Marine Stewardship Council (MSC) Pre-assessment Report

Kerala deep-sea shrimp trawl fishery

On behalf of

Choice Canning Company (on behalf of various shrimp processors)

Prepared by

Control Union Pesca Ltd

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Glossary

Acronym	Definition
AIS	Automatic Identification Systems
BRD	Bycatch Reduction Device
CAB	Conformity Assessment Body
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CMS	(Convention on the) Conservation of Migratory Species (of Wild Animals)
CoC	Chain of Custody
CU Pesca	Control Union Pesca
DAHDF	Department of Animal Husbandry, Dairying and Fisheries
FIP	Fishery Improvement Project
FSI	Fishery Survey of India
KFBOA	Kerala Fishing Boat Operators Association
KMFR(A)	Kerala Marine Fisheries Regulation (Act)
MLS	Minimum legal size
MPEDA	Marine Products Exports Development Authority
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
NGO	Non-Governmental Organisation
NM	Nautical Mile
PI	Performance Indicator
PRI	Point of Recruitment Impairment
PSA	Productivity Susceptibility Analysis
RBF	Risk Based Framework
TED	Turtle Exclusion Device
UNCLOS	United Nations Convention on the Law of the Sea
VME	Vulnerable Marine Ecosystem (vulnerable habitats)
VMS	Vessel Monitoring Systems

1 Executive Summary

This report is an MSC pre-assessment of the Kollam-based deep sea shrimp trawl fishery, based on the following target species:

- *Aristeus alcocki*, Arabian red shrimp
- *Heterocarpus chani*, Thakkali
- *H. woodmasoni*, Thakkali

The assessment team consisted of the following assessors:

Dr Jo Gascoigne – P1 and P2

Dr Jo Gascoigne is a former research lecturer in marine biology at Bangor University, Wales and a shellfisheries and tuna fisheries expert, with over 25 years' experience working in the fisheries sector. In addition to numerous pre-assessments, Jo's experience with MSC fisheries includes the SZLC, HNSFC & CFA Cook Islands EEZ south Pacific albacore longline fishery, the Walker Seafood's Australian Eastern tuna and billfish tuna fishery, Bahamas spiny lobster fishery, North Sea demersal fishery, and Tristan da Cunha rock lobster fishery. Dr Gascoigne has been involved as expert and lead auditor in over 15 MSC pre- and full assessments. Jo has completed the fisheries traceability and risk based framework version 2.0 MSC online training module in 2015. Jo has no conflict of interest for this assessment.

Kat Collinson - Team Leader, P3 and traceability

Kat Collinson has a Master's degree from King's College University London, in Aquatic Resource Management. She has worked on a number of MSC pre- and full assessments including Walker Seafood yellowfin, albacore and swordfish longline fishery, DPPO & DFPO North Sea herring trawl fishery, Ben Tre hand-raked clam fishery, American Samoa yellowfin and albacore longline fishery and Bahamas spiny lobster full assessments. Kat has also been involved fishery improvements projects (FIPs) with WWF. She is a fully trained to version FCP v2.1 MSC fishery team leader with additional training in traceability and the RBF, ISO lead auditor and MSC/ASC Chain of Custody auditor. Kat has no conflict of interest for this assessment.

Site visit

A site visit was conducted in Kochi and Kollam, in the Indian State of Kerala between the 27th and 29th November 2018. The team first travelled to Kochi, where the opening meeting was held with the fishery stakeholders, namely the client group and Central Marine Fisheries Research Institute (CMFRI). The team also visited Mangala Marine Exports in Kochi to witness the deep-sea shrimp processing process. The fishery landing sites in Kollam was also visited to gain a picture of operations, species interacting in the fishery and traceability.

Fundamental information regarding the stocks and their management was collected whilst on site, and the team would like to sincerely thank Dr Sunil Mohammed and the members of staff at CMFRI for their time and effort in aiding the team with their enquiries.

The conclusions of the pre-assessment are summarised as follows:

Principle 1 - Data on landings from the fishery are good, as are biological data for the proposed target species. The stock status for the *Heterocarpus* species was evaluated based on preliminary

CMFRI stock assessment work, and for *Aristeus alcocki* based on Chakraborty et al. (2018) as well as using the RBF (a PSA); in both cases the outcome was a conditional pass / medium risk. The harvest strategy is based on control of effort and management of selectivity (gear technical measures and minimum sizes), as well as zoning (no mechanised trawling inshore) and a closed season. This approach makes sense for a mixed fishery but is not able to respond easily to changes in stock status for the individual target stocks.

Principle 2 – Landings from the fishery are diverse; a range of 'main' bycatch species were defined – including other shrimp species (some also target species of the fishery), fish and cephalopods (target species of the wider mixed-species trawl fishery). Main bycatch species were also evaluated using a PSA; all were 'medium risk'. The management strategy for bycatch species is the same as for target species and has the same issue; i.e. difficulty in responding to the status of individual stocks. There is no evidence that the fishery impacts ETP species or VMEs (sensitive habitats) but more information is needed to confirm this. For ecosystem impacts, by contrast, there is a range of information available.

Principle 3 – Overall, the fishery has strong management capabilities in place. Traditional fishing rights and culture are robustly protected and the roles and responsibilities of entities involved in the management of the fishery are clear and detailed. There are consultation processes in place to assert change in the fishery, but mechanisms for co-operation with other parties are not formally organised. The fishery has various compliance mechanisms implemented, including patrol vessels and fishery department compliance officers, but the team would need further investigation into the potential levels of non-compliance in the fishery and its management system performance. The fishery under assessment does not have any fishery specific management plans or objectives in place, which are some of the precluding reasons that the fishery is not yet meeting the MSC fisheries standard.

Traceability – There are fundamental difficulties with traceability in the fishery. Logsheets are not completed in the fishery; there are no observers and no forms of vessel tracking such as VMS or AIS (although the amended Kerala Marine Fisheries Regulation Act (2017) stipulates that all mechanised vessels should carry AIS by 30th November 2019). This makes verification of catch location impossible. Whilst vessels from Kerala do not typically fish out of state, there is no way of confirming this when catch is landed at landing centres.

Traceability after landing is further complicated, with auctions and traders adding complexity to the path of the product throughout the supply chain. Improvements to species and sales recording systems need to be put in place to ensure the integrity of the supply chain is maintained. Whilst some members of the client group have separate MSC Chain of Custody (CoC) for their processing facilities, CoC may be required at an earlier stage if traceability systems cannot be proved to be robust prior to the first change of ownership. These issues need to be further explored during the approaching Fishery Improvement Project (FIP).

Strengths of the fishery include:

- A robust system for monitoring landings, despite the scale and diversity of the fishery;
- A strong base of information is available on the biology of key species and the dynamics of the ecosystem;
- A management system which is able to control effort so that it should not increase significantly over current levels;
- Expertise and capacity for a range of stock assessment methodologies;

- Low levels of non-shrimp bycatch, relative to most shrimp trawl fisheries;
- Strong protection of traditional fisher rights;
- Generally good governance and policy, including clear and transparent processes to address disputes in the fishery;
- Explicitly defined role, responsibilities and function of those organisation involved in the management of the fishery;
- Strong structures for stakeholder input and consultation.

Weaknesses include:

- A lack of systematic, robust monitoring of stock status for target and main bycatch species;
- It is difficult for the harvest strategy to respond to individual stock status, for target, main bycatch or ETP species;
- Limited information on the fishery impact on habitats, including VMEs;
- Lack of fishery specific objectives;
- Incomplete traceability system, including lack of vessel location devices to aid traceability but more importantly compliance and IUU that may occur in the fishery.
- Unclear management evaluation processes.

The scoring of the individual PIs is summarised in Table 14 and detailed in Appendix 1. A range of improvements is needed for the fishery to meet the minimum standard required for MSC certification. An approach to addressing these gaps is set out in Part 2 of this document (FIP Scoping).

2 Introduction

2.1 Aims/scope of pre-assessment

This report presents the results of a pre-assessment study for Marine Stewardship Council (MSC) certification of the Kollam-based deep sea shrimp trawl fishery, targeting *Aristeus alcocki* (Arabian red shrimp), *Heterocarpus chani* and *H.woodmasoni* (Thakkali/nylon shrimp). The pre-assessment was carried out by Dr Jo Gascoigne and Kat Collinson on behalf of Control Union Pesca (CU Pesca). The client group consists of processing companies, headed by Choice Canning Company, who represent the group. A description of the fishery is provided in Section 3.2.

The pre-assessment was conducted in accordance with the MSC Fisheries Certification Requirements version 2.0 and pre-assessment reporting template version 2.1.

The purpose of this report is threefold:

- To assess whether MSC certification of this fishery can be achieved under the present circumstances;
- To identify any obstacles to MSC certification;
- To assist both the Client and Conformity Assessment Body (CAB) in planning for an eventual full assessment.

It should be noted that this report represents the views of the CUP pre-assessment team, not those of a Full MSC Assessment Team, which is subject to approval by the MSC and stakeholders. A Full MSC Assessment is a completely independent process, and involves a formal public and stakeholder consultation process. A pre-assessment provides a provisional assessment of a fishery based on a limited set of information provided by the client. Therefore, the outcome of a full assessment cannot be guaranteed to be the same as that foreseen in this report. In any case, the purpose of this pre-assessment is to inform the development of a Fisheries Improvement Project (FIP).

2.2 Constraints to the pre-assessment of the fishery

There were no significant constraints to the pre-assessment, although full information has not been gathered in all areas; however, sufficient information was gathered to inform the FIP.

2.3 The MSC programme

The three MSC Principles are further explained below:

Principle 1: A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted; the fishery must be conducted in a manner that demonstrably leads to their recovery.

Principle 2: Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

Principle 3: The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Each Principle comprises a number of "Components" which are each divided into performance indicators (PIs), listed in Annex 1. Each PI is scored for every separate Unit of Certification along three scoring guideposts (SGs): SG60, SG80 and SG100. SG60 represents the minimum standard for certification in the short term, but with a requirement to improve to the 80 level. SG80 represents the minimum long-term acceptable level for certification, while SG100 represents the ideal.

A pre-assessment study does not attempt to predict scores at a high level of detail; it attempts instead to assign scores to a category associated with a traffic light system:

Information suggests fishery is not likely to reach SG60 and therefore would fail on this PI	**<60**
Information suggests fishery will reach SG60 but may need a condition for this PI	**60-79**
Information suggests fishery is likely to exceed SG80 resulting in an unconditional pass for this PI	**≥80**

In order to pass an assessment, a fishery must:

- Have no single score below 60
- Have an average score of at least 80 for each of the three Principles.

Any score <60 identified during the pre-assessment would lead to a pre-condition, i.e. an issue that needs to be resolved before MSC certification can be attempted. Any score of 60-80 would lead to a condition, i.e. a successful certification but with requirements for the fishery to improve to the SG80 level within a specified timeframe. In practice, very few fisheries pass with no conditions.

2.3.1 Full assessment process

The full MSC assessment is a multiple-step process to determine whether a fishery meets the MSC standard. CU Pesca and its expert assessment team would lead the process. It involves consulting with stakeholders, scoring the fishery against a set of performance indicators and scoring guideposts, identifying ways that the fishery can strengthen its performance (if needed), peer review and making a final determination about whether the fishery meets the MSC standard. This is an intensive process that calls for a high level of information to be provided by the fishery and others and also calls for a significant level of involvement by the fishery client.

The following steps form the MSC full assessment process (as per Version 2.0 of the Fisheries Certification Requirements):

- Confirmation of scope (determining the fishery is eligible for MSC assessment and confirming the units of assessment (UoA) and units of certification (UoC) to be put forward for assessment);
- Agreement of contract;
- Return of the **Client Document Checklist,** as completed by the client;
- Announcement of Fishery Assessment. Here the fishery is announced as going forward for assessment. At the same time the CAB is required to:
- Provide the names and CVs of the assessment team;
- Announce the use of the default assessment tree (if to be used) and application of Risk-Based Framework (RBF), where necessary;
- Announce the date and location of the proposed site visit(s);

- Submit to the MSC, the **MSC Notification Report Form** (outlining the fishery details);
- Submit to the MSC the returned **Client Document Checklist;**
- Allow for a period of at least thirty (30) days before the site visit;
- Site visit, to include stakeholder meetings and data gathering;
- Scoring of the performance indicators and drafting of the **Client Draft Report;**
- Review of **Client Draft Report** by client (maximum 30 calendar days);
- Preparation of Client Action Plan by client, if required;
- Drafting of Peer Review Draft Report;
- Selection and approval of peer reviewers from the MSC Peer Review College;
- Peer review of Peer Review Draft Report;
- Incorporation of Peer review comments, as required, and subsequent production of **Public Comment Draft Report;**
- Publication of **Public Comment Draft Report** on MSC website and its review by stakeholders and MSC (30 calendar days);
- Response to stakeholder comments; revision of report as required;
- Certification determination and publication of the **Final Report;**
- Stakeholders given opportunity to object to the certification determination (15 working days);
- Objection procedure and consultation with stakeholders, if necessary;
- Certification and publication of **Public Certification Report** – assuming a successful certification outcome.

A certificate lasts for five years from date of issue, during which time it is subject to annual surveillance audits to ensure continuing compliance with all MSC Certification Requirements and to evaluate progress against any conditions of certification. These surveillance audits will vary between the requirement for a full on-site audit, off-site audit or review of information, dependent on the risk as assessed during the previous audit by the CAB.

When the certificate is due to expire, a reassessment against the MSC Certification Requirements is required to ensure on-going certification beyond the original certificate expiry date. This reassessment may constitute a full reassessment (same process as followed for initial certification) or a reduced reassessment. The reduced reassessment allows for fisheries which meet set criteria to have a 'reduced ' audit with only one team member required to go on-site during the process and only one peer reviewer required to review the reassessment peer review report.

Prior to applying for full assessment for any of the UoAs within this assessment, the client should:

- Inform CU Pesca of any actions undertaken following this pre-assessment to address the conclusion of this report;
- Report on any new issues that may be a barrier to certification;
- Report on any communications that may need to take place with management agencies, environment groups, post-harvest sectors, relevant commercial and non- commercial fishing

groups to explain the MSC assessment process and the implications (including costs and benefits) of certification;

- Ensure the completion of the Client Document Checklist, identifying the type and extent of data and information available for a full assessment;
- Indicate whether the client would like to receive the optional MSC training material on the fishery assessment process for clients.

2.4 Units of certification

Note on MSC vocabulary: Unit of Certification (UoC) vs. Unit of Assessment (UoA)

The UoA is defined as consisting of the target stock(s), fishing method or gear type(s), vessel type(s) and/or practices, fishing fleets or groups of vessels, or individual fishing operators pursuing that stock, including any other eligible fishers that are outside the unit of certification.

The UoC is defined as consisting of the target stock(s), fishing method or gear type(s), vessel type(s) and/or practices, fishing fleets or groups of vessels, or individual fishing operators pursuing that stock including those client group members initially intended to be covered by the certificate.

In summary, the UoA = UoC + any other eligible fishers identified at the start of assessment.

The purpose of this pre-assessment is to inform the development of a FIP, so it is only necessary to define initial Units of Assessment at present. Units of Assessment can be reviewed, changed, added or removed during the course of the FIP. The final Unit(s) of Assessment and Certification can be determined at the end of the FIP when the fishery is ready to move to full assessment.

A note on eligible fishers – the client group are not the fishery operators. They purchase product from the fishery, so the assessment is not conventionally structured. At this stage, fishery product being legally landed, then bought and sold through the client group would be eligible to carry the MSC ecolabel upon certification. The terms and conditions of those transactions between the client group and fishery are yet to be determined, but will need to ensure continued compliance with the MSC fishery requirements.

Based on the information available, the assessment team proposes the following initial UoAs as set out below. Each UoA is based on species and gear combination. As noted above, UoAs can be adjusted, added or removed over the course of the FIP. See also further information in Section 3.3.1.

Table 1. UoA 1 – *Aristeus alcocki*

Species	*Aristeus alcocki* (Arabian red shrimp)
Geographical range	Kerala coast (mainly off Quilon Bank)
Method of capture	Demersal trawl
Vessels	Mechanised vessels
Stock	Kerala (see Section 3.3.4 on stock definitions below)
Management Systems	Government of Kerala

Table 2. UoA 2 – *Heterocarpus chani*

Species	*Heterocarpus chani* (known locally as 'Thakkali')
Geographical range	Kerala coast (mainly off Quilon Bank)
Method of capture	Demersal trawl
Vessels	Mechanised vessels
Stock	Kerala (see Section 3.3.4 on stock definitions below)
Management Systems	Government of Kerala

Table 3. UoA 3 – *Heterocarpus woodmasoni*

Species	*Heterocarpus woodmasoni* (known locally as 'Thakkali')
Geographical range	Kerala coast (mainly off Quilon Bank)
Method of capture	Demersal trawl
Vessels	Mechanised vessels
Stock	Kerala (see Section 3.3.4 on stock definitions below)
Management Systems	Government of Kerala

2.5 Total Allowable Catch (TAC) and Catch Data

There are no TACs in the fishery for any of the target species. Target species catch is summarised below (Table 4). Full catch data for the fishery (2018) are given in [redacted] below.

Table 4. Catch of target species 2015-17 from Kollam region (including Sakthikulangara and Neendakara regions) and for all of Kerala (tonnes)

	Kollam Bank (main area)			**All of Kerala**		
	A. alcocki	***H. chani***	***H. woodmasoni***	***A. alcocki***	***H. chani***	***H. woodmasoni***
2015	1205	1555	530	1507	1739	556
2016	746	1158	467	902	1386	524
2017	1821	1244	149	2039	1514	175

3 Description of the fishery

3.1 Scope of the fishery in relation to the MSC programme (optional)

CU Pesca confirms that the fishery under assessment is within the scope of the MSC Fisheries Standard (7.4 of the MSC Certification Requirements v2.0):

- The target species is not an amphibian, reptile, bird or mammal;
- The fishery does not use poisons or explosives;
- The fishery is not conducted under a controversial unilateral exemption to an international agreement;

- The client or client group does not include an entity that has been successfully prosecuted for a forced labour violation in the last two years;
- The fishery has in place a mechanism for resolving disputes, and disputes do not overwhelm the fishery;
- The fishery is not an enhanced fishery as per the MSC FCR 7.4.3; and
- The fishery is not an introduced species-based fishery (ISBF) as per the MSC FCR 7.4.4.

The report should include a statement of the CAB's determination that the fishery is within scope of the MSC certification sought.

3.2 Overview of the fishery

The fishery under assessment is a multi-species deep-sea trawl fishery for mechanised vessels. Catch is bought from the auction by the client group. The potential for deep-sea shrimp resources was identified in the mid to late 1980s, however the exploitation of the resource did not begin until around 2000 (Dr. Rehkadevi Chakraborty, CMFRI, pers. comm.).

3.2.1 Operation of the fishery

The fishery operates in the waters off Kerala's coast, an area of high productivity and diversity. Out of the 1097 marine species recorded in Indian fishery landings, 781 have been reported in Kerala between 2007 and 2016 (Zacharia et al., 2011; Dr. Sunil Mohamed, CMFRI, pers. comm.). This particular fishery mainly operates in an area called Kollam Bank. 80% of deep-sea shrimp caught in Kerala are captured here (Dr. Rehka Devi Chakraborty, CMFRI, pers.comm.).

The fishery is a mixed trawl fishery, with each vessel carrying six or seven types of trawl gear, including bottom, midwater and pelagic trawls. Each vessel may catch 200 – 250kg of shrimp per tow. The target *Heterocarpus* shrimp are caught in around 200-300 metres depth, with *Aristeus alcocki* mainly taken at 250-300m. Other deep-sea shrimp are also landed in the fishery, with for example *Solenocera hextii* being significant in the catch from ~150 metres. Small amounts of cephalopods and deep-sea shark species are also landed by the same boats.

There are 700 – 750 boats operated from Sakthikulangra, and less than 50 from Vypin, 20% of which go fishing for deep-sea shrimp. Trips last between four and ten days, landing their catch in the early mornings in Kollam, which is the nearest landing site to the fishing grounds. A single vessel may do two to three hauls a day, with a towing duration of two to three hours. The fishing season is between September to May, with peak fishing in November to January. The SW monsoon brings bad weather to the coast of Kerala, which can prevent the fishery from starting until mid-September in some cases, as it take two to three days steaming to reach the fishing grounds (Dr. Rehka Devi Chakraborty, CMFRI, pers. comm.). As with other mechanised trawl fisheries, the deep-sea fishery is subject to a ban during the monsoon period, which is discussed in Section 3.2.2 below. Figure 4 shows some gear in use at Kollam during the site visit.

3.2.2 Trends in landings

Landings of deep-sea shrimp (all species) have fluctuated over time but overall the trend over the last decade is stable, as is the trend in catch-per-unit-effort (CPUE) (Figure 1). The deep-sea shrimp catch is made up of eight principle species, including both penaeid and non-penaeid shrimp species. Key penaeid species are *Metapenaeopsis andamanensis* (24%) and *A. alcocki* (22%), and key non-penaeid species are *Plesionika quasigrandis* (23%), *H. chani* (16%) and *H. woodmasoni* (12%); other

species making a smaller contribution to the catch include *Penaeopsis jerryi* (0.8%), *Solenocera hextii* (0.1%) (both penaeids) and *Plesionika semilaevis* (1.2%) (non-penaeid) (annual average percentages) (Figure 2).

A catch breakdown over time was only provided for *H. chani* and *H. woodmasoni*, showing that trends are likely to vary between species, and hence the proportion of different species making up the catch will also be variable from year to year.

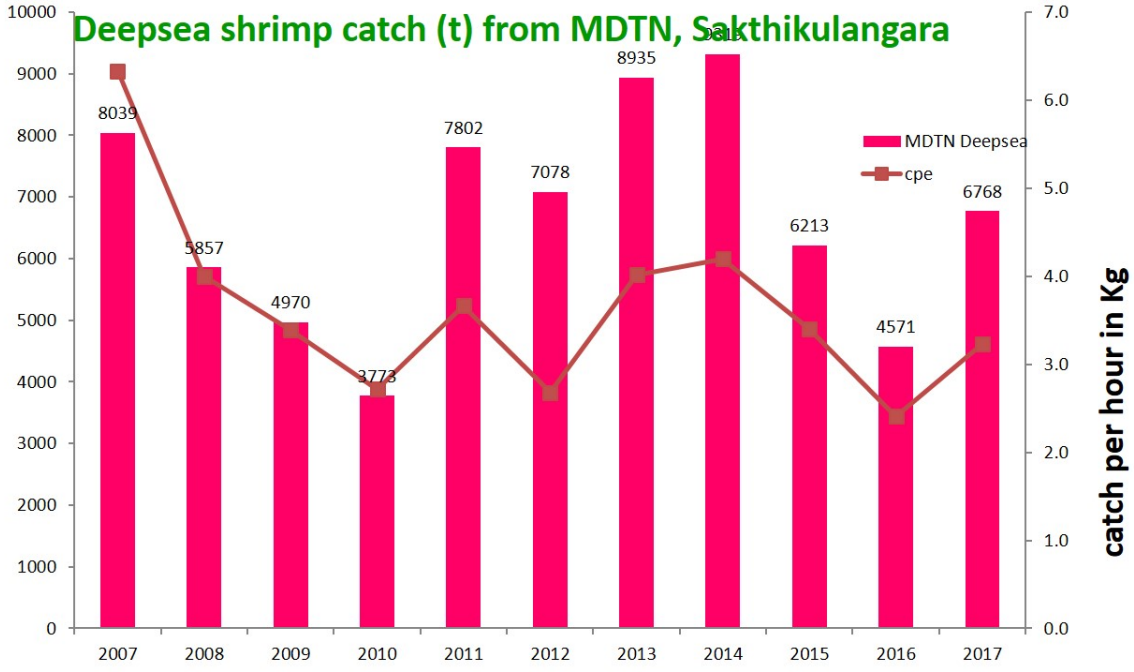

Figure 1. Trends in deep-sea shrimp landings (t) from the key landing site (columns) and trends in CPUE (kg per hour; line), from fortnightly CMFRI sampling; 2007-2017 (figure provided by CMFRI)

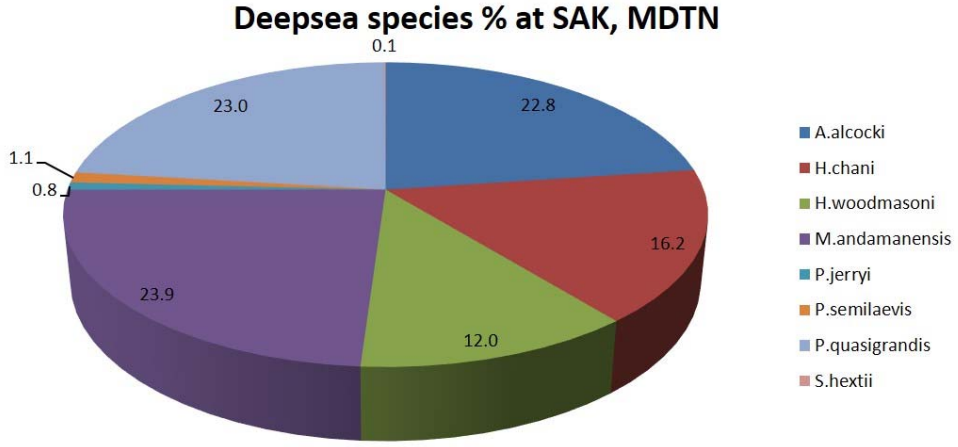

Figure 2. Proportion of different deep-sea shrimp species in the landings at Sakthikulangra (average annual percentages, 2007-2017 (figure provided by CMFRI)

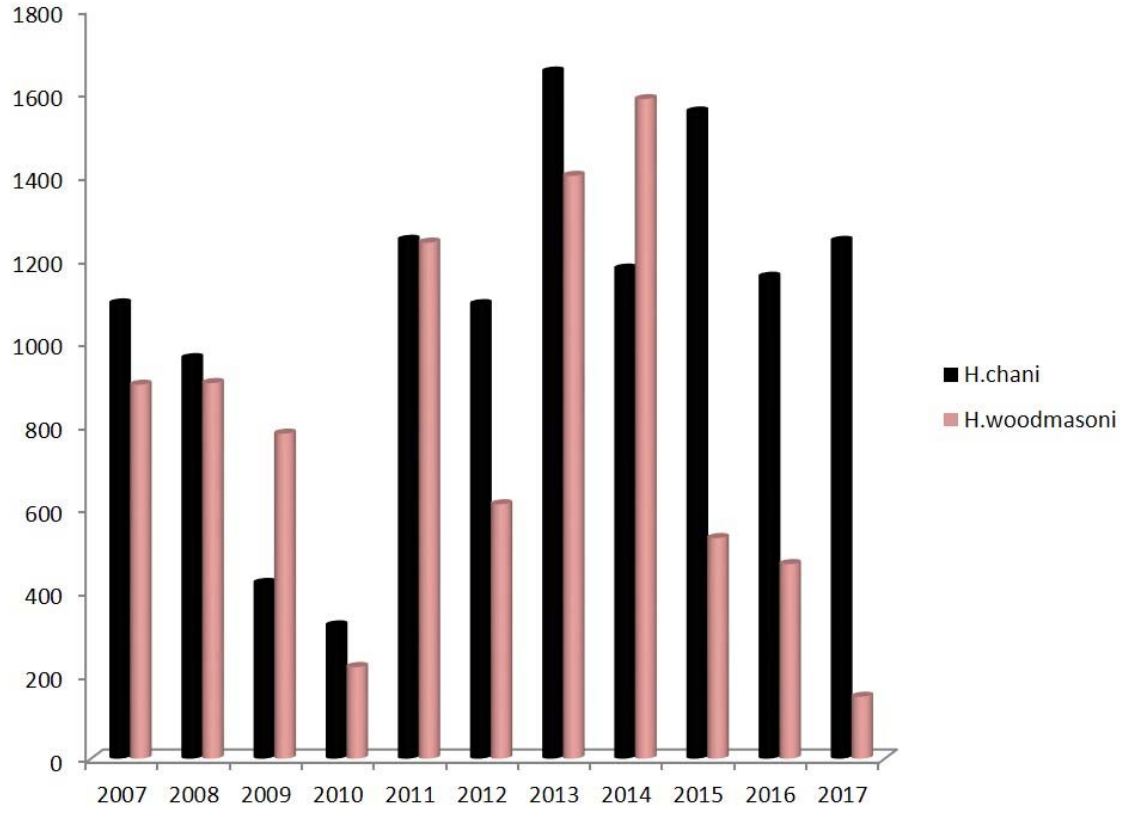

Figure 3. Trends in landings of the two *Heterocarpus* species (t), 2007-2017 (Figure provided by CMFRI)

3.2.3 Management

The fishery is managed by the Department of Fisheries, Government of Kerala. Waters in India are managed by state up to 12 nautical miles (nm) from shore. Beyond 12nm, the jurisdiction falls under the central government. The main piece of legislation that governs the fishery is the Kerala Marine Fisheries Regulation Act (2017). This is implemented at the state level and discussed further in Section 3.5. For scientific purposes, the coast is also divided into regions: Kerala, Karnataka and Goa make up the southwest region.

