, but studies that have estimated discards in these fisheries all suggest discards are fairly low and that most of the catch is retained. However, incidental catches of dolphins may occur in these fisheries and there has been limited monitoring of these catches or studies to investigate the impact on dolphin populations (GFCM 2012e). Recently, the General Fisheries Commission for the Mediterranean (GFCM) did adopt new measures that requires countries to monitor, record and report incidental captures of marine mammals (GFCM 2012d). However, since it remains to be seen whether countries will follow this regulation and because bycatch collection to this point, has been limited, we have awarded an ineffective score.

#### **Subfactor 3.2.3 - Management Record of Following Scientific Advice**

*Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels). A highly effective rating is given if managers nearly always follow scientific advice.*

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### **Moderately Effective**

We awarded a moderately effective score for the following of scientific advice (see harvest strategy

section for the rationale for this rating).

### **Subfactor 3.2.4 - Enforcement of Management Regulations**

*Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's' compliance with regulations. To achieve a highly effective rating, there must be regular enforcement of regulations and verification of compliance.*

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Black Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**

**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated**

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

#### **Moderately Effective**

We have awarded a moderately effective score for enforcement (see harvest strategy section for the rationale for this rating).

## **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 (plus the mitigation of gear impacts score) and the Ecosystem Based Fisheries Management score.*

Region / Method	Impacts of Gear Type on Substrate	Mitigation of Gear Impacts	Ecosystem Based Fisheries Management	Criterion 4 Score
Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Black Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>
Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated	5.00:None	0.00:Not Applicable	2.00:High Concern	<b>Yellow (3.162)</b>

### **Justification of Ranking**

#### **Factor 4.1 – Impact of Fishing Gear on the Habitat/Substrate**

##### *Scoring Guidelines*

- 5 (None) = Fishing gear does not contact the bottom
- 4 (Very Low) = Vertical Line Gear
- 3 (Low) = Fishing gear that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine

fished on resilient mud/sand habitats. Midwater trawl that is known to contact bottom *occasionally* (<25% of the time) or purse seine known to commonly contact bottom

- 2 (Moderate) = Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine fished on habitats other than mud/sand;
- 1 (High) = Dredge or trawl gear fished on moderately sensitive habitats (e.g. cobble or boulder).
- 0 (Very High) = Dredge or trawl fished on biogenic habitat, e.g. deep-sea corals, eelgrass and maerl.

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Black Sea, Pelagic Trawl & Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated

Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

5.00

None

European anchovies and Atlantic sardines are primarily caught by purse seines that fish at or near the surface in the Mediterranean basin (GFCM 2013b). They are also caught by pelagic trawlers in some areas (GFCM 2012c) (Casey et al. 2012). These types of fishing gears rarely come in contact with bottom habitats so we have awarded a no concern score.

## Factor 4.2 - Mitigation of Gear Impacts

### Scoring Guidelines

- +1 (Strong Mitigation) = Examples include large proportion of habitat protected from fishing gear (>50%), fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.
- +0.5 (Moderate Mitigation) = 20% of habitat protected from fishing gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.
- +0.25 (Low Mitigation) = A few measures are in place to limit gear impacts on habitat, e.g., vulnerable habitats protected but other habitats not protected; some limits on fishing effort/intensity, but not actively being reduced.

- 0 (No Mitigation) = No effective measures are in place to limit gear impacts on habitats.

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

0.00

**Not Applicable**

Purse seines and pelagic trawls that capture small pelagic species rarely come in contact with the bottom, so mitigation techniques are not required.

### Factor 4.3 – Ecosystem-Based Fisheries Management

#### *Scoring Guidelines*

- 5 (Very Low Concern) = Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g. large proportion of fishery area protected with marine reserves, abundance is maintained at sufficient levels to provide food to predators).
- 4 (Low Concern) = Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. If hatchery supplementation or fish aggregating devices (FADs) are used, measures are in place to minimize potential negative ecological effects.
- 3 (Moderate Concern) = Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species. OR negative ecological effects from hatchery supplementation or FADs are possible and management is not in place to mitigate these impacts.
- 2 (High Concern) = The fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.
- 1 (Very High Concern) = The use of hatchery supplementation or Fish Aggregating Devices (FADs) in the fishery is having serious negative ecological or genetic

