MarinTrust Whole fish fishery assessment V 3.0

FIP Reporting document

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Indian oil sardine (Goa and Maharashtra)

Key Traceability

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Instructions to FIP assessors/assessment teams

This MarinTrust Whole fish fishery assessment for the Indian Oil Sardine (Goa and Maharashtra) has been conducted by Key Traceability Ltd. Team members of the assessment include Emily Wardrop, Charles Horsnell, Ayoni Dutti and Tom Evans. Both Charles and Tom are approved IP fishery assessors, as listed on the MarinTrust website.

The assessment was desk-based and took place between June-August 2024, with information on the fishery provided by Omega Fishmeal and Oil Pvt Ltd and TJ Marine Products Pvt Ltd, along with information found online in relevant publications and other public documentation.

Template amendment log

DATE	ISSUE	AMENDMENT	AUTHORISED BY

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Introduction to the fishery

Fishery scope

Table 1: Fishery scope

FIP name	India oil sardine (Goa and Maharashtra)
Main species (common name, Latin name)	Indian oil sardine *(Sardinella longiceps)* Indian mackerel (*Rastrelliger kanagurta*) Lesser sardine (*Sardinella fimbriata*)
Fishery location	State-managed waters of Goa State-managed waters of Maharashtra
Gear type(s)	Purse seine
Management authority (country/state)	Goa and Maharashtra (India)

Summary of outcomes

Table 2: Summary of outcomes of gap analyses

Overall outcome		**Gap**
Clauses failed		**Reason for failure**
M1.5	M1.5.3 – The fishery management system is subject to periodic internal or external review to validate the decision-making process, outcomes and scientific data.	No information was available to demonstrate that the fishery management system is subject to external review. Only certain reports could be considered for internal review.
M2.1	M2.1.3 – There is evidence of monitoring and surveillance activity appropriate to the intensity, geography, management control measures and compliance behaviour of the fishery.	Despite written documents from Goa and Maharashtra about MCS, only Goa provided any detail. This also demonstrated 19 incidents of violations between 2023-2024 and was not fishery specific. More specific about the fishery required – particularly Maharashtra - as at present it cannot be evidenced the Monitoring and Surveillance is 'appropriate to the intensity, geography, management control measures and compliance behaviour of the fishery'.
M2.3	M2.3.1 – The level of compliance is	There is some evidence as provided by the departments (MCS letters), but it is not

	documented and updated routinely, statistically reviewed and available.	understood if it is statistically reviewed and how often it is updated, nor what data actually relates to the specific fishery under assessment. Further information required to fully close this out.
	M2.3.2 – Fishers provide additional information and cooperate with management/enforcement agencies/organisations to support the effective management of the fishery.	Adequate information and/or record supporting the fact that fishers provide additional information and cooperate with management/enforcement agencies/organisations to support the effective management of the fishery has not been found.
A2.2	A2.2 – The assessment provides an estimate of the status of the biological stock relative to a reference point or proxy.	There are indicators that some reference proxies are available, including BMSY and FMSY. While traditional reference points like TRP and LRP are not available here, it is noted that for some fisheries biomass-based reference points may not be applicable and measures such as CPUE might be more warranted. However, as the research by Ratnagiri College of fisheries is not the assessment that government bases their management decisions on, without more comprehension, a gap remains.
A3.2	A3.2 – Total fishery removals of this species do not regularly exceed the level indicated or stated in the stock assessment. Where a specific quantity of removals is recommended, the actual removals may exceed this by up to 10% only if the stock status is above the limit reference point or proxy.	Whilst a proxy is used, this still must be applied into the management plan, evidence of which could not be found during this initial assessment.
A3.3	A3.3 – Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).	As there are no limit reference points available for this stock, this cannot pass.

A4.1	A4.1 – The stock is at or above the target reference point; OR IF NOT: the stock is above the limit reference point or proxy and there is evidence that a fall below the limit reference point would result in fishery closure; OR IF NOT: the stock is estimated to be below the limit reference point or proxy, but fishery removals are prohibited	There is no distinct TRPs in place for this stock, nor are there any LRPs. Therefore, there is also no information available that describes whether the fishery should be closed if these reference points are breached.
B1 (Lesser sardine)	B1 – Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).	There is very little information and evidence available to analyse the status of this stock.
Da (several species)	N/a	Several of the Category D species did not pass their PSA.
Db (several species)	N/a	All of the species that did not pass Da, also did not pass Db due to lack of management measures.
E1.1	E1.1.2 – Interactions between the fishery and ETP species are recorded and reported to management organisations.	There is no third-party (e.g. observer) data that would be able to demonstrate that the fishery does not interact with ETP species, therefore, there is no way of understanding how the fishery communicates and reports incidents to management organisations. Scientific papers are available that demonstrate low ETP catch rate in Indian purse seine fisheries compared to gillnet fisheries, but these are largely outdated and are not specific to the fishery being assessed.
E1.3	E1.3.2 – The measures are considered likely to achieve the objectives of regional, national and international legislation relating to ETP species.	Despite there being letters provided from Maharashtra and Goa about the monitoring and compliance, there are a number of other measures that are unaccounted for
E2.1	E2.1.2 – Information on the scale, location and intensity of fishing activity relative to habitats is collected.	Currently, there is no information available about the scale, location and intensity of fishing activity relative to habitats for this fishery. Information about overlapping habitats, including coral reefs, and seagrasses is evident through

		scientific papers, but without specific information on vessel movements, there is no way to fully verify that the vessels are not operating on these environments.
E2.2	E2.2.1 – The information collected in relation to E2.1.3 indicates that the fishery does not have a significant negative impact on marine habitats.	Without specific information on the fishery's scale, location and intensity, it cannot be confirmed that the purse seine fisheries does not have a significant negative impact on seafloor habitats.
E3.2	E3.2 – The information collected in relation to E3.1.3 indicates that the fishery does not have a significant negative impact on marine ecosystems.	The lack of information or variance of specific catch composition limits the ability to accurately assess the contribution of the fishery to total ecosystem impacts. Furthermore, several Productivity and Susceptibility Analysis (PSAs) were conducted as required by MarinTrust assessment criteria, and currently did not pass – which does not provide confidence that the fishery does not have a significant negative impact on the marine ecosystem.

Species composition of the fishery

The India oil sardine (Goa and Maharashtra) fishery being assessed has three main species in their catch, the Indian oil sardine (*Sardinella longiceps*), the Indian mackerel (*Rastrelliger kanagurta*), and the lesser sardine (*Sardinella fimbriata*). The largest contribution to total catch is from the Indian mackerel (44%), followed by the Indian oil sardine (43%) and lesser sardine (11%).

Species categorisation

List of all the species assessed. Type 1 species are assessed against Category A or Category B. Type 1 species must represent 95% of the total annual catch. Type 2 species are assessed against Category C or Category D. Type 2 species may represent a maximum of 5% of the annual catch. Species that comprise less than 0.1% of the catch are not required to be assessed or listed here.

Table 3: Species categorisation table

Species name (common & Latin name)	Stock	CITES appendix 1 or 2 listed Yes/no	IUCN Red list Category	% catch composition	Management (Y/N)	Category (A, B, C or D)
Indian oil sardine *(Sardinella longiceps)*	Maharashtra and Goa	No	No	43%	Y	B – Failed A
Indian mackerel *(Rastrelliger kanagurta)*	Maharashtra and Goa	No	No	44%	Y	B – not enough information for Category A assessment
Lesser sardines *(Sardinella fimbriata)*	Maharashtra and Goa	No	No	11%	Y	B – not enough information for Category A assessment
Yellowfin tuna *(Thunnus albacares)*	Indian Ocean	No	No	1.08%	Y	C
Other finfish and invertebrate species	Maharashtra and Goa, and Indian Ocean	No	No	Unknown	N	D

Rationale

For this assessment, initially Indian oil sardine (*Sardinella longiceps*), Indian mackerel (*Rastrelliger kanagurta*), and Lesser sardines (*Sardinella fimbriata*) were categorised as a category A species due to meeting the assessment criteria (species-specific management regime in place), however due to failing some clauses under that category, they were also assessed as a Category B species, so has been listed here as such. Note: in this report only the IOS assessment for category A has been included, the assessment for Indian mackerel and Lesser sardines went directly to category B. Further, the percentage contribution to total catch was obtained from the original FIP pre-assessment as no current data was made available.

The contribution to total catch from yellowfin tuna was described in the scientific article "Catch composition of purse seine fishing along Ratnagiri coast of Maharashtra State, India", 2017 (Kamble, et al., 2017).

Other finfish and invertebrate species were identified from reports provided by the existing FIP, however there was no indication about the percentage composition of these species to total catch. Therefore, as a precaution, all species listed in the report were considered in Category D, including running a series of Productivity-Susceptibility Analyses.

References

Kamble, S., Kazi, T., Chaudhari, K. & Shirdhankar, M., 2017. Catch composition of purse seine fishing along Ratnagiri coast of Maharashtra State, India. *Journal of Experimental Zoology - India,* Volume 20, pp. 431-434.

Management requirements

This section, or module, assesses the general management regime applied to the fishery under assessment. It comprises two parts, M1, which evaluates the management framework, and M2, which evaluates surveillance, control and enforcement within the fishery.

1.1. All management criteria must be met (pass) for a fishery to pass the Management requirements.

1.1.1. The sub-criteria offer a structured evidence base to demonstrate that the fishery sufficiently meets the management criteria. It is not expected that sub-criteria are assessed independently of the main criterion.

M1 Management framework

M1.1	**M1.1 There is an organisation responsible for managing the fishery.** *In reaching a determination for M1.1, the assessor should consider if the following is in place:*	
	M1.1.1 The management and administration organisations within the fishery are clearly identified.	*Meets*
	M1.1.2 The functions and responsibilities of the management organisations include the overall regulation, administration, science and data collection and enforcement roles, and are documented and publicly available.	*Meets*
	M1.1.3 Fishers have access to information and/or training materials through nationally recognised organisations.	*Meets*
Clause outcome		***Pass***

Rationale

M1.1.1 –

Management of the Indian oil sardine fishery falls under the jurisdiction of multiple authorities, reflecting a cooperative federalism approach. At the federal level, the Department of Animal Husbandry, Dairying and Fisheries (DADF) within the Ministry of Agriculture and Farmers Welfare oversees fishing activities conducted in the Exclusive Economic Zone (EEZ) waters beyond 12 nautical miles from shore. Within the EEZ, the central government is responsible for fisheries management up to 200 nautical miles.

For fisheries active within 12 nautical miles of shore, state governments hold jurisdiction. In this assessment, the relevant authorities are the Directorate of Fisheries in Goa and the Department of

Fisheries in Maharashtra. Additionally, various other national and state-level authorities, including the Ministries of Defence; Science and Technology; Food and Processing Industries; Earth Sciences; and Environment, Forests and Climate Change, have influence over fisheries management.

Traditional fishing communities in coastal India also play a significant role in fisheries management. These communities maintain informal systems such as the padu system or alternate-day fishing. These community-run systems have a long history of adapting to changes and focus on keeping fish stocks healthy by setting rules on who can fish, what methods are used, and sometimes even creating closed fishing periods. This community-based approach offers a unique perspective on sustainable fisheries management in India.

Therefore, this element currently meets the scoring requirement.

M1.1.2 –

Overall regulation and administration:

- Fisheries management in India is supported by a robust legal framework at both federal and state levels. Key state-level regulations include the Goa Marine Fishing Regulation Act (1980) and the Maharashtra Marine Fishing Regulation Act (1981), detailing each state's regulations such as sanctions, licensing rules, closed areas and seasons.
- Other significant legislations include the Maritime Zones of India Act, 1981 (controlling foreign fishing vessel activities within the Indian Maritime Zone); the Environment (Protection) Act, 1986 (mandating Environmental Impact Assessments for certain activities); the New Deep Sea Fishing Policy, 1991 (licensing and controlling deep sea fishing); the Murari Committee recommendations, 1995 (adopted by the Indian government in 1997, introducing new technical measures and licensing changes); the Biological Diversity Act, 2002 (aiming to protect biological diversity); the Marine Fisheries (Regulation and Management) Bill, 2009; and the National Policy on Marine Fisheries (NPMF), 2017.

Data collection:

- The Central Marine Fisheries Research Institute (CMFRI), established in 1947, is the primary national research organization for marine wild capture fisheries and mariculture. CMFRI uses a Stratified Multistage Random Sampling Scheme to collect landings data and conducts rapid stock assessments for 28 economically important species groups, including oil sardine. This data informs state-level management decisions and is collected through CMFRI's regional centres in Mandapam, Visakhapatnam, Veraval, and research centres in Mangalore, Kozhikode, Mumbai, Vizhinjam, Karwar, Tuticorin, and Chennai.
- The Fishery Survey of India (FSI), operating since 1946, is the main agency for surveying and assessing fish stocks in India's EEZ. The FSI conducts regular surveys, marine fisheries forecasting, and monitors fishery resources for regulation, management, and conservation. They also conduct experimental fishing to discover new resources and collect data on tuna for reporting to the Indian Ocean Tuna Commission (IOTC).
- The Central Institute of Fisheries Technology (CIFT) within the Indian Council of Agricultural Research (ICAR) is another relevant organization, focusing on basic and strategic research in fishing and processing, and developing energy-efficient fishing systems for responsible and sustainable fisheries management.

Documentation and transparency:

- The CMFRI publishes an annual report providing comprehensive information on fishery

management, including landings estimates by state, scientific efforts like ecosystems modelling and genetic analyses, climate change impacts, economic and social components of fisheries management, budgets, training, and major events. The Directorate of Animal Husbandry, Dairying, and Fisheries (DADF) also produces an annual report summarizing fisheries management activities at a national level. At the state level, the Goa Directorate of Fisheries publishes an annual report with similar content, although no equivalent report could be found from the Maharashtra Department of Fisheries. The majority of the information for this assessment was publicly available online, with additional data provided by the applicant organization without restrictions

Therefore, this element currently meets the scoring requirement.

M1.1.3 –

The Central Marine Fisheries Research Institute (CMFRI) publishes an annual report that includes extensive information on fishery management. This report provides summaries of landings estimates by state, scientific efforts such as ecosystems modelling and genetic analyses, climate change impacts, economic impacts, social components of fisheries management, budgets, training, and major events. Regular stakeholder consultation meetings further ensure transparency in the management process.

The Directorate of Animal Husbandry, Dairying, and Fisheries (DADF) also produces an annual report summarizing fisheries management activities, though it covers a broader area and is necessarily more general. At the state level, the Goa Directorate of Fisheries publishes an annual report with similar content to the national CMFRI report, although no equivalent report is available from the Maharashtra Department of Fisheries. Most of the information used to inform this assessment was freely available online, with the remainder provided by the applicant organization without restrictions.

India's fisheries policies prioritise both a healthy marine environment and the well-being of fishers. In 2020, a National Fisheries Policy was drafted and focuses on the long-term sustainability of fish stocks within India's Exclusive Economic Zone (EEZ). It emphasises responsible fishing practices and the social upliftment of fishers. However, to date, this Policy has not yet been implemented.

To empower fishers and ensure effective practices, another policy promotes knowledge management. This involves using technology to provide real-time data on fish abundance, potential fishing zones, and weather conditions. Additionally, temporary fishing closures are recognized as beneficial. However, regular reviews are conducted to ensure these closures do not negatively impact fishers' livelihoods. These reviews involve scientific data, a cautious approach, and participation from fishers and stakeholders.

Therefore, this element currently meets the scoring requirement.

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M1.2	**M1.2 Fishery management organisations are legally empowered to take management actions.** *In reaching a determination for M1.2, the assessor should consider if the following is in place:*	
	M1.2.1 There are legal instruments in place to give authority to the management organisation(s) which can include policies, regulations, acts or other legal mechanisms.	*Meets*
	M1.2.2 Vessels wishing to participate in the fishery must be authorised by the management organisation(s).	*Meets*
	M1.2.3 The management system has a mechanism in place for the resolution of legal disputes.	*Meets*
	M1.2.4 There is evidence of the legal rights of people dependent on fishing for food or livelihood.	*Meets*
Clause outcome		***Pass***

Rationale

M1.2.1 –

Legal framework:

India has established robust legal frameworks at both federal and state levels to guide and empower the management of fisheries. The primary national legislation is the Indian Fisheries Act of 1897, which delegates significant legislative authority over fisheries to individual states. At the state level, notable laws include the Goa Marine Fishing Regulation Act of 1980 and the Maharashtra Marine Fishing Regulation Act of 1981. These state-specific Marine Fishing Regulation Acts outline regulations such as penalties, licensing, and designated closed areas and seasons.

Additional legislation includes:

- The Maritime Zones of India Act, 1981: Regulates foreign fishing vessels in Indian waters.
- The Environment (Protection) Act, 1986: Mandates Environmental Impact Assessments for certain activities.
- The New Deep Sea Fishing Policy, 1991: Regulates deep-sea fishing.
- The Murari Committee recommendations, 1995: Adopted by the government in 1997, introducing various technical measures and licensing changes.
- The Biological Diversity Act, 2002: Aims to protect biodiversity.
- The Marine Fisheries (Regulation and Management) Bill, 2009.
- The National Policy on Marine Fisheries (NPMF), 2017 (which is set to be superseded by the National Fisheries Policy 2020, but this has not been approved yet)

Policies:

India's fisheries policies prioritize both a healthy marine environment and the well-being of fishers. The National Policy on Marine Fisheries (NPMF), 2017 focused on the long-term sustainability of fish stocks within India's Exclusive Economic Zone (EEZ).

To empower fishers and ensure effective practices, the National Policy on Marine Fisheries (NPMF), 2017 promotes knowledge management. This involves using technology to provide real-time data on fish abundance, potential fishing zones, and weather conditions. Additionally, temporary fishing closures are recognized as beneficial, but regular reviews are conducted to ensure these closures do not negatively impact fishers' livelihoods. These reviews involve scientific data, a cautious approach, and participation from fishers and stakeholders.

Building on this, the National Fisheries Policy 2020 aims to take a comprehensive approach to revitalize India's fisheries sector. It aims to unlock the country's full potential for fish production through responsible and sustainable practices. A key part of this strategy is establishing a strong legal framework to manage fisheries resources effectively, considering the entire ecosystem and adhering to both national and international regulations. The policy aims to strive for a future with increased fish production, improved incomes for fish farmers, and a wider variety of seafood choices for consumers. However, this policy has not yet been approved.

Therefore, this element currently meets the scoring requirement.

M1.2.2 –

As part of the National Policy on Marine Fisheries (NPMF), introduced in 2017, all vessels must be licensed to the national and State level (including Goa and Maharashtra). However, there appears to be no evidence of a vessel monitoring system (VMS), nor are there mandatory requirements for logbooks or observers onboard the vessels. There are measures regarding input/effort restrictions: These regulations might limit the type or amount of fishing gear used or the amount of fishing time allowed, and spatial and temporal restrictions: MFRAs can designate specific areas or times when fishing is prohibited or restricted. For example, between 15th April-to-15th June (61 days inclusive), there is a fishing ban across Indian coastal states, including Goa and Maharashtra, first established in 2021 and repeated annually thus far.