There has been a trawling ban for mechanised vessels in place during the southwest monsoon season since 1985. Motorised (outboard) and non-motorised boats are not included in this ban. Originally trawling was prohibited between 15th June to July 31st, but this year this was extended and the ban commenced on the 10th June. The increase is due to the request from the central government to bring the ban up to 61 days in total. At this time, the harbours are closed, and boats cannot leave. The ban is enforced by the state fisheries department and police.

There are also trawl cod-end mesh size restrictions in place, which have recent changed for the shrimp trawl from 35 mm diamond mesh to 25mm square mesh. There is no mechanised trawling shallower than 15 fathoms north of Kollam and 10 fathoms south of Kollam (the main purpose of this regulation being to avoid conflict with traditional fishers). Minimum sizes (MLS) are defined for some of the species in the fishery, including *A. alcocki* at 13cm total length, corresponding to the estimated size at 50% maturity (Kerala Gazette, 17 May 2017), and for some of the bycatch species, but not for *Heterocarpus chani* nor *H. woodmasoni*.

Figure 4. The trawl net from the cod end (notice the small square mesh underneath the green diamond mesh), the middle and mouth of the net (source: photographs taken by the author)

3.2.4 Landings

2018 landings from the deep-sea trawl fishery, from CMFRI's database, are given in [redacted], with target species for this assessment in bold. Note that *H. chani* does not appear separately in the landings data; only under '*Heterocarpus* spp.' or misidentified as *H. gibbosus* (Yang et al., 2017). There are almost 30 known species in the genus *Heterocarpus*, at least eight of which may occur in Keralan waters according to SeaLifeBase. Furthermore, *Plesionika* is a closely related genus (e.g. *Heterocarpus laevis* has been reclassified into *Plesionika*) and contains almost 80 species. For many species in both genera, the geographical distribution and biology is poorly known. This means that there are issues of species identification in this fishery, which inevitably results in problems for the quality of data and stock assessments, despite the biological expertise of CMFRI scientists (see for example Rajool Shanis et al., 2014).

[redacted]

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3.3 Principle One: Target species background

3.3.1 Defining Principle 1 species

Prior to the site visit, there was some discussion about which species should be defined as the target species for the purposes of the pre-assessment and FIP; i.e. which should be included in Principle 1. During the site visit, it was requested that the two *Heterocarpus* species be considered as target species, being important species in the fishery and also because some significant stock assessment work has been done for these species (see below). However, it was also understood at the site visit that the most valuable species in the fishery (and the only one separated on board) is *A. alcocki*. Noting that it can be complicated and expensive to extend the scope of a 'comprehensive' FIP under the rules put in place by FisheryProgress[1], CU Pesca took the decision to include *A. alcocki* as a target species as well as the two *Heterocarpus* species, in order to keep options open for the FIP.

3.3.2 Key LTL requirements

MSC has stricter requirements under Principle 1 for 'key low trophic level' (key LTL) species – that is, species which are considered to play a key role in the ecosystem as forage species for higher trophic levels. They provide a default list of taxa which should be evaluated against these criteria (MSC Fisheries Certification Requirements (FCR) Box SA1) – this list does not include shrimp. Otherwise, the majority of the following requirements should be met:

- A large proportion of trophic connections in the ecosystem involve this stock;
- A large proportion of the energetic flux in the ecosystem passes through this stock;
- There are few other species in the ecosystem at the same trophic level;
- It feeds mainly on plankton; has small body size, early maturity, high fecundity; and forms dense schools.

The shrimp species considered here meet a few of these criteria but not most of them. They have small body size and a rapid population turnover. They may form shoals at times (e.g. during mating) but are not generally schooling species. The shrimp species are omnivores/detritivores. The ecosystem is highly diverse at all trophic levels (781 species recorded in fishery landing in the SW region; 137 species recorded at Kochi fisheries harbour in 2016; CMFRI, 2017). CMFRI has undertaken some ecosystem modelling (see Section 3.4.8), none of which have highlighted the role of these stocks; it would seem that in (parts of) this ecosystem the 'key LTL' role is more likely played by the Indian oil sardine. On this basis, none of these species are considered to meet the MSC definition of 'key LTL' stocks.

[redacted]

3.3.3 Biology of the target species

Information is available on the biology of the target species, including reproduction, size at maturity, fecundity (see e.g. Paramasivam et al., 2018); and age, growth and natural and fishing mortality (e.g. Chakraborty et al., 2018), as well as information on habitat, depth range and taxonomic keys (see e.g. Chakraborty (undated)).

3.3.4 Defining stocks or management units

In common with many (most?) invertebrate fishery species, it is not known exactly what constitutes a 'stock' for the three target species. *H. woodmasoni*, for example, is distributed in the Indo-West Pacific, potentially as far as New Zealand, but within this area, the boundaries between stocks (populations) is not known. The short lifespan and demersal habit of the species mean that it is not likely that there is direct gene flow between widely spaced areas, even where the population is continuous – and even less likely that there is any linkage in terms of population dynamics, which is the important point as far as fisheries management is concerned. Most likely, there is a gradual reduction in connectivity with distance, but no objective means of defining clear stock boundaries[2]. The same analysis applies to *H. chani*. The population structure of *A. alcocki* in southern India has, however, been investigated by CMFRI, using morphometrics, with some indication that the Kerala population may be somewhat separate from populations further south and south-east (Chakraborty et al., 2018).

MSC requires that a 'stock' be defined as part of the Unit of Assessment; i.e. for MSC purposes, some kind of boundary must be defined somehow. For *A. alcocki*, there is some biological basis for defining Kerala as a suitable management unit, but for the other species there is no information. The best solution for these species seems to be to base the 'stock' on the management unit; i.e. also Kerala. This is also informed by CMFRI (2018) which suggests that the deep-sea shrimp fishery is focused on Kerala, and is not significant in the neighbouring states (Karnataka, Tamil Nadu).

3.3.5 Information

Landings data: The monitoring of landings is subject to a range of constraints in India and Kerala: there is a very large number of vessels, trips and landing sites and a high diversity of both gears and target species. It is impractical for fishers to complete logsheets, so monitoring of catch (landings) is done by enumerators at landing sites. CMFRI is justly proud of its system for collecting landings data, which across India takes about half a million enumerator-hours a year, leaving aside the time spent entering, checking, correcting, storing and analysing the data.

The sampling system is designed on the basis of stratified random sampling (Stratified Multistage Random Sampling Design; Srinath et al. 2005). The coast is divided into 'fishing zones' which may comprise one large landing centre (e.g. Kochi, Kollam) or several smaller ones; fishing zones are in turn nested within states (Kerala) and regions (SW). Sampling is also stratified by vessel and gear type, and sampling frequency is based on the number of vessels but also the observed variability in fishing intensity and landings. Data collected by enumerators includes: catch by species, effort, type of vessel and gear, fishing grounds and sometimes other information including environmental information (Srinath et al. 2005; Dr TV Sathianandan, pers. comm.). Catch has been reported by species since 2007 (although this remains a bit problematic for deep-sea shrimp – see above); but

[redacted]

enumerators receive training in species identification (CMFRI, 2017), and there are quality checks by CMFRI scientific staff, who also provide the enumerators with monthly workplans based on the sampling strategy.

Effort data: In addition to the above, there is a Marine Fishery Census across India approximately every 5 years, which attempts to quantify the number of fishers, fishing-dependent households, vessels, gears etc. The most recent was carried out in 2016, but does not yet seem to be available; the most recent publically-available is from 2010 (CMFRI, 2010). Reportedly, the 2016 census shows that there are more than half a million people in Kerala dependent on fishing (CMFRI, 2017).

Discard data: Discarding may happen but is rare for the species considered under Principle 1 which are high value. More information on discarding and discard data is given under Principle 2 below.

Data handling and analysis: Data are provided monthly by each enumerator to CMFRI's National Marine Fisheries Data Centre in Kochi, which maintains a database of catch data, and provide an online service of catch and price data ('FishWatch'). The database is available to CMFRI staff for their analyses, as well as to other stakeholders (by agreement). A second database ('BioBase') includes biological and environmental data. CMFRI has completed the development of a web/tablet based interface for direct entry of data from landing sites (CMFRI, 2017), which is being rolled out starting in July 2018.

3.3.6 Stock assessment – *Heterocarpus* species

CMFRI have a range of stock assessment methodologies which they are able to apply to target species or species groups, although as far as we could tell, this is not done systematically (e.g. annually) for all techniques and all species (although it could be). At the site visit, CMFRI presented the methodology and results for a range of different stock assessment techniques, as applied to *H. chani* and *H. woodmasoni*, noting that these analyses are preliminary for the moment.

3.3.6.1 Rapid stock status

First of all, CMFRI have a methodology called 'rapid stock status', which is applied systematically to key groups of species (e.g. as presented in the CMFRI annual reports; see CMFRI 2017 and CMFRI 2018). This compares the average catch over the latest three years to the historical maximum catch and classifies stock as follows:

- abundant (recent 3-year average > 70% of historical maximum);
- less abundant (50-70%);
- declining (10-50%);
- depleted (5-10%);
- collapsed (<5%)

Obviously this does not take account of socio-economic factors; e.g. if fishermen switch target species because of market factors; nevertheless it gives (as the name suggests) a quick idea of stock which might be in trouble, where scientific attention could then be focused.

Often this analysis is done for groups of species (e.g. in this case non-penaeid shrimps) but for the two target species it has been done individually. *H. chani* is 'abundant' by this metric, while *H. woodmasoni* is 'declining'; it is clear from Figure 3 above that landings of *H. woodmasoni* have been relatively low in recent years, although it is not known, of course, to what extent this is driven by changes in stock status vs. fishery operation vs. environmental conditions.

3.3.6.2 Length-based analysis

CMFRI have also evaluated trends in observed size, including minimum length observed in landings (Lr; mid-point of smallest size class in landings) and mean length and length range in landings; and used these as the basis for an analysis of stock status by various means, e.g. by estimating the probability of capture at various sizes, and by estimating the optimum mean size in the fishery.

For *H. chani*, there are no particular trends in catch-at-size, except that Lr for females appears to have declined since 2010. For *H. woodmasoni*, trends are likewise unclear; mean size was somewhat lower in 2015-17 than previously, although more so for females than males. It is clear that the fishery is tending to exploit both species starting well below the size at maturity (Lm – size at 50% maturity), the only exception being males of *H. woodmasoni* ([redacted]).

CMFRI have also estimated the cumulative probability of capture for individuals of a given size; by the time *H. chani* individuals reach Lm, they have approximately a 25% probability of capture by the fishery (somewhat more for females and somewhat less for males), but for individuals at Lm for *H. woodmasoni*, the estimated probability of capture is much lower ([redacted]).

CMFRI have also used a VPA (see below) to estimate the optimum mean length in the landings (mean length at maximum yield); this can be compared to the actual mean and median[3] size in the landings. The fishery for both species appears to be operating at somewhat below the optimum ([redacted]).

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Survey data also suggest that the largest size class may not be represented in the landings (i.e. is not taken by the fishery); a research cruise observed the maximum size of individuals of *H. woodmasoni* significantly larger than that observed in landings (177mm vs. 128mm for females, 150 mm vs. 130 mm for males).

[redacted]

3.3.6.3 Estimate of 'E' using VPA

E (F/Z – fishing mortality as a proportion of total mortality[4]) is a parameter which is commonly estimated for species such as small pelagics where formal stock assessments are difficult. For small pelagic fish species, an empirical analysis across a wide range of stocks led to the conclusion that E=0.4 could be a suitable reference point (Patterson, 1992); i.e. F should ideally not exceed 2/3M (whether and how this analysis should apply to shrimp is not known by the authors).

E can be estimated using a VPA[5], which (in summary) uses the proportion of individuals in different age classes to estimate Z and uses catch data to partition Z into F and M. There are a range of difficulties in doing this; e.g. the size-composition of landings may not reflect those of the population (as noted above; although survey data may be more reliable) and converting size to age is not always easy, although for these species, CMFRI has information about growth rates. Alongside E, it is possible to estimate a range of other parameter values: e.g. U (exploitation rate; the proportion of the total biomass removed by fishing for a given value of F); and (with some additional data / assumptions about the stock-recruit (SR) relationship), Emax (the value of E giving the highest yield-per-recruit for the fishery). Fishing a stock at Emax is, however, not recommended to be precautionary as SR relationships are usually not known and recruitment is naturally variable.

CMFRI have estimated E for *H. chani* at ~0.5 for both sexes, from landings (2010-2017) plus biological data. For *H. woodmasoni*, they estimate E to be higher, at 0.77 for females and 0.68 for males from landings data and 0.9 for females and 0.84 for males using survey data. This means that they estimate that F~=M for *H. chani* and F>M for *H. woodmasoni*.

For *H. chani*, the current level of F is estimated to result in an exploitation rate of 69% for females and 58% for males; i.e. 31% and 42% of the unfished level. Spawner biomass is estimated to be at ~22% of the unfished level. To reduce the exploitation rate of females to 50% requires a reduction in F to E=~0.4 (0.38). Emax is estimated for *H. chani* (females and males) at ~0.8.

For *H. woodmasoni*, the current level of F (as estimated from the fishery data) is estimated to result in an exploitation rate of 68% for females and 77% for males; i.e. 32% and 23% of the unfished level. Spawner biomass is estimated at 45% of the unfished level, which estimate is not consistent with the estimate of exploitation rate based on total biomass (which should be higher); but since the estimate use different techniques and these stock assessments are preliminary, this is not particularly surprising. Estimates from the survey result in higher estimates of exploitation rate (89% for females and 83% for males). To reduce exploitation rate of females to 50% requires a reduction in F, again to E=~0.4 (0.45 from fishery data and 0.43 from survey data). Emax is estimated for *H. woodmasoni* females at 0.93 from the survey data and approaching 1 from the fisheries data; for males 0.72 and approaching 1[6].

[redacted]

Estimated values of E, Emax, exploitation rate and spawner biomass depletion for each species are summarised in Table 7.

Table 7. Estimated parameter values from the preliminary VPA stock assessment (explained in the text); data from CMFRI

Parameter	Sex	*H. chani* (fishery data)	*H. woodmasoni* (fishery data)	*H. woodmasoni* (survey data)
$E_{current}$ (fishery data 2010-17 for *H. chani*; 2011-17 for *H. woodmasoni*)	Female	0.50	0.77	0.90
	Male	0.51	0.68	0.84
Exploitation rate (U; % removed by fishing) at $E_{current}$	Female	69%	68%	89%
	Male	58%	77%	83%
E_{max}	Female	0.80	~1.0	0.93
	Male	0.81	~1.0	0.72
E at biomass depletion of 50%	Female	0.38	0.45	0.43
	Male	0.38	0.46	0.38
E at biomass depletion of 90%	Female	0.71	~1.0	0.85
	Male	0.71	~1.0	0.93
SB / SB_0	Both	22 %	45 %	-

3.3.7 Stock status – *Heterocarpus* species

The above section summarising the range of stock assessment techniques applied by CMFRI is complex and hence (potentially) a bit confusing, hence here we summarise the conclusions regarding stock status for the two *Heterocarpus* species.

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3.3.8 Stock status – *Aristeus alcocki*

A. alcocki was included into this assessment at the last minute, and CMFRI has not had the opportunity to present an analysis for this species as per the analyses for *H. chani* and *H. woodmasoni* presented above. A Rapid Stock Status assessment is presented in CMFRI (2018) for Kerala penaeid shrimps (considered 'less abundant'); but since the shallow-water shrimp fishery is dominated by these species, it is not likely to be particularly relevant to stocks of *A. alcocki*

specifically. *A. alcocki* was evaluated individually using rapid stock assessment by CMFRI in 2017; the categorisation was 'less abundant' (i.e. catch at 50-70% of historical maximum) (CMFRI, 2017).

CMFRI have also published some analysis of population dynamics and stock indicators for A. alcocki, based on similar techniques to those described above (Chakraborty et al., 2018). Estimates of some useful indicators in terms of MSC scoring are given in Table 9; the length at maturity is below the length at 50% probability of capture, while E, although quite high, is below Emax for both sexes.

Table 9. Estimates of some population dynamics parameters for A. alcocki, based on samples from landings, 2012-16 (Chakraborty et al., 2018)

Indicator	Estimate for *A. alcocki*, 2012-16	
	Female	Male
Carapace length (CL) at 50% maturity	35 mm	20 mm
CL at 50% probability of capture	40 mm	22 mm
E	0.72	0.56
Emax	0.91	0.95
E/Emax	79 %	59 %

A. alcocki was also evaluated by CU Pesca using MSC's 'risk-based framework' technique; results are provided in Appendix 2.

3.3.9 Reference points

MSC require that management of stocks is relative to defined reference points – usually but not inevitably a target (setting a stock management objective) and a limit (a level which managers should avoid going below). There can also be (instead or as well) a trigger, which is a reference point which triggers some management action or change. Although there are no formal reference points incorporated into the management system of this fishery at present, the above analysis suggests some implicit reference points. For example, spawner biomass depletion is evaluated as to whether it is above or below 20%, suggesting that this is an implicit limit or trigger. Likewise, the reference point E=0.4, which is widely used in fisheries with somewhat similar dynamics (e.g. small pelagic fisheries) could potentially be applied as a target.

3.3.10 Harvest strategy and control rules

The amended Kerala Marine Fishery Regulation Act (2017) gives the State for the first time the ability to restrain increases in fishing effort by requiring permits for the construction of fishing vessels. Currently, there is a moratorium on the construction of new vessels >12m, although existing vessels may be replaced with one of the same capacity. There is not the same regulation applied to smaller vessels but this has no implications for the stocks of deep-sea species, which are taken with mechanised trawls.

Over and above this general ceiling on effort, the regulations applied to the management of the deep-sea shrimp fishery are set out in Section 3.2.3 above; in summary they are: MLS for *A. alcocki*, minimum 25mm square-mesh cod end and mechanised trawl ban in June/July (being extended in

stages to 61 days). The MLS for *A. alcocki* is based on the mean size at maturity, and is applied based on percentage of the catch (not more than 50% can be below the MLS).

Aside from the MLS, management has avoided making regulations that apply to individual species (as would quotas, for example) because of the mixed-species and highly diverse nature of the mechanised trawl fishery overall. The deep-sea component of the fishery is less diverse, but nevertheless includes eight species of shrimp (five making up a significant proportion of the catch) as well as a range of fish bycatch (see [redacted] above).

Unfortunately, this type of 'single-species' approach is to some extent unavoidable with MSC, which has put in place very specific requirements for Principle 1 species; i.e. a harvest strategy that is responsive to the state of the stock and a harvest control rule which is able to adjust the exploitation rate according to stock status in relation to specific stock-based reference points. A challenge of the FIP will be to address these stock-specific issues in the context of a multi-species fishery, without the unintended consequences that have been a problem in other such situations (such as increased discarding).

3.4 Principle Two: Ecosystem background

3.4.1 Designation of species under Principle 2

The fishery's impact of non-target species (i.e. those not included in Principle 1) is analysed differently if the species is from a "managed" stock or not, or considered Endangered, Threatened or Protected (ETP). These are defined as follows:

Primary species (MSC Component 2.1):

- Species that are within scope of the MSC program, i.e. no amphibians, reptiles, birds or mammals;
- Species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit (LRP) or target reference points (TRP). Primary species can therefore also be referred to as 'managed species'.

Secondary species (MSC Component 2.2):

- Species that are not managed in accordance with limit or target reference points, i.e. do not meet the primary species criterion;
- Species that are out of scope of the programme, but where the definition of ETP species is not applicable (see below).

ETP (Endangered, Threatened or Protected) species (MSC Component 2.3) are assigned as follows:

- Species that are recognised by national ETP legislation;
- Species listed in binding international agreements (e.g. CITES, Convention on Migratory Species (CMS), ACAP, etc.);
- Species classified as 'out-of scope' (amphibians, reptiles, birds and mammals) that are listed in the IUCN Redlist as vulnerable (VU), endangered (EN) or critically endangered (CE).

Both **primary** and **secondary** species are defined as 'main' if they meet the following criteria, otherwise they are 'minor':

- The catch comprises 5% or more by weight of the total catch of all species by the UoC;
- The species is classified as 'less resilient' and comprises 2% or more by weight of the total catch of all species by the UoC;
- The species is out of scope (secondary species only);
- Exceptions to the rule may apply in the case of exceptionally large catches.

Note: At the pre-assessment stage there is no need to identify minor bycatch species (primary and secondary) since they intervene in scoring only at SG100.

3.4.2 Bycatch species

As already noted under Principle 1 (Section 3.3.10), the fishery is not managed via individual management objectives (targets or limits) by species. All non-P1, non-ETP species in the catch are therefore categories under 'secondary' rather than 'primary'. 'Main' secondary species have been evaluated based on the landings data from the deep-sea fishery for 2018– see [redacted]). These data are, however, uncertain, for two reasons:

- We only have one year of data, while catches of some (most?) species are clearly variable from year to year (see for example Figure 3 above);
- It is not clear how CMFRI have defined the deep-sea fishery for the purposes of providing catch information (e.g. by fishing depth, fishing area, catch profile or other means). Clearly, the details of how that is done will alter the details of the catch profile (e.g. according to whether vessels include deep and shallower hauls in the same landing). (This also has a bearing on traceability, and hence risks being a complicated issue, but it can be worked out in detail down the line, at the start of a MSC full assessment.)

For these reasons, we have used a more precautionary cut-off for 'main' species of 1% instead of 5% – to try and ensure that no potential 'main' species are missed. Catch profiles can be monitored as part of the FIP, and FIP activities on bycatch species can be adjusted if necessary.

Based on 2018 landings ([redacted]) and the 1% cut-off[7], 'main' secondary species are as follows:

- *Metapenaeopsis andamanensis* (velvet shrimp)
- *Plesionika* spp.
- *Solenocera* spp. (mud shrimp)
- *Cubiceps* spp. (driftfish)
- *Priacanthus* spp. (probably mainly *P. hamrur* – bull's eye)
- *Sepia* spp. (probably mainly *S. pharaeonis* – cuttlefish)
- *Nemipterus* spp. (threadfin bream)
- *Uroteuthis* spp. (probably mainly *U. duvaucelli* – squid)

For the first three species, the rapid stock status analysis (CMFRI, 2018) for penaeid shrimp (*M. andamanensis*) and non-penaeid shrimp (*Plesionika* and *Solenocera*) would apply, but as far as we know, no stock-specific analyses have been attempted. The cephalopods (the main species *Sepia pharaonis* and *Uroteuthis duvaucelli*) have likewise been evaluated by this method, with both being considered 'abundant' as of 2017; the same applies to the threadfin bream (*Nemipterus*) (CMFRI, 2017). The other species have not been evaluated as far as we know. For the purposes of this report, these species have all been evaluated using the PSA methodology, as used for *A. alcocki* under Principle 1 (for details see Appendix 2).

The cephalopod species are included as target species in the multi-species trawl FIP while threadfin bream has its own FIP (see under 'Scoping' below).

3.4.3 Discarding

Unlike in some fisheries (e.g. those managed by individual species quotas), there is not an incentive in this fishery for any discarding of species with commercial value. A MLS can sometimes lead to discarding; this is the reason why i) the MLS is enforced based on 50% of the landings; and ii) the introduction of the MLS was combined with an increase in the cod-end selectivity (change from 35mm diamond to 25mm square mesh for shrimp trawls, which CIFT reports should result in a 25% reduction in the bycatch of juvenile fish). CIFT noted, however, that they would like more emphasis on gear selectivity, such as the introduction of technologies such as bycatch reduction devices (BRD).