consequences. OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

**2.00**

**High Concern**

European anchovy and sardine are considered "species of exceptional importance" because they are important prey species in pelagic food webs, providing food for numerous species. Explicit efforts have not been made by the General Fisheries Commission for the Mediterranean (GFCM) to evaluate how much anchovy/sardine need to be left in the ocean to ensure there is enough food for their predators and that food webs are not disrupted (GFCM 2012b)(Casey et al. 2012). The Scientific Committee has recommended that role of small pelagic fish in the ecosystem be taken into account when setting abundance reference point/conservation goals for these species (GFCM 2013b), but since scientific assessments to account for their role in the ecosystem do not seem to be underway yet, we have awarded a high concern score.



## Overall Recommendation

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

The overall recommendation for the fishery is calculated as follows:

▲ **Best Choice/Green** = Final Score between 3.2 and 5, **and** no Red Criteria, **and** no Critical scores

▬ **Good Alternative/Yellow** = Final score between 2.2 and 3.199, **and** Management factors 3.1 (management of retained species) and 3.2 (management of bycatch species) are not scored as very high concern, **and** no more than one Red Criterion, **and** no Critical scores

▬ **Avoid/Red** = Final Score between 0 and 2.199, **or** Management factor 3.1 or 3.2 is scored as very high concern, **or** two or more Red Criteria, **or** one or more Critical scores.

Species/ Fishery	Impacts on Species Under Assessment	Impacts on other Species	Management Effectiveness	Impacts on Habitat and Ecosystem	Overall Recommendation
European anchovy Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.41)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>
Atlantic sardine Spain Mediterranean – Pelagic Trawl & Purse Seine, Unassociated	Red (1.41)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>
European anchovy Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Yellow (2.45)	Yellow (3.16)	<b>Good Alternative/Yellow (2.440)</b>
Atlantic sardine Adriatic Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Yellow (2.45)	Yellow (3.16)	<b>Avoid/Red (2.195)</b>
European anchovy Gulf of Lion – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.41)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.022)</b>
Atlantic sardine Gulf of Lion –	Red (1.41)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.819)</b>

Pelagic Trawl & Purse Seine, Unassociated					
European anchovy Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
Atlantic sardine Strait of Sicily – Pelagic Trawl & Purse Seine, Unassociated	Red (2.16)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.022)</b>
European anchovy Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
Atlantic sardine Alboran Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
European anchovy Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
Atlantic sardine Aegean Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
European anchovy Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Yellow (2.64)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>
Atlantic sardine Ionian Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
European anchovy Ligurian Sea & North Tyrrhenia Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Red (1.73)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (1.914)</b>
European anchovy Black Sea – Pelagic Trawl & Purse Seine, Unassociated	Red (1.73)	Yellow (2.64)	Red (1.41)	Yellow (3.16)	<b>Avoid/Red (2.127)</b>

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## **Appendix A: Review Schedule**

The anchovy and sardine small pelagic fisheries should be reviewed in 2-3 years to evaluate the effectiveness of the new management plan developed for the Adriatic Sea fisheries, and to review whether any new management has been implemented in other areas.

## **Appendix B: List of All Species Assessed in the Fishery**

Summary of all main species considered in the assessment

<b>Atlantic sardine/European Anchovy: Adriatic Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
ATLANTIC CHUB MACKEREL	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
ATLANTIC SARDINE	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
SHORT-BEAKED COMMON DOLPHIN	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
ATLANTIC MACKEREL	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
EUROPEAN ANCHOVY	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
EUROPEAN SPRAT	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
MEDITERRANEAN HORSE MACKEREL	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
SPANISH SARDINE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
STRIPED DOLPHIN	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

<b>Atlantic sardine/European Anchovy: Aegean Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
ATLANTIC CHUB MACKEREL	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
SHORT-BEAKED COMMON DOLPHIN	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
ATLANTIC SARDINE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
EUROPEAN ANCHOVY	Low	3.00: Moderate	2.33: Moderate	<b>2.644</b>

		Concern	Concern	
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>
<b>BOGUE</b>	Medium	3.00: Moderate Concern	3.67: Low Concern	<b>3.318</b>

