Marine Stewardship Council fisheries assessments

Western Australia sea cucumber

Public Certification Report
Scope Extension

Conformity Assessment Body (CAB)	bio.inspecta (mandated by q.inspecta)
Assessment team	Ms Sascha Brand-Gardner and Dr Klaas Hartmann
Fishery client	Tasmanian Seafoods Pty Ltd
Assessment type	Scope Extension
Date	12 December 2022

Contents

1 Glossary

Acronym	Description
AIMS	Australian Institute of Marine Sciences
CAB	Conformity Assessment Body
CPUE	Catch per unit effort
ERA	Ecological Risk Assessment
EBFM	Ecosystem Based Fisheries Management
FIS	Fisheries independent survey
HCR	Harvest Control Rule
HS	Harvest Strategy
IUCN	International Union for Conservation of Nature
NT	Northern Territory
SCPUE	Standardised catch per unit effort
UoA	Unit of Assessment
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring systems
WA	Western Australia
WAM	Western Australia Museum
WASCF	Western Australia sea cucumber fishery

2 Executive summary

This report is the Public Certification Report which outlines the scope extension to include the Kimberley sandfish stock as the third unit of certification in the Western Australia sea cucumber fishery (WASCF). The assessment team consists of Ms Sascha Brand-Gardner (Team Leader and Principle 2 and 3) and Dr Klaas Hartmann (Principle 1).

The WASCF was certified in December 2019 under MSC Standard v 2.0. The default assessment tree of MSC Fisheries Standard v 2.0 and the MSC Fisheries Certification Process version 2.2 is being used for this scope extension, however only those performance indicators identified in the gap analysis (i.e. all Principle 1 performance indicators, habitat and ecosystem) have been assessed. The other assessment components were the same as the original assessment.

The site visit was held on 31st May 2022 in Fremantle, Western Australia with the assessment team on site. There were no stakeholder submissions received or requests for a private meeting.

Fishery strengths

- The fishery uses hand collection which is highly selective and therefore has minimal impact on Principle 2 components
- Restrictions on entry, vessel size and number of divers minimises impacts on P2 components
- ERA provides key information on fishery
- The fisheries independent survey provides a sound biomass estimate for the surveyed area.
- Catch has been at low levels for an extended period allowing substantial biomass recovery.

Fishery weaknesses

- The standardised CPUE index is only standardised for sub-areas. The biomass trend in the assessment model is based on this index and as the FIS has only been conducted a single time this currently serves to scale biomass.
- There is no information on the stock structure of the Kimberley population.

On completion of the site visit and scoring and taking into account peer reviewer's comments, no PIs scored less than the Scoring Guidepost (SG) of 60 and the average score for the three Principles remained at or above SG80 for this UoA. Two performance indicators scored between 60 and 80 under principle 1 and two additional conditions have been placed on the fishery. bio.inspecta's certifier, the decision making entity, has determined that the scope of the certificate is extended to include Kimberley sandfish.

3 Report details

3.1 Authorship and peer review details

All team members listed below meet the competency criteria in Annex PC of the MSC Fisheries Certification Process v2.2 and have confirmed that there are no conflicts of interest.

Ms. Sascha Brand-Gardner, Lead Auditor and Principle 2 and 3 Expert

Ms. Brand-Gardner is bio.inspecta's MSC Fisheries Program Manager and has been a Lead Auditor at bio.inspecta since 2019. Sascha has led the Full Assessment of a wide range of fisheries including the Bass Strait Scallop Fishery (in assessment), Blue Grenadier Winter Spawning Fishery, Blue Grenadier Fishery, Lakes and Coorong Pipi Fishery amongst others. Sascha is an experienced Principle 3 auditor evidenced by her role in the Heard and McDonald Islands and Macquarie Island toothfish re-assessments in 2016 and the Eastern Tuna and Billfish Fishery re-assessment in 2020. She also conducted MSC Pre-assessments and Surveillance Audits for an even wider range of species, fisheries and regions.

Sascha brings to be team more than 20 years of experience in fisheries policy, ecosystem-based fishery management, project management and liaison with the fishing and aquaculture industries. Prior to bio.inspecta, Sascha was a senior fishery manager at the Department of Primary Industries and Regional Development (DPIRD) - Fisheries Division in Western Australia (WA) where she worked on a range of resource management projects for over 15 years. She holds an Honours degree in Marine Zoology from the University of Queensland and has also worked on several marine research projects related to endangered, threatened and protected species, fishery habitats, abalone and aquaculture.

During her time at DPIRD, Sascha managed several large trawl and pelagic fisheries as well as multispecies ornamental species. She worked in WA's Fisheries Certification Project team that supported MSC pre-assessments of 50 commercial fisheries and full certification of several invertebrate fisheries.

Sascha has been trained by the MSC to use the Risk Based Framework (RBF) and the most recent MSC Standard and Certification Process. She is a certified Lead Auditor under the ISO 9001:2015 standard. Sascha is also a trained MSC Chain of Custody auditor performing assessments for numerous businesses throughout Australia.

Dr Klaas Hartmann, Team Member and Principle 1 Expert

Dr Hartmann is a Senior Research Fellow and Mathematician at the Institute for Marine and Antarctic Studies (IMAS) University of Tasmania whose research involves bio-economic modelling across a broad range of fisheries. Throughout his career he has worked on resource and conservation management from a mathematical ecology and ecological economics perspective. After working in fisheries at CSIRO for two years, Klaas focused on prioritising resources for biodiversity conservation, particularly using phylogenetic information.

Since commencing work at IMAS in 2009, Klaas has returned to his initial interest in fisheries modelling. At IMAS Dr Hartmann works on bio-economic models and developing/evaluating novel management strategies in collaboration with fisheries managers and industry. This work has helped support large changes in several fisheries that have substantially increased their profitability whilst improving environmental outcomes. Klaas has been responsible for conducting or overseeing Southern rock lobster and giant crab assessments in Tasmania for over ten years and Victoria for five years. Klaas was responsible for producing the Tasmanian Scalefish assessment for three years and has overseen and/or advised the assessment process for a further five years. Klaas is a committee member of the Tasmanian Crustacean Fisheries Advisory Committee and the Status of Key Australian Fish Stocks Advisory

Committee. Dr Hartmann has been the P1 expert on several confidential pre-assessments and the recent annual surveillance audits of WA fisheries including the Peel Harvey Estuarine Fishery and the WA sea cucumber fishery.

The peer review was conducted by either Chris Grieve or Peter Trott. For further information please see details on the fisheries MSC assessment page (here).

3.2 Version details

Table 1 – Fisheries program documents versions	
Document	Version number
MSC Fisheries Certification Process	**Version 2.2**
MSC Fisheries Standard	**Version 2.0**
MSC General Certification Requirements	**Version 2.4.1**
MSC Reporting Template	**Version 1.2**

4 Unit of Assessment and Unit of Certification and results overview

4.1 Unit of Assessment and Unit of Certification

4.1.1 Unit of Assessment

bio.inspecta confirms that this fishery is "within scope" and eligible for MSC certification (FCP v2.2 7.4) as it:

- Does not operate under a controversial unilateral exemption to an international agreement, use destructive fishing practices or target amphibians, reptiles, birds or mammals
- Does not include an entity that has been convicted for a forced or child labour violation in the last 2 years
- Does not engage in shark finning, is not an enhanced fishery and is not based on an introduced species
- Has a mechanism for resolving disputes and is not overwhelmed by disputes.

Table 2 – Unit of Assessment (UoA)	
UoA 3	Description
Species	Kimberley sandfish (*Holothuria scabra)*
Stock	*Holothuria scabra* stock in the Kimberley

Fishing gear type(s) and, if relevant, vessel type(s)	Hand collection
Client group	Tasmanian Seafoods Pty Ltd
Other eligible fishers	There are no other eligible fishers
Geographical area	North coast of Western Australia. FAO Major Fishing Area 57, Subarea 57.5. Division 57.5.1

4.1.2 Unit of Certification

Table 3 – Unit of Certification (UoC)	
UoC 3	Description
Species	Kimberley sandfish (*Holothuria scabra)*
Stock	*Holothuria scabra* stock in the Kimberley
Fishing gear type(s) and, if relevant, vessel type(s)	Hand collection
Client group	Tasmanian Seafoods Pty Ltd
Geographical area	North coast of Western Australia. FAO Major Fishing Area 57, Subarea 57.5. Division 57.5.1

4.2 Gap analysis for scope extension

The procedural requirements for scope extensions to MSC fisheries are set out in Annex PE of the MSC Fisheries Certification Process v2.2 (2018). In line with PE1.2.2.1, the CAB shall include the additional information in the announcement:

a. A gap analysis, described in FCP 7.27.4, and justifications for the outcomes.
b. The assessment components held in common between the two fisheries.
c. The assessment components that will be assessed in the scope extension.
d. Justification confirming whether there are any potential implications for other Performance Indicators (PIs).

Table 4. Gap analysis for proposed scope extension

Principle	Components	Overlaps With Existing Fishery?	Explanation Of The Degree Of Overlap	Is Updated Assessment Needed?	Comment Re. Need For Updated Assessment
P1	1.1.1 Stock status	No	NA	Yes	Maybe genetic differences between the fished stocks in the Kimberley and

					Pilbara. These two are considered as two separate stocks for management purposes
	1.2.1 Harvest strategy	No	NA	Yes	An assessment of the Kimberley sandfish specific performance indicator, reference levels and control rules is required.
	1.2.2 Harvest control rules and tools	No	NA	Yes	An assessment of the Kimberley sandfish specific control rules is required.
	1.2.3 Information and monitoring	No	NA	Yes	Information base has been expanded for this stock
	1.2.4 Assessment of stock status	No	NA	Yes	Managed as a separate stock
P2	2.1.1 – 2.1.3 Primary Species	Yes	There are no primary species	No	NA
	2.2.1 -2.2.3 Secondary species	Yes	There is a very small take of other sea cucumbers that are also found in the Kimberley	No	NA
	2.3.1-2.3.3 ETPs	Yes	It overlaps with the existing fishery in that there are no interactions with ETPs	No	NA
	2.4.1-2.4.3 Habitat	No	The stock is fished in a different region and occupy different habitats	Yes	The stock is fished in a different region and occupy different habitats with different management arrangements (e.g. closed areas) and information.
	2.5.1-2.5.3 Ecosystem	No	The stock is fished in a different region.	Yes	The stock is fished in a different region and occupy different habitats with different management arrangements (e.g. closed areas) and information.
P3	3.1.1-3.1.3 Governance and Policy	Yes	Full overlap	No	NA
	3.2.1-3.2.4 Fishery specific management system	Yes	Full overlap	No	NA

4.3 Assessment results overview

4.3.1 Determination, formal conclusion and agreement

On completion of the site visit and scoring, and taking into consideration the peer reviewer's comments, two PIs in Principle 1 scored less than the Scoring Guidepost (SG) of 80 and two conditions were assigned (Table 6). The average scores for the three Principles remained above SG80 (Table 5). Following the recommendation from the assessment team, bio.inspecta's certifier has determined that the Kimberley sandfish UoA should be certified.

4.3.2 Principle level scores

This is the third unit of certification to be added to the existing certificate.

The new scores for the performance indicators assessed as part of this scope extension were added to those original scores to ensure the average across each principle remained ≥ 80.

Table 5 - Principle level scores	
Principle	UoA 3
Principle 1 – Target species	83.3
Principle 2 – Ecosystem impacts	85.5
Principle 3 – Management system	92.9

4.3.3 Summary of conditions

Table 6 – Summary of conditions						
Condition number	Condition	Performance Indicator (PI)	Deadline	Exceptional circumstances?	Carried over from previous certificate?	Related to previous condition?
9	Demonstrate that the HCRs are robust to the main uncertainties (e.g consideration of the spatial representativeness of the biomass estimate and/or the spatial areas represented by different data sources).	1.2.2	**Audit 1, next certification period**	**Yes**	**NA**	**NA**
10	Sufficient information relevant to stock structure should be	1.2.3	**Audit 1, next certifica**	**Yes**	**NA**	**NA**

	made available to support the harvest strategy.		**tion period**			

In accordance with FCP 7.27.8 and the associated guidance, UoA 3, the subject of this scope extension, still has the full 5 year timeframe to close out the conditions raised. This extended UoA is considered an exceptional circumstance in line with 7.18.1.6 and thus the conditions are due to be closed out at audit 1 of the next certification period. The original assessment had 8 conditions and these additional two conditions will be condition 9 and 10.

4.3.4 Recommendations

More details should be provided on the spatial closures required by the harvest control rule including processes and monitoring that would be used as part of the reopening.

5 Traceability and eligibility

5.1 Eligibility date

Products from UoC3 are eligible to be sold as MSC certified from the date in which the Public Comment Draft Report was published. The addition of Kimberley sandfish means that all retained catch from the fishery will be certified. All catch is transported to the processing facility in Victoria and the facility holds an MSC chain of custody certificate. The traceability and segregation systems that are required to ensure the separation of any certified product from non-certified product are already in place for the client fleet. bio.inspecta considers that the traceability and segregation systems in the fishery are appropriately implemented.

The client has been informed that any sea cucumbers harvested after the eligibility date and sold or stored as under-assessment sea cucumbers shall be handled in conformity with the following requirements:

a. All under-assessment products shall be clearly identifiable and segregated from certified and non-certified products.
b. The client shall maintain full traceability records for all under-assessment product demonstrating traceability back to the UoC and including the date of harvest.
c. Under-assessment products shall not be sold as certified or labelled with the MSC ecolabel, logo, or trademarks until fishery certification and product eligibility are confirmed.

5.2 Traceability within the fishery

Only certified species are retained by the client. Vessels do not fish in Western Australia and the Northern Territory at the same time. Sandfish are cut, gutted and boiled (for 10-20 mins), drained and placed into onion bags and frozen on board the vessel. When they are landed, they are moved into refrigerated transport and sent directly to Victoria. See the table below for more details.

Table 6.1 – Traceability information	
Factor	Description

Will the fishery use gears that are not part of the UoC? If yes, please describe: - If this may occur on the same trip, on the same vessels, or during the same season; - How any risks are mitigated.	No
Will vessels in the UoC also fish outside the UoC geographic area? If yes, please describe: - If this may occur on the same trip; - How any risks are mitigated.	The Client's fishing operations in the Kimberley (targeting sandfish) are conducted from a Darwin-based vessel. The vessel used in WA is also licenced to fish in the Northern Territory (NT) and the Torres Strait. However, this does not occur on the same trip. Fishing for sea cucumber in WA waters only occurs during WA-specific trips.
Do the fishery client members ever handle certified and non-certified products during any of the activities covered by the fishery certificate? This refers to both at-sea activities and on-land activities. - Transport - Storage - Processing - Landing - Auction If yes, please describe how any risks are mitigated.	Fishery client members handle only certified product until the product is packaged by batch onto trip-specific pallets upon landing. It may occur that pallets from different trips (e.g. WA and NT trips) are transported by the same truck to the processing plant in Victoria. Supply chain: The catch is processed in-part and sorted (by species) on-board before being frozen in blocks according to the following process: On-board processing method for sandfish and redfish: o Slit and gut and put in tub with circulating salt water o Once 2 tubs ready, put into cooker and bring to boil – cook for between 10 and 20 minutes (depending on size) o Take out and either put in circulating salt water to cool down (circa 1hr) or put on racks for approximately 30 minutes to 1 hr (depending on ambient temperatures and size of sea cucumbers) o Freeze either by snap or normal freezer (depending on vessel's capacity) Processed weight and number of individuals is estimated and recorded on-board. Product is packed in labelled onion bags and put on trip-specific pallets on landing (either in Darwin in the NT or in Dampier, Onslow or Exmouth in the Pilbara). All individuals of a single species caught during a single trip constitute a 'batch'. Pallets are labelled with batch numbers and may contain multiple batches (species) from a single trip, but do not contain batches from multiple trips, ensuring segregation of WA product. Pallets are loaded into a truck at the point of landing for transport to the client's plant in Victoria. Trucks occasionally may transport pallets from multiple vessels / trips (e.g. separate WA and NT trips by different vessels).

	At the processing plant, each batch is weighed. The product then completes processing in preparation for export. The plant receives product from all regions and currently does keep WA caught sea cucumbers separated from those caught elsewhere. (The Department receives both the on-board estimated processed weights and number of individuals and the processed weights as determined and recorded at the processing plant. It has copied the on-board processing method in order to establish species-specific processed weight : live weight ratio's, which are applied to the recorded processed weights to calculate live weight of the catch. The ratio used for redfish is 1:4 while the ratio for sandfish, teatfish and all other species is 1:3.)
Does transhipment occur within the fishery? If yes, please describe: - If transhipment takes place at-sea, in port, or both; - If the transhipment vessel may handle product from outside the UoC; - How any risks are mitigated.	No
Are there any other risks of mixing or substitution between certified and non-certified fish? If yes, please describe how any risks are mitigated.	There are no risks of mixing between or substitution of certified and non-certified product in the supply chain up until delivery to the processing plant in Victoria

5.3 Eligibility to enter further chains of custody

Tracking and traceability information for this fishery is considered sufficient for product to be eligible to enter further chains of custody. The Kimberley sandfish stock will be included on the MSC certificate and is eligible to carry the ecolabel. Eligible points of landing include Darwin, Dampier, Exmouth and Onslow. As is the case with the existing certificate, Chain of custody is required once the product reaches the processing facility in Dandenong, Victoria.

6 Scoring

6.1 Summary of Performance Indicator level scores

The score for each performance indicator assessed in the scope extension (UoA 3) presented below has been agreed by all team members as a result of ongoing post site visit discussions and revisions of the report. Scoring rationales are presented in the following sections of the report.

Principle	Component	Performance Indicator (PI)		Score
One	Outcome	1.1.1	Stock status	90
	Management	1.2.1	Harvest strategy	85
		1.2.2	Harvest control rules & tools	75
		1.2.3	Information & monitoring	75
		1.2.4	Assessment of stock status	85
Two	Habitats	2.4.1	Outcome	80
		2.4.2	Management strategy	85
		2.4.3	Information	80
	Ecosystem	2.5.1	Outcome	80
		2.5.2	Management	80
		2.5.3	Information	80

6.2 Principle 1

6.2.1 Principle 1 background

The Principle 1 background is based largely on extracts from the comprehensive background provided in Hart et al. 2022.

6.2.2 Biological background

Taxonomy and Distribution

In Australia Sandfish, *Holothuria scabra*, grows up to 40 cm long. It is generally recognised that a sub-species of *H. scabra*, known as *H. scabra versicolour* does exist (Hamel et al. 2001). The distinction however, has not been made for WA stocks, and all animals harvested are assumed to be *H. scabra*.

Stock Structure

Holothuria scabra is widely dispersed in shallow water on soft sediments throughout the Indo-Pacific region, bounded by the East Coast Africa, the tropics of Cancer and Capricorn and west of mid Pacific Ocean (Bell et al. 2008).

In WA, the boundaries of commercially fished populations are Barrow Island in the south-west of its range, and Wyndham in the north, a distance of about 1800 km. Within these populations, areas fished are discrete and generally separated by large distances. Most fishing activity targets the densest populations of sandfish, occurring within the remote bays and estuaries of the Pilbara and Kimberley coasts.