[redacted]

However, there are thought to be some discards from two sources: i) species with no commercial value – in particular benthic invertebrates such as gastropods, echinoderm, ascidians etc.; and ii) highgrading of low-value species towards the end of long trips. Fishermen report that the main taxon which is discarded is gastropods; presumably these are mainly alive on discard. They also always discard pufferfish (which damage the catch) and jellyfish.

None of these sources of discards are quantified, although CMRFI has done some work in the mechanised trawl fishery in general to identify the main species in the former category, based on last-haul analysis (species list provided by CMFRI). Space on board permitting, low value or damaged fish is likely to be taken by women for sale to fish meal plants rather than being discarded; in which case it would be quantified with the rest of the landings. On this basis, it is presumed that this source of discarding is not significant, but for a full assessment, data would be required. Benthos are considered further below under habitats (Section 3.4.7).

Overall, CMFRI estimate (based on interviews with fishers) that ~40-60kg of catch is discarded per trip, which would sum to <1% of the total catch (Dr. Rehka Devi Chakraborty, CMFRI, pers. comm.).

3.4.4 Out-of-scope species

No interactions with out-of-scope species have been reported, other than those considered under ETP species below. The mechanised trawl fishery in general reports some interactions with sea snakes (*Enhydrina schistosa*), but since these occur only in shallow water, they are not considered likely to interact with the deep-sea component.

3.4.5 Vulnerable species

The 2018 landings do not include any species which are known to be particularly vulnerable. There are four species of elasmobranch on the list: bramble shark (*Echinorhinus brucus*) – 102t; sicklefin chimaera (*Neoharriota pinnata*) – 39t; gulper shark (*Centrophorus* spp.) – 4t and houndshark (*Lago* spp.) – 7kg (i.e. one small individual). None of these species are IUCN red-listed as vulnerable or above (all data-deficient except houndshark which is least concern). The bramble shark, of which catches are highest, occurs down to ~900m and for a shark is relatively fecund, being ovoviviparous with litters of ~20 young[8]. While it is not likely that this fishery is having a serious impact on these stocks, it might be useful, for precautionary reasons, to track trends in landings over time.

3.4.6 ETP species

The key source of protection for wildlife in Indian is the Wildlife Protection Act (1972, last amended 2006), which gives full protection to those species on Schedules 1-4 (although the penalties vary). This includes all sea turtles (Schedule 1), all cetaceans (mainly Schedule 2), some seabirds (Schedule 4), dugongs (Schedule 1) and some sharks (Schedule 1). There is reported to be zero interaction with seabirds and dugongs (the latter only occur on the east coast). As already noted, none of the sharks which occur in the landings data are vulnerable or protected.

Various species of benthic invertebrates are also protected under the Wildlife Protection Act: e.g. some gastropods, holothurians and sponges. Since they are not included in the landings data, these

[8] https://www.fishbase.se/Summary/SpeciesSummary.php?ID=641&AT=bramble+shark

species have been considered under habitats for now but for a full assessment, they strictly should be included as ETP.

Turtle nesting is only sporadic on the west coast of India, in contrast to the east coast. There are reportedly two turtle nesting beaches in Kerala; both for olive ridleys. Strandings are monitored by CMFRI and are also reported to be olive ridleys. Some fishermen report that turtles are never encountered, others suggest rarely – this is supported by information from the CMFRI research trawler, which notes rare interactions. All report that they are released alive. Fishermen report that dolphins are also released if accidentally entangled, but this is rare; strandings are also monitored by CMFRI, which notes that almost all mortality comes from gillnets (CMFRI, 2017). There is, however, no objective information about interactions and outcomes. Although shrimp are exported to the US, the fishery is exempt from the requirement to use Turtle Exclusion Devices (TEDs) as a 'traditional' fishery.

3.4.7 Habitats

There are no formal habitat maps available, although there is some general information available about the nature of habitats in the area of the mechanised trawl fishery. North of Kollam, the habitat is reportedly to be muddy, while south of Kollam it is more sandy. Areas of hard substrate are provided by laterite clay – very compacted clay part-way between rock and sediment; a geological feature of tropical areas which was first identified in this part of India. The width of the shelf narrows from north to south, with the ecosystem becoming more oceanic and oligotrophic; benthos such as corals occurs only in the far south of Kerala.

It is clear that the trawl operates on the bottom when targeting prawns. There are lead weights on the trawl footrope, and the bycatch (last haul analysis) shows a wide range of benthic invertebrates; mainly crustaceans and gastropods but also bivalves, ascidians, echinoderms and scaphopods, but no corals or sponges or other habitat-forming invertebrates. This analysis is not specific to the area of the deep-sea trawl fishery, but covers the whole mechanised trawl fishery, which mainly operates in shallower areas. There is no information about demersal habitats in the area of the deep-sea fishery specifically.

Trawlers are excluded from inshore areas (inshore of 15 fathoms (30m) north of Kollam, 10 fathoms (20m) south). Fishermen also report that some of the rocky (laterite?) areas are unsuitable for trawling. There is, therefore, some area of habitat that is protected from the impacts of trawling, although some more detailed mapping is required to evaluate the proportion. Some trawl footprint mapping has been done by CMFRI (CMFRI, 2017).

3.4.8 Ecosystem

As already noted, the Kerala marine ecosystem is extremely diverse. 1097 species are recorded in total in Indian fishery landings, including 781 in the SW region (which is the most diverse).

The Western India Coastal Current flows north to south during the SW monsoon (~June-August), driving seasonal coastal upwelling in the SW region during this period (the 'Malabar upwelling zone'). Upwelling is highest at Goa and diminishes gradually towards the south. In October, the current switches direction to northwards, and weakens. Coastal waters are moved inshore/offshore by these longshore currents (Ekman transport) and the annual migration patterns of many commercially-important species tend to mirror this inshore/offshore pattern.

During the upwelling season, the Kerala coast has a unusual oceanographic phenomenon: 'mud banks'. These are areas of high turbidity which form in association with upwelling, whereby the high load of fine suspended sediment causes patches of calm water (in contrast to the situation usually prevailing during the SW monsoon). The specific drivers for the creation of these mud banks is still not completely understood, despite several years of study (Jyothibabu et al., 2018). The phenomenon is important for the trawl fishery in that it provides areas of calm water where vessels can operate during a period when the sea is generally rough.

As well as studying these mud banks, CMFRI collect and analyse a wide range of oceanographic and biogeochemical information, as described, for example, in the most recent annual report (CMFRI, 2017). Several ecosystem models have been developed, focusing on different aspects of the ecosystem; it is not clear if any of the existing models are suitable for evaluating the role of this fishery specifically, but in any case, the technical capacity is available.

The devastating floods in Kerala in 2018 raised awareness among the public of (among other things) the large quantities of plastic debris entering the rivers, lakes and backwaters. In fact, the members of the Trawl Association have been aware of this problem for a long time, since the plastic ends up in the sea and often in their nets. They have started a project called 'Suchitwa Sagaram' (Clean Seas) to collect this rubbish, bring it to shore and with the help of the local administration recycle it – collecting an almost incredible 25,000 t of plastic in first year[9]. CMFRI has also been participating in raising awareness of the problem of plastic pollution (e.g. an art installation, a project for non-disposable shopping bags) (CMFRI, 2017).

[9] See https://news.nationalgeographic.com/2018/05/fishermen-kerala-india-recycle-plastic-pollution-culture/?user.testname=photogallery:2

3.5 Principle Three: Management system background

3.5.1 Governance and legal framework

Responsibility for marine fisheries in India are shared between the National (Central) and State governments. The national legal framework in India gives individual States control of the seas and living marine resources up to 12 nautical miles (nm) from the shore, while the Central Government has control from 12nm to the 200nm exclusive economic zone (EEZ) boundary. Although this fishery operates inside and outside 12nm, management jurisdiction in practice is with the Kerala fisheries department. There is however a potential for the stocks under assessment to be shared with neighbouring states, i.e., Karnataka, and also the central government, if the stocks' ranges extend past the 12nm demarcation. This will need to be taken into consideration when defining the UoAs at full assessment and will be under discussion during the FIP work.

According to the World Bank (2010) report there are five major legal instruments of the Central government that directly govern marine fisheries and activities:

- The Indian Fisheries Act, 1897;
- Marine Products Export Development Authority Act 1972 (No. 13 of 1972);
- The Maritime Zones of India (Regulation of fishing by foreign vessels) Act, 1981 (No. 42 of 1981);
- The Maritime Zones of India (Regulation of fishing by foreign vessels) Rules, 1982;
- The Operation of Deep Sea Fishing Vessels, 20m OAL and above, Notifications dated 14 December 2006.

State legislation is based on a model Act prepared by the central government in 1979 (World Bank, 2010) with each State developing its own marine fisheries legislation to manage fisheries in their respective area. In Kerala State, fisheries management is guided by the *Kerala Marine Fisheries Regulation Act, 1980* (KMFR Act). It was amended in 2017 (KMFRA Amendment) and is in the process of being implemented across the State (KMFRA Rules Amendment – November 2018). Prior to the implementation of the amended Act, a gap analysis (Department of Fisheries, 2016) was completed on the original, 1980 version. These gaps included, but were not limited to:

- No provisions for alterations to fishing vessels:
- No mandatory lifesaving equipment required;
- No minimum mesh sizes prescribed for fishing gears, except for codends of trawl nets;
- No provisions for regulating fishing vessels from other states;
- No provisions for regulating production, keeping and transportation of fishing gears;
- No provisions for the management of fish resources through a participatory approach (i.e. engagement with communities;
- No provisions for fishing gear markings.

The amendment brought with it bans on the use of dynamite and explosives (which incidentally would have prevented the fishery under assessment here from being within MSC fishery scope), and the requirement for the registration of boat building yards and net gear production facilities. This last element is essential as it allows the State Government to control effort in the fishery, by putting a moratorium on the construction of new fishing vessels.

The KMFR Act and subsequent amendments under Paragraph 4(1) empower the government to:

- Reserve and delimit specific areas of the territorial sea for fishing by specified types of vessels;
- Determine the number of vessels that can operate in the specific areas;
- To regulate or prohibit catching of specific species of fish in any specified area;
- To regulate or prohibit the use of specified fishing gear in specified areas;
- To regulate the size of fishing gear or the vessel and the production, keeping and transportation of gear or vessel;
- To regulate use of destructive materials, such as dynamite to catch or destroy fish in specified areas.

Fishers found guilty of any contravention under the Act or Rules (i.e. *The Kerala Marine Fisheries Regulation Act, 1980; KMFRA Amendment (2017); KMFRA Rules Amendment (2018)*) or any of the conditions of their licence can under Section 17 of the KMFRA Amendment, have their licence cancelled, suspended or revoked by the Adjudicating Officer. They can also be fined and their fishing vessel and catch seized by the Government. Any person aggrieved by this order may appeal within thirty days to the Appellate Authority constituted under the Act (Paragraph 18) who will hear the appeal and make a final decision. A unique feature of the legislation is that any penalty must be paid prior the appeal being heard. The Appellate Authority is deemed a civil court under the Code of Civil Procedure 1908. If disputes remain unsettled, fishers can appeal to the High Court and Supreme Court. There is evidence that this has occurred. For example, the monsoon trawl ban was challenged as unreasonable under the Constitution by the owners and operators of mechanised trawlers in Kerala Trawlnet Boat Operator's Association vs. State of Kerala in the High Court (Pillai, 1997). In this case, the contentions of the fishers were upheld but then reversed by the Supreme Court upon appeal by the State government. This decision has meant that the validity of the monsoon trawl ban is judicially recognised (Pillai, 1997).

One of the main reasons behind the development of the KMFR Act (1980) was due to the "conflict of interests between the operators of mechanised boats and trawlers, and traditional fishermen using non-mechanised boats" and "the need for…legislation to safeguard the interests of traditional fishermen and the fishing resources of the State." The KMFR Act therefore has specific provisions for the protection of legal rights of traditional and artisanal fishers. A previously advised, under Paragraph 4(1) of the KMFR Act, the government has the power to *inter alia* regulate, restrict or prohibit fishing in specified areas, the number of vessels allowed to fish in a specified area, the catching of certain species spatially and temporally and the use of fishing gear in certain areas. In making these orders however, the government under Paragraph 4(2) must have regard to "the need to protect the interests of different sections of persons engaged in fishing, particularly those engaged in fishing using of traditional fishing craft such as catamaran, country craft or canoe".

Kerala also uses zoning as a fisheries management tool to protect the interest of traditional and artisanal fishers using country craft. Mechanised vessels (with the exception of traditional motorised crafts) are banned from specified areas of the fishery (e.g. up to 30m deep in the sea along the coast from Kollengode to Paravoor Pozhikkara (a length of 70km) and up to the 20m deep from Paravoor to Manjeswaram (a length of 512km) (DOF, 2016) (see Table 10). The importance of State zoning to protect the interests of traditional and artisanal fishers was recently recognised by the Central Government of India in their National Policy on Marine Fisheries, 2017 which under paragraph 13 states "…States have specified 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. The government will continue to provide such support to artisanal/traditional fishers and in consultation with user groups."

Table 10. Summary of areas specified for traditional vessels under KMFRA Act 1980. Adapted from: https://static1.squarespace.com/static/55930a68e4b08369d02136a7/t/5a02916ae4966b0fcde72632/1510117740011/7_Rules+and+Regulations+Governing+Fisheries+in+Different+States+along+the+Indian+Coast.pdf

State	Year effective	Specified areas for traditional vessels	Mechanised fishing vessels operating areas (to a distance of 12nm)
Kerala	1980	Southern sector (1- Kollengode to Paravoor Pozhikkara)- up to 25 fathoms Southern Sector (2- Pozhikkara to Kovilthottam): up to 18 fathoms Northern Sector (Pozhikkara to Kovilthotttam): up to 12 fathoms	Motorised fishing vessels: Southern Sector: area up to 20 fathoms Northern Sector: area up to 10 fathoms Mechanised fishing vessels less than 25GRT: Southern Sector: up to 35 fathom line Northern Sector: up to 20 fathom line

India is a signatory to the United Nations (UN) Convention on the Law of the Sea (UNCLOS) (India ratified in 1982) and the UN Fish Stocks Agreement 1995 (India ratified in 2003) and a member of regional fisheries management organisations (RFMOs), which makes them obliged to implement "hard law" or binding instruments and conservation and management measures (CMMs). India also should be implementing (as a cooperating coastal, flag and port State) non-binding instruments such as the 2001 Food and Agricultural Organisation (FAO) International Plan of Action on Illegal, Unreported and Unregulated (IUU) Fishing. However, much of the fisheries legislation in place in India predates these international treaties and instruments that form the basis for fisheries management principles and policies. A 2010 report by the World Bank suggested the current legal framework in India is not comprehensive and contains a number of gaps, particularly in regards to fisheries management. For example, it is suggested that regulations such as minimum mesh size for specific fisheries, zoning and seasonal bans are inconsistent between States (World Bank, 2010) suggesting a lack of cooperation among States. In saying that there is evidence that India has recognised these deficiencies and has taken steps to address this through the development of the National Policy on Marine Fisheries, 2017 and Indian Marine Fisheries Code developed by the Central Marine Fisheries Research Institute (CMFRI) also in 2017.

3.5.2 Consultation, roles and responsibilities of stakeholders

Stakeholders involved in the management process are explicitly defined and well understood for all areas. At the central government level, marine fishing is managed by the Department of Animal Husbandry, Dairying and Fisheries (DAHDF), which is part of the Ministry of Agriculture, Government of India. The fisheries division within the DAHDF implements and monitors the central government schemes and centrally sponsored schemes delivered through State governments (World Bank, 2010). DAHDF is responsible for fisheries management from 12nm to the 200nm EEZ boundary.

In Kerala, the Department of Fisheries has responsibility for fisheries management in the territorial sea up to 12nm and the formulation of marine fisheries policy, development and management programs and their implementation. It is headed by a Director Fisheries and organised as depicted in Figure 5. It is also supported by a variety of other organisations such as the Kerala State Cooperative Federation for Fisheries Development Ltd (Matsyafed) as depicted in Figure 6.

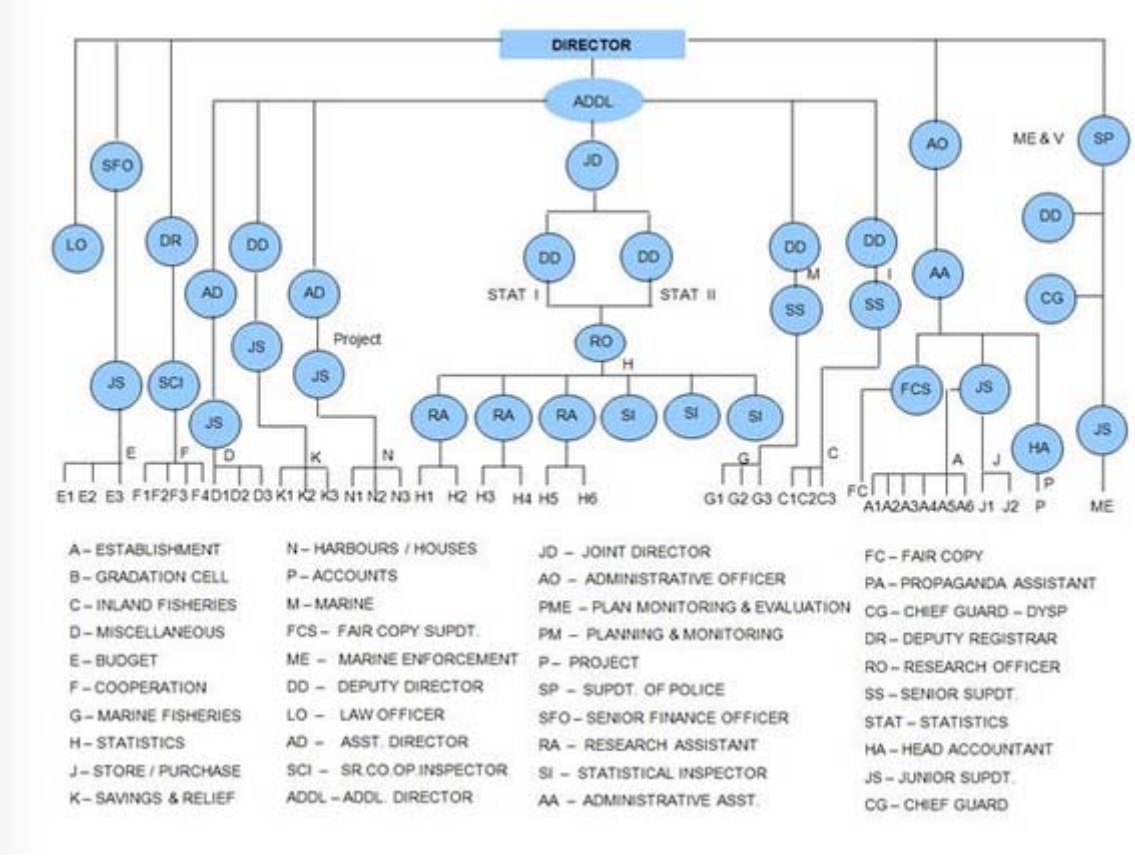

Figure 5. Hierarchical structure of the Department of Fisheries in Kerala State. Sourced from Department of Fisheries
http://www.fisheries.kerala.gov.in/index.php?option=com_content&view=article&id=57&Itemid=18

Figure 6. Governance of fisheries in Kerala State. Sourced from Department of Fisheries
http://www.fisheries.kerala.gov.in/index.php?option=com_content&view=article&id=57&Itemid=18

Scientific research is undertaken by a variety of organisations in India including: (i) the CMFRI in Kochi, Kerala, which undertakes research on marine fisheries catch and effort, stock assessments, taxonomy and bio-economic modelling; (ii) the Central Institute of Fisheries Education (CIFE) in MumbaI, which undertakes education and research in fisheries; (iii) the Fishery Survey of India (FSI) in Mumbai, which undertakes fish abundance surveys and; (iv) the Central Institute of Fisheries Technology (CIFT) in Kochi, which carries out research on fishing technology, craft and gear, processing and preservation and also helps in quality control certification for the export of seafood.

CMFRI scientists have played an important role in the development of various reports that have shaped fisheries management in India including: *Indian Marine Fisheries Code: Guidance on a marine fisheries management model for India* and *Report of the Committee to Evaluate Fish Wealth/Impact of Trawl ban along Kerala coast.* They were also involved with the Department of Fisheries in the development of the 2016 report – *Recommendations on Amendments to the KMFR Act and Rules* that made recommendations on proposed amendments to the KMFR Act to improve fisheries management and sustainability of marine resources in Kerala.

There are also a number of local fisher organisations that participate in the management process including *inter alia*, the Kerala Swathantra Matsya Thozhilali Federation (KSMTF) representing artisanal fishers and the Kerala Fishing Boat Operators Association (KFBOA) representing the mechanised sector. The role of these organisations in the consultation and management process has become clearer through the 2017 amendment to the KFMR Act. In 2017, the KFMR Act was amended to include participatory management councils at the village, district and state level (Figure 7). These councils will have representatives from fishers, government officials, vessel owners, vessel builders, fish traders, non-government organisation (NGO) representatives and scientists. Section 13A of the amended KFMR Act explicitly outlines the composition of each council. Sections 13(B,C and D) outline the powers, duties and functions of each village, district and state council. Importantly, each council is tasked with contributing to the development of a marine fisheries management plan. The amended KFMR Act is still in the process of being fully implemented, so at present the process is not formalised.

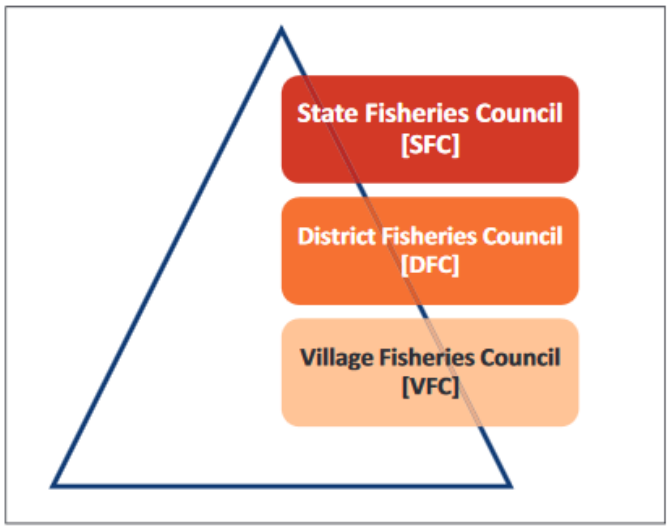

Figure 7. Hierarchical 3-tiered fishery management councils implemented under the 2017 amendment to the KMFR Act. Sourced from Mohamed et al., 2017.

The new participatory management councils will improve overall consultation processes in Kerala and this has been recognised in the National Policy on Marine Fisheries 2017 under Paragraph 14

which states that a co-management approach "will be worked out in consultation with the fisheries research institutions, coastal States/UT Governments, fishers and their associations and other concerned stakeholders in the sector". Nevertheless, there is evidence that consultation processes in the past have provided opportunity for all relevant stakeholders to be involved and provide information that can be used by government in decision-making. For example, a committee with officials from the Department of Fisheries and central fisheries research institutes was formed in 2016 with the mandate to make recommendations on proposed amendments to the KMFR Act that would improve fisheries management and sustainability of marine resources in Kerala. This committee held multiple public consultations to develop draft recommendations and then convened a meeting of all trade union representatives to seek their suggestions on the draft recommendations before finalising them (DOF, 2016). Furthermore, an expert committee formed in 2014 to assess the impact of the monsoon trawl ban conducted multiple stakeholder consultations before developing recommendations, which were then submitted in a draft report and placed on the Fisheries Department website for the general public and stakeholders to comment (Mohamed, et al., 2014). Following this, further meetings with stakeholders and the committee members occurred to get opinions on draft recommendations before they were finalised. Another example of how local knowledge is incorporated into the development of regulations is through the 2015 and 2017 notifications in the Gazette that prohibited catches of juvenile fish through the imposition of minimum size limits on 58 species of fish. Consultation on the minimum size limits regularly occurred, with State fisheries officers visiting villages and communicating the issues and proposals for changes in the local language. CMFRI and the State Fisheries Department also have regular contact with fishers at landing sites through the establishment of local Fisheries offices.

3.5.3 Short- and long-term objectives

There are no specific fishery-management plans for the fishery and species under assessment and therefore there are no short- or long-term objectives to manage the specific stocks covered in the unit of assessments (UoAs). Furthermore, the State KMFR Act and subsequent amendments and Central government fisheries legislation is not consistent with the concepts and requirements of United Nations Convention on the Law of the Sea (UNCLOS) and subsequent international instruments such as the UN Fish Stocks Agreement 1995 requiring the use of the ecosystem and precautionary approach to fisheries management (World Bank, 2010). This is mainly due to the fact that they were developed prior to the finalisation of these international treaties and instruments. The development of the Indian Marine Fisheries Code in 2017, identified this issue and the importance of India having a comprehensive national policy on marine fisheries encompassing "all aspects of sustainable use of marine fisheries resources, with provision to review and revise the same every ten years" (Mohamed et al., 2017). Following this recommendation, a National Policy on Marine Fisheries was released in 2017 that is "intended to guide the coordination and management of marine fisheries in the country during the next ten years". The precautionary approach is explicit within this Policy under Paragraph 7, in "taking a precautionary approach in line with the global standards regarding wild fish harvests" and again in Paragraph 11 through reviews of spatial and temporal closures "taking into account the best scientific information available, including a precautionary approach…" in the development of fishery management plan.

3.5.4 Decision-making processes

There are no fishery-specific objectives to guide decision-making as outlined above, however if they did exist there are some decision-making processes established that could guide management. For example, the implementation of minimum size limits through a notification in the Gazette as per clause (d) of sub-section (1) of Paragraph 4 of the KMFR Act for a further 44 juvenile fish species, was

based on recommendations that came out of the expert committee report to the Department of Fisheries (DOF, 2016) as a result of stakeholder concern that too many juveniles and under-minimum size fish were being caught in trawls. The overall decision behind this was based on the marine policy objective to promote the protection of living aquatic resources. Furthermore, in 2014 there was a review of the monsoon trawl ban by an expert committee, which recommended that the duration of the trawling ban be extended to increase yield and value (Mohamed, K. et al., 2014). Parties to this review were the State fisheries department and CMFRI. It is clear from the report how the recommendations were derived and these were used by the government as justification for extension of the trawl ban from 47 to 52 days in 2018 as a first step to raising it to 61 days, as similarly implemented by other southern States (Anon, 2018).