<b>Atlantic sardine/European Anchovy: Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC CHUB MACKEREL</b>	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>EUROPEAN ANCHOVY</b>	Low	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>SHORT-BEAKED COMMON DOLPHIN</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>ATLANTIC SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>ATLANTIC SAURY</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>BULLET TUNA</b>	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>MEDITERRANEAN HORSE MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

European anchovy: Black Sea, Pelagic Trawl & Purse Seine, Unassociated				
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
EUROPEAN ANCHOVY	Low	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
MEDITERRANEAN HORSE MACKEREL	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
SHORT-BEAKED COMMON DOLPHIN	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

Atlantic sardine/European Anchovy: Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated				
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
ATLANTIC SARDINE	Medium	2.00: High Concern	1.00: High Concern	<b>1.414</b>
ATLANTIC CHUB MACKEREL	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
SHORT-BEAKED COMMON DOLPHIN	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
ATLANTIC MACKEREL	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
EUROPEAN ANCHOVY	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
EUROPEAN SPRAT	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
MEDITERRANEAN HORSE MACKEREL	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
SPANISH SARDINE	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
STRIPED DOLPHIN	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

Atlantic sardine/European Anchovy: Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated				
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
ATLANTIC CHUB MACKEREL	Medium	3.00: Moderate	1.00: High Concern	<b>1.732</b>



		Concern		
<b>ATLANTIC SARDINE</b>	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>SHORT-BEAKED COMMON DOLPHIN</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>EUROPEAN ANCHOVY</b>	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>
<b>BOGUE</b>	Medium	3.00: Moderate Concern	3.67: Low Concern	<b>3.318</b>
<b>PICAREL</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

<b>European anchovy: Ligurian Sea and North Tyrrhenian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC CHUB MACKEREL</b>	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>EUROPEAN ANCHOVY</b>	Low	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>SHORT-BEAKED COMMON DOLPHIN</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>MEDITERRANEAN HORSE MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

<b>Atlantic sardine/European Anchovy: Strait of Sicily, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC CHUB MACKEREL</b>	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>EUROPEAN ANCHOVY</b>	Low	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>SHORT-BEAKED COMMON DOLPHIN</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC SARDINE</b>	Medium	2.00: High Concern	2.33: Moderate Concern	<b>2.159</b>
<b>ATLANTIC MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>MEDITERRANEAN HORSE MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

<b>Atlantic sardine/European Anchovy: Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated</b>				
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>
<b>ATLANTIC SARDINE</b>	Medium	2.00: High Concern	1.00: High Concern	<b>1.414</b>
<b>ATLANTIC CHUB MACKEREL</b>	Medium	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>EUROPEAN ANCHOVY</b>	Low	3.00: Moderate Concern	1.00: High Concern	<b>1.732</b>
<b>SHORT-BEAKED COMMON DOLPHIN</b>	High	1.00: Very High Concern	3.67: Low Concern	<b>1.916</b>
<b>ATLANTIC MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>ATLANTIC SAURY</b>	Medium	3.00: Moderate	2.33: Moderate	<b>2.644</b>

		Concern	Concern	
<b>BULLET TUNA</b>	Low	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>MEDITERRANEAN HORSE MACKEREL</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>SPANISH SARDINE</b>	Medium	3.00: Moderate Concern	2.33: Moderate Concern	<b>2.644</b>
<b>STRIPED DOLPHIN</b>	High	2.00: High Concern	3.67: Low Concern	<b>2.709</b>

### Assessment of main species not included in body of report

## ATLANTIC MACKEREL

### Factor 2.1 - Inherent Vulnerability to Fishing

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

#### Medium

Atlantic mackerel have a medium vulnerability to fishing score of 44 out of 100 according to FishBase (Froese and Pauly 2013). Atlantic mackerel are broadcast spawners (Watson et al. 1992) with a fecundity range of 88,000 to 1.98 million eggs (Froese and Pauly 2013). Sexual maturity is reached around 30-34 cm and 1-3 years of age. Atlantic mackerel live around 12-18 years and reach 60 cm in size (Collette et al. 2011c) (Froese and Pauly 2013). Within the food chain, they are an intermediate to top level species.

