Department of Agriculture and Fisheries

Sustainable Fisheries Strategy 2017–2027

Ocean Beach Fishery (East Coast Inshore Fishery)

Level 2 Ecological Risk Assessment

Queensland Government

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Executive Summary

In May 2019, a whole-of-fishery or Level 1 ERA was released for the *East Coast Inshore Fishery* (ECIF). The Level 1 ERA provided a broad risk profile for the ECIF, identifying key drivers of risk and the ecological components most likely to experience an undesirable event. As part of this process, the Level 1 ERA considered both the current fishing environment and what can occur under the current management regime. In doing so, the outputs of the Level 1 ERA helped differentiate between low and high-risk elements and established a framework that can be built on in subsequent ERAs.

In the Level 2 ERA, the focus of the assessment shifts to individual species with risk evaluations based on a *Productivity & Susceptibility Analysis* (PSA). The PSA evaluates risk through an assessment of seven biological attributes (*age at maturity*, *maximum age*, *fecundity*, *maximum size*, *size at maturity*, *reproductive strategy*, and *trophic level*) and up to seven fisheries-specific attributes (*availability*, *encounterability*, *selectivity, post-capture mortality, management strategy, sustainability assessments* and *recreational desirability / other fisheries*). As the PSA can over-estimate risk for some species (Zhou *et al.*, 2016), the Level 2 ERA also included a Residual Risk Analysis (RRA). The RRA gives further consideration to risk mitigation measures that were not explicitly included in the PSA and/or any additional information that may influence the risk status of a species (Australian Fisheries Management Authority, 2017). The primary purpose of the RRA is to minimise the number of 'false positives' or instances where the risk level has been overestimated.

As the ECIF incorporates multiple sub-fisheries and apparatus, risk was assessed separately for the large mesh nets (gillnets and ring nets), tunnel nets, and ocean beach fishing. The focus of this assessment being the Ocean Beach Fishery which operates in south-east Queensland under the K1–K8 fishery symbols (Department of Agriculture and Fisheries, 2019a). The scope of the Level 2 assessment was based on the outputs of the Level 1 ERA (Jacobsen *et al.*, 2019) and considered the risks posed to the target & byproduct species ecological component and *Species of Conservation Concern* (SOCC). The SOCC subgroup includes no-take species (*e.g.* marine turtles, dolphins) and retainable species that have conservation listings in State and Commonwealth legislation or international instruments like the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A review of catch data, current legislation and international instruments produced a list of 33 target & byproduct species and 84 SOCC that were considered for inclusion in the Level 2 ERA. This list was subsequently reduced to 22 species consisting of 11 teleosts (target & byproduct), three marine turtles (SOCC), three dolphins (SOCC), three sharks (SOCC) and two batoids (SOCC). The omitted species were either teleosts with low rates of retention, species where the risk of overexploitation is being effectively managed (*i.e.* tailor) or SOCC with low or limited potential to interact with this sector of the ECIF. When and where appropriate, consideration will be given to including these species in subsequent ERAs involving the Ocean Beach Fishery.

When the outputs of the PSA and RRA were taken into consideration, all of the target & byproduct species were classified as either a low (n = 7, 63%) or medium (n = 4, 37%) risk. These results were attributed to the fact operators target schools of mullet or tailor and use a selective form of net fishing. The sustainability of these two species have also been confirmed through multiple quantitative stock assessments and indicative sustainability evaluations (Leigh *et al.*, 2017; Litherland *et al.*, 2018; Lovett *et al.*, 2018; Stewart *et al.*, 2018). The remaining species are caught in smaller quantities and retained opportunistically. That is, when targeting mullet or tailor. These species are generally viewed as

secondary targets, have less-prescriptive management regimes, and are low priorities in terms of stock assessments and/or transition to output controls (Department of Agriculture and Fisheries, 2020c).

The Level 2 assessment for the SOCC was more complicated with all eleven species categorised as being at an intermediate (*n* = 8 species) or high (*n* = 3 species) risk. The final risk ratings were heavily influenced by the life-history constraints of the species assessed, with attributes based on reproduction and longevity identified as the key drivers of risk. As with the target and byproduct species, the operational constraints of the fishery were identified as a key mitigator of risk. For example, the area of operation, comparatively short shot times and the use of smaller mesh sizes.

Unlike the target & byproduct species ecological component, final ratings for the SOCC are considered more representative of the potential risk *versus* a real or actual risk. **For most of the species, this risk will only come to fruition if there is a substantial and long-term change in fishing patterns or behaviours. Final risk ratings for a number of these species are likely to be overestimates and will not require significant species-specific reforms.** It is recognised though, that the Ocean Beach Fishery will be a contributor of risk for a number of the SOCC and further information is required on how the fishery interacts with these species, including on the fine-scale movement of effort, catch compositions, and release fates.

A number of the above risks are being actively addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027*, including an extended use of *Vessel Tracking*, the introduction of a *Data Validation Plan*, and the development of an ECIF-specific harvest strategy (Department of Agriculture and Fisheries, 2017; 2018f; g; 2020c). These initiatives will improve the level of understanding on how the Ocean Beach Fishery interacts with these species (for example, catch compositions, interaction rates, discards) and will contribute to a lowering of the risk rating for a number of the species included in this assessment. With additional information and improved mechanisms to monitor catch in real or near time, it is anticipated that a number of the species will be omitted from future ERAs involving the Ocean Beach Fishery, including a number of the SOCC.

General recommendations

1. Improve the efficacy of mechanisms used to validate data submitted through the logbook program, including information on the dynamics of the fishery and the number of interactions with non-target species. As part of this process, it is recommended that the gear reporting requirements be extended to include information on what fishing symbol is being used.

2. Identify avenues/mechanisms that can be used to monitor the catch of target and non-target species effectively (preferably in near or real time) and minimise the risk of non-compliance with Species of Conservation Interest (SOCI) reporting requirements.

3. Implement measures to improve the level of information on the dynamics of the K-fishery, including fine-scale effort movements and effort patterns with apparatus other than a seine/haul net.

4. Establish a measure to estimate the ‘gear affected area’ and, when available, reassess the risk posed to teleost species using a more quantitative ERA method, such as bSAFE.

Summary of the outputs from the Level 2 Ecological Risk Assessment for the Ocean Beach Fishery.

Common name	Species name	Productivity	Susceptibility	*Risk rating*
Target Species				
Sea mullet	*Mugil cephalus*	1.29	2.00	Low
Bluespot mullet	*Valamugil seheli*	1.14	2.14	Low
Fantail (silver) mullet	*Paramugil georgii*	1.29	2.14	Low
Goldspot (tiger/flat tail) mullet	*Liza argentea*	1.14	2.14	Low
Diamondscale mullet	*Liza vaigiensis*	1.29	2.14	Low
Trumpeter (winter) whiting	*Sillago maculata*	1.43	2.71	Precautionary Medium
Sand (summer) whiting	*Sillago ciliata*	1.29	2.14	Low
Yellowfin bream	*Acanthopagrus australis*	1.29	2.14	Low
Tarwhine	*Rhabdosargus sarba*	1.43	2.57	Precautionary Medium
Snubnose dart	*Trachinotus blochii*	1.57	2.43	Medium
Swallowtail dart	*Trachinotus coppingeri*	1.29	2.43	Medium
Species of Conservation Concern				
Marine turtles				
Green turtle	*Chelonia mydas*	2.29	1.75	Medium
Loggerhead turtle	*Caretta caretta*	2.43	1.75	Precautionary Medium
Hawksbill turtle	*Eretmochelys imbricata*	2.29	1.75	Precautionary Medium
Dolphins				
Australian humpback dolphin	*Sousa sahulensis*	2.57	1.75	Precautionary Medium
Common bottlenose dolphin	*Tursiops truncatus*	2.86	1.50	Precautionary High
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	2.71	1.75	Precautionary Medium
Sharks				
Great hammerhead	*Sphyrna mokarran*	2.86	1.50	Precautionary High
Scalloped hammerhead shark	*Sphyrna lewini*	2.86	1.50	Precautionary High
Smooth hammerhead shark	*Sphyrna zygaena*	2.86	1.25	Precautionary Medium
Batoids				
Bottlenose wedgefish	*Rhynchobatus australiae*	2.57	1.75	Precautionary Medium
Giant shovelnose ray	*Glaucostegus typus*	2.43	1.75	Precautionary Medium

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Definitions & Abbreviations

AFMA	–	*Australian Fisheries Management Authority*
CAAB	–	*Codes for Australian Aquatic Biota*
CMS	–	*Convention on the Conservation of Migratory Species of Wild Animals.*
CITES	–	*Convention on International Trade in Endangered Species of Wild Fauna and Flora.*
CSIRO	–	*Commonwealth Scientific and Industrial Research Organisation*
EPBC Act	–	*Environment Protection and Biodiversity Conservation Act 1999*
ERA	–	Ecological Risk Assessment
ERAEF	–	*Ecological Risk Assessment for the Effects of Fishing*. A risk assessment strategy established by Hobday *et al*. (2011) and employed by the AFMA.
False positive	–	The situation where a species at low risk is incorrectly assigned a higher risk rating due to the method being used, data limitation *etc.* In the context of an ERA, 'false positives' are preferred over 'false negatives'.
False negative	–	The situation where a species at high risk is assigned a lower risk rating. When compared, false negative results are considered to be of more concern as the impacts/consequences can be more significant.
GBRMP	–	*Great Barrier Reef Marine Park*
GBRMPA	–	*Great Barrier Reef Marine Park Authority*
Gillnets	–	Gillnets include general purpose mesh nets (excluding ring nets), set mesh nets and nets that are neither fixed nor hauled *i.e.* general gillnet fishing under the N1, N2 and N4 fishery symbols including anchored and drifting gillnets. For the purpose of this ERA, the definition of gillnets does not include ring net operations which are considered as a separate entity, seine nets used in the Ocean Beach Fishery (K1–K8 fishery symbols), tunnel nets (N10 fishery symbol) or small mesh net fishing activities under the N11 fishery symbol.
ITQs	–	Individual Transferrable Quotas
Large Mesh Nets	–	Nets permitted for use under the N1, N2 and N4 fishery symbol. Does not include small mesh nets permitted for use under the N11 fishing symbol, tunnel nets (N10) and seine nets used in the Ocean Beach Fishery (K1–K8 fishery symbol).

MEY	–	Maximum Economic Yield
MSY	–	Maximum Sustainable Yield
PCM	–	Post-capture mortality
PSA	–	*Productivity & Susceptibility Analysis.* One of the two ERA methodologies that can be used as part of the Level 2 assessments.
Ring net	–	Defined in accordance with section 8 of the *Fisheries (General) Regulations 2019* as a large mesh net shot in a way that allows it to encircle the fish being targeted. Ring nets are deployed and retrieved in open water (not from the shore) and do not include seine nets used in the Ocean Beach Fishery which are deployed in an arc from the shoreline.
RRA	–	Residual Risk Analysis
SAFE	–	*Sustainability Assessment for Fishing Effects*. One of the two ERA methodologies that can be used as part of the Level 2 assessments. This method can be separated into a base SAFE (bSAFE) and enhanced SAFE (eSAFE). The data requirements for eSAFE is higher than a bSAFE which aligns more closely to a PSA.
SAFS	–	The National *Status of Australian Fish Stocks*. Refer to www.fish.gov.au for more information.
SOCC	–	*Species of Conservation Concern*. Term used in the Level 1 and Level 2 ERA to categorise the list of species with ongoing concern. The SOCC includes both no-take species and species that are targeted within the ECIF.
SOCI	–	*Species of Conservation Interest.* No-take species that are subject to additional reporting requirements if caught in a commercial fishery operating in Queensland.
StrandNET	–	Reporting system used by the *Department of Environment and Science* (DES) to complete the *Marine Wildlife Stranding and Mortality Database*. StrandNET summarises all records of sick, inured or dead marine wildlife reported through DES and annual reports can be accessed at: https://environment.des.qld.gov.au/wildlife/animals/caring-for-wildlife/marine-strandings/data-reports/annual-reports#document_availability.
TACC	–	Total Allowable Commercial Catch Limit
TEP	–	Threatened, Endangered & Protected

1 Introduction

Ecological Risk Assessments (ERA) are important tools for sustainable natural resource management and they are being used increasingly in commercial fisheries to monitor long-term risk trends for target and non-target species. In Queensland, ERAs have previously been developed on an as needs basis and these assessments have often employed alternate methodologies (Department of Agriculture and Fisheries, 2019d). This process is now being formalised as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (the Strategy) (Department of Agriculture and Fisheries, 2018e). Once completed, the ERAs will inform a range of Strategy initiatives including the development of harvest strategies, identifying key research needs and implementing detailed bycatch mitigation strategies (Department of Agriculture and Fisheries, 2017; 2018d; e; 2020c).

In May 2019, a whole-of-fishery or Level 1 ERA was released for the *East Coast Inshore Fishery* (ECIF; Jacobsen *et al.*, 2019).[1] The Level 1 ERA provided a broad-scale assessment of risks posed by this fishery including the key drivers of risk and the ecological components most likely to experience an undesirable event. These outputs were based on considerations given to the current fishing environment (*e.g.* catch and effort levels, participation rates) and actions that are permissible under the current management regime (*e.g.* shifting effort, increasing fishing mortality). In the context of the broader ERA, these results were used to differentiate between low and high-risk elements and determine what ecological components should be progressed to a finer-scale or species-specific ERA (Department of Agriculture and Fisheries, 2018e).

For the Level 2 ERA, the focus of the analysis shifts to a species-specific level and the scope of the assessment is refined to the current fishing environment. Applying more detailed assessment tools, Level 2 ERAs establish risk profiles for individual species using one of two methods: the semi-quantitative *Productivity & Susceptibility Analysis* (PSA) or the quantitative *Sustainability Assessment for the Effects of Fishing* (SAFE) (Department of Agriculture and Fisheries, 2018e; Hobday *et al.*, 2007; Zhou & Griffiths, 2008). While both methods have been developed for use in data limited fisheries, the use of the PSA or SAFE will be dependent on the species being assessed, the level of information on gear effectiveness, and the distribution of the species in relation to fishing effort (Hobday *et al.*, 2011).

As the ECIF incorporates multiple sub-fisheries and apparatus, risk was assessed separately for the large mesh nets (gillnets and ring nets), tunnel nets, and ocean beach fishing. The focus of this assessment being the Ocean Beach Fishery which operates in south-east Queensland under the K1–K8 fishery symbols (Department of Agriculture and Fisheries, 2019a). The scope of the Level 2 assessment was based on the outputs of the Level 1 ERA (Jacobsen *et al.*, 2019) and considered the risks posed to the target & byproduct species ecological component along with a range of species with ongoing conservation concerns *e.g.* marine turtles, dolphins, sharks, rays and dugongs.

[1] *The East Coast Inshore Fishery (ECIF) was formally referred to as the East Coast Inshore Fin Fish Fishery or ECIFFF.*

2 Methods

2.1 The Fishery

The ECIF is one of the more complicated commercial fisheries operating on the Queensland east coast. The management system incorporates multiple fishing symbols, and the fishery operates across a wide range of habitats and water depths. Despite this variability, the fishery is often assessed and monitored as single entity *e.g.* for *Wildlife Trade Operation* (WTO) approvals, annual fisheries summaries (Department of Agriculture and Fisheries, 2018a; 2019a; Department of Environment and Energy, 2019). Even so, the ECIF can be subdivided into a number of informal sub-fisheries based on the apparatus being used: large mesh nets (general purpose mesh nets, set nets and ring nets), tunnel nets, beach seine/haul nets, small mesh nets, and a line fishery (Department of Agriculture and Fisheries, 2019a). These arbitrary separations or sub-divisions provide a more accurate representation of how the ECIF operates.

For the purpose of this ERA, the *Ocean Beach Fishery* is defined as beach-based commercial fishing operations targeting schools of fish with a seine or haul net under the *K* fishery symbol. When compared to the large mesh net fishery (*e.g.* N1, N2 and N4 fishery symbols), the Ocean Beach Fishery has a smaller number of symbols (*n* = 36, K1–K8 total) and a smaller footprint. Operations are limited to waters between Noosa Heads and the Queensland / New South Wales border, and access is restricted through regional management provisions (Department of Agriculture and Fisheries, 2019a). The use of a commercial seine net is further limited by temporal provisions that restrict their use to between 1 April and 31 August (inclusive) each year. For these reasons, the Ocean Beach Fishery is widely considered to be a contributor of risk for most species *verse* the main driver of risk.

In Queensland, operators with a K1–K8 fishery symbol can use any general purpose net providing a) it is permitted for use under the N1 fishery symbol and b) the net is not used within a designated Ocean Beach Fishery area from 1 April to 31 August.[2] **In this Level 2 ERA, only beach seine fishing activities conducted during the 1 April to 31 August period will be considered in the final assessment.** Other non-seine net fishing activities, including the use of a general purpose mesh net under a K-symbol, will be considered and assessed as part of the large mesh net (gillnet and ring net) Level 2 ERA.

Outputs of the Level 2 ERA were based on the current fishing environment and management arrangements used to regulate activities in the Ocean Beach Fishery at the time of the assessment (Department of Agriculture and Fisheries, 2019a). It is recognised that the broader management regime for the ECIF is being reviewed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017) and a number of alternate management strategies are being developed and considered *e.g.* further use of regional management initiatives, increased use of species-specific quotas and the development of a dedicated bycatch management plan (Department of Agriculture and Fisheries, 2019b; c). This review is ongoing and a high number of the alternative strategies are still in development and are yet to be adopted or fully implemented. For these reasons, outputs from the Level 2 ERA will only consider arrangements that are in place and enforceable at the time of the assessment.

[2] *Provisions determining the use of general purpose mesh nets under the K1–K8 symbol are outlined in Part 2, Division 1, Subdivision 2 of the Fisheries (Commercial Fisheries) Regulation 2019. Provisions relating to the permitted areas of fishing for the Ocean Beach Fishery are located in Part 1 of the Fisheries (Commercial Fisheries) Regulation 2019.*

In addition to the management reforms, the Ocean Beach Fishery Level 2 ERA includes species that may interact with the recreational and charter fishing sectors or be impacted on by other marine-based activities. These cumulative risks were taken into consideration as part of the Level 1 ERA and, when and where appropriate, will be given further consideration as part of this assessment. It is noted though that these impacts or cumulative risks involve a wider range of stakeholders and are difficult to address through a fisheries management framework. Accordingly, cumulative risk comparisons will only be used to provide further context on the extent of the risk posed by commercial fishing activities to key species or species complexes.[3]

2.2 Information sources / baseline references

Where possible, baseline information on the life history constraints and habitat preferences for each species were obtained from peer-reviewed articles. In the absence of peer-reviewed data, additional information was sourced from grey literature and publicly accessible databases such as *FishBase* (www.fishbase.org), *SeaLifeBase* (www.sealifebase.ca), *Fishes of Australia* (www.fishesofaustralia.net.au), *Seamap Australia* (www.seamapaustralia.org) and the *IUCN Red List of Threatened Species* (www.iucnredlist.org). Additional information including on the distribution of key seabirds, fish and endangered species was obtained through the *Atlas of Living Australia* (www.ala.org.au), *Species Profile and Threats Database* (Department of Environment and Energy, www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) and resources associated with the management and regulation of marine national parks *e.g.* the *Moreton Bay Marine Park* and *Great Sandy Marine Park.* Where possible regional distribution maps were sourced for direct comparison with effort distribution data (Whiteway, 2009).

Fisheries data used in the Level 2 ERA were obtained through the fisheries logbook program (including *Species of Conservation Interest* or SOCI logbook), a previous *Fisheries Observer Program* (FOP), the *Fishery Monitoring Program* and the *Statewide Recreational Fishing Survey* (Webley *et al.*, 2015). This information was supplemented with data from ancillary sources including from the *Marine Wildlife Stranding and Mortality Database*—herein referred to as '*StrandNET*' (Department of Environment and Science, www.environment.des.qld.gov.au/wildlife/caring-for-wildlife/marine_strandings.html).

For the Ocean Beach Fishery Level 2 ERA, catch and effort data was cross-referenced with the nominated apparatus, fishing location and time of year. This provided a good representation of seine net effort on the Queensland east coast and a solid descriptor of ocean beach fishing activities over the 2017–2019 period. Catch and effort in all other areas will be taken into consideration as part of the large mesh net and tunnel net Level 2 ERA *e.g.* general net fishing activities permitted under a K fishing symbol including those conducted outside of a designated ocean beach fishing area from 1 April to 31 August.

2.3 Species Rationalisation Processes

The scope of the Ocean Beach Fishery Level 2 ERA was determined by the outcomes of the whole-of-fishery (Level 1) assessment (Jacobsen *et al.*, 2019). This assessment identified a number of high-risk

[3] *A number of the species caught in the ECIF attract significant levels of attention from the recreational fishing sector (Webley et al., 2015). The use of nets in the recreational fishing sector is regulated and the risks posed by this sector will be more applicable to the target and byproduct species.*

elements that will now be progressed through a finer-scale (Level 2) ERA including target & byproduct species, bycatch, marine turtles, dugongs, dolphins, batoids and sharks (Table 1).