Uthicke and Benzie (2001) investigated gene flow in *H. scabra* populations with a view to increasing knowledge on this commercially important species and assisting management along the north-east coast of Australia. Allozyme analyses identified and concluded that *H. scabra* populations along the north-east coast of Australia can be grouped into at least 3 genetically distinct stocks: (1) southern populations from the Hervey Bay area, (2) one population from the central coast, and (3) populations from Torres Strait. The latter region is closely related to samples from the Solomon Islands. A similar result was reported by Gardner and Fitch (2012) in relation to *H. scabra* populations within Northern Territory waters, suggesting the existence of genetically distinct stocks in the Gulf of Carpentaria (or eastern population) and the Arafura Sea (or western population).

In view of these studies, and noting the existence of morphological differences between Pilbara and Kimberley sandfish, these are considered to represent two separate stocks for management purposes. Hence they are assessed as two separate UoAs. Within these stocks the available evidence indicates that local populations with moderate connectivity (largely through larval dispersal) exist. However, the scale, number and source-sink dynamics of these populations is unknown. In the MSC Guidance to the Fisheries Certification Process (v2.1) this is most closely matches the stock structure C in table G2: "*Local populations with moderate connectivity within the meta-population*". A key aspect of this is that "*Information and uncertainties related to stock structure need to be scored in PIs 1.2.2, 1.2.3 and 1.2.4.*".

Morphological Relationships

Adults generally measure between 150 and 400 mm in length. The body wall accounts for about 56 % of the total weight (Conand 1989). The reported body weight varies considerably, between 300 and 3000 g, over its geographical range. However, it has been noted that the weight depends on the amount of coelomic water and sediment in the alimentary canal (Conand 1989) and length-weight measurements can be highly variable. The relationship for WA is of a similar form to a Queensland population from the Torres Strait.

Habitats

Holothuria scabra are distributed within low energy environments behind fringing reefs or within protected bays. Original distributions are mostly the shallow sub-tidal areas but can occur in depths up to 40 m. Strong tidal currents appear to be the common habitat/environmental feature of both historical and presently important areas of wild stocks.

Age and Growth

Average growth of *H. scabra* under controlled conditions range from 7 to 15 mm per month and a corresponding weight gain, estimated between 6 to 27 grams per month (Battaglene et al. 1999). When *H. scabra* were stocked at a biomass > 225 g m^{-2}, growth ceased and some individuals even lost weight (Battaglene et al. 1999; Conand 1983). In contrast, studies in the wild, although scarce indicate a growth rate of 10 to 15 mm per month (Mercier et al. 2000). Hatchery reared *H. scabra* juveniles of 15 mm cm have been known to attain 10 cm after six months spent in a closed lagoon.

Age and growth estimation is difficult in Holothurians due to their variable morphology, however sandfish have been estimated to live beyond six years of age and reach the age at maturity in two years (Conand 1989, 1998; Kinch et al. 2008).

Natural Mortality (M)

Limited information is available on natural mortality (M) in these species due to the difficulty in measuring age and size, or conducting mark-recapture experiments. A recent review of harvest strategies for populations of sea cucumbers on East Coast Sea Cucumber fishery of Queensland assumed an M of 0.4 year-1 was appropriate for most species, with 0.3 year-1 being used in species considered especially vulnerable (Skewes et al. 2014). These estimates of M are considerably lower than several estimates reported in the literature for *H. scabra* (e.g. Dissanayake & Wijeyaratne 2007), and highlights the uncertainty surrounding knowledge of this important parameter. Given this uncertainty, and the fundamental importance of M in fisheries assessment, for the purposes of estimating stock levels using population modelling, an M of 0.35 (with appropriate uncertainty) was assumed for *Holothuria scabra* in WA.

Reproduction

In Australia, the main spawning season of *H. scabra* occurs in the spring months of September to November. Geographically, there is variability from month to month and season to season. Triggers for spawning include temperature, salinity and lunar changes, including chemical cues from males which initiate spawning. Numerous studies have concluded spawning continues year round (Hamel et al. 2001).

Size at-maturity (L50) for male *H. scabra* various geographically, and has been reported in the range of 140 to 170 mm. Females were identified from 199 mm onwards and the sex ratio reached 45:55 female to male at maturity, other studies in different geographical locations indicate sex ratios are more even at 1:1 (Hamel et al. 2001). No studies are available for size at maturity studies of WA populations of sandfish and voluntary size limits are based on Northern Territory data. Preliminary examination of 20 animals in the size-range of 115 to 330 mm from WA populations found only three animals with undefined gonads (Hart and Murphy, unpublished data).

Conand (1989, 1993) evaluated potential fecundity by dissecting mature whole gonads of *H. scabra* and proposed values of >2 – 18 million oocytes per female, with higher values for the larger females. Conand

(1989, 1993) found that the absolute fecundity of *H. scabra versicolour* varied between nine and 17 x 10^6 oocytes per female and was correlated with body size (Hamel et al. 2001).

Factors Affecting Year Class Strength and Other Biological Parameters

Field studies in the Solomon Islands (Mercier et al. 2000) indicate the larvae of *H. scabra* actively select certain seagrasses, possibly through chemical selection. Mercier et al. (2000) hypothesised that larvae settling on suitable seagrass have an increased chance of growth and survival because they are provided with a suitable sub-stratum to grow, and a bridge to sandy sub-stratum.

James et al. (1994) indicated that the main predators of the larval forms of *H. scabra* were copepods and ciliates that attacked the larvae, causing injury and death. These organisms also indirectly harmed juveniles, especially those recently settled, by competing for food (Battaglene et al. 1999).

In relation to *H. scabra*, water temperature, salinity and tidal movements are likely to be the most important factors affecting settling recruits for this species as they generally inhabit protected bays and estuaries of the Kimberley.

Inherent Vulnerability

Plaganyi et al. (2013) examined climatic effects on managing sea cucumber fisheries and concluded that higher sea temperatures will have a positive effect i.e. higher production and yields given the expected faster growth rates leading to larger sizes and increased fecundity. This positive view on their vulnerability is supported by a productivity susceptibility analysis (PSA) which indicates that sea cucumbers are inherently robust to exploitation as a result of their life history parameters which suggest they are high productivity populations.

However, sea cucumbers are also considered to have a high level of inherent vulnerability to fishing. Most species with tropical distributions inhabit shallow waters within the range of breath-hold or hookah-assisted divers (Kinch et al. 2008). They tend to have sluggish displacement rates (e.g. Purcell and Kirby 2006 with respect to *H. scabra*), indicating they are slow to move away from high density patches identified and targeted by fishers (Purcell et al. 2013).

As gonochoric broadcast spawners, sea cucumbers need to be in close proximity of mates to ensure fertilisation success (Purcell et al 2013). Fertilisation rates decline with decreasing density, due to reduced gamete densities and associated reduced probabilities of egg-sperm encounters (Levitan 1991; Babcock et al. 1994; Wahle and Peckham 1999). Such changes in fertilization success and resulting reduced gamete production are disproportional to changes in adult densities, a form of Allee effect (Uthicke 2004).

Allee effects and population density extremes have been suggested to be more pronounced in broadcast-spawning echinoderms with planktotrophic larval stages (such as sandfish) as opposed to species with lecithotrophic development. This is because larvae of the latter species are independent from the requirement to feed in the plankton and tend to settle quicker (presumably resulting in lower mortality rates in the plankton and enhanced local recruitment) (Uthicke et al. 2009).

For species vulnerable to Allee effects, the severity of a population decline and ultimate time for recovery depends on the geographic extent of the decline, and the connectivity of subpopulations (Uthicke et al. 2009). In the case of the *H. scabra*, population reduction in the Torres Strait off northern Australia (which resulted in a population biomass of <10% of the original biomass determined from fishery surveys in 2002 and 2004, 4 and 6 years after the fishery was closed in 1998, showed that recovery was very slow (Skewes et al. 2000).

6.2.3 Commercial Fishery

History of Development

Commercial fishing for sea cucumbers began in 1995, and until 2007 it was primarily a single species fishery with 99% of the catch being sandfish (*Holothuria scabra*). Initially high catches of sandfish were taken (a total of 1360 t in the first 6 years), however, total catch of sea cucumbers has averaged 90 tonnes per year in the subsequent 16 years. Total catch has varied between 0 t (2013) and 380 t (1997). Between 2007 and 2018, redfish was typically the dominant species caught, however, sandfish remains the primary species in the fishery due to its wider distribution and longer catch history.

Current Fishing Activities

The WASCF is currently managed under Fisheries Notice No. 366 (Prohibition for Commercial Fishers Unless Otherwise Endorsed- Shellfish, Coral, Fish of class Echinoidea and Bêche-de-Mer). Fishers in the WASCF operate under an exemption to this Notice under Section (7)(3)(c) of the Fish Resources Management Act (FRMA). Currently there are two exemptions issued to permit commercial exploitation of sea cucumbers in the WASCF. One exemption permits commercial fishing in all areas of WA, and the other exemption permits commercial fishing by appropriate persons in waters adjacent to the traditional lands of the Mulgana, Bayungu, and Thalanyji Aboriginal people, which are in the Shark Bay and Exmouth Gulf regions.

The WASCF is permitted to operate throughout WA waters with the exception of marine parks, reserves and sanctuaries and a number of specific closures around Cape Keraudren, Cape Preston and Cape Lambert, the Rowley Shoals and the Abrolhos Islands. To date however fishing has only occurred on tropical species in the northern half of the state.

The WASCF targets remote and largely inaccessible stocks in a very large region with challenging conditions (e.g. extreme tidal movements, strong currents, poor visibility and the presence of saltwater crocodiles). Both the Kimberley region for sandfish (*H. scabra*) and the Barrow Island/the Montebello Islands and Shark Bay regions for redfish (*A. echinites*) are isolated, making these populations difficult and expensive to access and requiring immediate processing of the catch (gutting, boiling, freezing) to maintain the quality of the product for market.

The environmental conditions under which fishing in these regions takes place result in limited 'windows of opportunity'. To maintain high catch rates, current practice for sandfish is a 'pulse' fishing operation that targets sandfish aggregations throughout a number of specific locations in the Kimberley on average for two to three trips of 14-20 days each per year. Sandfish in the Pilbara region have been targeted less frequently. Redfish has historically been targeted sporadically, and the newly developed Shark Bay fishery has only received one year of significant catch. These conditions have resulted in natural refuges for sea cucumbers and significant periods during which aggregations that are targeted by the fishery are left undisturbed.

Fishing Methods and Gear

The method of fishing involves drift diving using hookah, scuba, or free diving, in small vessels <3 m long known as dorys. Fishers operate using the one up one down method, one diver is in the water collecting sea cucumbers and the other remaining in the vessel steering its course. Diving is typically in water <5 m deep. The divers and dorys return to the main vessel at the end of a day where the sea cucumbers undergo initial processing. This involves gutting, boiling and a short drying period before being frozen in blocks. Secondary processing occurs in Melbourne where sea cucumbers are dried and packaged before being exported as 'beche-de-mer' to Asian markets.

Susceptibility

The species are both widely distributed in the shallow near-shore habitat; however fishing mostly occurs in shallow-water mangrove lagoons and estuaries during neap tides, as the strong currents and poor visibility in the Pilbara and Kimberley regions due to the extreme tidal ranges renders fishing impractical at other times. Collection is limited to specific sites characterised by easily accessible, open water areas where impediments to fishing operations from crocodiles are less likely to occur and visibility is sufficient to allow collection by hand. These limitations, coupled with the burrowing nature of sea cucumbers (for example, Skewes et al. (2000) found that the population abundance of the sandfish can be underestimated by up to 60 % due to its burrowing habit in seagrass beds at high tide), means that individuals less than the size at maturity are rarely caught, as evidenced also by observed trends in size structure.

6.2.4 Harvest Strategy

The harvest strategy for the sea cucumber resource of WA is a constant exploitation approach where the catch varies in proportion to variation in stock abundance.

The sandfish fishery in the Kimberley is based on a large number of smaller populations that have been harvested over a longer time period. In line with the harvest strategy, the WASCF is managed primarily using input controls, including limited entry, species restrictions and minimum legal sizes, gear/method restrictions, and spatial closures.

Recreational harvest of sea cucumbers is allowed under a capped daily bag limit of 10 individuals of other [non-listed] molluscs and invertebrate species. However, the actual recreational catch is negligible. Similarly, customary take is allowed, but also negligible.

Harvest Strategy

A harvest strategy for the sea cucumber resource outlines the long- and short-term objectives for management (DPIRD 2018). It also provides a description of the performance indicators used to measure performance against these objectives, reference levels for each performance indicator, and associated control rules that articulate pre-defined, specific management actions designed to maintain the resource at target levels.

The key considerations informing the harvest strategy for the sea cucumber resource in WA are its geographical isolation, the spatially discrete nature of the resource, and the intrinsic vulnerability of sea cucumber stocks when effort is difficult to constrain.

The harvest control rule has been updated significantly since the development of the harvest strategy and is detailed in Hart et. al. (2022). The principal performance indicator for the Kimberley sea cucumber population is the annual biomass estimate introduced in Hart et. al. (2022) (Figure 3). The biomass estimates is derived from a population model which uses three main data sources: 1) catch data from the beginning of each fishery; 2) catch rate data from the inception of the daily logbook programme, and 3) one or more fishery independent surveys (currently one is available). Associated reference points have been set using the estimate of unfished biomass (B0) at the beginning of the fishery. Reference levels defined as: Target (50% B0), threshold (40% B0) and limit (30% B0).

Fisheries Dependent Data

Historically sea cucumber fishers provided monthly returns of catch and effort at a 60nmx60nm statistical block scale.

Since 2007, there has been a statutory obligation to provide a daily catch and effort logbook. Information recorded on this logbook includes detail on the vessel; name and registration numbers, crew names/numbers and vessel anchorage. The effort component includes number of dives (air supply or snorkel) and wades, catch by method in both biomass (kg) and numbers, GPS starting positions, duration of effort, depth fished and distances covered. This is used to develop detailed spatial maps of the catch distribution trends (Figure 1).

A key indicator calculated from the logbook data is the standardised CPUE. The standardised CPUE is calculated from:

$$\ln(CPUE+1) = \mu + \beta_1(Year) + \beta_2(Sub-area) + \varepsilon$$

Where the sub-areas are the only factor for which the index is being standardised. In the Kimberley region four sub-areas are considered. The calculated index is shown in Figure 2. There are years with missing data as no fishing occurred and years with high uncertainty due to the limited fishing activity and data availability. However the sCPUE index has exhibited a general upwards trend.

Fisheries Independent Survey

The fisheries independent survey (FIS) for sandfish have been undertaken once in the Kimberley region in 2019 at the Osbourn Islands, Vansittart Bay, and Napier Broome Bay (Figures 5 and 6). Due to safety considerations these were surveyed by an ROV (Remotely Operated Vehicle).

Sea cucumber population distribution is governed by habitat heterogeneity and prevailing oceanography. For example, in the Kimberley area, 81 strata were identified as holding populations of sandfish, but the average area was small, being 70 hectares or 0.7 km2. The two main species targeted by the WASCF have a wide Indo-Pacific distribution and are key components of tropical marine ecosystems. However, the Kimberley has not been comprehensively surveyed for sea cucumbers and there are likely to be populations that have remained undiscovered.

To account for this spatial constraint, a key parameter in the estimation of biomass from the FIS programme is a scaling factor that relates area surveyed to the total area of available habit. This estimate has been based on historical fishing data and some exploratory surveys, however very small areas can hold substantial biomass. For Kimberley sandfish it was estimated that the FIS surveyed 22% of the Kimberley sandfish populations.

Data collected were used to estimate current biomass (Figure 4), and virgin biomass (Figures 7 and 8) as part of the input information to a biomass dynamics model.

Biomass Dynamics Model

A discrete version of the surplus production model with an annual time step (or biomass-dynamics model), applying the Schaefer (1954) production equation, was fitted to the catch, catch rate and fishery-independent survey biomass data for sandfish in the Kimberley region. This approach had previously been applied to the other UoAs.

In the Kimberley and Pilbara regions, two biomass modelling scenarios were investigated to account for the fact that fishery independent surveys (FIS) of sandfish biomass did not cover 100% of the known area of catch and populations.

Scenario 1, or “conservative”, assumed that the area covered by the FIS strata (53.3 km2 in Kimberley) included all known stocks. This was overly-conservative and represents a minimal scenario.

Scenario 2 or "realistic" used the knowledge of the % of populations that occurred in the strata covered by the FIS surveys. To calculate this, investigations of historical catch were made, particularly within the early years of the fishery, which generally involved more exploratory fishing. For the Kimberley region, 22% of the populations were surveyed by FIS. For these scenarios, the FIS biomass estimate was multiplied by (1/0.22 = 4.55) for the Kimberley stocks.

Model outputs are summarised in Figures 7 and 8.

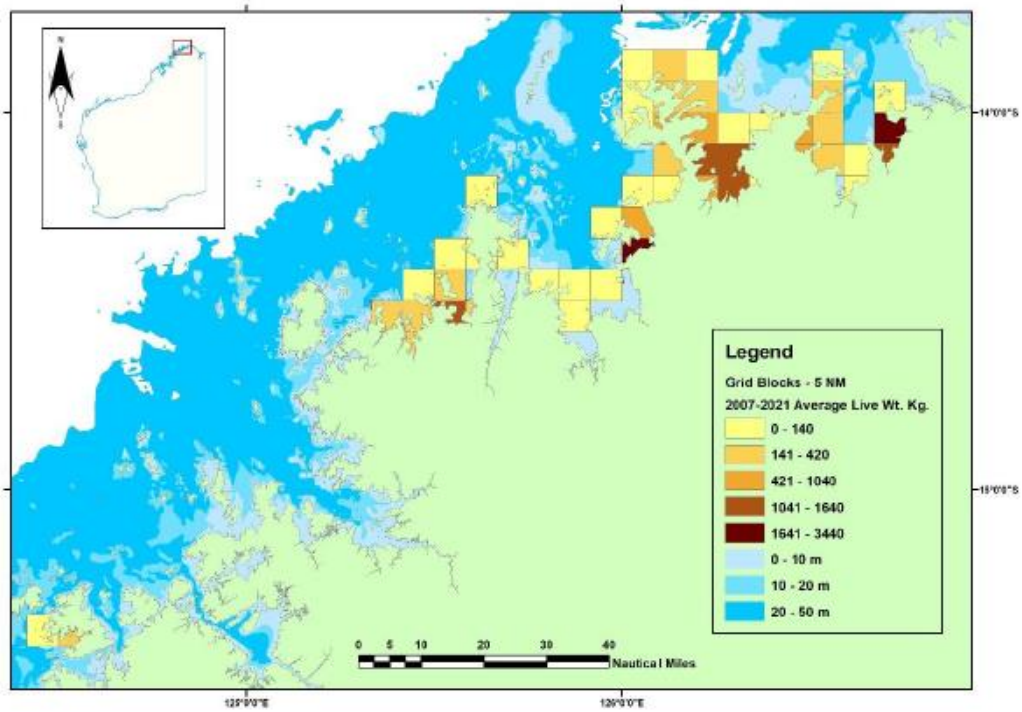

Figure 1: Catch distribution map (5x5nm blocks) for the Kimberley stock of sandfish. Data is mean annual catch for the period 2007-2021 where fine-scale fishing data was available (from Hart et. al. 2022).