### Factor 2.2 - Abundance

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

**3.00****Moderate Concern**

The International Union for Conservation of Nature (IUCN) considers Atlantic mackerel a species of 'Least Concern' for the entire North Atlantic, but abundance is decreasing (Collette et al. 2011c). Within the Mediterranean region, population assessments of this species have not been conducted, so the abundance of Atlantic mackerel with regard to abundance targets and reference points is unknown. Since Atlantic mackerel have a medium inherent vulnerability to fishing, abundance is rated a moderate concern.

**Factor 2.3 - Fishing Mortality**

Adriatic Sea, Pelagic Trawl &amp; Purse Seine, Unassociated

Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl &amp; Purse Seine, Unassociated

Ligurian Sea &amp; North Tyrrhenian Sea, Pelagic Trawl &amp; Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl &amp; Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated

**2.33****Moderate Concern**

No population assessments of Atlantic mackerel in the Mediterranean Sea have been conducted, and thus fishing levels on Atlantic mackerel are uncertain. We have therefore rated fishing mortality a moderate concern.

**ATLANTIC SAURY****Factor 2.1 - Inherent Vulnerability to Fishing**

Alboran Sea, Pelagic Trawl &amp; Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl &amp; Purse Seine, Unassociated

**Medium**

Atlantic saury have a medium vulnerability score of 50 out of 100 according to FishBase (Froese and Pauly 2013). Atlantic saury are considered a fast growing species of fish, living less than 4 years and reaching sexual maturity at 25 cm (~10 in) or 2-3 years (DFO 2009). Atlantic saury reach a maximum size of 50 cm (20 in) (Froese and Pauly 2013). Atlantic saury are broadcast spawners (Nesterov and Shiganova 1976) but information on fecundity/egg production is not available. Atlantic saury are an intermediate species in the food web (Froese and Pauly 2013).

## Factor 2.2 – Abundance

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.00

**Moderate Concern**

The status of Atlantic saury in the Mediterranean is unknown and no population assessments of this species have been conducted (GFCM 2013b). We have awarded a moderate concern score since abundance is unknown and Atlantic saury have a medium inherent vulnerability to fishing.

## Factor 2.3 - Fishing Mortality

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

2.33

**Moderate Concern**

The fishing mortality of Atlantic saury in the Mediterranean is unknown and no population assessments of this species have not been conducted (GFCM 2013b). They are reported to be caught in anchovy and sardine fisheries in the Alboran Sea and northern Spain (GFCM 2008). We have awarded a moderate concern score because of a lack of information.

## **BOGUE**

### Factor 2.1 - Inherent Vulnerability to Fishing

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated

Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

**Medium**

Bogue have a medium FishBase vulnerability score of 41 out of 100 (Froese and Pauly 2013). Bogue have been reported to live up to 17 years in age, but more commonly live for 7-13 years (Allam 2003)(Hernandez 1989)(Khemiri et al. 2005). They reach a maximum size of around 21 cm (8 in). Sexual maturity is reached around one year of age and 13 cm (5 in) in length (Allam 2003) (Froese and Pauly 2013). Bogue are broadcast spawners and produce up to 395,000 eggs (Bauchot and Hureau 1986) (Froese and Pauly 2013). Bogue are an intermediate species in the food web (Froese and Pauly 2013).

## Factor 2.2 – Abundance

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated

**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated****3.00****Moderate Concern**

Bogue are reported to be caught in Anchovy and sardine fisheries in the Aegean and Ionian Seas. In the Aegean Sea, abundance is only at 66% of the target abundance level, which is biomass at the maximum sustainable yield (BMSY). However, no limit reference point/overfished threshold has been determined for this population, so it is unclear whether the population is overfished or not. The results of the assessment conducted in the Ionian Sea are considered unreliable so abundance in relation to sustainable abundance targets/goals is unknown (Cardinale and Osio 2012). Since the statuses of these populations are unknown and bogue have a medium vulnerability to fishing, we have awarded a moderate concern score.

**Factor 2.3 - Fishing Mortality****Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated****Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated****3.67****Low Concern**

In the Aegean Sea, bogue are currently thought to be sustainably fished, with current fishing levels at only 62% of the fishing mortality at maximum sustainable yield. However, it has been noted that further data is needed to fully evaluate that status of this population. In the Ionian Sea, the results of the latest population assessment are considered unreliable and the fishing mortality is unknown, but catches of Bogue in this region account for less than 3% of the total Mediterranean catch (Cardinale and Osio 2012). Since fishing levels on bogue in these two areas appear to be sustainable or low, we have awarded a low concern score.