The primary focus of this ERA was key target species, byproduct species and species with ongoing conservation concerns. While this assessment does not cover all species that interact with the Ocean Beach Fishery, the structure of the Level 2 ERA allows for the inclusion of additional species—if for example catch and effort increases for a particular species or the marketability of a bycatch species increases substantially.

Table 1. *Summary of the outputs from the Level 1 (whole-of-fishery) Ecological Risk Assessment for the East Coast Inshore Fishery (ECIF) (Jacobsen et al., 2019). *Does not include Species of Conservation Concern or target & byproduct species that were returned to the water for any reason.*

Ecological component	Level 1 Risk Rating	Progression
Target & Byproduct	High	Level 2 ERA
Bycatch*	Intermediate / High	Level 2 ERA
Species of Conservation Concern (SOCC)		
Marine turtles	High	Level 2 ERA
Dugongs	Intermediate / High	Level 2 ERA
Whales	Low / Intermediate	Not progressed further.
Dolphins	High	Level 2 ERA
Sea snakes	Low	Not progressed further.
Crocodiles	Low	Not progressed further.
Protected teleosts	Low	Not progressed further.
Batoids	High	Level 2 ERA
Sharks	High	Level 2 ERA
Syngnathids	Negligible	Not progressed further.
Seabirds	Low	Not progressed further.
Terrestrial mammals	Negligible	Not progressed further.
Marine Habitats	Low	Not progressed further.
Ecosystem Processes	Precautionary High	Not progressed, data deficiencies.

2.3.1 Target & Byproduct Species

A preliminary list of target & byproduct species was compiled using catch data submitted through the logbook monitoring program from 2017–2019 (inclusive). Catch reported against each species or species complex was summed across years and ranked from highest to lowest. Cumulative catch comparisons were then used to identify the species / species complexes that made up 95% of the total catch. Any categories with low species resolution (*e.g.* unspecified teleosts) were removed from the analysis and the *Codes for Australian Aquatic Biota* (CAAB; http://www.marine.csiro.au/data/caab/) used to expand multi-species catch categories. A secondary review was then undertaken to remove duplicates, species with low or negligible catches, and species that have limited potential to interact with the fishery. A full overview of the species rationalisation process for target & byproduct species has been provided in Appendix A.

2.3.2 Species of Conservation Concern

In Queensland, the list of *Species of Conservation Interest* formed the basis of Level 2 assessment. *Species of Conservation Interest* or SOCI refers specifically to a limited number of non-target species that are subject to mandatory commercial reporting requirements. This list was expanded though a review of Commonwealth and State legislation (*e.g.* the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Fisheries Declaration 2019*, the *Nature Conservation Act 1992*) and international conventions with the potential to influence fishing activities in Queensland such as the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS) an the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

For the purposes of this ERA, the expanded list of species was collectively referred to as the *Species of Conservation Concern* or SOCC. This classification aligns with the Level 1 ERA (Jacobsen *et al.*, 2019) and reflects the fact that the subgroup includes species that can be retained for sale and species afforded additional protections under State or Commonwealth legislation. As the preliminary list included species with limited potential to interact with the Ocean Beach Fishery, a final review was undertaken to ensure that all SOCC included in the analysis were relevant to this fishery. A summary of the species rationalisation process and the justifications used to include or omit a SOCC from the Level 2 ERA has been provided in Appendix B.

2.4 ERA Methodology

Methodology used to construct the Level 2 ERA aligns closely with the *Ecological Risk Assessment for the Effects of Fishing* (ERAEF) and includes two assessment options: the *Productivity & Susceptibility Analysis* (PSA) and the *Sustainability Assessment for Fishing Effects* (SAFE) (Australian Fisheries Management Authority, 2017; Hobday *et al.*, 2011; Zhou & Griffiths, 2008). Data inputs for the two methods are similar and both were designed to assess fishing-related risks for data-poor species (Zhou *et al.*, 2016). Similarly, both methods include precautionary elements that limit the potential for false negatives *i.e.* high risk species being incorrectly assigned a lower risk rating. However, the PSA tends to be more conservative and research has shown that it has a higher potential to produce 'false positives'. That is, low risk species being assigned a higher risk score due to the conservative nature of the method, data deficiencies *etc.* (Hobday *et al.*, 2011; Hobday *et al.*, 2007; Zhou *et al.*, 2016).

In the PSA, the level of risk (low, medium or high) is defined through a finer scale assessment of the life-history constraints of the species (*Productivity*), the potential for the species to interact with the fishery and the associated consequences (*Susceptibility*). In comparison, the SAFE method quantifies risk by comparing the rate of fishing mortality against key reference points including the level of fishing mortality associated with *Maximum Sustainable Fishing Mortality* (F_{msm}), the point where biomass is assumed to be half that required to support a maximum sustainable fishing mortality (F_{lim}) and fishing mortality rates that, in theory, will lead to population extinction in the long term (F_{crash}) (Zhou & Griffiths, 2008; Zhou *et al.*, 2016; Zhou *et al.*, 2011). As SAFE is a quantitative assessment, the method provides an absolute measure of risk or a continuum of values that can be compared directly to the above reference points. This contrasts with the PSA which provides an indicative measure (low, medium, high) of the potential risk (Hobday *et al.*, 2007).

While research has shown that SAFE produces fewer false positives, it requires a sound understanding of both the fishing intensity and the degree of overlap between a species' distribution and fishing effort (Hobday *et al.*, 2011; Zhou *et al.*, 2009). These parameters are used to determine the 'gear effected area' and the estimate of risk is sensitive to this quantity (Hobday *et al.*, 2011). The

gear affected area being the proportion of the fished area that a species resides in that is impacted on by the apparatus (Zhou *et al.*, 2019; Zhou *et al.*, 2014). This in itself can be difficult to calculate for species with poorly defined geographical distributions and those that have insufficient datasets. In the context of this ERA, this will be a factor for a number of the species included in the analysis; especially the SOCC (Australian Fisheries Management Authority, 2017).

When compared to gillnets which are set in place or across a designated area, beach seine or haul netting is a more active form of fishing. As seine/haul nets are towed around a school of fish or an area where fish congregate, the fished area will vary between fishing events. Similarly, the length of the fishing event will vary between operations and will be influenced by environmental conditions. These factors introduce a level of uncertainty surrounding the gear affected area and any (potential) estimates. This is considered to be less of an issue in the Ocean Beach Fishery as, proportionately, it covers a smaller percentage of the Queensland east coast. However, uncertainty surrounding the fished area could lead to inaccurate estimates of the gear affected area. Due to this uncertainty and the limitations of SAFE in assessing risk for key groups, the PSA was adopted for the first phase of the Ocean Beach Fishery Level 2 ERA.

Going forward, it is recommended that subsequent ERAs reconsider the suitability and applicability of the SAFE method with the continued role out of initiatives being undertaken as part of the Strategy (Department of Agriculture and Fisheries, 2017). This includes the extended use of *Vessel Tracking* which will increase the level of information on fine-scale effort movements and aid in this transition; particularly for the target & byproduct species ecological component.

2.4.1 Productivity & Susceptibility Analysis (PSA)

The PSA was largely aligned with the ERAEF approach employed for Commonwealth fisheries (Australian Fisheries Management Authority, 2017; Hobday *et al.*, 2011). As a detailed overview of the methodology and the key assumptions are provided in Hobday *et al*. (2007), only an abridged version will be provided here.

The *Productivity* component of the PSA examines the life-history constraints of a species and the potential for an attribute to contribute to the overall level of risk. These attributes are based on the biology of the species and include the *size and age at sexual maturity*, *maximum size and age*, *fecundity*, *reproductive strategy* and *trophic level* (Table 2). *Productivity* attributes used in the Level 2 assessment were consistent with the ERAEF (Hobday *et al.*, 2011) and were applied across all ecological components subject to a PSA. Criteria used to assign each attribute a score of low (1), medium (2) or high (3) risk are outlined in Table 2.

Table 2. *Scoring criteria and cut-off scores for the productivity component of the Productivity & Susceptibility Analysis (PSA) utilised as part of the Ocean Beach Fishery Level 2 ERA. Attributes and the corresponding scores/criteria align with national (ERAEF) approach (Hobday et al., 2011).*

Attribute	High productivity (low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)
Age at maturity*	<5 years	5–15 years	>15 years
Maximum age*	<10 years	10–25 years	>25 years
Fecundity**	>20,000 eggs per year	100–20,000 eggs per year	<100 eggs per year

Attribute	High productivity (low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)
Maximum size*	<100cm	100–300cm	>300cm
Size at maturity*	<40cm	40–200cm	>200cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer (& birds)
Trophic Level	<2.75	2.75–3.25	>3.25

** Where only ranges for species attributes were provided, the most precautionary measure was used. **Fecundity for broadcast spawners was assumed to be >20,000 eggs per year (Miller & Kendall, 2009).*

For the *Susceptibility* component of the PSA, ERAEF attributes were used as the baseline of the assessment and included *availability*, *encounterability*, *selectivity* and *post-capture mortality* (Hobday et al., 2007; Hobday et al., 2011). The following provides an overview of the *susceptibility* attributes used in the PSA with Table 3 detailing the criteria used to assign scores for this part of the analysis.

- **Availability—**Where possible, *availability* scores were based on the overlap between fishing effort and the portion of the species range that occurs within the broader geographical spread of the fishery. To account for inter-annual variability, percentage overlaps were calculated for three years (2017, 2018 and 2019) and the highest value used as the basis of the *availability* assessment. Regional distribution maps were sourced from the *Atlas of Living Australia*, the *Species Profile and Threats Database* (Department of Environment and Energy, www.environment.gov.au/cgi-bin/sprat/public/sprat.pl), the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) and, where possible, refined using bathymetry and topographical data (Whiteway, 2009).

  As the Ocean Beach Fishery forms part of the ECIF, overlap percentages were based on the effort footprint of the broader fishery. Effort distribution maps for the Ocean Beach Fishery revealed that the effort footprint for this subfishery is <10% of that reported for the entire ECIF. Based on these calculations, it is reasonable to assume that overlap percentages for all 22 species (target, byproduct and SOCC) are below 10% and all were assigned a low (1) risk rating for this attribute. If circumstances changes and/or there is a significant expansion in ocean beach fishing effort, this assumption will need to be reviewed.

  In instances where a species did not have a distribution map, *availability* scores were based on a broader geographic distribution assessment (global, southern hemisphere, Australian endemic) described in Hobday *et al.* (2007) (Table 3). A full summary of the overlap percentages used to assess *availability* has been provided in Appendix C.

- **Encounterability—***Encounterability* considers the likelihood that a species will encounter the fishing gear when it is deployed within the known geographical range (Hobday *et al.*, 2007). The *encounterability* assessment is based on the behaviour of the species as an adult and takes into consideration information on the preferred habitats and bathymetric ranges. For the PSA, both parameters (*i.e.* adult habitat overlap and bathymetric range overlap) are assigned an individual risk score with the highest value used as the basis of the *encounterability* assessment. The notable exceptions to this are air-breathing species which, under the ERAEF framework, are assigned the highest score due to their need to access the surface and their potential to interact with the gear during the deployment and retrieval process (Hobday *et al.*, 2007).

- **Selectivity—***Selectivity* is effectively a measure of the likelihood that a species will get caught in the apparatus. Factors that will influence the *selectivity* score include the fishing method, the

apparatus used and the body size of the species in relation to the mesh size. In the large mesh net fishery (*e.g.* gillnets and ring nets), *selectivity* was determined by the size of the mesh used and the body size of the animal. As seine nets use smaller mesh sizes and encircles shoals or schools of fish (*vs.* enmeshment), this criteria were less suited to this sector of the ECIF. Accordingly, a more generalised set of criteria was used for the Ocean Beach Fishery (Table 3).

Table 3. *Scoring criteria and cut-off scores for the susceptibility component of the PSA. Attributes and the corresponding scores/criteria are largely aligned with ERAEF approach (Hobday et al., 2011).*

Attribute	Low susceptibility (low risk, score = 1)	Medium susceptibility (medium risk, score = 2)	High susceptibility (high risk, score = 3)
Availability			
Option 1 – Overlap of species range with fishing effort.	<10% overlap.	10–30% overlap.	>30% overlap.
Option 2 – Global distribution & stock proxy considerations.	Globally distributed.	Restricted to same hemisphere / ocean basin as fishery.	Restricted to same country as fishery.
Encounterability			
*Option 1. Habitat type**	Low overlap with fishery area.	Medium overlap with fishery area.	High overlap with fishery area.
*Option 2. Depth check**	Low overlap with fishery area.	Medium overlap with fishery area.	High overlap with fishery area.
Selectivity	Low susceptibility to gear selectivity.	Moderate susceptibility to gear selectivity.	High susceptibility to gear selectivity.
Post-capture mortality	Evidence of post-capture release and survival.	Released alive with uncertain survivability.	Retained species, majority dead when released, interaction likely to result in death or life-threatening injuries.
Management strategy**	Species-specific management of catch or effort (*e.g.* TACC limits) based on biomass estimates/reference points. Management regime able to actively address emerging issues within the current framework.	Catch or effort restricted in some capacity (*e.g.* species-specific TACC limits or analogous arrangements), restrictions based on arbitrary or outdated biomass estimates / reference points. Limited capacity to address emerging catch and effort trends without legislative amendments or reforms.	Harvested species do not have species-specific catch limits or robust input & output controls. Management regime based at the whole-of-fishery level.
Sustainability assessments**	Sustainability confirmed through stock assessments / biomass estimates.	Sustainability confirmed through indicative sustainability evaluations & weight-of-evidence approach *e.g.* national SAFS.	Not assessed, biomass depleted, declining or not conducive to meeting 2020 SFS targets.
Recreational desirability / other fisheries**	<33% retention.	33–66% retention.	>66% retention.

**Scores vary by fishery. **The criteria for selectivity and post-capture mortality were broadened to account for variability across fisheries (i.e. net, pot, line). ** Attribute only applied to assessments involving retainable product / species.*

- **Post-capture mortality—***Post-capture mortality* (PCM) is one of the more difficult attributes to assess in a marine environment; particularly for non-target species. For target and byproduct species that fall within the prescribed regulations, the survival rate will be zero as they will (most likely) be retained for sale. Survival rates for the remainder of the species will be more varied as scores assigned to this attribute will be influenced by data limitations or require further qualitative input or expert opinion. In the absence of expert judgement and/or independent field observations the default value for the PCM attribute will be high (3) (Hobday *et al.*, 2011; Hobday *et al.*, 2007).

In addition to the four baseline attributes, the Level 2 ERA included three additional *susceptibility* attributes for target & byproduct species: *management strategy*, *sustainability assessments* and *recreational desirability / other fisheries*. These attributes were included in the assessment to address risks associated with other fishing sectors (*e.g.* recreational and charter fisheries) and management limitations for key species (*e.g.* an absence of effective controls on catch or effort). While the additional attributes are not included in the ERAEF, variations of all three have been used in risk assessments involving species experiencing similar fishing pressures (Patrick *et al.,* 2010; Furlong-Estrada *et al.,* 2017). In the Level 2 ERA, the three additional attributes will be used to further reduce the influence of false positives or risk overestimations for key species. These attributes considered the following.

- **Management strategy—**Considers the suitability of the current management arrangements including the ability to manage risk through time *e.g.* the presence of an effective control on total catch or effort, regional management, biomass estimates that are directly linked to species-specific Total Allowable Commercial Catch (TACC) limits *etc*. This attribute was considered to be of particular relevance to multi-species fisheries where the management regime often lacks species-specific control measures. Alternatively, this attribute provides the assessment with greater scope to assess risk mitigation measures including the use of quotas based on biological reference points like Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY).

- **Sustainability assessments—**The *sustainability assessment* attribute is directly linked to the level of information that is available on the stock structure and status of harvested species. Species where sustainability status has been confirmed through stock assessments or the national *Status of Australian Fish Stocks* (SAFS) will be assigned lower risk scores. Conversely, species that are being fished above key biomass reference points (*e.g.* MSY), have been assessed as depleting, overfished, or recovering in the most recent SAFS assessment and/or have no assessment will be assigned more precautionary risk scores.

- **Recreational desirability / other fisheries—**Specifically included in the PSA to account for the risk posed by recreational fishing, charter fishing and non-ECIF commercial fisheries. Few of the species targeted by ocean beach fishers are retained for sale in commercial fisheries outside of the ECIF. For this reason, the majority of the non-commercial risks come from the recreational and charter fishing sectors. For the purpose of this ERA, recreational retention rates were used as an indicative assessment of a species popularity across the two sectors (Table 3). It is however acknowledged that the charter fishery is monitored and managed as a separate entity. When and where appropriate the impacts of this sector will be given further consideration as part of the *Residual Risk Assessment* (RRA).

  In addition to the recreational and charter fisheries, ocean beach species will be retained for sale in other sectors of the ECIF (Department of Agriculture and Fisheries, 2019a). As these risks

come from within the fishery, catch reported from these sectors of the ECIF were not taken into consideration as part of the *recreational desirability / other fisheries* assessment. Instead, they will be assessed as part of the Level 2 assessment for the Large Mesh Net Fishery (gillnets and ring nets), and Tunnel Net Fishery.

The three additional *susceptibility* attributes were only applied to retainable product, and therefore were not include in assessments involving most of the SOCC subgroups.

2.4.2 PSA Scoring

Each attribute was assigned a score of 1 (low risk), 2 (medium risk) or 3 (high risk) based on the criteria outlined in Table 2 and Table 3 (Brown *et al.*, 2013; Hobday *et al.*, 2011; Patrick *et al.*, 2010). In instances where an attribute has no available data and in the absence of credible information to the contrary, a default rating of high risk (3) was used (Hobday *et al.*, 2011). This approach introduces a precautionary element into the PSA and helps minimise the potential occurrence of 'false negative' assessments. The inherent trade off with this approach is that the outputs of the Level 2 ERA can be conservative and may include a number of 'false positives' (Zhou *et al.*, 2016). Issues associated with 'false positives' and the overestimation of risk will be examined further as part of the RRA.

Risk ratings (*R*) were based on a two-dimensional graphical representation of the *productivity* (*x*-axis) and *susceptibility* (*y*-axis) scores (Fig. 1). Cross-referencing of the *productivity* and *susceptibility* scores provides each species with a graphical location that can be used to calculate the Euclidean distance or the distance between the species reference point and the origin (*i.e.* 0, 0 on Fig. 1). This distance is calculated using the formula $R = ((P - X_0)^2 + (S - Y_0)^2)^{1/2}$ where *P* represents the *productivity* score, *S* represents the *susceptibility* score and X_0 and Y_0 are the respective *x* and *y* origin coordinates (Brown *et al.*, 2013). The further a species is away from the origin the more at risk it is considered to be. For the purpose of this ERA, cut offs for each risk category were aligned with previous assessments with scores below 2.64 classified as low risk, scores between 2.64 and 3.18 as medium risk and scores >3.18 classified as high risk (Brown *et al.*, 2013; Hobday *et al.*, 2007; Zhou *et al.*, 2016).

As the PSA includes an *'uncertainty'* assessment and RRA (refer to section *2.4.3 Uncertainty* and *2.4.4 Residual risk*), the initial risk ratings may be subject to change. To this extent, scores assigned as part of the PSA analysis can be viewed as a measure of the potential for risk each species may experience (Hobday *et al.*, 2007) with the final risk scores determined on the completion of the RRA.

2.4.3 Uncertainty

A number of factors including imprecise or missing data and the use of averages or proxies can contribute to the level of uncertainty surrounding the PSA. Examples of which include the use of a default 'high score' for attributes missing data and the use of values based at a higher taxon *i.e.* genera or family level (Hobday *et al.*, 2011). In the Level 2 ERA, uncertainty is examined through a baseline assessment of each risk profile to determine the proportion of attributes assigned a precautionary high risk rating due to data deficiencies. As species with greater data deficiencies are more likely to attract the default 'high risk' rating, their profiles are more likely to fall on the conservative side of the spectrum. In these instances, it may be more appropriate to address these risks and data deficiencies through measures like the *Queensland Sustainable Fisheries Strategy—Monitoring and Research Plan* (Department of Agriculture and Fisheries, 2018d).