There are Monitoring, Control and Surveillance (MCS) requirements for all fisheries operating in Goa and there are sanctions and penalties in place for fishers that violate the rules and regulations. Between 2023-2024, there were a reported 19 cases that were violating rules and regulations. Therefore, despite the threat of sanctions and penalties, these violations still occur (this information can be found on the FIP profile on MarinTrust. Nevertheless, the Goa Department of Fisheries (DOF) is said to be responsible for conducting inspections of around 1,200 fishing vessels, and patrols

within 5km of the shore.

The MCS for Maharashtra are more ambiguous at this stage and even when directly asked about the measures in place, the feedback was not sufficient to demonstrate appropriate MCS objectives.

The latest National Fisheries Policy, drafted in 2020 but still not entered into effect, emphasizes the need to strengthen the existing mechanisms for a sound and effective Monitoring, Control, and Surveillance (MCS) regime in the marine fisheries sector.

Enforcement activities:

In Goa, the Enforcement Section of the Directorate of Fisheries (DoF) is responsible for inspecting around 1,200 fishing vessels and 2,000 canoes and conducting patrols within 5 km of the shore. These activities are aimed at ensuring compliance with the regulations and help in maintaining sustainable fishing practices.

However, in Maharashtra, there is no clear equivalent enforcement section within the Department of Fisheries (DoF), and it is unclear what specific enforcement activities are carried out in the state. This highlights a need for better-defined and strengthened enforcement mechanisms across all states to ensure effective MCS.

Overall, while there are several regulatory measures in place under the MFRAs, the existing MCS regime requires further strengthening to ensure sustainable and responsible fishing practices. The implementation of advanced monitoring systems like VMS, mandatory logbooks, and an at-sea observer program would enhance the effectiveness of fisheries management in India.

Therefore, this element currently meets the scoring requirement.

M1.2.3 –

The Indian Fisheries Act of 1897 empowers government representatives (such as police officers) to arrest individuals committing offences against the Act. More detailed sanctions are defined in the state fishery legislation. The Goa, Daman and Diu Marine Fishing Regulation Act (1980) sets out a range of potential penalties, including a substantial fine (up to five times the value of the fish involved); the suspension or revocation of the relevant vessel licencing; and the seizure of the illegally caught fish or proceeds. Similarly, the Maharashtra Marine Fishing Regulation Act (1981) lists potential penalties including the seizure of fish and the impounding of fishing vessels; a substantial fine of up to five times the value of the fish caught; and the suspension or revocation of the fishing vessel licencing.

The Central, State/UT Governments will put in place a sound and effective Monitoring, Control and Surveillance (MCS) system with necessary legal backing. All fishing vessels will abide by MCS requirements and have suitable transponders/communication systems when out at sea which reveal the latitude-longitude of vessel adequately

Therefore, this element currently meets the scoring requirement.

M1.2.4 –

Recognising the global importance of small-scale fisheries for food security and poverty reduction, international agreements emphasize empowering these communities and upholding their human rights. India is committed to implementing these guidelines while considering the complexities within the small-scale sector. The Indian National Policy on Marine Fisheries, 2017 reflects on small-scale fishers and the efforts to ensure that they are considered within management, including:

1. The Government will initiate steps towards training, capacity building as well as up-

gradation of technological skills of traditional fishers in moving from artisanal fishing to more economic and efficient means of fishing

2. Government will also undertake review and periodic evaluation of the existing marine protected areas (MPAs) and for providing legislative support to ensure that tenure rights of the traditional fishermen are secured, and their livelihoods not impacted by such conservation measures.
3. Management of fisheries will follow an integrated approach, blending traditional knowledge and science with business principles and effective engagement of both primary stakeholders, and also those engaged in ancillary activities to ensure that fisheries are ecologically and economically sustainable. Fisheries governance will be improved to address conflict resolution between the traditional and mechanised sectors, emerging issues of common concern and to facilitate promotion of national capacity building by encouraging coherent management approaches and better collaboration.
4. Presently, coastal States/UTs have specific areas reserved (based on depth or distance from shore) for traditional fishers where mechanised fishing is not permitted. Such Territorial Use Rights for Fisheries or TURFs have proved to be useful in sustaining the livelihoods of artisanal fishers.
5. The Government will introduce new scheme(s) for enhancing the skills and capabilities of the traditional fishermen to undertake and popularize deep sea fishing.

The National Fisheries Policy, 2020 aligns with the preceding Policy in the respect for small-scale, traditional fisher rights. However, as this policy has not yet been approved, further details will not be described here.

Therefore, this element currently meets the scoring requirement.

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M1.3	**M1.3 There is an organisation responsible for collecting data and (scientifically) assessing the fishery.** *In reaching a determination for M1.3, the assessor should consider if the following is in place:*	
	M1.3.1 The organisation(s) responsible for collecting data and assessing the fishery is/are clearly identified.	*Meets*
	M1.3.2 The management system receives scientific advice regarding stock, non-target species and ecosystem status.	*Meets*
	M1.3.3 Scientific advice is independent from the management organisation(s) and transparent in its formulation through a clearly defined process.	*Meets*
Clause outcome		***Pass***

Rationale

M1.3.1 –

Role of research institutions:

The Central Marine Fisheries Research Institute (CMFRI), established by the Indian government in 1947, is the primary national research organization for marine wild capture fisheries and mariculture. CMFRI collects landings data using a Stratified Multistage Random Sampling Scheme and conducts rapid stock assessments for 28 economically important species groups, including oil sardine. The data collected and analysed by CMFRI informs state governments' management decisions. CMFRI maintains a regional presence with centres in Mandapam, Visakhapatnam, and Veraval, and research centres in Mangalore, Kozhikode, Mumbai, Vizhinjam, Karwar, Tuticorin, and Chennai.

Another relevant agency is the Fishery Survey of India (FSI), which is responsible for surveying and assessing fish stocks in India's Exclusive Economic Zone (EEZ). FSI conducts marine fisheries forecasting and monitors fishery resources for regulation, management, and conservation. However, based on FSI's most recent annual report (2020/21), current research appears to focus on demersal and tuna fisheries, and it is unclear whether FSI efforts are relevant to this Indian oil sardine (IOS) assessment specifically.

The Central Institute of Fisheries Technology (CIFT), within the Indian Council of Agricultural Research (ICAR), is also significant. CIFT is responsible for basic and strategic research in fishing and processing and develops energy-efficient fishing systems for responsible fishing and sustainable

management.

India National Marine Fisheries Policy 2017:

The India National Marine Fisheries Policy 2017 emphasizes the importance of robust data for effective fisheries management. It includes the regular collection of information on fish populations and fishing activities across the country, similar to a national fisheries census. To achieve this, the government "will implement a National Marine Fisheries Data Acquisition Plan, involving Central and State Governments, research institutions and stakeholders. The Plan will aim at strengthening these institutions through appropriate technology and capacity building for timely and reliable data acquisition and management system for fisheries."

The plan includes creating a network of monitoring facilities from local areas to a central level. These facilities will track fishing activities, enforce regulations, and analyse data to understand the health of fish stocks and overall fisheries operations. This comprehensive approach ensures the collection of accurate data, which is crucial for informed decision-making and sustainable fisheries management in India.

Therefore, this element currently meets the scoring requirement.

M1.3.2 –

The management system receives scientific advice on sustainability measures from the Marine Fisheries Information Service Technical & Extension Series on Minimum Legal Size (MLS) of capture to avoid growth overfishing of commercially exploited fish.

Therefore, this element currently meets the scoring requirement.

M1.3.3 –

The Central Marine Fisheries Research Institute (CMFRI) publishes an annual report that includes extensive information related to fishery management. This report provides summaries of landings estimates by state, scientific efforts such as ecosystem modelling and genetic analyses, climate change impacts, economic impacts, social components of fisheries management, budgets, training, and major events. Regular stakeholder consultation meetings further ensure transparency in the management process.

The Directorate of Animal Husbandry, Dairying, and Fisheries (DADF) also produces an annual report summarizing fisheries management activities at a higher level due to the broader area covered by the department. At the state level, the Goa Directorate of Fisheries produces an annual report with similar content to the national CMFRI report, though no equivalent report could be found from the Maharashtra Department of Fisheries. Most of the information used to inform this assessment was freely available online, with additional data provided by the applicant organization without restrictions.

To prevent the depletion of fish stocks due to uncontrolled fishing, the government collaborates with scientists and fishers to optimize fishing efforts and implement sustainable measures. These measures might include:

- Limiting the number of boats.
- Restricting fishing days.
- Regulating gear size.
- Enforcing minimum fish size limits.

Efforts might also be redirected to less-fished areas, and specific management zones could be

created to manage fishing activities more effectively. For already depleted fish stocks, rebuilding plans will be developed to restore these populations to sustainable levels.

Therefore, this element currently meets the scoring requirement.

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Parappurathu, J And Ramachandran, C (2017). Marine Fishery Regulations and Policies for Conservation in India, V.52 No.45 pp.360 – 370
Marine Fisheries Information Service (MIFS): MFIS 250Eldho Varghese paper_2.pdf (fisheryprogress.org)

M1.4	**M1.4 The fishery management system is based on the principles of sustainable fishing and a precautionary approach.** *In reaching a determination for M1.3, the assessor should consider if the following is in place:*	
	M1.4.1 A policy or long-term management objective for sustainable harvesting based on the best scientific evidence and a precautionary approach is publicly available and implemented for the fishery.	*Meets*
Clause outcome		***Pass***

Rationale

M1.4.1 –

The DADF website does not appear to contain a summary of the goals and objectives of the Department in relation to fisheries; however, the over-arching approach of the Indian government is most recently defined in the 2017 National Policy on Marine Fisheries (NPMF). This approach includes the text:

- "A healthy and vibrant marine fisheries sector that meets the needs of the present and future generations."
- "While keeping sustainability of the resources at the core of all actions, the policy framework will meet the national, social and economic goals, livelihood sustainability and socio-economic upliftment of the fisher community and is intended to guide the coordination and management of marine fisheries in the country during the next ten years."
- Participation of small fishing communities, fishermen groups, fishery cooperatives or Government organizations will be specially encouraged and supported.

The DADF was also responsible for creating the National Fisheries Development Board (NFDB), a semi-autonomous organisation responsible for "coordinating fishery development in an integrated and holistic manner", and to "achieve sustainable management and conservation of natural aquatic resources including the fish stocks" (amongst other goals). At the state level, the Goa Directorate of Fisheries states that one of its goals is to "manage and conserve the fisheries resources", although it also aims to "increase the fish production in the state". Similarly, the Maharashtra Department of Fisheries states that its aims include "sustainable fisheries development with ecological balance" and "ensuring protection of environment and conservation of biodiversity".

The National Policy on Marine Fisheries, 2017, mentions about a collaborative approach to managing fish stocks within India's Exclusive Economic Zone (EEZ). The central government will develop a comprehensive resource utilization plan, considering the needs of coastal states/UTs. These states, in turn, need to acknowledge the EEZ as a shared resource and avoid isolated fishing strategies that could lead to overfishing and conflict. To achieve this, the central government and states will work together to agree on sustainable management practices for the EEZ. Additionally, institutional mechanisms will be strengthened to address conflicts arising between states and even internationally. Finally, the government will develop integrated development plans for coastal and island

communities. These plans will focus on sustainable fishing practices, promote coastal and island tourism, and provide essential services like floating refuelling barges, mother carrier vessels (likely for support and processing at sea), and mobile marine ambulances, ultimately aiming to boost the economy of these regions. Therefore, this element currently meets the scoring requirement.
References Goa, Daman and Diu Marine Fishing Regulation Act, 1980: Microsoft Word - 65-The Goa, Daman and Diu Marine Fishing Regulation Act, 1980 and Rules, 1982.doc (indiacode.nic.in) Goa DoF, Enforcement Section: Enforcement (goa.gov.in) Indian Fisheries Act, 1897. https://indiankanoon.org/doc/286852/ India National Fisheries Policy (2020) (not in use) IndiaNational_Fisheries_Policy_2020.pdf Maharashtra Marine Fishing regulation Act, 1981: maharashtra_marine_fishing_regulation_act_1981.pdf National Policy on Marine Fisheries National Policy on Marine Fisheries 2017. | FAOLEX

M1.5	**M1.5 There is a clearly defined decision-making process which is transparent, with processes and results made publicly available.** *In reaching a determination for M1.5, the assessor should consider if the following is in place:*	
	M1.5.1 There is participatory engagement through which fishery stakeholders and other stakeholders can access, provide information, consult with, and respond to, the management systems' decision-making process.	*Meets*
	M1.5.2 The decision-making process is transparent, with results made publicly available.	*Meets*
	M1.5.3 The fishery management system is subject to periodic internal or external review to validate the decision-making process, outcomes and scientific data.	*Gap*
Clause outcome		***Fail***

Rationale

M1.5.1 –

The Indian national government provides various mechanisms to consult fishery stakeholders during the development of fishery management strategies. The Central Marine Fisheries Research Institute (CMFRI) holds annual stakeholder consultation meetings at many of its regional offices, summarizing the outcomes in its annual report. The latest available report (2022) report highlights stakeholder meetings conducted at the CFMRI office in Kochi on 5th July 2022, and also meetings held across various states to promote shark conservation and management.

The Directorate of Animal Husbandry, Dairying, and Fisheries (DADF) website also provided a link to a consultation on the National Inland Fisheries and Aquaculture Policy. This consultation, led by an expert committee of regional fisheries managers, scientists, and academics, sought responses from various stakeholders, including fishers, fish farmers, industry representatives, academics, NGOs, and others. The Fishery Survey of India (FSI) also holds regional workshops and engagement events. While explicit evidence of stakeholder consultations at the state level is less abundant, there is considerable evidence of stakeholder interactions through training, fishing festivals, and other outreach events.

The India National Marine Fisheries Policy 2017 aims to underscore the importance of a collaborative effort between the central government and states/UTs to enhance India's fisheries sector. The policy aims to create a supportive environment that benefits both fishers (large and small-scale) and stakeholders. "To promote direct engagement of stakeholders in setting up of such infrastructure facilities, fisher cooperatives will be encouraged along with the PPP mode to ensure speedy fulfilment of the requirements."

A key component of this collaboration is the establishment of a "National Fisheries Development Council," led by the Union Fisheries Minister. This council will serve as a central body for guiding policy implementation, reviewing progress, and ensuring that all stakeholders have a voice in shaping the future of India's fisheries sector. This collaborative approach is designed to foster a more sustainable and prosperous fisheries industry, with active participation and input from all relevant parties.

Therefore, this element currently meets the scoring requirement.

M1.5.2 –

The Central Marine Fisheries Research Institute (CMFRI) annual report provides extensive information related to fishery management. This includes summaries of landings estimates by state, scientific efforts such as ecosystem modelling and genetic analyses, climate change impacts, economic impacts, social components of fisheries management, budgets, training, and major events. Regular stakeholder consultation meetings further ensure transparency in the management process.

The Directorate of Animal Husbandry, Dairying, and Fisheries (DADF) also produces an annual report summarizing fisheries management activities at a national level, though it covers a broader area. At the state level, the Goa Directorate of Fisheries publishes an annual report with similar content to the CMFRI report, but no equivalent report was found from the Maharashtra Department of Fisheries. Most of the information used for this assessment was freely available online, with additional data provided by the applicant organization without restrictions.

The Fishery Survey of India (FSI) is the main government agency responsible for studying and monitoring fish populations within India's Exclusive Economic Zone (EEZ). Established in 1946, FSI follows a clear set of guidelines to gather valuable information about fish locations and quantities, ensuring responsible fishing practices. In addition to regular surveys, FSI conducts experimental fishing at different water depths to discover new resources.

Therefore, this element currently meets the scoring requirement.

M1.5.3 –

The National Fisheries Policy (NFP) aims to acknowledge the need for on-going review to ensure its continued relevance. This is outlined in the policy text in section 5.3: “The NFP is an evolving instrument that is open to review based upon evolving needs and technologies. It will be reviewed in consultation with stakeholders to ensure that the policy remains relevant and is in sync with changing needs and requirements of the sector through an institutional mechanism”

While taking the above into account, for this assessment, there was no public evidence to showcase the fishery management in fact has come under periodic internal or external review to validate the decision-making process, outcomes and scientific data. It is likely this may take place and the score can be updated one appropriate evidence of this is supplied.

Furthermore, it is noted for this assessment that it is understood that the Indian Oil Sardine (Goa and Maharashtra) FIP will advocate for a five yearly review period.

Therefore, this element currently meets the scoring requirement.

References

DADF annual report, 2016/17. http://dahd.nic.in/sites/default/files/Annual%20Report%202016-17.pdf

CMFRI annual report, 2022: https://eprints.cmfri.org.in/17732/1/CMFRI%20Annual%20Report_2022.pdf
Goa Department of Fisheries (DOF) Annual Report (2021-2022): Annual Report 2021-22 (English) (dof.gov.in)
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Goa DoF, Enforcement Section: Enforcement (goa.gov.in)
National Policy on Marine Fisheries National Policy on Marine Fisheries 2017. | FAOLEX

M2 Surveillance, control and enforcement

M2.1	**M2.1 There is an organisation responsible for monitoring compliance with fishery laws and regulations.** *In reaching a determination for M2.1, the assessor should consider if the following is in place:*	
	M2.1.1 There is an organisation responsible for monitoring compliance with specific monitoring, control and surveillance (MCS) mechanisms in place.	*Meets*
	M2.1.2 There are relevant tools or mechanisms used to minimise IUU fishing activity.	*Meets*
	M2.1.3 There is evidence of monitoring and surveillance activity appropriate to the intensity, geography, management control measures and compliance behaviour of the fishery.	*Gap*
Clause outcome		***Fail***

Rationale

M2.1.1 –

The primary organization responsible for enforcing fisheries rules and regulations in India is the Indian Coast Guard (ICG). The ICG's duties include preserving and protecting the maritime environment, preventing and controlling marine pollution, and enforcing the provisions of relevant maritime enactments. According to the Department of Defence (DoD) annual report for 2016/17, the ICG undertook several enforcement activities during the 2016 calendar year, including:

- Apprehension of poacher trawlers (11 boats and 69 crew members)
- Apprehension for Marine Wildlife Violations (11 boats and 104 crew members)
- Repatriation of fishermen (333 Indian fishermen from Sri Lanka and 9 Sri Lankan fishermen from India)

More recently the Annual reports for 2022 and 2023 published by the DoD, there was no mention on these types of statistics relating to fishing activities.

At the state level, the Goa Directorate of Fisheries has an Enforcement Section responsible for implementing the Marine Fishing Regulation Act of 1980, patrolling the sea coast up to 5 km, booking offenses, and registering and licensing trawlers and fishing nets. Information about a similar enforcement section within the Maharashtra Department of Fisheries (DoF) was not available. However, the Maharashtra Marine Fishing Regulation Act of 1981 defines an "Enforcement Officer" as a DoF officer, and the licensing of fishing vessels in Maharashtra may fall

under the Maharashtra Maritime Board (MMB). The MMB's functions include enforcing Maritime Acts and Rules, administering ports, regulating traffic, fare structures, and licensing crafts.