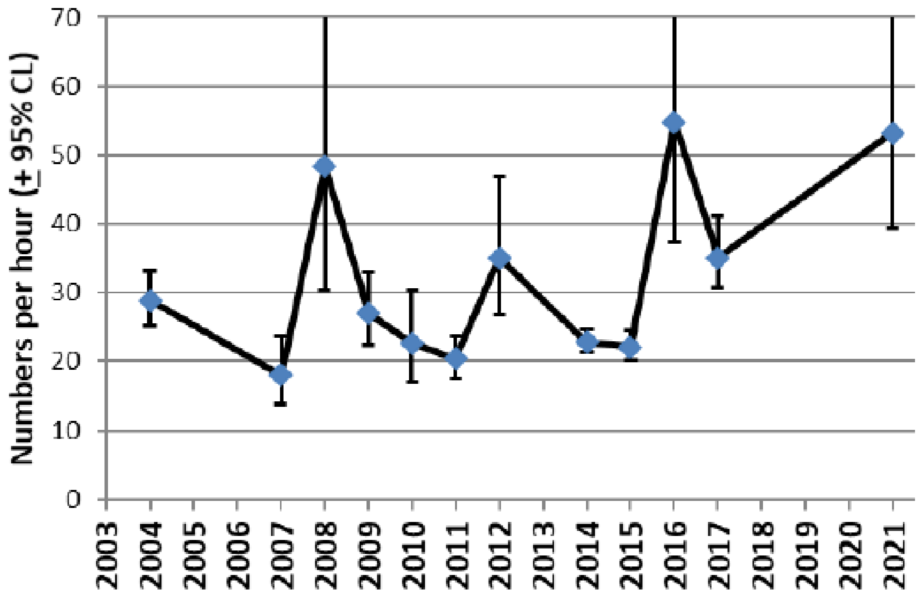

Figure 2: Standardised catch rate index (SCPUE; +/- 95% CL) for the Kimberley sandfish stock (from Hart et. al. 2022).

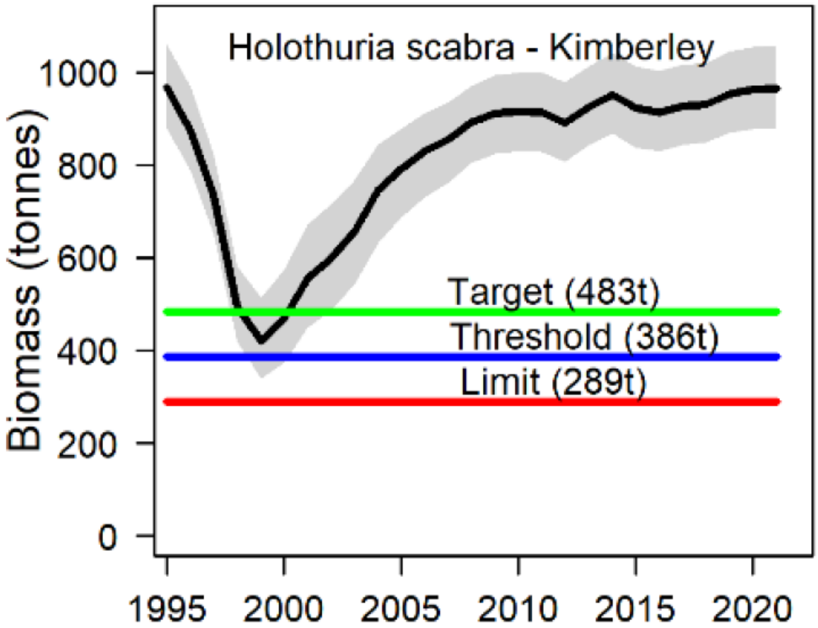

Figure 3: The biomass performance indicator for Kimberley sandfish. The 60% CL is shown so that the lower confidence limit can be used to assess whether the biomass has an 80% probability of being above each of the reference levels (as required by the harvest control rule) (from Hart et. al. 2022).

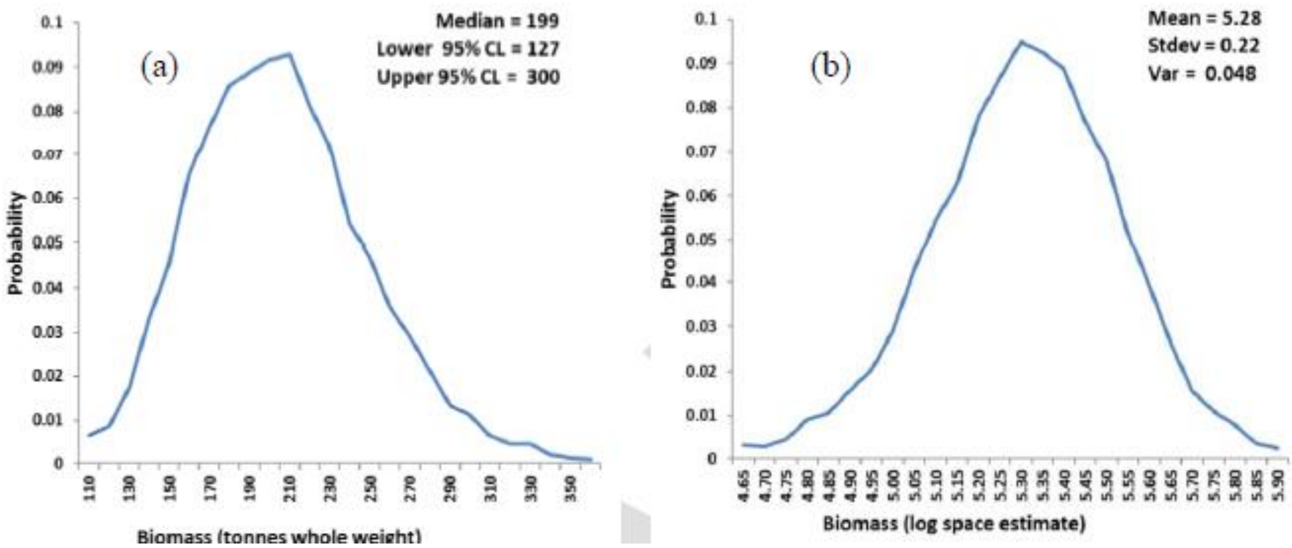

Figure 4: Probability estimates of biomass for the sandfish (*Holothuria scabra*) stock in the surveyed area of the Kimberley region (estimated to contain 22% of the Kimberley sandfish populations). (a) Distribution in normal units (tonnes) with statistical parameters; (b) Distribution in log-transformed space with statistical parameters. (from Hart et. al. 2022).

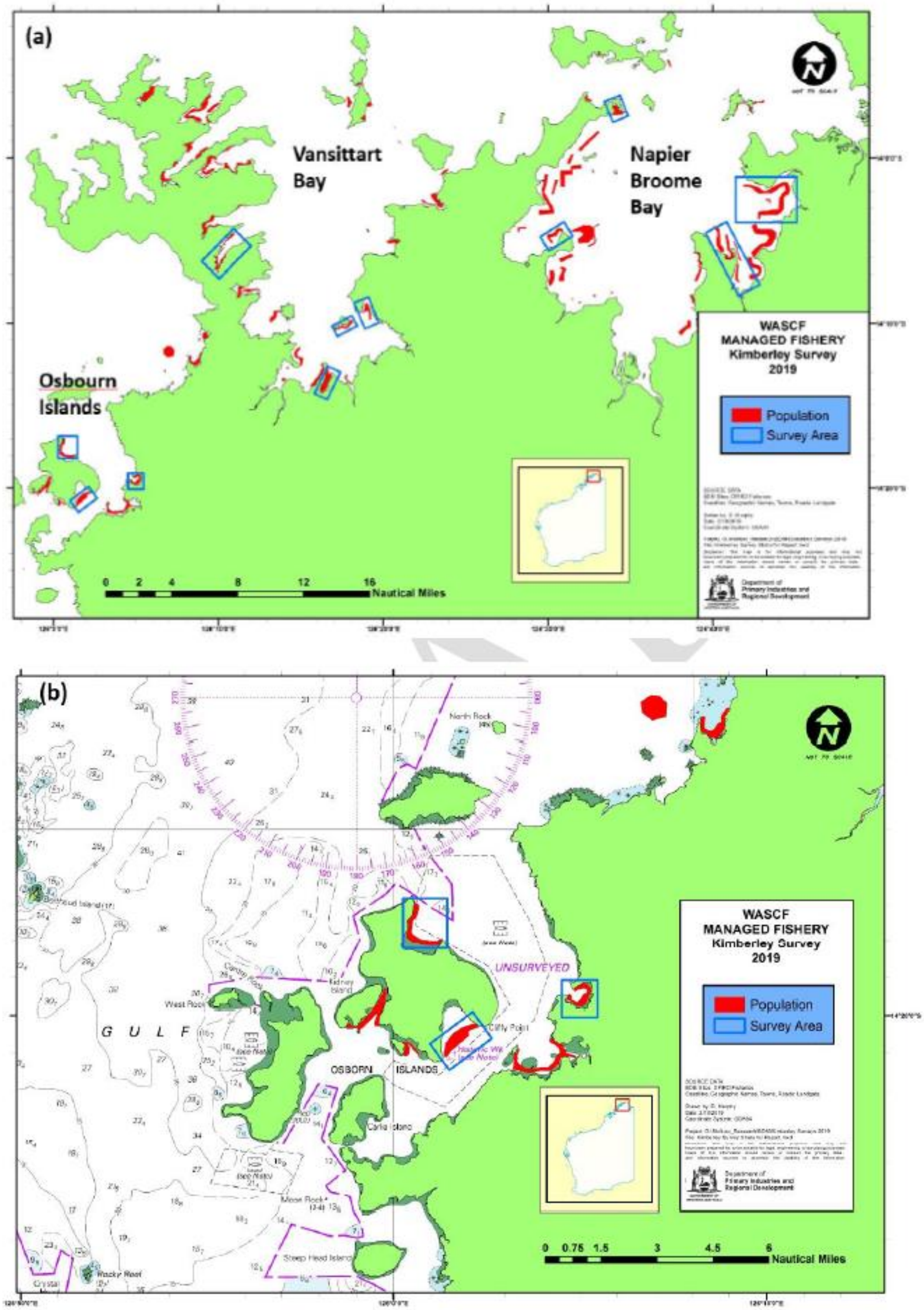

Figure 5: Biomass survey design for sandfish (*Holothuria scabra*) within the Kimberley region, populations in red shading, survey areas in blue box. (a) All areas combined, (b) Osborn Islands. (from Hart et. al. 2022).

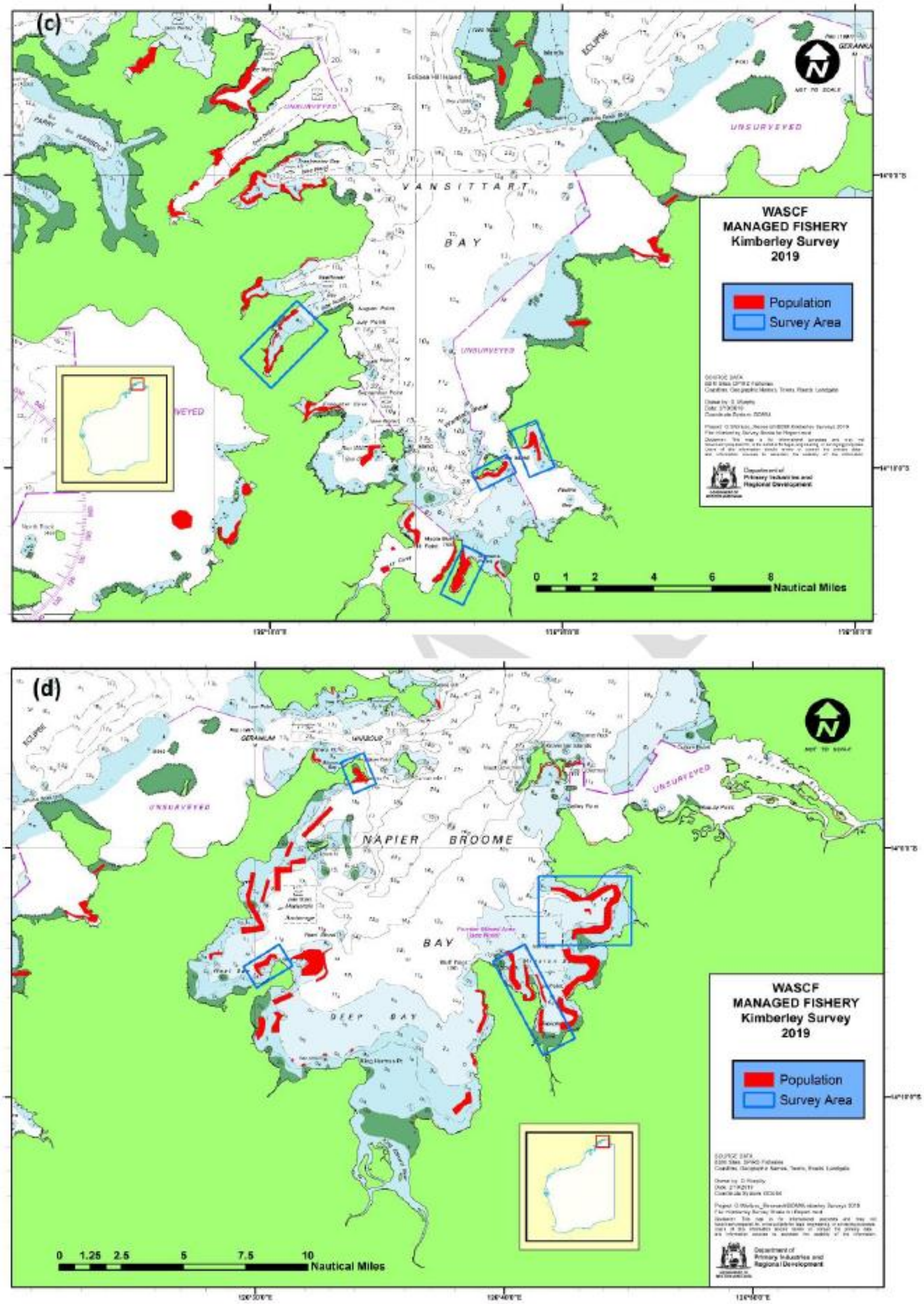

Figure 6: Biomass survey design for sandfish (*Holothuria scabra*) within the Kimberley region (c) – Vansittart Bay, and (d) Napier Broome Bay. (from Hart et. al. 2022).

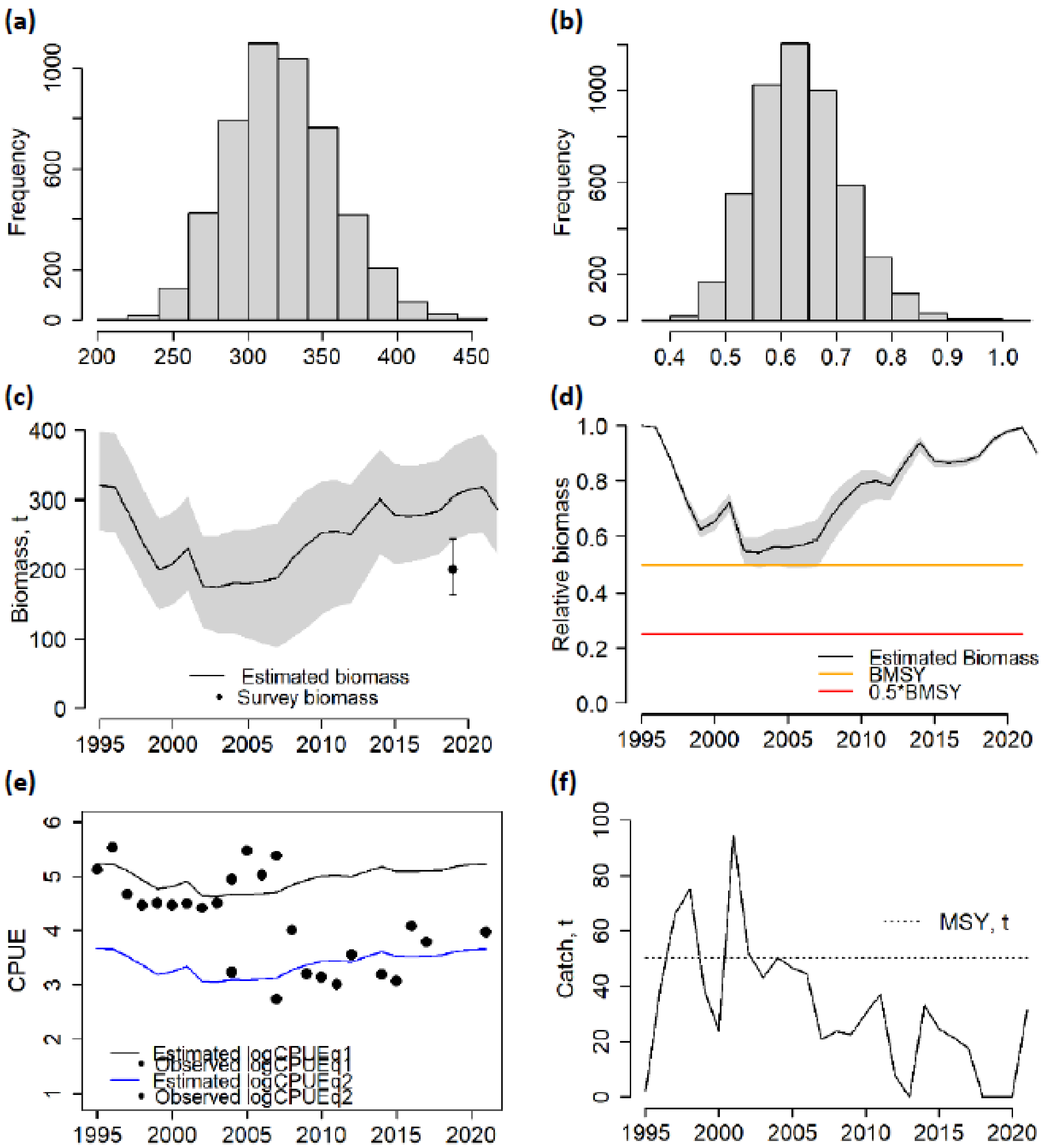

Figure 7: *Holothuria scabra* - Kimberley region sub-area (Scenario 1). Estimates of parameters and outputs for sandfish stocks in the surveyed area of the Kimberley. (a) Unfished Biomass (K or B0), (b) Intrinsic rate of population increase (r), (c) Biomass between 1995 and 2021 with FIS estimate, (d) Annual biomass as a proportion of the unfished level (B/B0), (e) estimated and observed SCPUE, (f) Maximum Sustainable Yield (tonnes). Outputs from n = 5000 model runs (from Hart et. al. 2022).