**BULLET TUNA****Factor 2.1 - Inherent Vulnerability to Fishing****Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated****Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated****Low**

Bullet tuna have a low vulnerability score of 34 out of 100 according to FishBase (Froese and Pauly 2013). Bullet tuna reach sexual maturity around 35 cm (14 in) and two years of age (Rodriguez-Roda 1983). The maximum length is 50 cm (20 in). Bullet tuna are broadcast spawners with a fecundity range of 31,000 to 103,000 eggs per spawning event (Collette and Nauen 1983).

## Factor 2.2 – Abundance

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.00

**Moderate Concern**

In the Mediterranean, bullet tuna are assessed together with other "small tuna" by a joint General Fisheries Commission for the Mediterranean (GFCM) and International Commission for the Conservation of Tuna (ICCAT) committee. The last assessment conducted in 2008, determined there was not enough information available to determine the population status of bullet tuna or any other small tuna species (ICCAT 2008). The International Union for Conservation of Nature (IUCN) has classified bullet tuna as a species of 'Least Concern' with a stable population trend (worldwide), based on the fact they are widely distributed (Collette et al. 2011a). We have awarded a moderate concern score based on their medium vulnerability to fishing and lack of information on their population status in the Mediterranean Sea.

## Factor 2.3 - Fishing Mortality

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

2.33

**Moderate Concern**

Fishing mortality estimates are not available for bullet tuna. Catches from the combined Atlantic and Mediterranean since 2000, have varied from a low of 3798 t to (2003) to a high of 9307 t (2010) (ICCAT 2013). In the Mediterranean, they are reported to be caught in anchovy and sardine fisheries in the Alboran Sea and northern Spain (GFCM 2008). We have awarded a moderate concern score due to the lack of information.

## EUROPEAN SPRAT

### Factor 2.1 - Inherent Vulnerability to Fishing

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated

**Low**

FishBase assigned a low vulnerability to fishing score of 33 out of 100 for sprat (Froese and Pauly 2013). Sprat reach sexual maturity between 8-12 cm in length and 2-4 years of age. They reach a maximum size of 16 cm and live around 6 years (Froese and Pauly 2013). Sprat are broadcast spawners with a fecundity ranging from 2,000 to 36,000 eggs (Koli 1990). Within the food chain, they are an intermediate species

(Froese and Pauly 2013).

## Factor 2.2 - Abundance

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.00

**Moderate Concern**

In the Northern Adriatic Sea, sprat are caught in the small pelagic fishery that targets anchovy and sardine. No abundance goals have been established for sprat in this region and no formal assessment has been conducted, therefore the population status is unknown (Casey et al. 2012). Sprat have also been reported to be caught in the Gulf of Lion since 2008 (GFCM 2011b). Information on abundance of sprat in the Gulf of Lion is not available. We have therefore awarded a moderate concern score since abundance levels are unknown and sprat have a low vulnerability to fishing.

## Factor 2.3 - Fishing Mortality

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

2.33

**Moderate Concern**

In the northern Adriatic Sea, European sprat are caught in the same fisheries targeting European anchovy and sardine. Sprat are discarded (thrown back to sea) by the Italian fishing fleet but kept by the Slovenia and Croatia fishing fleets. The amount caught is not known, and no assessments have been conducted on sprat in this region to evaluate fishing levels (Casey et al. 2012). Sprat have also been caught in the Gulf of Lions fisheries since 2008 (GFCM 2011b), but fishing levels are not known. We have therefore awarded a moderate concern score.

# PICAREL

## Factor 2.1 - Inherent Vulnerability to Fishing

Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

**Medium**

Picarel have a medium FishBase vulnerability score of 39 out of 100 (Froese and Pauly 2013). Picarel begin life as females and become males later in life (Vidalis and Tsimenidis 1996). Females reach sexual maturity around 9 cm (3.5 in) in length (Froese and Pauly 2013). The maximum life span in Greek waters



is reported to be 5 years for females and 7 years for males (Vidalis and Tsimenidis 1996). Picarel spawn multiple times during a season with fecundity ranging from 2,000 to 16,000 eggs per spawning event (Karlou-Riga and Petza 2010) (Karlou-Riga et al. 2007). Picarel are an intermediate species in the food web (Froese and Pauly 2013).