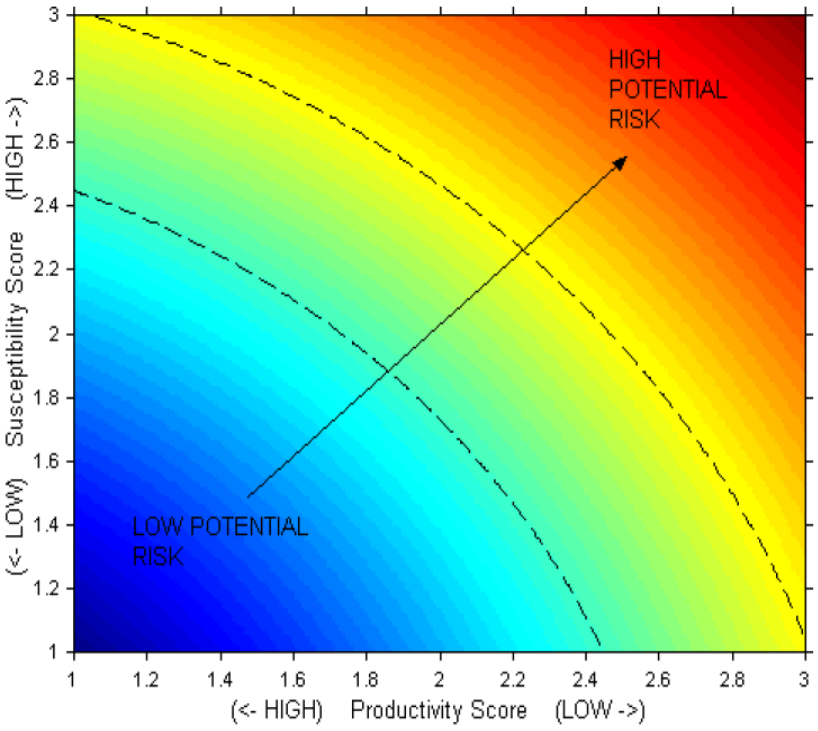

Figure 1. PSA plot demonstrating the two-dimensional space which species units are plotted. PSA scores for species units represent the Euclidean distance or the distance between the origin and the productivity (x-axis), susceptibility (y-axis) intercept (excerpt from Hobday *et. al.,* 2007).

2.4.4 Residual Risk Analysis (RRA)

Precautionary elements in the PSA combined with an undervaluation of some management arrangements can result in more conservative risk assessments and a higher number of false positives. Similarly, the effectiveness of some attributes may be exaggerated and subsequent risks could be underestimated (false negatives). To address these issues, PSA results were subject to a residual risk analysis (RRA). The RRA gives further consideration to risk mitigation measures that were not explicitly included in the attributes and any additional information that may influence the risk status of a species (Australian Fisheries Management Authority, 2017). In doing so, the RRA provides management with greater capacity to differentiate between potential and actual risks (Department of Agriculture and Fisheries, 2018e) and helps refine risk management strategies.

The RRA framework was based on guidelines established by CSIRO and the *Australian Fisheries Management Authority* (AFMA) (Australian Fisheries Management Authority, 2018). These guidelines identify six avenues where additional information may be given further consideration as part of a Level 2 assessment. Given regional nuances and data variability, a degree of flexibility was required with respect to how the RRA guidelines were applied to commercial fisheries in Queensland and the justifications used. The RRA was also expanded to include a seventh guideline titled '*Additional Scientific Assessment & Consultation'*. While a version of this guideline has been used in previous risk assessments involving Commonwealth Fisheries, it has since been removed as part of a broader RRA procedural review (Australian Fisheries Management Authority, 2018). In Queensland, this guideline was retained as the broader ERA framework includes a series of consultation steps that aid in the development and finalisation of both the whole-of-fishery (Level 1) and species-specific (Level 2) ERAs (Department of Agriculture and Fisheries, 2018e; Jacobsen *et al.*, 2019).

In instances where the RRA resulted in an amendment to the preliminary score, full justifications were provided (Appendix C) including the guidelines in which the amendments were considered. A brief summary of each guideline and the RRA considerations is provided in Table 4.

Table 4. *Guidelines used to assess residual risk including a brief overview of factors taken into consideration. Summary represents a modified excerpt from the revised Australian Fisheries Management Authority (AFMA) Ecological Risk Assessment, Residual Risk Assessment Guidelines (Australian Fisheries Management Authority, 2018).*

Guidelines	Summary
Guideline 1*: Risk rating due to missing, incorrect or out of date information.*	Considers if *susceptibility* and/or *productivity* attribute data for a species is missing or incorrect for the fishery assessment, and is corrected using data from a trusted source or another fishery.
Guideline 2*: Additional scientific assessment & consultation.*	Considers any additional scientific assessments on the biology or distribution of the species and the impact of the fishery. This may include verifiable accounts and data raised through key consultative processes including but not limited to targeted consultation with key experts and oversite committees established as part of the *Sustainable Fisheries Strategy 2017–2027 e.g. Fisheries Working Groups* and the *Sustainable Fisheries Expert Panel*.
Guideline 3*: At risk with spatial assumptions.*	Provides further consideration to the spatial distribution data, habitat data and any assumptions underpinning the assessment.
Guideline 4*: At risk in regards to level of interaction/capture with a zero or negligible level of susceptibility.*	Considers observer or expert information to better calculate *susceptibility* for those species known to have a low likelihood or no record of interaction nor capture with the fishery.
Guideline 5*: Effort and catch management arrangements for target & byproduct species.*	Considers current management arrangements based on effort and catch limits set using a scientific assessment for key species.
Guideline 6*: Management arrangements to mitigate against the level of bycatch.*	Considers management arrangement in place that mitigate against bycatch by the use of gear modifications, mitigation devices and catch limits.
Guideline 7*: Management arrangements relating to seasonal, spatial and depth closures.*	Considers management arrangements based on seasonal, spatial and/or depth closures.

3 Results

3.1 Productivity & Susceptibility Analysis (PSA)

3.1.1 Target & Byproduct Species

As ocean beach fishers target near-shore schools of fish, catch from this sector tends to be more one dimensional. This was reflected in the catch data where 11 catch categories made up more than 95% of the reported catch. The majority of this catch was reported as *mullet—unspecified* (75.1%), *sea mullet* (5.1%) or *tailor* (3.6%). The remainder consists of smaller quantities of byproduct species that are retained opportunistically while targeting mullet or tailor: *whiting—unspecified* (3.0%), *dart—unspecified* (2%), *garfish—unspecified* (1.3%), *trevally—unspecified* (1.0%), *bream—unspecified* (0.9%), *silver biddies* (*Family Gerreidae*), *hardyheads* (*Family Atherinidae / Dentatherinidae*) and *spinefoot / scribbled rabbitfish* (0.9%).

The 11 catch categories produced a preliminary list of 33 species or species groupings that were considered for inclusion in the Level 2 ERA. This list was subsequently rationalised to 11 species; a number of which were included as a precautionary measure. This list did not include tailor (*P. saltatrix*) due to the species having a long catch history in Queensland, clear and positive *sustainability assessments,* and a more advanced management regime that includes output controls (Appendix A).

Productivity scores for the target & byproduct species ranged from 1.14 to 2.29 (*average* = 1.52). These scores showed a high degree of variability which was driven by data deficiencies; particularly for *age at maturity*, *maximum age* and *size at sexual maturity* (Table 5). Of the target and byproduct species assessed, the snubnose dart (2.29), diamondscale mullet (1.86) and the fantail mullet (1.86) had the highest *productivity* scores. At 1.14, the bluespot mullet recorded the lowest *productivity* score of the assessment (Table 5).

The *susceptibility* component of the PSA showed less variability with four of the seven attributes receiving the maximum score across all 11 species (Table 5). Seven of the 11 species recorded an assessment high *susceptibility* score of 2.71. The remaining species registered *susceptibility* scores >2.00, the lowest being yellowfin bream at 2.14 (Table 5).

When the *productivity* and *susceptibility* scores were taken into consideration, the subgroup of target & byproduct species registered preliminary risk scores from 2.50 to 3.55 (Table 5). Based on these scores, two species where assigned a low preliminary risk rating, six species a medium risk rating and three species a high risk rating (Table 5).

3.1.2 Species of Conservation Concern

The use of a seine net on the Queensland east coast is subject to both spatial and temporal restrictions (Department of Agriculture and Fisheries, 2019a). These provisions limit the footprint of the fishery and the number of SOCC that will interact with this sector of the ECIF. This was reflected in the species rationalisation process where only 11 of the 84 species were identified for inclusion in the Level 2 ERA including three marine turtles, three sharks, three dolphins and two batoids (Table 5).[4]

[4] *The list of target and byproduct species does not include hammerhead sharks, shovelnose rays and guitarfish as they did not meet the 95% catch threshold. However, these species are afforded additional legislative protections and or are included in international instruments like CITES and CMS. Therefore they were assessed as part of the Level 2 ERA.*

Table 5. *Preliminary risk ratings compiled as part of the Productivity & Susceptibility Analysis (PSA) including scores assigned to each attribute used in the assessment. Risk ratings are solely based on criteria outlined in Table 2 and Table 3 and have not been subject to a Residual Risk Analysis. Scores with an '*' and situated in a pink square represent attributes that were assigned a precautionary score in the preliminary assessment due to an absence of species-specific data. **Management strategy, Sustainability assessments and Recreational desirability / other fisheries only applied to retainable product.*

Common name	Species name	Age at maturity	Maximum age	Fecundity	Maximum size	Size at sexual maturity	Reproductive strategy	Trophic level	Productivity	Availability	Encounterability	Selectivity	Post-capture mortality	Management strategy**	Sustainability assessments**	Recreational desirability / other fisheries**	Susceptibility	*PSA score*
Key Target & Byproduct																		
Sea mullet	*Mugil cephalus*	1	2	1	2	2	1	1	1.43	1	3	3	3	3	1	3*	2.29	**2.70**
Bluespot mullet	*Valamugil seheli*	1	1	1	1	2	1	1	1.14	1	3	3	3	3	3	3*	2.71	**2.95**
Fantail (silver) mullet	*Paramugil georgii*	3*	3*	1	1	3*	1	1	1.86	1	3	3	3	3	3	3*	2.71	**3.29**
Goldspot (tiger/flat tail) mullet	*Liza argentea*	3*	2	1	1	1	1	1	1.43	1	3	3	3	3	3	3*	2.71	**3.07**
Diamondscale mullet	*Liza vaigiensis*	3*	3*	1	1	3*	1	1	1.86	1	3	3	3	3	3	3*	2.71	**3.29**
Trumpeter (winter) whiting	*Sillago maculata*	1	2	1	1	1	1	3	1.43	1	3	3	3	3	3	3	2.71	**3.07**
Sand (summer) whiting	*Sillago ciliata*	1	2	1	1	1	1	2	1.29	1	3	3	3	3	1	3*	2.29	**2.62**
Yellowfin bream	*Acanthopagrus australis*	1	2	1	1	1	1	2	1.29	1	3	3	3	3	1	1	2.14	**2.50**
Tarwhine	*Rhabdosargus sarba*	1	2	1	1	1	1	3	1.43	1	3	3	3	3	3	3	2.43	**2.82**
Snubnose dart	*Trachinotus blochii*	3*	3*	1	2	3*	1	3	2.29	1	3	3	3	3	3	3*	2.71	**3.55**
Swallowtail dart	*Trachinotus coppingeri*	1	1	1	1	1	1	3	1.29	1	3	3	3	3	3	3*	2.71	**3.00**

Common name	Species name	Age at maturity	Maximum age	Fecundity	Maximum size	Size at sexual maturity	Reproductive strategy	Trophic level	Productivity	Availability	Encounterability	Selectivity	Post-capture mortality	Management strategy**	Sustainability assessments**	Recreational desirability / other fisheries**	Susceptibility	*PSA score*
SOCC—Retainable species																		
Batoids																		
Bottlenose wedgefish	*Rhynchobatus australiae*	3*	3*	3*	2	2	3	3	2.71	3*	3	3	3*	3	3	3*	3.00	**4.05**
Giant shovelnose ray	*Glaucostegus typus*	2	2	3*	2	2	3	3*	2.43	1	3	3	3*	3	3	3*	2.71	**3.64**
Sharks																		
Great hammerhead	*Sphyrna mokarran*	2	3	3	3	3	3	3	2.86	1	3	1	3	3	3	3*	2.43	**3.75**
Scalloped hammerhead	*Sphyrna lewini*	2	3	3	3	3	3	3	2.86	1	3	3	3	3	3	3*	2.71	**3.94**
Smooth hammerhead	*Sphyrna zygaena*	2	2	3	3	3	3	3	2.71	1	3	3	3	3	3	3*	2.71	**3.84**
SOCC—Non-retainable																		
Marine turtles																		
Green turtle	*Chelonia mydas*	3	3	3	2	2	2	1	2.29	1	3	3	3*	n/a	n/a	n/a	2.50	**3.39**
Loggerhead turtle	*Caretta caretta*	3	3	3	1	2	2	3	2.43	1	3	3	3*	n/a	n/a	n/a	2.50	**3.49**
Hawksbill turtle	*Eretmochelys imbricata*	3	3	3	1	2	2	2	2.29	1	3	3	3*	n/a	n/a	n/a	2.50	**3.39**
Dolphins																		
Australian humpback dolphin	*Sousa sahulensis*	3*	3	3	2	3*	3	3	2.86	1	3	3	3*	n/a	n/a	n/a	2.50	**3.80**
Common bottlenose dolphin	*Tursiops truncatus*	2	3	3	3	3*	3	3	2.86	3*	3	3	3*	n/a	n/a	n/a	3.00	**4.14**
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	2	3	3	2	3	3	3	2.71	3*	3	3	3*	n/a	n/a	n/a	3.00	**4.05**

Based on the prescribed criteria, all of the SOCC had *productivity* scores greater than 2.00 (average = 2.64; range 2.29–2.86). At 2.29, the hawksbill turtle had the lowest *productivity* score with two hammerhead sharks and two dolphin species registering an assessment high score of 2.86 (Table 5). Of the six *productivity* attributes assessed, *fecundity* (average 3.00) and *maximum age* (average 2.82) had the highest average score. Conversely, *maximum size* and *size at maturity* had the lowest average score at 2.18 and 2.55 respectively (Table 5).

In the *susceptibility* analysis, all SOCC were assigned scores of between 2.00 and 3.00 at an average of 2.64 (Table 5). The two bottlenose dolphins and the bottlenose wedgefish were the only species assigned the maximum score for all four *susceptibility* attributes. Three of the four attributes, *encounterability, selectivity* and *post-capture mortality* had an average score of 3.00 (Table 5).

When the *productivity* and *susceptibility* scores were taken into consideration, the common bottlenose dolphin had the highest preliminary risk score (4.14) followed by the Indo-pacific bottlenose dolphin (4.05) and the bottlenose wedgefish (Table 5). Based on the *productivity* and *susceptibility* scores, all 11 species were assigned preliminary PSA scores in the high risk category (Table 5).

3.2 Uncertainty

The vast majority of the target & byproduct species *productivity* assessments were supported by data. However, *age at sexual maturity*, *maximum age* and *size at sexual maturity* were missing data for at least three of the species assessed (Table 6). In the *susceptibility* component, most attributes were assigned a score based on the available data, a clear understanding of their management regime and/or *sustainability assessments*. The notable exception being *recreational desirability / other fisheries* where 82% of the species assessed were assigned a precautionary high score (Table 6).

In the SOCC, precautionary high risk ratings were more broadly spread across the 14 attributes. In the *productivity* assessment, attributes linked with a species longevity and reproduction were most influenced by data deficiencies (Table 6). In the context of the overall assessment, assigning a precautionary score to the *fecundity* attribute was not viewed as significant as these species have low reproductive rates. However, the use of precautionary scores for the other attributes may have contributed to the production of more conservative risk assessments (Table 6).

In the *susceptibility* component of the PSA, data deficiencies were more influential in assessments involving the *post-capture mortality* attribute (Table 6). These scores reflect deficiencies in the amount of data that is available on SOCI-seine net interactions and survival rates. For this attribute, the extent of any (potential) risk overestimation will be dependent on the species in question, the extent of the interaction and their level of protection.

3.3 Residual Risk Analysis

The Level 2 ERA for the Ocean Beach Fishery covers an array of species with varying life-history traits, habitat preferences and information gaps. The fishery also operates under a number of fishery-specific management constraints that include restrictions on when and where a seine/haul can be used on the Queensland east coast. These species and fishery-specific nuances were given further consideration as part of the RRA and resulted in a number of changes being made to the preliminary risk ratings. The following provides an overview of the changes adopted as part of the RRA (Table 7). A full overview of the RRA including the considerations and justifications has been provided in Appendix C.

Table 6. *Summary of the number of attributes that were assigned a precautionary high (3) score due to data deficiencies. * Management strategy, Sustainability assessments and Recreational desirability / other fisheries were only applied to retainable product.*

	Age at sexual maturity	Maximum age	Fecundity	Maximum size	Size at sexual maturity	Reproductive strategy	Trophic level	Availability	Encounterability	Selectivity	Post-capture mortality	Management strategy*	Sustainability assessments*	Recreational desirability / other fisheries*
Target & Byproduct (n = 11)														
No. Species with data	8	8	3	11	7	11	11	11	11	11	11	11	11	2
No. Species missing data	4	3	8	0	4	0	0	0	0	0	0	0	0	9
% Unknown Information	36%	27%	73%	0%	36%	0%	0%	0%	0%	0%	0%	0%	0%	82%
SOCC (n = 11)														
No. Species with data	9	10	9	11	9	11	10	8	11	11	3	5	5	0
No. Species missing data	2	1	2	0	2	0	1	3	0	0	8	0	0	5
% Unknown Information	18%	9%	18%	0%	18%	0%	9%	27%	0%	0%	73%	0%	0%	100%
All Species (n = 22 max)														
No. Species with data	17	18	12	22	16	22	21	19	22	22	14	16	16	3
No. Species missing data	6	4	10	0	6	0	1	3	0	0	8	0	0	13
% Unknown Information	27%	18%	45%	0	27%	0%	5%	14%	0%	0%	36%	0%	0%	81%

3.3.1 Target & Byproduct Species

Five target or byproduct species received precautionary high (3) risk ratings for at least one of the seven *productivity* attributes (Table 5). In the RRA, a number of the scores were reduced through the use of proxies from species with similar morphological and biological traits (Table 7; Appendix C). In the target & byproduct species assessment, the majority of these amendments involved secondary mullet species. For these species, biological parameters used in the sea mullet assessment were viewed as a suitable proxy (Appendix C). A similar strategy was employed for the snubnose dart, the only other non-SOCC species whose *productivity* scores were amended as part of the RRA (Appendix C).

All of the RRA amendments in the *susceptibility* component involved the *management strategy* and *recreational desirability / other fisheries* attributes (Table 7). In the RRA, further consideration was given to the suitability of the *management strategy* criteria (Table 3) and how they were applied to ocean beach species. As part of this process, the RRA reviewed the status of the species within the

fishery, their catch history and the suitability, applicability, and effectiveness of the current management arrangements (Appendix C).

Sea mullet has a long catch history on the Queensland east coast and the sustainability of the stock has been confirmed through multiple stock assessments and indicative sustainability evaluations (Department of Agriculture and Fisheries, 2018b; 2020b; Lovett *et al.*, 2018; Stewart *et al.*, 2018). A long and stable catch history combined with positive *sustainability assessments* suggest that there is a lower risk of the stock being overfished in the current fishing environment. While this situation may change in the future, the best available evidence supported a reduction in the score assigned to this attribute (Table 7; Appendix C).

Revised *management strategy* scores for the remainder of the target and byproduct species better reflect their status as secondary targets within the Ocean Beach Fishery (Appendix C). These species have comparatively low rates of harvest and are considered low priorities for transition to quota. Unless there is a significant change to the current fishing environment, management arrangements used in the Ocean Beach Fishery will minimise the risk posed to these species. This includes the four secondary mullet species that, when compared to sea mullet, will be caught and harvested in lower quantities (Department of Agriculture and Fisheries, 2019a).

A number of the target and byproduct species included in the Level 2 ERA had limited recreational data or catch estimates based at a higher taxonomic level *e.g.* mullet (Webley *et al.*, 2015). These deficiencies resulted in the production of more conservative risk assessments. Further investigation of recreational surveys and charter fishery data indicated that the listed species were less likely to be at risk from cumulative fishing pressures. Accordingly, the majority of scores assigned to the *recreational desirability / other fisheries* attribute adjusted downwards as part of the RRA (Appendix C). The notable exceptions being yellowfin bream and tarwhine where retention rates may underestimate harvest rates for legal sized fish and the cumulative fishing risk posed to these species.

As a result of the RRA, the risk scores of 10 species were reduced (Table 7). For eight of these species, these reductions resulted in a reclassification of their overall risk rating. The most significant reductions were for the fantail mullet (high to low), diamondscale mullet (high to low) and snubnose dart (high to medium). Based on the revised RRA scores, seven species were assessed as being at low risk from fishing activities in the Ocean Beach Fishery with the remaining four species classified as medium risk (Table 7).

3.3.2 Species of Conservation Concern

Only minor amendments were made to the SOCC *productivity* attributes as part of the RRA. All of the RRA amendments were in response to the provision of additional data (Appendix C) which refined a number of the biological parameter estimates; namely *age at maturity, fecundity* and *size at maturity* (Table 7). As a result of these amendments, *productivity* scores for the loggerhead turtle, the Australian humpback dolphin and the bottlenose wedgefish were reduced (Table 7). *Productivity* scores for the eight remaining species were unchanged.