These examples outlined above illustrate the process of decision-making and suggest that the government responds to serious issues identified in relevant research, monitoring, evaluation and consulting. The implementation of the minimum size limits (outlined in the previous paragraph) occurred following stakeholder consultation and was likely in a timely manner (i.e. around a year after the release of DOF, 2016). In saying that however, these are only a few examples and it is clear that other important issues that have been identified, have not been responded to by government. For example, many of the recommendations from the expert committee report to the Department of Fisheries (DOF, 2016) have not been implemented, such as to mesh size limits used by mechanised vessels using gear other than trawl nets, which is resulting in continued fishing of juveniles (Sudhish, 2018; Mohammed, 2016). This suggests that the general principles and policies of fisheries management based on international treaties and conventions, such as the precautionary approach, use of the best scientific information and the ecosystem approach to fisheries (EAFM) are not being implemented in practice as yet. Nevertheless, the National Policy on Marine Fisheries 2017 explicitly references the precautionary approach under Paragraphs 7 and 11 of the "Fisheries Management" section. Similarly, the need to take into account the best scientific information and the ecosystem approach to fisheries management (EAFM) is reflected in Paragraphs 11 and 14 respectively. It is still too early to determine if the strategies outlined in this policy will be implemented in management decision-making in Kerala.

The Department of Fisheries in Kerala provides information on fishery performance and management actions upon request. Some documents such as the "*Report of the Committee to Evaluate Fish Wealth/Impact of Trawl Ban along Kerala Coast*" are available online on the CMFRI website, while relevant legislation is also available on the Department of Fisheries website. Findings from relevant reviews, research and notifications in the Gazette however, are not all regularly published online and cannot be said to constitute formal reporting to all stakeholders, nor can it be said that comprehensive information on the fishery's performance and management actions.

There is no evidence of the fishery being subject to legal challenges and in the future it is likely it will be proactive in avoiding these through the formation of participatory management councils at the village, district and state level (as enacted through the 2017 amendment to the KMFRA Act), which will facilitate co-management and involvement of relevant stakeholders in decision-making. In the interim, Kerala does have transparent mechanism for the resolution of legal disputes, which would allow it to respond to legal challenges in a transparent and timely fashion. Legal challenges can be heard through the Appellate Authority (Civil Court) or the High Court or Supreme Court. There is evidence that a timely response to legal challenges has previously occurred. For example, the monsoon trawl ban was challenged as unreasonable under the Constitution by the owners and operators of mechanised trawlers in Kerala Trawlnet Boat Operator's Association vs. State of Kerala in the High Court and Supreme Court upon appeal (Pillai, 1997).

3.5.5 Monitoring, Control and Surveillance (MCS) system

MCS tools in the fishery include licensing and registration for all vessels, as well as at-sea and in-port inspections. Patrol vessels (five in total) are based in Kollam and Kochi and operated by the Department of Fisheries enforcement wing. The enforcement wing were created through the Transport, Fisheries and Ports Department. The head of the unit is the Superintendent of the Police, who supervises the overall functions of the Wing, and also submits critical assessments and recommendations to the Director of Fisheries regarding the implementation and enforcement of the Kerala Marine fishing Regulation Act (1980), including its trawl ban (Department of Fisheries, Govt. of Kerala website). There are no at-sea observers or vessel monitoring system (VMS) implemented in the fishery.

Under Paragraph 14 of the KMFR Act, authorised (compliance) officers are given powers to search vessels used or suspected to have been used in contravention of any of the provisions of the Act, or the rules framed thereunder, or of any of the conditions of the licence. Under Paragraph 16, where any compliance officer has reason to believe that the fishing vessel has been used or is being used in contravention of any of the provisions of the Act, they can report this to the Adjudicating Officer who will hold an enquiry into the matter and determine a sufficient penalty if applicable under the KMFR Act. Violations include, *inter alia*, not fishing with a valid licence and landing fish below the minimum legal size. Financial penalties for violations were strengthened in the 2017 amendment to the KMFR Act based on recommendations from the DOF (2016) report but these still remain low compared to other global jurisdictions (World Bank, 2010). The size of the fine as listed in Paragraph 17(1) depends on the horse-power of the boat (see Table 11).

Table 11. Financial penalties listed under for contravention of the amended KMFR Act 1980

Horse power of vessel	Fine under Act	Fine in US Dollars
100hp engine or above as single or in toto or any mechanised fishing vessel	Two-lakh and fifty thousand rupees	~US$3,400
Any non-mechanised fishing vessel fitted with engine between 10hp and 100hp as a single or in toto	One lakh rupees	~US$1,400
Any non-mechanised fishing vessel or any motorised fishing vessel fitted with 10hp engine or below	Ten thousand rupees	~US$140

The Adjudicating Officer can also confiscate (seize) the catch under Paragraph 15 and revoke, cancel or suspend the fishing licence for the vessel under Paragraph 17(2), which may act as an even greater deterrence than the fines listed under Paragraph 17(1). Therefore, there is a clear protocol for penalising fishers under the Act for violations, which is considered by the Department of Fisheries to be consistently applied and thought by the government and fishers to provide effective deterrence. While data on the number of violations are known by the Department of Fisheries, this has not been analysed to determine subsequent rates of non-compliance so it was not possible to evaluate whether the sanctions demonstrably provide effective deterrence to reduce or eliminate non-compliance.

During the site visit, interviews with fishers and managers from the Department of Fisheries suggested that regulations under the KMFR Act were adhered to and strictly enforced. Fishers will inform the Department of Fisheries if other fishers are landing fish below the minimum legal size, for

example. The increased monetary value of the (revised – 2017) penalties for non-compliance means that fishers are very aware of the cost and implications of violations. Fishing gear seen by the assessment team during the site visit demonstrated regulation with 35mm minimum mesh-size. During the monsoon, when the trawl ban is in force, the harbour is closed, so no boats may leave to fish, thus contravention of the ban is prevented. These are all examples of compliance with regulations and effective MCS, however there is also some literature suggesting the contrary. Previous reports and articles have highlighted the difficulties Kerala State have had in enforcing fisheries regulations due to a lack of sufficient personnel, financial constraints and lack of patrol boats (Pillai, 1997; World Bank, 2010) and that MCS needed to be improved in areas such as, control of fishing fleets, in-port inspections after landing, monitoring of destructive fishing practices (Ail et al., 2014). Concerns have also been raised as to the awareness of fishers with existing rules and regulations and their necessity (Mohamed, et al., 2014; DOF, 2016; World Bank 2010). A clear example of non-compliance was in a study done by Ail et al., (2014), which found during a survey of fishing gears that trawlers were using nets with cod-end mesh sizes as small as 16mm, which is in violation of the 35mm minimum mesh size allowed under the KMFR Act. The CMFRI has also previously noted that the minimum mesh size limit of 35mm is often violated by trawlers (Mohammed, 2016). Furthermore, the lack of a VMS or Automatic Identification System (AIS) on all vessels (the latter is planned to be implemented) and information on monitoring and enforcement (e.g. number and area of patrols, number of inspections at-sea and in-port) obtained by the assessment team suggests a lack of a functioning MCS system in place in Kerala. AIS is now mandated to be in place for all mechanised vessels by November 30th 2019, through provision in the amended KMFR Act (2017).

A more comprehensive assessment of non-compliance and the MCS system would therefore be required if a full assessment was conducted due to the conflicting nature of information sourced by the assessment team. In particular, information would be needed on *inter alia* rates of non-compliance through time and number of at-sea and in-port inspections.

3.5.6 Monitoring and management performance evaluation

There is a lack of mechanisms in place to evaluate parts of the fishery-specific management system in Kerala. There have been internal audits but the scope of these audits were not clear to the assessment team. The National Policy on Marine Fisheries 2017 calls for “periodic reviews” of management measures and marine protected areas (MPAs) but this is yet to be fully implemented. Typically, reviews have been part of the political process rather than requirements of policy and procedure. For example, when a new government is elected (for a five-year term), the fishery would be reviewed, a report produced a couple of years later, but no progress made on improvements, as potentially another new government would be in power before changes could be made. Nevertheless, the National Policy on Marine Fisheries developed in 2017 is set to have an implementation plan, which will include “a monitoring and evaluation section that will address the timeliness and efficacy of implementation.” Furthermore, this Policy is expected to be reviewed every ten years. In Kerala, amendments to the KMFR Act were due to CMFRI involvement (Dr. Sunil Mohammed, CMFRI) rather than due to existing mechanisms of review. It is likely there will be a review of the implementation of the participatory management councils at the village, district and state level, as prescribed under the 2017 amended KMFR Act and indeed following the enactment of a fishery management plan (Dr. Sunil Mohammed, CMFRI). To date, certainly reviews have

happened, as mentioned above, but the extent to which mechanisms are in place to evaluate the fishery-specific management system is unknown.

Evaluation Procedure

3.6 Assessment methodologies used

The pre-assessment was conducted in accordance with the MSC Fisheries Certification Requirements v2.0 and pre-assessment reporting template version 2.1.

3.7 Summary of site visits and meetings held during pre-assessment

The site visit was held at various locations in Kochi and Kollam in the state of Kerala between the 27th and 29th November 2018. The team visited the Central Marine Fisheries Research Institute (CMFRI), the State Fisheries Department office in Kollam, and the landing and auction sites in Kollam. The individuals met during the site visit are listed in Table 12. The sites and representatives visited gave the team an understanding on the fishery operations and management, the supply chain and also the data collection and research that is currently available in the fishery. All communications were in-person, but there has been further correspondence between the team and CMFRI.

Table 12. List of attendees at the on-site meetings.

Organisation	Name	Location and date
Choice Canning Company	Sheela K	27th – 29th November 2018
CMFRI	Dr Sunil Mohamed	27th November 2018, Kochi
CMFRI	Dr Rekhadevi Chakraborty	27th, 29th November 2018, Kochi
WWF India	Vinod Malayilethu	28th, 29th, 31st August 2018
MSC India	Ranjit Suseelan	28th, 29th, 31st August 2018
Boat Operative Association	Peter Mathias	31st August 2018
Fishery Scientist	Dr K.K. Appukuttan	28th November 2018, Kollam
CU Pesca - Assessor	Kat Collinson	27th – 29th November 2018

3.8 Stakeholders to be consulted during a full assessment

Stakeholders to be consulted during a full assessment include:

- CMFRI;
- Kerala State Fisheries Department;
- CIFT;
- WWF India;
- MPEDA;
- Boat Operative Association;
- Processors members of the client group;
- Fishers/auction representatives supplying product;
- Karnataka State Fisheries Department.

Anticipated stakeholder consultation during the full assessment process would be for both the application of the default methodology and risk based framework (RBF).

3.9 Harmonisation with any overlapping MSC certified fisheries

There are no overlapping fisheries currently in certification, which would require harmonisation on Principle 1. Minor elements of the overall management structure of Keralan fisheries may overlap with the certified Ashtamudi Estuary short-necked clam fishery, which became certified in 2014. It should be noted that this fishery was assessed under version 1.3 of the MSC Fisheries Standard. Further investigation at full assessment would be needed to determine whether the fisheries require some harmonisation on some Principle 3 Performance Indicators (PIs).

4 Traceability (issues relevant to chain of custody certification)

4.1 Eligibility of fishery products to enter further chains of custody

The structure of this assessment is slightly unconventional. The client group are not the operators of the fishery, but instead purchase product from the fishers via auctions. This adds an extra step to the certificate and those parties eligible to handle the product under the certificate, prior to the change of ownership from the client group. The relationship between the client group and the fishers still needs to be considered prior to full assessment, so this section merely highlights the systems currently in place in the fishery and any gaps, but does not postulate how the client group/fisher/auction agreement may look in future.

Trawlers in this fishery are typically multi-day boats, with fishing trips ranging from three to 15 days at a time. The length of the trip is dependent on the fuel and hold capacity of the vessel. Following capture, catch is hauled aboard and placed on ice in the holds.

Fishers carry different gears on the same trip, and then select the gear most appropriate for the substrate. It is therefore not possible to tell which catch came from which gear, as they are mixed together in the boat's holds. Consideration will have to be made to this fact when defining the UoA for the full assessment, as prescribing the use of only one gear per trip or Chain of Custody certification at the vessel level is not practically feasible.

Boats arrive in port, moor up and wait to unload their catch. Landings are separated by gear type, with trawl catch being offloaded at one end of the adjacent landing centre, whilst longline vessels unload at the opposite end. Unloading starts early in the morning, with catch being brought into the centre to be separated and given fresh ice. Boats land one at a time, with the effect that for general sale, the first boats to land often receive the best price for their catch due to the demand. Alternatively whole catches can be pre-pledged to a buyer at a pre-agreed rate.

Catch is separated into piles (Figure 8), but the target species of this pre-assessment have not been separated historically by individual species (i.e. *H. chani* and *H.woodmasoni* are not differentiated between during catch separation or auction). CMFRI informed the team that in 2018 however, *H.chani* was auctioned separately because of the high export demand. If the target species remain mixed at auction at MSC full assessment, Inseparable or Practically Inseparable (IPI) MSC requirements (for more information see Annex PA of the MSC Fisheries Certification Requirements v2.0) will have to be followed. This would limit the sale of mixed species catch to a maximum certification period of one certification period (five years). It is therefore recommended, if practical, to separate by species when landed to avoid limited certification or complications for traceability at full assessment.

Following the separation into piles, product is then auctioned off. The price paid by the customer is for the pile, rather than there being a price per kilogramme. The weight is estimated and the price set by the auctioneer. The auctioneer records the boat, the catch and the price for the catch.

Following the purchase, the product bought is weighed before transport to the customer (normally a processor, such as a member of the client group). The purchasing exporter records details such as the auctioneer, the species, the weight, the price, the purchasing date and also the product destination, i.e. whether it is for the domestic or exporter market. The landing centre takes daily figures for the entire auction, and this information is collected and then collated with other landing centres in Kerala by CMFRI for their data collection programme.

In summary, there is a traceability system in place at the landing centre, however documentation is not sufficient to trace the fishery products back to the UoA. Auctioneers know from which vessel the catch came, but this information is not passed onto the purchaser. Depending on how the full assessment is structured, it is possible that only a portion of the trawlers fishing will be able to sell to the client group and thus the product be eligible to bear the MSC ecolabel; and this should therefore be considered during the FIP and full assessment preparation. The biggest issue is the lack of location devices and catch reporting, which would be verified by a third party, such as CMFRI or the state fisheries department. This means catch cannot be confirmed as coming from the UoA, regardless of whether traceability systems are in place at the landing centre and beyond.

Figure 8. Examples of piles of catch waiting for collection at auction site in Kollam (source: taken by author)

Figure 9 shows the target species of the pre-assessment *Heterocarpus woodmasoni* and other deep sea shrimp captured in the fishery. *A.alcocki* is separated by the fishers prior to auction, as they fetch a higher price at auction, as they have a developed market in Spain. The two *Heterocarpus* species remain mixed, having been separated from other species, the catch is aggregated and sold during early morning auctions. For the purposes of this assessment, there are two ports of landing, Kochi and Kollam.

Figure 9. Deep-sea shrimp for auction in Kollam: left (single specimen) – *H. chani*; right (four individuals) – top two are *A. alcocki*, 3rd is *H. chani*, 4th is *H. woodmasoni* (source: taken by author).

Table 13 provides an overture of risks to traceability identified in the fishery. These will have to be considered as part of the FIP and addressed prior to full assessment.

Table 13. Risks to traceability

Traceability Factor	Description of risk factor if present.
Potential for non-certified gear/s to be used within the fishery	Gear type is specified in the fishing licence, for example trawl and there are heavy fines for vessels using gear for which they are not licensed. However, multiple trawl gears may be authorised and present on the vessel during the same trip, as gear use is dependent on substrate on which the vessel is fishing.
Potential for vessels from the UoC to fish outside the UoC or in different geographical areas (on the same trips or different trips)	Based on the assessment's definition of the stock, the target species' stock range is the State of Kerala. This may change by the time the fishery is ready for full assessment. The UoA and UoC are the same in this pre-assessment. It is unlikely that vessels will fish outside of the UoC away from coastal regions due to boat capacities and specific location of fishing grounds on Kollam Bank, but it is possible for vessels to land outside the UoC in other states (the state fisheries departments have jurisdiction up to 12 nautical miles), if they have the appropriate fishing licence to do so. To the best of the team's knowledge, vessels from Kerala tend to only fish in Keralan waters. This is generally because trips, especially for smaller boats, are short (although most are multi-day trawlers) and the waters in Kerala are productive. There is therefore little need to travel further afield for the same catch. The fishing area (as well as gear) is specified on their fishing licence. If vessels continue only to fish in Kerala, there is not a risk to traceability as mixing of catch from certified and non-certified waters will not occur. However, logsheets are not completed in the fishery, there are no observers and there are no forms of vessel tracking such as VMS or AIS[10]. This makes verification of catch location impossible. This needs to be addressed during the FIP.
Potential for vessels outside of the UoC or client group fishing the same stock	Based on the assessment's definition of the stock, the target species' stock range is the State of Kerala. This may change by the time the fishery is ready for full assessment. The UoA and UoC are the same in this pre-assessment. There is a potential for other vessels, outside the UoA to fish the same stocks, however these are not landed in Kerala, but in the neighbouring states of Karnataka or even Maharashtra. Vessels from different states are painted different colours for identification purposes, so it is easy to know if unlicensed boats are landing in Kerala. Vessels in contravention of the KMFR Act (2017) are fined heavily if found to be fishing beyond the scope of their licence. The 1980 KFMR Act did not have provisions to regulate vessels from other states.
Risks of mixing between	This is possible both onboard fishing vessels and later. If a vessel only fishes in

[redacted]

certified and non-certified catch during storage, transport, or handling activities (including transport at sea and on land, points of landing, and sales at auction)	certified waters, it still may use uncertified gear on the same trip, which will mix certified and non-certified catch in the holds, as there is no separation based on gear-type. At the landing site itself, mixing does not occur. As mentioned above, target species have not been historically separated into species-only piles and mixed together for sale, although during 2018, *H.chani* was separated out due to favourable market conditions. The species are visually different, and so if operationally practical, species should be separated out to circumvent IPI requirements needing to be followed during full assessment. By the time product is transported, the change of ownership to the exporters has already occurred. Catch is taken in individual open boxes with ice. There is still the opportunity to mix species, but is unlikely given the preceding auction process.
Risks of mixing between certified and non-certified catch during processing activities (at-sea and/or before subsequent Chain of Custody)	There are no 'at sea' processing activities nor processing activities prior to onward sale where separate Chain of Custody certification is required.
Risks of mixing between certified and non-certified catch during transhipment	To the best of the team's knowledge, transshipment at sea does not occur.
Any other risks of substitution between fish from the UoC (certified catch) and fish from outside this unit (non-certified catch) before subsequent Chain of Custody is required	There is a risk of mixing catch from different boats at the landing site. Catch is placed in open piles on the floor of the landing centre for auction. This leaves opportunity for mixing, although the risk is considered small. Boats offload one at a time, so one boat's haul will be completely auctioned before another vessel's catch is brought ashore. However, there is no identification of any kind in the landing centre, so it is not possible to know the owner of the catch being auctioned without conversing with the auctioneer. Additionally, vessels with different gears (such as longlines) also land at the same time, but species diversity is likely to be different given the types of fishing (pelagic vs. demersal).

5 Preliminary evaluation of the fishery

5.1 Applicability of the default assessment tree

The default assessment tree, Annex SA of the MSC Certification Requirements v2.0 would be used for this assessment. The fishery is not enhanced, nor is it based on introduced species. The use of the RBF methodology is anticipated (see Section 5.2 below).

5.2 Expectations regarding use of the Risk-Based Framework (RBF)

In this assessment, the RBF has been used to evaluate one of the Principle 1 target stocks (*A. alcocki*); the default tree was also used. In addition, the RBF was used for secondary species (there are no primary species and no significant ETP species), due to the lack of biologically-based limits for bycatch species in the fishery. At full assessment, there is a further potential for the RBF to be applied to habitats if necessary, but activities are proposed within the FIP such that this would not be required. See Appendix 2 for RBF (PSA) scoring.

5.3 Evaluation of the fishery

The evaluation of the fishery is summarised in Table 14 below, and summary rationales for each PI are provided in Appendix 1 Pre-assessment full scoring tables (for those scored using the PSA see in Appendix 2 – PSA).

Principle 1 - Data on landings from the fishery are good, as are biological data for the proposed target species. The stock status for the *Heterocarpus* species was evaluated based on preliminary CMFRI stock assessment work, and for *Aristeus alcocki* based on an analysis of population dynamics as well as by using the RBF (a PSA). In all cases the outcome was a conditional pass / medium risk. The harvest strategy is based on control of effort and management of selectivity (gear technical measures and minimum sizes), as well as zoning (no mechanised trawling inshore) and a closed season. This approach makes sense for a mixed fishery but is not able to respond easily to changes in stock status for the individual target stocks.

Principle 2 – Landings from the fishery are diverse; a range of 'main' bycatch species were defined – including other shrimp species (some also target species of the fishery), fish and cephalopods (target species of the wider mixed-species trawl fishery). Main bycatch species were also evaluated using a PSA; all were 'medium risk'. The management strategy for bycatch species is the same as for target species and has the same issue; i.e. difficulty in responding to the status of individual stocks. There is no evidence that the fishery impacts ETP species or VMEs (sensitive habitats) but more information is needed to confirm this. For ecosystem impacts, by contrast, there is a range of information available.

Principle 3 – Overall, the fishery has strong management capabilities in place. Traditional fishing rights and culture are robustly protected and the roles and responsibilities of entities involved in the management of the fishery are clear and detailed. There are consultation processes in place to assert change in the fishery, but mechanisms for co-operation with other parties are not formally organised. The fishery has various compliance mechanisms implemented, including patrol vessels and fishery department compliance officers, but the team would need further investigation into the potential levels of non-compliance in the fishery and its management system performance. The fishery under assessment does not have any fishery specific management plans or objectives in

place, which are some of the precluding reasons that the fishery is not yet meeting the MSC fisheries standard.

5.3.1 Traceability

At present the traceability system in place in the fishery is not sufficient to trace products from the UoAs to the purchase by the client group. Further development of the traceability systems are needed prior to approaching a full assessment, in particular securing a documentation pathway system for products caught and landed in the fishery. *Heterocarpus* species have been sold as mixed species in the past, with the exception of last year. As IPI requirements would have to be followed during a full assessment if species remain to be mixed, it is recommended that the fishery looks into separation methods to avoid complications at full assessment. As the target species are visually different, this is not impossible, but the practicalities do need to be evaluated by the fishery.

Perhaps most importantly, is the need for the introduction of location devices for vessels, for example in the form of Automatic Identification Systems (AIS) or Vessel Monitoring Systems (VMS), not only to verify the location of catch landed (i.e. inside the UoA) assuring traceability needs satisfactorily, but also for more robust MCS systems, and improve fisher and vessel safety. AIS is now required through the amended KMFR Act (2017) for all mechanised vessels by November 2019, but the success of this implementation is yet to be seen and so will be followed during the FIP.

5.3.2 Next steps

Part 2 – Scoping of this document (FIP Scoping) considers options for how these issues could be addressed.

5.4 Summary of likely PI scoring levels

Key to likely scoring level in Table 14

Information suggests fishery is not likely to reach SG60 and therefore would fail on this PI	<60
Information suggests fishery will reach SG60 but may need a condition for this PI	60-79
Information suggests fishery is likely to exceed SG80 resulting in an unconditional pass for this PI	≥80

Table 14. Summary scoring of pre-assessment (see also Appendices 2 and 3)

Component	PI	Performance Indicator	RBF required? (Y/N)	Likely scoring level	Rationale/ Key points
PRINCIPLE 1 – *Heterocarpus chani* and *H. woodmasoni* (conclusions are the same for each species)					
Outcome	1.1.1	Stock status	N		Stock likely to be above the PRI but unclear if at a level consistent with MSY
	1.1.2	Stock rebuilding	N	Not evaluated	Cannot be evaluated based on existing information – requires agreed management targets
Management	1.2.1	Harvest Strategy	N/A		Harvest strategy is expected to work to keep impacts on stocks away from high risk, but not is responsive to the status of individual stocks
	1.2.2	Harvest control rules and tools	N/A		No HCR in place or implicit, no means of reducing exploitation level as limit reference points / PRIs are approached
	1.2.3	Information and monitoring	N/A		Information is quite good but stock status is not monitored systematically, although this could be done with the information available
	1.2.4	Assessment of stock status	N		Stock assessments are preliminary and highly uncertain for the moment; information exists to improve them however
Principle 1 conclusion for *Heterocarpus chani* and *H. woodmasoni*			The monitoring of the fishery, and the knowledge of the biology of the target species, is quite good. The difficulty is to translate this monitoring at the fishery level into a systematic monitoring of stock abundance, which can then be used in management, i) to monitor trends in stock status; ii) to define suitable reference points; and iii) to put in place a harvest strategy which is responsive to stock status.		
PRINCIPLE 1 – *Aristeus alcocki*					
Outcome	1.1.1	Stock status	Maybe		Stock likely to be above the PRI but unclear if at a level consistent with MSY. Scoring with RBF (PSA) suggests impact of the fishery is 'medium risk' (Note: this is uncertain because in a full assessment would have to be combined with a stakeholder scoring exercise)
	1.1.2	Stock rebuilding	Maybe		Not scored if RBF used, otherwise same conclusion as for *Heterocarpus* species
Management	1.2.1	Harvest Strategy	N/A		Harvest strategy is expected to work to keep impacts on stocks away from high risk, but not is responsive to the status of individual stocks

	1.2.2	Harvest control rules and tools	N/A		No HCR in place or implicit, no means of reducing exploitation level as limit reference points / PRIs are approached
	1.2.3	Information and monitoring	N/A		Information is quite good but stock status is not monitored systematically, although this could be done with the information available
	1.2.4	Assessment of stock status	Y	Default	Given a default score of 80 when the RBF is applied to 1.1.1
Principle 1 conclusion for *Aristeus alcocki*			As for *Heterocarpus* species. Use of the RBF is not strictly required based on the information provided in Chakraborty et al. (2018), but the comparison is useful.		
PRINCIPLE 2					
Primary Species	2.1.1	Outcome	N		No main primary species; default score of >80
	2.1.2	Management	N/A		No main primary species; default score of >80
	2.1.3	Information	N/A		No main primary species; default score of >80
Secondary species	2.2.1	Outcome	Y		Scored using the PSA; see Appendix 2. All the species scored 'medium risk'. Note that more information, e.g. about the footprint of the fishery in relation to the distribution of the species, or the proportion of juveniles in the catch, could adjust these scores.
	2.2.2	Management	N/A		There are measures in place (control of effort, MLS), but it is not clear that monitoring is able to evaluate the status of all these species; and it is not clear how management could react should a stock be shown to be depleted
	2.2.3	Information	N/A		There is biological information available for the main secondary species, and information was sufficient to score the PSA for all the species. The information has been sufficient to put in place some measures for some but not all of the main species (e.g. to define a MLS); based on the biological data available, this could probably be done for the other species as well.
ETP species	2.3.1	Outcome	N		For the turtles and dolphins, interactions are reported by all stakeholders to be rare and unlikely to result in mortality.
	2.3.2	Management	N/A		The measures / strategy is the nature of the fishery, which results in few interactions.