The Indian National Marine Fisheries Policy 2017 outlines a sustainable and responsible management approach for fisheries in India. It aims to integrate fisheries with other sectors such as agriculture, coastal development, and eco-tourism. The policy emphasizes collaboration between central and state governments to enhance the socio-economic well-being of fishers, particularly those in small-scale and traditional operations.

A critical component of the policy is the establishment of a robust Monitoring, Control, and Surveillance (MCS) system. This legally mandated system requires all fishing vessels must comply that "MCS functions will also be strengthened by the mandatory use of log books, movement tokens, colour coding of fishing vessels, biometric cards to fishers for their identity and also space technologies and IT tools (e.g. Vessel Monitoring System/Automatic Identification System)".

To ensure the effectiveness of the MCS system, the policy emphasizes the need for well-trained and well-equipped enforcement agencies, including the Indian Coast Guard, Coastal Police, and fishing communities themselves.

Therefore, this element currently meets the scoring requirement.

M2.1.2 –

Criticism has been directed towards the extent to which some fishery regulations in India rely on self-reporting and may not be fully enforced. There are concerns about the enforcement of closed areas, with some sources describing it as 'questionable'. Additionally, fishing vessels of Indian build operating in the EEZ waters outside state control are perceived to fish under a 'legal vacuum'. Despite these criticisms, India has not been issued a 'yellow card' or a 'red card' by the EU under the Illegal, Unreported, and Unregulated (IUU) regulation.

The India National Marine Fisheries Policy 2017 aims to ensure a sustainable and prosperous future for Indian fisheries. A key aspect of the policy is addressing illegal fishing. As part of its commitment to international agreements against illegal, unreported, and unregulated fishing practices, the Indian "Government will establish a sound mechanism both at the port and at sea to ensure that the Indian fishing fleet does not engage in any IUU fishing within its own EEZ, high seas and EEZs of other nations."

Therefore, this element currently meets the scoring requirement.

M2.1.3 –

There is some evidence available of monitoring and surveillance activity that is appropriate to the intensity, geography, management control measures and compliance of the fishery. For this assessment, MCS documents were provided from both Goa and Maharashtra – these documents were in the form of letters sent to the FIP after a specific request on MCS for the fisheries was made by the FIP. Specifically, the document provided by Goa to the FIP in 2024 that states that there were 19 vessels who were violating rules (unspecified) between 2023-2024.

For Maharashtra, a letter from the Assistant Commissioner of Fisheries in Ratnagiri in 2021 stated the arrangement for MCS, mentioning that 150 fishing vessels are equipped with Vessel Tracking Systems (VTS), and that 'The Department has an Enforcement Cell which is responsible for checking the compliance of Fishery Rules and Regulations in accordance with the Maharashtra Marine Fisheries Regulation Act, 1981'. The following are the functions of the Enforcement Cell:

A. Strict implementation of the MFR Act, 1981
B. Implementation of Indian Fisheries Act, 1897
C. To register fishing vessels under the MS Act (The Merchant Shipping Act), 1958
D. To issue fishing licenses to the vessel owners
E. To lease fishing stakes in reserved areas
F. To conduct Patrolling for preventing IUU fishing (only one patrolling vessel is in operation)
G. To issue Biometric Cards to fishermen
H. Posting of Fisheries Wardens at major landing centres for monitoring the fishing activities.

Over 2019-2020, there were 107 cases that have been registered, and in 121 between 2020-2021 against the erring fishermen for violating the Fishing Rules & Regulations.

Therefore, there is some indication that there is monitoring of the compliance of vessels. However, this was not related to the specific fishery under assessment, so it is not understood if these measures are appropriate to the intensity, geography, management control measures and compliance behaviour of the fishery.

Therefore, this element currently cannot meet the scoring requirement.

References

European Commission website, EU rules to combat illegal fishing, "Overview of existing procedures as regards third countries". Illegal fishing - European Commission (europa.eu)
The Goan, June 2017, "Enforcement of new fisheries guidelines questioned". http://englishnews.thegoan.net/story.php?id=34084
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Maharashtra Maritime Board website, "Functions of MMB". https://mahammb.maharashtra.gov.in/1172/Functions-of-MMB
India National Policy on Marine Fisheries: National Policy on Marine Fisheries 2017. | FAOLEX
Project Seahorse, "Rules and Regulations Governing Fisheries in Different States along the Indian Coast".

M2.2	**M2.2 There is a framework of sanctions which are applied when infringements against laws and regulations are discovered.** *In reaching a determination for M2.2, the assessor should consider if the following is in place:*	
	M2.2.1 The laws and regulations provide for penalties or sanctions that are adequate in severity to act as an effective deterrent.	*Meets*
	M2.2.2 There is no evidence of systematic non-compliance.	*Meets*
Clause outcome		***Pass***

Rationale

M2.2.1 –

Marine Fishing Regulation Acts (MFRAs) have come into existence from the early 1980s, and barring a few States, the MFRAs were in place by mid1990s. Keeping in view the fact that most of the MFRAs were adopted before adoption of key International Agreements/Arrangements (1982 UNCLOS, 1992 UNFSA, 1995 FAO CCRF), the Government will consider updating the existing rules and regulations for governing fisheries in the MFRAs and also aligning with International Instruments/Arrangements to ensure that they cover all aspects of fisheries management. This will be carried out by preparation of a Model Bill for consideration of the coastal States/UTs.

The Department of Fisheries, Government of India will draft the guidelines in consultation with the Ministry of Shipping, Coast Guard, Indian Navy, Ministry of Science and Ministry of Environment, Forest &Climate Change for undertaking mariculture activities in the EEZ. The model guidelines will factor in the relevant international/voluntary agreements, laws and standards and supporting both regulation and development of mariculture for the adoption by States/UTs.

The update aims to close loopholes in these regulations by aligning them with stricter international standards. This strengthens enforcement and deters violations. In addition, the development of a "Model Bill" for coastal states will ensure consistency in regulations across different regions and establish clear guidelines. This would enhance transparency and also improved mechanisms, which were pledged to be undertaken (as stated in the National Policy of Marine Fisheries, 2017) would provide a better understanding to the fishermen to understand the potential consequences of violating regulations, acting as a deterrent against harmful practices. (refer to reference link given below in the immediate reference box below)

Therefore, this element currently meets the scoring requirement.

M2.2.2 –

No evidence of systematic non-compliance is found in this assessment, however, while there are legal and regulatory frameworks in place to combat IUU fishing, the effectiveness of these measures is hindered by data inadequacies and limited enforcement capabilities (National Maritime Foundation, 2024). The implementation of AIS and biometric IDs indicates efforts to improve compliance, but

challenges remain in registration and data accuracy. Therefore, this element currently meets the scoring requirement.
References India National Policy on Marine Fisheries: National Policy on Marine Fisheries 2017. | FAOLEX National Maritime Foundation, "Indian Responses to the Challenge of IUU Fishing: A First Look", 2024. Available at: https://maritimeindia.org/indian-responses-to-the-challenge-of-iuu-fishing-a-first-look-at/

M2.3	**M2.3 There is substantial evidence of widespread compliance in the fishery, and no substantial evidence of IUU fishing.** *In reaching a determination for M2.3, the assessor should consider if the following is in place:*	
	M2.3.1 The level of compliance is documented and updated routinely, statistically reviewed and available.	*Gap*
	M2.3.2 Fishers provide additional information and cooperate with management/enforcement agencies/organisations to support the effective management of the fishery.	*Gap*
	M2.3.3 The catch recording and reporting system is sufficient for effective traceability of catches per vessel and supports the prevention of IUU fishing.	*Meets*
Clause outcome		***Fail***

Rationale

M2.3.1 –

The Indian National Marine Fisheries Policy 2017 describes traceability as an increasingly important requirement for seafood sustainability and therefore notes that “The Government will create an enabling environment for promoting eco-labelling of key Indian fisheries that would benefit fish stocks, seafood industry and fishers.” However, there is no evidence of this being implemented.

Further to this, evidence was provided for this assessment in the way of letters from the Directorate of Fisheries Goa and the Assistant Commissioner of Fisheries Ratnagiri (Maharashtra) that provided information on MCS activities. However, these letters do not provide an understanding if this information (e.g. compliance events) is statistically reviewed – it cannot be ascertained the percentage of compliance of the fishery in this assessment.

Therefore, this element cannot currently meet the scoring requirement.

M2.3.2 –

Adequate information and/or record supporting the fact that fishers provide additional information and cooperate with management/enforcement agencies/organisations to support the effective management of the fishery has not been found.

This assessment, it is worthwhile to note that it is understood from the FIP body that fishers collaborate with regards to research, giving access to enumerators and meeting with fisheries departments. To pass this clause, additional third-party evidence is required (e.g. documents from fisher cooperatives, meeting minutes, etc.).

Therefore, this element cannot currently meet the scoring requirement.

M2.3.3 –

Some sources have been critical of the extent to which some fishery regulations rely on self-reporting and may not be fully enforced; have stated that enforcement of closed areas is 'questionable'; have stated that fishing vessels of Indian build operating in the EEZ waters outside state control fish under a 'legal vacuum'. India has not been awarded a 'yellow card' or a 'red card' by the EU under the IUU regulation.

As mentioned in the Indian National Marine Fisheries Policy 2017, India aims to deter, prevent and eliminate Illegal, Unreported and Unregulated (IUU) fishing. It is not understood from this review whether any measures have been put in place, however in practice there are currently different organisations and agencies all how play a role in the prevention of IUU fishing. These include:

Central Marine Fisheries Research Institute (CMFRI)

Sampling methodology:

- CMFRI employs a Stratified Multistage Random Sampling Scheme to collect landings data from various fish landing centres across the Indian coast.
- The data collection includes details such as the species composition, quantity, and size of the catch.

Regional research centres:

- CMFRI maintains a regional presence with centres in Mandapam, Visakhapatnam, Veraval, and research centres in Mangalore, Kozhikode, Mumbai, Vizhinjam, Karwar, Tuticorin, and Chennai.
- These centres help in the decentralized collection and analysis of data, making it region-specific and comprehensive.

Annual reports:

- The CMFRI publishes annual reports summarizing the collected data, which includes landings estimates by state, scientific efforts like ecosystem modelling and genetic analyses, and socio-economic impacts.

Fishery Survey of India (FSI)

Survey and assessment:

- The FSI is responsible for surveying and assessing fish stocks in India's Exclusive Economic Zone (EEZ).
- It conducts regular surveys to gather information about the location and quantity of fish,

ensuring responsible fishing practices.

Licensing and registration:

- State fisheries departments are responsible for the registration and licensing of fishing vessels.
- They collect data on fishing activities within their territorial waters (up to 12 nautical miles).

Local data collection:

- States like Goa and Maharashtra have specific regulations and enforcement mechanisms to ensure compliance with fishing regulations.
- The Directorate of Fisheries in Goa, for instance, has an Enforcement Section that monitors and collects data on local fishing activities.

National Fisheries Data Acquisition Plan

National policy:

- The National Fisheries Policy 2020 emphasizes the importance of good data for effective fisheries management.
- The government aims to launch a "National Fisheries Data Acquisition Plan" involving central and state governments, research institutions, and fishermen.

Real-time data and monitoring:

- This plan includes the use of technology to provide real-time data on fish abundance, potential fishing zones, and weather conditions.
- The establishment of a network of monitoring facilities from local areas to a central level is planned to track fishing activities, enforce regulations, and analyse data on fish stocks.

Further to the above, as of 2010 to be in compliance with EU Regulations 1005/2008, Catch details from fishing vessels are collected by Harbour Data Collectors posted at fishing harbours/ major landing centres. MPEDA is the nodal agency of Government of India for the implementation of catch certification system, which is available for users with a login and accessed at https://c-cert.mpeda.gov.in/

For this assessment, evidence was also provided that could trace back fish product at the fishmeal production facility back to vessels that have been sourced from – including handling by transport agencies. It is deemed for this assessment, that the random checks at landing sites by enumerators to document catches, the catch certification system that has been in place since 2010 to meet EU regulations, and specific traceability to the vessel level for product purchased, that this meets the requirement of supporting the prevention of IUU fishing in relation to the Unit of Assessment.

References

European Commission website, EU rules to combat illegal fishing, “Overview of existing procedures as regards third countries”. Illegal fishing - European Commission (europa.eu)
European Commission, "Council Regulation (EC) No 1005/2008 of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing", Official Journal of the European Union, 2008. Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32008R1005
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http://englishnews.thegoan.net/story.php?id=34084
India National Policy on Marine Fisheries: National Policy on Marine Fisheries 2017. | FAOLEX

Species requirements

This section, or module, comprises of four species categories. Each species in the catch is subject to an assessment against the relevant species category in this section (see clauses 1.2 and 1.3 and Table 6).

Type 1 species can be considered the 'target' or 'main' species in the fishery under assessment. They make up the bulk of the catch and a subjected to a detailed assessment. Type 1 species must represent 95% of the total annual catch. If a species-specific management regime is in place for a Type 1 species, it shall be assessed under Category A. If there is no species-specific management regime in place for a Type 1 species, it shall be assessed under Category B.

Type 2 Species can be considered the 'non-target' species in the fishery under assessment. They comprise a small proportion of the annual catch and are subjected to a relatively high-level assessment. Type 2 species may represent a maximum of 5% of the annual catch. If a species-specific management regime is in place for a Type 2 species, it shall be assessed under Category C. If there is no species-specific management regime in place for a Type 2 species, it shall be assessed under Category D.

Species that comprise less than 0.1% of the catch are not required to be assessed or listed here.

Category A species

1.2. All clauses must be met for a species to pass the Category A assessment.

1.2.1. If a species fails any of the Category A clauses, it should be re-assessed as a Category B species.

A1 Data collection – Indian Oil Sardine

A1.1	**A1.1 Landings data are collected such that the fishery-wide removals of this species are known.**
Clause outcome	***Pass***
A1.1 – The Central Marine Fisheries Research Institute (CMFRI) monitors marine fish landings, and the latest annual report (2022) demonstrates that landings reached 3.49 million tonnes, a dramatic increase of 14.53% from 2021. The Marine Fish Landings in India 2023 report demonstrated that from 2022, the total fish landings increased by 1.2%, to 3.53 million tonnes. The CMFRI of the India Council of Agricultural Research (ICAR-CMFRI) takes estimated landings data from 1,269 landing centres within 11 coastal states in India, including Maharashtra and Goa. The Marine Fish Landings in India 2023 report highlighted specific species landings, including the Indian oil sardine as one of the highest contributors to total landings for 2023 (245,000 tonnes) (6.95% total landings). Specific details about the total estimated landings from each state are also referenced in the CMFRI annual	

report and the Marine Fish Landings in India 2023 report, and mention that Maharashtra total landings increased by 23.3%, and in Goa, total landings increased by 16.8% from 2022.

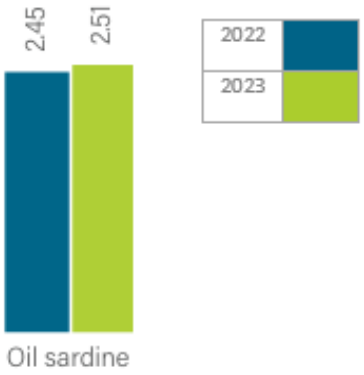

Figure 1: Estimated total Indian oil sardine landings in India from 2022, to 2023

Landings take place at all times of the day and night and due to the scale of the monitoring regime, a strong and valid sampling design is required to estimate these data. The stratified multistage random sampling design (SMRSD) was developed in 1961 but is still being used today Sampling is stratified both temporally and spatially, separating each maritime state into sampling zones and calendar months. Historical landings data is available for pre-2020 (impacts of Covid-19) and 2021-2023. Specific data can be found in the CMFRI annual reports but Figure 1 demonstrates the most recent 2022-2023 data findings.

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2022. *CMFRI Annual Report 2022,* Kerala: Indian Council of Agricultural Research: Central Marine Fisheries Research Institute. CMFRI Annual Report_2022.pdf

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K. G, M. et al., 2023. Fish catch survey and analysis - an online application for deriving measures and indicators for fish stock assessment. *Fisheries Research,* Volume 267, p. 106821 Fish Catch Survey and Analysis – An online application for deriving measures and indicators for fish stock assessment - ScienceDirect

A1.2	A1.2 Sufficient additional information is collected to enable an indication of stock status to be estimated.
Clause outcome	*Pass*

Rationale

A1.2 –

There is evidence that fishery-dependent data, including information about the biology of the species and the estimated number of removals data that is able to reliably inform a stock assessment. The Fishery Survey of India (FSI) releases annual reports that include the collection of such data for demersal and tuna fisheries (FSI, 2021).

Estimated landings data from the 2023 Marine Fish Landings in India report have reliable information about the total catch and landings of the species from the stock (FRAEED, CMFRI, 2024). The above information has been used to conduct the most recent stock assessments for this species and should therefore be considered sufficient to supply data and information for stock assessments.

The 2022 stock assessment also conducted a thorough review of the biological characteristics of the species including length-frequency analysis, recruitment pattern, length-weight relationship, food and feeding habits, reproductive biology including fecundity, and size at maturity (Omega Fishmeal & Oil Private Limited, 2022).

Over the past few years, there has been vast improvement demonstrated by the relevant stock assessments and analyses of the Indian oil sardine stock. The 2018 stock assessment conducted by CMFRI estimated that the stock was overfished in both Goa and Maharashtra populations (CMFRI, 2018). This was supported in 2021 by the modelling of stock biomass dynamics, which estimated that these stocks were also overfished (Sathianandan, et al., 2021). However, in 2022, the Omega Fishmeal & Oil Private Limited stock assessment indicated that catch rates were well below MSY since 2019. Similarly, a report published by CMFRI in 2022 on the Marine Fish Stock Status of India 2022 highlighted that Indian oil sardine across all of the relevant coastal states' fisheries had "green light status" meaning that the stock is sustainable (B/B_{MSY}=>0.8, and F/F_{MSY} = <1.2) (CFMRI, 2022b). Therefore, there seems to be growing interest by the CMFRI and relevant fisheries researchers in assessing the status of this stock and accurately monitoring the information over time.