When compared to the *productivity* attributes, the RRA of the *susceptibility* scores resulted in a more substantive list of amendments (Table 7; Appendix C). These amendments were, for the most part, driven by further consideration of how the Ocean Beach Fishery operates and the type of apparatus used. While the amendments were addressed at a species-specific level, there was a degree of commonality with respect to the reasons why a score was reduced across multiple species. These

Table 7. *Residual Risk Assessment (RRA) of the preliminary scores assigned as part of the Productivity and Susceptibility Analysis (PSA). Shaded squares ( ) represent the scores that were amended as part of the RRA. Refer to Appendix C for a full account of the RRA including the key justifications.*

Common name	Species name	Age at maturity	Maximum age	Fecundity	Maximum size	Size at sexual maturity	Reproductive strategy	Trophic level	Productivity	Availability	Encounterability	Selectivity	Post-capture mortality	Management strategy**	Sustainability assessments**	Recreational desirability / other fisheries**	Susceptibility	*PSA score*
Key Target & Byproduct																		
Sea mullet	*Mugil cephalus*	1	2	1	1	2	1	1	1.29	1	3	3	3	1	1	2	2.00	**2.38**
Bluespot mullet	*Valamugil seheli*	1	1	1	1	2	1	1	1.14	1	3	3	3	1	3	2	2.29	**2.50**
Fantail (silver) mullet	*Paramugil georgii*	1	2	1	1	2	1	1	1.29	1	3	3	3	1	3	2	2.29	**2.62**
Goldspot (tiger/flat tail) mullet	*Liza argentea*	1	2	1	1	1	1	1	1.14	1	3	3	3	1	3	2	2.29	**2.56**
Diamondscale mullet	*Liza vaigiensis*	1	2	1	1	2	1	1	1.29	1	3	3	3	1	3	2	2.29	**2.62**
Trumpeter (winter) whiting	*Sillago maculata*	1	2	1	1	1	1	3	1.43	1	3	3	3	3	3	3	2.71	**3.07**
Sand (summer) whiting	*Sillago ciliata*	1	2	1	1	1	1	2	1.29	1	3	3	3	2	1	2	2.14	**2.50**
Yellowfin bream	*Acanthopagrus australis*	1	2	1	1	1	1	2	1.29	1	3	3	3	2	1	2	2.14	**2.50**
Tarwhine	*Rhabdosargus sarba*	1	2	1	1	1	1	3	1.43	1	3	3	3	3	3	2	2.57	**2.94**
Snubnose dart	*Trachinotus blochii*	1	2	1	1	2	1	3	1.57	1	3	3	3	2	3	2	2.43	**2.89**
Swallowtail dart	*Trachinotus coppingeri*	1	1	1	1	1	1	3	1.29	1	3	3	3	2	3	2	2.43	**2.82**
SOCC—Retainable species																		
Batoids																		
Bottlenose wedgefish	*Rhynchobatus australiae*	2	3	3	2	2	3	3	2.57	1	2	2	2	2	3	2	1.86	**3.17**

Common name	Species name	Age at maturity	Maximum age	Fecundity	Maximum size	Size at sexual maturity	Reproductive strategy	Trophic level	Productivity	Availability	Encounterability	Selectivity	Post-capture mortality	Management strategy**	Sustainability assessments**	Recreational desirability / other fisheries**	Susceptibility	*PSA score*
Giant shovelnose ray	*Glaucostegus typus*	2	2	3	2	2	3	3	2.43	1	2	2	2	2	3	2	1.86	**3.06**
Sharks																		
Great hammerhead	*Sphyrna mokarran*	2	3	3	3	3	3	3	2.86	1	2	2	2	3	2	1	1.71	**3.33**
Scalloped hammerhead	*Sphyrna lewini*	2	3	3	3	3	3	3	2.86	1	2	2	2	3	2	1	1.71	**3.33**
Smooth hammerhead	*Sphyrna zygaena*	2	2	3	3	3	3	3	2.71	1	1	2	2	3	2	1	1.51	**3.14**
SOCC—Non-retainable																		
Marine turtles																		
Green turtle	*Chelonia mydas*	3	3	3	2	2	2	1	2.29	1	2	3	1	n/a	n/a	n/a	1.75	**2.88**
Loggerhead turtle	*Caretta caretta*	3	3	2	2	2	2	3	2.43	1	2	3	1	n/a	n/a	n/a	1.75	**2.99**
Hawksbill turtle	*Eretmochelys imbricata*	3	3	3	1	2	2	2	2.29	1	2	3	1	n/a	n/a	n/a	1.75	**2.88**
Dolphins																		
Australian humpback dolphin	*Sousa sahulensis*	2	3	3	2	2	3	3	2.57	1	1	2	1	n/a	n/a	n/a	1.25	**3.12**
Common bottlenose dolphin	*Tursiops truncatus*	2	3	3	3	3	3	3	2.86	1	2	2	1	n/a	n/a	n/a	1.50	**3.23**
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	2	3	3	2	3	3	3	2.71	1	2	2	1	n/a	n/a	n/a	1.50	**3.10**

amendments primarily involved the *encounterability*, *selectivity* and *post-capture mortality* attributes (Table 7).

A high number of the species assessed had relatively broad or generalised habitat and bathymetry descriptions. These broader descriptions were used in the PSA and resulted in a number of species being assigned a higher risk score for the *encounterability* attribute (Table 5). In the RRA, further consideration was given to the available data and the areas in which these species were more likely to be encountered. For example, the Australian humpback dolphin is viewed as a coastal species with most observations occurring in shallow water environments within 10 kilometres of the shoreline (Department of the Environment, 2019r; Parra *et al.*, 2017b). Research also suggests that this species is more likely to be encountered in relatively shallow and protected habitats such as inlets, estuaries, major tidal rivers, shallow bays, inshore reefs and coastal archipelagos (Department of the Environment, 2019r; Parra *et al.*, 2017b; Parra & Cagnazzi, 2016). Conversely, they are less likely to be found in open stretches of coastline (Parra & Cagnazzi, 2016) including in areas that are actively fished as part of the Ocean Beach Fishery. In the RRA, this type of regional or fine-scale habitat data was used to refine the *encounterability* assessments for a number of the species (Appendix C).

As ocean beach fishing relies on encircling fish *verse* their entanglement, the majority of the SOCC were assigned a preliminary high (3) score for the *selectivity* attribute (Table 5). The premise being that fish or species located within the enclosed area have a higher probability of being caught. In practice, the *selectivity* of a seine net will vary across a fishing event. For example, the selectivity of the apparatus will be lower during the net-setting process and when it is used in deeper water environments. In these instances, the net is more likely to be pulled over benthic species and/or provide greater avenues for more mobile species (*e.g.* dolphins, hammerheads) to escape. These factors were given further consideration as part of the RRA and resulted in a number of the *selectivity* scores being downgraded (Table 7, Appendix C).

The extent of the score reductions for the *selectivity* attribute was limited by an absence of data of interaction rates, catch compositions and contact without capture events (Appendix C). With additional information on how these species interact with the fishery or navigate the apparatus, these scores could be reduced further. This information would also assist in the refinement of assessments involving the *encounterability* and *availability* attributes (Table 7).

Of the remaining attributes, the most significant changes were made to preliminary scores assigned to *post-capture mortality* (Table 5 & 7). *Post-capture mortality* in non-target species is difficult to quantify and assessments are often impeded by data deficiencies. The Ocean Beach Fishery Level 2 ERA was no exception with all 11 species receiving a precautionary high score in the PSA (Table 5). In the RRA, further consideration was given to the operational constraints of the fishery and the ability of a species to survive a fishing event. Key considerations included the fishery having comparatively short shot times (<30 minutes, *pers. comm.* T. Ham), input controls already in place (*e.g.* seasonal use of a seine net, mesh size restrictions), limited soak times and in increased capacity to sort between non-target and target species while the animal is alive. As a result of these considerations, a number of the SOCC preliminary *post-capture mortality* scores were reduced as part of the RRA (Table 7; Appendix C).

When the RRA amendments were taken into consideration, the risk scores of all 11 species were reduced (Table 7). For eight of these species, these reductions resulted in a reclassification of their risk rating from high to medium. The three remaining species, the common bottlenose dolphin (*T.*

truncatus), the great hammerhead shark (*S. mokarran*) and the scalloped hammerhead shark (*S. lewini*) remained at high risk (Table 7).

4 Risk Evaluation

4.1 Ocean Beach Fishery

Net fishing is generally viewed as a less selective form of fishing as it often relies on fish swimming into and becoming entangled (*e.g.* gillnets) or trapped (*e.g.* tunnel nets) within the net. A relatively passive form of fishing, this often results in a wider range of target and non-target species being caught (Department of Agriculture and Fisheries, 2019a). In the Ocean Beach Fishery, *selectivity* is considered to be less of an issue as the net is towed around a school of fish and quickly retrieved. This minimises the length of the fishing event (estimated at <30 minutes, *pers. comm*. T. Ham) and restricts the interaction potential of the fishery to species inhabiting the immediately fished area. As seine nets are used to target pelagic schools of sea mullet or tailor (Department of Agriculture and Fisheries, 2019a), their use also improves the specificity of the operation as a whole.

Risk in the Ocean Beach Fishery is managed through a range of measures that limit when and where commercial seine nets can be used on the Queensland east coast. The sector, as a whole, operates under regional management which restricts the use of a seine net to waters south of Baffle creek (~-24˚S) and tidal waters out to 400m.[5] The risk posed by this fishery is further managed by temporal provisions that restrict the use of a seine net to between 1 April and 30 August (inclusive) each year. These regulations provide a degree of temporal and spatial risk management not found in other sectors of the ECIF. In terms of the Level 2 ERA, these factors were accounted for in the *availability* scores assigned to each species (Table 7).

In addition to the above restrictions, mesh sizes permitted for use in a seine net (12–70mm) are smaller than that prescribed for most nets used under the N1, N2 and N4 fishery symbols (mesh size range = 160 to 215mm; Department of Agriculture and Fisheries, 2019a). While not universal, the use of smaller mesh sizes will reduce the entanglement risk for larger species and improve post-interaction mortality rates. In the Level 2 ERA, these risk mitigation measures were largely taken into consideration as part of the RRA (Appendix C).

At the other end of the spectrum, data deficiencies were prevalent in a number of the species-specific risk profiles. For target & byproduct species, these deficiencies largely relate to catch compositions and harvest rates for retainable product including hammerhead sharks, guitarfish and shovelnose rays. In the SOCC assessment, these deficiencies reflect a (current) inability to validate data compiled through the logbook program or quantify catch rates and release fates in real or near time. In the Level 2 ERA, these deficiencies limited the extent of any score reductions applied in the RRA (*e.g.* to the *selectivity*, *encounterability* and *post-release mortality* attributes; Appendix C) and contributed to the production of more conservative risk assessments. With improved data and catch monitoring techniques, these risk ratings could be refined and the scope of future ERAs narrowed through the omission of low-risk species.

[5] *A full description of the regulations governing the use of K fishery symbols can be found in the Fisheries (Commercial Fisheries) Regulation 2019.*

Within the broader ECIF, the Ocean Beach Fishery is considered to be a contributor of risk for most of the species included in the Level 2 ERA *verse* the main driver of risk. While a number of the species were classified as medium or high risk, the conservative nature of these assessments and the operational constraints of the fishery must be recognised. For these species, particularly the SOCC, the final risk ratings are more likely to be a false positive result or a risk overestimation. This inference was supported by an ad-hoc *Likelihood & Consequence Analysis* which provided further insight into the probability of the risk coming to fruition over the short to medium term (Appendix D).[6]

With improved data on species compositions, interaction rates, and release fates, a number of the risk profiles could be further refined. This information would allow for the scope of the Level 2 ERA to be reviewed and facilitate the removal of low-risk species from future ERAs. This however could only be achieved with improved mechanisms to verify and validate the catch compositions and interaction rates in this sector of the ECIF.

General recommendations

1. *Identify avenues/mechanisms that can be used to validate data submitted through the logbook program, monitor the catch of target and non-target species effectively (preferably in near or real time), and minimise the risk of non-compliance including with reporting requirements for Species of Conservation Interest (SOCI).*

2. *Implement measures to improve the level of information on the dynamics of the K-fishery including fine-scale effort movements and effort patterns with apparatus other than a seine/haul net. As part of this process, it is recommended that gear reporting requirements be extended to include information on what fishing symbol is being used.*

3. *Establish a measure to estimate the 'gear affected area' and, when available, reassess the risk posed to teleosts species using a more quantitative ERA method e.g. bSAFE.*

4.2 Target & Byproduct Species

While ocean beach fishers primarily target mullet and tailor, they can retain any species permitted for sale in the ECIF. This is reflected in the catch data where a wider range of species and species complexes (including 'unspecified' categories) have been reported through the logbook system since 2000. A high proportion of these categories have small catch quantities and were excluded from the analysis as part of the species rationalisation process (Appendix A). However, a number of the species had catch quantitates that, while smaller, warranted their inclusion in the Level 2 ERA. Similarly, a number of the generic catch categories (*e.g. Mullet—unspecified*) required the inclusion of secondary species that make varying contributions to the overall catch (Department of Agriculture and Fisheries, 2019a). This includes the bluespot mullet (*V. seheli*), fantail mullet (*P. georgii*), goldspot mullet (*L. argentea*) and diamondscale mullet (*L. vaigiensis*).

The inclusion of (comparatively) low harvest and secondary species increased the scope of the Level 2 ERA and ensures that it provides an adequate baseline of risk assessments. For most of these species, the Ocean Beach Fishery will be a contributor of risk (*verse* the main driver of risk) and the

[6] *In the Level 2 ERA, the Likelihood & Consequence Analysis (LCA) was used to provide further insight into the probability of the risk coming to fruition over the short to medium term (Appendix D). The LCA is a fully qualitative assessment and was used to provide an indicative assessment of how conservative an assessment might be. As the LCA is qualitative and lacks the detail of the PSA, the outputs should not be viewed as an alternate or competing risk assessment and the results of the PSA/RRA will take precedence over the LCA.*

final risk ratings will be more reflective of the potential risk (Table 7; Appendix D). The assessment though will assist in evaluating the cumulative risks posed to these species across the entire ECIF.

4.2.1 Mullidea (mullet)

Species	Sub-fishery / Apparatus	Risk Rating
Sea mullet (*M. cephalus*)	Seine / Haul nets	Low
Bluespot mullet (*V. seheli*)	Seine / Haul nets	Low
Fantail mullet (*P. georgii*)	Seine / Haul nets	Low
Goldspot mullet (*L. argentea*)	Seine / Haul nets	Low
Diamondscale mullet (*L. vaigiensis)*	Seine / Haul nets	Low

As ocean beach fishers target schools of sea mullet and tailor, these two are arguably at greatest risk of experiencing an over-fishing event. Tailor is one of the few ECIF species managed under species-specific output controls and stock sustainability has been confirmed through multiple stock assessments and indicative sustainability evaluations (Department of Agriculture and Fisheries, 2019a; Leigh *et al.*, 2017; Litherland *et al.*, 2018). Tailor are also the focus of a comprehensive monitoring program that examines catch compositions across sectors (commercial and recreational) and provides additional information on the cumulative fishing pressures (Department of Agriculture and Fisheries, 2014; 2018h). When the above factors were taken into consideration, it was determined that the risk posed to this species was being managed effectively on the Queensland east coast. Accordingly, tailor was excluded from the Ocean Beach Fishery Level 2 ERA (Appendix A).

Mullet makes a significant contribution to the total ECIF catch (Department of Agriculture and Fisheries, 2019a) with the majority being retained in the Ocean Beach Fishery. Ocean beach fishers utilise seine nets and actively target near-shore schools of fish between 1 April and 31 August (Department of Agriculture and Fisheries, 2019a). When compared to the Large Mesh Net Fishery (*e.g.* gillnets and ringnets), ocean beach fishers harvest more than three times the amount of mullet—making it a key driver of risk for this complex. While a high proportion of this catch is reported as *unspecified*, the majority will consist of sea mullet (*M. cephalus*), and this species is viewed as a good indicator for the rest of the complex.

Sea mullet are not managed under output controls and this limitation was the catalyst for its inclusion in the Level 2 ERA. Evidently, the absence of an effective mechanism to control catch and effort was identified as the key risk factor for this species. While noting this management limitation, the Level 2 ERA indicates that the risk posed to this species is being managed within the current fishing environment (Table 7). Sea mullet has a long catch history on the Queensland east coast and stock sustainability has been confirmed through multiple assessments and indicative sustainability evaluations (Lovett *et al.*, 2018; Smith & Deguara, 2002; Stewart *et al.*, 2018; Virgona *et al.*, 1998). As mullet are not viewed as a primary target for recreational fishers, cumulative fishing pressures for this species will also be lower than that reported for tailor. These factors were given significant weighting in the RRA and were reflected in scores assigned to the *management strategy, sustainability assessments,* and *recreational desirability* attributes (Table 7; Appendix C).

The inclusion of bluespot (*V. seheli*), fantail (*P. georgii*), goldspot (*L. argentea*) and diamondscale (*L. vaigiensis*) mullet recognises the fact that these species will be caught in conjunction with sea mullet

(Table 7; Appendix A). When compared to sea mullet, data sets for the secondary mullet species are less developed and their risk profiles needed to account for a number of data deficiencies (Table 5). Where possible, these deficiencies were addressed in the RRA through the use of proxies. The use of proxies helped refine a number of the risk profiles and produced ratings that were more reflective of the actual risk. Of notable importance, all of the proxies were based on the highest attribute score assigned to the complex (Appendix C). While this approach produced more conservative assessments, it minimised the risk of a false negative result (*i.e.* a risk underestimation).

While difficult to quantify without additional information, expectations are that the biology and rebound potential of the secondary mullet species will be similar to sea mullet. These species are targeted with less frequency and individual rates of fishing mortality will be comparatively low. For these reasons, the risk posed to bluespot, fantail, goldspot and diamondscale mullet is expected to be equal to or lower than sea mullet. With that said, future ERAs would benefit from additional data on the composition of the mullet catch (commercial and recreational), and on the biology of these secondary species. This information would reduce the reliance on data from proxy species (Appendix C), enable refinements to be made to the scope of the Level 2 ERA, and facilitate the removal of low risk species from future assessments.

The outputs of the Level 2 ERA indicate that mullet are at low risk of being fished beyond sustainability reference points within the current fishing environment. As the complex is not managed under output controls, there is a risk that catch or effort will increase to a level that impacts on their long-term sustainability. A long history of *sustainability assessments* though suggest that this risk is manageable over the short to medium term. This risk of this occurring over the longer-term will be further managed through the use of harvest strategies established under the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017). For example, a proposed harvest strategy for the ECIF classifies sea mullet as a *Tier 2* species which (if implemented) would see the species or the broader complex managed under output controls (Queensland Government, 2018b).

Mullet-specific recommendations

1. *Implement output-based management for mullet that minimises the long-term risk of overfishing—noting the cross-jurisdictional nature of sea mullet stocks and the targeting of the species in both QLD and NSW.*

2. *If outputs controls are not viable, maintain a stock assessment regime that upholds a high level of certainty that the stock is still being sustainably fished within Queensland and across jurisdictions.*

3. *Improve catch composition data and identify mechanisms to improve data on harvest rates for secondary species across sectors—allowing for further refinements to be made to the ERA process and facilitate the removal of some species.*

4.2.2 Secondary Species

Species	Sub-fishery / Apparatus	Risk Rating
Sand whiting (*S. ciliate*)	Seine / Haul nets	Low
Trumpeter whiting (*S. maculata*)	Seine / Haul nets	Precautionary Medium

Species	Sub-fishery / Apparatus	Risk Rating
Yellowfin bream (*A. australis*)	Seine / Haul nets	Low
Tarwhine (*R. sarba*)	Seine / Haul nets	Precautionary Medium
Snubnose dart (*T. blochii*)	Seine / Haul nets	Medium
Swallowtail dart (*T. coppingeri*)	Seine / Haul nets	Medium

Risk ratings for the remaining target and byproduct species were more varied with two assessed as low risk and four assessed as medium risk. For a number of the species, their final risk ratings are viewed as precautionary and are more representative of the potential risk. This is of particular relevance to the trumpeter whiting (*S. maculata*) where less-specific management arrangements, no legal size limits, and the absence of stock sustainability data produced a more conservative risk assessment (Table 7). With improved information, it is likely that risk ratings for one or more of these species could be reduced further.

As expected, the *productivity* component of the PSA was the key factor in terms of mitigating the risk posed to these species. As teleosts, these species display typical *r*-selected life-history traits including more rapid rates of growth, reaching sexual maturity at a (comparatively) early age, and increased fecundity (King & McFarlane, 2003). These traits translated to *productivity* scores of low (1) or medium (2) for the majority of the attributes assessed (Table 7). This resulted in all six non-mullet species registering an average *productivity* score almost half that reported for the SOCC (1.38 *vs* 2.55) (Table 7). While proxies were used in some profiles, values assigned as part of the RRA provide a reasonable account of the *productivity* risks. There may however be further room for improvement and scores assigned to some attributes could be reduced further with information on the biology of individual species.

Net selectivity, *management strategy* limitations, and minimal *sustainability assessments* were identified as the key drivers of risk for this subgroup. As the Ocean Beach Fishery uses a seine net, there is a high probability that these species will be caught if and when they are located within the sweep of the net. While noting these assessments, seine nets will only be set or shot once a suitable school of fish has been observed from the shore. Once shot around the school, the net is immediately retrieved to the shore, increasing the probability of the catch being more one-dimensional (*e.g.* tailor or sea mullet). This contrasts with other sectors of the ECIF where mesh nets (gillnets) are set in place and allowed to soak for an extended period of time (Jacobsen *et al.*, 2019).