## Factor 2.2 – Abundance

### Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

5.00

Very Low Concern

Picarel are reported to be a primary accompanying species in the anchovy fisheries in the Ionian Sea (Tsagarakis et al. 2012). In the Ionian Sea, the abundance of picarel is above the target abundance level, which is the biomass at maximum sustainable yield (BMSY) (Cardinale and Osio 2012). Current abundance is at 115% of BMSY. We have therefore awarded a very low concern score for picarel in this region.

## Factor 2.3 - Fishing Mortality

### Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

5.00

Very Low Concern

In the Ionian Sea, picarel are sustainably fished, with current fishing levels at only 30% of the fishing level at maximum sustainable yield (FMSY) (Cardinale and Osio 2012). Therefore we have awarded a very low concern score.

## **SHORT-BEAKED COMMON DOLPHIN**

### Factor 2.1 - Inherent Vulnerability to Fishing

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated

Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated

Black Sea, Pelagic Trawl & Purse Seine, Unassociated

Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated

Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated

Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated****High**

Marine mammals are considered to have a high vulnerability to fishing because they are long-lived and have low reproductive rates.

**Factor 2.2 – Abundance**

**Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated**

**Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated**

**Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated**

**Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated**

**1.00****Very High Concern**

Short-beaked common dolphins were at one time abundant and widespread throughout the Mediterranean. However, in recent years this species has declined in the Mediterranean, and is now only abundant in the Alboran Sea, along with small concentrations around the Maltese Islands, Aegean, Tyrrhenian and eastern Ionian Seas (Bearzi et al. 2003). For example, in the Ionian Sea, the number of animals present decreased from 105 in 1996 to only 15 in 2007 (Bearzi et al. 2008). The International Union for the Conservation of Nature (IUCN) classifies the Mediterranean population of short-beaked common dolphin as Endangered (Bearzi 2003). Habitat degradation and environmental changes, in addition to incidental capture by fisheries, have been identified as potential reasons for recent and quick population declines (Bearzi et al. 2003). We have awarded a very high concern based on the IUCN classification.

**Black Sea, Purse Seine, Unassociated****2.00****High Concern**

Short-beaked common dolphins in the Black Sea may be a different subspecies than the Mediterranean Sea species, though this remains uncertain. The International Union for the Conservation of Nature (IUCN) classifies the Black Sea species/population as "Vulnerable" (Birkun 2008). We have awarded a high concern based on the IUCN classification.

### Factor 2.3 - Fishing Mortality

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Black Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.67

**Low Concern**

Although the majority of small pelagic purse seine fisheries in the Mediterranean do not have high incidental capture rates with dolphins or other marine mammals, there is some suggestion that the Spanish fleet in the Alboran Sea has had a history of catching large numbers of dolphins, primarily short-beaked common dolphins. For example, estimates from the 1990's suggest up to 300 dolphin mortalities occur per year and that as many as 5700 may be caught per year, although most are released alive. There has been some suggestion that low interaction rates in other fisheries are the result of a loss of short-beaked common dolphins along the remaining Spanish Mediterranean coast (Tudela 2004). Purse seine fisheries in the Black Sea also reported common dolphin interactions during the late 1990's (Payne et al. 2004). Still, other fishing gears such as driftnets, static nets (gillnets) and longlines are thought to have a much greater impact on dolphin populations (Tudela et al. 2005) (GFCM 2012e). As well, in some areas, like the Ionian Sea, the decline in short-beaked common dolphins has been primarily attributed to prey depletion caused by overfishing, rather than incidental fisheries catches (Bearzi et al. 2008). To help protect marine mammals, managers established the Pelago Marine Mammal Sanctuary in 2007, which encompasses part of the territorial waters of France, Italy and Monaco and includes the Ligurian Sea and parts of the Corsican and Tyrrhenian Seas (GFCM 2007). As well, recently (2012), the General Fisheries Commission for the Mediterranean adopted a regulation that bans the use of certain gillnet gear and requires countries to report all marine mammals catches so they can better assess the impacts on their populations (GFCM 2012d). Overall, there is some suggestion that the small-pelagic fisheries in the Mediterranean impact short-beaked common dolphin populations to a degree. However, since other fisheries in the region likely have a much greater impact on this species, we have rated fishing mortality a low concern.