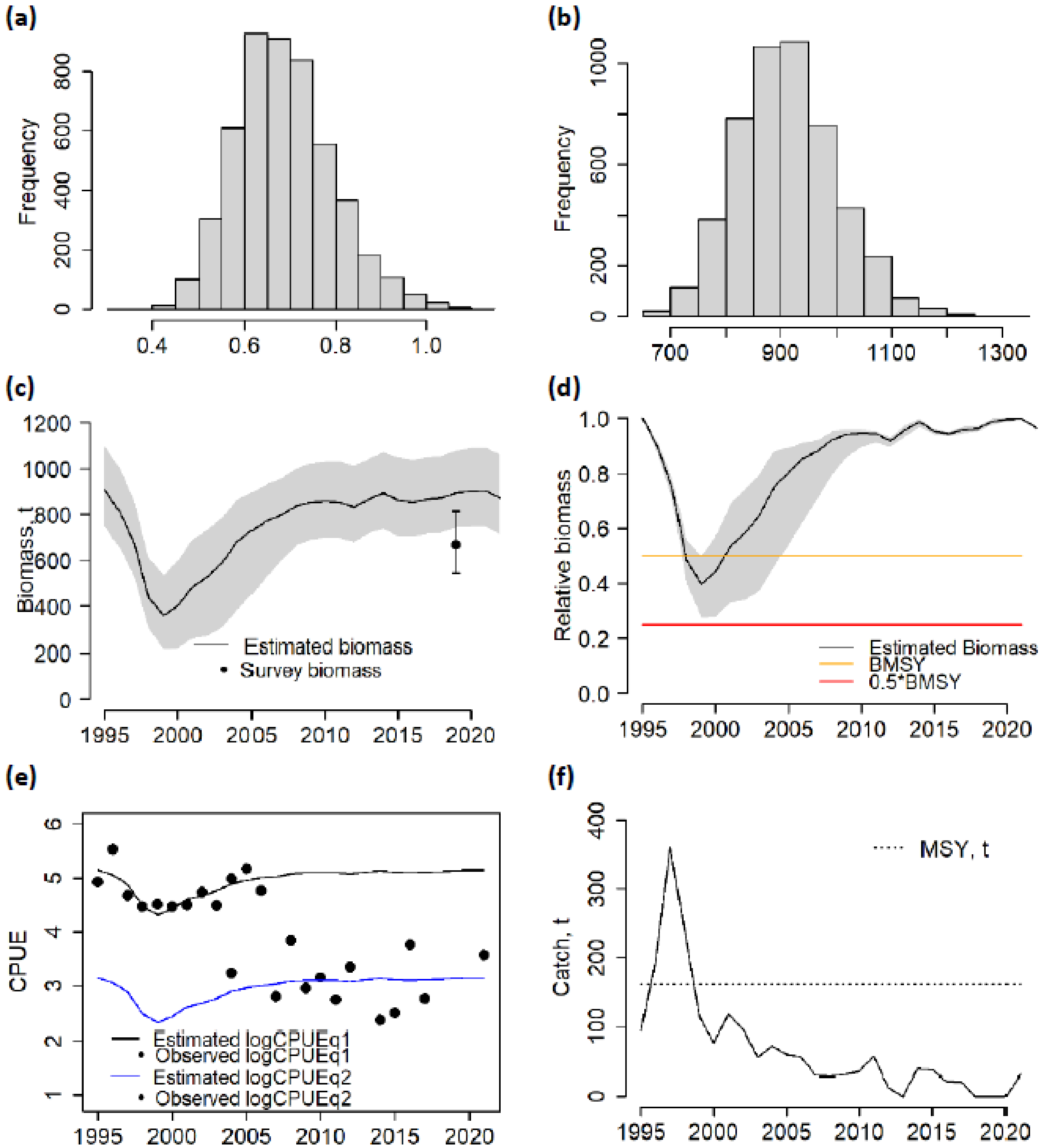

Figure 8: *Holothuria scabra*-Kimberley region (Scenario 2). Estimates of key model parameters and outputs for sandfish stocks in the entire Kimberley region. (a) Intrinsic rate of population increase (r), (b) Unfished Biomass (K or B0), (c) Biomass over the history of the fishery (2007 to 2021) with FIS (Fishery Independent Survey) estimate in 2019, (d) Annual biomass as a proportion of the unfished level (B/B0), (e) estimated and observed SCPUE, (f) Maximum Sustainable Yield (tonnes). Outputs from n = 5000 model runs (from Hart et. al. 2022).

6.2.5 Catch profiles

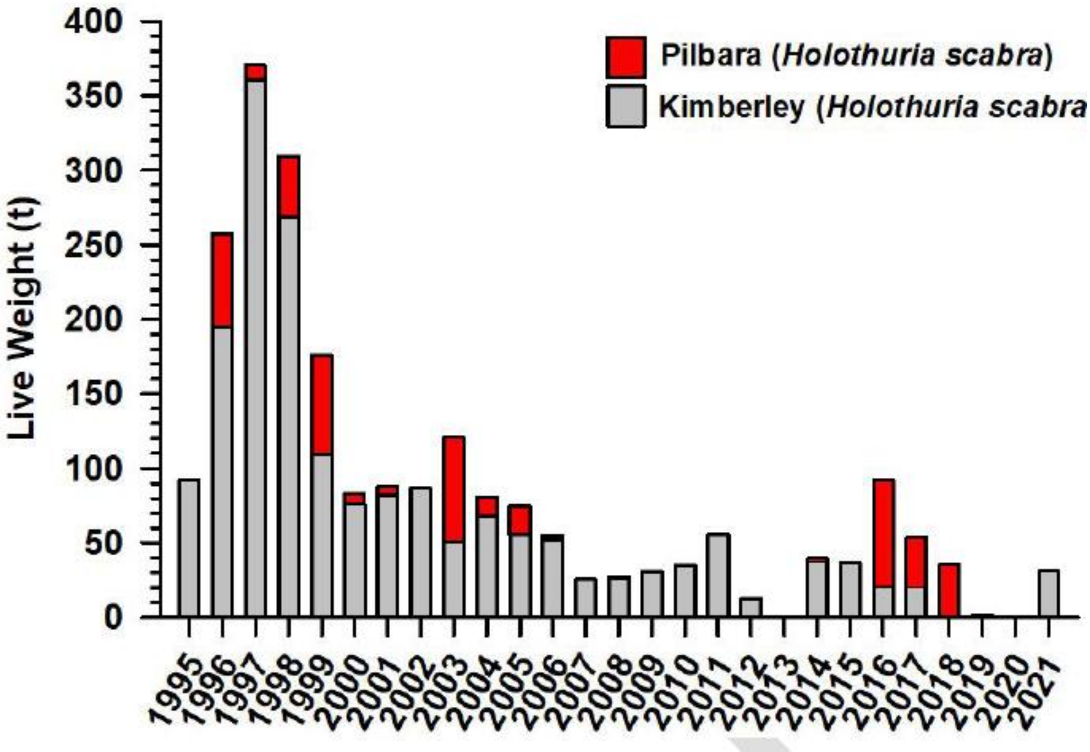

Figure 9: Annual total retained catches (t) of sandfish in the Kimberley (grey bars) and Pilbara (red bars) (from Hart et. al. 2022).

6.2.6 Total Allowable Catch (TAC) and catch data

Table 7 – Total Allowable Catch (TAC) and catch data				
TAC	Year	**NA**	Amount	**NA**
UoA share of TAC	Year	**NA**	Amount	**NA**
UoA share of total TAC	Year	**NA**	Amount	**NA**
Total green weight catch by UoC	Year (most recent)	**2021**	Amount	**30 t**
Total green weight catch by UoC	Year (second most recent)	**2020**	Amount	**0 t**

6.2.7 Principle 1 Performance Indicator scores and rationales

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	Stock status relative to recruitment impairment			
	Guide post	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.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

After high initial catches peaking at about 360t in mid 90s (Figure 9), the sandfish catch in the Kimberley region dropped rapidly, most likely due to depletion and lowering CPUE. In the last 15 years the catch has been under 50t (except in 2011) and in four years including 2018-2020 was zero. Low catches in recent years have been largely driven by the remoteness of the area and challenges caused by high tidal ranges (Hart and Murphy 2021).

The average weight of Kimberley sandfish has remained well above the estimated size at maturity providing good protection of the spawning stock.

The standardised CPUE index has steadily increased since first recorded in 2004. The current low level of catch coupled with the increasing CPUE index and the protection of the spawning stock satisfies the requirements of SG60.

A fishery independent survey was conducted covering the primary fished area in the Kimberly sandfish population (compare Figures 1 and 5a). This provided a biomass estimate of 199t (95% CI of 127t-300t; Figure 4). The survey aligns with key fished areas and thus in light of the spatial structure of the stock the survey is likely negatively (and thus conservatively) biased. This biomass estimate indicates that the current exploitation rate is modest for this species and coupled with the increasing CPUE meets the requirements of SG80.

A biomass dynamics model was applied with two different assumptions. The first (scenario 1) effectively assumes that the FIS strata cover all known stocks, thereby providing a conservative biomass estimate. The second (scenario 2) scaled the biomass estimate up using knowledge of the proportion of the stocks covered by the FIS strata, particularly using historic spatial fishing data during the early peak years of the fishery. Both models found that biomass had returned to near unfished levels. The lower 95% confidence interval exceeded $0.9B_0$ in both cases (Figures 7 and 8). A new limit reference point based on 30% of the model estimated level of B_0 has been introduced and is readily met (Hart et. al. 2022; Figure 3). There are some concerns about the spatial representativeness of the FIS and assessment model, however the key fishing area has been widely surveyed and limited fishing has taken place outside of this area. There is potential for climate change impacts to further impact the representativeness of the FIS (see PI 1.2.2), however there is not yet any evidence of large scale impacts. Coupled with the very low exploitation rate and the high biomass estimate there is a sufficient degree of certainty to meet SG100.

	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
b	Guide post		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.
	Met?		**Yes**	**No**
Rationale				

The biomass dynamics model discussed in SI a shows that in the last ten years across the Kimberley region the biomass has exceed $0.9B_0$ (Figure 8). In the more conservative scenario 1 (Figure 7), the median biomass estimate dropped as low as ~$0.57B_0$ in 2002 in response to early high catches. It is uncertain whether the lower catches of 50-75t from 2000-2006 would have allowed slow stock rebuilding (as indicated by the median biomass estimate) or ongoing depletion (as indicated by the lower 95% biomass confidence interval). In the latter case the biomass may have dropped to nearly $0.2B_0$ in 2007.

However, as catches dropped, there was a rapid recovery from at least 2007 and the lower 95% biomass CI estimate exceeded $0.5B_0$ by 2013 and $0.9B_0$ by 2019.

Thus under both scenarios biomass has clearly exceed any reasonable estimate of B_{MSY}, likely for a decade or longer. This comparison against B_{MSY} is also formalised through the adoption of a new threshold limit reference point which is a proxy for MSY at 40% of the model estimated level of B_0. This RP is readily met (Hart et. al. 2022; Figure 3). This meets the requirements of SG80.

The modelling outputs indicate that with a high degree of certainty the stock has been well above MSY in recent years. This would meet the requirements of SG100, however there are some concerns about the spatial representativeness of the analysis. The FIS focuses on the area that has been commercial fished in recent years. Consequently present information collected for the core fishing activity is being used to infer stock recovery and status across the Kimberley. This also does not consider the possibility that climate change may have impacted some of the un-surveyed areas disproportionately.

It is likely that this unfished area has fully recovered to or close to unfished levels, however it creates sufficient uncertainty that it cannot be said that there is a high degree of certainty that the overall stock is at or above a level consistent with MSY. Note that this scoring was close given the extremely low levels of catch in recent years and the work required by conditions 9 and 10 would allow SG100 to be more robustly assessed. Nevertheless at this time SG100 is not met.

References

Hart, A.M., Murphy, D.M., and Fabris, F.F (2022). Western Australian Sea Cucumber Resource. Resource Assessment Report (2022). Fisheries Research Report No. 324. Department of Primary Industries and Regional Development, Western Australia. 113pp.

Hart, A., Murphy, D. 2021. Sea Cucumber Resource Status Report 2021. In: Status Reports of the Fisheries and Aquatic Resources of Western Australia 2020/21: The State of the Fisheries eds. Newman, S.J., Wise, B.S., Santoro, K.G. and Gaughan, D.J. Department of Primary Industries and Regional Development, Western Australia. pp. 171-173

Stock status relative to reference points			
	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	B_{limit} (30% of B_0; limit reference level in Hart et. al. 2022)	289 t	873 t (CI: 714-1063)
Reference point used in scoring stock relative to MSY (SIb)	B_{MSY} (40% of B_0; threshold reference level in Hart et. al. 2022)	386 t	873 t (CI: 714-1063)

Draft scoring range	**≥80**
Information gap indicator	**More information sought** • The body of the RAR, sCPUE figure and sCPUE conclusions table discusses upwards trends in the Kimberley sCPUE. The Weight of evidence risk assessment states the sCPUE is oscillating with no obvious trend. Why is sCPUE perceived differently in different sections of the RAR and which is correct? • The harvest strategy shows a sCPUE index through to 2017 with some differences from the RAR that are more in-line with oscillation than increases, what was changed in the standardisation process? • The sCPUE index figure in the RAR differs from the sCPUE index shown in the model diagnostic plots. Why is this, and does it have any impact on the model reliability? • The reference levels in the RAR figures appear to be incorrect and have been calculated inconsistently across UoAs (this will be updated at the site visit). • Why does the weight of evidence risk assessment for Kimberley sandfish not consider the biomass dynamics model? • Have the new reference points for Kimberley sandfish been formally adopted into the harvest strategy? • Is the 1995 biomass level representative of an unfished stock state? • What is the scaling factor (22%; 4.55 for Kimberley) based on? One statement indicates it is based on populations rather than biomass?

	• Is any information available about stock recovery outside the area fished / surveyed in the last ~ten years? • If not, how does the footprint of the fishery in the last ~ten years compare to the footprint during the peak period? (i.e. how representative is recent data of the stock that was initially depleted).

Overall Performance Indicator score	**90**
Condition number (if relevant)	

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	Harvest strategy design			
	Guide post	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.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The 2018-2023 harvest strategy (DPIRD 2018) is nearing the end of its life but has been informally updated with a new harvest control rule based on new information and including a new methodology, primary indicator and assessment based reference points (Hart et al. 2022).

Effort is controlled through limited entry with six fishing boat licence holders and limited crew numbers actively fishing on each vessel (noting that only one vessel has fished in recent years due to economic reasons). The catch resulting from this effort control is monitored through a catch tolerance range, with a maximum of 50t for the Kimberley region. This maximum catch is conservative with respect to the model based MSY estimates (see Figure 7 and 8 panel f) for the Kimberley.

Coupled with a minimum size limit above the size at maturity and a responsive HCR, the harvest strategy clearly meets SG60.

The harvest strategy includes a daily logbook monitoring program, compliance strategies, a responsive HCR, effort controls, gear limitations (hand collection), biologically appropriate size limits and fisheries dependent and independent indices and model based assessment methods. These elements work together to ensure effort and catch are limited appropriately, accurately monitored and the stock status is appropriately assessed to ensure responsiveness to the harvest strategy. This meets the requirements of SG80.

The harvest strategy has been updated in Hart et. al. (2022). The key update has been the use of a biomass dynamics model to ensure the reference levels used by the harvest strategy and HCR reflect the objectives in PI 1.1.1 SG80.

However the input controls and the catch tolerance range used by the harvest strategy have not been updated on the basis of this new modelling and appear to be based on historically observed ranges rather than having been designed to achieve the stock management objectives. Consequently, SG100 is not met.

b	Harvest strategy evaluation			
	Guide post	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.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The elements of the harvest strategy discussed in SI a are appropriate for this species and DPIRD has extensive experience successfully using these elements in other harvest strategies. Consequently, the harvest strategy is likely to work and SG60 is met.

The harvest strategy was adopted in July 2018 and key elements have been in place for many years prior. The stock has rebuilt from early depletion and available information indicates that it continues to be maintained at a high level. This provides sufficient evidence to meet SG80.

The harvest strategy has not been comprehensively tested and in particular in recent years economic circumstances have limited the level of exploitation. It remains untested how the harvest strategy would respond to a broader range of circumstances (e.g. if the catch tolerance range were exceeded). Consequently SG100 is not met.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale				

A number of indicators are monitored regularly including biomass estimates, sCPUE, mean weight and catch tolerance ranges. These allow assessment of different aspects of the harvest strategy – stock status, effectiveness of size limits, effectiveness of input controls. Collectively this provides good monitoring of a broad range of aspects of the harvest strategy and SG60 is met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**Yes**
Rationale				

The harvest strategy is designed around a five year review cycle with the current harvest strategy due for renewal in 2023. However, across a number of fisheries DPIRD has demonstrated that harvest strategies are updated as necessary within this cycle. In this case the primary indicator and monitoring program were updated to improve the harvest strategy for Kimberley Sandfish and a new harvest control rule has been adopted (Hart et. al. 2022). This meets the requirements of SG100.

e	Shark finning			
	Guide post	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.
	Met?	**NA**	**NA**	**NA**
Rationale				

Sharks are not a target species, and regulations are in place to prevent sharks being caught. Surveillance and enforcement are adequate. There is a high degree of certainty that shark finning is not taking place.

f	Review of alternative measures			
	Guide post	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 **biennial** 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.
	Met?	**NA**	**NA**	**NA**
Rationale				

The harvest strategy limits harvesting to hand collection. This is highly specific with negligible unwanted catch. The absence of output controls further reduces any incentive for post capture high grading. Due to the negligible nature of the unwanted catch of the stock this SI is not applicable.

References

DPIRD (2018) Fisheries Management Paper No. 287: Western Australian Sea Cucumber Resource Harvest Strategy 2018-2023, Version 1.0, 26pp

Draft scoring range	
Information gap indicator	**More information sought** • Has the new biomass performance indicator been formally adopted? • Is the new biomass PI the FIS biomass estimate or the model based biomass estimate?

	• Is it an annual indicator as specified for other UoA's in the harvest strategy? If so how is it calculated in years between fisheries independent surveys?

Overall Performance Indicator score	**85**
Condition number (if relevant)	

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	HCRs design and application			
	Guide post	**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.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The harvest strategy (DPIRD 2018) needs to be read in conjunction with the updated harvest control rule contained in Hart et. al. 2022. This sets out a harvest control rule that compares biomass estimates to reference levels: A target 50% B_0, a threshold B_{MSY} proxy at 40% B_0 and a limit level at 30% B_0.

If the biomass performance indicator (PI) is above the target no action is required. Between the target and threshold a review of all available information to decide if further management action is required. If there is <80% probability that the PI is above the threshold then a 2 year spatial closure is implemented. If there is <80% probability that the PI is above the limit then a 3 year spatial closure is implemented.

This is sufficiently well detailed to be generally understood and is expected to reduce the exploitation rate as the PRI is approached (in fact a closure is implemented as the PI falls below the MSY proxy). This meets the requirements of SG60.

A two year spatial closure is required when the fishery has a >20% chance of being below the MSY proxy and a three year spatial closure once there is a > 20% probability of being below 30% B_0. Together these will ensure that the exploitation rate is reduced as the PRI is approached. The closures are precautionary in that they commence at a high biomass level. Due to the scale of functional stock structure spatial management has previously been shown to be effective for a broad range of sea cucumber species (Plaganyi et. al. 2015). The proven effectiveness coupled with the precautionary nature of the reference points should therefore ensure the stock fluctuates around a target level consistent with MSY as required by SG80. The FIS is conducted every 5 years with annual biomass estimates being provided by model based estimates incorporating all available catch and CPUE information. Additional FIS will be conducted as required, for example if there is concern about stock levels. This provides further confidence in the likely effectiveness of the HCR. Collectively this meets the requirements of SG80.

The HCR only takes action when biomass declines below the B_{MSY}. It remains unclear how quickly this action will result in a reversal and therefore whether the population is likely to oscillate around B_{MSY} (as required for SG80) or remain above the B_{MSY} as required by SG100. This may be exacerbated by the reduced information available during periods of closure. Due to these factors SG100 is not met.

	HCRs robustness to uncertainty			
b	Guide post		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.
	Met?		**No**	**No**
Rationale				

A key uncertainty for the HCR is the reliability of the biomass estimate produced form the biomass dynamics model. This model addresses uncertainty in a number of key input parameters including the survey data and abundance index (Hart et. al. 2022).