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2022. *CMFRI Annual Report 2022,* Kerala: Indian Council of Agricultural Research: Central Marine Fisheries Research Institute. CMFRI Annual Report_2022.pdf
CFMRI, 2022b. *Marine Fish Stock Status of India 2022,* Kerala: ICAR-Central Marine Fisheries Research Institute.FRAEED, CMFRI, 2024. *Marine Fish Landings in India 2023, Technical Report,* Kochi: ICAR-Central FSI, 2021. *Annual Report 2020-21,* Mumbai: Fishery Survey of India. ar2020-21e.pdf (fsi.gov.in)
Marine Fisheries Research Institute: Marine Fish Landings in India_2023.pdf (cmfri.org.in)
Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian*

mackerel, s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

A2 Stock assessment – Indian Oil Sardine

A2.1	**A2.1 A stock assessment is conducted at least once every 3 years (or every 5 years if there is substantial supporting information that this is sufficient for the long-term sustainable management of the stock) and considers all fishery removals and the biological characteristics of the species.**
Clause outcome	***Pass***

A2.1 –

In 2018, a report written by the CMFRI, The Enigmatic Indian Oil Sardine: An Insight (CMFRI, 2018) describes a stock assessment that was conducted using the length based FiSAT software and CMSY method. Using both length data and otolith growth rings data, the growth parameters of Indian oil sardine were able to be estimated. Further research into the biological characteristics of the species were identified, including the recruitment patterns of the species, and indicators about spawning seasons that align with the phytoplankton blooms throughout the year. Fishery removals were considered via both natural mortality and exploitation rates were described in the report to identify the other sources of mortality for this species' stock. The yield per recruit to the population, a virtual population analysis, and estimates on the probability of capture were also captured in this research and report. Using this information, estimates on the maximum sustainable yield (MSY), and spawning biomass were reported. In Maharashtra, the average spawning stock biomass (SSB) between 2010-2015 was 40.2%, and for Goa it was 30.7%. MSY was 21,618 t for Maharashtra and 50,745 t for Goa. The stock assessment conducted in 2018 demonstrated that most of the states were experiencing over exploitation of a relatively depleted stock. However, overall, the estimated total catch rate of Indian oil sardine was within the confidence limits of the predicted MSY. In 2012, the stock was subject to exploitation beyond MSY levels but has not continued on this trajectory in recent years (CMFRI, 2018). Further, in 2021, research conducted into the status of Indian marine fish stocks highlighted that the Indian oil sardine stocks are overfished in Goa (Figure 2) and Maharashtra (Figure 3) (Sathianandan, et al., 2021).

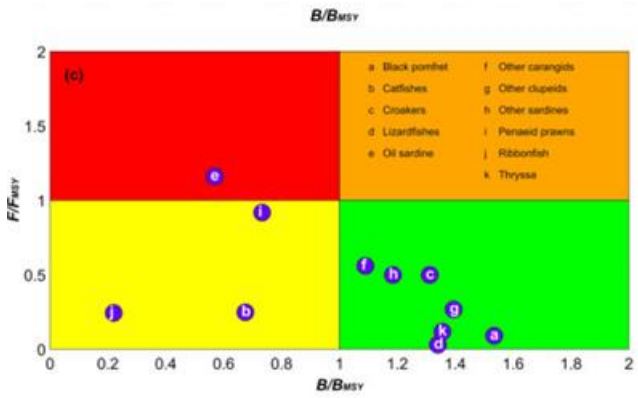

Figure 2: Kobe plot for Goa fisheries. Icon 'e' represents Indian oil sardine (Sathianandan, et al., 2021)

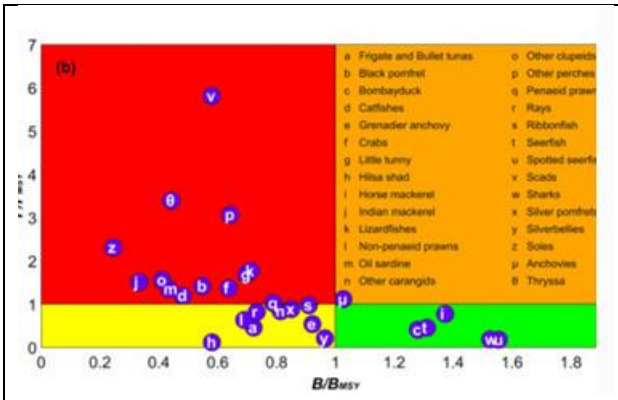

Figure 3: Kobe plot for Maharashtra fisheries. Icon 'm' represents Indian oil sardine (Sathianandan, et al., 2021)

The 2018 report about the Indian oil sardine was able to demonstrate a full inspection into the status of the Indian oil sardine stock health.

In 2022, Omega fisheries was commissioned to conduct and publish the results of an updated stock assessment for Indian mackerel and Indian oil sardine species (Omega Fishmeal & Oil Private Limited, 2022). The stock assessment report used a plethora of biological data about the two species, including length-frequency analysis, recruitment pattern, length-weight relationship, food and feeding habits, reproductive biology including fecundity, and size at maturity. The MSY was also captured in the report, estimated at 54,570 t. Despite recent years (2010-2015, and 2017-2018) demonstrating that total landings exceeded MSY, since 2018, landings have been significantly below MSY. However, there was no indication about the SSB, nor indications about the reference points related to MSY. Nonetheless, the two stock assessments conducted within three years of one another, and the new Fisheries Management Plan that is expected in 2024 aims that the fishery will commit to a regular stock assessment for this species.

Furthermore, the Marine Fish Stock Status of India, 2022 report also summarised the current estimated status of the Indian oil sardine stocks for all relevant coastal states' fisheries and highlighted that in all states, the stock is sustainable (B/B_{MSY}=>0.8, and F/F_{MSY} = <1.2) (CFMRI, 2022b).

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute Enigmatic Indian Oil Sardine: An Insight - CMFRI Repository

CFMRI, 2022b. *Marine Fish Stock Status of India 2022,* Kerala: ICAR-Central Marine Fisheries Research Institute.

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

Sathianandan, T. et al., 2021. Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries. *ICES Journal of Marine Science,* 78(5), pp. 1744-1757 Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries | ICES Journal of Marine Science | Oxford Academic (oup.com)

A2.2	A2.2 The assessment provides an estimate of the status of the biological stock relative to a reference point or proxy.
Clause outcome	***Fail***

Rationale

A2.2 –

The assessment of the stock described in the 2018 report from the CMFRI, Enigmatic Indian oil sardine: An Insight, included estimates of the biological reference points for the species, and segregated these by states (Figure 4).

Table 19. Estimated Biological Reference Points (BRPs) of Indian oil sardine

Area	E_{curr}	B_{curr}	B_{MSY}	E_{curr}/E_{MSY}*	B_{curr}/B_{MSY}
India	0.800	659744	809127	1.02	0.815
West Coast	0.812	532511	685287	1.04	0.777
East Coast	0.735	127233	123840	0.94	1.027
Andhra Pradesh	0.669	15507	8281	0.85	1.873
Tamil Nadu	0.816	83581	101272	1.04	0.825
Kerala	0.7926	348601	429265	1.01	0.812
Karnataka	0.810	127829	174526	1.04	0.732
Goa	0.863	23933	45556	1.10	0.525
Maharashtra	0.796	18362	29023	1.02	0.633
Gujarat	0.629	13786	6917	0.80	1.993

*E_{MSY} = 0.782

Figure 4: Estimated biological reference points for Indian oil sardine (CMFRI, 2018)

The report also describes the biomass reference point (B/B_{MSY}) across the whole coast (rather than individual states), as well as the exploitation reference point (F/F_{MSY}) (Figure 5).

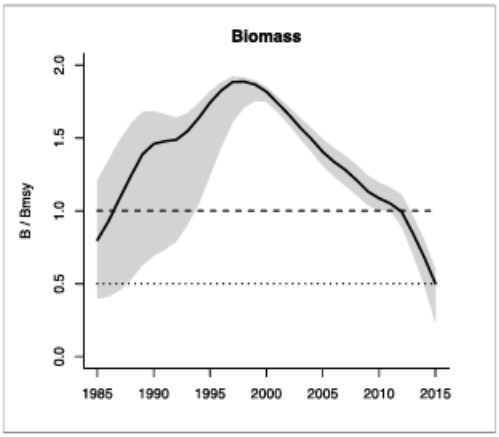

Fig.50. Biomass Reference Point (B/B_{MSY}) for Indian oil sardine along the southwest coast

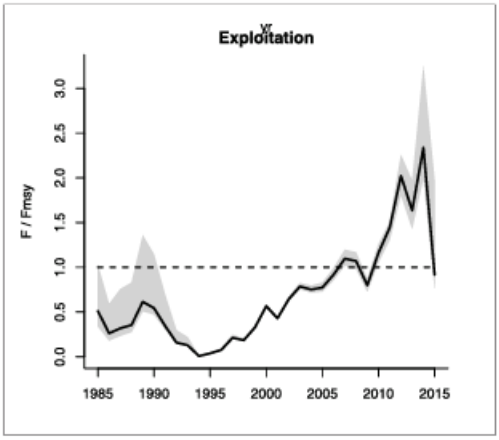

Fig.51. Exploitation Reference point (F/F_{MSY}) of Indian oil sardine ($F/F_{MSY} > 1.0$= over fishing) along the southwest coast

Figure 5: Estimated biomass and exploitation reference points for Indian oil sardine across all coastal states (CMFRI, 2018)

Using the biological information collected on the species in the report, estimates on the maximum sustainable yield (MSY), and spawning biomass were reported. In Maharashtra, the average spawning stock biomass (SSB) between 2010-2015 was 40.2%, and for Goa it was 30.7%. An SSB of 20% is considered as a normal precautionary standard for most species to sustain the stock, therefore, although fishing pressure is high, it is considered that the SSB is sufficiently high to support stock replenishment (CMFRI, 2018).

The assessment of the Indian oil sardine stock conducted in 2021 made no reference to specific reference points, however, did indicate that in both Maharashtra and Goa, Indian oil sardine stocks are reportedly "overfished" (Sathianandan, et al., 2021).

The most recent stock assessment conducted by Omega Fishmeal & Oil Private Limited (2022), mentioned fishing mortality and the current MSY for the stocks and indicated that catch rates were below MSY since 2019. However, there was no mention of other specific reference points or proxy in their evaluation of the stock status. As this was the most recent assessment of the stock of Indian oil sardine, and there has been no further identified assessment conducted by the CMFRI, this indicator cannot meet a pass. When a new stock assessment is conducted by CMFRI, and relates the assessment outcomes to reference points, the score may increase.

It is to be noted here that it is not explicit in Indian law or the MarinTrust Standard that certain reference points (e.g TRP and LRP) must be utilised for this clause to pass – for some fisheries

biomass-based reference points may not be appropriate, and other measures – such as Catch Per Unit Effort (CPUE) based on indicator species, may be more applicable (Canales et al 2024)

The FIP will need to advocate for regular stock assessments conducted by CMFRI as part of their new Fisheries Management Plan.

The FIP should be commended in its efforts of encouraging the fishing agencies to adopt formal target and limit reference points into the management of this species. In 2022, they conducted an international workshop on reference points and harvest strategy for Indian oil sardine stocks of Maharashtra and Goa. However, there was no indication that the fishing agencies had yet adopted the recommendations made by the FIP at this stage.

Therefore, this element currently cannot meet the scoring requirement.

References

FIP Workshop Report May 2022_Compressed-compressed.pdf (marin-trust.com)CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight* , Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute Enigmatic Indian Oil Sardine: An Insight - CMFRI Repository

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

Sathianandan, T. et al., 2021. Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries. *ICES Journal of Marine Science,* 78(5), pp. 1744-1757 Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries | ICES Journal of Marine Science | Oxford Academic (oup.com)

A2.3	A2.3 The assessment provides an indication of the volume of fishery removals which is appropriate for the current stock status.
Clause outcome	*Pass*

Rationale

A2.3 –

The most recent stock assessment conducted by Omega Fishmeal & Oil Private Limited in 2022 used catch and effort data provided by the Fish Production Report of Department of Fisheries, Government of Maharashtra. These data were analysed in the surplus production model to estimate MSY. Since the CMFRI stock assessment that was conducted in 2018, the 2022 assessment demonstrated a clear improvement in the annual catch of the species to fall back below MSY as opposed to previous years where catch exceeded MSY.

Estimated landings data provided by the annual report from the ICAR-CMFRI demonstrates awareness about the number of removals from the stock (CMFRI, 2022).

The 2021 assessment report outlines the average annual landings for all catches of fish from each state, including Goa and Maharashtra. This information was also then used to determine the current status of the specific fish stocks (overfished, recovering, sustainable etc.) respective of their given MSY. For Indian oil sardine from Maharashtra and Goa, the estimated status based on MSY was "overfished".

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute Enigmatic Indian Oil Sardine: An Insight - CMFRI Repository

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

A2.4	A2.4 The assessment is subject to internal or external peer review.
Clause outcome	***Pass***

Rationale

A2.4 –

While there is no specific indication available about whether the CMFRI stock assessment of 2018 was externally peer-reviewed, it is estimated that it would have been internally reviewed before publication. Likewise, to this, the CMFRI have produced a circular in 2015 (circular vide F. No. 1(4)/PME/Publ./15) which outlines the guidelines for forwarding manuscripts for publication in research journals.

Furthermore, Mini et al 2023 produced an article which discusses the development and implementation of a web-based application called Fish Catch Survey and Analysis (FCSA) by the Central Marine Fisheries Research Institute (ICAR-CMFRI) for real-time data collection, processing, and analysis of fish catches along the Indian coastline. The application aims to provide reliable data for fish stock assessment, helping to ensure sustainable fisheries management.

Likewise, the Omega Fishmeal & Oil Private Limited stock assessment in 2022 has no indication about whether it was externally reviewed, however, again, it can be estimated that it underwent internal review.

The 2021 journal article assessing the Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries, was externally peer reviewed and published in the ICES Journal of Marine Science.

Due to the above evidence, this clause passes, as it is evident there is either an internal or external review of assessments.

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute.Sathianandan, T. et al., 2021. Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries. *ICES Journal of Marine Science,* 78(5), pp. 1744-1757.

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

A2.5	A2.5 The assessment is made publicly available.
Clause outcome	***Pass***

Rationale

A2.5 –

All stock assessments and analysis reports were made publicly available and are able to be accessed online if required (please see the references below for all accessible material).

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute.

CMFRI, 2022. *CMFRI Annual Report 2022,* Kerala: Indian Council of Agricultural Research: Central Marine Fisheries Research Institute.

CFMRI, 2022b. *Marine Fish Stock Status of India 2022,* Kerala: ICAR-Central Marine Fisheries Research Institute.

FRAEED, CMFRI, 2024. *Marine Fish Landings in India 2023, Technical Report,* Kochi: ICAR-Central Marine Fisheries Research Institute.

FSI, 2021. *Annual Report 2020-21,* Mumbai: Fishery Survey of India.

K. G, M. et al., 2023. Fish catch survey and analysis - an online application for deriving measures and indicators for fish stock assessment. *Fisheries Research,* Volume 267, p. 106821.

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

Sathianandan, T. et al., 2021. Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries. *ICES Journal of Marine Science,* 78(5), pp. 1744-1757.

A3 Harvest strategy – Indian Oil Sardine

A3.1	A3.1 There is a mechanism in place by which total fishing mortality of this species is restricted.
Clause outcome	*Pass*

Rationale

A3.1 –

There is a fishing ban in place annually from June 1 to July 31 (monsoon season), during which only smaller craft (either non-motorised or fitted with a motor of maximum 10HP) are permitted to fish. This fishing ban is applicable to all fisheries and all coastal states, meaning that transboundary stocks like the Indian oil sardine are included.

The majority of measures are implemented by the individual states, through the Marine Fishing Regulation Acts (MFRAs). In Maharashtra, the MFRA sets out closed seasons, mesh size restrictions, and closed areas. Likewise, the new construction of purse seiners is not allowed in Maharashtra, thereby limiting the number of new vessels allowed to operate in the area.

In Goa, there are closed areas, mesh size restrictions (24mm for fish nets), and a ban on the use of LED light fishing and bull/pair trawling. Maharashtra has also implemented no trawl zones, mechanised trawlers are not permitted to operate at night, and mechanised purse-seiners (which are the vessel type covered by this report) are restricted from operating in the territorial waters of Thane, Greater Mumbai, Raigad and Sindhudurg.

These are good examples of management measures in place for the Indian oil sardine stock and using the information from the 2022 stock assessment conducted by Omega Fisheries, the catch rates were reportedly lower than MSY, which indicates that the measures are expected to achieve stock management objectives.

Therefore, this element currently meets the scoring requirement.

References

Government of Goa, 1980. *The Goa, Daman and Diu Marine Fishing Regulation Act, 1980 and Rules, 1982,* s.l.: Marine Fishing Regulation Act and Rules.
Government of Maharashtra, 1981. *Maharashtra Marine Fishing Regulation Act,* s.l.: Government of Maharashtra Law and Judiciary Department.
Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited. Omega Project_Final Report.pdf (marin-trust.com)

A3.2	**A3.2 Total fishery removals of this species do not regularly exceed the level indicated or stated in the stock assessment. Where a specific quantity of removals is recommended, the actual removals may exceed this by up to 10% ONLY if the stock status is above the limit reference point or proxy.**
Clause outcome	***Fail***

Rationale

A3.2 –

The MSY described across section A2 demonstrates that the status of the stock has been well researched in recent years and an awareness about the sustainability of the stock. Since 2019, there is data available to demonstrate that the catch rates of Indian oil sardine has not exceeded the MSY (Figure 6). (The data from this source is combined with the total annual catch of Indian mackerel by the same fisheries) (Omega Fishmeal & Oil Private Limited, 2022).

Fig. 29 Year-wise Catch

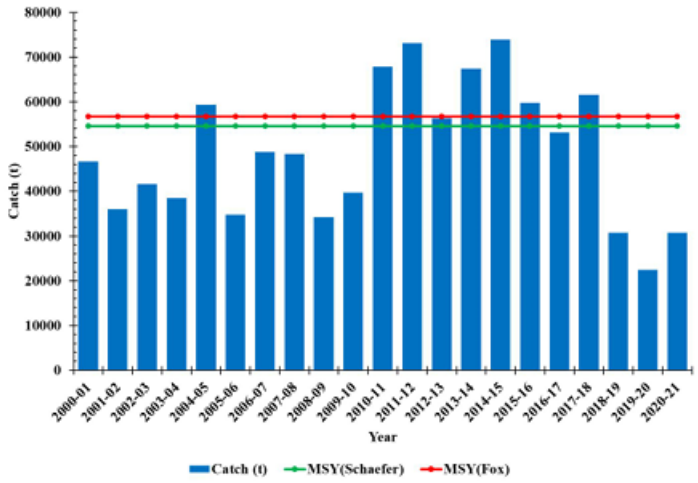

Figure 6: Total annual catch of Indian oil sardine and Indian mackerel, with reference to the agreed upon MSY

As can be seen from Figure 6, there was a period of eight years where catch exceeded MSY, however since 2019 the catch rate has been well below this point. Likewise, the SSB has been used as a biological reference point in the 2018 stock assessment conducted by CMFRI, and estimates that though fishing pressure is high, SSB is sufficient to support stock replenishment (CMFRI, 2018). However, as there is no indication across any of the stock assessment or similar reports about limit or target reference points (LRP and TRP, respectively, or a suitable proxy being utilised by management), there is no indication if this level of catch is within optimal harvesting levels.

Therefore, this element currently cannot meet the scoring requirement.
References CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute. Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited.