	2.3.3	Information	N/A		Data are limited and mainly (although not entirely) anecdotal
Habitats	2.4.1	Outcome	Option		There is no particular evidence that there are VMEs in the area of the fishery, or that the fishery is causing serious or irreversible harm; however, there is not enough information to know for sure.
	2.4.2	Management	N/A		
	2.4.3	Information	N/A		
Ecosystem	2.5.1	Outcome	N		By plausible argument the fishery is not likely to be causing harm to the ecosystem (i.e. a multispecies fishery with flexible fishing strategy, a productive ecosystem driven mainly by upwelling processes)
	2.5.2	Management	N/A		The cap on overall effort should constrain ecosystem impacts, although the role of the fishery in the ecosystem is not quantified.
	2.5.3	Information	N/A		CMFRI has done work to elucidate key elements of the ecosystem dynamics, as well as studying physical processes and biogeochemical cycles. The biology and ecology of the main species in the fishery is generally known (see Appendix 2), and some ecosystem modelling has been attempted. Monitoring of both the fishery and the ecosystem is probably adequate to detect increases in risk (e.g. ecosystem or species abundance shifts).
Principle 2 conclusion			For the fishery to meet MSC requirements, a range of actions are needed to address the management of main bycatch species and to collect more data on the impacts of the fishery on demersal habitats.		
PRINCIPLE 3					
Governance & policy	3.1.1	Legal and customary framework			The national legal framework in India gives individual States control of the seas and living marine resources up to 12 nautical miles (nm) from the shore, while the Central Government has control from 12 nm to the 200 nm exclusive economic zone (EEZ) boundary. In 2017, the KFMR Act was amended to include participatory management councils at the village, district and state level. These councils will have representatives from fishers, government officials, vessel owners, vessel builders, fish traders, non-government organisation (NGO) representatives and scientists. The amended KFMR Act is in the process of being implemented, and as the fishery is only at state level, all necessary cooperation is provided for. The fisheries management system in Kerala State has a transparent mechanism for the resolution of legal disputes. The KMFR Act therefore has specific provisions for the

					protection of legal rights of traditional fishers.
	3.1.2	Consultation, roles and responsibilities			The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. Under Amended KFMR, role of Village Fisheries Management Council to inform District Fisheries Management Council on matters of fisheries conservation resources. In turn, it is prescribed that the District Fisheries Management Council shall provide the same to the State Fisheries Management Council. The state must provide Fisheries Management Plan for the State. "To ensure that these management measures effectively improve the livelihoods of fishers, periodic reviews will be conducted, taking into account the best scientific information available, including a precautionary approach, and with due engagement of fishers and other concerned stakeholders" – National Policy on Marine Fisheries, 2017.
	3.1.3	Long term objectives			National Marine Policy, 2017. Long-term objectives. ''The overall strategy of the NPMF, 2017 is based on seven pillars, namely sustainable development, socio-economic upliftment of fishers, principle of subsidiarity, partnership, inter-generational equity, gender justice and precautionary approach".
Fishery specific management system	3.2.1	Fishery specific objectives			No fishery specific objectives currently exist in the fishery, for example presented in fishery management plans.
	3.2.2	Decision making processes			There is evidence of decision-making processes responding to serious issues identified in relevant research, monitoring, evaluation and consulting. Through research and information collected by CMFRI at landing sites and stakeholder consultation, minimum size limits were implemented in the fishery through notifications in the Gazette. There is not evidence however that other important issues identified are responded to in decision-making processes. Further to this, the precautionary approach is part of National Policy for Marine Fisheries, however it is too early to tell if this approach is being used to guide decision-making processes, which prevents the award of a higher score.
	3.2.3	Compliance and enforcement			There are sanctions within the MFA of Kerala, but enforcement is an issue. NPMR, 2017 points out that the existing mechanisms in place for a sound and effective MCS regime for marine fisheries sector need further strengthening. Vessels do not have VMS/AIS yet to confirm fishing area compliance and regulate IUU fishing. The extent of IUU and other non-compliance is needed to assess whether sanctions which exist under the KMFR Act provide effective deterrence.

	3.2.4	Management performance evaluation			The precautionary score of SG60 – 79 has been applied for this PI due to lack of information. There are mechanisms in place to evaluate some parts of the fishery-specific management system. A recent review led to the amendment to the KFMR Act. Typically however, reviews have been part of the political process rather than requirements of policy and procedure, but they have occurred. The National Policy on Marine Fisheries 2017 calls for "periodic reviews" of management measures and marine protected areas (MPAs) but this is yet to be fully implemented.
Principle 3 conclusion					Only one PI has scored <SG60, but the aggregate score for this Principle would most likely not reach the necessary SG80 average necessary to pass a MSC fishery assessment without further action.

6 References

Anon. 2018. 52-day trawling ban to being in Kerala on Saturday Midnight. The New Indian Express 6th June 2018. http://www.newindianexpress.com/cities/kochi/2018/jun/06/52-day-trawling-ban-to-begin-in-kerala-on-saturday-midnight-1824275.html

Chakraborty R.D., P. Purushothaman, G. Maheswarudu, G. Kuberan, L. Sreesanth and N. Ragesh 2018. Population dynamics of Aristeus alcocki Ramadan 1938 (Decapoda: Penaeoidea: Aristeidae) from south-western India. Regional Studies in Marine Science 20, 64–71.

Chakraborty R.D. (undated). Taxonomy, Biology and Distribution of Deep-sea Shrimps. Crustacean Fisheries Division, Central Marine Fisheries Research Institute, Kochi

CMFRI 2010 – Marine Fishery Census, Kerala.

CMFRI 2017. Annual Report 2016 - 17. Central Marine Fisheries Research Institute, Kochi. 292 pp

CMFRI 2018. Annual Report 2017-18. Central Marine Fisheries Research Institute, Kochi. 304 pp

Control Union Pesca, 2018. Marine Stewardship Council (MSC) Pre-assessment Report; Kerala multi-species trawl fishery. On behalf of Seafood Exporters Association of India (SEAI).

Department of Fisheries. 2016. Recommendations on amendments to the KMFR Act & Rules. December 2016, 35pp.

Jyothibabu, R., Balachandran, K.K., Jagadeesan, L., Karnan, C., Arunpandi, N., Naqvi, S.W.A., Pandiyayajan, R.S. et al., 2018. Mud banks along the southwest coast of India are not too muddy for plankton. Nature. 8:2544. DOI:10.1038/s41598-018-20667-9

Mohamed, K.S., K. Vijayakumaran, P.U. Zacharia, T.V. Sathianandan, G. Maheswarudu, V. Kripa, R. Narayanakumar, Prathibha Rohit, K.K. Joshi, T. V. Sankar, Leela Edwin, K. Ashok Kumar, Bindu J, Nikita Gopal and Pravin Puthra. 2017. Indian Marine Fisheries Code: Guidance on a Marine Fisheries Management Model for India. CMFRI Marine Fisheries Policy Series 4: 120 pp.

Mohamed, K.S., P. Puthra, T.V. Sathianandan, M.V. Baiju, K.A. Sairabanu, K.M. Lethy, P. Sahadevan, Chandrasekharan Nair, M. Lailabeevi and P.S. Sivaprasad. 2014. Report of the committee to evaluate fish wealth and impact of trawl ban along Kerala coast. Department of Fisheries, Government of Kerala. 85pp.

National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries.

Paramasivam P., R. D. Chakraborty, M. Gidda, K. Ganesan, B. Ponnathara Kandankoran, S. Laxmanan and R. Nadakkal 2018. Reproduction in the deep-sea penaeoid shrimp *Aristeus alcocki* Ramadan, 1938 (Decapoda: Penaeoidea: Aristeidae) from southwestern India. *Journal of Crustacean Biology* (2018) 1–13.

Patterson K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Reviews in Fish Biology and Fisheries 2, 321-338.

Pillai, K. 1997. Legal control of fishing industry in Kerala. PhD Thesis, Cochin University of Science and Technology, May 1997, 434pp.

Purushothaman P., Rekhadevi Chakraborty, G. Kuberan, G. Maheswarudu, P.K. Baby, L. Sreesanth1, N. Ragesh and Deepak George Pazhayamadom (draft). Stock structure analysis of '*Aristeus alcocki* Ramadan, 1938 (Decapoda: Aristeidae)' in the Indian coast with truss network morphometrics.

Rajool Shanis CP, Redhakrishnan EV, Ganga U and Pillai NGK 2014. Misidentification in fishery: the case of deep-sea pandalid shrimp *Plesionika spinipes* (Spence Bate, 1888) from Indian waters. International Journal of Marine Science 4(50), 1-4

Srinath M., Kuriakose S. and Mini K.G. 2005. Methodology for the estimation of marine fish landings in India. CMFRI.

Sudish, N. 2018. Juvenile fishing goes unchecked. The Hindu 26th June 2018. https://www.thehindu.com/news/national/kerala/juvenile-fishing-goes-unchecked/article24265069.ece

The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments.

World Bank. 2010. India Marine Fisheries: Issues, Opportunities and Transitions for Sustainable Development. Agriculture and Rural Development Sector Unit South Asia Region. Report No. 54259-IN. New Dehli, India 101pp.

Yang C-H, Kumar AB, Chan T-Y 2017. Further records of the deep-sea pandalid shrimp *Heterocarpus chani* Li, 2006 (Crustacea, Decapoda, Caridea) from southern India. ZooKeys 685: 151–159.

Zacharia P.U., K.S. Mohamed, T.V. Sathianandan, P.K. Asokan, P.K. Krishnakumar, K.P. Abdurahiman, R.N. Durgekar and V. Shettigar 2011. Alpha, beta and gamma diversity of fished marine taxa along the southwest coast of India during 1970-2005. Journal of the Marine Biological Association of India 53, 21-26.

7 Part 2 – Scoping

7.1 FIP scoring and preparation

Part 1 of this report (pre-assessment) provides a baseline for the fishery relative to the MSC Standard. In Part 2 of the report (scoping), this baseline analysis is used to highlight areas where improvement in performance is needed, and to identify some options for how these might be addressed. This set of issues to deal with and options to address them is set out below.

The purpose of the 'scoping' and the draft workplan is to inform discussion of stakeholders ahead of the FIP stakeholder workshop. The workshop will consider each issue, the various options and the draft workplan in detail, and make recommendations, which CU Pesca will then use to draft a full FIP workplan. The FIP can then be implemented on this basis. It is important to bear in mind, however, that the FIP workplan provided at the end of this process is just a starting point for the FIP, and is liable to review and adjustment (or wholesale change) throughout the life of the FIP.

7.2 Scoping: FIP structure

7.2.1 Interaction with other FIPs

This fishery is part of the Kerala multispecies trawl fishery more broadly. A FIP is already underway for this species, although this wider trawl FIP is not focusing on any of the target species of the deep-sea shrimp component, in terms of the target species of the FIP (i.e. the Principle 1 species are different in that FIP to those evaluated here). Nevertheless, much of the analysis in the pre-assessment is similar, and FIP activities to address i) the management framework for target species in general; ii) bycatch species (wanted and unwanted); iii) habitats and iv) the wider management framework (Principle 3) will be the same.

This fishery may either create its own FIP, or (if other participants agree) incorporate their activities into the wider Kerala trawl FIP – this is a decision for the clients for each assessment with the other key FIP participants (in particular the Department of Fisheries, CMFRI, SEAI and KFBOA) and CU Pesca have no particular recommendations; either could work fine.

For the purposes of this document, so that the situation is clear, full scoping has been carried out so that it can be used as a stand-alone supporting document for the preparation of a FIP Action Plan. However, areas of overlap are indicated throughout.

There is also a FIP underway focuses on the threadfin bream (*Nemipterus*) fishery. This FIP has a somewhat different structure (it is a Basic rather than a Comprehensive FIP) but nevertheless, it is likely to be useful for the various projects to work together on activities relating to this species (which is a 'main' secondary species here as well as in the other Kerala trawl FIP).

7.2.2 Target species

It is proposed that initially three target species be included in Principle 1. This includes two species requested during the site visit (*Heterocarpus chani* and *H. woodmasoni*), plus one additional species which has been added on the basis that it is the most valuable of the target species of the fishery (*Aristeus alcocki*). The Scoping has been prepared on this basis, but since the actions are basically the same for all the target species (and most likely for the other target species as well) the FIP can easily be adjusted down the line in response to fishery, market, scientific or other requirements.

7.2.3 Spatial area

In terms of defining the spatial extent of the Units of Assessment (UoA) (lacking information on biologically-defined 'stocks'), it is proposed that the State of Kerala be the spatial area in which the FIP operates, since this is the management unit for the fishery. In practice, nearly all the fishery operates on Quilon Bank; i.e. over a smaller area than Kerala waters, so some FIP activities could concentrate at this smaller scale; however management decision-making is at the level of the State of Kerala. It is not thought necessary to include interactions with neighbouring states in the FIP, since the fishery seems to operate mainly or entirely in Kerala. (This is different from the wider trawl fishery, where there is likely to be some overlap with Karnataka.)

7.2.4 Bycatch species list

For the purposes of this pre-assessment, 'main' secondary species have been defined based on the catch of the deep-sea fishery (2018), but with a more precautionary cut-off level of 1% instead of 5%. A more detailed analysis of the catch dataset would allow catch profiles to be defined for each of the target (P1) species individually (by excluding records without those species from each dataset), which might give a slightly different list of main species in each case. The FIP could therefore refine the list of 'main' secondary species, and also update the list based on more recent catch data, as it becomes available. We are, however, relatively confident that the current list, covering the most significant species in the fishery, is adequate for planning and initiating the FIP.

7.3 Scoping: Issues for the FIP to deal with

7.3.1 General approach to Principle 1

The approach proposed for Principle 1 is firstly to try and move away from using the RBF (PSA) for scoring the status of the P1 species – it appears that they all score 'medium risk'; but nevertheless, the default assessment tree ('normal' scoring) provides a more robust and less unpredictable basis for an MSC assessment, particularly for PI 1.1.1 since i) this PI has a high weighting in the calculation of the aggregate score for Principle 1; and ii) in a full assessment, the PSA scoring has to be combined with a score derived from a stakeholder exercise, which can be unpredictable. This means that systematic monitoring is required for these species, such that we are able to determine the stock status relative to the 'point of recruitment impairment' (PRI) and B_{MSY}, or suitable proxies (which can be model-based or empirical).

Secondly, a harvest strategy and control rule is required for these species (whichever approach to scoring is chosen); clearly this will be difficult in this mixed-species context, and it may be appropriate to prioritise some Principle 1 species over others – perhaps selecting one as a 'pilot' for testing and refining the harvest strategy approach? It would be appropriate here to work with the Kerala trawl FIP, since they are addressing the same issue at a larger scale; in fact, if the two fisheries are combined into one FIP, it might be useful to consider piloting a harvest strategy in the deep-sea segment of the fishery, since it is somewhat simpler (few target and main bycatch species and fewer types of gear and fishing strategy) than the wider trawl fishery.

7.3.2 General approach to Principle 2

For bycatch species in Principle 2, a two-pronged approach is proposed. Firstly the FIP could incorporate activities which aim to reduce the amount of low-value bycatch (particularly of juveniles) in the fishery. This addresses some MSC scoring issues about 'unwanted catch' directly.

Secondly, given that the fishery is a diverse mixed fishery, it is proposed that the FIP take a risk-based approach ('ecological risk assessment' or other) to define the likely level of risk posed to individual stocks, and to prioritise research and monitoring activities and management actions accordingly. A similar risk-based approach could also potentially be applied to habitat impacts.

Note that this approach is the same as that proposed for the Kerala trawl FIP, and again, it would make sense for FIPs, even if kept separate, to work together.

7.3.3 General approach to Principle 3

Principle 3 is less problematic than the other two Principles, but nevertheless, some important issues have been raised. In terms of fishery-specific objectives, this can be (is often) addressed in a fishery management plan, but this is not a specific MSC requirement. The process of defining a harvest strategy for target and main bycatch species requires management objectives (target reference points) to be defined, so that monitoring of stock status is in relation to some fixed point. In other words, this issue is already covered to a large extent by the proposed harvest strategy for Principle 1 species and the risk-assessment process for Principle 2.

7.3.4 Specific scoping issues

The issues set out here are derived from the analysis of the fishery relative to the MSC standard in Appendix 1 Pre-assessment full scoring tables (summarised in Table 14 above). For each 'red' PI, a 'high priority' issue is identified (sometimes covering more than one PI). For each 'orange' PI, a 'medium priority' issue is identified, unless the PI is already covered by a high priority issue.

High priority issues

Note: All these issues are shared with the Kerala mixed-species trawl FIP. That fishery also includes some other high priority issues which are not required for the deep-sea fishery (i.e. are not included here).

1: Evaluation of stock status for the target species (PIs 1.1.1, 1.2.3, 1.2.4 for all P1 species): Monitoring of the fishery (landings) is good, and various stock assessment techniques have been tried, at least in a preliminary way, for the *Heterocarpus* species. There is not, however, monitoring of the status of these stocks in a systematic way. This may not require complicated stock assessment techniques (particularly not given that the stocks are short-lived and variable); CMFRI's approach of trying a range of different techniques is a good way to start.

One option is to make more use of the good catch and effort data, e.g. via systematic monitoring of CPUE – particularly since other data are also available that could be used to standardise the CPUE time series (i.e. month, season, fishing grounds, gear etc.). There are, however, some difficulties with this; e.g. if fishermen target different species at different times, or due to the natural variability in catch rates (for reasons which are unclear).

Other options are also available, including modelling-based analyses (e.g. potential yield analysis, evaluation of E, length-based analyses), or more empirical analyses (e.g. based on the performance of the fishery at the very start of the season, a pre-season survey) – or some other means. MSC does not define what method should be used, only that there is some relatively robust means of keeping track of stock status in relation to reference points (whether empirical or model-based).

2: Harvest strategy for the target species (PIs 1.2.1, 1.2.2 for all P1 species, PI 3.2.1, 3.2.2): This fishery is a multi-species fishery, and is managed as such. However, MSC requires that the management of the fishery is able to respond to the status of individual P1 species (and main P2 species to some extent – see below) by reducing the exploitation rate if necessary, to ensure that the species can be maintained at sustainable target levels (defining these target levels also responds to the element of the standard about 'fishery-specific objectives' for P1, and defining how to respond to changes in stock status responds to PI 3.2.2 'decision-making processes'). This is an extremely tricky issue for this fishery, and the FIP will most likely need to work towards defining possible solutions as it goes along. There are, however, some options that can be investigated further; e.g. continuing to improve selectivity to provide minimum escapement, space-time closures tied to key areas or seasons for a given species, risk-based management approaches (target and trigger levels), continuing work on multispecies modelling approaches … a starting point for the FIP could be an evaluation of best-practice in the management of complex mixed-species fisheries across the world.

This deep-sea fishery is simpler compared to the wider mixed-species trawl fishery, so there is the option, if the FIPs are combined, of using the deep-sea component to test management approaches which could then be applied to the wider trawl fishery.

3: Bycatch reduction and selectivity (PI 2.2.1, 2.2.2): Research to improve selectivity is ongoing in the fishery, and should continue. Technologies such as sorting grids, large-mesh panels and multiple cod-ends (and others) are available and are used in this fishery but only to a limited extent. The FIPs may be able to play an important role by bringing stakeholders together (e.g. Scotland has a successful programme whereby scientists test objectively gear selectivity improvements proposed by fishermen).

4: Risk-based monitoring of P2 species (PI 2.2.1, 2.2.2, 2.2.3): For main secondary species, MSC requires that the impact of the fishery on these stocks can be determined and management put in place if required. There is a wide range of species represented in the catch, but fewer main species for the deep-sea fishery than for the wider trawl fishery, and some level of systematic monitoring for these species may be possible (e.g. based on some of the techniques applied to the *Heterocarpus* species as described above). There is also significant overlap with the trawl FIP in terms of main species; e.g. the two cephalopod species are target species in that FIP, while *Priacanthus* and *Nemipterus* are 'main' secondary species.

Another useful approach, which is being explored by the other FIP, is to take a risk-based approach, such as the ecological risk assessment (ERA) approach developed in Australia to deal with multi-species fisheries. In this approach, stocks are ranked according to their likely risk from the fishery, based on a combination of stakeholder input, biological information and fishery information (an approach similar to MSC's RBF, which was developed from the ERA approach). Stocks considered to have the highest risk are targeted for high-level data collection and monitoring (e.g. stock assessments) in relation to management targets (objectives), which then determine if management action is required, while stocks consider at low risk are monitored less robustly and frequently.

5: Evaluation of impacts of the fishery on habitats (PI 2.4.1, 2.4.2, 2.4.3): Although there is no particular evidence of VMEs within the footprint of the fishery, there is currently not enough information about habitats and habitat impacts to satisfy MSC. Systematic habitat mapping is very expensive, but some information is already available, and more could potentially be pieced together from the benthos taken in the trawl (e.g. the known habitat preferences of the gastropods etc.), as well as from fishermen's knowledge (areas which cannot be trawled etc.). The footprint of the

fishery could be mapped in an exercise with fishermen, or by installing AIS on all or selected vessels (which also has other benefits; notably safety). If this does not provide sufficient data, further scientific research could focus on areas identified by this means as potentially high risk for benthic impacts (a risk-based approach similar to that proposed for bycatch species above).

Again, this is an issue which will be addressed by the wider trawl FIP, and given the limited spatial extent of the deep-sea component (mainly on Kollam Bank), it could potentially be used as a pilot for a wider project to address this question across the whole trawl fishery.

6: Fishery objectives / management plan (PI 3.2.1): Above, the question of fishery-specific objectives has been folded into the proposed approach addressing different elements of the fishery: i.e. the management of target species and main bycatch species (see FIP issues 2 and 4 above). An alternative approach is to follow a formal process to develop fishery objectives, for example via the development of a fishery management plan. In fact, the fishery has already been through this process, but the resulting management plan has never been used. This document may provide a basis for the development of fishery-specific objectives (e.g. by reviewing and updating the management plan that already exists) – or the fact that it has never been used may indicate that such an approach is not successful in this fishery. This issue overlaps with the other Kerala FIP for the multi-species trawl fishery, of which vessels in this fishery may also operate.

Medium priority issues

7: Monitoring of discards (PI 2.2.3, 2.3.2, 2.3.3): Reportedly, not much is discarded by this fishery, but a few species are systematically discarded: e.g. turtles and dolphins (although interactions are rare) and some benthic invertebrates. It is essential for MSC to have some data on these discards and the fate of the animals involved, even if from a subset of the fishery (e.g. some fishermen that agree to cooperate), from which the 'unseen' impact of the fishery on these stocks can be evaluated. From these data, it can be determined if management actions are required. This work can most likely be combined with the other FIP.

8: Ecosystem model including the fishery (PIs 2.5.1, 2.5.2): Although CMFRI report various activities in relation to ecosystem modelling (CMFRI,2017), none incorporate this fishery, in order to evaluate the overall ecological footprint of the fishery. The exercise is not straightforward because of the multispecies nature of the fishery, but the (corrected) catch data allow the catch to be partitioned more or less by ecological group. It may be that this can be done as an extension to existing work. This work can most likely be combined with the other FIP.

9: Evaluation of management and compliance (PI 3.2.3, 3.2.4): PI 3.2.3 (monitoring, control and surveillance) scored <80 on a precautionary basis because the effectiveness of compliance was a bit unclear in some areas, while some process for periodic evaluation of the management system is required for PI 3.2.4; this is met for some parts of the system (e.g. in relation to the KMFRA) but not all. The FIP could therefore focus for both these PIs on establishing a process for periodic review of the management system, including monitoring and compliance, with a system for stakeholders to propose adjustments if necessary. It may be, however, that the proposed Fishery Management Councils (being established under the new Act) will meet this requirement. As with issue 6, this ties in with the other Kerala FIP for the multi-species trawl.

10: Traceability: As outlined in 5.3.1 above, changes to the traceability system are necessary for the successful completion of a full MSC assessment. To bring MSC-certified product to market, a robust traceability system is essential, so this could be regarded as 'high priority'; however, it is included

here as medium priority, since the timeframe for this fishery to full assessment is most likely relatively long.

The most important is the implementation of a system which can verify the catch came from the UoCs. Logbooks, Automatic Identification Systems (AIS) or Vessel Monitoring Systems (VMS) are not yet used in the fishery, and observers are not carried aboard vessels during vessel trips. Therefore catch landed cannot be traced back in any form to the UoCs at present. Further risk is added if the stocks' ranges spread further than the UoAs and if vessels fish in other States on the same trip. Physical separation and clear identification of MSC product will be required to satisfy MSC traceability requirements.

A full documentation trail is also needed, bridging the gaps in the current system. The paper trail needs to extend from the fishing vessel, through the landing and auctioning process to the first point of sale, following which MSC chain of custody (CoC) would then be required (as per FCR 7.12.2.1a) to maintain the integrity of the MSC standards if the purchasing party is not covered by the fishery certificate.