However, the spatial population structure remains a key source of uncertainty and one which may have undesired consequences for the HCR. Changes in spatial fishing within sub-areas may mask serial depletion. More concerningly the assumptions made in scaling from the surveyed area and sCPUE index to the entire Kimberley region remain unclear and are likely susceptible to uncertainty in the population structure and connectivity. A key issue is that the FIS is scaled to the historic extent of the fishing activity whilst the sCPUE index is representative of the much more limited fishing activity in recent years. Due to these issues SG80 is not met.

Climate change has had a significant impact on other species in Western Australia (e.g. abalone) with heatwaves causing significant mortalities. The potential for this to impact sea cucumber has not been clearly evaluated and the harvest control rule has not been developed for or tested against regional productivity shifts or changes in connectivity. These aspects should be incorporated to meet the SG100 level.

	HCRs evaluation			
c	Guide post	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.

	Met?	Yes	Yes	No
Rationale				

Compliance and reporting ensures that removals by the UoC are well understood. The catch tolerance range is evaluated annually to ensure that the management measures in place are limiting the exploitation rate to the level required by the HCR. This meets the requirements of SG60 and SG80.

The level of effort has been partly constrained by economic conditions. Consequently, it is unclear whether the harvest strategy would limit the exploitation levels appropriately in all circumstances and SG100 is not met.

References

DPIRD (2018) Fisheries Management Paper No. 287: Western Australian Sea Cucumber Resource Harvest Strategy 2018-2023, Version 1.0, 26pp

Hart, A.M., Murphy, D.M. and Fabris, F.F (2022). Western Australian Sea Cucumber Resource. Resource Assessment Report (2022). Fisheries Research Report No. 324. Department of Primary Industries and Regional Development, Western Australia. 113pp.

Plaganyi, E., Skewes, T., Murphy, N., Fisher, M. (2015) *Crop rotations in the sea: Increasing returns and reducing risk of collapse in sea cucumber fisheries*. PNAS 112(21) 6760-6765

Draft scoring range	**60-79**
Information gap indicator	**More information sought** • Just to confirm: with the shift to biomass PI are the control rules linked to reference levels by the same name? • How much information (sample size and how recent) is required for biomass estimates from the model to be used in the HCR? • Post closure how much information / what process is implemented for a re-opening?

Overall Performance Indicator score	**75**
Condition number (if relevant)	**9**

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	Range of information			
	Guide post	**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 are 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.
	Met?	**Yes**	**No**	**No**
Rationale				

The current monitoring in place provides extensive information including:

- Fisheries dependent spatially explicit catch, effort and CPUE data through logbooks
- Fisheries independent spatially explicit abundance and size structure data.

The fleet is small and well understood. The stock structure is understood at a coarse spatial scale. This information supports key elements of the harvest strategy and is sufficient to meet the requirements of SG60.

The stock structure of sandfish in WA has not yet been established, however genetic studies from the Northern Territory and Queensland indicate that genetic differences may occur not just between the Kimberley and Pilbara populations but also within these. The functional scale of stock structure may be at a smaller spatial scale again, particularly between embayments. Information about this stock structure is required to ensure that the harvest strategy is robust to the dynamics arising from the spatial stock structure, its potential impact on assessment methods and the appropriateness of potential response mechanisms (see also PI 1.2.2(b)). Consequently, SG80 is not met.

Biological characteristics are known to have substantial spatial variation (Hart et. al. 2018). Despite this, key biological parameters for the Kimberley sandfish fishery are based on work from other regions. For example, the size at maturity estimates (upon which the size limit is based) are based on Northern Territory studies. Local estimates and an indication of the impact of environmental conditions on them would be required as part of the comprehensive range of information required at the SG100 level. This would include a consideration of the possible impact of climate change on sea cucumber. Consequently SG100 is not met.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the**	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and

		frequency to support the harvest control rule.	**harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**No**
Rationale				

UoA removals from the stock and sCPUE indices are available on an annual basis when commercial fishing takes place. Biomass estimates are calculated periodically, the harvest strategy requires these to be calculated at a minimum every five years. This supports the HCR and satisfies the requirements of SG60.

The UoA removals are monitored with a high degree of accuracy and full coverage consistent with the HCR. Model based biomass estimates will be used as the primary indicator. The fisheries independent survey will be conducted at least every 5 years and is a key data source for the model. Increasing uncertainty as time progresses between FIS will be dealt with by the probabilistic nature of the evaluation of the reference points in the HCR. The new primary indicator (Hart et. al. 2022) will therefore be monitored with sufficient frequency to support the HCR. This meets the requirements of SG80.

There are range of uncertainties in the sCPUE index and fisheries independent index arising from issues such as limited sample size and restricted spatial and temporal coverage. Due to these issues in cannot be said that these indices are monitored with a high degree of certainty and SG100 is therefore not met.

c	Comprehensiveness of information			
	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

Indigenous catches may exist but are small, under a commercial licence and are monitored. Recreational catches are considered very low and restricted by a daily bag limit. These sources of removals are sufficiently small in quantity that regular monitoring is not required. This meets the requirement of SG80.

References

Hart, A.M., Murphy, D.M., Caputi, N., Hesp, S.A., Fisher, E.A. (2018). Western Australian Marine Stewardship Council Report Series No. 12: Resource Assessment Report Western Australian Sea Cucumber Resource. Department of Primary Industries and Regional Development, Western Australia. 89pp.

Hart, A.M., Murphy, D.M. and Fabris, F.F (2022). Western Australian Sea Cucumber Resource. Resource Assessment Report (2022). Fisheries Research Report No. 324. Department of Primary Industries and Regional Development, Western Australia. 113pp.

Draft scoring range	**60-79**
Information gap indicator	**More information sought** • Is any information available about stock structure within the Kimberley population? • With what frequency will the fisheries independent survey be conducted? • What frequency is required for the primary biomass indicator (the HS indicates that for the other stocks an "Annual biomass estimate" is required)? • If biomass estimates are not provided on an annual basis how will the HCR be applied in intervening years?

Overall Performance Indicator score	**75**
Condition number (if relevant)	**10**

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	Appropriateness of assessment to stock under consideration			
	Guide post		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.
	Met?		**Yes**	**No**
Rationale				

The primary indicator prior to the update in Hart et. al. (2022), was the standardised CPUE index. In dive fisheries sCPUE indices can exhibit stability due to diver compensatory behaviour, however this remains the best available biomass index for this stock and is supported by complementary data sources including the fisheries independent survey. Concerns about the robustness of this index were addressed by the precautionary definition of the reference levels, the probabilistic assessment against these and the precautionary HCR. As such sCPUE was an appropriate key indicator for the UoA and is now used as a secondary indicator (through a weight of evidence assessment) and a key input for the assessment model.

The fisheries independent survey is based on ROV transects using an appropriate protocol that compensates for aspects such as the required hover distance, depth and visibility. As such it is appropriate for the stock and provides high accuracy biomass estimates for the surveyed areas.

In Hart et. al. (2022) a model-based assessment was used to provide an integrated analysis using sCPUE, the fisheries independent survey, catch data and biological parameters. This model is appropriate for the stock. The revised reference levels are based on the model estimates of B_0 and thus the HCR which is based on the reference levels is consistent with the assessment model.

Appropriate data sources are being used and integrated through an assessment model around which the HCR has been updated. This meets the requirements of SG80.

The method used to calculate the scaling factor for scaling the fisheries independent survey to the total population remains unclear. It is not well documented and uncertainty in the scaling does not appear to be incorporated in the biomass estimate. In the assessment model the sCPUE index which represents the fished component of the stock is combined with the scaled up biomass estimate for the whole Kimberley region. This is appropriate if the stock is well connected and mixed, however given the likely spatial structure of the stock this assumption may produce biased stock status estimates. Due to these issues SG100 is not met.

b	Assessment approach			
	Guide post	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.	
	Met?	**Yes**	**Yes**	
Rationale				

The biomass reference points implemented in the updated HCR in Hart et. al. (2022) are based on a comparison of estimated biomass against model derived estimates of B_0. Reference levels of 30% and 40% B_0 have been chosen and are appropriate for the species category. This meets the requirements of SG60.

The 40% reference level is the same as the default reference level for B_{MSY} defined by the MSC standard. Whilst the 30% reference level is higher (more precautionary) than the 20% defined by the standard. A precautionary approach is also taken through the requirement to exceed the reference levels with 80% probability. As such the reference levels are appropriate, can be estimated and are used in a precautionary manner. This meets the requirements of SG80.

c	Uncertainty in the assessment			
	Guide post	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.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Major sources of uncertainty in the primary datasets are identified. For sCPUE this includes spatial differences, fishing vessels, changing fishing footprint and stock structure. For the FIS this includes highly skewed spatial variability in densities, the proportion of the habitat surveyed and variability in observing conditions (Hart et. al. 2022). The identification of these sources of uncertainty meets the requirements of SG60.

CPUE standardisation is used to take into account regional variation at sub-area level. The FIS methodology has been developed to provide data that is consistent to variations in observing conditions. Parametric resampling is used to provide biomass estimates that area scale up from the FIS transects to the total stock with associated uncertainty. More could be done to account for additional factors in both of these approaches, however the current methods are sufficient to meet the requirements of SG80.

The biomass model (Hart et. al. 2022) integrates multiple data sources taking into account the inherent uncertainty in these to produce a probability density for the total biomass estimate. This is evaluated against reference levels with a requirement to exceed these with 80% probability. This probabilistic evaluation meets the requirement of SG100.

d	Evaluation of assessment			
	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			**No**
Rationale				

Only a single fisheries independent survey has been carried out to date and there are concerns about the sCPUE index given the size of the fishery, the inconsistent fishing taking place and the limited size of the fleet. Consequently there is no means by which to test the assessment and alternative approaches have not been rigorously explored. SG100 is not met.

e	Peer review of assessment			
	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**Yes**	**No**
Rationale				

The assessment is internally peer reviewed through the annual process of producing DPIRD's Status Reports of the Fisheries and Aquatic Resources of Western Australia. This meets the requirements of SG80.

A rigorous external peer review of the assessment including the modelling approach and FIS methodology has not been conducted, hence SG100 is not met.

References

Hart, A.M., Murphy, D.M. and Fabris, F.F (2022). Western Australian Sea Cucumber Resource. Resource Assessment Report (2022). Fisheries Research Report No. 324. Department of Primary Industries and Regional Development, Western Australia. 113pp.

Draft scoring range	**≥80**
Information gap indicator	**More information sought** • In the diagnostics plot what is the difference between sCPUE and sCPUE_2 and how is this accounted for in the main sCPUE graph which spans from part way through the sCPUE series to the present. • Is it appropriate in Scenario 2 to apply sCPUE and scaled up biomass estimates for different spatial areas given the spatial stock structure which is not represented in the model?

Overall Performance Indicator score	**85**
Condition number (if relevant)	

6.3 Principle 2

6.3.1 Principle 2 background

This background was written by Dr Clara Obregón.

6.3.2 Habitats

The MSC standard states that if a fishery interacts with benthic habitats, habitat categories should be based on the following characteristics;

- substratum,
- geomorphology, and
- biota.

The habitats that the WA sea cucumber fishery may interact with in the Kimberley can be classified as;

- commonly encountered- habitats which regularly comes into contact with a gear used by the UoA, considering the spatial (geographical) overlap of fishing effort with the habitat's range within the management area(s) covered by the governance body(s) relevant to the UoA (SA 3.13.3.1). According to this definition and for this UoA, sandy and muddy habitats are therefore classified as "commonly encountered".
- Vulnerable Marine Ecosystem (VME)- as per paragraph 42 subparagraphs (i)-(v) of the FAO Guidelines (definition provided in GSA3.13.3.22) "as having one or more of the following characteristics: uniqueness or rarity, functional significance, fragility, life-history traits of component species that make recovery difficult, and/or structural complexity". This definition shall be applied both inside and outside EEZs and irrespective of depth. In addition, MSC states that CABs need to consider VMEs and potential VMEs (as defined by the FAO Guidelines; see GSA3.13.3.2) that have been accepted, defined or identified as such by a local, regional, national, or international management authority/governance body (see MSC interpretation log for VME identification). According to this definition and the fact that fishing occurs in sandy and muddy habitats, for the purpose of this assessment, VMEs were not identified.
- minor- all other habitats. For this UoA rocky shores, mangroves, sponges and seagrasses would be considered as minor.
    - The WA sea cucumber fishery does wading for less than 5% of the catch in the Pilbara region. In the Kimberley, depending on the conditions some years there is no wading and other years there may be up to 25% of wading activity. When wading, fishers may go through some rocky shores. However, it is still considered minor.
    - Mangroves are also found throughout the coast, though their distribution does not overlap with the WA sea cucumber fishery in the Kimberley.
    - Sponges appear to be patchily distributed through the Kimberley coast (see Figure 10, Fromont & Sampey, 2014), though not overlapping with the areas where the WA sea cucumber fishery operates, which is mainly sandy and muddy habitat, robust to fishing activities.
    - Around 25 species of seagrasses have been represented in WA, which makes WA the region with the highest diversity of seagrasses worldwide. These are distributed throughout temperate and tropical environments, and are influenced by turbidity, shelter, tidal exposure and characteristics of the sediment. There is little information regarding seagrasses in the Kimberley, however it appears that the northern region has less seagrass richness than the southern Kimberley (Seagrass Watch, 2021).

Sea cucumber biomass and distribution were estimated through several surveys conducted in 2017 and 2020 (Figures 5, 6). Information from these surveys were combined with spatial information sourced from industry skippers (Hart et al., 2022).

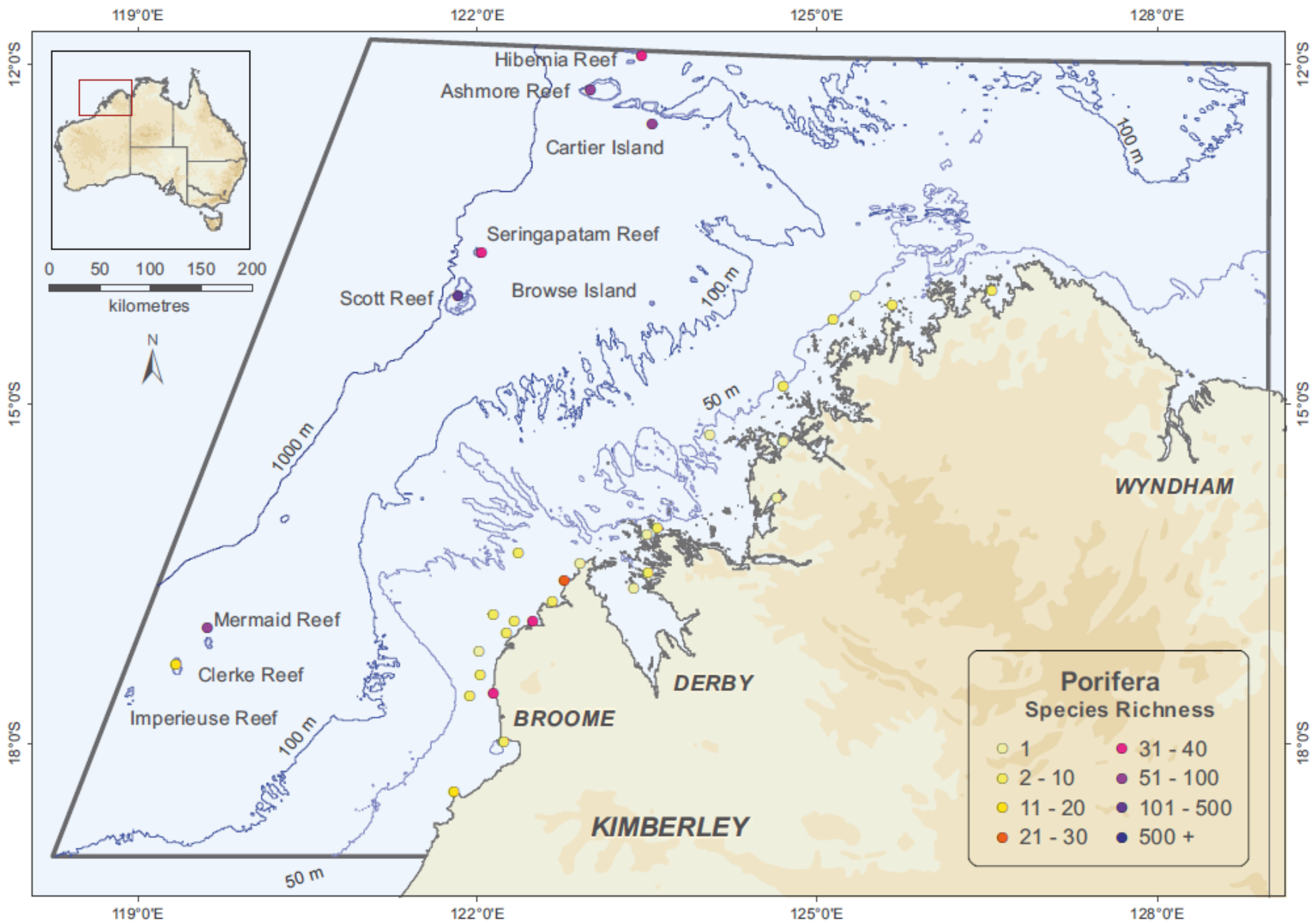

Figure 10: Species richness of sponges for each main location in the Project Area. Map projection: GDA94, Scale: 1:6, 250,000. (Source: Fromont & Sampey, 2014).

The WA sea cucumber fishery in the Kimberley operates over sandy and/or muddy substrates (Figures 11, 12). During the biomass surveys in the Kimberley, no extensive seagrass beds were identified (A. Hart pers. comm). Typically, the fishing method involves hand collection through hookah or diving or snorkelling (where operators do not usually touch the bottom) or wading (for a very small amount of the catch), generally over sandy or muddy intertidal areas (Figure 1). Fishers use hooker line floats so it does not drag on the ground. The fishery is a 'pulse' fishery operating on a rotational basis (ie generally only fished every few years). Thus, the fishery has minimum interaction with the benthos (Webster & Hart, 2018). In addition, sea cucumbers are a very small size when they leave the seagrass leaves (approx. 1.5 g) and move onto sediment-based habitat. As juveniles develop, they spend 4-5 days moving on and off the seagrass leaves (Mercier et al 2000). Larger animals do not reside on seagrass beds as they cannot burrow into the sand due to the rhizomes from the seagrass.