A3.3	**A3.3 Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).**
Clause outcome	***Fail***
Rationale **A3.3 –** As mentioned in A3.2, there is no formal limit reference points or proxy established for this species. Therefore, it is unknown as to whether commercial fishery removals are prohibited when the stock as been estimated to be below the limit reference point. Therefore, this element currently cannot meet the scoring requirement.	
References Please refer to A3.2	

A4 Stock status – Indian Oil Sardine

A4.1	**A4.1 The stock is at or above the target reference point; OR IF NOT: the stock is above the limit reference point or proxy and there is evidence that a fall below the limit reference point would result in fishery closure; OR IF NOT: the stock is estimated to be below the limit reference point or proxy, but fishery removals are prohibited**
Clause outcome	***Fail***
Rationale **A4.1 –** As mentioned in A3.2, there is no distinct TRPs in place for this stock, nor are there any LRPs. Therefore, there is also no information available that describes whether the fishery should be closed if these reference points are breached. Therefore, this element currently cannot meet the scoring requirement.	
References Please refer to A3.2	

Category B species

Category B species are assessed using a risk-based approach.

1.3. The risk matrix in Table B(a) shall be used when assessing a Category B species when estimates of Fishing mortality (F), Biomass (B) and reference points are available.

1.4. The risk matrix in Table B(b) shall be used when assessing a Category B species when no reference points are available.

B1	**B1.1 Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).**
Table used **B(a) or B(b)**	B(b)
Clause outcome	***Pass***

Rationale

B1.1 –

Indian oil sardine (*Sardinella longiceps*)

There do not appear to be any established reference points for the Indian oil sardine stock other than an estimated MSY. Without established reference points and an indication of stock status in relation to these, Table Ba cannot be used. To complete Table Bb, a resilience rating must first be established. The Indian oil sardine is listed as being of medium resilience by Fishbase (FishBase, 2017), therefore, under the requirements of table Bb, "B > Bav and F < Fav" (current biomass > long-term average biomass, and current fishing mortality < long-term average fishing mortality).

Over the past few years, there has been vast improvement demonstrated by the relevant stock assessments and analyses of the Indian oil sardine stock. The 2018 stock assessment conducted by CMFRI estimated that the stock was overfished in both Goa and Maharashtra populations. Information about biological reference points (MSY and Biomass estimates) were made available and demonstrated that spawning stock biomass (SSB) was reportedly high (Goa: 37%, and Maharashtra: 48.5%) - an SSB of 20% is considered as a normal precautionary standard for most species to sustain the stock (CMFRI, 2018). Therefore, the assessment estimated that whilst fishing pressure is high, SSB is sufficiently high to support stock replenishment. However, this was not sufficiently linked to the estimated MSY and therefore, the assessor felt that table Bb was required for this assessment.

As mentioned, current SSB is above the normal precautionary standard, which supports the requirement that B>Bav. In the 2021 stock assessment carried out by Omega Fishmeal & Oil Private Limited, it was demonstrated that total catch (t) per year has been significantly lower than MSY since the 2018-2019 period compared to earlier years (Figure 7) (Omega Fishmeal & Oil Private

Limited, 2022). Clearly, the impacts of Covid-19 are thought to be a contributor to this decrease in catch, as well as CPUE. However, the decline began before the impacts of Covid-19 arose.

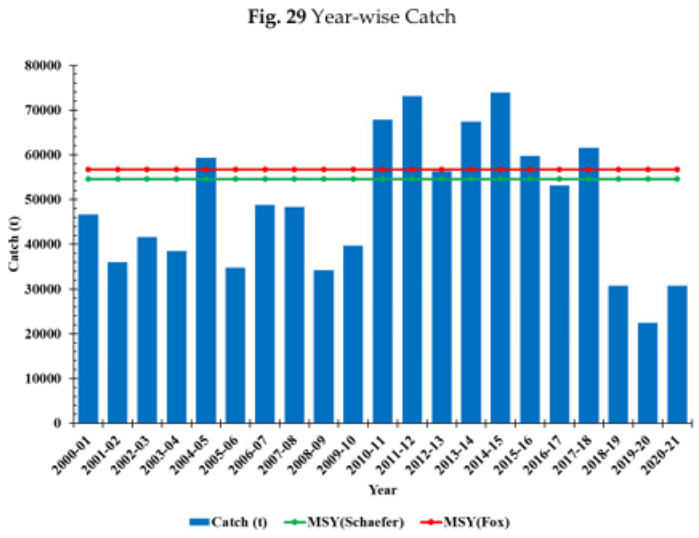

Figure 7: Total annual catch of Indian oil sardine and Indian mackerel, with reference to the agreed upon MSY

Similarly, a report published by CMFRI in 2022 on the Marine Fish Stock Status of India 2022 highlighted that Indian oil sardine across all of the relevant coastal states' fisheries had "green light status" meaning that the stock is sustainable (B/B_{MSY}=>0.8, and F/F_{MSY} = <1.2 (CFMRI, 2022b). Therefore, there seems to be growing interest by the CMFRI and relevant fisheries researchers in assessing the status of this stock and accurately monitoring the information over time.

Therefore, this element currently meets the scoring requirement.

References

CMFRI, 2018. *The Enigmatic Indian Oil Sardine: An Insight ,* Kochi: Indian Council of Agricultural Research Central Marine Fisheries Research Institute.

CFMRI, 2022b. *Marine Fish Stock Status of India 2022,* Kerala: ICAR-Central Marine Fisheries Research Institute.

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Available at: https://www.fishbase.se/summary/sardinella-longiceps.html

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited.

Sathianandan, T. et al., 2021. Status of Indian marine fish stocks: modelling stock biomass dynamics in multigear fisheries. *ICES Journal of Marine Science,* 78(5), pp. 1744-1757.

B1	**B1.1 Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).**
Table used B(a) or B(b)	(Bb)
Clause outcome	***Pass***

Rationale

B1.1 –

Indian mackerel (*Rastrelliger kanagurta*)

There do not appear to be any established reference points for the mackerel stock(s). Without established reference points and an indication of stock status in relation to these, Table Ba cannot be used. To complete Table Bb, a resilience rating must first be established. The Indian mackerel is listed as being of medium resilience by Fishbase (FishBase, 2017b), therefore, under the requirements of table Bb, "B > Bav and F < Fav" (current biomass > long-term average biomass, and current fishing mortality < long-term average fishing mortality).

In the 2021 stock assessment carried out by Omega Fishmeal & Oil Private Limited, it was demonstrated that total catch (t) per year has been significantly lower than MSY since the 2018-2019 period compared to earlier years (Figure 8) (Omega Fishmeal & Oil Private Limited, 2022). Clearly, the impacts of Covid-19 are thought to be a contributor to this decrease in catch, as well as CPUE. Whilst it is not clear what constitutes as "long-term" when considering average fishing mortality, since 2019, it has been well below estimated MSY, meeting the requirements of table Bb.

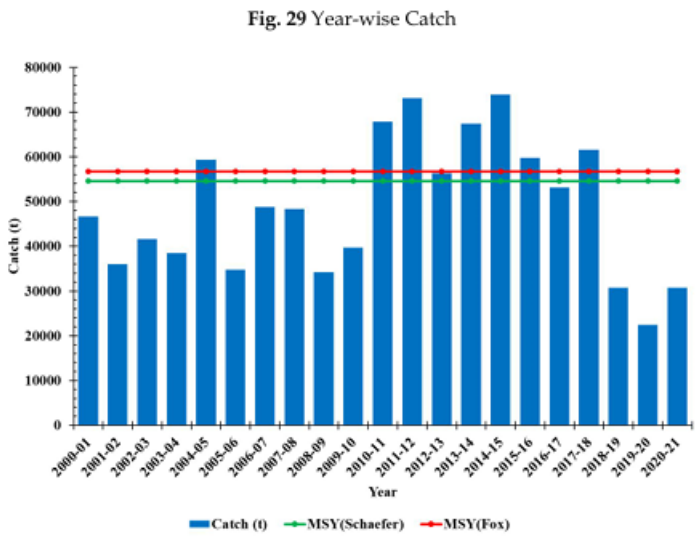

Figure 8: Total annual catch of Indian oil sardine and Indian mackerel, with reference to the agreed upon MSY

Furthermore, as with Indian oil sardine, a report published by CMFRI in 2022 highlighted that Indian mackerel across all of the relevant coastal states' fisheries had "green light status" meaning that the stock is sustainable (B/B_{MSY}=>0.8, and F/F_{MSY} = <1.2 (CFMRI, 2022b). Therefore, there seems to be growing interest by the CMFRI and relevant fisheries researchers in assessing the status of this stock and accurately monitoring the information over time.

Therefore, this element currently meets the scoring requirement.

References

CFMRI, 2022b. *Marine Fish Stock Status of India 2022,* Kerala: ICAR-Central Marine Fisheries Research Institute.

FishBase, 2017b. *FishBase: Rastrelliger kanagurta.* [Online]
Available at: https://www.fishbase.se/summary/Rastrelliger-kanagurta.html
[Accessed 24 June 2024].

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited.

B1	**B1.1 Commercial fishery removals are prohibited when the stock has been estimated to be below the limit reference point or proxy (small quotas for research or non-target catch of the species in other fisheries are permissible).**
Table used B(a) or B(b)	(Bb)
Clause outcome	***Fail***
Rationale **B1.1 –** Lesser sardines (*Sardinella fimbriata, S. gibbosa, S. albella, S. dayi, S. sindensis, S. clupeoides, S. melanura, S. jonesi, S. bracysoma, Koala coval, Dussumieria acuta,* and *D. hasseltii*) Unlike the other two main species in this assessment, there is very little information and evidence available to analyse the status of this stock. There are no clear reference points, which means that table Ba cannot be used. However, as there is also no indication about the long-term average biomass nor fishing mortality. The species is listed as being of high resilience by FishBase (FishBase, 2017c) so only biomass data is required. However, this element currently cannot meet the scoring requirement.	
References FishBase, 2017c. *FishBase: Sardinella fimbriata.* [Online] Available at: https://www.fishbase.se/Summary/SpeciesSummary.php?ID=1507&AT=Fringe-Scale+sardine	

Category C species

1.5. All clauses must be met for a species to pass the Category C assessment.

1.5.1. Where a species fails this Category C clause, it should be assessed as a Category D species instead, except if there is evidence that the species is currently below the limit reference point.

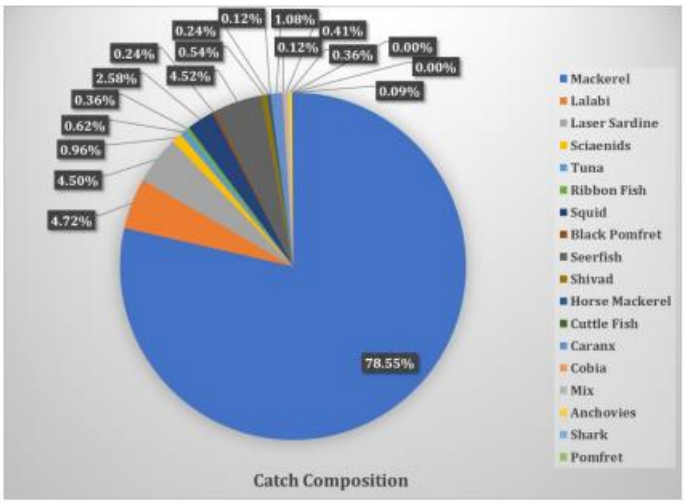

Figure 9: Expected species composition from Indian oil sardine fisheries (Omega Fishmeal & Oil Private Limited, 2022)

C1.1	**C1.1 Fishery removals of the species in the fishery under assessment are included in the stock assessment process OR are considered by scientific authorities to be negligible.**
Clause outcome	***Pass***

Rationale

C1.1 –

Yellowfin tuna (*Thunnus albacares*) (Indian Ocean sock)

There is no specific mention of this current fishery's removals of yellowfin tuna from the stock in the recent stock assessment carried out in 2021 by the Indian Ocean Tuna Commission (IOTC). As tuna is considered to contribute to 1.08% of the bycatch rate for Indian purse seine fisheries (Omega Fishmeal & Oil Private Limited, 2022) this is considered to be a negligible rate of removal.

Therefore, this element currently meets the scoring requirement.

References

International Seafood Sustainability Foundation. (2021). IOTC Yellowfin Tuna Rebuilding. Retrieved from https://www.iss-foundation.org/vessel-and-company-commitments/conservation-measures-

and-auditing/our-conservation-measures/1-rfmo/1-3-iotc-yellowfin-tuna-rebuilding/

Omega Fishmeal & Oil Private Limited, 2022. *Stock assessment of Indian oil sardine and Indian mackerel,* s.l.: Omega Fishmeal & Oil Private Limited.

C1.2	**C1.2 The species is considered, in its most recent stock assessment, to have a biomass above the limit reference point (or proxy), OR removals by the fishery under assessment are considered by scientific authorities to be negligible.**
Clause outcome	***Pass***

Rationale

C1.2 –

Yellowfin tuna (*Thunnus albacares*)

The most recent stock assessment for yellowfin tuna (2021) was carried out using Stock Synthesis III (SS3) (FU et al., 2021), a fully integrated model that is currently used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean (IOTC, 2022). Compared to the previous assessment (2018) it represented an improvement by incorporating a wider range of uncertainty through sensitivity runs and addressing errors in the projections and estimations. According to the stock assessment, current (2020) spawning biomass is estimated to be below SBMSY (SB2020/SBMSY = 0.87), and fishing mortality is estimated to be above FMSY (F2020/FMSY = 1.32). Fishing mortality has remained above the estimated MSY since 2012, with the 2019 catch the largest since 2010 (IOTC, 2022). Consequently, overall stock status does not differ significantly from the previous assessment. The probability of the stock being in the red Kobe quadrant in 2020 is estimated to be 68%. On the weight-of-evidence available since 2018, the yellowfin tuna stock is determined to remain overfished and subject to overfishing (FU et al., 2021). Current interim limit reference points under IOTC Resolution 15-10 (IOTC_RES, 2015), include a biomass reference point (0.4 BMSY) and a F reference point (1.4 FMSY). Current (2020) spawning biomass is estimated to be well above the LRP of 0.4 BMSY (SB2020/SBMSY = 0.87 (0.63-1.10 - 80% CI)). Therefore, there is less than a 20% probability that the stock is below PRI, hence it is highly likely that yellowfin tuna is above the PRI. Stock projections were carried out in the 2021 assessment for a range of catch levels from -40% to +20% relative to the 2020 catch (Urtizberea, 2021). For each stock scenario, the probability of the biomass being below the SBMSY level was determined after 3 years (2023) and 10 years (2030). For the base model, if catches are reduced by 60% and <80% from the 2020 levels there is a >50% probability of being above the BMSY levels by 2023 and 2030 respectively (Urtizberea, 2021). The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (IOTC Resolution 21-01 (IOTC_RES, 2021a) which superseded 19-01, 18-01 and 17-01). However, it has been noted by the SC for several years now that while some fisheries subject to the catch restrictions have achieved a decrease in catches in accordance with the levels of reductions specified in the. Resolution: these reductions are being offset by increases in the catches from CPCs exempt from and some CPCs subject to limitations on their catches of yellowfin tuna (IOTC, 2022j). For example, the total catches of yellowfin tuna in

2018 and 2019 increased by around 9% and 5% respectively, from 2014/2015 levels (IOTC, 2022j). It is therefore not clear that the catch reductions applied in the stock projections for yellowfin tuna will be achieved.

In 2021 a new stock assessment was carried out for yellowfin tuna in the IOTC area of competence. The model used in 2021 is based on the model developed in 2018 with a series of revisions. The new model grid represents a marked improvement over the previous results available in 2018 and incorporates a far wider range of uncertainty. Stock status estimates are more pessimistic, but do not differ substantially, from the previous assessment (**Figure IO-6**):

1. The ratio of $F_{current}/F_{MSY}$ in 2020 is estimated at 1.32 (80% CI: 0.68-1.95), indicating that overfishing is occurring.
2. The stock is in an overfished state as spawning biomass in 2020 is estimated to be below the SSB_{MSY} level. $SSB_{current}/SSB_{MSY}$ = 0.87 (80% CI: 0.63-1.10).
3. The value of MSY is estimated to be 349,000 (80% CI: 286,000-412,000 tonnes). Catches since 2012 (~410,300 t in 2022) are above the estimated MSY.

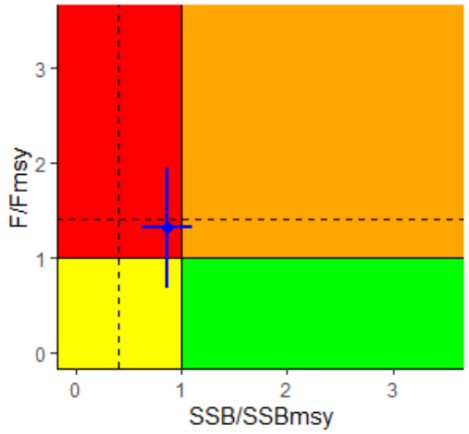

Figure IO-6. Latest estimate of SSB/SSB_{MSY} and F/F_{MSY} (in blue, including range) for IO yellowfin. Solid black lines represent interim target reference points and black dashed lines represent interim limit reference points.

Figure 10: ISSF Status of the World Fisheries for Tuna, March 2024

Therefore, there is evidence that the stock of yellowfin tuna in the Indian Ocean is above the limit reference point (LRP), despite being in an overfished state and experiencing overfishing. Nevertheless, this status is still indicative that the stock may meet the PRI without further management measures.

Therefore, this element currently meets the scoring requirement.

References

IOTC status of the stock report for yellowfin tuna, 2023 - WPTT17 Report (iotc.org)
ISSF 2024-02: Status of the World Fisheries for Tuna. March 2024* - International Seafood Sustainability Foundation (iss-foundation.org)

Category D species

Category D species are assessed against a risk-based approach.

The Productivity-Susceptibility Analysis (PSA) in Table D(a) shall be used when assessing Category D species.

Table D(b) shall be used to calculate the overall PSA risk rating for the Category D species.

Should the PSA indicate a high risk, further assessment shall be completed against the requirements in Table D(c).

Productivity Susceptibility Analysis (PSA) and scores

Table D(a) provides detailed values and scores for the species productivity and susceptibility attributes and attributes, the assessor shall use Table D(a) to the PSA table.

Table D(b) is used to calculate the overall PSA risk rating for the Category D species.

The table below outlines the most commonly encountered species in the purse seine fishery of Goa and Maharashtra. The data is sourced from the Indian Oil Sardine: Catch Characteristics report.

It is to be noted here, that there is uncertainty in catch categorisation statistics, as identified elsewhere in this report. As per Marin Trust Version 3 criteria 1.3.2 'Species which make up less than 0.1% of catches do not need to be assessed'. It is likely that most of the species assessed via PSAs in the below section would be below this 0.1% threshold, however these have still been included in this assessment pending further catch categorisation statistics for these species.