Appendices

Appendix 1 Pre-assessment full scoring tables

Appendix 1.1 Principle 1

Evaluation Table for PI 1.1.1 – Stock status

PI 1.1.1	**The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing**		
Scoring Issue	SG 60	SG 80	SG 100
a	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
b		The stock is at or fluctuating around a level consistent with MSY.	There is a **high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.
Justification	<u>*H. chani*</u>: For *H. chani*, the RSS categorises the stock as 'abundant', E is estimated at ~0.5, well below Emax. Total biomass depletion from the fishery is estimated at ~60-70% and spawner biomass (SB) depletion at ~78% (i.e. SB / SB_0 = ~22%). SB / SB_0 = 20% corresponds to MSC's default PRI. On the one hand, the stock assessments are preliminary and uncertain, but on the other hand, the estimate of the PRI at 20% of SB_0 is likely to be overly precautionary for a shrimp stock. On this basis we can argue that at least SG60 is met. However, to argue that SG80 is met we need more information about what is likely to constitute 'a level consistent with MSY'. To score this stock the risk-based framework (a PSA) is not required, since there are stock assessments, so this has not been attempted. However, extrapolating from the scoring of other non-penaeid shrimp species under Principle 2 (see 2.2.1 and Appendix 2), this would likely result in the same scoring category. <u>*H. woodmasoni*</u>: For *H. woodmasoni*, the situation is less clear-cut than for *H. chani*. The RSS categorises the stock as 'declining', based on a reduced catch in the last couple of years. Length-based indicators are a little better than for *H. chani* in that fishing mortality below the size at maturity is low and there may also be a larger size class which is not fished. Conversely, estimates of E and exploitation rate are higher, although the estimate of spawner biomass depletion is lower – overall, estimates relating to biomass may be quite uncertain. Overall, like *H. chani*, it is possible to make a qualitative argument that the stock is likely to be above the PRI (which is likely to be low for this species), because the size at 25% probability of capture is well above the size at maturity. It is not possible, however, to draw any inferences about stock status in relation to MSY. SG60 is likely to be met but SG80 not. **Table 15. Summary of stock status indicators for H. chani and H. woodmasoni (data from CMFRI)**		

	<table><tr><th>Technique</th><th>H. chani</th><th>H. woodmasoni</th></tr><tr><td>Rapid stock status</td><td>abundant</td><td>declining</td></tr><tr><td>Fished below Lm?</td><td>yes</td><td>not much</td></tr><tr><td>E (F/Z)</td><td>0.5</td><td>0.7-0.9</td></tr><tr><td>E / Emax</td><td>~0.6</td><td>~0.7-1.1</td></tr><tr><td>Exploitation rate (U)</td><td>60-70 %</td><td>70-80 %</td></tr><tr><td>Depletion of spawner biomass by the fishery</td><td>78 %</td><td>55 %</td></tr><tr><td>SB / SB_0</td><td>22 %</td><td>45 %</td></tr></table> <u>*A. alcocki*</u>: *A. alcocki* was scored using the PSA; see Appendix 2.
References	CMFRI 2017; 2018; Chakraborty et al., 2018 For PSA references, see Appendix 2 Stock assessment information from CMFRI (Dr Rekhadevi Chakraborty, pers. comm.; unpublished)
Stock Status relative to Reference Points: N/A	
OVERALL PERFORMANCE INDICATOR SCORE: *HETEROCARPUS CHANI* SHRIMP	**Default tree** / **RBF**
OVERALL PERFORMANCE INDICATOR SCORE: *HETEROCARPUS WOODMASONI* SHRIMP	**Default tree** / **RBF**
OVERALL PERFORMANCE INDICATOR SCORE: *ARISTEUS ALCOCKI* SHRIMP	**Default tree** / **RBF**
CONDITION LIKELY?	**See Scoping Issue 1**

Evaluation Table for PI 1.1.2 – Stock rebuilding

This PI is not used when the RBF (PSA) is used to score PI 1.1.1.

PI 1.1.2	Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe		
Scoring Issue	SG 60	SG 80	SG 100
a	A rebuilding timeframe is specified for the stock that is **the shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the stock.
b	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is evidence that the rebuilding strategies are rebuilding stocks, **or it is likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the specified timeframe.	There is **strong** evidence that the rebuilding strategies are rebuilding stocks, **or it is highly likely** based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the specified timeframe.
Justification	If 1.1.1 is scored using the default scoring (above) and scores <80, this PI should be scored. In practice, because there are no agreed management targets for the stocks, and they are not considered depleted, it is not really possible to evaluate this PI. Once progress has been made on a management framework for target stocks, this PI can be addressed.		
References			
OVERALL PERFORMANCE INDICATOR SCORE:			**Not scored**
CONDITION LIKELY?			**N/A**

Evaluation Table for PI 1.2.1 – Harvest strategy

PI 1.2.1	There is a robust and precautionary harvest strategy in place		
Scoring Issue	SG 60	SG 80	SG 100
a	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
b	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
c	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
d		The harvest strategy is periodically reviewed and improved as necessary.	
e	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
f	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a **biannual** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.
Justification	The overarching harvest strategy is based around controlling effort, or at least, not allowing it to increase further. This is done in the new KMFRA (2017) by licensing boat-builders and putting a moratorium on the construction of new fishing vessels (>12m). Effort is also limited via the trawl ban period (June and July, due to increase incrementally to 61 days). There is also an inshore area where mechanised trawling is not permitted (15 fathoms in the north, 10 fathoms in the south). Aside from these general requirements, there is a MLS in place for *A. alcocki*, but not for the other target species of the fishery (up to 50% of the landings can be below the MLS). In practice, enforcement of the MLS is mainly via the general cod-		

	end mesh-size requirements for shrimp trawls (25mm square-mesh). Other elements of the harvest strategy; i.e. monitoring of landings and stock trends, enforcement of regulations etc. are in place, although monitoring of stock status indicators could be more systematic (see 1.2.3). For the deep-sea shrimp fishery, due to the distance offshore and the requirements for specialised gear, the entire catch is taken by multi-day mechanised trawls, for which effort is expected to be capped more or less at current levels (although vessels can be modernised). PI 1.1.1 scored 'medium risk' using the PSA for all the species, and 60-80 based on the default assessment tree for the *Heterocarpus* species. On this basis, we can argue that the harvest strategy is working at least at a basic level to avoid a high risk situation. There can also be argued to be some (stock-level) management objectives in place (although these are implicit rather than clearly incorporated into management). It is therefore possible to argue that SG60a and b are met. Since monitoring is in place, the target species are not sharks and there has been work done on size-selectivity, SG60 overall is arguably met. SG80 is not met, because there are not clearly-defined stock-level objectives and the harvest strategy is not clearly responsive to the status of target stocks.
References	KMFRA 2017, Regulations, Sasikumar et al. 2015, Kerala Gazette 17 May 2017 (MLS notification)
OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	**See Scoping Issue 2**

Evaluation Table for PI 1.2.2 – Harvest control rules and tools

PI 1.2.2	There are well defined and effective harvest control rules (HCRs) in place		
Scoring Issue	SG 60	SG 80	SG 100
a	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
b		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
c	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
Justification	The elements of the harvest strategy are summarised above, along with the likely impact on controlling exploitation rate for each species. Although there are various elements of the harvest strategy that act to constrain effort, including on the P1 species, there is not a clear system which can trigger management action for individual species based on an analysis of stock status relative to the PRI – at least, not within the timeframe which would be required given the short lifespan and high turnover rate of the species being considered here. On this basis, SG60a is not met for any of the species.		
References	See 1.2.1		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			**See Scoping Issue 2**

Evaluation Table for PI 1.2.3 – Information and monitoring

PI 1.2.3	Relevant information is collected to support the harvest strategy		
Scoring Issue	SG 60	SG 80	SG 100
a	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
b	Stock abundance and UoA removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
c		There is good information on all other fishery removals from the stock.	
Justification	A discussion of the biological and fisheries information available from the species and fishery is provided in Sections 3.3.3, 3.3.5 and 3.3.5. In short, there is data on landings and effort, information about the fishery (vessels, gear, fishing grounds) and a reasonable amount of biological information for each of the target species, including age-and-growth, fecundity, behaviour, diet and habitat use. This information is available throughout India (i.e. can be used according to whatever geographical definition of 'stock' seems appropriate). This meets the requirements for SG80a. SIb is more of a problem, because although UoA removals are monitored regularly, stock abundance does not appear to be monitored systematically; or at least, not in a way that feeds into the management system. As noted in Section 3.3.6, various types of stock assessment have been tried provisionally for the *Heterocarpus* species, it is not clear that this is consistent or systematic. For A. alcocki, the only evaluation is the rapid stock status, and this is not apparently annual (e.g. it is presented in CMRFI 2017, but not CMFRI 2018). CPUE trends are available but are not standardised, as far as we know. As shown in relation to the *Heterocarpus* species, however, systematic analysis is clearly possible with the data available. Nevertheless, for the moment it is not clear that SG60b is met for any of the species.		
References	CMFRI 2017; 2018; see references in Sections 3.3.3, 3.3.5 and 3.3.5		

OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	**See Scoping Issue 1**

Evaluation Table for PI 1.2.4 – Assessment of stock status

PI 1.2.4	There is an adequate assessment of the stock status		
Scoring Issue	SG 60	SG 80	SG 100
a		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
b	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
c	The assessment **identifies major sources** of uncertainty.	The assessment takes uncertainty into account.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
d			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
e		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
Justification	The various stock assessment methodologies in use or available are described in Section 3.3.6; so far they have been applied in a provisional way to the *Heterocarpus* species, but not to *A. alcocki*. *H. chani* and *H. woodmasoni*: Considering SG60, some reference points are used, at least implicitly, in the provisional stock assessment presented during the site visit (see Section 3.3.9). Emax can be considered a limit reference point, and SB/SB_0=20% also appears to be considered in this way (i.e. as a maximum level of depletion for the stock); see Section 3.3.9. Targets could be selected in terms of E, U or SB/SB_0. Stock status has been estimated in relation to these reference points, as summarised in [redacted], so SG60b is met. However, it is clear that this analysis is high in uncertainty (e.g. noting the significant differences in the analysis for *H. woodmasoni* based on fishery data vs. survey data); so it is not clear that SG60c is met for this assessment as yet – it is important to note that these analyses are provisional. It is, however, clear that data are available for improved analyses of these species via various methodologies; it is just that this has not been done in a systematic way up till now. *A. alcocki*: The same might apply to *A. alcocki* as to the *Heterocarpus* species, as per the discussion above. If the RBF is used for 1.1.1, this PI is given a default score of 80.		

References	Stock assessment information provided by CMFRI (unpublished); for PSA references see Appendix 2		
OVERALL PERFORMANCE INDICATOR SCORE:		**RBF**	**Default assessment tree**
CONDITION LIKELY?		**See Scoping Issue 1**	

Appendix 1.2 Principle 2

Evaluation Table for PI 2.1.1 – Primary species outcome

PI 2.1.1	The UoA aims to maintain primary species above the PRI and does not hinder recovery of primary species if they are below the PRI.		
Scoring Issue	SG 60	SG 80	SG 100
a	Main primary species are **likely** to be above the PRI OR If the species is below the PRI, the UoA has measures in place that are **expected** to ensure that the UoA does not hinder recovery and rebuilding.	Main primary species are **highly likely** to be above the PRI OR If the species is below the PRI, there is either **evidence of recovery** or a demonstrably effective strategy in place **between all MSC UoAs which categorise this species as main**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main primary species are above the PRI **and are** fluctuating around a level consistent with MSY.
b			For minor species that are below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species
Justification	There are no main primary species in this fishery, since management is not by species-specific reference points for any species. SG80 is met by default.		
References	[redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			

Evaluation Table for PI 2.1.2 – Primary species management strategy

PI 2.1.2	**There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species, and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There are **measures** in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to above the point where recruitment would be impaired.	There is a **partial strategy** in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the point where recruitment would be impaired.	There is a **strategy** in place for the UoA for managing main and minor primary species.
b	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the fishery and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the fishery and/or species involved.
c		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its overall objective as set out in scoring issue (a).
d	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
e	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate.
Justification	There are no main primary species in this fishery, since management is not by species-specific reference points for any species. SG80 is met by default.		
References	[redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			

CONDITION LIKELY?	

Evaluation Table for PI 2.1.3 – Primary species information

PI 2.1.3	**Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species**		
Scoring Issue	SG 60	SG 80	SG 100
a	Qualitative information is **adequate to estimate** the impact of the UoA on the main primary species with respect to status. OR If RBF is used to score PI 2.1.1 for the UoA: Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species.	Some quantitative information is available and is **adequate to assess** the impact of the UoA on the main primary species with respect to status. OR If RBF is used to score PI 2.1.1 for the UoA: Some quantitative information is adequate to assess productivity and susceptibility attributes for main primary species.	Quantitative information is available and is **adequate to assess with a high degree of certainty** the impact of the UoA on main primary species with respect to status.
b			Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status.
c	Information is adequate to support **measures** to manage **main** primary species.	Information is adequate to support a **partial strategy** to manage **main** Primary species.	Information is adequate to support a **strategy** to manage **all** primary species, and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
Justification	There are no main primary species in this fishery, since management is not by species-specific reference points for any species. SG80 is met by default.		
References	[redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			

Evaluation Table for PI 2.2.1 – Secondary species outcome

PI 2.2.1	The UoA aims to maintain secondary species above a biological based limit and does not hinder recovery of secondary species if they are below a biological based limit.		
Scoring Issue	SG 60	SG 80	SG 100
a	Main Secondary species are **likely** to be within biologically based limits. OR If below biologically based limits, there are measures in place expected to ensure that the UoA does not hinder recovery and rebuilding.	Main secondary species are **highly likely** to be above biologically based limits OR If below biologically based limits, there is either **evidence of recovery** or a **demonstrably effective partial strategy** in place such that the UoA does not hinder recovery and rebuilding. AND Where catches of a main secondary species outside of biological limits are considerable, there is either evidence of recovery or a, demonstrably effective strategy in place between those MSC UoAs that also have considerable catches of the species, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main secondary species are within biologically based limits.
b			For minor species that are below biologically based limits', there is evidence that the UoA does not hinder the recovery and rebuilding of secondary species
Justification	Potential main secondary species have been designed as below. Note that this list uses a cut-off of 2% rather than 5%, to allow for variability in catch profiles over time and between individual target species, so for a full assessment, the list may be shorter (or different). • *Metapenaeopsis andamanensis* (velvet shrimp) • *Plesionika* spp. (narwhal shrimp)		

	• *Solenocera* spp. (mud shrimp) • *Cubiceps* spp. (driftfish) • *Priacanthus* spp. (probably mainly *P. hamrur* – bull's eye) • *Sepia* spp. (probably mainly *S. pharaeonis* – cuttlefish) • *Nemipterus* spp. (threadfin bream) • *Uroteuthis* spp. (probably mainly *U. duvaucelli* – squid) These species have been evaluated using a PSA – see Appendix 2.	
References	Appendix 2	
OVERALL PERFORMANCE INDICATOR SCORE:		**(All species)**
CONDITION LIKELY?		**See Scoping Issues 3, 4**

Evaluation Table for PI 2.2.2 – Secondary species management strategy

PI 2.2.2	**There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There are **measures** in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be within biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **partial strategy** in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be within biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **strategy** in place for the UoA for managing main and minor secondary species.
b	The measures are considered **likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/species).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or species involved.
c		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a).
d	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
e	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of all secondary species, and they are implemented, as appropriate.
Justification	The management strategy for main secondary species is the same as for the Principle 1 species; i.e. controlling effort, plus technical measures (cod-end mesh-size limits) and in most cases MLS. There is a MLS in place for *Nemipterus japonicus*, *Priacanthus hamrur*, *Plesionika* (*quadrigrandis*), *Uroteuthis*		

	duvaucelli and *Sepia pharaonis*. There is some monitoring and assessment for these species groups as described in Section 3.4.2. Overall, there are measures in place, however, it is not clear that monitoring is able to evaluate their status relative to biologically-based limits; at least, not for all the species individually, and it is not clear how it could react (in this mixed-fished context) should a stock be shown to be depleted. SG60a and b are most likely not met. Sharks must be landed with fins attached.	
References	CMFRI, 2017; Kerala Gazetta, 24 July 2015 (MLS notification); Kerala MFRA amended; CU Pesca, 2018	
OVERALL PERFORMANCE INDICATOR SCORE:		
CONDITION LIKELY?		**See Scoping Issues 3, 4**

Evaluation Table for PI 2.2.3 – Secondary species information

PI 2.2.3	**Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species.**		
Scoring Issue	SG 60	SG 80	SG 100
a	Qualitative information is **adequate to estimate** the impact of the UoA on the main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.	Some quantitative information is available and **adequate to assess** the impact of the UoA on main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.	Quantitative information is available and **adequate to assess with a high degree of certainty** the impact of the UoA on main secondary species with respect to status.
b			Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status.
c	Information is adequate to support **measures** to manage **main** secondary species.	Information is adequate to support a **partial strategy** to manage **main** secondary species.	Information is adequate to support a **strategy** to manage **all** secondary species, and **evaluate** with a **high degree of certainty** whether the strategy is **achieving its objective**.
Justification	In relation to scoring issue a, generally there is biological information available for the main species represented in the fishery, and information was sufficient to score the PSA, at least to a first order of accuracy, for all the species; SIa is met at least SG60, perhaps SG80. The information has been sufficient to put in place some measures for some but not all of the main species (e.g. to define a MLS); based on the biological data available, this could probably be done for the other species as well. SG60c may be met, but SG80c is not met since measures do not apply to all species.		
References	Appendix 2 and references therein		
OVERALL PERFORMANCE INDICATOR SCORE:			**?**
CONDITION LIKELY?			**See Scoping Issues 4, 7**

Evaluation Table for PI 2.3.1 – ETP species outcome

PI 2.3.1	The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species		
Scoring Issue	SG 60	SG 80	SG 100
a	Where national and/or international requirements set limits for ETP species, the effects of the UoA on the population/stock are known and **likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, the **combined effects of the MSC UoAs** on the population/stock are known and **highly likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, there is a **high degree of certainty** that the **combined effects of the MSC UoAs** are within these limits.
b	Known direct effects of the UoA are likely to not **hinder recovery** of ETP species.	Known direct effects of the UoA are **highly likely** to not **hinder recovery** of ETP species.	There is a high degree of confidence that there are no significant detrimental direct effects of the UoA on ETP species.
c		Indirect effects have been considered and are thought to be **highly likely** to not create unacceptable impacts.	There is a high degree of confidence that there are no significant detrimental indirect effects of the fishery on ETP species.
Justification	Since there are no formal catch limits for ETP species in this fishery, SIa is not scored. The ETP species identified in this pre-assessment as interacting with the fishery are olive ridley turtles and dolphins (Indo-Pacific humpback and bottlenose). Interactions are reported by all stakeholders to be rare and unlikely to result in mortality; on this basis SIb is met probably at SG80; since interactions are rare, indirect effects are also not likely.		
References	Stakeholder discussions, [redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			

Evaluation Table for PI 2.3.2 – ETP species management strategy

PI 2.3.2	**The UoA has in place precautionary management strategies designed to:** • **meet national and international requirements;** • **ensure the UoA does not hinder recovery of ETP species.** **Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There are **measures** in place that minimise the UoA-related mortality of ETP species, and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for managing the UoAs' impact on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the UoAs impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
b	There are **measures** in place that are expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **strategy** in place that is expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **comprehensive strategy** in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species
c	The measures are **considered likely** to work, based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the measures/strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work.
d		There is some **evidence** that the measures/strategy is being implemented successfully.	There is **clear evidence** that the strategy/comprehensive strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a) or (b).
e	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are implemented, as

		appropriate.	appropriate.
Justification	The measures / strategy is the nature of the fishery (i.e. a trawl fishery by relatively small vessels), which results in few interactions with turtles and dolphins. This is considered likely to work, but based mainly on anecdotal information (stakeholder discussions) so there is perhaps not an 'objective basis for confidence' (although CMFRI have some formal monitoring in place, e.g. of strandings). Some work has been done on mitigation measures, such as TEDs and BRD by CIFT, which would meet at least SG60e, but it is not clear that this can be considered 'regular'. SG80 is probably not met.		
References	Stakeholder discussions, [redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			**See Scoping Issue 7**

Evaluation Table for PI 2.3.3 – ETP species information

PI 2.3.3	**Relevant information is collected to support the management of UoA impacts on ETP species, including:** • **Information for the development of the management strategy;** • **Information to assess the effectiveness of the management strategy; and** • **Information to determine the outcome status of ETP species.**		
Scoring Issue	SG 60	SG 80	SG 100
a	Qualitative information is **adequate to estimate** the UoA related mortality on ETP species. OR If RBF is used to score PI 2.3.1 for the UoA: Qualitative information is **adequate to estimate productivity and susceptibility** attributes for ETP species.	Some quantitative information is **adequate to assess** the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species. OR If RBF is used to score PI 2.3.1 for the UoA: Some quantitative information is adequate to assess productivity and susceptibility attributes for ETP species.	Quantitative information is available to assess with a high degree of certainty the **magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status** of ETP species.
b	Information is adequate to support **measures** to manage the impacts on ETP species.	Information is adequate to measure trends and support a **strategy** to manage impacts on ETP species.	Information is adequate to support a **comprehensive strategy** to manage impacts, minimise mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.
Justification	Interactions with turtles and dolphins are known to be very limited, and qualitative information is sufficient to evaluate that impacts are likely to be minimal. Information on the species, biology, distribution and habitat use is available, sufficient to score a PSA if necessary. SG60 is met. There is not, however, quantitative information on interactions, so SG80 is not met.		
References	Stakeholder discussions, [redacted]		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			**See Scoping Issue 7**

Evaluation Table for PI 2.4.1 – Habitats outcome

PI 2.4.1	The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area(s) covered by the governance body(s) responsible for fisheries management.		
Scoring Issue	SG 60	SG 80	SG 100
a	The UoA is **unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.
b	The UoA is **unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.
c			There is **evidence** that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm.
Justification	There is no evidence that the fishery interacts with any VMEs, but probably not enough information to say this for sure. There is some information about the fishery footprint from CMFRI, but no direct information about the impact of the trawl on habitats in this area, except what can be inferred from bycatch. Some more information is needed to score this PI at 60 or above. The RBF could be used here; this has not been attempted for this pre-assessment, since it requires stakeholder input (and basically, more data than the normal scoring methodology).		
References	CMFRI 2017; 2018		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			**See Scoping Issue 5**

Evaluation Table for PI 2.4.2 – Habitats management strategy

PI 2.4.2	There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats.		
Scoring Issue	SG 60	SG 80	SG 100
a	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats.
b	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on **information directly about the UoA and/or habitats** involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on **information directly about the UoA and/or habitats** involved.
c		There is **some quantitative evidence** that the measures/partial strategy is being implemented successfully.	There is **clear quantitative evidence** that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a).
d	There is **qualitative evidence** that the UoA complies with its management requirements to protect VMEs.	There is **some quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.	There is **clear quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.
Justification	There are measures in place to protect inshore habitats from trawling (inshore trawl limit) but nothing further offshore which would apply to this fishery; as noted in 2.4.1 above, there is no particular evidence that measures are required, but not enough information to be sure.		
References	KMFRA 2017, Regulations		
OVERALL PERFORMANCE INDICATOR SCORE:			
CONDITION LIKELY?			**See Scoping Issue 5**

Evaluation Table for PI 2.4.3 – Habitats information

PI 2.4.3	**Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat.**		
Scoring Issue	SG 60	SG 80	SG 100
a	The types and distribution of the main habitats are **broadly understood**. OR If CSA is used to score PI 2.4.1 for the UoA: Qualitative information is adequate to estimate the types and distribution of the main habitats.	The nature, distribution and **vulnerability** of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. OR If CSA is used to score PI 2.4.1 for the UoA: Some quantitative information is available and is adequate to estimate the types and distribution of the main habitats.	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.
b	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats.	Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the consequence and spatial attributes of the main habitats.	The physical impacts of the gear on all habitats have been quantified fully.
c		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in habitat distributions over time are measured.
Justification	The distribution of main habitats (sand/mud/clay) is broadly understood, but not the overall impacts of the fishery, for reasons explained above.		

References	See above
OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	**See Scoping Issue 5**

Evaluation Table for PI 2.5.1 – Ecosystem outcome

PI 2.5.1		**The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Ecosystem status			
	Guidepost	The UoA is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The UoA is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
	Justification	The fishery is a multispecies fishery, and fishermen respond opportunistically to target species according to their abundance (e.g. switching from the deep-sea fishery to shallower areas or in deep water between shrimp and cephalopods). Overall effort is more or less capped by the moratorium on new boat construction. This means that the fishery is not likely to reduce the biomass of the main target species to the level were there would be serious or irreversible harm to the ecosystem. The ecosystem is productive and driven largely by physically processes (upwelling). On this basis, at least SG60 is met. CMFRI monitors landings and assesses trends in the main species groups (rapid assessments) and there is also some ecosystem modelling work, although not directly related to the impact of the fishery.		
References		CMFRI, 2017; CMFRI, 2018		
OVERALL PERFORMANCE INDICATOR SCORE:				**?**
CONDITION LIKELY?				**See Scoping Issue 8**

Evaluation Table for PI 2.5.2 – Ecosystem management strategy

PI 2.5.2	**There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There are **measures** in place, if necessary which take into account the **potential impacts** of the fishery on key elements of the ecosystem.	There is a **partial strategy** in place, if necessary, which takes into account **available information and is expected to restrain impacts** of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	There is a **strategy** that consists of a **plan**, in place which contains measures to **address all main impacts of the UoA** on the ecosystem, and at least some of these measures are in place.
b	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/ ecosystems).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or ecosystem involved
c		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a).
Justification	There are measures in place to constrain impacts on the ecosystem; notably the cap on overall effort (see 1.2.1), as well as monitoring of landings, assessments, ecosystem modelling etc. Given the nature of the ecosystem, these should meet at least SG60.		
References	KMFRA 2017, Regulations		
OVERALL PERFORMANCE INDICATOR SCORE:			**?**
CONDITION LIKELY?			**See Scoping Issue 8**

Evaluation Table for PI 2.5.3 – Ecosystem information

PI 2.5.3	There is adequate knowledge of the impacts of the UoA on the ecosystem.		
Scoring Issue	SG 60	SG 80	SG 100
a	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the key elements of the ecosystem.	
b	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but **have not been investigated** in detail.	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.
c		The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and Habitats) in the ecosystem are **known**.	The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of these components in the ecosystem are **understood**.
d		Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred.	Adequate information is available on the impacts of the UoA on the components **and elements** to allow the main consequences for the ecosystem to be inferred.
e		Adequate data continue to be collected to detect any increase in risk level.	Information is adequate to support the development of strategies to manage ecosystem impacts.
Justification	As noted above, CMFRI has done some work to elucidate key elements of the ecosystem and ecosystem dynamics, as well as studying physical processes (upwelling) and biogeochemical cycles. The biology and ecology of the main species in the fishery is generally known, and some ecosystem modelling has been attempted. Monitoring of both the fishery and the ecosystem is probably adequate to detect increases in risk (e.g. ecosystem or species abundance shifts). SG80 is most likely met.		
References	CMFRI, 2017, 2018; and references therein; see also references in Appendix 2		
OVERALL PERFORMANCE INDICATOR SCORE:			**?**

CONDITION LIKELY?	