## SPANISH SARDINE

### Factor 2.1 - Inherent Vulnerability to Fishing

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated

Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

### Medium

Spanish sardine have a medium FishBase vulnerability score of 36 out of 100 (Froese and Pauly 2013). In the Northern Aegean Sea, Spanish sardines have been reported to live up to 5 years and reach 24.8 cm (~10 in) in size. Sexual maturity is reached between 12 and 22 cm (4.7-8 in) and prior to 3 years of age (Froese and Pauly 2011). Spanish sardines are broadcast spawners with fecundity ranging from 9,700 to 72,700 eggs per spawn (Froese and Pauly 2013). Spanish sardines are an intermediate species in the food web.

## Factor 2.2 - Abundance

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.00

### Moderate Concern

Although Spanish sardine are considered a priority species by the General Fisheries Commission for the Mediterranean, they are not currently assessed (GFCM 2013b). We have awarded a moderate concern score based on their medium vulnerability and lack of information on their population status.

## Factor 2.3 - Fishing Mortality

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated

Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

2.33

**Moderate Concern**

Spanish sardine are captured in the small pelagic fisheries that target Anchovy and sardine in several areas. However information on fishing mortality on Spanish sardine is not available. We have therefore awarded a moderate concern score.

## **STRIPED DOLPHIN**

### **Factor 2.1 - Inherent Vulnerability to Fishing**

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

**High**

Marine mammals are considered to have a high vulnerability to fishing because they are long-lived and have low reproductive rates.

### **Factor 2.2 – Abundance**

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

2.00

**High Concern**

The International Union for Conservation of Nature (IUCN) has classified striped dolphin as a species of 'Least Concern' with an unknown population trend globally, but the Mediterranean population is considered 'Vulnerable' (Aguilar and Gaspari 2012). We have therefore awarded a high concern score.

### Factor 2.3 - Fishing Mortality

Adriatic Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Aegean Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Alboran Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Gulf of Lion, Pelagic Trawl & Purse Seine, Unassociated  
 Ionian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Ligurian Sea & North Tyrrhenian Sea, Pelagic Trawl & Purse Seine, Unassociated  
 Strait of Sicily, Pelagic Trawl & Purse Seine, Unassociated  
 Spain Mediterranean, Pelagic Trawl & Purse Seine, Unassociated

3.67

**Low Concern**

Although the majority of small pelagic purse seine fisheries in the Mediterranean do not have high incidental capture rates with dolphins or other marine mammals, the Spanish fleet in the Alboran Sea has had a history of catching large numbers of dolphins. Catches of striped dolphins appear to be less frequent than catches of short-beaked common dolphins (Tuelda et al. 2004). It has been estimated that 100 striped dolphins are killed annually by the Spanish fleet in Catalonia and the Gulf of Lions (UOB 1995). Other fishing gears, like driftnets, gillnets, and longlines, are thought to have much greater impact on dolphin populations in Mediterranean compared to pelagic purse seines and trawls (Tudela 2004)(Tudela et al. 2005)(GFCM 2012e). To help protect marine mammals, managers established the Pelago Marine Mammal Sanctuary in 2007, which encompasses part of the territorial waters of France, Italy and Monaco and includes the Ligurian Sea and parts of the Corsican and Tyrrhenian Seas (GFCM 2007). As well, recently (2012), the General Fisheries Commission for the Mediterranean adopted a regulation that bans the use of certain gillnet gear and requires countries to report all marine mammals catches so they can better assess the impacts on their populations (GFCM 2012d). Overall, there is some suggestion that the small-pelagic fisheries in the Mediterranean impact striped dolphin populations to some degree. However, since other fisheries in the region likely have a much greater impact on this species, we have rated fishing mortality a low concern.

## **About Blue Ocean Institute**

Blue Ocean Institute creates an original blend of science, art and literature that inspires a deeper connection with nature, especially the sea. Our books, films and educational programs instill hope, enlighten personal choices and build a larger constituency for conservation. From Alaskan fishing villages to Zanzibar's shores, we witness firsthand how nature is changing, then explain what these changes mean for wildlife and for people. Blue Ocean translates science into language people can understand. Our goal is to be a unique voice of hope, guidance and inspired change. Our work is disseminated through major, mainstream outlets such as the PBS television network, *The New York Times*, Huffington Post, NationalGeographic.com and CNN.com plus other established print, television and online media.