Scientific name	Common name	Fish Meal
Pampus argenteus	Silver pomfret	N
Pampus chinensis	Chinese silver pomfret	N
Parastromateus niger	Black pomfret	N
Rastrelliger kanagurta	Indian mackerel	N
Epinephelus diacanthus	Spinycheek grouper	N
Sciaenids	Sciaenids	N
Scomberomorous commersoni	Narrow-barred Spanish mackerel	N
Scomberomorous lineolatus	Streaked seerfish	N
Trichiurus lepturus	Largehead hairtail	N
Lepturocanthus savala	Savalai hairtail	N
Tenualosa ilisha	Hilsa shad	N
Lactarius lactarius	False trevally	N
Fenneropenaeus merguiensis	Banana shrimp	N
Parapenaeopsis stylifera	Tiny shrimp	N
Uroteuthis duvauceli	Indian squid	N

Scientific name	Common name	Fish Meal
Thunnus albacares	Yellowfin tuna	N
Thunnus tonggol	Longtail tuna	N
Rays	Rays	N
Megalaspis cordylla	Torpedo scad	Y/N
Arius jella	Blackfin sea catfish	Y/N
Photopectoralis bindus	Orangefin ponyfish	Y/N
Eubleekeria splendens	Splendid ponyfish	Y/N
Decapterus russelli	Indian scad	Y/N
Cynoglossus macrostomous	Malabar tonguesole	Y/N
Coilia dussumieri	Goldspotted anchovy	Y/N
Cynoglossus lingua	Long tongue sole	Y
Sardinella fimbriata	Fringescale sardinella	Y
Hyporamphus dussumieri	Dussumier's halfbeak	Y
Cheilopogon spilopterus	Manyspotted flyingfish	Y
Opisthopterus tardoore	Tardoore	Y
Oratosquilla nepa	Mantis shrimp	Y

Figure 11: Estimated bycatch provided by the FIP from a 2021 presentation about the fishery and catch composition.

Table 4: PSA for Indian scad mackerel

Species name	Indian scad (*Decapterus russelli*)	
Productivity attributes	**Value**	**Score**[1]
Average age at maturity	1 year	1
Average maximum age	4 years	2
Fecundity	20,000 – 100,000	1
Average maximum size	22 cm	2
Average size at maturity	11-16 cm	2
Reproductive	Broadcast spawner	1

[1] Indian oil sardine S.longiceps 51 57 Surv v 2.0 Nov 2018 (1).pdf

strategy		
Mean Trophic Level (MTL)	3.7	1
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.43
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Indian scad occupy similar habitats as the target species so there is considered to be high areal overlap.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Indian scad occupy similar habitats as the target species so there is considered to be high encounterability.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. b. Individuals < half the size at maturity are retained by the gear because the mesh traps them.	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 5: PSA for longtail tuna

Species name	Longtail tuna (*Thunnus tongol*)

Productivity attributes	Value	Score
Average age at maturity	2 (Maturity Age[2])	1
Average maximum age	19	2
Fecundity	1,200,000 - 1,900,000	1
Average maximum size	150cm	2
Average size at maturity	60.7cm	2
Reproductive strategy	Broadcast spawner	1
Mean Trophic Level (MTL)	4.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.75
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Marine; pelagic-neritic; oceanodromous. They can be found at 10m depth. They can be found near the coastal areas where chances of getting caught are higher.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. b. Individuals < half the size at	3

[2] Thunnus tonggol | fishIDER

	maturity are retained by the gear because the mesh traps them.	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 6: PSA for blackfin sea catfish

Species name	Blackfin sea catfish (*Arius jella*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1 year [5]	1
Average maximum age	4 years	1
Fecundity	25-120 eggs / year	3
Average maximum size	30 cm	1
Average size at maturity	14-16 cm	1
Reproductive strategy	Demersal egg layer	2
Mean Trophic Level (MTL)	3.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.71
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N	3

	Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N. High areal overlap with the fishery.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Found mostly in coastal marine waters, estuaries, and tidal rivers. Feeds mainly on invertebrates. Caught with stake traps, shore seines, set bagnets and on hook and line.[3] Therefore, there is low overlap with fishing gear.	1
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		2.5
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

[3] Arius jella, Blackfin sea catfish : fisheries (mnhn.fr)

[5] D-3342.pdf (egranth.ac.in)

Table 7: PSA for torpedo scad

Species name	Torpedo scad (*Megalaspis cordyla*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	2.5 years	1
Average maximum age	5	1
Fecundity	146,400	1
Average maximum size	80cm	1
Average size at maturity	22-26cm	1
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	3.9	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.29
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Found mostly in marine; brackish; reef-associated; depth range 20 - 100 m, which is within the access area of purse seine vessels[4].	3
Selectivity of gear type: Potential of the gear to retain	a. Individuals < size at maturity are regularly caught because	3

[4] Fishing Gear: Purse Seines | NOAA Fisheries

Megalaspis cordyla, Torpedo scad : fisheries (fishbase.se)

species	this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 8: PSA for orangefin ponyfish

Species name	Orangefin ponyfish (*Photopectoralis bindus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1[5]	1
Average maximum age	3[6]	1
Fecundity	4,377 - 10,449	2
Average maximum size	11-14cm	1

[5] Photopectoralis bindus, Orangefin ponyfish : fisheries (fishbase.se)

[6] (PDF) Population characters of silverbelly Photopectoralis bindus (Valenciennes, 1835) along the Ratnagiri coast of India (researchgate.net)

Average size at maturity	9.3 cm[7]	1
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	2.9	2
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.29
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Distributed across, Indo-West Pacific: Port Sudan in the Red Sea and the Persian Gulf to Japan, the Arafura Sea, and Australia. There is a overlap of the fishing effort with a species concentration of the stock.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Orangefin ponyfish are widely distributed in tropical and subtropical coastal waters, often overlapping with fishing efforts.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps	3

[7] (PDF) Reproductive biology of the orange ponyfish, Photopectoralis bindus (Valenciennes, 1835) off Mangaluru coast, Karnataka (researchgate.net)

	them (3).	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 9: PSA for splendid ponyfish

Species name	Splendid ponyfish (*Eubleekeria splendens*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1	1
Average maximum age	2.3 years	1
Fecundity	6,000-58,000[8]	2
Average maximum size	23cm[9]	1
Average size at maturity	9.4cm	1
Reproductive strategy	Broadcast spawner	1
Mean Trophic Level (MTL)	2.9	2
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.28
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort	Distributed across: Indo-West Pacific: from India to Papua	3

[8] (PDF) Reproductive Biology of Splendid Ponyfish Leiognathus splendens (Cuvier, 1829) in Myeik Coastal Waters, Myanmar (researchgate.net)

[9] Eubleekeria splendens, Splendid ponyfish : fisheries (fishbase.se)

with a species concentration of the stock	New Guinea; north to Japan; south to Australia. This indicates possibility of overlap.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Marine; brackish; demersal; amphidromous; depth range 10 - 100 m, a range within the functioning area of Purse Seine.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 10: PSA for Malabar tonguesole

Species name	Malabar tonguesole (*Cynoglossus macrostomus*)	
Productivity attributes	**Value**	**Score**

Average age at maturity	1 year[10]	1
Average maximum age	1.27- 3 years[11]	1
Fecundity	5000 – 65000[12]	2
Average maximum size	17.3 cm[13]	1
Average size at maturity	97 mm	1
Reproductive strategy	Broadcast spawner	1
Mean Trophic Level (MTL)	3.3	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.42
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are marine; brackish; benthopelagic; non-migratory species. Their distribution is mostly restricted to the coast of India, which matches the location of the fishing gear in the coastal regions.	3
Selectivity of gear type: Potential of the gear to retain	a. Individuals < size at maturity are regularly caught because this species inhabits the same	3

[10] Microsoft Word - MS 3338.docx (niscpr.res.in)

[11] (PDF) Studies on growth and mortality of Malabar tongue sole, Cynoglossus macrostomus (Norman, 1928) along the Ratnagiri coast of Maharashtra India (researchgate.net)

[12] Jayaprakash_85-95.pdf (cmfri.org.in)

[13] Cynoglossus macrostomus, Malabar tonguesole : fisheries (fishbase.se)

species	environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 11: PSA for goldspotted grenadier anchovy

Species name	Goldspotted grenadier anchovy (*Coilia dussumieri*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	6-7 months[14]	1
Average maximum age	20 months	1
Fecundity	1,000 - 5,000	2
Average maximum size	1cm	1
Average size at maturity	18-20 cm	1
Reproductive strategy	Broadcast spawners	1

[14] Coilia dussumieri, Goldspotted grenadier anchovy : fisheries (mnhn.fr)

Mean Trophic Level (MTL)	3.3	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.42
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are pelagic and found in coastal waters and have high chances of being encountered by Purse Seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught. Despite being largely estuarine, indications of bycatch suggest that there is at least regular landings of these animals (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3

PSA risk rating (from Table D(b))	Pass
Compliance rating	N/a

Table 12: PSA for long tongue sole

Species name	Long tongue sole (*Cynoglossus lingua*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	2 years [15]	1
Average maximum age	7-11 years	2
Fecundity	360 - 35,926	2
Average maximum size	9-12.2 cm[16]	1
Average size at maturity	4.5 cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	3.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.57
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the	They live in oceans; freshwater; brackish water at the bottom; non-ovipositive retrodrome . Depth of their dwellings range from upper and lower limit 10 -	1

[15] downloadfile.php (asianfisheriessociety.org)

[16] Cynoglossus lingua, Long tongue sole : fisheries (fishbase.se)

habitat relative to the position of the gear	961 m, reducing their chances of being caught by purse seine vessels[17].	
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 13: PSA for Dussumier's halfbeak

Species name	Dussumier's halfbeak (*Hyporhamphus dussumieri*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 – precautionary
Fecundity	Not known	3 – precautionary
Average maximum size	38cm[18]	1
Average size	19cm	1

[17] Fishing Gear: Purse Seines | NOAA Fisheries

[18] Hyporhamphus dussumieri, Dussumier's halfbeak : fisheries (fishbase.se)

at maturity		
Reproductive strategy	Broadcast	1
Mean Trophic Level (MTL)	3.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		2.15
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Distributed in the Indo-Pacific: Seychelles through the East Indies, Borneo, Philippines, and New Guinea north to Hong Kong and Okinawa and eastward as far as Tuamoto Islands. However, chances of being encountered in India are less. Although they are still present in the Indo-Pacific.	2
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or	3

permitting subsequent survival	suffocation.	
Average susceptibility score		2.75
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 14: PSA for manyspotted flying fish

Species name	Manyspotted flying fish (*Cheilopogon spilopterus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 – precautionary
Average maximum age	5	1
Fecundity	7,196 - 23,195[19]	1
Average maximum size	25cm	1
Average size at maturity	29cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	4.2	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.57
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position	They are pelagic and found in coastal waters and have high chances of being encountered by Purse Seine vessels.	3

[19] Cheilopogon spilopterus, Manyspotted flyingfish : fisheries (mnhn.fr)

of the gear		
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 15: PSA for tadoore

Species name	Tadoore (*Opisthopterus tardoore*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 – precautionary
Fecundity	2,000-11,140[20]	2
Average maximum size	23cm[21]	1
Average size at maturity	Not known	3 - precautionary

[20] STUDIES ON THE BIOLOGY OF OPISTHOPTERUS TARDOORE (CVWIER) FROM RATNAGIRI | Indian Journal of Fisheries (icar.org.in)

[21] Opisthopterus tardoore, Tardoore : fisheries (mnhn.fr)

Reproductive strategy	Broadcast spawner	1
Mean Trophic Level (MTL)	3.4	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		2.29
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Tardoore are pelagic and found in coastal waters, and thus have high possibility of being encountered by purse seine fishing vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**

Compliance rating	N/a

Table 16: PSA for Smalleyed squillid mantis shrimp

Species name	Smalleyed squillid mantis shrimp (*Miyakea nepa*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 - precautionary
Fecundity	50,000	1
Average maximum size	16 cm[22]	1
Average size at maturity	8 cm	1
Reproductive strategy	No distinct information is available in this regard, however, they are known as a "very common shore species" that burrows in "level-bottom habitats" with a preference for "sandy-muddy bottoms" [SeaLifeBase]. This benthic lifestyle suggests they spend most of their time on the seabed, making demersal spawning (laying eggs on the bottom) more likely.	2
Mean Trophic Level (MTL)	3.27	3
Density dependence (to be used when scoring invertebrate species only)	Not known	3 - precautionary
Average productivity score		2.12
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E -	3

[22] (PDF) Population dynamics of mantis shrimp (Miyakea Nepa Fabricius, 1781) in Siwa, Bone Bay, South Sulawesi, Indonesia (researchgate.net)

the stock	80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They have a benthic lifestyle. Although they have a preference for sandy muddy bottoms, but they are very common shore species as well, and this nature enhance the possibility of them being by purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 17: PSA for silver pomfret

Species name	Silver pomfret (*Pampus argenteus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	7 years	1

Fecundity	Bay of Bengal: 40,610 - 90,460 Gujarat (2012-2013): 58,345 - 131,523	1
Average maximum size	18cm[23]	1
Average size at maturity	25.3cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	3.3	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.57
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are pelagic and found in coastal waters, and thus have high possibility of being encountered by purse seine fishing vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the	3

[23] Pampus argenteus, Silver pomfret : fisheries (fishbase.se)

	gear because the mesh traps them (3)	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 18: PSA for Chinese silver pomfret

Species name	Chinese silver pomfret (*Pampus chinensis*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 - precautionary
Fecundity	57,969 – 248,520[24]	1
Average maximum size	40cm	1
Average size at maturity	22-25cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	3.6	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.86
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E -	3

[24] Pampus chinensis, Chinese silver pomfret : fisheries (fishbase.se)

the stock	80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are pelagic and found in coastal waters, and thus have high possibility of being encountered by purse seine fishing vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 19: PSA for black pomfret

Species name	Black pomfret (*Parastromateus niger*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1	1
Average maximum age	Not known	3 - precautionary

Fecundity	1,692 - 151,796[25]	3
Average maximum size	75cm	2
Average size at maturity	23cm	1
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	2.9	2
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.86
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Black pomfrets are found in coastal areas with muddy substrate, but they exhibit a diurnal vertical migration, i.e., they spend their days near the bottom and ascend towards the surface at night. Thus, there is high chance of being encountered by purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2).	3

[25] Parastromateus niger, Black pomfret : fisheries (fishbase.se)

	b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3).	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 20: PSA for spinycheek grouper

Species name	Spinycheek grouper (*Epinephelus diacanthus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 - precautionary
Fecundity	4,165 - 24,765[26]	1
Average maximum size	55cm	1
Average size at maturity	39.2cm	2
Reproductive strategy	Broadcast	1
Mean Trophic Level (MTL)	3.9	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		2
Susceptibility attributes		
Areal overlap (availability):	Species found in Indian ocean	3

[26] Epinephelus diacanthus, Spinycheek grouper : fisheries (fishbase.se)

Overlap of the fishing effort with a species concentration of the stock	FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They reside over muddy sand or mud substrata and caught in depths of 63 to 100 m off the Kerala coast, which is within the access area of purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 21: PSA for narrow-barred Spanish mackerel

Species name	Narrow-barred Spanish mackerel (*Scomberomorus commersoni*)	
Productivity attributes	**Value**	**Score**
Average age	2[27]	1

[27] Scomberomorus commerson, Narrow-barred Spanish mackerel : fisheries, gamefish (fishbase.se)

at maturity		
Average maximum age	22	2
Fecundity	590,000 - 1,500,000	1
Average maximum size	240cm	3
Average size at maturity	75.2cm	2
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	4.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.86
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Narrow-barred Spanish mackerel are pelagic and found in coastal waters where purse seine vessels could encounter them.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps	3

	them (3)	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 22: PSA for streaked seerfish

Species name	Streaked seerfish (*Scomberomorous lineolatus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	2 years[28]	1
Average maximum age	5 years	1
Fecundity	559,000 - 2,143,000	1
Average maximum size	94 cm [29]	1
Average size at maturity	70 cm	2
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	4.5	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.43
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort	Species found in Indian ocean FAO areas.	3

[28] Maturity, spawning and fecundity of the streaked seer, Scomberomorus lineolatus (Cuvier & Valenciennes), In the Gulf of Mannar and Palk Bay - CORE Reader

[29] Scomberomorus lineolatus, Streaked seerfish : fisheries, gamefish (fishbase.se)

with a species concentration of the stock	Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are pelagic and found in coastal waters where purse seine vessels could encounter them.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 23: PSA for largehead hairtail

Species name	Largehead hairtail (*Trichiurus lepturus*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1 year[30]	1

[30] Trichiurus lepturus, Largehead hairtail : fisheries, gamefish (fishbase.se)

Average maximum age	6.8 years[31]	1
Fecundity	22,533 - 186,667	1
Average maximum size	207cm	2
Average size at maturity	50 cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	4.4	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.43
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are benthopelagic and found in coastal waters where they can be encountered by purse seine.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the	3

[31] Indian oil sardine S.longiceps 51 57 Surv v 2.0 Nov 2018 (1).pdf

	gear because the mesh traps them (3)	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 24: PSA for Savalai hairtail

Species name	Savalai hairtail (*Lepturacanthus savala*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	Not known	3 - precautionary
Fecundity	9,178 - 17,347[32]	1
Average maximum size	100 cm	1
Average size at maturity	38 cm	1
Reproductive strategy	Not known	3 - precautionary
Mean Trophic Level (MTL)	4.3	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		2.14
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E -	3

[32] Lepturacanthus savala, Savalai hairtail : fisheries (fishbase.se)

the stock	80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They inhibit in coastal waters and often come near the surface at night, and there is high possibility of them being encountered by purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		**Fail**
Compliance rating		N/a

Table 25: PSA for Hilsa shar

Species name	Hilsa shar (*Tenualosa Ilisha*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1.2 years[33]	1

[33] article_119368_db9790434609d8e72f425f41b2a3a138.pdf (ekb.eg)

Average maximum age	5 years[34]	1
Fecundity	375,000 - 1,423,000	1
Average maximum size	31.3cm	1
Average size at maturity	60cm	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	2.9	2
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.14
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Schooling in coastal waters and ascending rivers for as much as 1200 km and have high chances of being encountered by purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the	3

[34] Tenualosa ilisha, Hilsa shad : fisheries, aquaculture (fishbase.se)

	gear because the mesh traps them (3)	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 26: PSA for false trevally

Species name	False trevally (*Lactarius lactarius*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary
Average maximum age	1-2 years[35]	1
Fecundity	9,000 – 79,000	2
Average maximum size	40cm	1
Average size at maturity	15cm	1
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	4.2	3
Density dependence (to be used when scoring invertebrate species only)	N/a	N/a
Average productivity score		1.71
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E -	3

[35] Lactarius lactarius, False trevally : fisheries (fishbase.se)

the stock	80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are found in coastal waters down to a depth of about 100m and they have chances of getting encountered by purse seine vessels.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 27: PSA for banana shrimp

Species name	Banana shrimp (*Fenneropenaeus merguiensis*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	0.5 years[36]	1

[36] Prawns | Australian Fisheries Management Authority (afma.gov.au)

Average maximum age	1.5 years[37]	1
Fecundity	100 000 - 450 000 [38]	1
Average maximum size	24cm	1
Average size at maturity	3cm	1
Reproductive strategy	Broadcast spawning	1
Mean Trophic Level (MTL)	2.5 - 3.0	2
Density dependence (to be used when scoring invertebrate species only)	Not known	3 - precautionary
Average productivity score		1.38
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are unlikely to be caught by purse seine fishing due to their bottom-dwelling lifestyle and the midwater targeting of purse seines.	1
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2).	3

[37] Prawns | Australian Fisheries Management Authority (afma.gov.au)

[38] Maturation and spawning of the banana prawn Penaeus merguiensis de Man (Crustacea : Penaeidae) in the Gulf of Carpentaria, Australia - ScienceDirect

	b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		2.5
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 28: PSA for kiddi shrimp

Species name	Kiddi shrimp (*Parapenaeopsis stylifera*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	1	1
Average maximum age	2	1
Fecundity	39,500 - 236,000	1
Average maximum size	15cm	1
Average size at maturity	6.5-7.5 cm[39]	1
Reproductive strategy	Broadcast spawners	1
Mean Trophic Level (MTL)	2.9	2
Density dependence (to be used when scoring invertebrate species only)	Not known	3 - precautionary
Average productivity score		1.36
Susceptibility attributes		

[39] PROCEEDINGS OF THE WORLD SCIENTIFIC CONFERENCE ON THE BIOLOGY AND CULTURE OF SHRIMPS AND PRAWNS (fao.org)

Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	They are found at coast to depths of 90 m, but usually down to 50 m on muddy or sandy-mud substrates. So, there are possibilities of them being encountered by Purse seine.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Table 29: PSA for Indian squid

Species name	Indian squid (*Uroteuthis duvaucelii*)	
Productivity attributes	**Value**	**Score**
Average age at maturity	Not known	3 - precautionary

Average maximum age	3	1
Fecundity	11,802 - 30,100	1
Average maximum size	40cm	1
Average size at maturity	10cm	2
Reproductive strategy	Demersal spawning	2
Mean Trophic Level (MTL)	<2.75	1
Density dependence (to be used when scoring invertebrate species only)	Not known	3 - precautionary
Average productivity score		1.75
Susceptibility attributes		
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	Species found in Indian ocean FAO areas. Indian Ocean Western: 30° E - 80° E; 45° S - 30° N Indian Ocean Eastern: 77°E - 150°E; 55°S - 24°N.	3
Encounterability: The position of the stock/ species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Found in shallow waters, they have lesser chance of being encountered by purse seine vessels as purse seine vessels do not ideally operate in shallow waters.	3
Selectivity of gear type: Potential of the gear to retain species	a. Individuals < size at maturity are regularly caught because this species inhabits the same environment as the main species. Also, there is no indication about the frequency at which these animals are caught (2). b. Individuals < half the size at maturity are retained by the gear because the mesh traps them (3)	3

Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Due to the nature of purse seine fishing, it is highly unlikely that the species will survive once it is removed from the water due to crushing or suffocation.	3
Average susceptibility score		3
PSA risk rating (from Table D(b))		Pass
Compliance rating		N/a

Further assessment for Category D species

Should the PSA indicate a high risk, further assessment shall be completed against the requirements D1 and D2 – Table D(c).