Appendix 1.3 Principle 3

Evaluation Table for PI 3.1.1 – Legal and/or customary framework

PI 3.1.1	**The management system exists within an appropriate legal and/or customary framework which ensures that it:** • **Is capable of delivering sustainability in the UoA(s); and** • **Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and** • **Incorporates an appropriate dispute resolution framework.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There is an effective national legal system **and a framework for cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2	There is an effective national legal system and **organised and effective cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.	There is an effective national legal system and **binding procedures governing cooperation with other parties** which delivers management outcomes consistent with MSC Principles 1 and 2.
b	The management system incorporates or is subject by law to a **mechanism** for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes which is **considered to be effective** in dealing with most issues and that is appropriate to the context of the UoA.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes that is appropriate to the context of the fishery and has been **tested and proven to be effective**.
c	The management system has a mechanism to **generally respect** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **observe** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **formally commit** to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
Justification	**a)** The national legal framework in India gives individual States control of the seas and living marine resources up to 12 nautical miles (nm) from the shore, while the Central Government has control from 12 nm to the 200 nm exclusive economic zone (EEZ) boundary. Each State has its own marine fisheries legislation to manage fisheries in their respective area. In Kerala State, fisheries management is guided by the Kerala Marine Fishing Regulation Act, 1980 (KMFR Act). The KMFR Act and subsequent amendments provide for regulation of marine fishing in the territorial sea through *inter alia* vessel registration, licensing, participatory management councils, mesh size regulations for trawlers, seasonal fishing closures (monsoon ban) and delimitation of fishing zones for vessels. In Kerala, there is a general framework for cooperation that may allow the delivery of		

	management outcomes consistent with MSC Principles 1 and 2. For example, the Central Marine Fisheries Research Institute (CMFRI) have multiple data collection sites, so it is possible to collect data across the range of the stock, with the ability to share that information with States. Indian States are in discussions about the implementation of minimum size limits on shared stocks, however state-wide agreement of implementing the minimum size limits has not yet occurred. To date, only Kerala has implemented this, so there is still a possibility for species (of a shared stock with the UoA) under the minimum size limits to be landed in other states. In 2017, the KFMR Act was amended to include participatory management councils at the village, district and state level (Figure 7). These councils will have representatives from fishers, government officials, vessel owners, vessel builders, fish traders, non-government organisation (NGO) representatives and scientists. The amended KFMR Act is yet to be fully implemented, but the legislation provides the structure for organised effective cooperation with all relevant parties involved in the management of the fishery. As the fishery is only in operation at the state level, no further cooperation from other states' fisheries departments etc. is necessary. **b)** The fisheries management system in Kerala State has a transparent mechanism for the resolution of legal disputes. Under Section 13 of the KMFR Act, fishers may appeal a refusal to grant a fishing licence, suspension, cancellation of fishing licence or registration of a vessel. While they can also appeal against any penalty determined by the Adjudicating Officer for infractions under the KMFR Act. Any person aggrieved by this order may appeal within thirty days to the Appellate Authority constituted under the Act who will hear the appeal and make a final decision. A unique feature of the legislation is that any penalty must be paid prior the appeal being heard. The Appellate Authority is deemed a civil court under the Code of Civil Procedure 1908. If disputes remain unsettled, fishers can appeal to the High Court and Supreme Court. There is evidence that this has occurred. For example, the monsoon trawl ban was challenged as unreasonable under the Constitution by the owners and operators of mechanised trawlers in Kerala Trawlnet Boat Operator's Association vs. State of Kerala in the High Court (Pillai, 1997). In this case the contentions of the fishers were upheld but then reversed by the Supreme Court upon appeal by the State government. This decision has meant that the validity of the monsoon trawl ban is judicially recognised (Pillai, 1997) and the mechanism for disputes tested and proven to be effective. On this basis **SG 100** is met. **c)** One of the main reasons for developing the KMFR Act was due to the "conflict of interests between the operators of mechanised boats and trawlers, and traditional fishermen using non-mechanised boats". The KMFR Act therefore has specific provisions for the protection of legal rights of traditional fishers. Under Paragraph 4(1) of the KMFR Act, the government has the power to regulate, restrict or prohibit fishing in specified areas, the number of vessels allowed to fish in a specified area, the catching of certain species spatially and temporally and the use of fishing gear in certain areas. In making these orders however, the government under Paragraph 4(2) must have regard to "the need to protect the interests of different sections of persons engaged in fishing, particularly those engaged in fishing using of traditional fishing craft such as catamaran, country craft or canoe". This suggests the management system has a mechanism to observe legal rights of traditional fishers such that **SG80** is met. Furthermore, the government has introduced zoning in Kerala to protect the interests and rights of traditional fishers, with mechanised vessels (with the exception of traditional motorized crafts) banned from specified areas of the fishery (e.g. up to 30 m deep in the sea along the coast from Kollengode to Paravoor Pozhikkara and up to the 20 m deep from Paravoor to Manjeswaram (DOF, 2016). The importance of this zoning has also been recognised by the Central Government of India in their National Policy on Marine Fisheries, 2017 which under paragraph 13 states "…States have specified areas reserved (based on depth or distance from shore) for traditional fishers where mechanized fishing is not permitted. Such

	Territorial Use Rights for Fisheries or TURFs have proved to be useful in sustaining the livelihoods of artisanal fishers. The government will continue to provide such support to artisanal/traditional fishers and in consultation with user groups." This suggests the management system has a mechanism to formally commit to the legal rights of traditional fishers in a manner consistent with achieving MSC Principles 1 and 2. On this basis **SG 100** is met.
References	The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments. National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries Department of Fisheries (2016) Recommendations on amendments to the KMFR Act & Rules. December 2016, 35pp. Pillai, K. (1997) Legal control of fishing industry in Kerala. PhD Thesis, Cochin University of Science and Technology, May 1997, 434pp. World Bank (2010) India Marine Fisheries: Issues, Opportunities and Transitions for Sustainable Development. Agriculture and Rural Development Sector Unit South Asia Region. Report No. 54259-IN. New Dehli, India 101pp.
OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	

Evaluation Table for PI 3.1.2 – Consultation, roles and responsibilities

PI 3.1.2	**The management system has effective consultation processes that are open to interested and affected parties.** **The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties**		
Scoring Issue	SG 60	SG 80	SG 100
a	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **generally understood**.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for key areas** of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for all areas** of responsibility and interaction.
b	The management system includes consultation processes that **obtain relevant information** from the main affected parties, including local knowledge, to inform the management system.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information and **explains how it is used or not used**.
c		The consultation process **provides opportunity** for all interested and affected parties to be involved.	The consultation process provides **opportunity and encouragement** for all interested and affected parties to be involved, and **facilitates** their effective engagement.
Justification	**a)** Organisations and individuals involved in the management process are explicitly defined and well understood for all areas. At the central government level, marine fishing is managed by the Department of Animal Husbandry, Dairying and Fisheries (DAHDF), which is part of the Ministry of Agriculture, Government of India. The fisheries division within the DAHDF implements and monitors the central government schemes and centrally sponsored schemes delivered through State governments (World Bank, 2010). In Kerala, the Department of Fisheries has responsibility for the formulation of marine fisheries policy, development and management programs and their implementation. It is headed by a Director Fisheries and organised as depicted in Figure 5. It is also supported by a variety of other organisations such as the Kerala State Cooperative Federation for Fisheries Development Ltd (Matsyafed) as depicted in Figure 6. Scientific research is undertaken by a variety of organisations in India including: (i) the Central Marine Fisheries Research Institute (CMFRI) in Kochi, Kerala, which undertakes research on marine fisheries catch and effort, taxonomy and bio-economic modelling; (ii) the Central Institute of Fisheries Education (CIFE) in Mumbai, which undertakes education and research in fisheries; (iii) the Fishery Survey of India (FSI) in Mumbai, which undertakes national fish stock assessments and; (iv) the Central Institute of Fisheries Technology (CIFT) in Kochi, which carries out research on fishing technology, craft and gear, processing and preservation and also helps in quality		

	control certification for the export of seafood. There are also a number of local fisher organisations that participate in the management process including *inter alia*, the Kerala Swathantra Matsya Thozhilali Federation (KSMTF) representing artisanal fishers and the Kerala Fishing Boat Operators Association (KFBOA) representing the mechanised sector. The role of these organisations in the consultation and management process has become clearer through the 2017 amendment to the KFMR Act. The amended Act describes the roles of the different management tiers (Figure 7) and outlines their obligations, for example information sharing from the village council level up to subsequent district and state levels. The role and responsibilities of individuals and organisations involved in the fisheries management process in Kerala are therefore explicitly defined and well understood for all areas meeting **SG 100**. **b)** The management system includes consultation processes that obtain relevant information from stakeholders, in particular, those directly involved in the Kerala management system. For example, a committee with officials from the Department of Fisheries and central fisheries research institutes was formed in 2016 with the mandate to make recommendations on proposed amendments to the KMFR Act that would improve fisheries management and sustainability of marine resources in Kerala. This committee held multiple public consultations to develop draft recommendations and then convened a meeting of all trade union representatives to seek their suggestions on the draft recommendations before finalising them (DOF, 2016). Furthermore, an expert committee was formed in 2014 to assess the impact of the monsoon trawl ban and conducted multiple stakeholder consultations before developing recommendations (Mohamed, et al., 2014) . Another example of how local knowledge is incorporated into the development of regulations is through the 2015 and 2017 notifications in the Gazette that prohibited catches of juvenile fish through the imposition of minimum size limits on 58 species of fish. This was implemented by the Fisheries Department in consultation with fishers, CMFRI and CIFT. These examples demonstrate how information and knowledge is regularly sought from stakeholders and consideration given to them in the formation of recommendations such that **SG 80** is met. With the exception of the recommendations from the assessment of the monsoon trawl ban report by Mohamed, et al., (2014), it is unclear how other information from stakeholders is used or not used so **SG 100** is probably not met. **c)** The consultation process provides opportunity for organisations and individuals to be involved and there are some examples of active facilitation by the government. For example, the expert committee formed in 2014 to assess the impact of the monsoon trawl ban conducted multiple stakeholder consultations before developing recommendations, which were then submitted in a draft report and placed on the Fisheries Department website for the general public and stakeholders to comment (Mohamed, et al., 2014). Following this, further meetings with stakeholders and the committee members occurred to get opinions on draft recommendations before they were finalised. Furthermore, consultation on the minimum size limits implemented through the 2017 amendments to the KMFR Act regularly occurred, with State fisheries officers visiting villages and communicating the issues and proposals for changes in the local language. CMFRI and the State Fisheries Department also have regular contact with fishers at landing sites. There are also local Fisheries offices that facilitate grassroots engagement. The Kerala State government is also required under Section 24 of the KFMR Act to make rules for carrying out the provisions of the Act (Kerala Marine Fishing Regulation Rules, 1980) by notification in the Gazette, and then the rules are laid out before the legislative assembly for 14 days where consultation on them can occur and modifications and amendments made prior to their effect. As previously outlined in 3.1.1(a) the amendments made to the KFMR Act in 2017 include participatory management councils at the village, district and state level (Figure 7), which will facilitate active engagement of stakeholders. However the amended KFMR Act is yet to be fully implemented so this hasn't been tested. Lastly, the 2017 National Policy on

	Marine Fisheries (2017) under Paragraph 14 references the important of a co-management approach, which involves groups of fishers and "will be worked out in consultation with the fisheries research institutions, coastal States/UT Governments, fishers and their associations and other concerned stakeholders in the sector". On this basis **SG 100** is met.
References	The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments. National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries Mohamed, K.S., P. Puthra, T.V. Sathianandan, M.V. Baiju, K.A. Sairabanu, K.M. Lethy, P. Sahadevan, Chandrasekharan Nair, M. Lailabeevi and P.S. Sivaprasad. (2014). Report of the committee to evaluate fish wealth and impact of trawl ban along Kerala coast. Department of Fisheries, Government of Kerala. 85pp. Department of Fisheries (2016) Recommendations on amendments to the KMFR Act & Rules. December 2016, 35pp.
OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	

Evaluation Table for PI 3.1.3 – Long term objectives

PI 3.1.3		**The management policy has clear long-term objectives to guide decision-making that are consistent with MSC fisheries standard, and incorporates the precautionary approach.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guidepost	Long-term objectives to guide decision-making, consistent with the MSC fisheries standard and the precautionary approach, are **implicit** within management policy.	Clear long-term objectives that guide decision-making, consistent with MSC fisheries standard and the precautionary approach are **explicit** within management policy.	Clear long-term objectives that guide decision-making, consistent with MSC fisheries standard and the precautionary approach, are **explicit** within **and required by** management policy.
	Justification	The KMFR Act and other Indian fisheries legislation is not consistent with the concepts and requirements of the United Nations Convention on the Law of the Sea (UNCLOS) and subsequent international instruments requiring the use of the ecosystem and precautionary approach to fisheries management (World Bank, 2010). The development of the Indian Marine Fisheries Code in 2017, identified this issue and the importance of India having a comprehensive national policy on marine fisheries encompassing "all aspects of sustainable use of marine fisheries resources, with provision to review and revise the same every 10 years" (Mohamed, K. et al., 2017). Following this recommendation, a National Policy on Marine Fisheries was released in 2017 that is "intended to guide the coordination and management of marine fisheries in the country during the next ten		

		years". The precautionary approach is explicit within this Policy under Paragraph 7, in "taking a precautionary approach in line with the global standards regarding wild fish harvests" and again in Paragraph 11 through reviews of spatial and temporal closures "taking into account the best scientific information available, including a precautionary approach…" The strategy in the National Policy on Marine Fisheries is also consistent with the MSC fisheries standard such that **SG 80** is met.
References		The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments. National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries Mohamed, K.S., K. Vijayakumaran, P.U. Zacharia, T.V. Sathianandan, G. Maheswarudu, V. Kripa, R. Narayanakumar, Prathibha Rohit, K.K. Joshi, T. V. Sankar, Leela Edwin, K. Ashok Kumar, Bindu J, Nikita Gopal and Pravin Puthra (2017). Indian Marine Fisheries Code: Guidance on a Marine Fisheries Management Model for India. CMFRI Marine Fisheries Policy Series 4: 120 pp.
OVERALL PERFORMANCE INDICATOR SCORE:		
CONDITION LIKELY?		

Evaluation Table for PI 3.2.1 Fishery-specific objectives

PI 3.2.1		The fishery-specific management system has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2.		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guidepost	**Objectives**, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **implicit** within the fishery-specific management system.	**Short and long-term objectives**, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.	**Well defined and measurable short and long-term objectives**, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery-specific management system.
	Met?			
	Justification	There are no specific fishery management plans for the fisheries/species under assessment and so no objectives to manage the specific stocks covered in the UoAs. **SG60** is therefore not met.		
References				
OVERALL PERFORMANCE INDICATOR SCORE:				
CONDITION LIKELY?				**See Scoping Issues 2, 6**

Evaluation Table for PI 3.2.2 – Decision-making processes

PI 3.2.2	The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery.		
Scoring Issue	SG 60	SG 80	SG 100
a	There are some decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are **established** decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
b	Decision-making processes respond to **serious issues** identified in relevant research,	Decision-making processes respond to **serious and other important issues** identified in	Decision-making processes respond to **all issues** identified in relevant research,

	monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
c		Decision-making processes use the precautionary approach and are based on best available information.	
d	Some information on the fishery's performance and management action is generally available on request to stakeholders.	**Information on the fishery's performance and management action is available on request**, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	Formal reporting to all interested stakeholders **provides comprehensive information on the fishery's performance and management actions** and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
e	Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.	The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.	The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.
Justification	**a)** This PI is asking about the decision-making processes used in determining and delivering fishery-specific management. The fishery under assessment is without fishery-specific management objectives contained for example in a management plan. However the assessment team felt that should fishery-specific objectives be developed, there are decision-making processes in place, possibly even established, that would be able to guide management decision-making such that **SG 60** would be met and **SG 80** could possibly be met. For example, the implementation of minimum size limits through a notification in the Gazette as per clause (d) of sub-section (1) of Paragraph 4 of the KMFR Act for a further 44 juvenile fish species, was based on recommendations that came out of the expert committee report to the Department of Fisheries (DOF, 2016) as a result of stakeholder concern that too many juveniles and under-minimum size fish were being caught in trawls. The overall decision behind this was based on the marine policy objective to promote the protection of living aquatic resources. Furthermore, in 2014, there was a review of the monsoon trawl ban by an expert committee, which recommended that the duration of the trawling ban be extended to increase yield and value (Mohamed, K. et al., 2014). Parties to this review were the State fisheries department and CMFRI. As a result, changes have recently been made in Kerala to extend the ban from 47 to 52 days in 2018 as a first step to raising it to 61 days, as similarly implemented by other southern States (Anon, 2018).		

	b) There is evidence of decision-making processes responding to serious issues identified in relevant research, monitoring, evaluation and consulting. Through research and information collected by CMFRI at landing sites and stakeholder consultation, minimum size limits were implemented in the fishery through notifications in the Gazette as per clause (d) of sub-section (1) of Paragraph 4 of the KMFR Act in 2015 and 2017. This was seen as the most effective/practical way to reduce undersized fish being caught in the fishery. It can be argued that this demonstrates management change in response to serious issues arising in the fishery. The implementation of the minimum size limits occurred following stakeholder consultation and was likely in a timely manner (i.e. around a year after the release of DOF, 2016) meaning that **SG60** is likely met. Other important issues that have been identified however have not been responded to by governments. For example, many of the recommendations from the expert committee report to the Department of Fisheries (DOF, 2016) have not been implemented, such as to mesh size limits used by mechanised vessels using gear other than trawl nets, which is resulting in continued fishing of juveniles (Sudhish, 2018; Mohammed, 2016). On this basis **SG 80** is not met. **c)** The need for a precautionary approach to management decision-making was recommended in the Indian Marine Fisheries Code in 2017, with CMFRI tasked with, *inter alia* identifying fish stocks on which adequate scientific information is not available and for which a precautionary approach is required. The National Policy on Marine Fisheries 2017 explicitly references the precautionary approach under Paragraphs 7 and 11 of the "Fisheries Management" section. Similarly, the need to take into account the best scientific information and the ecosystem approach to fisheries management (EAFM) is reflected in Paragraphs 11 and 14 respectively. It is still too early to determine if the strategies outlined in this policy have been implemented in management decision-making in Kerala. Therefore, **SG80** is not met. It should be noted that this score may improve, if the fishery can demonstrate implementation of the objectives outlined in PI 3.1.3 above. **d)** Information on fishery performance and management actions taken are available on request. The assessment team were able to access a number of documents through stakeholders in order to undertake this pre-assessment. Some documents such as the "*Report of the Committee to Evaluate Fish Wealth/Impact of Trawl Ban along Kerala Coast*" are available online (e.g. http://www.cmfri.org.in/uploads/files/Kerala%20trawl%20ban%20committee%20report%20jan%202014%20final.pdf) on the CMFRI website, while legal Acts are available on the Department of Fisheries website (e.g. http://www.fisheries.kerala.gov.in/index.php?option=com_content&view=article&id=82&Itemid=65). Explanations are provided to the outcomes of scientific reviews and the subsequent action. For example, the monsoon trawl ban report outlines 67 recommendations as a result of research findings and discussion with stakeholders. It is clear from the report how the recommendations were derived and these were used by the government as justification for extension of the trawl ban from 47 days up to eventually 61 days (Anon, 2018). The implementation of the minimum size limits on juvenile fish through notifications in the Gazette as per clause (d) of sub-section (1) of Paragraph 4 of the KMFR Act was based on the recommendation from expert committee report to the Department of Fisheries (DOF, 2016). On this basis **SG 80** is met. Findings from relevant reviews, research and notifications in the Gazette however, are not all regularly published online and cannot be said to constitute formal reporting to all stakeholders, nor can it be said that comprehensive information on the fishery's performance and management actions is shared. Therefore **SG 100** is not met.

	e) There is no evidence of the fishery being subject to legal challenges that the assessment team could find, however further information would need to be sought on this PI if undertaking a full assessment. As previously outlined in PI 3.1.1(b), the fisheries management system in Kerala State has a transparent mechanism for the resolution of legal disputes, which would allow it to respond to legal challenges in a transparent and timely fashion. Legal challenges can be heard through the Appellate Authority (Civil Court) or the High Court or Supreme Court. There is evidence that a timely response to legal challenges has previously occurred. For example, the monsoon trawl ban was challenged as unreasonable under the Constitution by the owners and operators of mechanised trawlers in Kerala Trawlnet Boat Operator's Association vs. State of Kerala in the High Court and Supreme Court upon appeal (Pillai, 1997). Therefore **SG 80** is met. There is evidence that the management system (in the future) will try to proactively avoid legal disputes through improving communication with stakeholders through participatory management councils at the village, district and state level (2017 KMFR Act amendment). Therefore if implemented, **SG 100** could potentially be met.
References	The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments. National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries Department of Fisheries (2016) Recommendations on amendments to the KMFR Act & Rules. December 2016, 35pp. Anon (2018) 52-day trawling ban to being in Kerala on Saturday Midnight. *The New Indian Express* 6th June 2018. http://www.newindianexpress.com/cities/kochi/2018/jun/06/52-day-trawling-ban-to-begin-in-kerala-on-saturday-midnight-1824275.html Pillai, K. (1997) Legal control of fishing industry in Kerala. PhD Thesis, Cochin University of Science and Technology, May 1997, 434pp Sudish, N. (2018) Juvenile fishing goes unchecked. *The Hindu* 26th June 2018. https://www.thehindu.com/news/national/kerala/juvenile-fishing-goes-unchecked/article24265069.ece Mohammed, S. (2016) Use of small mesh size nets threatens fish wealth *Deccan Chronicle* 10th January 2016 https://www.deccanchronicle.com/150610/nation-current-affairs/article/use-small-mesh-size-nets-threatens-fish-wealth Mohamed, K.S., P. Puthra, T.V. Sathianandan, M.V. Baiju, K.A. Sairabanu, K.M. Lethy, P. Sahadevan, Chandrasekharan Nair, M. Lailabeevi and P.S. Sivaprasad. (2014). Report of the committee to evaluate fish wealth and impact of trawl ban along Kerala coast. Department of Fisheries, Government of Kerala. 85pp. Mohamed, K.S., K. Vijayakumaran, P.U. Zacharia, T.V. Sathianandan, G. Maheswarudu, V. Kripa, R. Narayanakumar, Prathibha Rohit, K.K. Joshi, T. V. Sankar, Leela Edwin, K. Ashok Kumar, Bindu J, Nikita Gopal and Pravin Puthra (2017). Indian Marine Fisheries Code: Guidance on a Marine Fisheries Management Model for India. CMFRI Marine Fisheries Policy Series 4: 120 pp. Pillai, K. (1997) Legal control of fishing industry in Kerala. PhD Thesis, Cochin University of Science and Technology, May 1997, 434pp.
OVERALL PERFORMANCE INDICATOR SCORE:	

CONDITION LIKELY?	See Scoping Issue 2

Evaluation Table for PI 3.2.3 – Compliance and enforcement

PI 3.2.3	Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with.		
Scoring Issue	SG 60	SG 80	SG 100
a	Monitoring, control and surveillance **mechanisms** exist, and are implemented in the fishery and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance **system** has been implemented in the fishery and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A **comprehensive** monitoring, control and surveillance system has been implemented in the fishery and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
b	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, **are consistently applied** and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and **demonstrably** provide effective deterrence.
c	Fishers are **generally thought** to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	**Some evidence exists** to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a **high degree of confidence** that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
d		There is no evidence of systematic non-compliance.	
Justification	**a)** Monitoring, control and surveillance (MCS) tools in the fishery include licensing and registration for all vessels, as well as at-sea and in-port inspections. Patrol vessels (five in total) are based in Kollam and Kochi and operated by the Department of Fisheries enforcement wing. There are no at-sea observers or vessel monitoring system (VMS) implemented in the fishery. Under the KMFR Act, compliance officers are given powers to search vessels used or suspected to have been used in contravention of any of the provisions of the Act, or the rules framed thereunder, or of any of the conditions of the licence. The compliance officers will report the contravention to the Adjudicating Officer who will hold an enquiry into the matter and determine a sufficient penalty if applicable under the KMFR Act. The Adjudicating Officer can also cancel, revoke or suspend the registration or licence of the vessel involved. While interviews with fisher groups during the site visit suggested that regulations under the KMFR Act were strictly enforced, (meaning **SG 80** could be met), there is large amount of literature suggesting the contrary. Previous reports and articles have highlighted the difficulties Kerala State have had in enforcing fisheries regulations due to a lack of sufficient personnel, financial constraints and lack		

	of patrol boats (Pillai, 1997; World Bank, 2010) and that MCS needed to be improved in areas such as, control of fishing fleets, in-port inspections after landing, monitoring of destructive fishing practices (Ail et al., 2014). Concerns have also been raised as to the awareness of fishers with existing rules and regulations and their necessity (Mohamed, et al., 2014; DOF, 2016; World Bank 2010). Therefore the team were doubtful whether the MCS system has sufficiently demonstrated an ability to enforce management measures. Further to that, the current lack of a VMS or Automatic Identification System (AIS) on all vessels (the latter is planned to be implemented) and information on monitoring and enforcement (e.g. number and area of patrols, number of inspections at-sea and in-port) obtained by the assessment team suggests **SG80** cannot be currently met. **b)** Sanctions to deal with non-compliance exist and are specified in the KFMR Act (2017), along with the violations. Violations include, *inter alia*, not fishing with a valid licence and landing fish below the minimum legal size. Financial penalties for violations were strengthened in the 2017 amendment to the KMFR Act based on recommendations from the DOF (2016) report but these still remain low compared to other global jurisdictions (World Bank, 2010). The size of the fine as listed in Paragraph 17(1) depends on the horse-power of the boat (100hp or above, 10-100hp and <10hp and non-motorised) equating to around US$3,400, US $1,400 and US $140. The catch can also be confiscated (seized) under Paragraph 15 and the vessel licence revoked, cancelled or suspended under Paragraph 17(2), which may act as an even greater deterrence than the fine. Therefore, there is a clear protocol for penalising fishers for violations, which is considered by the Department of Fisheries to be consistently applied and thought to provide effective deterrence meeting **SG 80**. The number of violations are known by the Department of Fisheries because the names of fishers are recorded when they are fined etc., as part of the sanction process. However data on non-compliance (e.g. the number of particular offences) has not been analysed by the Department of Fisheries (to determine subsequent rates of non-compliance) or made available to the assessment team, so this PI would need to be revisited during a full assessment. It was not possible to evaluate whether the sanctions demonstrably provide effective deterrence to reduce or eliminate non-compliance, so **SG 100** is not met. **c)** Some evidence exists to suggest fishers comply with the management system. During the site visits, interviews were held with various stakeholders, including, fishers and two members of the State Fisheries Department (in Kollam and Kochi). The team's understanding from these meetings was that there is good levels of compliance in the fishery. Fishers will inform the Department of Fisheries if other fishers are landing fish below the minimum legal size for example. The increased monetary value of the (revised – 2017) penalties for non-compliance means that fishers are very aware of the cost and implications of violations. Fishing gear seen by the assessment team during the site visit demonstrated regulation with 35mm minimum mesh-size, however there is also evidence of the contrary in the literature (e.g. Ali et al., 2014).. During the monsoon, when the trawl ban is in force, the harbour is closed, so no boats may leave to fish, thus contravention of the ban is prevented. On this basis **SG 80** is met. As mentioned in PI 3.2.3(b), there is no data available on the rates of non-compliance, so the assessment team could not say that there is a high degree of confidence that fishers are complying with the management system so **SG 100** is not met. However, the scoring of this PI would need to be reassessed during any full assessment as there is also some literature that suggests not all fishers comply with management regulations (e.g. Ali et al., 2014) as detailed below in PI 3.2.3(d). **d)** This PI will need further investigation at the full assessment as there are a number of sources of information that suggest that regulations are not complied with in the fishery. For example in an assessment of the compliance of the marine fisheries of Kerala with the UN Code of Conduct for

	Responsible Fisheries, Ail et al., (2014) found during a survey of fishing gears that trawlers were using nets with cod-end mesh sizes as small as 16mm, which is in violation of the 35mm minimum mesh size allowed under the KMFR Act. The CMFRI has also previously noted that the minimum mesh size limit of 35mm is often violated by trawlers (Mohammed, 2016). In contrast, interviews held with the State Fisheries Department during the site visit didn't mention any such laws which weren't adhered to by fishers. Illegal, Unreported and Unregulated (IUU) fishing potentially occurs, where boats (in-State and out-of-State) may take undersized fish in the Kerala fishery, but these are not then landed in Kerala (i.e. landed out of State where no minimum size limit regulations exist and so therefore classed as legal). This would also need further investigation during a full assessment. This PI is therefore difficult to score, **SG 80** is probably met if issues with compliance are found to be minimal, but a condition is also possible.
References	The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries Department of Fisheries (2016) Recommendations on amendments to the KMFR Act & Rules. December 2016, 35pp. Pillai, K. (1997) Legal control of fishing industry in Kerala. PhD Thesis, Cochin University of Science and Technology, May 1997, 434pp Mohammed, S. (2016) Use of small mesh size nets threatens fish wealth *Deccan Chronicle* 10th January 2016 https://www.deccanchronicle.com/150610/nation-current-affairs/article/use-small-mesh-size-nets-threatens-fish-wealth Mohamed, K.S., P. Puthra, T.V. Sathianandan, M.V. Baiju, K.A. Sairabanu, K.M. Lethy, P. Sahadevan, Chandrasekharan Nair, M. Lailabeevi and P.S. Sivaprasad. (2014). Report of the committee to evaluate fish wealth and impact of trawl ban along Kerala coast. Department of Fisheries, Government of Kerala. 85pp. World Bank (2010) India Marine Fisheries: Issues, Opportunities and Transitions for Sustainable Development. Agriculture and Rural Development Sector Unit South Asia Region. Report No. 54259-IN. New Dehli, India 101pp Ail, S.S., Krishnan, M., Jayasankar, J., Landge, A., & Shenoy, L. (2014) Evaluation of Compliance of Marine Fisheries of Kerala with Article 8 of the FAO CCRF. *Fishery Technology* 51, pp. 167-172.
OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	**See Scoping Issue 9**

Evaluation Table for PI 3.2.4 – Monitoring and management performance evaluation

PI 3.2.4	**There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives. There is effective and timely review of the fishery-specific management system.**		
Scoring Issue	SG 60	SG 80	SG 100
a	There are mechanisms in place to evaluate **some** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **key** parts of the fishery-specific management system	There are mechanisms in place to evaluate **all** parts of the fishery-specific management system.
b	The fishery-specific management system is subject to **occasional internal** review.	The fishery-specific management system is subject to **regular internal** and **occasional external** review.	The fishery-specific management system is subject to **regular internal** and **external** review.
Justification	**a)** There mechanisms in place to evaluate some parts of the fishery-specific management system. Recently a review occurred which led to the amendment to the KFMR Act. Typically however, reviews have been part of the political process rather than requirements of policy and procedure. For example, when a new government is elected (for a five-year term), the fishery would be reviewed, a report produced a couple of years later, but no progress made on improvements, as potentially another new government would be in power before changes could be made. Nevertheless, the National Policy on Marine Fisheries developed in 2017 is set to have an implementation plan, which will include "a monitoring and evaluation section that will address the timeliness and efficacy of implementation." Furthermore, this Policy is expected to be reviewed every 10 years. In Kerala, amendments to the KMFR Act were due to CMFRI involvement (Dr. Sunil Mohammed, CMFRI) rather than due to existing mechanisms of review. It is likely there will be a review of the implementation of the participatory management councils at the village, district and state level, as prescribed under the 2017 amended KMFR Act and indeed following the enactment of a fishery management plan (Dr. Sunil Mohammed, CMFRI). To date, certainly reviews have happened, as mentioned above, but the extent to which mechanisms are in place to evaluate key parts of the fishery-specific management system is unknown such that **SG 80** could not be awarded. **b)** At present, there is limited review of the fishery-specific management system in place. There have been internal audits but the scope of these audits were not clear to the assessment team. The National Policy on Marine Fisheries 2017 calls for "periodic reviews" of management measures and marine protected areas (MPAs) but this is yet to be fully implemented. The World Bank externally reviewed the marine fisheries in India in 2010 so **SG 80** could potentially be met in the future if evidence was provided of regular internal review. The lack of clarity of when and what is reviewed meant the team only awarded. **SG60**.		
References	The Kerala Marine Fisheries Regulation Act, 1980 and subsequent amendments. National Policy on Marine Fisheries, 2017, 28th April 2017, Department of Animal Husbandry, Dairying and Fisheries World Bank (2010) India Marine Fisheries: Issues, Opportunities and Transitions for Sustainable Development. Agriculture and Rural Development Sector Unit South Asia Region. Report No. 54259-IN. New Delhi, India 101pp		

OVERALL PERFORMANCE INDICATOR SCORE:	
CONDITION LIKELY?	**See Scoping Issue 9**

Appendix 2 – PSA

Appendix 2.1 PSA standard tables

Table 16. PSA Productivity attributes and scores (Table PF4 in MSC Fisheries Certification Requirements v2.0). Note: last column header should read 'Low productivity (high risk, score = 3)'

Productivity determinant	High productivity (Low risk, score=1)	Medium productivity (medium risk, score=2)	High productivity (high risk, score=3
Average age at maturity	<5 years	5-15 years	>15 years
Average maximum age	<10 years	10-25 years	>25 years
Fecundity	>20,000 eggs per year	100-20,000 eggs per year	<100 eggs per year
Average maximum size (not to be used when scoring invertebrate species)	<100 cm	100-300 cm	>300 cm
Average size at maturity (not to be used when scoring invertebrate species)	<40 cm	40-200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic Level	<2.75	2.75-3.25	>3.25
Density dependence !! (to be used when scoring invertebrate species only)	Compensatory dynamics at low population size demonstrated or likely	No depensatory or compensatory dynamics demonstrated or likely	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely

Table 17. PSA Susceptibility attributes and scores (Table PF5 in MSC Fisheries Certification Requirements v2.0)

Susceptibility attribute	Low susceptibility (Low risk, score=1)	Medium susceptibility (medium risk, score=2)	High susceptibility (high risk, score=3
Areal overlap (availability) Overlap of the fishing effort with a species concentration of the stock	<10% overlap	10-30% overlap	>30% overlap
Encounterability The position of the stock/species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Low overlap with fishing gear (low encounterability)	Medium overlap with fishing gear	High overlap with fishing gear (high encounterability) Default score for target species (P1)
Selectivity of gear type Potential of the gear to retain species	a Individual < size at maturity are rarely caught	a Individuals < size at maturity are regularly caught	a Individuals < size at maturity are frequently caught
	b Individuals < size at maturity can escape or avoid gear	b Individuals < half the size at maturity can escape or avoid gear	b Individuals < half the size at maturity are retained by gear
Post-capture mortality (PCM) The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released postcapture and survival	Evidence of some released postcapture and survival	Retained species or majority dead when released Default score for retained species (P1 or P2)

Appendix 3.2 PSA analysis

7.4 PI 1.1.1 – Target species outcome

				Productivity Scores [1-3]									Susceptibility Scores [1-						Cumulative only						
Scientific name	Common name	Species type	Fishery descriptor	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
Aristeus alcocki	Arabian red shrimp	Invertebrate	Deep sea trawl	2	1	1			1	2	2	1.50	3	3	3	3	3.00	3.35					52	High	<60

7.5 PI 2.2.1 – Secondary species outcome

Scientific name	Common name	Species type	Fishery descriptor	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependance	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
Metapenaeopsis andamanensis	Rice velvet shrimp	Invertebrate	Deep sea trawl	1	1	2			1	2	2	1.50	3	3	3	3	3.00	3.35			63	Med	60-79
Plesionika spp.	Pandalid shrimp	Invertebrate	Deep sea trawl	1	1	2			3	2	2	1.83	3	3	3	3	3.00	3.52			58	High	<60
Solenocera hextii	Deep sea mud shrimp	Invertebrate	Deep sea trawl	1	1	1			2	2	2	1.50	3	3	3	3	3.00	3.35			63	Med	60-79
Aristeus alcocki	Arabian red shrimp	Invertebrate	Deep sea trawl	2	1	1			1	2	2	1.50	3	3	3	3	3.00	3.35			63	Med	60-79
Sepia pharaeonis	Pharoah cuttlefish	Invertebrate	Deep sea trawl	1	1	1			2	3	3	1.83	3	3	3	3	3.00	3.52			58	High	<60
Uroteuthis duvaucelli	Indian squid	Invertebrate	Deep sea trawl	1	1	1			2	3	3	1.83	3	3	3	3	3.00	3.52			58	High	<60
Priacanthus hamrur	Lunar-tailed bigeye	Non-invertebrate	Deep sea trawl	2	2	1	1	1	1	3		1.57	3	3	3	3	3.00	3.39			62	Med	60-79
Nemipterus japonicus	Japanese threadfin bream	Non-invertebrate	Deep sea trawl	1	1	1	1	1	1	3		1.29	3	3	3	3	3.00	3.26			66	Med	60-79
Nemipterus mesoprion	Mauvelip threadfin bream	Non-invertebrate	Deep sea trawl	1	1	2	1	1	1	3		1.43	3	3	3	3	3.00	3.32			64	Med	60-79
Nemipterus randalli	Randall\s threadfin bream	Non-invertebrate	Deep sea trawl	1	1	1	1	1	1	3		1.29	3	3	3	3	3.00	3.26			66	Med	60-79

7.6 PSA rationales

Productivity		
Scoring element (species)	**Rice velvet shrimp (*Metapenaeopsis andamanensis*)**	
Attribute	Rationale	Score
Average age at maturity.	There was little information on this species in the literature aside from its preferred depth range and morphological characteristics. Deshmukh (2013) states that *Metapeneaopsis* is the largest genus of penaeid prawns. Size is known to affect biological characteristics such as fecundity, so it is essential to derive information to assess this species from a species in the same genus. The nearest relative with substantial biological information available is the Kishi velvet shrimp, *Metapenaeopsis dalei*, studied in the Sea of Korea*(Choi et al., 2005). Given the life expectancy is just over 1 year (between 14 and 16 months), it is unlikely that average age at maturity is below 5 years.	1
Average maximum age	Maximum life spans of males and females appear to be similar and range between 14-16 months (well under the 10-year cut off for a score of 1) (Choi et al., 2005). It would be more far fetched to claim that the species assessed here exceeds its relative's life expectancy by ten years than the opposite, so a score of 1 is deemed precautionary.	1
Fecundity	Choi et al. (2005) found that fecundity varied significantly with size, with clutches varying from 5065 eggs in the smallest female (14 mm CL), to 12981 eggs in the largest (18 mm CL). This neatly falls within the range for the score of 2.	2
Reproductive strategy	*Metapenaeopsis sibogae, Metapenaeus dobsoni,* and *Metapenaeus dalei* are all known for multiple spawning events per year, and for some even continuous spawning (Choi et al., 2005; De Croos et al., 2011; Rahman & Ohtomi, 2017). Though no information is available specifically for *M. andamanensis*, as score of 1 is deemed accurate here given how widespread spawning is within the genus.	1
Trophic level	No direct information is available on this species, though it is unlikely that it's trophic level is greater than 3. To remain precautionary, a score of 2 is awarded here corresponding to TL 2.75-3.25.	2
Density dependence	No information available, so a precautionary score of 2 is awarded.	2
Susceptibility		
Fishery only where the scoring element is scored cumulatively	[Insert list of all the fisheries impacting the given scoring element, as required in PF4.4.3].	
Attribute	Rationale	Score
Areal Overlap		
Encounterability		

Selectivity of gear type		
Post capture mortality		

* All of the information, and the basis of the assessment (for this species) is a precautionary assessment of data from this species – and not *M. andamensis*.

Productivity		
Scoring element (species)	**Pandalid shrimp (*Plesionika spp.*)**	
Attribute	Rationale	Score
Average age at maturity.	Though the exact age at maturity has not yet been reported in the literature, the average maximum age for a Plesionika spp. was found to be 5 years (Chakraborty et al., 2014), thus, by plausible argument, the average age at maturity is highly likely to be <5 years. A score of 1 is therefore awarded.	1
Average maximum age	Age data was found for one of the Plesionika spp, *Plesionika quasigrandis*. According to Chakraborty et al. (2014), males and females have an average longevity of ~5 years. Despite this being only one species within the genus, the reported maximum age is half of the maximum age to score 1 in this category, therefore it has been deemed highly unlikely that the average maximum age for this genus exceeds 10 years and a score of 1 is awarded.	1
Fecundity	Chakraborty et al. (2014) found that the relative fecundity ranged from 1630 to 17376 for specimens weighing between 2.8 and 7.5 grams. The values represent an adequate range within the species and can be assumed to be representative of the genus (though variation is likely, these orders of magnitude are unlikely to be exceeded) as there is no other information currently available to the team. A score of 2 is therefore awarded	2
Reproductive strategy	Females have been found with fertilised eggs attached to the ovigerous setae years (Chakraborty et al., 2014). Therefore, the reproductive strategy of Pandalid shrimp is closest to live bearing. Broadcast spawning involves external fertilization (as does demersal egg laying occasionally). Demersal egg laying is explicitly a different strategy, therefore a score of 3 was chosen in order to be precautionary, and as accurate as possible.	3
Trophic level	There are currently no studies on the trophic level or diet of Pandalid shrimp off the Indian coastline. A diet study on Pandalid shrimp in the Aegean Sea revealed that their diet is mainly composed of other shrimp and detritus (Kitsos et al., 2008). This means that it is highly unlikely that their trophic level is above 3, though in order to remain precautionary a score of 2 (TL 2.75-3.25) is awarded here.	2
Density dependence	There is currently no literature on density dependence for this genus, or in this region of the world for demersal deep sea shrimp. Density has been found to limit population growth in *Pandalus borealis* in West Greenland (Wieland, 2005). But this is such a unique and detached example that a strong argument	2

	could be made against using it for this analysis. A precautionary score of 2 will be awarded here.	
Susceptibility		
Fishery only where the scoring element is scored cumulatively	[Insert list of all the fisheries impacting the given scoring element, as required in PF4.4.3].	
Attribute	Rationale	Score
Areal Overlap		
Encounterability		
Selectivity of gear type		
Post capture mortality		

Productivity		
Scoring element (species)	**Deep sea mud shrimp (*Solenocera hextii*)**	
Attribute	Rationale	Score
Average age at maturity.	Given that the maximum lifespan of a close relative is approximately three years, it is safe to assume that the age at maturity is below 5 years – a score of 1 is deemed sufficiently precautionary.	1
Average maximum age	The main information on this genus as a whole is morphometric. Little biological data exists on this species. Ganesh and Chakravarty (2016) found that *Solenocera melantho* had a lifespan of approximately 36 months. This is the most closely related species to *S. hextii* for which this type of information is available. Score:1	1
Fecundity	Fecundity data is available for one study of *Solenocera choprai* off the Mangalore coast, with fecundities observed ranging from 38 532 to 133 689 (Dineshbabu & Manissery, 2008). Both upper and lower boundaries are above 20 000 so a score of 1 is applied.	1
Reproductive strategy	Reproductive strategy is not known for *Solenocera hextii* and is not explicitly stated for any other species in the genus. Therefore, a precautionary score of 2 must be used (regardless of the fact that this score represents demersal egg laying – the score represents the middle value on the scale for PSAs).	2
Trophic level	No information exists on the trophic level of this species, though it is noted that mud shrimp in general tend to be detritivores. Since there is no direct reporting of the trophic level, a precautionary score of 2 will be awarded.	2
Density dependence	Unknown density dynamics. *S. hextii* is not a burrowing species so a comparison to *Nephrops* is not appropriate. As a result, a score of 2 will be given.	2
Susceptibility		
Fishery only where the scoring	[Insert list of all the fisheries impacting the given scoring element, as	

element is scored cumulatively	required in PF4.4.3].	
Attribute	Rationale	Score
Areal Overlap		
Encounterability		
Selectivity of gear type		
Post capture mortality		

Productivity		
Scoring element (species)	**Cigarfish (*Cubiceps spp.*)**	
Attribute	Rationale	Score
Average age at maturity.	The maximum age reported below means that average age at maturity is most likely below 5 years, so a score of 1 is awarded here.	1
Average maximum age	Agatonova and Poluyakto (1992) found that two species of cigarfish – *Cubiceps caeruleus* and *C. pauciradiatus* have a maximum life span of approximately four years. Given that this component of the PSA cannot be broken down to species level, the 4 year maximum age is deemed precautionary enough.	1
Fecundity	There are no reports of fecundity for Cubiceps species online – a score of 2 is awarded as previously when information is lacking.	2
Average maximum size	An average was taken between *Cubiceps macrolepis, C. gracilis, C. pauciradiatus, C. whiteleggii, C. baxteri* (Fishbase), and the average maximum size is 33cm. It is worth noting that four out of five species have a maximum recorded size 20 cm or below, and *C. baxteri* was measured at 100cm. Nevertheless, the average maximum size is well below the score= 1 limit.	1
Average size at maturity	With the average maximum size among Cubiceps species being 33cm, it is near certain that the average size at maturity is below 40 cm, so a score of 1 can be awarded.	1
Reproductive strategy	The reproductive strategy is unknown, and unreported in the literature. A score of 2 will be awarded as a result.	1
Trophic level	Cubiceps are known to feed mainly on salps and microzooplankton and are commonly predated upon by large pelagics such as tuna and swordfish, and also marine mammals (Dollar et al., 2003; Potier et al., 2007). While there is no numerical value describing their trophic level in the literature, it can be inferred that it is between 2.75 and 3.25 based on diet and predator information.	2
Susceptibility		
Fishery only where the scoring element is scored cumulatively	[Insert list of all the fisheries impacting the given scoring element, as required in PF4.4.3].	
Attribute	Rationale	Score

Areal Overlap		
Encounterability		
Selectivity of gear type		
Post capture mortality		

Productivity		
Scoring element (species)	**Arabian red shrimp (*Aristeus alcocki*)**	
Attribute	Rationale	Score
Average age at maturity.	There is no explicit reporting of the age at maturity for this species in the literature. Paramasivam (2018) report size at maturity between 75 and 170mm, however since there is no current estimate of what this converts to in years, the precautionary approach will have to be applied and a score of 2 awarded.	2
Average maximum age	Chakraborty et al. (2018) found that average longevity ranged from 5.41 years in males to 6.17 years for females. Score = 1	1
Fecundity	Average fecundity is found to be between 50 240 and 288 965, which is above the 20 000 cut off for a score of 1.	1
Reproductive strategy	The reproductive strategy is not explicitly stated in the literature so a score of 2 must be awarded.	1
Trophic level	The only mention of feeding ecology of this species is in Chakraborty et al. (2018) where the main food source for this species is believed to be benthic assemblages. Thus, the trophic level of this species is likely to be around 3, so a score of 2 is deemed appropriate.	2
Density dependence	There is no description of density-related dynamics for this species in the literature. A precautionary score of 2 is awarded.	2
Susceptibility		
Fishery only where the scoring element is scored cumulatively	[Insert list of all the fisheries impacting the given scoring element, as required in PF4.4.3].	
Attribute	Rationale	Score
Areal Overlap		
Encounterability		
Selectivity of gear type		
Post capture mortality		

PSA References

Agafonova T.B., Poluyaktov V.F., 1992, Age and growth rate of two species of cigarfishes, *Cubiceps caeruleus* and *C. pauciradiatus* (Nomeidae). J. Ichthyol. 32, 1–10,

Chakrabothy, R. D., Nandakumar, G., Maheswardu, G., Chellapan, K, Sajeev, C. K., Purushothama, P., and Kuberan, G. 2014. Fishery and biology of *Plesikonia quasigrandis* (Chace, 1985) off Sakthikulangara, south-west coast of India. Indian Journal of Fish, 61(4): 10-17,

Chakraborty, R. D., Purushothaman, P., Maheswarudu, G., Kuberan, G., Sreesanth, L., & Ragesh, N. (2018). Population dynamics of Aristeus alcocki Ramadan, 1938 (Decapoda: Penaeoidea: Aristeidae) from southwestern India. Regional Studies in Marine Science, 20, 64–71. doi:10.1016/j.rsma.2018.04.003

Choi, J. H., Kim, J. N., Ma, C. W., & Cha, H. K. (2005). Growth and reproduction of the kishi velvet shrimp, *Metapenaeopsis dalei* (Rathbun, 1902) (Decapoda, Penaeidae) in the western sea of Korea. Crustaceana, 78(8), 947–963. doi:10.1163/156854005775197262,

De Croos, M. D. S. T., Pálsson, S., & Thilakarathna, R. M. G. N. (2011). Sex ratios, sexual maturity, fecundity, and spawning seasonality of *Metapenaeus dobsoni* off the western coastal waters of Sri Lanka. Invertebrate Reproduction & Development, 55(2), 110–123. doi:10.1080/07924259.2010.548649,

Deshmukh, V. D. 2013. Trachypenaeus, Metapenaeopsis and Parapenaeus,

Dineshbabu, A. P., Manissery, J. 2008. Reproductive biology of ridgeback shrimp *Solenocera choprai* (Decapoda, Penaeoidea, Solenoceridae) off Mangalore coast, south India. Fisheries Science 74, 796-803,

Dollar M.L., Walker W.A., Kooyman G.L., Perrin W.F., 2003. Comparative feeding ecology of spinner dolphins (*Stenella longirostris*) and Fraser's dolphins (*Lagenodelphis hosei*) in the Sulu Sea. Mar. Mamm. Sci. 19, 1–19

Ganesh, P. R. C., and Chakravarty, S. 2016. Age and growth of the deep-water mud shrimp *Solenocera melantho* (De Man, 1907) off Visakhapatnam coast, India. Indian Journal of Fisheries 63(4):22-27. doi:10.21077/ijf.2016.63.4.45856-04,

Kitsos, M. S., Tzomos, Th., Anagnostopoulou, L., and Joujouras, A. 2008. Diet composition of the Pandalid shrimp, *Plesionika narval* (Fabricius, 1787) (Decapoda, Pandalidae) in the Aegean Sea. Crustaceana 81(1): 23-33,

Paramasivam, P., Chakraborty, R. D., Gidda, M., Ganesan, K., Ponnathara Kandankoran, B., Laxmanan, S., & Nadakkal, R. (2018). Reproduction in the deep-sea penaeoid shrimp Aristeus alcocki Ramadan, 1938 (Decapoda: Penaeoidea: Aristeidae) from southwestern India. Journal of Crustacean Biology, 38(3), 354–366. doi:10.1093/jcbiol/rux112,

Potier M., Marsac F., Cherel Y., Lucas V., Sabatier R., Maury O., Ménard F., 2007c, Forage fauna in the diet of three large pelagic fishes (lancetfish, swordfish and yellowfin tuna) in the western equatorial Indian Ocean. Fish. Res. 83, 60–72,

Rahman, M., & Ohtomi, J. (2017). Reproductive biology of the deep-water velvet shrimp *Metapenaeopsis sibogae* (De Man, 1907) (Decapoda: Penaeidae). Journal of Crustacean Biology, 37(6), 743–752. doi:10.1093/jcbiol/rux084,

Wieland, K. (2005). Changes in recruitment, growth, and stock size of northern shrimp (*Pandalus borealis*) at West Greenland: temperature and density-dependent effects at released predation pressure. ICES Journal of Marine Science, 62(7), 1454–1462. doi:10.1016/j.icesjms.2005.02.012.