There is no information on the impacts of hand collecting of sea cucumbers on seabed habitats in the Kimberley. Despite this data gap, it is possible to infer the potential impact the fishery may have from previous studies. Generally, sandy habitats are not considered to be vulnerable to fishing impacts, even when fisheries use mobile gear (which is not the case for the sea cucumber fishery). When fishing impacts have been detected, recovery rates have been described as faster than for other habitats. On the other hand, muddy habitats seem to be considered more sensitive to fishing impacts (Andrews & Skewes, 2019)

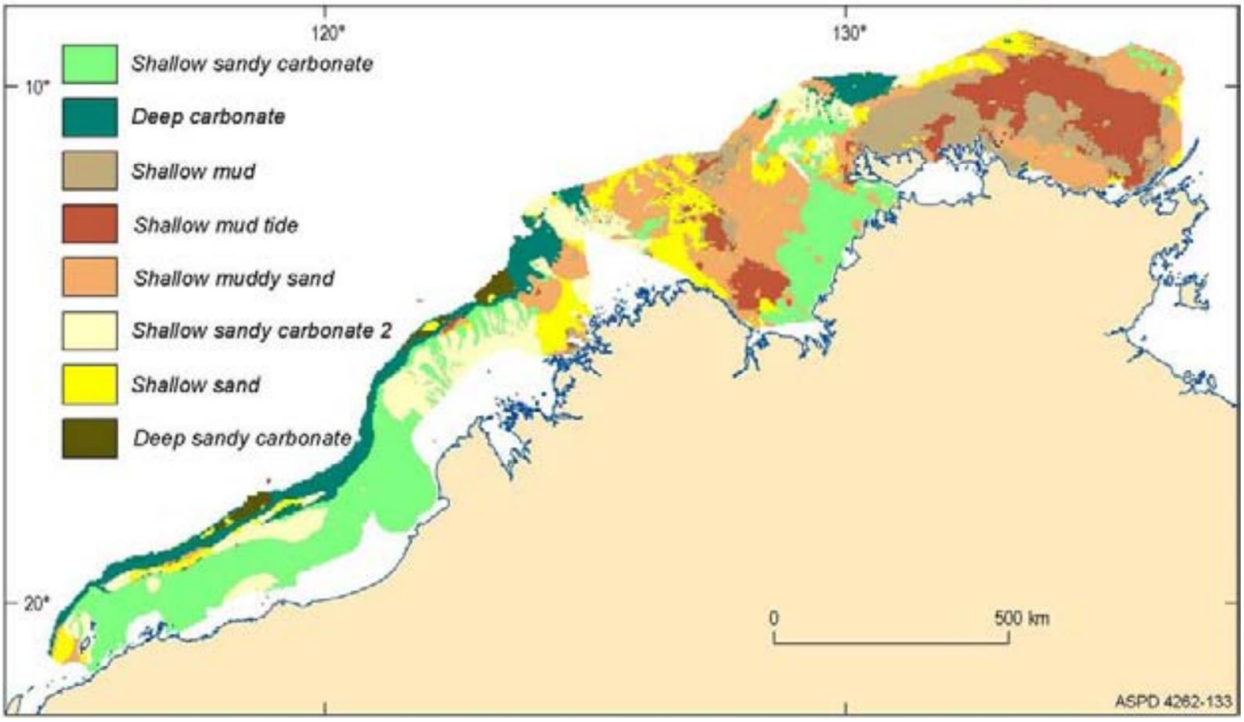

Figure 11: Sediment types in the Northwest Region (Source: Heap et al., 2005)

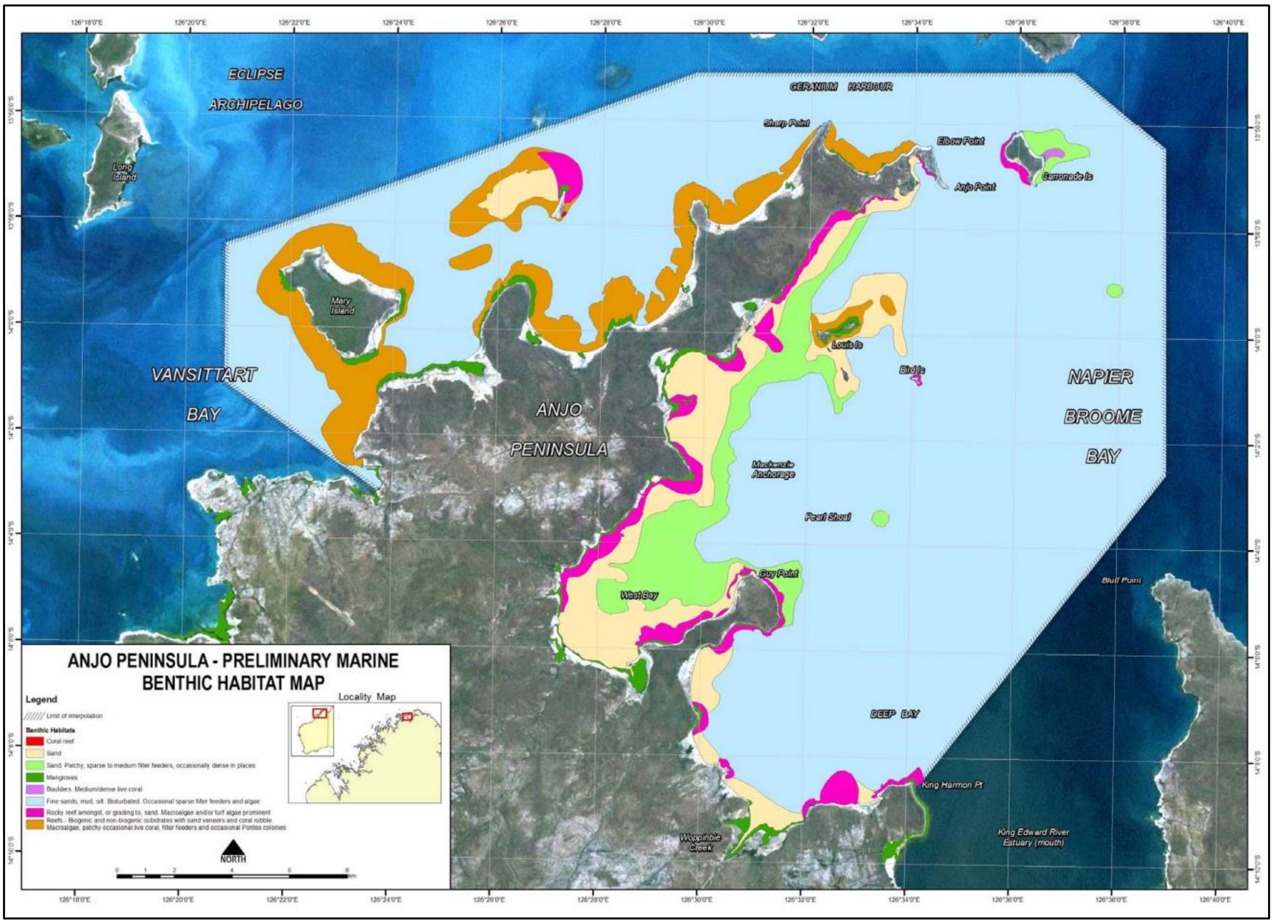

Figure 12: Preliminary marine benthic habitat map of the Anjo Peninsula Area, within the Northwest Region (Source: Department of Environment and Conservation, 2008)

The Great Kimberley Marine Park is located within Commonwealth waters, and is part of the North-west Marine Parks Network. The park covers an area of 74,469 km², and its depth ranges from 15m to 800m.

Zoning of the park occurs off the limit of coastal waters, and it includes a National Park Zone (IUCN II); two Habitat Protection Zones (IUCN IV) and the rest is classified as Multiple Use Zones (IUCN VI), which are adjacent to fishing areas and add more protection to those zones (Department of Parks and Wildlife, 2020; Environmental Resources Information Network (ERIN), 2018).

Within state waters, there are three designated marine parks close to the areas where the Kimberley sea cucumber fishery operates. These include the i) Lalang-garram/Horizontal Falls, ii) Lalang-garram/Camden Sound, and the iii) North Kimberley Marine Park.

The fishery operates within two of the three marine parks: the Lalang-garram/Camden Sound Marine Park and the North Kimberley Marine Park (Figure 13). Specific areas where commercial fishing is prohibited are outlined in the Western Australian Marine Stewardship Council Report (Hart et al., 2018); and are identified in the map below (Figure 13).

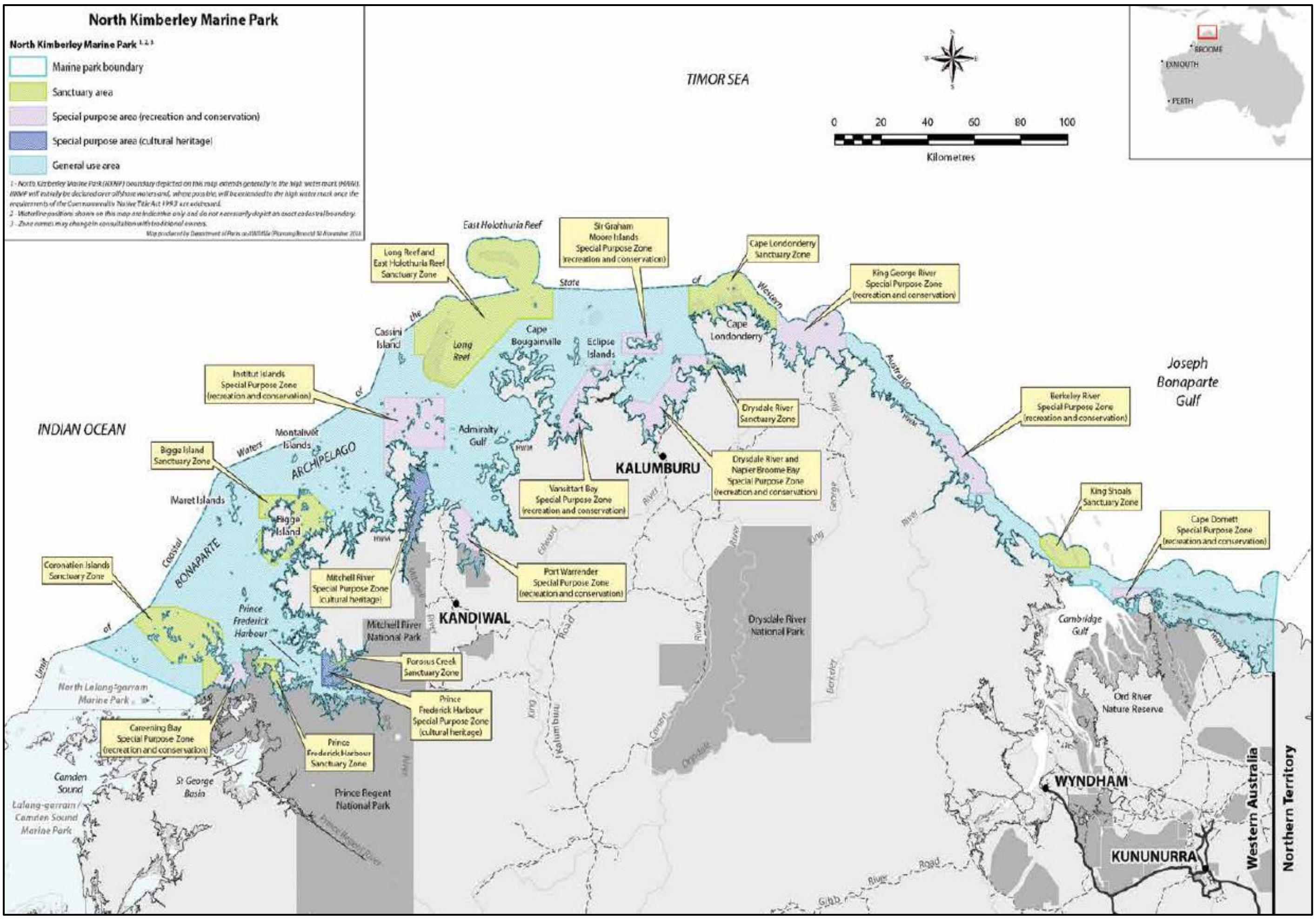

Figure 13: Management zoning for the North Kimberley Marine Park, adjacent to the Lalang-garram/Camden Sound Marine Park. (Sourced from: Department of Parks and Wildlife, 2013).

Within the Lalang-garram/Camden Sound Marine Park, the fishery operates within the Kuri Bay Special Purpose Zone (pearling), in which commercial fishing is permitted (Department of Parks and Wildlife, 2013). Within the North Kimberley Marine Park, sea cucumber fishing operations occur next to the Long Reef and East Holothuria Reef sanctuary zones, as well as the Bigge Island sanctuary zone (Figures 1 and 13). No commercial fishing is allowed in delimited sanctuary zones within the marine parks. Additionally, the fishery overlaps with several designated special purpose zones, where commercial fishing (using gears other than gillnet and prawn trawl) is permitted (Department of Parks and Wildlife, 2016).

6.3.3 Ecosystem

The Kimberley physical and biotic characteristics vary along and cross the shelf. As a result, a set of distinctive bioregions, known as the Interim Marine and Coastal Regionalisation of Australia (IMCRA) Bioregions have been recognised (Commonwealth of Australia, 2006).

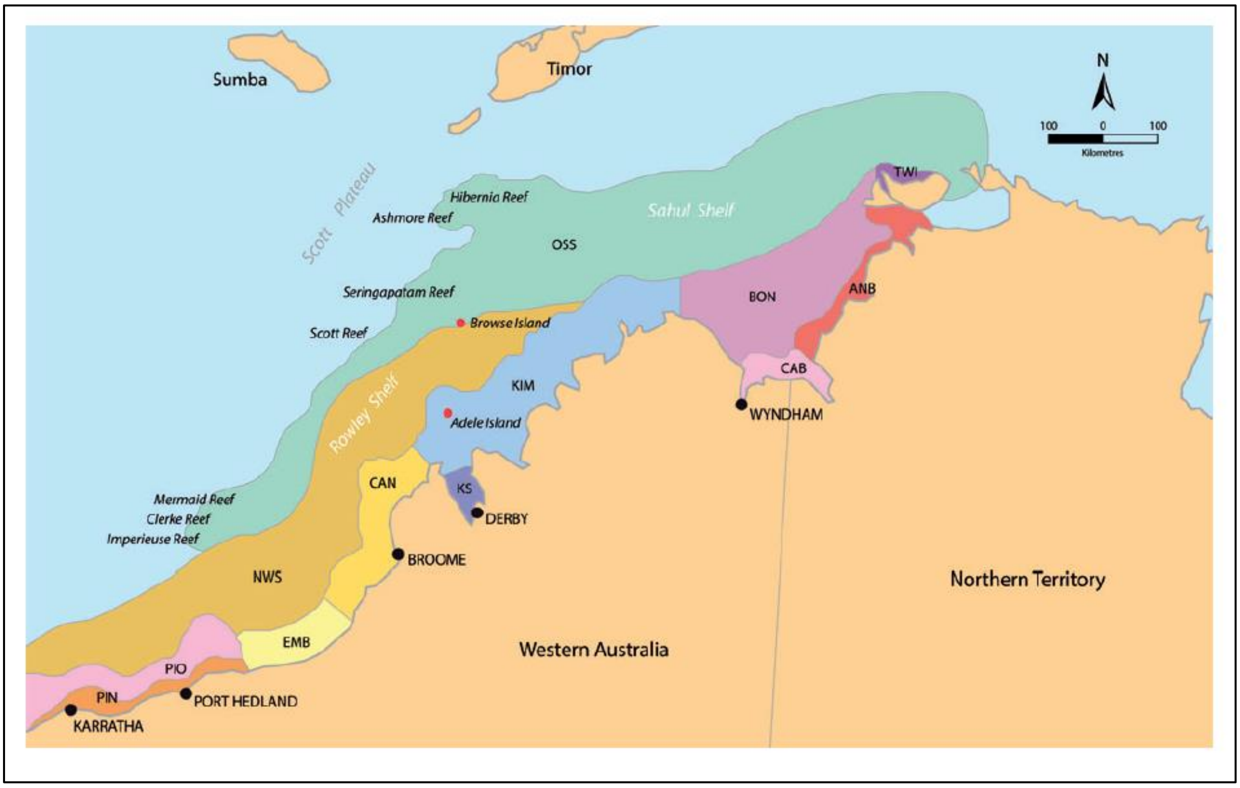

Figure 14: Distinctive Interim Marine and Coastal Regionalisation of Australia (IMCRA) Bioregions. Note the acronyms listed in the figure: PIN: Pilbara (nearshore); PIO: Pilbara (offshore) ; EMB: Eighty Mile Beach; NWS: North West Shelf; CAN: Canning; KS: King Sound; KIM: Kimberley; OSS: Oceanic Shoals; BON: Bonaparte Gulf; CAB: Cambridge-Bonaparte; ANB: Anson Beagle; TWI: Tiwi (Commonwealth of Australia, 2006).

The EBFM risk assessment of the WA sea cucumber fishery showcases where the fishery operates (Figure 1). In the Kimberley, the WA sea cucumber fishery operates in different areas which fall into the Kimberley bioregion (KIM), as classified by the Distinctive Interim Marine and Coastal Regionalisation of Australia (Commonwealth of Australia, 2006; Webster & Hart, 2018).

On the western side of the Joseph Bonaparte Gulf is the Kimberley bioregion (KIM). It is a macro-tidal area, with an extreme spring tidal range reaching up to 11 m south of the region (Figure 14). Thus, this side of the coast is subjected to high turbidity and severe tidal currents. The topography of this region is complex and irregular and reaches depths of 50m. There are many islands, as well as gulfs and inlets which receive the discharge from major rivers, supporting diverse mangrove habitats (~15 mangrove species according to Cresswell & Semeniuk, 2011). Intertidal sand flat habitats are rare, and there are abundant intertidal rock platforms and fringing coral reefs (Figure 14). The current data available was collected through surveys led by the Western Australian Museum (WAM) and the Australian Institute of Marine Sciences (AIMS) since the late 1980s. However, more information on the biota of this bioregion is still needed (Wilson, 2014).

Ecosystem role of sea cucumbers and possible ecosystem impacts of the fishery

During the original assessment of the WA sea cucumber fishery (Pilbara), there was a condition on ecosystem information on the fishery. DPIRD investigated this in detail and provided a short report with additional information on the possible ecosystem impacts of the fishery, which was included as an appendix in Brand-Gardner & Hartmann, 2021. Additionally, the Northern Territory shares similar coastal and benthic features with the Kimberley which also supports a sea cucumber fishery that only practices hand collection of sea cucumbers. Considering the similarities between the two regions and its fisheries, some information in this section has been inferred from the Ecological Risk Assessment (ERA) conducted for the NT sea cucumber fishery (Kimlin, 2021) as well as other references (Webster & Hart, 2018).

Sea cucumbers play an important role in the recycling of organic matter through feeding, excretion, and bioturbation processes (Lee et al., 2018; Purcell et al., 2016). Previous authors have attributed five key roles to sea cucumbers, including i) nutrient recycling; ii) influencing local water chemistry; iii) enhancing sediment health and cleaning through bioturbation; iv) creation of symbiotic relationships and v) adding value to the food chain. All these roles were assessed in the investigation of possible ecosystem impacts of the WA Sea Cucumber fishery (Brand-Gardner & Hartmann, 2021).

Nutrient cycling promoted primary production through enhanced sediment oxygenation. The investigation conducted determined that though the localised effects of sediment cleaning (i.e., removal of part of the organic load of sediment) could be measured, the impact to nutrient cycling would likely be non-quantifiable. It is highly likely that the effect of the tidal and current activity will disperse it, homogenising the waters around the fishing areas.

Sea cucumbers influence water chemistry locally, through increasing the availability of inorganic nutrients and providing greater alkalinity and carbonate buffer. However, because the habitats where the fishery operates are generally sandy or muddy, and due to the great tidal influence, it is considered that these localised effects of sea cucumbers in the environment are indistinguishable from the other broader environmental changes affecting the region (Brand-Gardner & Hartmann, 2021). Similarly, the NT sea cucumber ERA (Kimlin, 2021) classified the impact of sea cucumber removal on the benthos of the NT as negligible as most habitat where the fishery operates consists of sandy substrate.

Sea cucumbers actively burrow and ingest sediment, and as such have been identified as having a bioturbation and sediment cleaning role. When assessing the impact that the removal of holothurians in the UoA, Webster and Hart (2018) deducted that it would be limited to the immediate area where it occurred. As a result, this threat was classified as negligible (Brand-Gardner & Hartmann, 2021). Similarly, the NT sea cucumber ERA (Kimlin, 2021) rated that the removal of sea cucumbers had a low risk of impacting ecosystems' function.

Sea cucumbers are linked to other organisms through many symbiotic relationships. Such relationships enhance local biodiversity. Webster and Hart (2018) emphasised that to maintain the ecosystem role intact and functional, sea cucumber stocks in the UoA need to be sustainably managed.

Sea cucumbers add value to the food chain as they are prey to other organisms. The predators of sea cucumbers in the UoA are generalists and prey mostly on the juveniles, much smaller than the adults that are targeted by the fishery. This infers that predators do not only depend on this resource and therefore will not be greatly impacted by the fishery. Webster and Hart (2018) considered that "*the low number of sea cucumbers removed is unlikely to disrupt the ecosystem*". Similarly, the ERA conducted for the NT sea cucumber fishery (Kimlin, 2021) stated that the impact on the trophic structure through hand picking sea cucumbers is negligible.

Table 8 – Scoring elements			
Component	Scoring elements	Designation	Data-deficient
Habitats	Commonly encountered	Main	No
Ecosystem	NA		No

6.3.4 Principle 2 Performance Indicator scores and rationales

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 covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates		
Scoring Issue		SG 60	SG 80	SG 100
a	Commonly encountered habitat status			
	Guide post	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.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The WA sea cucumber fishery in the Kimberley operates over sandy and/or muddy substrates (figures 11, 12). Typically, the fishing method involves hand collection through hookah or diving or snorkelling (where operators do not usually touch the bottom) or wading (for a small amount of the catch). Fishers use hooker line floats to reduce drag and crew inductions are conducted to remind fishers to not drag catch bags or touch anything except for sea cucumbers. Thus, the fishery has minimum interaction with the benthos (Webster & Hart, 2018). In addition, the client confirmed that there have been no incidences of lost gear.

Generally, sandy habitats are not considered to be vulnerable to fishing impacts, even when fisheries use mobile gear (which is not the case for the sea cucumber fishery). When fishing impacts have been detected, recovery rates have been described as faster than for other habitats (Andrews & Skewes, 2019). The ERA found that the risk to benthic habitats from wading and anchoring was negligible due to the small number of vessels (2) (Webster & Hart, 2018). Similarly, the ERA for the NT sea cucumber fishery found that fishers would actively avoid disturbing the sediment as it reduces the visibility and the risk was considered negligible (Kimlin, 2021). Therefore, it is highly unlikely that the UoA will reduce structure and function of commonly encountered habitats to a point where there would be serious or irreversible harm and SG 60 and SG 80 are met.

As there is no evidence that the UoA is highly unlikely to reduce structure and function of commonly encountered habitats to a point where there would be serious or irreversible harm SG 100 is not met.

	VME habitat status			
b	Guide post	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.
	Met?	**NA**	**NA**	**NA**
Rationale				

VMEs were not identified for this fishery.

	Minor habitat status			
c	Guide post			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.
	Met?			**No**
Rationale				

Though it is possible to infer from other studies that the UoA is highly likely to have minimal impacts on minor habitats, similar to commonly encountered habitats, there is no information on the impacts of hand collecting of sea cucumbers on seabed habitats in the Kimberley. Therefore, SG 100 is not met.

References

Andrews, J., & Skewes, T. (2019). *MSC sustainable fisheries certification: western Australian sea cucumber fishery*.

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Webster, F. J., & Hart, A. M. (2018). *Ecosystem Based Fisheries Management (EBFM) Risk Assessment of the Western Australian sea cucumber fishery. Western Australian Marine Stewardship Council Report Series No.13*.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**80**

Condition number (if relevant)	

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	Management strategy in place			
	Guide post	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.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

There are a number of measures in the fishery that ensure that the fishery does not cause serious or irreversible harm to benthic habitats:

- Limited entry
- Restrictions on number of vessels and divers per licence
- Fishing method – hand collection by SCUBA, snorkelling or hookah (with hooker line floats)
- Spatial restrictions (e.g. fishing is prohibited within a 2 nm radius of the Rowley Shoals and some zones of marine parks)
- VMS for compliance with spatial management
- ERA to assess the risk the fishery poses to benthic habitats
- WA sea cucumber resource Harvest Strategy. The HS identifies actions that will be triggered in response to evidence of any impacts on marine habitats.
- Crew inductions/ Industry rotational strategy – practices to reduce impact with the seafloor and pulse fishing every few years.

Thus SG 60 is met. State marine parks in the area of operation of the WA sea cucumber fishery include i) Lalang-garram/Horizontal Falls, ii) Lalang-garram/Camden Sound, and iii) North Kimberley Marine Park were fishing is not permitted in sanctuary zones. Therefore, there is a partial strategy in place to ensure that the UoA does not pose a risk of serious or irreversible harm to the habitats and SG80 is met. Additionally, the number of measures in place and listed above have been designed and are implemented to protect the marine habitats within the UoA, therefore aligning with the MSC Standard definition of "strategy". The strategy sets cohesive management measures that work together to protect marine habitats. It is appropriate to the scale and intensity of the fisheries in the region.

Considering that the fishery has very low impact and is small scale, and that there is a strategic arrangement that has been designed to manage impact on habitats, SG 100 is met.

b	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on plausible argument (e.g. general	There is some **objective basis for confidence** that the measures/partial strategy will work, based	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on

		experience, theory or comparison with similar UoAs/habitats).	on **information directly about the UoA and/or habitats** involved.	**information directly about the UoA and/or habitats** involved.
	Met?	**Yes**	**Yes**	**No**
Rationale				

A number of measures such as limited entry and restrictions on the number of vessels and divers per licence, while not implemented specifically for habitat protection, limit effort in the fishery thereby minimising the potential impacts on benthic habitats. SG 60 is met.

Given the limited number of vessels operating in the WASCF, the spatially restricted and pulse nature of fishing and the method of collection (hand collection via SCUBA, snorkelling or hookah) and the preference of sea cucumbers for sandy habitats there is some objective basis for confidence that the measures/partial strategy will work and SG 80 is met.

The 2018 harvest strategy states that periodic risk assessments incorporating current management arrangements, extent of fishing activities, habitat distribution and available research are to be undertaken (Department of Primary Industries and Regional Development, 2018). The first risk assessment held in 2018 rated the impact to habitats as negligible (Webster & Hart, 2018) and it has not been updated to test its adequacy with high confidence, and therefore SG 100 is not met.

c	Management strategy implementation			
	Guide post		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).
	Met?		**Yes**	**No**
Rationale				

In addition to information from logbooks and VMS on the location of fishing activity, catches and other measures, the ERA provides some quantitative evidence the measures/partial strategy is being implemented successfully and SG80 is met. As there is no fishery independent mechanism for verifying logbook reporting there is no clear quantitative evidence that the partial strategy/strategy is being implemented successfully and SG 100 is not met.

d	Compliance with management requirements and other MSC UoAs'/non-MSC fisheries' measures to protect VMEs			
	Guide post	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	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.	MSC UoAs/non-MSC fisheries, where relevant.
	Met?	**NA**	**NA**	**NA**
Rationale				

VMEs were not identified for this fishery.

References

Department of Primary Industries and Regional Development. (2018). Western Australian Sea Cucumber Resource Harvest Strategy 2018 – 2023. *Fisheries Management Paper No.*, *Fisheries Management Paper No. 287*, 30.

Webster, F. J., & Hart, A. M. (2018). *Ecosystem Based Fisheries Management (EBFM) Risk Assessment of the Western Australian sea cucumber fishery. Western Australian Marine Stewardship Council Report Series No.13*.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**85**
Condition number (if relevant)	

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
	Information quality			
a	Guide post	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	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.

			distribution of the main habitats.	
	Met?	**Yes**	**Yes**	**No**
Rationale				

The Great Kimberley Marine Park is located within Commonwealth waters, and is part of the North-west Marine Parks Network. The park covers an area of 74,469 km², and its depth ranges from 15m to 800m. Zoning of the park occurs off the limit of coastal waters, and it includes a National Park Zone (IUCN II); two Habitat Protection Zones (IUCN IV) and the rest is classified as Multiple Use Zones (IUCN VI), which are adjacent to fishing areas and add more protection to those zones (Department of Parks and Wildlife, 2020; Environmental Resources Information Network (ERIN), 2018). Within State waters, there are three designated marine parks close to the areas where the Kimberley sea cucumber fishery operates. These include the i) Lalang-garram/Horizontal Falls, ii) Lalang-garram/Camden Sound, and the iii) North Kimberley Marine Park.

Through the planning and designation of these parks, data was collected to map and describe the habitats of this region, particularly within the waters of the Great Kimberley Marine Park. The fishery operates within two of the three State marine parks: the Lalang-garram/Camdem Sound Marine Park and the North Kimberley Marine Park (see figure 13).

Additionally, the ERA (EBFM risk assessment) analysed where the fishery operates (i.e., Kimberley Bioregion, figure 1) and compiled information previously classified by the Distinctive Interim Marine and Coastal Regionalisation of Australia (Commonwealth of Australia, 2006; Webster & Hart, 2018). Information on the distribution and vulnerability of certain habitats in the region enabled the delimitation of specific areas where commercial fishing is prohibited (Hart et al., 2018). This showcases that there is adequate information available to identify the main types of habitats and their distribution, as well as manage impacts accordingly, and thus, SG 60 is met. The recent biomass surveys using a ROV also provided some information on habitats types within the main fishing area.

SG 80 also requires consideration of the likelihood that the gear would encounter the habitat (MSC, 2018; SA3.15.4.1), and the likelihood that the habitat would be altered if an encounter between the gear and the habitat did occur (MSC, 2018; SA3.15.4.2). There is minimal interaction with benthic habitats as fishing method is hand collection by divers using SCUBA, snorkelling or hookah using line floats and there is a limited number of divers. Heat maps illustrate that the majority of fishing occurs in discrete areas. Therefore, SG 80 is met.

These data were mainly collected through surveys led by the Western Australian Museum (WAM) and the Australian Institute of Marine Sciences (AIMS) surveys since the late 1980s. There are still data gaps regarding the distribution and types of habitats in some regions, particularly outside of the marine parks. Additionally, recent studies highlight that more information on the biota of this bioregion is still needed (Wilson, 2014). Therefore, SG 100 is not met.

	Information adequacy for assessment of impacts			
b	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap	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	The physical impacts of the gear on all habitats have been quantified fully.

		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.	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.	
	Met?	**Yes**	**Yes**	**No**
Rationale				

The WA sea cucumber fishery in the Kimberley operates over sandy and/or muddy substrates as demonstrated through the fishery heat map and habitats maps (figures 1, 11, 12). Typically, the fishing method involves hand collection through hookah or diving or snorkelling (and sometimes wading), thus operators do not usually touch the bottom. Thus, the impact of gear on the benthos is minimal and SG 60 is met.

The ERA produced for the WA sea cucumber fishery (i.e., Pilbara and Kimberley) investigated in detail the role of sea cucumbers in the ecosystem and the impacts of the fishery (Webster & Hart, 2018). All issues identified through this study related to habitats were rated as negligible (Webster & Hart, 2018).

Additionally, the ERA conducted for the Northern Territory sea cucumber fishery (which shares similar coastal and benthic features with the Kimberley) also rated that the fishery has a minimal impact on the habitats where it operates (Kimlin, 2021).

All licensees in the WASCF must complete and submit logbooks when fishing (including the location and gear type used), with heat maps of the catch available (Figure CO2). SG 80 is met.
However, the physical impacts of the gear on all habitats have not been fully quantified and SG 100 is not met.

c	Monitoring			
	Guide post		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in all habitat distributions over time are measured.
	Met?		**Yes**	**No**
Rationale				

All licensees must complete and submit logbooks when fishing, with heat maps of the catch available (Figure CO2). Vessels are fitted with an operational Vessel Monitoring System (VMS) and although not currently produced, VMS data is available to validate the time and location of fishing. In addition, risk to benthic habitats in the area of operation have been assessed using an ERA, with risk to habitats from fishing operations ranked as negligible (Webster & Hart 2018). Therefore, adequate information is collected to detect any increase in risk to the main habitats and SG 80 is met. However, changes in all habitat distributions over time are not measured and SG 100 is not met.

References

Department of Parks and Wildlife. (2020). *Great Kimberley Marine Park*. Parks and Wildlife Service. https://parks.dpaw.wa.gov.au/connect/read/great-kimberley-marine-park

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Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**80**
Condition number (if relevant)	

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			
	Guide post	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.
	Met?	**Yes**	**Yes**	**No**
Rationale				

An RBF was conducted during the original MSC assessment of this fishery which resulted in a score of 100. Also, as a result of a condition imposed (PI 2.5.3) on the WA sea cucumber fishery, DPIRD investigated in detail and produced a short report on the ecosystem role of sea cucumbers for the WA (Pilbara and Kimberly) sea cucumber fishery (included as an appendix in Brand-Gardner & Hartmann, 2021) which supported the fact that with low numbers of sea cucumbers removed, the ecosystem is highly unlikely to be disrupted. Additionally, the ERA rated the fishery impacts on ecosystem (e.g., nutrient cycling, bioturbation, oxygenation) as negligible (Webster & Hart, 2018).

Finally, the ERA produced for the Northern Territory sea cucumber fishery also rated the fishery impacts on ecosystem as negligible (Kimlin, 2021). The NT fishery shares similar coastal and benthic features with the Kimberley and also practices hand collection of sea cucumbers. Considering the similarities between the two regions and the fisheries operating in these regions, it can be inferred that the rating of the NT fishery also applies to the Kimberley. This recent ERA assessed four different elements of ecosystem structure, including trophic structure, ecosystem function, addition of biological material and translocation of pests and diseases. Three of these elements were rated as negligible (trophic structure, addition of biological material and translocation of pests and diseases). The precautionary scoring recognising the potential risk of removal of holothurian species at a local level resulted in one trophic function classified as low risk. However, this report also highlights that the likelihood of fishery-wide ecosystem function would be considerably smaller (Kimlin, 2021).

Given the low impact fishing method (i.e., hand collection), no reported incidences of lost gear, the sporadic nature of the fishery and discrete localised nature of catches it is highly unlikely that the UoA will negatively affect the key elements supporting ecosystem structure and function to a point where there would be a serious or irreversible harm. Therefore, SG 60 and 80 is met.

However, there have been no directed investigations to provide evidence of this, SG 100 is not met.

References

Brand-Gardner, S., & Hartmann, K. (2021). *WA Sea cucumber fishery. Surveillance Report* (Issue June). https://fisheries.msc.org/en/fisheries/western-australia-sea-cucumber/@@assessments

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Webster, F. J., & Hart, A. M. (2018). *Ecosystem Based Fisheries Management (EBFM) Risk Assessment of the Western Australian sea cucumber fishery. Western Australian Marine Stewardship Council Report Series No.13*.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**80**
Condition number (if relevant)	

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	Management strategy in place			
	Guide post	There are **measures** in place, if necessary which take into account the **potential impacts** of the UoA 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.
	Met?	**Yes**	**Yes**	**No**

Rationale

There are a number of measures that ensure that the fishery does not impact the ecosystem:

- Limited entry
- Restrictions on number of vessels and divers per licence
- Fishing method – hand collection by SCUBA, snorkelling or hookah with float lines on a rotational basis
- Spatial restrictions
- VMS for compliance with spatial management
- ERA to assess the risk the fishery poses to the ecosystem

The fishing has a limited footprint with only a few divers fishing. There are also three State marine parks in the area of operation of the WA sea cucumber fishery; including i) the Lalang-garram/Horizontal Falls, ii) Lalang-garram/Camden Sound, and the iii) North Kimberley Marine Park. An ERA considered the impact of the sporadic removal of sandfish on the local ecosystem as negligible due to the low numbers of sea cucumbers removed and that predation on adult sea cucumbers is low due to toxins. Logbooks continue to provide information. Therefore, there is a partial strategy in place to ensure that the UoA does not pose a risk of serious or irreversible harm to the habitats and SG60 and SG 80 are met.

There is no strategy (e.g. research plan) in place that addresses main impacts on the ecosystem. Therefore SG 100 is not met.

b	Management strategy evaluation			
	Guide post	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar UoAs/ 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.
	Met?	**Yes**	**Yes**	**No**

Rationale

A number of measures such as limited entry and restrictions on the number of vessels and divers per licence, while not implemented specifically to minimise ecosystem impact, limit effort in the fishery thereby minimising the potential impacts of the UoA on the ecosystem. SG 60 is met.

Given the limited number of vessels operating in the WASCF and the spatially restricted and pulse nature of fishing there is some objective basis for confidence that the measures/partial strategy will work and SG 80 is met.

The 2018 harvest strategy states that periodic risk assessments incorporating current management arrangements, extent of fishing activities, ecosystem information and available research are to be undertaken (Department of Primary Industries and Regional Development, 2018). The first risk assessment held in 2018 rated the impact to the ecosystem as negligible and it has not been updated to test its adequacy with high confidence, and therefore SG 100 is not met.

c	Management strategy implementation			
	Guide post		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).**
	Met?		**Yes**	**No**

Rationale

In addition to information from logbooks and vessel monitoring systems (VMS) on the location of fishing activity, catch records and other measures, the ERA provides some quantitative evidence the measures/partial strategy is being implemented successfully and SG80 is met.

As there is no fishery independent mechanism for verifying logbook reporting there is no clear quantitative evidence that the partial strategy/strategy is being implemented successfully and SG 100 is not met.

References

Department of Primary Industries and Regional Development. (2018). Western Australian Sea Cucumber Resource Harvest Strategy 2018 – 2023. *Fisheries Management Paper No.*, *Fisheries Management Paper No. 287*, 30.

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**80**
Condition number (if relevant)	

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 quality			
	Guide post	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the key elements of the ecosystem.	
	Met?	**Yes**	**Yes**	
Rationale				

The EBFM risk assessment of the WA sea cucumber fishery showcases that the fishery operates in different areas which fall into the Kimberley bioregion (KIM), as classified by the Distinctive Interim Marine and Coastal Regionalisation of Australia (Commonwealth of Australia, 2006; Webster & Hart, 2018).

The key elements of the ecosystem in this bioregion have been identified through the logbooks, the ERA and through previous studies on habitats and ecosystems in the region (Commonwealth of Australia, 2006; Hart et al., 2018; Webster & Hart, 2018). These sources provide a broad understanding of key elements of the ecosystem and the impacts of the fishery. Thus, SG 60 and SG 80 are met.

b	Investigation of UoA impacts			
	Guide post	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**.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The main impacts of the UoA on key ecosystem elements can be inferred from existing information and research (Purcell, et al., 2016, Lee, et al., 2018) and the ERA (Webster & Hart 2018), therefore SG 60 is met.

The ERA produced for the WA sea cucumber fishery (including the Pilbara and Kimberley region) scored all the identified impacts of the fishery to the ecosystem as negligible (Webster & Hart, 2018). Additionally, the ERA produced for the Northern Territory sea cucumber fishery rated the fishery impacts on ecosystems as negligible (Kimlin, 2021). The NT fishery shares similar coastal and benthic features with the Kimberley and also practices hand-picking collection of sea cucumbers. Considering the similarities between the two regions and its fisheries, it can be inferred that the information on the impact of the NT fishery to the ecosystem is likely to apply to the Kimberley fishery.

While it is acknowledged that climate change is having an impact on some exploited stocks in WA (Caputi et al., 2015), there is little data from which the environmental impacts on sea cucumbers and preferred shallow water habitats in WA can be estimated. However, there is some evidence that suggests sea cucumbers are not among the most susceptible of organisms to ocean acidification (Dupont et al. 2010) and other studies that suggested higher sea temperatures may have a positive effect on growth rates and fecundity although these may be offset by increased larval and juvenile mortality associated with potential declines in seagrass habitats (Plaganyi et al., 2013).

DPIRD investigated the role of sea cucumbers and potential impact of the fishery as an action to meet an MSC condition which is published in the first surveillance report (Brand-Gardner & Hartmann 2021). Thus SG 80 is met.

Since there have been no quantitative investigations assessing in detail the impacts that the WA sea cucumber fishery may be causing in Kimberley ecosystems, SG 100 is not met.

c	Understanding of component functions			
	Guide post		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**.
	Met?		**Yes**	**No**
Rationale				

The main function of the components in the ecosystem target, primary, secondary and ETP species are known and the NT sea cucumber ERA has provided information on the risk posed by the NT sea cucumber fishery on each of the components (Kimlin, 2021). Considering the similarities between the two regions and its fisheries, some information on the role of sea cucumbers in the ecosystem can be inferred from the Ecological Risk Assessment (ERA) conducted for the NT sea cucumber fishery (Kimlin, 2021).

The ERA produced for the WA sea cucumber (including the Pilbara and Kimberley region) scored all the identified impacts of the fishery to ecosystem role as negligible, and only classified as low the issue of potential translocation of pests or diseases through vessel hulls.

Additionally, during the original assessment of the WA sea cucumber fishery, there was a condition targeting ecosystem information on the fishery (Pilbara sea cucumber fishery). Following this condition, DPIRD investigated in detail the ecosystem role of sea cucumbers and provided a short report with additional information on the possible ecosystem impacts of the fishery which is evidence that the main functions are known (Brand-Gardner & Hartmann, 2021). Therefore SG 80 is met.

The ERAs and report are based on qualitative information only at this stage. A quantitative assessment would provide a better understanding of the impacts of the fishery on P2 components, but this has not been done. Thus, SG100 is not met.

d	Information relevance			
	Guide post		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.
	Met?		**Yes**	**No**
Rationale				

Available data was used to assess the potential impact the fishery may pose to the broader ecosystem in the WA and NT sea cucumber ERAs (Webster & Hart, 2018; Kimlin, 2021). Therefore, adequate information was available to allow some of the main consequences for the ecosystem to be inferred at SG 80.

Additionally, the detailed investigation conducted by DPIRD on the ecosystem role of sea cucumbers in WA (i.e., Pilbara and Kimberley) provided additional information on the possible ecosystem impacts of the fishery (Brand-Gardner & Hartmann, 2021). More detailed information on the impacts of the UoA on both the components and elements is required before SG 100 is met.

e	Monitoring			
	Guide post		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.
	Met?		**Yes**	**No**
Rationale				

Information collected for the WA sea cucumber fishery includes catch and effort and fishing location data in logbooks which provides adequate information to support the Harvest Strategy (HS) already in place and the HCRs to monitor and manage ecosystem impacts (Department of Primary Industries and Regional Development, 2018). VMS data is available for fishery footprint and intensity information, however is not currently analysed by management. Therefore, SG80 is met.

While collection of industry catch and effort data allows examination of changes in targeting, fishing effort or fishing location, which may act as a mechanism to detect any increase in risk, there is no fishery independent monitoring in the fishery. Therefore, the information is not adequate to support the development of strategies to manage ecosystem impacts and SG 100 is not met.

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Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator score	**80**
Condition number (if relevant)	

7 Appendices

7.1 Small-scale fisheries

Table 8 – Small-scale fisheries		
Unit of Assessment (UoA)	Percentage of vessels with length <15m	Percentage of fishing activity completed within 12 nautical miles of shore
UoA 3	100%	100%

7.2 Evaluation processes and techniques

7.2.1 Site visits

The scope extension site visit comprised:

- An Audit Plan and agenda (see below) was provided to the client, management, and scientists before the meeting.
- A meeting took place at the Hub on SX in Fremantle 31st May 2022 with client representatives, scientists and managers of the fishery. Other stakeholders were notified of the time and location of the meeting. They were invited to participate or submit comments in writing. No requests for meetings or comments were received.
- Necessary documents were sent to the CAB by the client prior to the meeting.

Agenda

Remote participants were provided with a Microsoft Teams link prior to the meeting.

Scope extension			
Activity	**Items to Review/Actions**	**People required/attending**	**Approx. Time**
Principle 1	P1 discussion • Biomass estimates under new model • Survey frequency • Weight of evidence risk assessment • Stock structure	Management, Research staff, client, audit team	13:30-15:00
Principle 2	P2 discussion • Fishing habitats • Kimberley habitat and ecosystem information base	Management, Research staff, client, audit team	15:00-16:00
Preparation for closing meeting/Stakeholder meetings (if requested_		Audit team only/Stakeholders (if required)	16:00-16:30
Closing meeting	Findings, next steps	All	16:30-17:00

7.2.2 Stakeholder participation

Stakeholder opportunities were outlined in the Announcement of the fishery on the MSC website on 29 April 2022 and a separate email advising of the Announcement and inviting participation was sent to various representatives in the organisations on the list below. Stakeholders were invited to submit comments and offered private interviews and none were received.

Organisation
Tasmanian Seafoods Pty Ltd
WA Fishing Industry Council
Department of Primary Industries and Regional Development (DPIRD)
Department of Parks and Wildlife
WWF
Environs Kimberley
Kimberley Land Council
Roebuck Bay working group
Australian Marine Conservation Society
WA Ocean Foundation
University of WA

The following people attended the site visit meetings:

Name	**Role**	**Affiliation**
Dr Anthony Hart	Principal Research Scientist	DPIRD
Dr Luke Turner	Client	Tasmanian Seafoods Pty Ltd
Amie Steele	Fishery Manager	DPIRD
Anton Krsinich	Client	Tasmanian Seafoods Pty Ltd
Sheryl Priest (Remote)	Client	Tasmanian Seafoods Pty Ltd
Sascha Brand-Gardner	Team Leader, Principle 2 and 3 expert	bio.inspecta Pty Ltd
Dr Klaas Hartmann	Principle 1 expert	bio.inspecta Pty Ltd

7.2.3 Evaluation techniques

The client checked the stakeholder list prior to the announcement and emails. An allocated timeslot for meetings with stakeholders was provided at the site visit. In preparation for the site visit, the team requested personnel, with experience across all of the principles, make themselves available for questions from the assessment team.

The client submitted a comprehensive checklist with links to relevant documents and continued to submit information by email to inform the ACDR. Information continued to be collected during the site visit. Scoring was discussed by the assessment team during the site visit and the team agreed on a score (a consensus approach). Scoring was formally completed during the final preparation of the client draft report.

7.3 Peer Review report

General comments

Question	Yes/No	Peer Reviewer Justification (as given at initial Peer Review stage). Peer Reviewers should provide brief explanations for their 'Yes' or 'No' answers in this table, summarising the detailed comments made in the PI and RBF tables.	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)
Is the scoring of the fishery consistent with the MSC standard, and clearly based on the evidence presented in the assessment report?	Yes	This was a straight forward and simple scope extension. The information and scoring provided by the CAB was consistent and aligned with justifications provided. One area that wasn't clear to the reviewer was whether climatic impacts had been considered in the assessment under both P1 and ecosystems under P2. This is with particular reference to significant heat wave events that have occurred off the coast of WA a number of times in recent years, which had significant adverse impacts on numerous species and fishery stocks. No reference to this could be found and it is unclear if the stock assessment/risk assessment and Harvest Strategy/HCR has factored these past and potential future events into the framework?	Climatic effects were mentioned in the P1 background under "inherent vulnerability' on page 16. Climatic impacts have now been considered in the amended rationales for PIs 1.1.1, 1.2.2, 1.2.3 and 2.5.3b.
Are the condition(s) raised appropriately written to achieve the SG80 outcome within the specified timeframe? [Reference: FCP v2.2, 7.18.1 and sub-clauses]	Yes	Just two Conditions raised, which is no surprise for a straight forward scope extension. Conditions have been placed on the correct gaps in knowledge and are expected to deliver required outcomes in the specific timeframes.	
Optional: General Comments on the Peer Review Draft Report (including comments on the adequacy of the background information if necessary). Add extra rows if needed below, including the codes in Columns A-C.	NA	Report is well written, clear and concise.	Thank you

PI comments

UoA stock	UoA gear	PI	PI Information	PI Scoring	PI Condition	Peer Reviewer Justification (as given at initial Peer Review stage)	CAB Response to Peer Reviewer's comments (as included in the Public Comment Draft Report - PCDR)	CAB Res-ponse Code
Kimberley sandfish (*Holothuria scabra*)	hand collection	1.1.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	1.1.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	1.2.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	1.2.2	Yes	Yes	Yes			
Kimberley sandfish (Holothuria scabra)	hand collection	1.2.3	Yes	Yes	Yes			
Kimberley sandfish (Holothuria scabra)	hand collection	1.2.4	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.1.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.1.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.1.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.2.1	Yes	Yes	NA			

Kimberley sandfish (Holothuria scabra)	hand collection	2.2.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.2.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.3.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.3.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.3.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.4.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.4.2	Yes	Yes	NA	SI(b) is missing a reference for the risk assessment conducted in 2018 regarding habitats.	This has been added.	Accepted (no score change, change to rationale)
Kimberley sandfish (Holothuria scabra)	hand collection	2.4.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.5.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.5.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	2.5.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.1.1	Yes	Yes	NA			

Kimberley sandfish (Holothuria scabra)	hand collection	3.1.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.1.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.2.1	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.2.2	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.2.3	Yes	Yes	NA			
Kimberley sandfish (Holothuria scabra)	hand collection	3.2.4	Yes	Yes	NA			

7.4 Stakeholder input

There were no written submissions or requests for additional meetings received from stakeholders during the ACDR stage or during the site visit. Information received from those in attendance has been incorporated into the rationales presented in this report.

7.5 Conditions

7.5.1 Conditions

Table 9 – Condition 9	
Performance Indicator	1.2.2
Score	75
Justification	**Scoring issue b:** *"the spatial population structure remains a key source of uncertainty and one which may have undesired consequences for the HCR. Changes in spatial fishing within sub-areas may mask serial depletion. More concerningly the assumptions made in scaling from the surveyed area and sCPUE index to the entire Kimberley region remain unclear and are likely susceptible to uncertainty in the population structure and connectivity. A key issue is that the FIS is scaled to the historic extent of the fishing activity whilst the sCPUE index is representative of the much more limited fishing activity in recent years."*
Condition	Demonstrate that the HCRs are robust to the main uncertainties (e.g consideration of the spatial representativeness of the biomass estimate and/or the spatial areas represented by different data sources).
Condition deadline	Audit 1, next certification period.
Exceptional circumstances ☒	As this is a scope extension there is insufficient time to conduct the scientific study to fulfil this condition within the current certification cycle.
Milestones	**Audit 3:** a) Develop a plan for addressing the identified spatial issues in the assessment process and HCR. b) Determine whether a FIS with a broader or different spatial coverage is required. Resulting Score: 75 **Audit 4:** a) Provide initial results of the updated assessment and HCR identified in Audit 3.a b) Conduct the FIS identified in Audit 3 if required. Resulting Score: 75 **Re-assessment:** a) Provide final results of the updated assessment and HCR identified in Audit 3.a b) Determine whether further updates are required to the assessment to incorporate the findings in Condition 10. Resulting Score: 75

	Audit 1 (next certification period): Provide a final assessment and HCR that is robust to the identified issues and provide a plan for ensuring future spatial changes in fishing do not cause a recurrence of this issue. Resulting Score: 80
Verification with other entities	DPIRD

Table 10 – Condition 10	
Performance Indicator	1.2.3
Score	75
Justification	**Scoring issue a:** *"The stock structure of sandfish in WA has not yet been established, however genetic studies from the Northern Territory and Queensland indicate that genetic differences may occur not just between the Kimberley and Pilbara populations but also within these. The functional scale of stock structure may be at a smaller spatial scale again, particularly between embayments. Information about this stock structure is required to ensure that the harvest strategy is robust to the dynamics arising from the spatial stock structure, its potential impact on assessment methods and the appropriateness of potential response mechanisms (see also PI 1.2.2(b))."*
Condition	Sufficient information relevant to stock structure should be made available to support the harvest strategy.
Condition deadline	Audit 1, next certification period.
Exceptional circumstances ☒	As this is a scope extension there is insufficient time to conduct the scientific study to fulfil this condition within the current certification cycle.
Milestones	**Audit 3:** Prepare a proposal for investigating Kimberley sandfish population structure. Resulting Score: 75 **Audit 4:** Commence the project proposed at Audit 3. Resulting Score: 75 **Re-assessment:** a) Complete field work and initial analyses. b) Provide draft results from the sandfish population structure project. Resulting Score: 75 **Audit 1 (next certification period):** a) Provide final results on the sandfish population structure. Resulting Score: 80

Verification with other entities	DPIRD

7.6 Client Action Plan

The client action plan for the additional conditions was developed by DPIRD in conjunction with Tasmanian Seafoods using the MSC client action plan template v 1.0. The roles and responsibilities are clearly articulated and DPIRD is well resourced for this fishery. The following email was received to support the client action plan.

Sascha, Anton and I discussed this today.
I can confirm that DPIRD and TS are committed to closing out the conditions within the specified timeframe.
Regarding Klaas's comment I will return the document with my detailed reply first thing tomorrow.

Dr Anthony Hart | Principal Research Scientist
Western Australian Fisheries and Marine Research Laboratories
Department of Primary Industries and Regional Development
39 Northside Drive, Hillarys WA 6025
PO Box 20 North Beach WA 6920 Australia
t +61 8 9203 0202 **f** +61 8 9203 0199 **m** 0419 967 542 **w** dpird.wa.gov.au
Email: Anthony.Hart@dpird.wa.gov.au

Progress on conditions from the original assessment has been adequate to date and it is considered that the closure of conditions are achievable and realistic within the timeframe.

Client action plan

1	Condition number
	9
2	Performance Indicator(s)
	1.2.2 b
3	Score
	75
4	Condition(s)
	Demonstrate that the HCRs are robust to the main uncertainties (e.g consideration of the spatial representativeness of the biomass estimate and/or the spatial areas represented by different data sources).
5	Milestone(s)
	Audit 3: a) Develop a plan for addressing the identified spatial issues in the assessment process and HCR. b) Determine whether a FIS with a broader or different spatial coverage is required. Resulting Score: 75 **Audit 4:** a) Provide initial results of the updated assessment and HCR identified in Audit 3.a b) Conduct the FIS identified in Audit 3 if required. Resulting Score: 75 **Re-assessment:** a) Provide final results of the updated assessment and HCR identified in Audit 3.a

	b) Determine whether further updates are required to the assessment to incorporate the findings in Condition 10. Resulting Score: 75 **Audit 1 (next certification period):** Provide a final assessment and HCR that is robust to the identified issues and provide a plan for ensuring future spatial changes in fishing do not cause a recurrence of this issue. Resulting Score: 80
6	Summary of action plan

Milestone	Action	Roles & Responsibilities	Outputs
Audit 3, milestone a)	Quantify the known spatial distribution of *Holothuria scabra* populations in the Kimberley	TF (Tasmanian Seafoods) Provide all past spatial fishing data to DPIRD DPIRD Compare the frequency and distribution of current fishing with knowledge of stocks	% of current area fished relative to historical fishing Method for incorporating the "% fished" data into the HCR
Audit 3, milestone b)	Develop a FIS plan for *Holothuria scabra* that accounts for spatial knowledge. Determine if spatial connectivity studies (e.g. through spatial genetics or ocean current studies) are required to fill gaps in knowledge of spatial connectivity.	TF (Tasmanian Seafoods) Provide future fishing plans to DPIRD for analysis DPIRD Present plans for spatial connectivity studies	TF Schedules of harvest by vessels DPIRD Objectives and methods for spatial connectivity studies
Audit 4, milestone a)	Updated initial HCR with new spatial information parameters Spatial connectivity studies underway	DPIRD Completed HCR with new parameters DPIRD + TF Completed spatial connectivity studies.	HCR estimates current biomass relative to performance indicators, and responsive management actions
Audit 4, milestone b)	FIS survey of Kimberley stocks of *Holothuria scabra* underway	DPIRD Completed HCR with new FIS biomass estimates	HCR estimates current biomass relative to performance indicators, and responsive management actions

Re-assessment, milestone a)	Updated initial HCR with new spatial information parameters Spatial connectivity studies underway	DPIRD Completed HCR with new parameters	HCR estimates current biomass relative to performance indicators, and responsive management actions
Re-assessment, milestone b)	Review whether new FIS survey design and updated HCRs are robust to the main uncertainties for Kimberley stocks of *Holothuria scabra* (i.e. meet condition 10)	DPIRD+TF Comprehensive HCR with sensitivity analyses to all identified uncertainties, including changes in stock structure	HCR provides current biomass relative to performance indicators, and responsive management actions, for all of Kimberley and any likely smaller spatial populations with the Kimberley bioregion.
Audit 1 (next certification period)	Finalise a spatially robust HCR for *Holothuria scabra*	TF Provide medium to long term fishing plans to DPIRD DPIRD Embed the spatially robust HCR into a formal harvest strategy for the Sea Cucumber Resource	New Harvest strategy with spatially robust HCR's.

1	Condition number
	10
2	Performance Indicator(s)
	1.2.3 a
3	Score
	75
4	Condition(s)

	Sufficient information relevant to stock structure should be made available to support the harvest strategy.
5	Milestone(s)
	Audit 3: Prepare a proposal for investigating Kimberley sandfish population structure. Resulting Score: 75 **Audit 4:** Commence the project proposed at Audit 3. Resulting Score: 75 **Re-assessment:** a) Complete field work and initial analyses. b) Provide draft results from the sandfish population structure project. Resulting Score: 75 **Audit 1 (next certification period):** a) Provide final results on the sandfish population structure. Resulting Score: 80
6	Summary of action plan

Milestone	Action	Roles & Responsibilities	Outputs
Audit 3	Develop R&D proposal for connectivity studies	TF Provide operational support details for project proposal DPIRD Develop sampling, spatial, and analysis protocols for R&D project	TF+DPIRD R&D project proposal
Audit 4	Implement a R&D project for connectivity studies, using ocean current and genetic indicators where fruitful	TF Provide operational support for connectivity project DPIRD	TF+DPIRD Draft sampling and analysis completed for connectivity project

		Implement connectivity project	
Re-assessment (a)	Complete field sampling and analysis for connectivity project	TF Provide feedback on initial analysis DPIRD Interim project report for connectivity project	TF+DPIRD Completed sampling and analysis for connectivity project
Re-assessment (b)	Write draft report for sandfish population structure	TF Provide feedback on draft report DPIRD Write draft report	TF+DPIRD Draft report completed
Audit 1 (next certification period)	Write final report for sandfish population structure	TF Provide feedback on final report DPIRD Write final report	TF+DPIRD Final report completed

7.7 Surveillance

The surveillance level is the same as the existing fishery certificate.

Table 10 – Fishery surveillance program				
Surveillance level	Year 1	Year 2	Year 3	Year 4
Level 4	On-site	Off-site	Off-site	On-site & Re-assessment

Table 11 – Timing of surveillance audit			
Year	Anniversary date of certificate	Proposed date of surveillance audit	Rationale
3	8 June 2023	May 2023	Expect the audit will be scheduled within 30 days prior to the anniversary date of the certificate

Table 12 – Surveillance level justification			
Year	Surveillance activity	Number of auditors	Rationale
3	Off-site audit	1 auditor on-site (already based there) with remote support from 1 auditor	1 auditor is already based at the fishery location and progress with milestones set for conditions can be verified by an assessment team on or off site.

8 References

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