Founded in 2003 by conservation pioneer and MacArthur "genius" award winner Dr. Carl Safina, Blue Ocean Institute builds on three decades of his field research, policy work, acclaimed books and other writing.

### **Blue Ocean's *From Sea to Table* Program**

Blue Ocean's founders created the first seafood guide in 1998. Blue Ocean's online seafood guide now encompasses over 160-wild-caught species. Our peer-reviewed seafood reports are transparent, authoritative, easy to understand and use. All rankings and full reports are available on our website in the *Seafood Choices* section. *From Sea to Table* helps consumers, retailers, chefs and health professionals discover the connection between human health, a healthy ocean, fishing and sustainable seafood.

- Our online guide to sustainable seafood is based on our scientific rankings for more than 160 wild-caught seafood species and provides simple guidelines.
- We partner with Whole Foods Market (WFM) to help educate their seafood suppliers and staff, and provide our scientific seafood rankings for WFM stores in the US and UK.
- Through our partnership with Chefs Collaborative, we created *Green Chefs/Blue Ocean*, a free, interactive, online sustainable seafood course for chefs and culinary professionals.
- Our website features tutorials, videos, blogs, links and discussions of the key issues such as mercury in seafood, bycatch, overfishing, etc.

Check out our Fellows Program, Scientific Collaborations and Carl Safina's current work at [www.blueocean.org](http://www.blueocean.org).

Blue Ocean Institute is a 501 (c) (3) nonprofit organization based in the School of Marine & Atmospheric Sciences at Stony Brook University, Long Island, NY. [www.blueocean.org](http://www.blueocean.org) admin@blueocean.org | 631.632.3763

## **About Seafood Watch®**

The Monterey Bay Aquarium Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the North American 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 mission is to engage and empower consumers and businesses to purchase environmentally responsible seafood fished or farmed in ways that minimize their impact on the environment or are in a credible improvement project with the same goal.

Each sustainability recommendation is supported by a seafood report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's sustainability criteria to arrive at a recommendation of "Best Choice," "Good Alternative," or "Avoid." In producing the seafood reports, Seafood Watch utilizes research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch research analysts also communicate with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying seafood reports will be updated to reflect these changes. Both the detailed evaluation methodology and the scientific reports are available on [seafoodwatch.org](http://seafoodwatch.org).

For more information about Seafood Watch and seafood reports, please contact the Seafood Watch program at Monterey Bay Aquarium by calling 1-877-229-9990 or visit online at [seafoodwatch.org](http://seafoodwatch.org)



## Guiding Principles

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished<sup>1</sup> 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 capture fisheries must possess to be considered sustainable by the Seafood Watch program:

- *Stocks are healthy and abundant.*
- *Fishing mortality does not threaten populations or impede the ecological role of any marine life.*
- *The fishery minimizes bycatch.*
- *The fishery is managed to sustain long-term productivity of all impacted species.*
- *The fishery is conducted such that impacts on the seafloor are minimized and the ecological and functional roles of seafloor habitats are maintained.*
- *Fishing activities should not seriously reduce ecosystem services provided by any fished species or result in harmful changes such as trophic cascades, phase shifts, or reduction of genetic diversity.*

Based on these guiding principles, Seafood Watch has developed a set of four sustainability **criteria** to evaluate capture fisheries for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Impacts on the species/stock for which you want a recommendation
2. Impacts on other species
3. Effectiveness of management
4. Habitat and ecosystem impacts

Each criterion includes:

- Factors to evaluate and rank
- Evaluation guidelines to synthesize these factors and to produce a numerical score
- A resulting numerical score and **rank** for that criterion

Once a score and rank has been assigned to each criterion, an overall seafood recommendation is developed on additional evaluation guidelines. Criteria ranks and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide:

**Best Choices/Green:** Are well managed and caught or farmed in environmentally friendly ways.

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

**Avoid/Red:** Take a pass on these. These items are overfished or caught or farmed in ways that harm other marine life or the environment.

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<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates.