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Blue Seafood Guide Assessment Report

Blue mackerel, East China Sea and Pacific Ocean stocks

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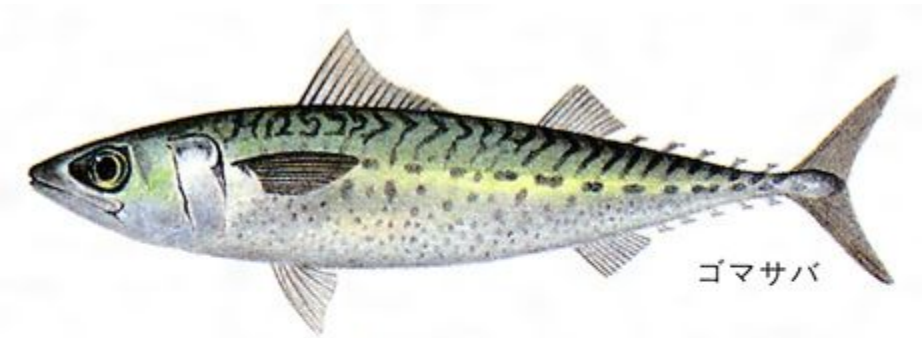

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Introduction to the BSG Assessment Methodology

The Blue Seafood Guide (BSG) methodology is primarily based on the Rapid Assessment tool co-developed by Ocean Outcomes (O2), World Wildlife Fund US, and the Sustainable Fisheries Partnership. The tool uses Marine Stewardship Council (MSC) performance indicators, with incorporation of some concepts from the Monterey Bay Aquarium Seafood Watch (MBA SFW) Fisheries Standard. The methodology has also been adapted to account for general characteristics of the existing Japanese fisheries management system. Specifically, deficiencies in information (e.g. monitoring of other species caught in a fishery) and management components (e.g. harvest control rules) that are systemic will be mentioned in the assessment, but not necessarily considered in the BSG species selection process.

To be included in the BSG, the stock/species must not receive a red score for any of the indicators that are considered.

Executive summary

In Japan, blue mackerel are managed as two stocks: East China Sea and Pacific Ocean. As of 2016, both stocks were determined to be at medium abundance levels based on FRA stock assessments, and in 2015, they were both close to or above an MSY-based target reference point. However, it is not clear whether the lower trophic level status of this species was considered in determination of stock reference points. Harvest of blue mackerel stocks is managed by TAC, with a single TAC being set for both stocks plus the two stocks of chub mackerel.

BSG qualification outcome

Blue mackerel does not qualify for inclusion in the BSG because the purse seine fisheries targeting mackerel also catch significant quantities of species of stock status concern, particularly Japanese anchovy. Management does not appear sufficient to minimize negative fishery impacts on these stocks of concern.

Scoring summary

Principle	Component	PI #	Performance Indicator	Scoring category
1	Outcome	1.1.1	Stock status outcome	
		1.1.2	Stock rebuilding outcome	Not considered
	Management	1.2.1	Harvest Strategy	
		1.2.2	Harvest control rules	Not considered
		1.2.3	Information and monitoring	
		1.2.4	Assessment of stock status	
2	Other species	2.2.3	Other species information	
		2.2.1	Other species outcome	
		2.2.2	Other species management	
	ETP species	2.3.3	ETP species information	
		2.3.1	ETP species outcome	
		2.3.2	ETP species management	
	Habitats	2.4.3	Habitats information	

		2.4.1	Habitats outcome	
		2.4.2	Habitats management	
	Ecosystem	2.5.3	Ecosystem information	
		2.5.1	Ecosystem outcome	
		2.5.2	Ecosystem management	
3	Governance & policy	3.1.1	Legal and customary framework	
		3.1.2	Consultation, roles and responsibilities	
		3.1.3	Long term objectives	
	Fishery specific management system	3.2.1	Fishery-specific objectives	
		3.2.2	Decision-making processes	
		3.2.3	Compliance and enforcement	
		3.2.4	Management performance evaluation	

Basic fishery information

Target species scientific name and common name	blue mackerel (*Scomber australasicus*), *gomasaba* (ゴマサバ)
Fishery location and season	In the East China Sea, blue mackerel are caught off the coasts of southern Honshu and Kyushu (Fig. 1). On the Pacific Ocean side of Japan, blue mackerel are caught on the continental shelf and around the Seto Inland Sea. Purse seine fisheries operate almost year-round and are most concentrated from September to December.
Gear type(s)	Large and small purse seines (*maki-ami*; 巻網). Although some other gears are used, most of the catch is from purse seines.

Catch quantity (weight)	Reported landings do not distinguish between chub and blue mackerel. Based on simulation models, the estimated landings of blue mackerel from Japanese fisheries were 37,000 t for the East China Sea stock and 95,000 t for the Pacific Ocean stock, averaged from 2012 to 2016.
Management authority	Fisheries Agency of Japan

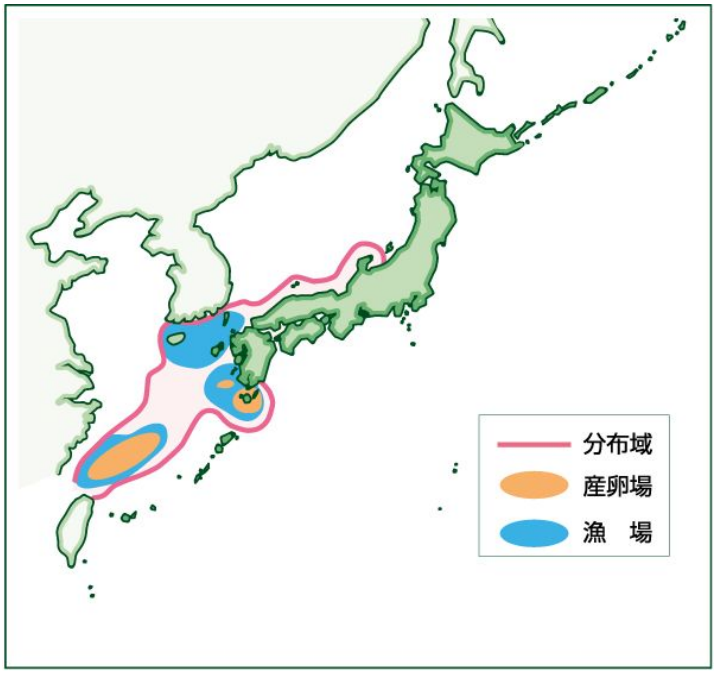


Figure 1. Distribution of the East China Sea stock of blue mackerel, outlined in pink. Spawning areas are shown in orange, and fishing areas are shown in blue.
http://abchan.fra.go.jp/digests2017/html/2017_08.html

Figure 2. Distribution of the Pacific Ocean stock of blue mackerel, outlined in pink. Spawning areas are shown in orange. Image from: http://abchan.fra.go.jp/digests2017/html/2017_07.html

Description of the fishery

Blue mackerel supports one of the largest commercial fisheries in Japan, and vessels targeting mackerel often harvest blue mackerel and chub mackerel (Scomber japonicus) together. In recent years, chub mackerel stocks have sometimes been assessed as depleted while blue mackerel stocks have been considered more abundant. However, these two species are essentially managed together due to their overlapping geographic distributions and similar physical appearances, and they are typically not separated when caught.

Table 1. Estimated landings (in thousands of t) of the East China Sea and Pacific Ocean stocks of blue mackerel by Japanese fisheries, based on cohort analysis models. Data available at http://abchan.fra.go.jp/digests2017/index.html

Year	East China Sea	Pacific Ocean
2007	54	122
2008	40	150
2009	36	179
2010	30	189
2011	49	181

2012	47	137
2013	38	109
2014	33	115
2015	31	70
2016	35	45

Unit of Assessment(s)

The Unit of Assessment is blue mackerel from the East China Sea and Pacific Ocean stocks caught by purse seine.

Status of target stock(s) - Principle 1

Blue mackerel and chub mackerel stocks has been managed together under Japan's national fishery management system since 1997 (Yukami et al. 2014a). These two species are often caught together in the central and northern districts of Japan, and the two species can be difficult to distinguish due to their similar physical appearance, similar ecology and overlapping geographic distributions (Kawabata et al. 2014b). They also hybridize naturally to a small extent (Saito 2001). Japanese fishery scientists and managers have designated two local blue mackerel stocks: the Pacific Ocean and East China Sea stocks.

The Fisheries Research and Education Agency of Japan (FRA) evaluates stock status (low, medium, or high) relative to reference points that are determined by historical abundance estimates and are not directly linked to maximum sustainable yield (MSY). Specifically, the total range of past abundance estimates is divided into thirds, and the third that the most recent abundance estimate falls into determines the status. Status is also determined in part by the limit reference point B_{limit} (aka B_{lim}), which is defined as a historically low estimate of spawning stock biomass. If the spawning stock biomass is below B_{lim}, stock status is rated as low. There is no target reference point, and catch per unit effort (CPUE) is not regularly estimated.

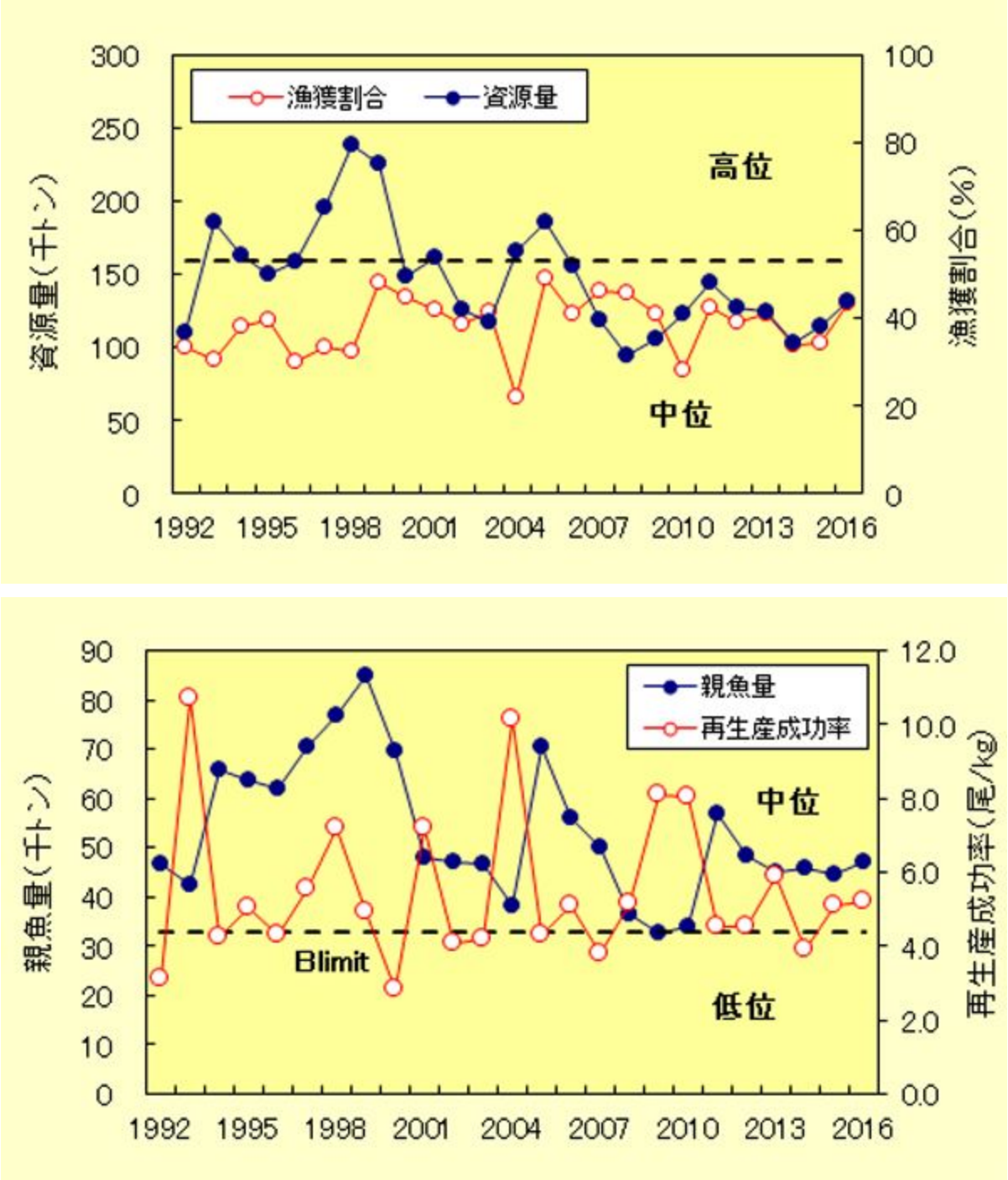
Fishing effort in Japan is largely regulated through input controls (Makino 2011). For chub and blue mackerel, effort is managed by limiting the number of vessels, particularly medium to large purse seiners, that can operate on the fishing grounds (Yukami et al. 2014a). However, comprehensive management of fishing effort will require some international coordination because Tsushima chub mackerel and East China Sea blue mackerel are also exploited by other countries, primarily China and Korea (Yukami et al. 2014a and 2014b). In terms of output controls, chub and blue mackerel stocks are managed under a total allowable catch (TAC) system.

Stock status outcome (1.1.1)

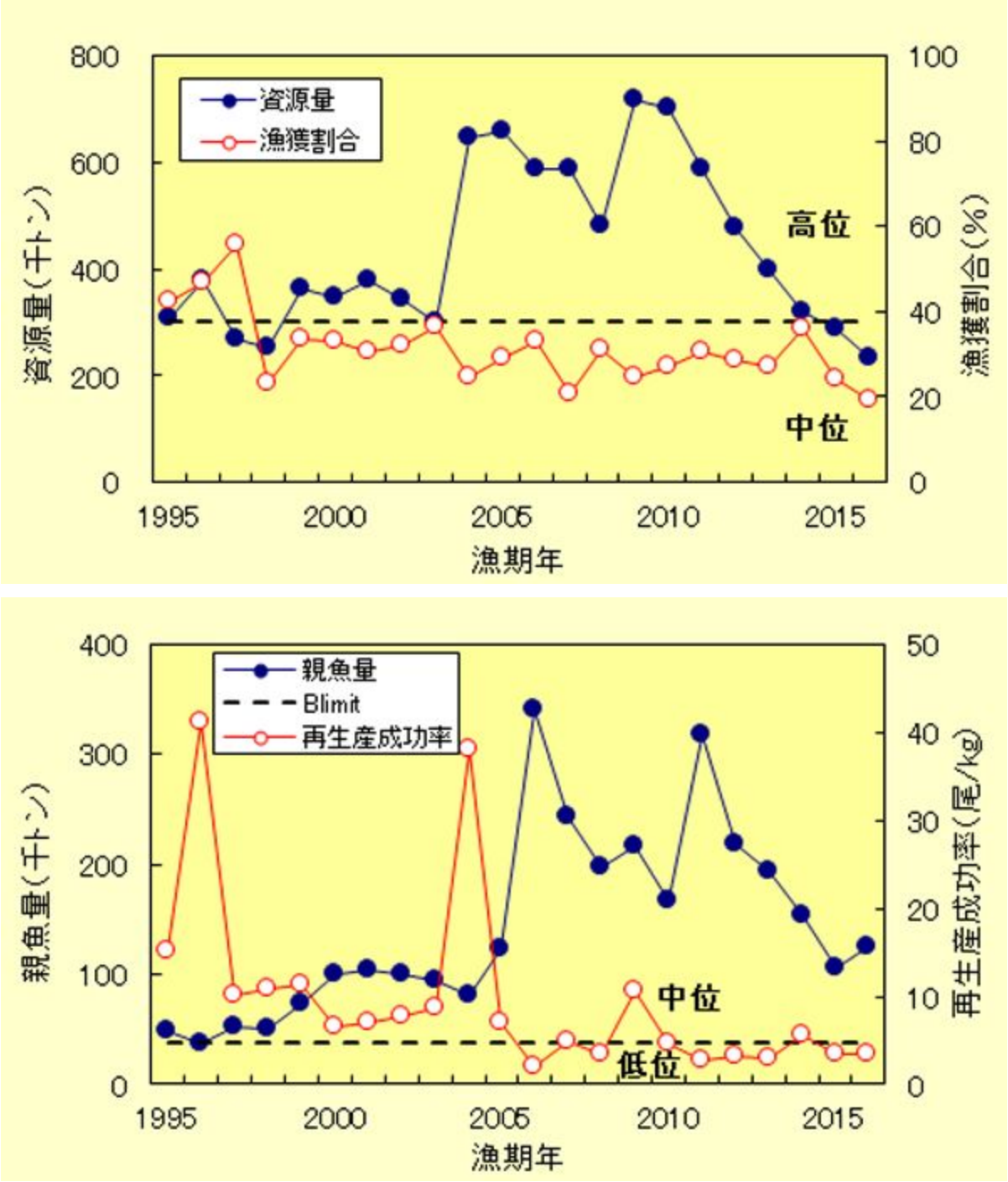
Scoring category	Yellow

Rationale:
The 2016 SSB estimate for the East China Sea blue mackerel stock was 47,000 t, which exceeded the B_{lim} of 33,000 t but not the threshold for high abundance, resulting in a determination of medium status (Kurota et al. 2017). Biomass showed a stable trend for the most recent five years (Fig. 1a), as did SSB (Fig. 1b). Recruitment rates appear to have been stable recently, and the relative proportion of biomass caught has not increased (Figs. 1b and 1a, respectively).

The 2016 SSB estimate for the Pacific Ocean blue mackerel stock was 125,000 t, which exceeded the B_{lim} of 38,000 t but not the threshold for high abundance, resulting in a determination of medium status (Yukami et al. 2017). Biomass showed a declining trend for the most recent five years (Fig. 2a), as did SSB, although the SSB estimate for 2016 was higher than the one for 2015 (Fig. 2b). Recruitment rates appear to have been stable recently, and the relative proportion of biomass caught has not increased (Figs. 2b and 2a, respectively).
According to preliminary, MSY-based assessments conducted in March 2018 for the Council for Promotion of Regulatory Policy Reform, the Pacific blue mackerel stock was at a sustainable abundance level in 2015, with an SSB_{2015} / SSB_{MSY} ratio of 2.63. The East China Sea stock had an SSB_{2015} / SSB_{MSY} ratio of 0.87, suggesting a medium abundance level.
In summary, both stocks were likely above a limit reference point (LRP), and close to or above a MSY-based target reference point (TRP) in 2015. However, it should be noted that MSC has identified mackerels as a default lower trophic level (LTL) species group, so the potential ecosystem impacts of fishery removals should be considered when setting the TRP, and it is not clear whether that was done. We have precautionarily rated stock status outcome as yellow for both stocks.



Figures 1a (top) and 1b (bottom). Figure 1a shows estimated East China Sea blue mackerel biomass (blue circles, in thousands of t) and relative catch proportion (white circles, in percent) over time. The dashed line indicates the threshold between high and medium status level. Figure 1b shows estimated East China Sea blue mackerel spawning stock biomass (blue circles, in thousands of t) and recruitment success rate (white circles, in numbers of recruits per kg of SSB) over time. The dashed line indicates the threshold between medium and low status level. Figures from http://abchan.fra.go.jp/digests2017/html/2017_08.html



Figures 2a (top) and 2b (bottom). Figure 2a shows estimated Pacific Ocean blue mackerel biomass (blue circles, in thousands of t) and relative catch proportion (white circles, in percent) over time. The dashed line indicates the threshold between high and medium status level. Figure 2b shows estimated Pacific Ocean blue mackerel spawning stock biomass (blue circles, in thousands of t) and recruitment success rate (white circles, in numbers of recruits per kg of

SSB) over time. The dashed line indicates the threshold between medium and low status level. Figures from http://abchan.fra.go.jp/digests2017/html/2017_07.html

Stock rebuilding outcome (1.1.2)

Scoring category	Not considered

Rationale:
This indicator was not considered because in Japan, stock rebuilding plans are rare and generally implemented only on a voluntary basis. They are not automatically developed in response to changes in stock status. No rebuilding plan or measures have been developed for either blue mackerel stock, likely because a need has not been identified by the Japanese management system.

Harvest strategy (1.2.1)

Scoring category	Yellow

Rationale:
As is typical with Japanese fisheries, harvest control rules (HCRs) are lacking. Information collected to support the harvest strategy includes stock structure, stock productivity, fishing vessel statistics, fleet composition, stock abundance, landings at major ports, field data from specific fisheries, and research conducted by the Japan Fisheries Agency and national research institutes (Yukami et al. 2017). FRA scientists assess the stocks every year and estimate an acceptable biological catch (ABC) for each stock that is used to determine a total allowable catch (TAC). Thus all harvest strategy components required by the MSC standard, excluding HCRs, are present.

Harvest of blue mackerel stocks is managed by total allowable catch (TAC). The TAC is set using acceptable biological catch (ABC) estimates from stock assessments and taking socio-economic conditions into account. However, despite the fact that separate ABCs are estimated for each chub and blue mackerel stock, a single TAC is used for all stocks combined. From 2011 to 2013, the annual TAC was essentially equivalent to the combined ABCs of all four stocks (JFA 2014). Although the TAC did not exceed the aggregated ABCs, this harvest control method may not adequately protect any individual stocks showing signs of depletion. The stock assessment mentioned a need to set different TACs for each species, but also acknowledged that separating catches by species is challenging from a operational standpoint (Kawabata et al. 2014b).

Despite these issues, the fact that TAC is used suggests that the harvest strategy could theoretically maintain stock biomass around a target reference point (TRP).

Harvest control rules (1.2.2)

Scoring category	Not considered

Rationale:
Since harvest control rules are not currently used in Japanese fisheries management, this indicator is not considered. There are no official harvest control rules (HCRs) for blue mackerel stocks, although there is some harvest management via TAC as described above. There is no evidence that exploitation is significantly reduced in response to stock depletion.

Information and monitoring (1.2.3)

Scoring category	Green

Rationale:
Blue and chub mackerel fisheries are some of the most important commercial fisheries in Japan, and they have been well characterized. Information on stock abundance and productivity, fishery removals, and fleet composition is collected, and is generally sufficient to support the TAC-based harvest strategy. China, Korea, and Russia also harvest mackerel from these stocks. There is information about Korea's catches of the East China Sea stock (Kurota et al. 2017), and the North Pacific Fisheries Council has reported catches by Russia and China since 2014. China's catches, which are dominant compared to Russia's, are reportedly mostly of chub mackerel rather than blue mackerel (Yukami et al. 2017).

Assessment of stock status (1.2.4)

Scoring category	Green

Rationale:
Stock assessment scientists at the Japan Fisheries Research and Education Agency (FRA) assess blue mackerel stocks annually. These assessments estimate stock abundance (both total biomass and spawning stock biomass) relative to reference points based on historical abundance estimates. The assessments are reviewed internally and also externally by experts and officials (JFA and FRA 2015). Uncertainty in recruitment is considered in simulations used to estimate ABC (Kawabata et al. 2014a). The assessment appears appropriate to the species and could be used to develop an HCR.

Ecosystem impacts - Principle 2

Japanese fishers do not systematically record discards or bycatch, though they often record catches of commercially important species.

The majority of the chub and blue mackerel catch is from large, single-vessel purse seines (http://www.maff.go.jp/j/tokei/kouhyou/kaimen_gyosei/index.html). These vessels commonly also catch Japanese pilchard (*Sardinops melanostictus*), Japanese anchovy (*Engraulis japonicus*), and amberjacks (e.g. *Seriola quinqueradiata*) in addition to mackerel (FRA 2017). No bait is used in purse seine fisheries, so bait species do not need to be considered in this assessment.

Other species information (2.2.3)

Scoring category	Yellow

Rationale:
Information on other species harvested within specific fisheries is not always readily available, but FRA scientists are in the process of writing SHUN (Sustainable, Healthy and "Umai" Nippon seafood project) reports, which do include information on catches on other species. Although a report for blue mackerel has not yet been published, one has been written for the Pacific Ocean stock of chub mackerel, which is commonly caught with blue mackerel. According to that report, about 86% of the catch for vessels targeting chub mackerel (Pacific stock) consists of chub mackerel, blue mackerel, Japanese pilchard, Japanese anchovy, and amberjacks (FRA 2017). More precise catch composition data were not provided, so these species are all considered main, comprising at least 5% of the total catch by weight. FRA scientists have not yet provided estimated catch composition data for fisheries targeting the East China Sea stock of blue mackerel. Information appears sufficient to inform management and determine the fishery's risk to these other species, at least for the Pacific stock. However, catches of bycatch and discard species are not monitored.

Other species outcome (2.2.1)

Scoring category	Red

Rationale:
Of the main species, one is currently identified as having poor stock status (Japanese anchovy, Pacific Ocean stock). Purse seine fisheries may be overfishing the Japanese anchovy stock (FRA 2017). Fishing mortality on the other main species does not appear to be at an unacceptable level, but the concern about the Japanese anchovy stock results in a red score for this indicator.

Other species management (2.2.2)

Scoring category	Red

Rationale:
There are management measures in place for the main species caught by the UoA. However, it is not clear whether they are expected to maintain or to not hinder rebuilding of these species, particularly Japanese anchovy.

ETP species information (2.3.3)

Scoring category	Yellow

Rationale:
There is no standardized monitoring of bycatch species in Japanese fisheries (Fukutake et al. 2014), and fishers do not usually record data on encounters with ETP species. Information about ETP species mortality resulting from the assessed fishery is therefore not available. However, FRA has identified ETP species that are at risk from incidental mortality in purse seine fisheries targeting the Pacific stock of chub mackerel (see FRA 2017), and there was sufficient qualitative information to conduct productivity susceptibility analyses (PSAs) for these species.

ETP species outcome (2.3.1)

Scoring category	Yellow

Rationale:
The FRA conducted productivity susceptibility analyses (PSAs) on the ETP species that may interact with the fishery, which include a variety of seabirds and sea turtles (Table 3).

Table 3. PSA results for ETP species that may interact with purse seine fisheries targeting blue mackerel. Color corresponds to risk level to the species from the fishery, which can be low (green), medium (yellow), or high (red). Data from FRA 2017.

Common name	Species name	PSA score and risk level
Loggerhead sea turtle, アカウミガメ	*Caretta caretta*	2.89
Japanese murrelet, カンムリウミスズメ	*Synthliboramphus wumizusume*	2.28
Short-tailed albatross, アホウドリ	*Phoebastria albatrus*	2.76
Tufted puffin, エトピリカ	*Fratercula cirrhata*	2.51

We also used the SFW Unknown Bycatch Matrices (UBM) to attempt to corroborate the PSA results. Using the UBM, we evaluated likely impacts on turtles, seabirds, and sharks from purse seines in the North Pacific or Northwest Pacific Ocean. Level of concern regarding fishing

mortality is marked by the following colors: high concern = red, medium concern = yellow, and low concern = green. Highest impacts receive a score of 1, and lowest impacts receive a score of 5. For benthic invertebrates, finfish, forage fish, and corals, impacts were not determined by region, and SFW did not assign concern categories.

Based on the information in the matrices, impacts on sea turtles, marine mammals, seabirds, and sharks are expected to be low concern (Table 4). If monitoring information or evidence can show that impacts on these potential ETP species are minimal, the score can be better confirmed.

Table 4. Impacts of purse seines in the North or Northwest Pacific Ocean based on the Monterey Bay Aquarium SFW Unknown Bycatch Matrices.

Bycatch susceptibility category	Region	Score and level of concern
Sea turtle	North Pacific	4
Marine mammal	Northwest Pacific	3.5
Seabird	Northwest Pacific	4
Shark	Northwest Pacific	3.5
Benthic invertebrates	N/a	5
Finfish	N/a	4
Forage fish	N/a	3
Corals and other biogenic habitats	N/a	5

Based on information from the PSAs and the UBM, fishery impacts on ETP species are generally expected to be low, though there are a few species potentially at medium risk. Thus the species outcome indicator receives a preliminary yellow score.

ETP species management (2.3.2)

Scoring category	Yellow

Rationale:
Japan has a Red Data Book identifying ETP species found within the country. In terms of national legislation, there is a Law for the Conservation of Endangered Species of Wild Fauna and Flora (Law No. 75) that aims to conserve endangered species and contribute to conservation of the natural environment (Ministry of the Environment 2016a). There is also a

Wildlife Protection and Hunting Law (Law No. 32) that protects birds and mammals by establishing wildlife protection areas (Ministry of the Environment 2016b). In addition, Japan accepted the application of CITES and has been implementing its requirements since 1980.

We found no documented information on management measures for minimizing negative impacts for this specific fishery. However, in practice Japanese fishers generally try to minimize incidental entanglement of seabirds and sea turtles, and often attempt to release them. Between the ETP species protection laws and common practices, measures are likely in place and expected to work.

Habitats information (2.4.3)

Scoring category	Yellow

Rationale:
Chub and blue mackerel are a pelagic species, and the primary gear type used to target them (purse seines) is unlikely to contact the sea bottom and directly impact marine habitat (FAO 2001). Thus the types and distribution of commonly encountered habitats and the nature of gear impacts upon those habitats is broadly understood. However, data are not adequate for verifying efficacy of habitat management measures and determining fishery risks to habitat.

Habitats outcome (2.4.1)

Scoring category	Green

Rationale:
Based on the nature of purse seines and their operation in upper water layers to catch pelagic mackerel, these fisheries are highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm. They are also highly unlikely to impact VME habitats.

Habitats management (2.4.2)

Scoring category	Yellow

Rationale:
The gear type and operations of purse seine fisheries for mackerel constitute an operational strategy for managing impacts on encountered habitats. Fishing takes place in deep water with gear that is used at the ocean surface and does not contact the sea bottom. Knowledge about this gear type provides an objective basis for confidence that the fisheries do not harm encountered habitats (FAO 2001). However, the effectiveness of the strategy has not been

tested, and there is no quantitative evidence that the operational strategy is being implemented successfully.

Ecosystem information (2.5.3)

Scoring category	Yellow

Rationale:
Trophic relationships involving blue mackerel are broadly understood, but ecosystem impacts of mackerel fisheries do not appear to have been studied in detail. Mackerel prey on krill, small fishes, and squids, including Japanese anchovy (*Engraulis japonicus*), benttooth (*Champsodon snyderi*), and Watase's lanternfish (*Diaphus watasei*). Mackerel juveniles are consumed by skipjack tuna and baleen whales (Kawabata et al. 2014a). MSC considers mackerels lower trophic level (LTL) species by default.

Ecosystem outcome (2.5.1)

Scoring category	Yellow

Rationale:
Blue mackerel are an LTL species, and fisheries harvest large quantities of the mackerel. However, they are a productive species, and estimated abundances have appeared stable in recent years (Figs. 1 and 2). Thus fisheries appear unlikely to disrupt key ecosystem elements to a point where there would be serious or irreversible harm.

There is some aquaculture production of chub and blue mackerel, where juveniles are captured from the wild and raised in net pens until they reach market size (Tatsuya 2009). The scale of production does not appear extensive; as an example, the Kagoshima Fisheries Technology Development Center (鹿児島水産技術開発センター) produced a peak quantity of 46,000 fish (~28 mt) for market between 2003 and 2007 (Tatsuya 2009). However, aquaculture may have negative ecosystem impacts relating to removal of juveniles from wild populations, reduction of bait fish populations, disease transmission to wild fish, and environmental pollution from net pen production. Individuals that escape from net pens may also interbreed with wild fish and affect the genetic structure of wild populations. Currently these types of impacts are not sufficiently investigated and considered by management (Makino 2011).

Ecosystem management (2.5.2)

Scoring category	Yellow

Rationale:

The Japanese fisheries management system focuses primarily on target species and currently lacks an ecosystem-based approach, although some policy documents, such as the Fisheries Policy of 2001, state that ecosystems should be conserved (Makino 2011). The management of mackerel harvests through TAC is a somewhat indirect measure for managing fishery impacts on the broader ecosystem, which does not consider the LTL status of mackerels and is partly driven by economic interests.

The 2011 Japan Ministry of the Environment document titled 'Marine life diversity conservation strategy' (海洋生物多様性保全戦略) suggests a general movement toward policies that protect marine diversity and promote the sustainable use of marine resources (Fukutake et al. 2014). Relevant management measures include implementation of Marine Protected Areas (see Makino 2013). Conservation policy strategies are established by the Marine Diversity Conservation Specialist Investigative Commission (海洋生物多様性保全戦略専門家検討会), which holds meetings and receives public comments.

Management - Principle 3

Japan's fisheries are managed on multiple levels. The national management body is the Fisheries Agency of Japan (JFA) within the Ministry of Agriculture, Forestry, and Fisheries (MAFF). Prefectural governments administer fishing rights and licenses within their jurisdictions (Makino 2011). At a smaller scale, fisheries are managed by fishery cooperative associations, whose membership consists of fishermen and small fishing companies. These cooperatives tend to be defined by region, target species, and/or gear type. Management is coordinated among all these levels, generally with the JFA and prefectural governments issuing regulations and the fishery cooperatives implementing those regulations (McIlwain 2013). In Japan there is an emphasis on resource users actively contributing to management of their own fisheries, and fishery cooperatives have considerable influence in determining operational rules (e.g. gear restrictions) and setting fishery openings and closures (Uchida and Watanabe 2008, Makino 2011).

Legal and/or customary framework (3.1.1)

Scoring category	Green

Rationale:
Fisheries governance in Japan is supported by an effective national legal system with binding procedures governing cooperation with other parties, and the system is capable of delivering management outcomes consistent with 1) management of the stock to a sustainable level and 2) minimising impacts on other species, habitats, and wider ecosystem components. The legal system aims to guarantee justice and transparency in administrative management, and there is a clear decision-making process for determining fishery measures and dealing with disputes as they arise (Fukutake et al. 2014). The system has a mechanism to observe the legal rights of people dependent on fishing for food or livelihood.

The Fisheries Law of 1949 outlines a framework for managing fisheries via fishery rights and licenses that are controlled by the government (Makino 2011).

Consultation, roles, and responsibilities (3.1.2)

Scoring category	Green

Rationale:
Functions, roles, and responsibilities are clearly defined and understood in the national management framework. The Japanese Fisheries Policy Council has a key role in seeking and accepting relevant information from stakeholders, which may then be incorporated into management measures. The JFA regularly offers opportunities for stakeholders, including fishing industry members, to participate in public consultation processes (Fukutake et al. 2014).

Additionally, the JFA supports economic incentives for sustainable fishing by providing some degree of compensation for income loss resulting from management measures (Makino 2011).

Long term objectives (3.1.3)

Scoring category	Green

Rationale:
The Fisheries Basic Act (2001) describes the overarching framework for fisheries management in Japan. Chapter 1, Article 2 states a requirement to manage fisheries resources to ensure their sustainable use as a component of marine ecosystems, following the recommendations of UN Convention on the Law of the Sea (UNCLOS). The Law of Conservation and Management of Marine Living Resources states the need to protect surrounding ecosystems and habitats. Thus long term objectives consistent with the precautionary approach and appropriate management of target stocks and ecosystem impacts are explicit within management policy.

Fishery-specific objectives (3.2.1)

Scoring category	Yellow

Rationale:
Blue mackerel stocks are managed by TAC at the national level, which constitutes an objective consistent with the precautionary approach. Additionally, prefectural management guidelines are available for at least some of the prefectures with fisheries that harvest blue mackerel. For example, the Chiba prefectural management guidelines mention that comprehensive resource management is necessary for purse seine fisheries, including those that harvest blue mackerel, because species-specific management is a challenge for these multispecific fisheries (Chiba

Prefectural Government 2015). Prefectures also have fishery adjustment rules (漁業調整規則) that describe regulations such as fishery permitting and prohibited harvest activities (e.g. https://www.pref.chiba.lg.jp/gyoshigen/naisuimen/chousei.html).

However, the management objectives driving fishery rules and management guidelines are usually not explicitly described, especially those relating to management of ecosystem impacts.

Decision-making processes (3.2.2)

Scoring category	Yellow

Rationale:
Status of the fishery and fish stocks are reviewed at least once per year, and the TAC is also set and adjusted each year (Yukami et al. 2017, JFA 2014). These reflect the existence of decision-making processes that result in measures for achieving fishery-specific objectives, and suggest that the processes respond to monitoring and evaluation results. Some information on the fishery's performance is available in materials posted on the FRA and MAFF websites. There is no indication that management authorities or fishers repeatedly violate regulations necessary for sustainability of the fishery. However, it is not apparent that decision-making processes employ a precautionary approach.

Compliance and enforcement (3.2.3)

Scoring category	Yellow

Rationale:
Fishing effort appears to be primarily regulated through permits and limited entry to the fishery. The JFA and Japan Coast Guard engage in some enforcement activities such as checking fishing logbooks and permits, and clear provisions exist for penalizing individuals or parties who violate fishery regulations (Clarke 2007). Thus MCS mechanisms exist and are implemented. These mechanisms are expected to be reasonably effective, and there are no reports of systematic non-compliance. More information on application of sanctions and evidence of compliance would be needed to score this indicator green.

Monitoring and management performance evaluation (3.2.4)

Scoring category	Yellow

Rationale:
Key components of the fishery-specific management system include monitoring and evaluation of stock status, management of ecosystem impacts (e.g. catches of other species and habitat issues), and performance of the compliance and enforcement system. Stock assessments are

regularly evaluated and subject to internal review (JFA 2015), but it is not clear whether the other components are regularly evaluated and adapted.

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