Dussumier's halfbeak (*Hyporhamphus dussumieri*)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Tadoore (Opisthopterus tardoore)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***

Rationale There is no mention of this species in the fisheries management for this fishery.
References

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Smalleyed squillid mantis shrimp (*Miyakea nepa*)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause	***Pass***

outcome	
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Chinese silver pomfret (*Pampus chinensis*)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Black pomfret (Parastromateus niger)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Spinycheek grouper (Epinephelus diacanthus)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	

References

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Narrow beaked Spanish mackerel (*Scomberomorus commerson*)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species.	

However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.
References

Savalai hairtail (Lepturacanthus savala)

D1	D1. The potential impacts of the fishery on this species are considered during the management process, and reasonable measures are taken to minimise these impacts.
Clause outcome	***Fail***
Rationale There is no mention of this species in the fisheries management for this fishery.	
References	

D2	D2. There is no substantial evidence that the fishery has a significant negative impact on the species.
Clause outcome	***Pass***
Rationale There is no substantial evidence that the fishery has a significant negative impact on the species. However, more specific information about the catch rate of this species will be required to understand more about the actual contribution to total catch composition.	
References	

Ecosystem requirements

This section, or module, assesses the impacts that the fishery under assessment may have on key ecosystem components: ETP species, habitat and the wider ecosystem.

1.6. All ecosystem criteria must be met (pass) for a fishery to pass the Ecosystem Requirements.

1.6.1. The sub-criteria offer a structured evidence base to demonstrate that the fishery sufficiently meets the ecosystem criteria, it is not expected that sub-criteria are assessed independently of the main criterion.

E1 Impact on Endangered, Threatened or Protected species (ETP species)

E1.1	**E1.1 Information on interactions between the fishery and ETP species is collected.** *In reaching a determination for E1.1, the assessor should consider if the following is in place:*	
	E1.1.1 ETP species which may be directly affected by the fishery have been identified.	Meets
	E1.1.2 Interactions between the fishery and ETP species are recorded and reported to management organisations.	Gap
	E1.1.3 Collection and analysis of ETP information is adequate to provide a reliable indication of the impact the fishery has on ETP species.	Meets
Clause outcome		***Fail***

Rationale

E1.1.1 –

Cetaceans

Dolphin interactions are well understood with multiple scientific papers. Small gillnets that operate near the shore are most prone to cetacean attacks. Gear damage and depredation by cetacean and non-cetacean species cause economic loss to the tune of Rs. 0.5 – 2.0 lakhs per incident in gillnet and purse seine/ ring seine fishery. Studies show that about 15.3% of respondents reported incidental bycatch of cetaceans, mainly in gillnets, purse seines and trawls. The number of interactions are found to be maximum during pre-monsoon season. It has also been observed that gillnets and purse seine/ ring seine are the most economically affected fisheries. Fishers employ mitigation measures like scaring away the animals or delaying fishing. The cetacean species most frequently found were Indo-pacific humpback dolphin (Sousa chinensis) (27.6%), spinner dolphin (*Stenella longirostris*) (22.5%), long beaked common dolphin (Delphinus capensis) (19.7%), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) (15%), Finless Porpoise (*Neophocaena phocaenoides*) (10.7%) and Risso's Dolphin (Grampus griseus) (2.8%). The Short-finned Pilot Whale (Globicephala *macrorhynchu*) and Sperm Whale (Physeter microcephalus) were occasionally sighted (< 1%). About 85.6% of fishers were able to correctly identify the cetacean species owing to their experience. Several studies have reported the occurrence of species like humpback dolphins and spinner dolphins (Raphael et al., 2017; Edwin et al., 2017; Koya et al., 2018) (Joseph, et al., 2021).

No additional marine mammals are observed.

Sharks and Rays

There is an active elasmobranch fishery in West Bengal. The landings of pelagic sharks in India during 2020 were estimated at 9,927 tonnes. The west coast (FAO Area 51) accounted for 47.85 percent, and the rest (52.15%) from the east coast (FAO Area 57). Previous research conducted on the rate of shark bycatch in Indian fisheries highlighted that shark bycatch is minimal in purse seine fisheries, contributing to 3.1% of total shark landings in Maharashtra, and 4.1% of landings in Goa and Karnataka (BOBP-IGO, 2021)

Turtles

Five species of marine turtles viz., Olive Ridley turtle (*Lepidochelys olivacea*), Loggerhead turtle (*Caretta caretta*), Leather back turtle (*Dermochelys coriacea*), Hawksbill turtle (*Eretmochelys imbricata*) and Green turtle (*Chelonia mydas*) are known to inhabit the Indian coastal waters. Government of India has given high priority to conserve the sea turtles and all the five species are protected as they are placed in Schedule I of the Indian Wildlife (Protection) Act 1972 as per the Amendments made to the Schedule in September 1977.

Seabirds

There are no records of seabirds interacting with purse seine Indian oil sardine fisheries in India.

Therefore, this element currently meets the scoring requirement.

E1.1.2 –

Cetaceans

Research conducted in 2021 observed dolphin interactions with Indian fisheries and noticed that the majority of dolphin interactions occurred within gillnet and purse seine fisheries. The research found that about 15.3% of fisheries reported on dolphin bycatch across gillnet, purse seine and trawl fisheries but that the majority of cetacean-interactions were due to depredation – when a dolphin preys on the fish caught in the net (Joseph, et al., 2021). There is no information available that describes the current fishery's specific interaction rate with cetaceans, this could be due to zero incidents of cetacean bycatch occurring, but further third-party data (e.g. observer coverage) will be beneficial to demonstrate this.

Sharks and Rays

There is no information available that describes the current fishery's specific interaction rate with elasmobranchs, this could be due to zero incidents of shark bycatch occurring, but further third-party data (e.g. observer coverage) will be beneficial to demonstrate this. However, previous research conducted on the rate of shark bycatch in Indian fisheries highlighted that shark bycatch is minimal in purse seine fisheries, contributing to 3.1% of total shark landings in Maharashtra, and 4.1% of landings in Goa and Karnataka (BOBP-IGO, 2021).

Turtle

There is no information available that describes the current fishery's specific interaction rate with turtles, and this will need to improve before the true awareness of the fishery's impact on turtles is assessed. As with sharks, despite there being no fishery-specific data on turtle bycatch incidents, previous research conducted on Indian fisheries' interaction with turtles demonstrates that gillnets and trawl fisheries provide the greatest threat to turtle bycatch.

Seabirds

There are no records of seabirds interacting with purse seine Indian oil sardine fisheries in India.

This element currently cannot meet the scoring requirement.

E1.1.3 –

Despite limited available information about the fishery-specific interaction rate with ETP species, previous research conducted in the interaction rate of Indian purse seine fisheries and ETP species described in E1.1.1 is sufficient to provide fishery managers with an informed and reliable view of the associated impacts.

Therefore, this element currently meets the scoring requirement.

References

Joseph, R., Das, P.H. and Edwin, L., 2021. Cetacean fishery interaction during operation of major fishing systems of India.

Kizhakudan, Shoba Joe, Zacharia, P. U., Thomas, Sujitha, and Vivekanandan, E. 2015. Guidance on National Plan of Action for Sharks in India. Central Marine Fisheries Research Institute, 2, pp.2395-8019: (PDF) Guidance on National Plan of Action for Sharks in India (researchgate.net)

Prabhakar, R. V. D., Pralaya Ranjan Behera, Loveson, L. Edward and Jeyabaskaran, R*

Visakhapatnam Regional Centre of CMFRI, Visakhapatnam. 2014. Accidental catch of Long-snouted Spinner Dolphin, Stenella longirostris (Gray, 1828) at Dummulapeta, Andhra Pradesh. * Central Marine Fisheries Research Institute, Cochin

E1.2	**E1.2 The fishery has no significant negative impact on ETP species.** *In reaching a determination for E1.2, the assessor should consider if the following is in place:*	
	E1.2.1 The information collected in relation to E1.1.3 indicates that the fishery does not have a significant negative impact on ETP species.	Meets
Clause outcome		***Pass***

Rationale

E1.2 –

As mentioned in E1.1.3, research conducted on other purse seine fisheries in India demonstrate low interaction rates in comparison to other fisheries and fishing gear types with ETP species. There are management measures in place, including fishery closures, anti shark retention, anti-shark finning (on board vessels at sea), and Marine Protected Areas that limited fishing activity enforced around India. In Maharashtra, the Department of Fisheries Government of Maharashtra launched a financial incentive in 2018 for all fishers that released "sharks, dolphins and marine mammals", and turtles and porcupine rays. A letter from the Department was provided to the FIP that informed that 19 fishers had received these rewards for compliance. However, there was no information about how the incidents of ETP species release were recorded and reported to the Department.

Due to the relatively low catch rate of all ETP species with purse seine fisheries in India as portrayed by previous research, it could be concluded that this fishery does not have a significant negative impact on ETP species. Therefore, this element currently meets the scoring requirement.

Therefore, this element currently meets the scoring requirement.

References

Letter from Maharashtra Department of Fisheries (2023) (available on FIP profile)

E1.3	**E1.3 There is an ETP management strategy in place for the fishery.** *In reaching a determination for E1.3, the assessor should consider if the following is in place:*	
	E1.3.1 There are measures applied to the fishery which are designed to manage the impacts of the fishery on ETP species.	Meets
	E1.3.2 The measures are considered likely to achieve the objectives of regional, national and international legislation relating to ETP species.	Gap
Clause outcome		***Fail***

Rationale

E1.3.1 –

Cetaceans

Besides Wildlife (Protection) Act 1972, the following Indian acts and global conventions are intended to directly or indirectly protect marine mammals:

- The Indian Fisheries Act, 1857
- The Indian Forest Act, 1927
- The Wildlife (Protection) Act, 1972
- The Wildlife (Transactions and Taxidermy) Rules, 1973
- The Wildlife (Stock Declaration) Central Rules, 1973
- Terrestrial water, continental shelf, Exclusive Economic Zone and other marine zones Act, 1976
- Water (Prevention and control of pollution) Act, 1977
- Maritime Zones of India (Regulation and fishing by foreign vessels) Act, 1980
- The Wildlife (Protection) Licensing (Additional matters for consideration) Rules, 1983
- Environmental (Protection) Act, 1986
- Coastal Zone Regulation Notification, 1991
- Wildlife (Protection) Amendment Act, 1991
- The Wildlife (Protection) Rules, 1995
- National Biodiversity Act, 2002

Fishers use a Dolphin excluder net. This net is made of 15 mm nylon twine having a mesh size of 400 mm (Fig. 1). The size of the net varies depending on the ring net and will generally be 100 m more than the ring net. The head rope is provided with plastic cans as floats and the foot rope with iron rings of 15 cm diameter as weight. Such a large ring used as weight is to avoid twisting of the net while shooting it. There are around 55 to 60 such rings which are tied at an interval of 8 m. The cost of making a net varies from Rs. 15,000 to Rs. 18,000/-. Immediately after the shooting of ring net, the dolphin excluder net loaded in the carrier boat is swiftly shot around the ring net at a distance of around 10 to 50 m away from it. The distance of the net from the ring net depends on the water current, species of fish etc. If the targeted fish shoal is of oil sardine, then the distance between the ring net and dolphin excluder net will be more, in order to avoid the entanglement of

the two nets as the oil sardine shoals have the habit of dragging out the net once it is encircled. For the operation of the dolphin excluder net, three fishermen are required, one to operate the carrier boat and two to shoot the net. This net acts as a protective wall for the ring net. The fishermen are of the view that the dolphins move away from it once the net is seen and thus the ring nets are now almost totally free from damage by dolphins. At present this net is used only up to 20-25 m depth where, according to the fishermen, the dolphin problem commonly occurs. In deeper areas, dolphin attacks are rarely felt (Sivadas and Pradeep Kumar, 2009).

Sharks and Rays

The National Plan of Action for Conservation and Management of Sharks (NPOA-Sharks) has been prepared by the Bay of Bengal Programme Inter-Governmental Organisation in collaboration with the Bay of Bengal Large Marine Ecosystem Project (Phase 1). In India, the following three species of marine sharks are listed under Schedule I of the Indian Wildlife (Protection) Act, 1972:

1. Whale shark
2. Pondicherry shark
3. Spear tooth shark

Further, with a view to stop the hunting of sharks and to enable the enforcement agencies to monitor the illegal hunting/poaching of the species of Elasmobranchs listed in Schedule I of the Wild Life (Protection) Act, 1972, the then Ministry of Environment and Forest vide its Policy Circular No. F. No. 4-36/2013 WL dated 25th of August 2013 has prohibited the removal of shark fins on board the vessels in the sea. The policy also prohibits any possession of shark fins that are not naturally attached to the body of the shark. In addition, the Ministry of Commerce, Government of India has also notified vide its Order No. 110 (RE. -2013)/2009- 2014 dated 6 February 2015 prohibiting export of shark fins of all species of sharks. The Guidance on National Plan of Action – Sharks, India, published in (2015) outlined a series of objectives to ensure that the management of sharks in Indian waters is monitored and maintained. One of the objectives was to understand more about the abundance, biology and current fishery impacts of sharks, as well as gather data on the utilisation of sharks and shark by-products.

Turtles

According to the Goa, Daman and Diu Marine Fishing Regulation Act, 1980 (amended in 1989), mechanized fishing vessels are allowed beyond 5 km. The Forest Department of Goa along with involvement of locals started the Turtle Conservation Programme in 1996. Only Olive Ridleys nest along Goa coast between November and April with identified nesting in Mandrem, Morjim, Agonda and Galgibaga beaches of Goa. Ecotourism is highly promoted where Forest department, NGOs and local people create special Eco-huts for tourists to watch this natural phenomenon from a distance. Recently, the Goa Coastal Zone Management Authority's (GCZMA) ordered demolition of 171 structures built in the No Development Zones at beaches which have turtle nesting sites. So far, incidental catches of sea turtles have not been reported since the turtle population is very small and only sporadic stranding of sea turtles has been reported.

As per the Maharashtra Marine Fishing Regulation Act 1981, operation of trawl net by mechanized fishing vessels is prohibited from the seashore to 5 fathoms and 10 fathoms depth zone in specified areas. Fishing by mechanized fishing vessels of any type with more than 6-cylinder engines is prohibited within the territorial waters of Maharashtra up to 22 km and operation of trawl gear by mechanized fishing vessels is prohibited between 6 pm and 6 am. The nesting season of Olive Ridley turtles is from October to March with reports of sporadic nesting along the entire coast. There are some reports of nesting of green turtle also. Main nesting of Olive Ridleys in Maharashtra occur in

Sindhudurg and Ratnagiri districts. In Velas, a tiny village on the northernmost boundary of Ratnagiri district the locals started turtle conservation since 2002. The annual Turtle Festival attracts around 3000 tourists a year giving new income opportunities for the villagers. Monitoring of turtle nesting in 39 locations across 4 districts of Maharashtra is being done since 2002. The Maharashtra forest department and Wildlife Conservation and Animal Welfare Association (WCAWA) have jointly announced reward `5000 for giving information about incidents of egg laying and incentives for release of threatened and endangered species of turtles. Sea turtles included in the Wildlife Protection Act, 1972 and killing or destroying their eggs is a criminal offence that can be fined up to `24,000 and 7 years of imprisonment. The 'Turtle treatment and transit centre' at Dahanu beach on an average, rescues, treats and rehabilitates over 60 turtles including Olive Ridley, Green Sea Turtles, Hawksbills and Loggerheads every year besides undertaking awareness programs for turtle conservation along the beach.

There have been no fishery-specific management measures for ETP species identified during this assessment of the fishery.

Therefore, this element currently meets the scoring requirement.

E1.3.2 –

There are national and regional measures in place to reduce the level of impact that fisheries have on ETP species, as described in 1.3.1. Therefore, these measures, if adopted, will be sufficient to meet a pass for this indicator. The Department of Fisheries Government of Maharashtra launched a financial incentive in 2018 for all fishers that released "sharks, dolphins and marine mammals", and "turtles and porcupine rays". A letter from the Department was provided to the FIP that informed that 19 fishers had received these rewards for compliance. Evidence of the release of these species must be presented via video coverage of the activity. This is one example of how management measures can be demonstrated to be functioning and effective. However, more regular updates on the progress of the management measures will be best to ensure that the fisheries are continuing to enforce these.

Therefore, this element currently cannot meet the scoring requirement.

References

M. Sivadas and K. C. Pradeep Kumar. 2009. Dolphin excluder net - an indigenous method to ward off the damage by dolphins in ring net. Calicut Research Centre of Central Marine Fisheries Research Institute, Calicut

E2 Impact on the habitat

E2.1	**E2.1 Information on interactions between the fishery and marine habitats is collected.** *In reaching a determination for E2.1, the assessor should consider if the following is in place:*	
	E2.1.1 Habitats which may be directly affected by the fishery have been identified, including any habitats which may be particularly vulnerable.	Meets
	E2.1.2 Information on the scale, location and intensity of fishing activity relative to habitats is collected.	Gap
	E2.1.3 Collection and analysis of habitat information is adequate to provide a reliable indication of the impact the fishery has on marine habitats.	Meets
Clause outcome		***Fail***

Rationale

E2.1.1 –

The CMFRI annual report of 2022 included a section discussing the various impacts on marine habitats, including algal blooms, wind gusts, extreme weather events, marine debris, and coastal marine pollution. The report continues to describe the coral reefs mangroves, seagrass beds that are located in the coastal waters of Maharashtra and Goa. However, the gear within the fishery used is purse seine. A purse seine is made of a long wall of netting framed with a lead line of equal or longer length than the float line. Because of this, the fishing gear rarely touches the seabed meaning that there is no substantial evidence that the fishery has a negative impact on the environment.

Therefore, this element currently meets the scoring requirement.

E2.1.2 –

As a purse seine fishery, there is expected to be minimal interaction with the seafloor. However, this will need to be explored further because of the general shallow nature of the fishery operations and therefore, the potential overlap that the fishery may have on shallow habitats.

As for the seagrass and coral reef habitats that are known to be in the coastal waters off the Maharashtra and Goan shores, it is anticipated that these habitats will be too close to shore (Saroj, et al., 2016; Geevarghese, et al., 2018). Further, mechanised purse seines are prohibited from operating within an area 5km from shore. It is unclear at this stage, however, that vessel monitoring data is “collected” as required by the element. There is no evidence of vessel monitoring, via tracking maps or observer records of longitude/latitude, which would help verify that the fishery is operating away from these sensitive habitats.

Therefore, this element cannot meet this scoring requirement.

E2.1.3 –

As mentioned in E2.1.2, there is a prohibition of mechanised fisheries operating within 5km of the shore, which is the typical environment of both seagrass and coral reef habitats (Saroj, et al., 2016; Geevarghese, et al., 2018). Therefore, there is minimal risk to these sensitive habitats from this purse seine fishery that, largely, operates in deeper waters and within the pelagic zone of the water column. To improve the score of E2.1.2, the fishery will need to provide VMS data or information about the specific locations in which the vessels operate.

Therefore, this element currently meets the scoring requirement.

References

Centre for Marine Fisheries Research Institute, 2022, Annual Report, Indian Council of Agricultural Research: CMFRI Annual Report_2022.pdf

Geevarghese, G. A. et al., 2018. A comprehensive geospatial assessment of seagrass distribution in India. *Ocean and Coastal Management,* Volume 159, pp. 16-25.

Saroj, J., Kumar Gautam, R., Joshi, A. & Tehseen, P., 2016. Review of coral reefs of India: Distribution, status, research and management. *International Journal of Science,* 5(5), pp. 3088-3098.

E2.2	**E2.2 The fishery has no significant impact on marine habitats.** *In reaching a determination for E2.2, the assessor should consider if the following is in place:*	
	E2.2.1 The information collected in relation to E2.1.3 indicates that the fishery does not have a significant negative impact on marine habitats.	Gap
Clause outcome		***Fail***
Rationale **E2.2 –** Given the nature of the gear and the habitats in the area, habitat impacts from this fishery are not likely. However, without specific information on the fishery's scale, location and intensity, it cannot be confirmed that the purse seine fisheries does not have a significant negative impact on seafloor habitats like coral reefs, and seagrasses. Once specific information about the scale, location and intensity of the fishery is provided, this indicator score may change. Therefore, this element currently cannot meet the scoring requirement.		
References NA		

E2.3	**E2.3 There is a habitat management strategy in place for the fishery.** *In reaching a determination for E2.3, the assessor should consider if the following is in place:*	
	E2.3.1 There are measures applied to the fishery which are designed to manage the impact of the fishery on marine habitats.	Meets
	E2.3.2 The measures are considered likely to prevent the fishery from having a significant negative impact on marine habitats.	Meets
Clause outcome		***Pass***

Rationale

E2.3.1 –

The Indian Marine Fisheries Bill, 2021 outlines that all destructive fishing (the use of dynamite, explosives, poison, noxious chemicals, destructive materials, or destructive methods), and juvenile fishing is prohibited.

In Maharashtra, the Malvan Marine Sanctuary was established in 1987. However, in the CMFRI annual report of 2022, it was mentioned that although some Marine Protected Areas (MPAs) have been identified with conservation actions taken up, there is still room to improve the identification of biologically sensitive areas along the coasts in order to be able to develop an action plan for these environments. Therefore, this indicates that whilst there are some large-scale measures in place to reduce negative impact on habitats, more can be done. The assumed impact of purse seine fisheries on seafloor habitats like coral reefs, mangroves and seagrass beds is minimal. However, as this fishery does operate in inshore waters, the risk of gear loss or accidental interaction with these habitats needs to be considered.

There was a fishing ban order was implemented in 2021 for all fishing vessels (with the exception of non-motorized units) operating within the Indian EEZ (including the States of Maharashtra and Goa) from 15th April to 14th June (61 days). This fishing ban was also upheld in 2024, for the same duration of 61 days. The ban was ordered to facilitate fish spawning seasons and conserve the marine ecology.

In Goa, the State implements a mechanised fishing ban in areas up to 5km from the sea coast, and there is a mesh size regulation of a minimum of 24mm for fish. The State also requires that mechanised and non-mechanised fishing vessels take appropriate preventative measures to avoid fishing of ETP species. However, the State does not define the measures, nor what would be considered as “appropriate”.

There are Monitoring, Control and Surveillance (MCS) requirements for all fisheries operating in Goa and there are sanctions and penalties in place for fishers that violate the rules and regulations. Between 2023-2024, there were a reported 19 cases that were violating rules and regulations. Therefore, despite the threat of sanctions and penalties, these violations still occur (this information

can be found on the FIP profile on MarinTrust).

Therefore, this element currently meets the scoring requirement.

E2.3.2 –

For the MPAs, there are commercial activity prohibitions to prevent overexploitation and also habitat destruction. However, the Malvan Marine Sanctuary off the coast of Maharashtra is the only state-specific MPA that could be identified and covers an area unlikely to be interacted with by this fishery. As the fishery uses purse seine gears, the potential impact on seafloor habitats is unlikely. However, improvements could be made to existing management measures to ensure that greater consideration of the types of biologically sensitive areas are well-known and researched.

Therefore, this element currently meets the scoring requirement.

References

Draft Indian Marine Fisheries Bill, 2021: Draft_Indian_Marine_Fisheries_Bill_2021.pdf (dof.gov.in)

E3 Impact on the ecosystem

E3.1	**E3.1 Information on the potential impacts of the fishery on marine ecosystems is collected.** *In reaching a determination for E3.1, the assessor should consider if the following is in place:*	
	E3.1.1 The main elements of the marine ecosystems in the area(s) where the fishery takes place have been identified.	Meets
	E3.1.2 The role of the species caught in the fishery within the marine ecosystem is understood, either through research on this specific fishery or inferred from other fisheries.	Meets
	E3.1.3 Collection and analysis of ecosystem information is adequate to provide a reliable indication of the impact the fishery has on marine ecosystems.	Meets
Clause outcome		***Pass***

Rationale

E3.1.1 –

In order to assess the impacts of overfishing upon food chain, a pilot study was employed using OSMOSE (Object-oriented Simulator of Marine ecosystems Exploitation) model configured for the Kerala coast with prime focus upon two species namely *Trichiurus lepturus* and *Sardinella longiceps*. The study revealed the inter-dependence of different species and yielded insight into the abrupt changes reflected at the ecosystem level owing to overfishing. Assessment of the impacts of overfishing upon ecosystem served as a valuable tool in formulating decisions and framing policies that aim at encouraging sustainable harvest of these resources. The study took a closer look at the effects of overfishing upon the population dynamics of higher trophic level species along the Kerala coast using OSMOSE model (a multi-species individual-based model which assumes size-based opportunistic predation). The spatial domain of the study extended from 6°N to 14°N and 73°E to 77°E covering the entire Kerala coast. The forage species is represented by *Sardinella longiceps* whereas *Trichiurus lepturus* formed predatory species. In order to understand the effects of overexploitation of fishery resources, the fishing mortality of the chosen species was kept at initial values for the normal scenario, whereas it was increased up to ten times its initial value so as to simulate the overfishing scenarios for a duration of 12 years. Depletion of planktivorous species due to excessive fishing did not have a significant impact upon the biomass of the predatory species since the predators were able to thrive upon zooplankton in the absence of forage species whereas exhaustion of predatory species due to overfishing contributed to a steeper increasing trend in biomass of planktivorous species that had no predators to keep its population under check.

In June 2024, a new Ecopath with Ecosim (EwE) software was used to run a model about the Northeastern Arabian Sea (Maharashtra and Gujarat) with emphasis on small pelagic herbivores (Mohamed, 2024). For the modelling inputs, 23 ecological groups were identified as being crucial for the region, including a range of marine mammals, large pelagics, benthic carnivores, pelagic herbivores, invertebrates, and large megafauna. Using this, fishery landings data, fleet level information, and other elements relative to fishing operations in the area, several inferences were made about the fishery and the ecosystem impacts, including:

Inferences

From the above results, the following inferences can be made:

1) The NASE is a subtropical marine ecosystem with low ascendancy and high overheads indicating a highly resilient ecosystem.
2) The NASE supports a large number of carnivorous fishes and its current mean trophic level was estimated as 3.43 showing a 2% decline in MTL from that of 2008 (after 15 years).
3) The shift in MTL was mainly because of increased abundance and capture of small pelagic herbivores (particularly the oil sardine, *Sardinella longiceps*). The catches increased by 17 times in 15 years.
4) The gross efficiency of the current model was 0.0014 and in the earlier model, it was 0.0015 indicating a change to a more pelagic fish-driven ecosystem. This also indicated that the ecosystem was becoming more mature.
5) The system omnivory index was relatively high for NASE indicating that the number of trophic links in NASE is higher than that in the southern Arabian Sea.
6) The trophic impacts analysis showed that the small pelagic herbivore group is highly negatively impacted by the midwater carnivores and large pelagics. Phytoplankton biomass has a positive impact on the small pelagic herbivore group.
7) The maximum exploitation rate was estimated for the large benthic carnivore group followed by large pelagics, medium benthic carnivores and Bombay Duck. Small pelagic herbivores comprising principally of oil sardines had low exploitation rates.
8) The current NASE trophic model indicates that the exploitation level of oil sardines is not high, but these resources are subject to fluctuations in abundance caused by climatic and oceanographic parameters, and therefore, excessive fishing effort can result in economic crisis in the sector.
9) Based on this ECOPATH model, simulations can be carried out for better policy decisions.

Therefore, this element currently meets the scoring requirement.

E3.1.2 –

As touched on in criteria E 3.1.1 above, the ecopath model of the Northeastern Arabian Sea (Mohammad, 2024) offers a detailed understanding of the marine ecosystem along the coasts of Maharashtra and Gujarat, with a particular focus on small pelagic herbivores such as the Indian oil sardine (IOS). Extensive research and data have been integrated into this model, elucidating the ecological roles, trophic interactions, and the impacts of fishing activities on various species within the ecosystem.

The study finds IOS plays an important role within the NAS ecosystem. It serves as a key prey item for numerous predators and significantly contributes to the biomass of small pelagic herbivores, which have experienced a notable increase in abundance and capture in recent years. Sardines, including IOS, are vital in transferring energy from lower trophic levels (like phytoplankton) to higher trophic levels, including commercially important predators such as large pelagics and

midwater carnivores. Additionally, phytoplankton biomass positively affects IOS populations, underscoring the importance of primary production to its sustainability.

Mackerels, another important small pelagic species, similarly play a significant role in the ecosystem. Both sardines and mackerels are key prey for larger predatory fish such as tunas, seerfish, and barracudas, as well as for marine mammals and birds. The model highlights that the IOS, along with mackerels, is heavily impacted by midwater carnivores and large pelagics, illustrating their integral positions within the food web. This trophic interaction is important for maintaining the balance and health of the marine ecosystem.

The introduction of mechanized ring seines (MRS), which primarily target IOS, has significantly boosted their capture, reflecting the evolving dynamics of the fishery. Despite these increased landings, the exploitation rate of IOS remains low, suggesting that current fishing levels do not exceed the species' reproductive capacity. This indicates a relatively sustainable fishing practice under current conditions.

The ecopath model is constructed from comprehensive data, including diet compositions, biomass estimates, and fishing effort metrics, providing insights into the ecosystem's functioning. This model facilitates simulations that evaluate the impacts of different fishery management scenarios, enhancing the understanding of the IOS's role and its sustainability within the marine ecosystem. It is important to note that IOS populations are subject to fluctuations influenced by climatic and oceanographic conditions, necessitating careful management to avoid overfishing and potential economic crises in the sector.

In conclusion, the detailed Ecopath model of the Northeastern Arabian Sea ecosystem, which includes specific research on the IOS and mackerels, demonstrates an understanding of their roles within the marine ecosystem. The research highlights the ecological importance of these small pelagic species, their trophic interactions, and the impacts of fishing activities on their population dynamics. Given the extensive research and data provided by the Ecopath model, it is clear that the roles of Indian oil sardines and mackerels in the marine ecosystem are well understood. Therefore, the purse seine Indian oil sardine fishery passes the criteria regarding the understanding of the species' role within the marine ecosystem.

Therefore, this element currently meets the scoring requirement.

E3.1.3 –

The information from the EwE modelling activity of 2024 is adequate to provide a reliable indication of the impact the fishery has on marine ecosystems.

Therefore, this element currently meets the scoring requirement.

References

Mohamed, S. K., 2024. *An ecopath model of the northeastern Arabian Sea (Maharashtra and Gujarat Coasts) with emphasis on small pelagic herbivores,* s.l.: Central Marine Fisheries Research Institute.

E3.2	**E3.2 There is no substantial evidence that the fishery has a significant negative impact on the marine ecosystem.** *In reaching a determination for E3.2, the assessor should consider if the following is in place:*	
	E3.2.1 The information collected in relation to E3.1.3 indicates that the fishery does not have a significant negative impact on marine ecosystems.	Gap
Clause outcome		***Fail***

Rationale

E3.2.1 –

The inferences made by the EwE modelling task mentioned in E3.1 estimate that the ecosystem is highly resilient however, the trophic model also suggested that whilst current exploitation of the sardine is not high, compounding climatic and oceanographic parameters can result in economic crisis in the area.

There has been research on catch composition on two occasions and the landings for purse seiners are monitored annually. However, whilst the EwE modelling finds that the key species taken from the fishery (IOS, mackerel, etc), are relatively sustainable under current conditions, several Productivity and Susceptibility Analysis conducted in this assessment based on catch composition statistics provided to the assessors, resulted in many fails.

Until there is more specific information about the specific catch composition rates and the potential extent of species removals from the fishery, the impact of the fishery on marine ecosystems cannot be fully evaluated.

Therefore, this element currently cannot meet the scoring requirement.

References

Mohamed, S. K., 2024. *An ecopath model of the northeastern Arabian Sea (Maharashtra and Gujarat Coasts) with emphasis on small pelagic herbivores,* s.l.: Central Marine Fisheries Research Institute.

E3.3	**E3.1 Information on the potential impacts of the fishery on marine ecosystems is collected.** *In reaching a determination for E3.3, the assessor should consider if the following is in place:*	
	E3.3.1 There are measures applied to the fishery which are designed to manage the impacts of the fishery on marine ecosystems.	Meets
	E3.3.2 The measures are considered likely to prevent the fishery from having a significant negative impact on marine ecosystems.	Meets
Clause outcome		***Pass***

Rationale

E3.3.1 –

The National Policy on Marine Fisheries, 2017, states that the Ecosystem Approach to Fisheries Management (EAFM) will be implemented as part of the policy, "with due consideration to the wellbeing of all living and non-living constituents of the marine ecosystem and the social attributes of stakeholders". This was further upheld in the 2020 National Fisheries Policy and the Indian Marine Fisheries Bill, 2021.

The Indian Marine Fisheries Bill, 2021 outlines that all destructive fishing (the use of dynamite, explosives, poison, noxious chemicals, destructive materials, or destructive methods), and juvenile fishing is prohibited.

In June 2024, a new Ecopath with Ecosim (EwE) software was used to run a model about the Northeastern Arabian Sea (Maharashtra and Gujarat) with emphasis on small pelagic herbivores (Mohamed, 2024). Continuation of this modelling task will be helpful to accurately assess the potential impacts of the fishery in the future.

There was a fishing ban order was implemented in 2021 for all fishing vessels (with the exception of non-motorized units) operating within the Indian EEZ (including the States of Maharashtra and Goa) from 15th April to 14th June (61 days). This fishing ban was also upheld in 2024, for the same duration of 61 days. The ban was ordered to facilitate fish spawning seasons and conserve the marine ecology.

In Goa, the State implements a mechanised fishing ban in areas up to 5km from the sea coast, and there is a mesh size regulation of a minimum of 24mm for fish. The State also requires that mechanised and non-mechanised fishing vessels take appropriate preventative measures to avoid fishing of ETP species. However, the State does not define the measures, nor what would be considered as "appropriate".

There are Monitoring, Control and Surveillance (MCS) requirements for all fisheries operating in Goa and there are sanctions and penalties in place for fishers that violate the rules and regulations. Between 2023-2024, there were a reported 19 cases that were violating rules and regulations.

Therefore, despite the threat of sanctions and penalties, these violations still occur (this information can be found on the FIP profile on MarinTrust).

Therefore, this element currently meets the scoring requirement.

E3.3.2

While the National Fisheries Policy describes the acknowledgement of the Ecosystem Approach to Fisheries Management, there were few specific measures described that related to ecosystems. As mentioned in E2.3.2, the fishing ban is helpful for spawning populations of fish to encourage stock growth. This would also therefore benefit the ecosystem. The other measures, mentioned in E3.3.1, which are forms of capacity controls (time/area/ger limits) also are assumed to be beneficial for the ecosystem, providing this score a pass.

Therefore, this element currently meets the scoring requirement.

References

Draft Indian Marine Fisheries Bill, 2021: Draft_Indian_Marine_Fisheries_Bill_2021.pdf (dof.gov.in)
The Indian Antarctic Act, 2022: ind201321.pdf (fao.org)
Indian oil sardine FIP (Goa and Maharashtra) evidence documents (marin-trust.com)
Mohamed, S. K., 2024. *An ecopath model of the northeastern Arabian Sea (Maharashtra and Gujarat Coasts) with emphasis on small pelagic herbivores,* s.l.: Central Marine Fisheries Research Institute.