Beach seine fishing occurs over a relatively short period with the net setting and retrieval process taking as little as 30 minutes (*pers. comm.* T. Ham). This limits the impact of a single fishing event to animals confined within the immediately fished area. While difficult to account for in the PSA, shorter shot times may reduce the *encounterability* potential for some species; particularly for species with smaller overlaps (Table 7). In the Level 2 ERA, refinements to scores assigned to the *encounterability* and *availability* attributes were limited by an absence of data on species compositions and finer-scale effort movements in inshore waters. These two issues are being actively addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* with the extended use of *Vessel Tracking* and the implementation of a *Data Validation Plan* (Department of Agriculture and Fisheries, 2017; 2018f; g). Data from these two programs will be used to improve the accuracy of the Level 2 ERAs and species rationalisation process (Appendix A).

Of the remaining attributes assessed, *management strategy* and *sustainability assessments* arguably provide the greatest avenues to reduce risk for these species. The management regime for these species is less specific and do not include the use of output controls *e.g.* ITQs or TACC limits. As the use of output controls formed the basis of the assessment, all of these species were assigned a precautionary high (3) risk score in the PSA (Table 5). For most of these species, a weight-of-evidence approach was applied to demonstrate that the risk was being managed to a moderate degree without the use of a quota system (Appendix C). This approach considered lower harvest rates in the Ocean Beach Fishery, minimum legal size limits which are largely aligned with their reproductive development, and that cumulative fishing pressures are restricted through the use of recreational in-possession limits. There was however less capacity to reduce scores assigned to this attribute due to an absence of data on species compositions, and uncertainty surrounding the rate of fishing mortality and how it compares to key biomass reference points. Similarly, there is room within the current management regime for catch/effort to increase for one or more of these species.

As with mullet, the above risks are being actively addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017). Under the draft ECIF harvest strategy, both whiting and yellowfin bream would be transitioned to a management system based on output controls**.** In terms of the Level 2 ERA, this change would minimise a key risk area for these species and reduce the likelihood of the species experiencing an undesirable event over the longer-term. While tarwhine (*R. sarba*), snubnose dart (*T. blochii*) and swallowtail dart (*T. coppingeri*) are viewed as low priorities for transition to output controls, their management will be strengthened through a series of (proposed) decision rules that will minimise the sustainability risk posed to these species**.** When implemented, the harvest strategy will be supported by a range of other initiatives which include the extended use of *Vessel Tracking,* identifying key monitoring/research priorities, and the establishment of a *Data Validation Plan* (Department of Agriculture and Fisheries, 2018f; g; 2020c).

In addition to the *management strategy* attribute, *sustainability assessments* was identified as key driver of risk for the secondary species (Table 7). Outside of sand whiting and yellowfin bream, few species have detailed stock assessments and/or have been the subject of an indicative sustainability evaluation. For species like trumpeter whiting, tarwhine and dart, these deficiencies resulted in the species receiving a high (3) risk score for *sustainability assessments* and contributed to these species receiving higher risk ratings (Table 7). Catch rates for these species are comparatively small in the Ocean Beach Fishery which, when considered in isolation, will present as a lower sustainability risk. This fact though was difficult to account for in the RRA due to the broader uncertainty surrounding current stock structures, cumulative fishing pressures, and catch compositions.

As whiting, bream and dart are secondary targets in the Ocean Beach Fishery and data sets for these species are less developed, these deficiencies contributed to the production of more conservative risk ratings and suggest that the final ratings are more representative of the potential risk (Appendix D). To this extent, there would be some benefit in reassessing bream, whiting, and bream using the *Sustainable Assessment of Fishing Effects* or SAFE approach. Comparisons have shown that SAFE method produces fewer false positives and may provide greater differentiation in terms of the risk posed to each species (Zhou & Griffiths, 2008; Zhou *et al.*, 2016). The ability to assess these species using bSAFE though will still be predicated on management's ability to quantify 'gear affected area' across the fishery.

Species-specific recommendations

1. *Improve catch composition data and identify mechanisms to improve data on harvest rates for secondary whiting species across sectors—allowing for further refinements to be made to the ERA process and facilitate the removal of some species.*

2. *Explore the need to include secondary species in stock assessments or indicative sustainability evaluations like SAFS.*

4.3 Species of Conservation Concern

A number of the species included in the Level 2 ERA will interact infrequently with the Ocean Beach Fishery and were assessed as a precautionary measure. The inclusion of these species provided the assessment with additional scope and will assist management if the current fishing environment changes significantly. Their inclusion in the assessment minimises the potential of an at-risk species being omitted from the analysis. It will however increase the likelihood that the outputs for some species represent the potential risk *verse* the actual risk. In these instances, there is a lower probability of the risk coming to fruition over the short to medium term and implementing species-specific risk mitigation strategies or management reforms are viewed as less of a priority. **For the purpose of this ERA, these are classified as *precautionary* risk assessments as they will not require management beyond what is already being undertaken as part of the *Queensland Sustainable Fisheries Strategy 2017–2027*** (Department of Agriculture and Fisheries, 2017).

When the results of the PSA and RRA were taken into consideration, the Level 2 ERA indicated that fishing activities in the Ocean Beach Fishery presented a medium risk to most of the SOCC (Table 7). While noting these results, there are a number of factors that need to be taken into consideration when reviewing the outputs of the Level 2 ERA, what they represent (*i.e.* a real or potential risk) and the key drivers of risk. For example, biological and life-history constraints were a key driver of risk for most SOCC and, in some instances, was the main contributor of risk. If for example, all of *susceptibility* attributes were assigned the lowest value possible (1), seven of the 11 species would still register a ‘medium’ risk rating. This highlights the inherent challenge of managing fishing-related risks for species with *k*-selected life histories. In fisheries where there is an increased risk of mortality, these biological constraints are significant as even low levels of fishing mortality may have long-term implications for a species or regional populations.

Similarly, the operational constraints of the Ocean Beach Fishery need to be taken into consideration when evaluating whether or not the risk will come to fruition over the short to medium term. Fishing events for this sector are shorter meaning SOCC interactions are likely to occur over a smaller time period. Further, the net will only interact with animals located within the area being immediately fished *verse* a net that is set in place and allowed to soak for an extended period of time. While not universal, these factors will lead to fewer *in-situ* (within net) mortalities and improved post-release survival rates. The extent of these benefits will be explored further in the complex-specific risk evaluations.

The following provides an overview of the key drivers of risk for all species included in the Level 2 ERA. Where possible, these evaluations include recommendations on where risk may be reduced within a particular subgroup and avenues that could be used to improve the accuracy of the risk assessments for key species.

4.3.1 Marine Turtles

Species	Sub-fishery / Apparatus	Risk Rating
Green turtle (*C. mydas*)	Seine / Haul nets	Medium
Loggerhead turtle (*C. Caretta*)	Seine / Haul nets	Precautionary Medium
Hawksbill turtle (*E. imbricata*)	Seine / Haul nets	Precautionary Medium

Based on the prescribed fishing area and species distributions, the Ocean Beach Fishery is more likely to interact with the green turtle (*C. mydas*). The green turtle has the largest population on the Queensland east coast (Department of the Environment, 2019a; Limpus, 2008) and the species is relatively abundant in the south-east Queensland region. While loggerhead (*C. caretta*) and hawksbill (*E. imbricata*) turtles are observed in the same areas, catch and stranding data suggest that these species are less likely to interact with the Ocean Beach Fishery (Biddle & Limpus, 2011; Department of Agriculture and Fisheries, 2019a; Department of Environment and Science, 2017; Greenland & Limpus, 2003; 2004; Greenland *et al.*, 2002; Haines *et al.*, 1999; Meager & Limpus, 2012). Outside of these three, expectations are that the fishery will have low to negligible interactions with the olive ridley turtle (*L. olivacea*), leatherback turtle (*D. coriacea*) and flatback turtle (*N. depressus*) (Appendix B).

While there is limited information on the extent of marine turtle interactions in the Ocean Beach Fishery, capture rates will be lower than what is reported in the Large Mesh Net Fishery (gillnets, ring nets) (Appendix E). When compared to this sector, the Ocean Beach Fishery has a smaller effort footprint, fewer licences and lower participation rates (Department of Agriculture and Fisheries, 2019a). The fishery also operates in areas where marine turtles are less likely to congregate in higher densities and outside their preferred habitats *e.g.* sheltered waters of Moreton Bay and Great Sandy Marine Park. This inference is partly supported by an absence of seine net / marine turtle interactions in the SOCI data and ancillary datasets like StrandNET (Department of Agriculture and Fisheries, 2019a; Department of Environment and Science, 2017).

At a species-specific level, all three marine turtles were assigned a high (3) risk rating for the *encounterability* and *selectivity* attributes (Table 7). This was primarily due to the fact that marine turtles are more likely to be encountered on the surface of the water and may have more difficulty avoiding the net. Both of these factors increase the risk or likelihood that a marine turtle located in the sweep of the net will be caught and require intervention. With improved information on marine turtle interaction rates, release fates and contact without capture events it is possible that scores assigned to one or both of these attributes could be reduced. Examples of where this could occur include data confirming low interaction rates, improved post release survival rates and information that shows marine turtles can effectively escape the net before it is pulled into shallow waters.

As marine turtles are air breathers, one of the most significant risks posed by net fishing is drowning as a result of net entanglements and exhaustion. This is considered to be less of a risk in the Ocean Beach Fishery as the method utilises smaller mesh sizes (12–70mm) and relies on the trapping of fish over a shorter period of time. These measures reduce the risk of an animal becoming entangled to the point where a) it cannot access the surface to breathe or b) dies before it can be extracted from the net. This contrasts with gillnet fishing where the net is left to soak for an extended period of time and animals or more likely to experience a protracted fishing event.

Based on the above considerations and the outputs of the Level 2 ERA, the Ocean Beach Fishery is considered to be a contributor of risk for the marine turtle subgroup *verse* the main driver of risk. The extent of this risk will be species-specific with green turtles more likely to interact with the apparatus. As most of the high risk elements relate to their biological constraints (refer section 4.3; Table 7) they will be difficult to address through the spectrum of management reforms. The risk profiles of all three species though could be refined with improved information on the broader dynamics of the fishery (*e.g.* net shot and retrieval times, fine-scale effort patterns), capture rates (or lack thereof), and release fates. For example, a reduction in the score assigned to the *selectivity* attribute from high (3) to low (1) would see at least two of the species re-classified as low risk.

While noting the above potential for improvement, the risk posed by fishing activities in the Ocean Beach Fishery will be low when compared to other sectors of the ECIF and non-fishing related risks. Evidently, injuries and mortalities stemming from boat strike, the negative consequences of habitat degradation (*e.g.* urban development, runoff) and disease, all present as a higher risk for this subgroup.

Species-specific recommendations

1. *Provide a synthesis of regional distribution data for green, loggerhead and hawksbill turtles to evaluate a) the level of overlap with the ocean beach mesh net effort and b) the potential for these species to interact with seine nets on the Queensland east coast.*

2. *Increase the level of information on marine turtle interactions in the Ocean Beach Fishery and the long-term implications (if any) of these types of interactions.*

3. *Establish a process where data on marine turtle interactions submitted through the SOCI logbook program can be integrated more effectively into the Marine Wildlife Stranding and Mortality Database (i.e. StrandNET).*

4. *Review the resources that are available on handling marine turtles that interact with commercial fishing apparatus and (if applicable) update to include information for the Ocean Beach Fishery.*

4.3.2 Dolphins

Species	Sub-fishery	Risk Rating
Australian humpback dolphin (*S. sahulensis*)	Seine / Haul nets	Precautionary Medium
Common bottlenose dolphin (*T. truncatus*)	Seine / Haul nets	Precautionary High
Indo-Pacific bottlenose dolphin (*T. aduncus*)	Seine / Haul nets	Precautionary Medium

The dolphin subgroup registered one of the highest average scores for the *productivity* component of the PSA. Dolphins have *k*-selected life-history traits (*e.g.* long-lived, delayed maturity, low fecundity) and all three were assigned the highest risk rating in at least four of the seven attributes assessed (Table 7). These biological risks are well researched, however, will be difficult to mitigate through the management reform process.

When compared to the biological data, there is less information on the extent of dolphin interactions in the Ocean Beach Fishery, the ability of a dolphin to escape capture if encircled by the net, and the number of individuals requiring assistance or removal. While noting these deficiencies, dolphin

entrapments in this sector of the ECIF are expected to be low and infrequent. This can be partly attributed to the operational constraints of the fishery which includes regional management, relatively short fishing events, and minimal soak times. When a dolphin does interact with a seine net, it is more likely to be instigated by the animal (*e.g.* targeting trapped fish) with a contact-without-capture event considered the most likely outcome. This however was difficult to account for in the Level 2 ERA due to an absence of data on dolphin interactions or lack thereof. This uncertainty was reflected in the PSA and limited the extent of any score reduction in the *selectivity* and *encounterability* RRA (Appendix C).

With interaction rates expected to be low, the decision to include the common bottlenose dolphin, the Indo-Pacific bottlenose dolphin (*T. aduncus*) and the Australian humpback dolphin (*S. sahulensis*) in the assessment was precautionary (Appendix B). One of the main reasons why these species were included in the analysis is that schools of fish being targeted are a likely source of food for regional dolphin populations. This increases the likelihood that one or more of these species will interact with the apparatus (Allen *et al.*, 2014; Gazo *et al.*, 2008; Hamilton & Baker, 2019) and, by extension, increases the risk that a dolphin will interact with or become fully enclosed by the seine/haul net.

As the net setting and retrieval period is relatively short, interactions will be confined to dolphins located within the swept area. In the event that a dolphin were to be partially or wholly encircled by a seine net, their increased manoeuvrability relative to marine turtles would improve their escapement potential (Appendix C). Furthermore, operators will be on hand to release any dolphin that cannot escape the net before it is hauled into shallow waters. In these instances, the animal is expected to experience higher levels of stress and will be more susceptible to injuries. In the Ocean Beach Fishery, early detection and sound handling/release techniques should minimise the extent of this risk and the probability of the interaction ending in a mortality (Table 7; Appendix C).

Given the above considerations, final risk ratings for the dolphin complex are considered to be more representative of the potential risk *verse* an actual risk. The risk profiles of all three were heavily influenced by their biology with operational constraints limiting the impact of the fishery on regional populations. These results indicate that further management of this risk in the Ocean Beach Fishery (*i.e.* beyond what is already being undertaken under the *Queensland Sustainable Fishery 2017–2027*) is not required. The risk profiles of all three species though would benefit from an improved understanding on how dolphins interact with the Ocean Beach Fishery, the selectivity of the net and the likelihood/probability that a net interaction will result in a capture event. With additional information on the type and frequency of interactions, it is conceivable that this group could be omitted from future ERAs involving the Ocean Beach Fishery.

Species-specific recommendations

1. *Identify avenues to improve the level of information on dolphin interactions with the Ocean Beach Fishery and (if applicable) areas where these interactions are more likely to occur.*

4.3.3 Guitarfish & Wedgefish

Species	Sub-fishery / Apparatus	Risk Rating
Bottlenose wedgefish (*R. australiae*)	Seine / Haul nets	Precautionary Medium
Giant shovelnose ray (*G. typus*)	Seine / Haul nets	Precautionary Medium

In the ECIF, wedgefish and shovelnose rays are more likely to be caught in large mesh nets (*e.g.* gillnets) and tunnel nets operating in inshore waters over sandy substrates. While the bottlenose wedgefish (*R. australiae*) and the giant shovelnose ray (*G. typus*) may be encountered in the Ocean Beach Fishery, their *susceptibility* to capture will vary across a fishing event. In areas where the drop of the net is less than the water depth, there is a lower probability of these species being caught as the seine/haul net will be pulled over a benthic species. This risk will increase as the net is hauled closer to shore and the drop of the net approaches then exceeds the water depth.

At present, it is difficult to quantify the number of wedgefish and shovelnose rays that are retained for sale in the Ocean Beach Fishery. However, total interaction and retention rates for this sector of the ECIF will be low. Catch data for the entire ECIF indicates that wedgefish, shovelnose rays and guitarfish are retained in small quantities with an average of 4.8t (range 0.2–12.2t) retained on the Queensland east coast each year.[7] While this data has poor species resolution (Department of Agriculture and Fisheries, 2019a), the eastern shovelnose ray (*A. rostrata*) will make a notable contribution to this catch. This species is relatively common in south east Queensland and has fewer conservation concerns (Kyne & Stevens, 2015; Last *et al.*, 2016).

A number of factors would contribute to wedgefish and shovelnose rays having lower retention rates in the Ocean Beach Fishery including the nature of seine net fishing (*e.g.* short shot times, regional impacts, minimal soak times), the targeting of fish schools (*e.g.* sea mullet, tailor) situated higher in the water column, and the low marketability of non-target batoids. In terms of management, the commercial take of guitarfish and shovelnose rays is also restricted by a combined in-possession limit of five and a 1.5m maximum total length size restriction.[8] These factors would have a significant bearing on the number of guitarfish and shovelnose rays that are retained for sale in the Ocean Beach Fishery. From an ERA perspective, these factors contributed to the bottlenose wedgefish and the giant shovelnose ray receiving lower overall risk scores (Table 7).

Under the attribute criteria, any species that can be retained for sale is assigned the highest risk score for *post-capture mortality* (Table 3, Table 5). Given the low levels of retention, this was considered to be an overestimate of the risk posed to these two species. While it is acknowledged that some wedgefish / shovelnose rays will be discarded as bycatch, the use of smaller mesh sizes and shorter shot times will improve post-release survival rates for these species. These factors were taken into consideration as part of the RRA and resulted in a reduction in the score assigned to the *post-capture mortality attribute* (Table 7; Appendix C). With improved information on catch compositions and retention rates, there may be additional avenues or grounds to reduce this score further.

Of note, the bottlenose wedgefish and the giant shovelnose ray were included in the Level 2 ERA in response to a decision to list the Rhinidae and Glaucostegidae families on CITES. While acknowledging these developments, it is important to understand the context of their listing and how it relates to species that interact with fisheries on the Queensland east coast. For giant shovelnose rays

[7] *Catch records obtained through QFish: http://qfish.fisheries.qld.gov.au/query/0a28a033-5885-4701-82fa-8dab94453a61/table?customise=True#*

[8] *The Fisheries (General) Regulations 2019 defines Guitarfish as any species from the Family Rhynchobatidae and shovelnose rays as any species from the Family Rhinbobatidae. A number of taxonomic reviews re-aligned the batoid families and included the establishment of a separate family of Giant Guitarfish (Family Glaucostegidae) which includes G. typus and the movement of all Rhynchobatus species into the Wedgefish family (Family Rhinidae) (Last et al., 2016). As a consequence, names contained within the Fisheries (General) Regulations 2019 are outdated. The intent of the legislation though remains the same.*

(*Family Glaucostegidae*), the listing was primarily linked to exploitation concerns surrounding the blackchin guitarfish (*G. cemiculus*) and the sharpnose guitarfish (*G. granulatus*). These two species are not found in the Indo-west Pacific (Last *et al.*, 2016) and they will not interact with commercial fisheries operating in Australian waters. However, listing advice for both species recognised that a) guitarfish can be difficult to differentiate between and b) other species may face similar pressures including in northern Australia (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2018a; Salini *et al.*, 2007). On the back of this advice, the entire Glaucostegidae family was listed on CITES.

The situation surrounding wedgefish differs slightly in that the bottlenose wedgefish was directly nominated for listing along with the whitespotted guitarfish (*R. djiddensis*) (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2018b; Last *et al.*, 2016). The bottlenose wedgefish is found in Australian waters and can be retained for sale in the Ocean Beach Fishery. Listing advice for this species largely focused on areas outside of Australia where fishing activities are less regulated and the risk of over-exploitation is significantly higher *e.g.* South-east Asia, Southern Asia, Northwest Indian Ocean and East Africa. In Australia where fisheries operate under a well-established regulatory framework, the majority of the identifiable risks relate to the poor resolution of catch data, bycatch, and potential declines in regional populations (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2018b).

The above considerations are important as they provide further context on how fishing-related risks in Queensland compare to global trends. As noted, one of the key threats for this subgroup is unsustainable and unregulated fisheries or trade (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2018a; b; Kyne & Rigby, 2019; Kyne *et al.*, 2019a; Kyne *et al.*, 2019b). This risk is largely mitigated in the ECIF through the use of input and output controls *e.g.* limited licencing, mesh size restrictions, spatial closures, in-possession limits (Department of Agriculture and Fisheries, 2019a).

Given the size of the fishery and the nature of the apparatus, the Ocean Beach Fishery is considered to be a contributor of risk for these species. The medium risk rating of both species was heavily influenced by their biological constraints and they are not considered to be a primary target in this sector of the ECIF. Outputs of the Level 2 ERA are considered to be more indicative of the potential risk and will not require species-specific reforms. However, it is recommended that measures be implemented to improve the level of information on species compositions and release fates across the ECIF (refer to general recommendations in section 4.1). A review of the legislative definitions should also be undertaken to ensure that they reflect recent taxonomic amendments involving these species.

Species-specific recommendations

1. *Improve catch composition data and identify mechanisms to improve data on harvest rates for guitarfish, shovelnose rays, and wedgefish—allowing for further refinements to be made to the ERA process and facilitate the removal of some species.*

2. *Review and update species definitions contained within Fisheries legislation to ensure that they align with the best available data and maintain relevance.*

4.3.4 Hammerhead Sharks

Species	Sub-fishery / Apparatus	Risk Rating
Scalloped hammerhead (*S. lewini*)	Seine / Haul nets	Precautionary High
Great hammerhead (*S. mokarran*)	Seine / Haul nets	Precautionary High
Smooth hammerhead (*S. zygaena*)	Seine / Haul nets	Precautionary Medium

The scalloped hammerhead shark (*S. lewini*) is listed as *Conservation Dependent* on the EPBC threatened species list and there is an ongoing review into the sustainability of the species in Australian waters (Department of the Environment and Energy, 2019). At present, no other hammerhead shark is listed under the EPBC Act or afforded species-specific protections in Queensland waters. Despite this, the decision was made to include both the great hammerhead shark (*S. mokarran*) and the smooth hammerhead shark (*S. zygaena*) in the Ocean Beach Fishery Level 2 ERA. This decision was based on the fact that hammerhead sharks can be difficult to differentiate between in an active fishing environment; particularly when dealing with juveniles and sub-adults.

As with most species included in the SOCC ERA, life-history constraints were highly influential in the final risk ratings. These constraints were sufficient to assign the scalloped, great, and smooth hammerhead shark with the highest risk score for all but one of the *productivity* attributes (Table 7). In addition to their biology, there are a number of traits that increase hammerhead shark's *susceptibility* to net fishing activities. For example, the distinctive shape of the hammerhead shark head makes them highly susceptible to net entanglements across a wide range of size classes (Department of the Environment and Energy, 2014; Harry *et al.*, 2011b). This risk if further compounded by the fact that hammerhead sharks have a low tolerance for net entanglements and are more likely to die without relatively rapid intervention (Harry *et al.*, 2011b).

In the Ocean Beach Fishery, the entanglement risk for larger animals is partly mitigated through the use of smaller mesh sizes; K-symbol mesh size = 12–70mm *vs.* 160–215mm for the N1, N2 and N4 fishery symbols (Department of Agriculture and Fisheries, 2019a). The effectiveness of this measure will be less for smaller individuals and this was the reason why the subgroup received a medium risk rating for the *selectivity* attribute (Table 7). With additional information on interaction rates, release fates and escapement potential, these scores could be reduced further. If this were to occur, all three species would fall into the medium risk category.[9]

Hammerhead sharks can be retained for sale in the ECIF and can be actively targeted by operators with a shark (S) fishing symbol (Department of Agriculture and Fisheries, 2019a). This introduces a degree of complexity that is not found in the risk profiles of most other SOCC. When compared to other sectors of the ECIF, ocean beach operators retain smaller quantities of hammerhead shark. From 2003 to 2018, this sector registered annual hammerhead shark catches of between 0.3 and 7.5t with catches dropping to <1t in the last three years (2016–2018; Department of Agriculture and Fisheries, 2020a). As hammerhead sharks are not targeted in the Ocean Beach Fishery, this component of the catch is considered to be incidental and opportunistic. While these factors were

[9] *Assessment based on the assumption that the level of information improved to a point where the score assigned to the selectivity attribute could be confidently downgraded from medium (2) to low (1).*

taken into consideration as part of the species rationalisation process (Appendix B), all three were retained in the assessment as a precautionary measure.

In the broader ECIF, the take of hammerhead sharks is managed through a combined 100t TACC limit. This limit applies to all *Sphyrna* species and its introduction was a significant step forward with respect to managing the resource on the Queensland east coast. The TACC limit is currently applied at a higher taxonomic level and is based on the retained hammerhead shark catch (excluding wingheads). While data is being collected on hammerhead shark discards, this data is reported by number and lacks the information required to calculate an accurate weight estimate. Without a weight estimate, hammerhead shark discards cannot be accounted for in the TACC limit.

Multi-species TACCs are useful for groups like hammerheads where morphological similarities make it difficult to differentiate between species in an active fishing environment. The disadvantage of this approach is that multi-species TACCs may not be flexible enough to respond to changing fishing environments or detect overfishing events for individual species. In the Ocean Beach Fishery, this is viewed as less of a risk as these species are not actively targeted. The fishery though will contribute to the total rate of fishing mortality and it will need to be considered when determining if a hammerhead shark is being fished above sustainability reference points (Leigh, 2015).

As the smooth hammerhead shark is a temperate species, it is more likely to be encountered in waters further south including in New South Wales. For these reasons, sustainability risks and concerns surrounding the scalloped and great hammerhead shark tend to be viewed as higher priorities for the Queensland east coast. In the ECIF, these risks are more synonymous with the Large Mesh Net Fishery (*e.g.* set mesh nets, anchored gillnets *etc*.) where hammerhead sharks are actively targeted and retained in much higher quantities (Department of Agriculture and Fisheries, 2019a; Jacobsen *et al.*, 2019). In comparison, the impact of the Ocean Beach Fishery and the associated risks will be smaller.

At a whole-of-fishery level, the Ocean Beach Fishery will be a cumulative risk factor for this subgroup (Appendix D). For this reason, the risk ratings were classified as precautionary and management of the risk not viewed as an immediate priority for this fishery. None of the species are targeted by this sector of the ECIF and, given the nature of the apparatus, this situation is unlikely to change in short to medium term. With additional information on catch and discard rates, this complex could potentially be removed from future iterations of the Ocean Beach Fishery Level 2 ERA.

Species-specific recommendations

1. *Implement measures to improve the effectiveness of the hammerhead shark catch reporting program and refine total rates of fishing mortality (retained plus discards) across the entire ECIF.*

2. *Undertake a review of the resources made available to licence holders to assist in hammerhead shark identifications.*

Summary

The Level 2 ERA provides additional depth to the risk profiles of key target species in the Ocean Beach Fishery and the SOCC that will interact with this sector of the ECIF (Department of Agriculture and Fisheries, 2018e). Outputs from the Level 2 ERA will help inform initiatives instigated under the

Queensland Sustainable Fisheries Strategy 2017–2027 and strengthen linkages between the ERA process and the remaining areas of reform (Department of Agriculture and Fisheries, 2017).

While the Ocean Beach Fishery included a number of high risk ratings, these were heavily influenced by the biological constraints of the species assessed *e.g.* the SOCC. Similarly, precautionary elements included in the methodology combined with data deficiencies contributed to the development of more conservative risk profiles. For most of the non-target species, final risk rating were considered precautionary and will not require significant species-specific reforms. There are however a number of areas where risk could be managed further including improvements in the monitoring and reporting of non-target species. This information will help refine risk assessment and provide further insight into the need to conduct subsequent ERAs for this component of the ECIF.

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6 Appendix

Appendix A – *Summary of the species rationalisation process for **target & byproduct** species including key justifications and considerations.*

Appendix B – *Summary of the species rationalisation process for **Species of Conservation Concern (SOCC)** species including key justifications and considerations.*

Appendix C – *Residual Risk Analysis of preliminary scores assigned in the Productivity & Susceptibility Analysis (PSA).*

Appendix D – *Supplementary Risk Assessment: Likelihood & Consequence Analysis.*

Appendix E – *Summary of the marine turtle interactions by gear type and species reported from the East Coast Inshore Fishery (ECIF).*

Appendix A—Target & Byproduct Species Rationalisation Process.

1. Overview

Catch data submitted through the commercial logbook system was used to construct a preliminary list of target & byproduct species that were considered for inclusion in the Level 2 ERA. Logbook data was considered over a three year period (2017–2019 inclusive) with the final species list refined using the following steps.

1. Data for each catch category (*i.e.* species or species groupings) was summed across the relevant period (2017–2019 inclusive) and ranked in order from highest to lowest.
2. Cumulative catch analysis was used to identify all of the categories that made up 95% of the total catch reported from the fishery over this period.
3. Species that fell below the 95% catch threshold were reviewed and, if no anomalies were detected, omitted from the initial list of target & byproduct species. Retention rates for most of these species are low and they are generally viewed as secondary byproduct species. When and where appropriate, these secondary species will be considered for inclusion in subsequent ERAs.
4. Species above the 95% catch threshold (*i.e.* those that were not omitted from the analysis) were than reviewed and the following steps undertaken:
    a. Where possible, multi-species catch categories were expanded using the relevant CAAB codes (*e.g.* blacktip shark CAAB code 37 018903 includes *Carcharhinus limbatus* and *C. tilstoni*). All additions took into consideration the operating area of the fishery and the potential for the species to interact with the fishery. In some instances, this required the re-inclusion of species that fell below the initial 95% cut-off.
    b. Duplications resulting from expansion of multi-species catch categories were then removed.
    c. Catch categories that could not be refined to species level such as '*Unspecified fish'* were excluded from the analysis.
    d. Species managed under Total Allowable Commercial Catch (TACC) limits that are directly linked to biomass estimates or managed under harvest strategies were removed. The premise being that the risk posed to this species is currently addressed through management controls. As a precautionary measure, any species whose TACC was not based on a stock assessment or had a stock assessment >5 years old was retained in the assessment.
5. A summary of the species rationalisation process was then completed and justifications provided for why each a target or byproduct species was included or omitted from the analysis.

2. Summary Tables

- *Table A1—Summary of the target & byproduct species that were considered for inclusion in the Ocean Beach Fishery Level 2 ERA.*
- *Table A2—Detailed overview of the key consideration and justifications used as part of the Target & Byproduct Species Rationalisation Process.*

***Table A1**—Summary of the target & byproduct species that were considered for inclusion in the Ocean Beach Fishery Level 2 ERA.*

All species with light green squares and a 'Y' were included in the Level 2 ERA. Pink squares with an 'N' are those that were considered for inclusion but omitted from the analysis. '*' Denotes species that were included or omitted in response to advice provided by key stakeholders and members of the scientific community.

Common name	Scientific name	CAAB	Included
Mullet			
Sea mullet	*Mugil cephalus*	37 381002	**Y**
Fantail (silver) mullet	*Paramugil georgii*	37 381009	**Y**
Goldspot (tiger/flat tail) mullet	*Liza argentea*	37 381004	**Y**
Diamondscale mullet	*Liza vaigiensis*	37 381008	**Y**
Bluespot (sand) mullet	*Valamugil seheli*	37 381017	**Y**
Pinkeye mullet	*Trachystoma petardi*	37 381011	**N**
Tailor			
Tailor	*Pomatomus saltatrix*	37 334002	**N**
Whiting			
Sand (summer) whiting	*Sillago ciliata*	37 330010	**Y**
Trumpeter (winter) whiting	*Sillago maculata*	37 330015	**Y**
Northern whiting	*Sillago sihama*	37 330006	**N**
Goldenline whiting	*Sillago analis*	37 330003	**N**
Dart			
Snubnose dart	*Trachinotus blochii*	37 337075	**Y**
Swallowtail dart	*Trachinotus coppingeri*	37 337076	**Y**
Bream			
Yellowfin bream	*Acanthopagrus australis*	37 353004	**Y**
Tarwhine	*Rhabdosargus sarba*	37 353013	**Y**
Luderick	*Girella tricuspidata*	37 361007	**N**
Bony bream	*Nematalosa erebi*	37 085019	**N**
Pikey bream	*Acanthopagrus pacificus*	37 353011	**N**
Diamondfish / Butter bream	*Monodactylus argenteus*	37 356002	**N**
Garfish			
Snubnose garfish	*Arrhamphus sclerolepis*	37 234006	**N**
Three-by-two garfish	*Hemiramphus robustus*	37 234013	**N**
Trevally			
Golden trevally	*Gnathanodon speciosus*	37 337012	**N**
Giant trevally	*Caranx ignobilis*	37 337027	**N**
Bigeye trevally	*Caranx sexfasciatus*	37 337039	**N**
Turrum (gold spot)	*Carangoides fulvoguttatus*	37 337037	**N**
Thicklip trevally	*Carangoides orthogrammus*	37 337057	**N**
Blue spot trevally	*Caranx bucculentus*	37 337016	**N**
Diamond trevally	*Alectis indica*	37 337038	**N**
Silver trevally	*Pseudocaranx georgianus*	37 337062	**N**

Common name	Scientific name	CAAB	Included
Other			
Scribbled rabbitfish (spinefoot)	*Siganus spinus*	37 438013	**N**
Silver biddies	*Family Gerreidae*	37 349000	**N**
Hardyhead	Atherinidae/Dentatherinidae	37 246000	**N**

***Table A2**—Detailed overview of the key consideration and justifications used as part of the Target & Byproduct Species Rationalisation Process. *Codes for Australian Aquatic Biota* (http://www.marine.csiro.au/data/caab/)*

Common name / Catch category	***Scientific name (CAAB)****	***Include***	**Notes, comments & catch data**
Mullet			
Sea mullet	*Mugil cephalus* (37 381002)	**Y**	***Notes*—**Since 2000, almost all of the mullet catch (~97%) has been reported as *unspecified*. The poor resolution of this data limits the scope of any species-specific assessments and introduces a high degree of uncertainty surrounding catch compositions. However, the vast majority of the catch retained in the Ocean Beach Fishery and across the wider ECIF will be sea mullet (*M. cephalus*) (*pers. comm.* T. Ham; Leigh *et al.*, 2017). In addition to sea mullet, the Ocean Beach Fishery will interact with at least five other mullet species: fantail (silver) (*P. georgii*), goldspot (tiger/flattail) (*L. argentea*), diamondscale (*L. vaigiensis*), bluespot (sand) (*V. seheli*) and pinkeye (*T. petardi*) mullet (Department of Agriculture and Fisheries, 2019a). While all five have species-specific catch data, this information is limited and provides an incomplete picture of the individual rates of fishing mortality. This is because all five species will contribute to the portion of catch reported as *unspecified* (Table 1). Catch of all five species though are expected to be much smaller when compared to sea mullet. Historical catch records suggest that, outside of sea mullet, the fantail and diamond scale mullet are the two main species caught. Catch data for the Ocean Beach Fishery and the broader ERA show that both of these have low but consistent catches across the ECIF (Department of Agriculture and Fisheries, 2019a) and within the Ocean Beach Fishery. In terms of the Level 2 ERA, the inclusion of the sea mullet, fantail mullet, goldspot (tiger/flat tail) mullet, and diamondscale mullet should adequately cover the majority of the ocean beach catch.
Fantail (silver) mullet	*Paramugil georgii* (37 381009)	**Y**	
Goldspot (tiger/flat tail) mullet	*Liza argentea* (37 381004)	**Y**	
Diamondscale mullet	*Liza vaigiensis* (37 381008)	**Y**	
Bluespot mullet / Sand mullet	*Valamugil seheli* *(also known as Moolgarda seheli)* (37 381017)	**Y**	

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td>Pinkeye mullet</td><td>Trachystoma petardi
(37 381011)</td><td>N</td><td>When and where appropriate the remaining species will be considered for inclusion in subsequent ERAs involving this sector of the ECIF.
Summary of the mullet catch categories (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table>
<tr><th rowspan="2">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr>
<tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr>
<tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr>
<tr><td>Diamond scale</td><td>72t (0.2%)</td><td>4t</td><td>3t</td><td>8t (0.1%)</td><td><1t</td><td><1t</td></tr>
<tr><td>Fantail/silver</td><td>104t (0.3%)</td><td>5t</td><td>3t</td><td>23t (0.1%)</td><td>1t</td><td><1t</td></tr>
<tr><td>Pink eye</td><td>27t (0.1%)</td><td>2t</td><td>10t</td><td>0t (<0.1%)</td><td><1t</td><td>N/A</td></tr>
<tr><td>Sand (blue-tailed)</td><td>13t (>0.1%)</td><td>1t</td><td>0t</td><td>0t (<0.1%)</td><td><1t</td><td>N/A</td></tr>
<tr><td>Sea/flathead</td><td>836t (2.3%)</td><td>42t</td><td>51t</td><td>618t (3.7%)</td><td>36t</td><td>49t</td></tr>
<tr><td>Tiger / flat tail</td><td>36t (0.1%)</td><td>2t</td><td>0t</td><td>3t (<0.1%)</td><td><1t</td><td><1t</td></tr>
<tr><td>Unspecified</td><td>35483t (97%)</td><td>1774t</td><td>1249t</td><td>16255t (96.1%)</td><td>813t</td><td>732t</td></tr>
<tr><td>Total</td><td>36572t</td><td>1829t</td><td>1314t</td><td>16908t</td><td>845t</td><td>783t</td></tr>
</table></td></tr>
<tr><td colspan="4">Tailor</td></tr>
<tr><td>Tailor</td><td>Pomatomus saltatrix
(37 334002)</td><td>N</td><td><u>Notes</u>—Tailor (P. saltatrix) has the second highest levels of catch and it is considered to be a key target species. Tailor attracts a significant level of attention from both the commercial and recreational fishing sectors. On the Australian east coast, tailor is a shared stock and it is readily exploited by fishers in Queensland, New South Wales, and Victoria (Leigh et al., 2017; Litherland et al., 2018). The structure and health of the east coast tailor stock is well understood, and the species has been included in a long-term monitoring program that gathers information on size and age classes.</td></tr>
</table>

Common name / Catch category	*Scientific name (CAAB)**	*Include*	**Notes, comments & catch data**
			A tailor stock assessment was completed in 2017 (Leigh *et al.*, 2017) with the results indicating that biomass levels were at or around 50% of an unfished population. The stock assessment also estimated the maximum sustainable yield to be 1350t across all fishing sectors *i.e.* commercial and recreational fishing in both Queensland and New South Wales (Leigh *et al.*, 2017). This compares with current estimates that place the combined New South Wales / Queensland catch at less than 400t: commercial fisheries = ~185 t, recreational fisheries = ~182t. These facts form the basis for the species being assigned a positive stock status evaluation as part of the national *Status of Australian Fish Stocks* process (Litherland *et al.*, 2018). In Queensland the commercial take of Tailor is managed under a 120t TACC limit. This limit was introduced in 2002 and the fishery currently utilises about half of the available quota. The majority of this catch is reported from the Ocean Beach Fishery and by operators using large mesh nets (*e.g.* gillnets and ringnets). While tailor are not harvested or managed as a single-species fishery (*e.g.* like Spanish mackerel), there are broader restrictions on the number of licences that can access the fishery and the use of seine nets in the Ocean Beach Fishery. In the recreational sector, fishers are restricted by an in-possession limit of 20 tailor and the sector has a minimum legal size limit of 35cm (Department of Agriculture and Fisheries, 2018c). As research indicates that males and females have a length at 50% maturity (L_{50}) of 29cm TL and 31cm TL respectively, these measures help ensure that a high percentage of the recreationally caught fish reproduce at least once before they are harvested. There is substantial protections in place to prevent catch increasing beyond key biomass reference points and the take of the species across sectors is being managed effectively. Similarly, there is considerable information on the health of the east coast tailor stock a long-term monitoring program will help to detect broader catch trends. Given the above considerations, tailor was excluded from Ocean Beach Fishery Level 2 ERA as the risk posed to this species is being effectively managed through the current harvest strategy. ***Catch data summary***

Common name / Catch category	*Scientific name (CAAB)**	*Include*	**Notes, comments & catch data**
			Ocean Beach Fishery (only) - Catch reported as tailor (2000–2019): average 53.2t (range 17.1–157.1t). Catch 2017–2019 (inclusive) = 104.7t at average of 34.9t. - Unspecified**:** N/A *Net fishing (all)* - Tailor, total reported net catch: average 101.2t (range 36.8–248.5t). Catch 2017–2019 (inclusive) = 161.6t total at an average of 53.9t. - Unspecified (Net): N/A. ***Note*—**Highest catches occurred prior to the introduction of quota of a 120t TACC limit in 2002. Catch in the pre-quota period (1988 to ~2001 inclusive) averaged 151.6t.
Whiting			
Sand (summer) whiting	*Sillago ciliata* (37 330010)	**Y**	***Notes*—**Both sand (summer) whiting (*S. ciliata*) and trumpeter whiting (*S. maculata*) are an important component of the ECIF and are retained in a number of the sub-fisheries. The resolution of the species data for whiting though has declined to a point where almost all the catch is reported as *'Whiting—unspecified*' (refer to table below). This is primarily due to a) net fishing having a lower degree of selectivity, and b) the likelihood that multiple whiting species will be caught during a single fishing event. Whiting species constitute a small but consistent portion of the catch reported from the Ocean Beach Fishery (around 40t). This catch, as with the wider ECIF, is reported as part of a broader catch category with minimal amounts recorded at the species level. Historical catch data from the ECIF suggests that the majority of this catch will consist of sand whiting and trumpeter whiting. This was reflected in a recent stock assessment where
Trumpeter (winter) whiting	*Sillago maculata* (37 330015)	**Y**	

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td></td><td></td><td></td><td>sand whiting was used as the primary species (Leigh et al., 2019). Due to these considerations, both sand and trumpeter whiting were included in the analysis.
Summary of the whiting catch categories (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table><tr><th rowspan="3">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr><tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr><tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr><tr><td>Whiting—summer</td><td>94t (2%)</td><td>5t</td><td>0</td><td>8t (1%)</td><td><1t</td><td>0</td></tr><tr><td>Whiting—trumpeter</td><td>11t (>1%)</td><td>1t</td><td><1t</td><td>4t (<1%)</td><td><1t</td><td>0</td></tr><tr><td>Whiting—unspecified</td><td>5328t (98%)</td><td>266t</td><td>165t</td><td>855t (99%)</td><td>43t</td><td>40t</td></tr><tr><td>Whole-of-fishery</td><td>5433t</td><td>272t</td><td>165t</td><td>867t</td><td>43t</td><td>40t</td></tr></table></td></tr>
<tr><td>Northern whiting</td><td>Sillago sihama
(37 330006)</td><td>N</td><td rowspan="2"><u>Notes</u>— Both the northern whiting (S. sihama) and goldenline whiting (S. analis) were considered for inclusion in the Ocean Beach Fishery Level 2 ERA as they would more than likely contribute to the ‘Whiting—unspecified’ catch. Distributional data suggests that both species will interact with the ECIF (Bray, 2017; 2019b) and are more likely retained in smaller quantities.
Catch data for the Ocean Beach Fishery does not include either the northern whiting or goldenline whiting, however both are likely to be retained in small quantities (pers. comm. T. Ham). When compared to summer (S. ciliata) and trumpeter whiting (S. maculata), catch for these two species will be lower. Accordingly, northern and goldenline whiting were considered to be secondary target species and omitted from the analysis. Depending on the information available, the two species may be considered for inclusion in subsequent ERA examining the risk posed to target and byproduct species in other sectors.</td></tr>
<tr><td>Goldenline whiting</td><td>Sillago analis
(37 330003)</td><td>N</td></tr>
<tr><td colspan="4">Dart</td></tr>
</table>

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td>Snubnose dart</td><td>Trachinotus blochii
(37 337075)</td><td>Y</td><td rowspan="2"><u>Notes</u>—The catch data and situation for dart is similar to that observed for whiting and trevally. The majority of the catch is reported as unspecified with the snub-nosed dart (T. blochii) dominating the species-specific catch data. This data also shows that the retained dart catch data can fluctuate with the last 10 years reporting annual harvests of between 9 and 23t. While dart is not viewed as a key target species, the combined catch is sufficient to consider it a secondary target species. In line with this assessment, both species were included in the Level 2 ERA. As the majority of the catch is likely to be snubnose dart, the decision to include the swallowtail dart (T. coppingeri) was considered precautionary.
Summary of the dart catch categories (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table><tr><th rowspan="2">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr><tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr><tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr><tr><td>Dart—snub nosed</td><td>48t (8%)</td><td>2t</td><td>2t</td><td>12t (3%)</td><td><1t</td><td><1t</td></tr><tr><td>Dart—swallow tailed</td><td>1t (<1%)</td><td><1t</td><td><1t</td><td>1t (<1%)</td><td><1t</td><td><1t</td></tr><tr><td>Dart—unspecified</td><td>526t (91%)</td><td>26t</td><td>22t</td><td>385t (97%)</td><td>19t</td><td>19t</td></tr><tr><td>Whole-of-fishery</td><td>575t</td><td>29t</td><td>24t</td><td>397t</td><td>20t</td><td>20t</td></tr></table></td></tr>
<tr><td>Swallowtail dart</td><td>Trachinotus coppingeri
(37 337076)</td><td>Y</td></tr>
<tr><td colspan="4">Bream</td></tr>
<tr><td>Yellowfin bream</td><td>Acanthopagrus australis
(37 353004)</td><td>Y</td><td><u>Notes</u>—As the majority of the bream catch (84%) is reported as unspecified, a wide range of species were considered for inclusion in the Level 2 ERA. As with whiting, the catch is expected to be dominated by one or two key species. Of these, yellowfin bream (A. australis) are more likely to be retained in this sector of the ECIF. As the morphologically similar Tarwhine (R. sarba) is often caught with yellowfin bream (pers. comm. T. Ham) it was also included in the assessment as a precautionary measure.</td></tr>
</table>

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td>Tarwhine</td><td>Rhabdosargus sarba
(37 353013)</td><td>Y</td><td rowspan="5">It is recognised that the Ocean Beach Fishery will interact with and retain other species of bream including back bream (luderick) and butter bream. Given the size of the fishery, the key species being targeted and annual bream retention rates, the Ocean Beach Fishery is not expected to make a significant contribution to the cumulative risks posed to these species. When and where appropriate, further consideration will be given to including these species in subsequent Ocean Beach Fishery ERAs and in assessments involving other sectors of the ECIF.
Summary of the bream catch categories (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table><tr><th rowspan="3">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr><tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr><tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr><tr><td>Bream—black (luderick)</td><td>253t (7%)</td><td>13t</td><td>4t</td><td>17t (5%)</td><td>1t</td><td><1t</td></tr><tr><td>Bream—bony (herring)</td><td>216t (6%)</td><td>11t</td><td>8t</td><td>2t (1%)</td><td><1t</td><td>0t</td></tr><tr><td>Bream—butter</td><td>55t (1%)</td><td>3t</td><td>7t</td><td>15t (4%)</td><td>1t</td><td>1t</td></tr><tr><td>Bream—tarwhine</td><td>75t (2%)</td><td>4t</td><td>5t</td><td>16t (4%)</td><td>1t</td><td><1t</td></tr><tr><td>Bream—unspecified</td><td>3038t (82%)</td><td>152t</td><td>71t</td><td>314t (84%)</td><td>16t</td><td>9t</td></tr><tr><td>Bream—yellowfinned</td><td>64t (2%)</td><td>3t</td><td><1t</td><td>8t (2%)</td><td><1t</td><td><1t</td></tr><tr><td>Butterflybream—unspecified</td><td>>1t (>1%)</td><td><1t</td><td>0t</td><td>0t (N/A)</td><td>0t</td><td>0t</td></tr><tr><td>Whole-of-fishery</td><td>3702t</td><td>185t</td><td>95t</td><td>373t</td><td>19t</td><td>11t</td></tr></table></td></tr>
<tr><td>Luderick</td><td>Girella tricuspidata
(37 361007)</td><td>N</td></tr>
<tr><td>Bony bream</td><td>Nematalosa erebi
(37 085019)</td><td>N</td></tr>
<tr><td>Pikey bream</td><td>Acanthopagrus pacificus
(37 353011)</td><td>N</td></tr>
<tr><td>Diamondfish / Butter bream</td><td>Monodactylus argenteus
(37 356002)</td><td>N</td></tr>
<tr><td colspan="4">Garfish</td></tr>
<tr><td>Snubnose garfish</td><td>Arrhamphus sclerolepis
(37 234006)</td><td>N</td><td><u>Notes</u>—As noted, the ocean beach catch is dominated by mullet which registered annual average catches (2017–19) of around 850t. The majority of the remaining catch consists of tailor, whiting and dart which have</td></tr>
</table>

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td>Three-by-two garfish</td><td>Hemiramphus robustus
(37 234013)</td><td>N</td><td>
annual average harvests (2017–19 average) of 20–35t. Catch for the remaining categories drops considerably with garfish and silver biddies the only other complexes with annual catches greater than 10t.

The reported garfish catch of in the ECIF has dropped with the fishery averaging around 100t during the 2017–2019 period compared with the long-term average of 151t (Department of Agriculture and Fisheries, 2019a; 2020a). Of this catch only a small proportion is reported from the Ocean Beach Fishery (2000–2019 average: 16t; 2017–2019 average: 12t). This catch for the most part is reported with generic identifiers with the majority classified as unspecified. Only the snubnose garfish has species-specific data; albeit limited.

Garfish are harvested with more regularity in other sectors of the ECIF with annual gillnet / ring net catches frequently exceeding 100t. In the Ocean Beach Fishery, garfish are considered to be a secondary species that is taken opportunistically when targeting mullet or tailor and, to a lesser extent, whiting and dart. For these reasons, the decision was made to exclude garfish from the first iteration of the Ocean Beach Fishery Level 2 ERA. The framework of the assessment though is flexible enough to include these species at a later date if, for example, concerns are raised surrounding the long-term sustainability of these stocks on the Queensland east coast.

Note—Garfish have been included in the Large Mesh Net (gillnets & ringnets) Level 2 ERA. The majority of the garfish catch is reported from this sector of the ECIF.
Summary of the garfish catch (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table>
<tr><th rowspan="2">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr>
<tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr>
<tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr>
<tr><td>Garfish—snub nosed</td><td>3t (<1%)</td><td><1t</td><td>0t</td><td>>1t (>1%)</td><td><1t</td><td>0</td></tr>
<tr><td>Garfish—unspecified</td><td>3026t (100%)</td><td>151t</td><td>100t</td><td>329t (100%)</td><td>16t</td><td>12t</td></tr>
<tr><td>Whole-of-fishery</td><td>3029t</td><td>151t</td><td>100t</td><td>329t (100%)</td><td>16t</td><td>12t</td></tr>
</table>
</td></tr>
</table>

Common name / Catch category	*Scientific name (CAAB)**	*Include*	Notes, comments & catch data
Trevally			
Golden trevally	*Gnathanodon speciosus* (37 337012)	**N**	***Notes*—**As with garfish, trevally are considered to be secondary species and make a comparatively small contribution (~13t) to the annual ocean beach catch. For the most part, these species will be retained opportunistically by licence holders when they are targeting mullet or tailor. Defining the scope and extent of the trevally component within this ERA is difficult as the catch data has poor species resolution. This is largely due to the fact that a) multiple trevally species may be caught in a single event, and b) it can be difficult to differentiate between similar looking species. As a consequence, the majority of catch for this complex is reported as *unspecified* with only a few key species recording smaller individual catches. At a whole-of-fishery level, around 83% of the reported trevally catch is reported under this category. This number is slightly higher (88%) for the Ocean Beach Fishery (see below). While it is difficult to quantify catch compositions for the trevally complex, anecdotal evidence suggests that the majority of the catch will consist of golden trevally (*G. speciosus*), silver trevally (*P. georgianus*), giant trevally (*C. ignobilis*) and turrum or goldspot (*C. fulvoguttatus*) (*pers. comm.* M. Keag). This inference is partly supported by data submitted through the logbook program for each of the respective species. Based on the available data, the Ocean Beach Fishery would be a contributor of risk for these species. Given the current catch rates and fishing method utilised, this risk is expected to be relatively low. For this reason, the trevally subgroup was excluded from the first iteration of the Ocean Beach Fishery Level 2 ERA. Consideration will be given to including these species in subsequent ERAs if circumstances change and/or the broader fishing environment starts to affect the long-term sustainability of these stocks. *Note—A number of the trevally species have been included in other ECIF ERAs including for the Large Mesh Net Fishery (gillnets & ring nets) which reports the majority of the catch.*
Giant trevally	*Caranx ignobilis* (37 337027)	**N**	
Bigeye trevally	*Caranx sexfasciatus* (37 337039)	**N**	
Turrum (gold spot) **(referred to as *Trevally—gold spot* in catch data)**	*Carangoides fulvoguttatus* (37 337037)	**N**	
Thicklip trevally	*Carangoides orthogrammus* (37 337057)	**N**	

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td>Bludger trevally</td><td>Carangoides gymnostethus
(37 337022)</td><td>N</td><td rowspan="4">Summary of the trevally catch categories (t) from 2000 to 2019 (inclusive) at the whole-of-fishery level and for the Ocean Beach Fishery.

<table><tr><th rowspan="3">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr><tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr><tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr><tr><td>Trevally—unspecified</td><td>922t (83%)</td><td>46t</td><td>58t</td><td>277t (88%)</td><td>31t</td><td>10t</td></tr><tr><td>Trevally—golden</td><td>146t (13%)</td><td>7t</td><td>7t</td><td>29t (9%)</td><td>5t</td><td>3t</td></tr><tr><td>Trevally—silver</td><td>14t (1%)</td><td>1t</td><td>1t</td><td>5t (2%)</td><td>1t</td><td><1t</td></tr><tr><td>Trevally—giant</td><td>17t (2%)</td><td>1t</td><td><1t</td><td>2t (1%)</td><td>1t</td><td>0t</td></tr><tr><td>Trevally—gold spot</td><td>7t (1%)</td><td><1t</td><td><1t</td><td>3t (1%)</td><td>3t</td><td><1t</td></tr><tr><td>Trevally—big eye</td><td>2t (>1%)</td><td><1t</td><td><1t</td><td><1t (>1%)</td><td><1t</td><td>0t</td></tr><tr><td>Trevally—thicklip</td><td>1t (>1%)</td><td><1t</td><td><1t</td><td><1t (<1%)</td><td><1t</td><td><1t</td></tr><tr><td>Trevally—blue spot</td><td>3t (>1%)</td><td><1t</td><td><1t</td><td><1t (<1%)</td><td>0t</td><td>0t</td></tr><tr><td>Trevally—diamond</td><td>2t (>1%)</td><td><1t</td><td><1t</td><td><1t (<1%)</td><td><1t</td><td>0t</td></tr><tr><td>Trevally—bludger</td><td>2t (>1%)</td><td><1t</td><td><1t</td><td><1t (<1%)</td><td>0t</td><td>0t</td></tr><tr><td>Whole-of-fishery</td><td>1116t</td><td>56t</td><td>67t</td><td>317t</td><td>32t</td><td>13t</td></tr></table></td></tr>
<tr><td>Blue spot trevally</td><td>Caranx bucculentus
(37 337016)</td><td>N</td></tr>
<tr><td>Diamond trevally</td><td>Alectis indica
(37 337038)</td><td>N</td></tr>
<tr><td>Silver trevally</td><td>Pseudocaranx georgianus
(37 337062)</td><td>N</td></tr>
<tr><td colspan="4">Other</td></tr>
<tr><td>Scribbled rabbitfish (spinefoot / happy moments)</td><td>Siganus spinus
(37 438013)</td><td>N</td><td><u>Notes</u>—The scribbled rabbitfish (aka spinefoot or happy moments) is another species with low but consistent levels of catch in the Ocean Beach Fishery. As with trevally and garfish, the species is reported with more frequency in large mesh net (gillnet & ring net) and tunnel net operations.

At a whole-of-fishery level, annual catches for this species has declined through time with the entire ECIF reporting an average annual catch of 75t during the 2000–2009 (inclusive) period compared with 34.9t during the 2010–2019 (inclusive) period (Department of Agriculture and Fisheries, 2019a; 2020a). Around 10% of the total scribbled rabbit fish catch reported from the ECIF since 2000 has come from the Ocean Beach Fishery.</td></tr>
</table>

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td></td><td></td><td></td><td>
The fishery though reports comparatively small quantities over a 12 month period and it is not considered to be a key target species.

As the Ocean Beach Fishery has comparatively low retention rates, it is unlikely that this sector of the ECIF will be a key driver of risk for this species. Given the current fishing dynamics including catch rates, the species was excluded from the initial Ocean Beach Fishery Level 2 ERA. Further consideration will be given to including the species in subsequent ERAs if the current fishing environment changes considerably and/or clear conservation concerns are raised about the long-term sustainability of the Queensland east coast stocks.

Note—This species will be considered for inclusion in a number of other risk assessments including the ECIF Large Mesh Net (gillnet and ring net) Level 2 ERA and the Tunnel Net Level 2 ERA.

Summary of the scribbled rabbitfish / spinefoot catch (t) from 2000 to 2019 (inclusive) reported at the whole-of-fishery level and for the Ocean Beach Fishery.
<table>
<tr><th rowspan="3">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr>
<tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr>
<tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr>
<tr><td>Spinefoot</td><td>1094t (99%)</td><td>55t</td><td>31t</td><td>106t (99%)</td><td>5t</td><td>8t</td></tr>
<tr><td>Spinefoot—black</td><td>6t (<1%)</td><td><1t</td><td><1t</td><td>1t (<1%)</td><td><1t</td><td>0</td></tr>
<tr><td>Whole-of-fishery</td><td>1100t</td><td>55t</td><td>31t</td><td>107t</td><td>5t</td><td>8t</td></tr>
</table>
</td></tr>
<tr><td>Silver biddies</td><td>Family Gerreidae
(37 349000)</td><td>N</td><td rowspan="2"><u>Notes</u>—Both silver biddies (Family Gerreidae) and hardyheads (Family Atherindae, Family Dentatherinidae) were considered for inclusion in the Level 2 ERA as they fell within the 95% catch threshold. The risk posed to these species by the Ocean Beach Fishery would be relatively low. The two are highly fecund species complexes and they are in a good position to absorb fishing mortalities incurred in the Ocean Beach Fishery. Given their comparatively small size, the selectivity of the nets would also be lower for these groups. Similarly, the groups would have lower marketability when compared to other species included in the assessment.</td></tr>
<tr><td>Hardyheads</td><td>Family Atherinidae</td><td>N</td></tr>
</table>

<table>
<tr><th>Common name / Catch category</th><th>Scientific name (CAAB)*</th><th>Include</th><th>Notes, comments & catch data</th></tr>
<tr><td></td><td>Family Dentatherinidae
(37 246000)</td><td></td><td>Due to their size, these species are reported in broader catch categories. This is often done out of necessity due to the species occurring in high abundance. These species though will share similarities in terms of the biology and reproductive outputs e.g. highly fecund species, relatively rapid growth, and early onset of sexual maturity. These characteristics increase the rebound potential of both groups and they are unlikely to be at significant risk from the Ocean Beach Fishery.
Summary of the catch (t) data for silver biddies and hardyheads at the whole-of-fishery level and for the Ocean Beach Fishery.
<table>
<tr><th rowspan="2">Species</th><th colspan="3">Entire ECIF</th><th colspan="3">Ocean Beach (only)</th></tr>
<tr><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th><th rowspan="2">Total (2000–19)</th><th colspan="2">Average</th></tr>
<tr><th>2000–19</th><th>2017–19</th><th>2000–19</th><th>2017–19</th></tr>
<tr><td>Silver biddies</td><td>309t</td><td>15t</td><td>17t</td><td>145t</td><td>7t</td><td>11t</td></tr>
<tr><td>Hardyheads</td><td>200t</td><td>10t</td><td>9t</td><td>168t</td><td>8t</td><td>9t</td></tr>
</table></td></tr>
</table>

Appendix B—Species of Conservation Concern Species Rationalisation Process.

1. Overview

In Queensland the list of *Species of Conservation Interest* was used as the foundation of the *Species of Conservation Concern* Level 2 ERA. *Species of Conservation Interest* or SOCI refers specifically to a limited number of non-target species that are subject to mandatory commercial reporting requirements. The original SOCI list was expanded though a review of Commonwealth and State legislation and international conventions that have the potential to influence fishing activities in Queensland. Key instruments that were reviewed as part of this process included:

- *Fisheries Act 1994* and the subordinate legislation (Qld)*;*
- *Nature Conservation Act 1992* and the subordinate legislation (Qld);
- *Marine Parks (Moreton Bay) Zoning Plan 2008* (Qld);
- *Marine Parks (Great Sandy) Zoning Plan 2017* (Qld);
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth);
- *Great Barrier Reef Marine Park Regulations 1983* (Commonwealth);
- *Convention on the Conservation of Migratory Species of Wild Animals* (CMS) (International Convention); and
- *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) (International Convention).

The expanded or preliminary list SOCC was regionally specific and included species that have been listed on international conventions but are subject to national reservations (*e.g.* thresher shark, *Alopias* spp.). Species afforded additional protections under legislation governing the use of resources in state and commonwealth marine parks were also included in the preliminary list of SOCC. Once established, the preliminary SOCC list was refined and finalised using the following steps:

1. All SOCC subgroups that were not classified as medium/high or high risk in the whole-of-fishery (Level 1) ERA (Jacobsen *et al.*, 2019) were removed from the analysis.
2. The distribution of the remaining species were then compared with the prescribed area of fishing symbols used in the *East Coast Inshore Fishery* (ECIF).
3. Species with distributions that had no or low overlap with the fishery, had a low interaction potential or low likelihood of capture within the apparatus were removed. Any species where there was uncertainty surrounding its distribution and interaction potential were retained in the assessment and further advice sought from scientific experts / key stakeholders.
4. A summary of the species rationalisation process was then compiled (Table B1 and B2) and justifications provided as to why a species was included or omitted from the analysis.

Justifications for the inclusion or omission of species in the Level 2 ERA for the large mesh net fishery are provided in Appendix B3.

2. Summary Tables

- *Table B1—Summary of the species considered for inclusion in the Ocean Beach Fishery SOCC Level 2 ERA.*
- *Table B2—Summary of the species omitted from the analysis whose distribution has no or very low overlap with the ECIF and/or are highly unlikely to interact with the fishery.*
- *Table B3—Detailed overview of the key consideration and justifications used as part of the SOCC Species Rationalisation Process.*

Table B1—*Summary of the Species of Conservation Concern (SOCC) that were considered for inclusion in the in the SOCC Level 2 ERA for the Ocean Beach Fishery.*

All species with green squares and a 'Y' were included in the SOCC Level 2 ERA. Red squares with an 'N' are those that were considered for inclusion but omitted from the analysis. '*' Denotes species that were included or omitted in response to advice provided by key stakeholders and members of the scientific community.

Common name	***Species name***	***CAAB***	**Ocean Beach**
Marine Turtles			
Green Turtle	*Chelonia mydas*	39 020002	**Y**
Loggerhead Turtle	*Caretta caretta*	39 020001	**Y**
Hawksbill Turtle	*Eretmochelys imbricata*	39 020003	**Y**
Flatback Turtle	*Natator depressus*	39 020005	**N**
Olive Ridley Turtle	*Lepidochelys olivacea*	39 020004	**N**
Leatherback Turtle	*Dermochelys coriacea*	39 021001	**N**
Sirenia			
Dugong	*Dugong dugong*	41 206001	**N**
Dolphins (Odontocetes)			
Australian humpback dolphin	*Sousa sahulensis*	41 116014	**Y**
Australian snubfin dolphin	*Orcaella heinsohni*	41 116010	**N**
Common bottlenose dolphin (Synonym—Offshore or Atlantic bottlenose dolphin)	*Tursiops truncatus*	41 116019	**Y**
Indo-Pacific bottlenose dolphin (Synonyms—Indian, inshore or spotted bottlenose dolphin)	*Tursiops aduncus*	41 116020	**Y**
Common dolphin	*Delphinus delphis*	41 116001	**N**
Sharks			
Great hammerhead	*Sphyrna mokarran*	37 019002	**Y***
Scalloped hammerhead	*Sphyrna lewini*	37 019001	**Y***
Winghead shark	*Eusphyra blochii*	37 019003	**N**
Smooth hammerhead	*Sphyrna zygaena*	37 019004	**Y***
School shark	*Galeorhinus galeus*	37 017008	**N***
Batoids			

Common name	***Species name***	***CAAB***	**Ocean Beach**
Bottlenose wedgefish (synonym—whitespotted guitarfish)	*Rhynchobatus australiae*	37 026005	**Y**
Eyebrow wedgefish	*Rhynchobatus palpebratus*	37 026004	**N***
Giant Shovelnose Ray	*Glaucostegus typus*	37 027010	**Y**
Estuary stingray	*Hemitrygon fluviorum*	37 035008	**N**

Table B2—*Summary of the species omitted from the analysis whose distribution has no or very low overlap with the ECIF and/or are highly unlikely to interact with the Ocean Beach Fishery. *Denotes species that were included or omitted in response to advice provided by key stakeholders and members of the scientific community.*

Ecological Component & Species	
<u>*Sharks*</u>	<u>*Rays / Batoids cont.*</u>
Whale shark, *Rhincodon typus* (CAAB 37 014001)	Giant devil ray, *Mobula mobular* (CAAB 37 041002)
Great White shark, *Carcharodon carcharias* (CAAB 37 010003)	Bentfin devil ray, *Mobula thurstoni* (CAAB 37 041003)
Grey Nurse shark, *Carcharias taurus* (CAAB 37 008001)	Chilean devil ray, *Mobula tarapacana* (CAAB 37 041006)
Sandtider shark, *Odontaspis ferox* (CAAB 37 008003)	Maugean skate, *Zearaja maugeana* (CAAB 37 031037)
Northern River shark, *Glyphis garricki* (CAAB 37 018042)	Largetooth sawfish, *Pristis pristis* (CAAB 37 025003)
Speartooth shark, *Glyphis glyphis* (CAAB 37 018041)	Narrow sawfish, *Anoxypristis cuspidata* (CAAB 37 025002)
Porbeagle shark, *Lamna nasus* (CAAB 37 010004)	Green sawfish, *Pristis zijsron* (CAAB 37 025001)
Shortfin mako shark, *Isurus oxyrinchus* (CAAB 37 010001)	Dwarf sawfish, *Pristis clavata* (CAAB 37 025004)
Longfin mako shark, *Isurus paucus* (CAAB 37 01002	Kuhl's devil ray, *Mobula kuhlii* (CAAB 37 041001)
Oceanic whitetip shark, *Carcharhinus longimanus* (CAAB 37 018032)	<u>*Dolphins (Odontetes)*</u>
Pelagic thresher, *Alopias pelagicus* (CAAB 37 012003)	Dusky dolphin, *Lagenorhynchus obscurus* (CAAB 41 116008)
Bigeye thresher, *Alopias superciliosus* (CAAB 37 012002)	Spectacled porpoise, *Phocoena dioptrica* (CAAB 41 117001)
Thresher shark, *Alopias vulpunus* (CAAB 37 012001)	Commerson's dolphin. *Cephalorhynchus commersonii* (CAAB N/A)
Basking shark *Cetorhinus maximus* (CAAB 37 011001)	Hourglass dolphin, *Lagenorhynchus cruciger* (CAAB 41 116007)
Harrisson's dogfish, *Centrophorus harrissoni* (CAAB 37 020010)	Southern right whale, *Lissodelphis peronii* (CAAB 41 116009)
Southern dogfish, *Centrophorus zeehaani* (CAAB 37 020011)	Burrunan dolphin, *Tursiops australis* (CAAB 41 116022)
Spiny dogfish, *Squalus acanthias* (CAAB 37 020008)	Irrawadddy dolphin, *Orcaella brevirostris*, (CAAB N/A)
Crested hornshark, *Heterodonitidae galeatus* (CAAB 37 007003)	Indo-Pacific humpback dolphin, *Sousa chinensis* (CAAB N/A)
	Strap toothed whale, *Mesoplodon layardii* (CAAB 41 120009)
<u>*Rays / Batoids*</u>	Giant beaked whale (aka Arnoux's), *Berardius arnuxii* (CAAB 41 120001)
Giant manta ray, *Mobula birostris* (CAAB 37 041004)	Dwarf sperm whale, *Kogia sima* (CAAB 41 119 002)
Reef manta ray, *Mobula alfredi* (CAAB 37 041005)	Southern bottlenose whale, *Hyperoodon planifrons* (CAAB 41 120003)

Ecological Component & Species	
Dolphins (Odontetes) cont. Fraser's dolphin, *Lagenodelphis hosei* (CAAB 41 116006)* Striped dolphin, *Stenella coeruleoalba* (CAAB 41 116016) Spotted dolphin, *Stenella attemuata* (CAAB 41 116015)* Risso's dolphin, *Grampus griseus* (CAAB 41 116005) Spinner dolphin, *Stenella longirostris* (CAAB 41 116017) Rough toothed-dolphin, *Steno bredanensis* (CAAB 41 116018)* Melon headed whale, *Peponocephala electra* (CAAB 41 116012)* Short-finned pilot whale, *Globicephala macrorhynchus* (CAAB 41 116003)* Killer whale, *Orcinus orca* (CAAB 41 116011) Pygmy killer whale, *Feresa attenuata* (CAAB 41 116002) Pygmy sperm whale, *Kogia breviceps* (CAAB 41 119001) Long-finned pilot whale, *Globicephala melas* (CAAB 41 116004) False killer whale, *Pseudorca crassidens* (CAAB 41 116017) Spinner dolphin, *Stenella longirostris* (CAAB 41 116017) Tropical bottlenose whale (aka Longman's), *Indopacetus pacificus* (CAAB 41 120003)	*Dolphins (Odontetes) cont.* Andrew's beaked whale, *Mesoplodon bowdoini* (CAAB 41 120004) Blainvilles's beaked whale, *Mesoplodon densirostris* (CAAB 41 120005) Ginkgo-toothed beaked whale, *Mesoplodon ginkgodens* (CAAB 41 120006) Gray's beaked whale, *Mesoplodon grayi* (CAAB 41 120007) Hector's beaked whale, *Mesoplodon hectori* (CAAB 41 120008) True's beaked whale, *Mesoplodon mirus* (CAAB 41 120010) Shepard's beaked whale, *Tasmacetus shepherdi* (CAAB 41 120011) Curvier's beaked whale, *Ziphius cavirostris* (CAAB 41 120012) *Species of Conservation Concern Subgroups excluded during the Level 1 ERA analysis (Jacobsen et al., 2019)* - Whales - Sea snakes - Crocodiles - Protected teleosts - Syngnathids - Seabirds - Terrestrial mammals

***Table B3**—Detailed overview of the key consideration and justifications used as part of the SOCC Species Rationalisation Process.*

The following provides a detailed overview of the key justifications and considerations used to omit or include a species in the Ocean Beach Fishery SOCC Level 2 ERA. All species with green squares and a 'Y' were included in the SOCC Level 2 ERA. Red squares with an 'N' are those that have been omitted from the analysis. '*' Denotes species that were included or omitted in response to advice provided by key stakeholders and members of the scientific community.

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Sharks				
Whale shark	*Rhincodon typus*	37 014001	**N**	***Not Included—***Whale sharks have been reported from the Queensland east coast and the ECIF overlaps with their known distribution (Last & Stevens, 2009). However, there have been no reports of the species interacting with net or line fisheries operating on the Queensland east coast. Further, commercial fishing has not been identified as a key threat (direct or indirect) to this species in Queensland waters, including in third party assessments (*e.g.* WTO export approvals) and previous whale shark recovery plans. *Rhincodon typus* is sighted more frequently on the West Coast of Australia where there are known aggregation sites (Department of the Environment and Energy, 2005).
Great White shark	*Carcharodon carcharias*	37 010003	**N**	***Notes—***Encounters with C*. carcharias* are considered to be highly unlikely in the Ocean Beach Fishery given that the sector uses a more active method of fishing and has a relatively short shot, soak and retrieval timeframe. In the event that a *C. carcharias* were caught within the fetch of the net, there is a high probability that the animal will escape the net before it is caught.
Grey Nurse shark	*Carcharias taurus*	37 008001	**N**	***Not Included—***The distribution of *C. taurus* does not overlap with the Ocean Beach Fishery and is unlikely to interact with the nets given the area of operation, the species being targeted (*e.g.* mullet, tailor) and their behavioural patterns.
Speartooth shark	*Glyphis glyphis*	37 018041	**N**	***Not Included –***The distribution of *Glyphis glyphis* remains uncertain with research suggesting that speartooth sharks are extirpated from the majority (if not all) of the Queensland east coast (Compagno *et al.*, 2009; Last

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
				& Stevens, 2009; Peverell *et al.*, 2006). If *G. glyphis* had viable east coast populations, it would more likely occur in areas outside the areas prescribed for the Ocean Beach Fishery (Department of Agriculture and Fisheries, 2019a; Peverell *et al.*, 2006).
Northern river shark	*Glyphis garricki*	37 018042	**N**	***Not Included—***Distribution does not extend into Queensland managed waters with the species primarily found in north-west Australia (Last & Stevens, 2009). Accordingly, *G. garricki* was not included in the Level 2 ERA.
Porbeagle shark	*Lamna nasus*	37 010004	**N**	***Not Included—***Interactions with *L. nasus* considered to be unlikely in the ECIF. *Lamna nasus* prefers more temperate environments and the species is more likely to occur on the continental shelf (Last & Stevens, 2009). This species, if encountered, will most likely interact with Commonwealth managed fisheries *e.g.* the East Coast Tuna & Billfish Fishery.
Sandtiger shark	*Odontaspis ferox*	37 008003	**N**	***Not Included—***Although *O. ferox* is listed as a *Species of Conservation Interest*, it inhabits deeper water environments and is unlikely to interact with the ECIF (*pers. comm.* D. Bowden; Last & Stevens, 2009).
Shortfin mako shark	*Isurus oxyrinchus*	37 010001	**N**	***Not Included—***While *I. oxyrinchus* will be found in the prescribed area of the Ocean Beach Fishery, their capture or entanglement in the apparatus is considered highly unlikely.
Longfin mako shark	*Isurus paucus*	37 010002	**N**	***Not Included –****Isurus paucus* is not expected to interact with the ECIF with great regularity and is infrequently encountered in inshore and near shore environments.
Great hammerhead	*Sphyrna mokarran*	37 019002	**Y**	***Notes—***Included in the ERA. Inclusion of the species is considered to be precautionary as the Ocean Beach Fishery retains/reports smaller amounts of shark. From 2003 to 2017 the annual (collective) catch of hammerhead sharks reported from the Ocean Beach Fishery ranged from 0.3 to 7.5t with the last three years averaging around 0.7t. Given that the fishery operates in south east Queensland, it is anticipated that the

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
				majority of this catch is the scalloped hammerhead shark (*S. lewini*) and potentially the smooth hammerhead shark (*S. zygaena)*.
Scalloped hammerhead	*Sphyrna lewini*	37 019001	**Y**	***Notes—***Included in the ERA. Inclusion of the species is considered to be precautionary as the Ocean Beach Fishery retains/reports smaller amounts of shark. From 2003 to 2017 the annual (collective) catch of hammerhead sharks reported from the Ocean Beach Fishery ranged from 0.3 to 7.5t with the last three years averaging around 0.7t. Given that the fishery operates in south east Queensland, it is anticipated that the majority of this catch is the scalloped hammerhead shark (*S. lewini*) and potentially the smooth hammerhead shark (*S. zygaena)*.
Winghead shark	*Eusphyra blochii*	37 019003	**N**	***Not Included—***When compared to the scalloped (*S. lewini*), great (*S. mokarran*) and smooth (*S. zygaena*) hammerhead shark, datasets for the winghead shark (*Eusphyra blochii*) are more limited. Distributional data for the species though indicates that this species is found to the north of the Ocean Beach Fishery (Last & Stevens, 2009; Smart & Simpfendorfer, 2016).
Smooth hammerhead	*Sphyrna zygaena*	37 019004	**Y***	***Notes—***Distribution of the smooth hammerhead is largely confined to temperate waters (Last & Stevens, 2009) and the species is more likely to interact with fisheries in New South Wales. In Queensland, any interactions with the smooth hammerhead shark will be confined to waters in and around south east Queensland (Simpfendorfer, 2014). This suggests that the majority of the *S. zygaena* population/stock is found in waters outside of Queensland and that the ECIF, as-a-whole, poses a limited risk to this species. This inference is partially supported by a non-detriment finding where the key discussions involving Queensland revolved around the scalloped hammerhead (*S. lewini*) and the great hammerhead (*S. mokarran*). Both of these species are being assessed as part of the Level 2 ERA. Additional consultation on the scope and structure of the TEP Level 2 ERA recommended that the smooth hammerhead shark be included as they will probably interact with the ECIF in south east Queensland (*pes. comm.* C. Simpfendorfer). Based on this recommendation and the operational boundaries of the Ocean

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
				Beach Fishery, the smooth hammerhead shark was included in the Level 2 ERA. The decision to include the species in the assessment is considered to be precautionary.
Oceanic whitetip shark	*Carcharhinus longimanus*	37 018032	**N**	***Not Included—****Carcharhinus longimanus* is largely associated with oceanic environments (Department of the Environment and Energy, 2014; Last & Stevens, 2009) and interactions with the Ocean Beach Fishery are highly unlikely.
Pelagic thresher	*Alopias pelagicus*	37 012003	**N**	***Not Included—****Alopias pelagicus* is generally considered to be an offshore/pelagic species (Last & Stevens, 2009) and interactions with the Ocean Beach Fishery are highly unlikely.
Bigeye thresher	*Alopias superciliosus*	37 012002	**N**	***Not Included—***This species is associated more with pelagic environments / continental shelves (Amorim *et al.*, 2009) and interactions with the Ocean Beach Fishery are highly unlikely.
Thresher shark	*Alopias vulpinus*	37 012001	**N**	***Not Included—****Alopias vulpinus* has a wide/global distribution but is most abundant in waters up to 40 or 50 miles offshore (Goldman *et al.*, 2009). Interactions with the Ocean Beach Fishery are highly unlikely.
Basking shark	*Cetorhinus maximus*	37 011001	**N**	***Not Included—****Cetorhinus maximus* prefer more temperate coastal regions and are unlikely to frequent Queensland managed waters (Last & Stevens, 2009). Interactions with the species are highly unlikely in the ECIF and therefore it was not included in the Level 2 ERA.
Harrisson's dogfish	*Centrophorus harrissoni*	37 020010	**N**	***Not Included—***A deepwater demersal species found on continental and insular slopes in depths of 220-680m (Last & Stevens, 2009).
Southern dogfish	*Centrophorus zeehaani*	37 020011	**N**	***Not Included—***The distribution of *C. zeehaani* does not extend into Queensland waters and the species is primarily found on the upper continental slope in depths of 210-700m (Last & Stevens, 2009).

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
School shark	*Galeorhinus galeus*	37 017008	**N**	***Not included—***The distribution of *G. galeus* has limited overlap with the ECIF with the species reported as far north as Moreton Bay in south-east Queensland. Based on the available information the species prefers continental and insular shelves and inhabits water depths down to 600m (Last & Stevens, 2009). School sharks have been reported from the ECIF with around 83t reported from the fishery since 1993. The overwhelming majority of this catch (78t) was reported from the fishery before the introduction of the shark (S) fishery symbol with 2004 accounting for more than half of the total catch reported (Department of Agriculture and Fisheries, 2019a). The majority of this catch was reported by operators using anchored and drifting gillnets (Large Mesh Net Fishery). Since the introduction of the S fishery symbol, the reported catch for *G. galeus* has dropped with less than 2t reported from the ECIF since 2009. While noting these figures, DAF recognises that the species may still be caught in the fishery but discarded. As the Ocean Beach Fishery targets schools of tailor and mullet, the sector will make a negligible contribution to the amount of school shark that is retained on the Queensland east coast. As the selectivity of the sector for teleosts is higher, there is also less potential for school sharks to be caught in this sector of the fishery. In the event that school sharks are retained for sale by operators in the Ocean Beach Fishery, the numbers are not expected to have a significant or long-term impact on regional population. *Additional Consultation*—Additional consultation indicated that the Queensland presents the upper limits of the school shark distribution. Due to this reason, it is recommended the species be removed from the assessment as there is a lower probability of it being caught in the ECIF (*pes. comm.* C. Simpfendorfer). In the event that the species is caught in the Ocean Beach Fishery, the extent of these interactions are not expected to have a longer term impact on the conservation status of this species.
Spiny dogfish	*Squalus acanthias*	37 020008	**N**	***Not Included—***Species distribution covers southern waters and *S. acanthias* does not occur in waters managed by Queensland (Last & Stevens, 2009).

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Crested Hornshark	*Heterodontus galeatus*	37 007003	**N**	***Not Included—***The crested hornshark (*H. galeatus*) was included on the preliminary list as it is afforded additional protections in Moreton Bay under the *Marine Parks (Moreton Bay) Zoning Plan 2008*. The majority of this species distribution occurs outside of Queensland; although the species can be found as far north as Cape Moreton (Bray, 2019a; Kyne & Bennett, 2016; Last & Stevens, 2009). The species is commonly associated with rocky reef systems, among large macroalgae and on seagrass beds. The species is classified as '*Least Concern*' under the IUCN (Kyne & Bennett, 2016) and it is not afforded any additional protections in Fisheries legislation and/or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There is limited evidence to suggest that *H. galeatus* interacts with the Ocean Beach Fishery and/or that regional populations are experiencing significant levels of fishing mortality within this sector of the ECIF.
Batoids				
Manta Ray	*Mobula birostris* (synonym—*Manta birostris*)	37 041004	**N**	***Not Included—***While there have been some reports of manta rays and devilrays (*Family Mobulidae*) interacting with the ECIF (*n* = 19), all of these have all been reported from gillnet operations. Devil rays are mostly pelagic and have a diet that consists primarily of planktonic organisms (Last *et al.*, 2016). Data on the behaviour, habitat preferences and movements of devil rays is limited. However research on manta ray movements indicate that they are more common around shallow-reef environments (coral and rocky reefs), potentially moving to deeper and offshore waters at night (Couturier *et al.*, 2011; Couturier *et al.*, 2012). They are also less likely to be observed in the surf zones / beach zones fished by operators with a K1–K8 fishery symbol. The above considerations combined with seasonal constraints imposed on the fishery (1 April–31 August inclusive), the area of operation and the species being targeted (*i.e.* larger schools of mullet or tailor) suggest
Reef Manta Ray	*Mobula alfredi*	37 041005	**N**	
Kuhl's devil Ray	*Mobula kuhlii* (synonym—*Manta eregoodootenkee)*	37 041001	**N**	

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Giant devil ray (synonym Japanese devil ray)	*Mobula mobular* (synonym—*M. japanica*)	37 041002	**N**	devil ray interactions are unlikely in the Ocean Beach Fishery. It is also anticipated that any devil ray caught within the sweep of the net will survive the interaction. This inference is based on the fact that the Ocean Beach Fishery has comparatively short shot times and operators have greater capacity to differentiate between retainable and non-retainable product while the animals are alive Given these considerations, none of the devil rays were included in the ocean beach PSA.
Bentfin devil ray	*Mobula thurstoni*	37 041003	**N**	
Chilean devil ray	*Mobula tarapacana*	37 041006	**N**	***Not Included—***Species will not interact / unlikely to interact with this component of the ECIF.
Largetooth sawfish (*synonym*—Freshwater sawfish)	*Pristis pristis*	37 025003	**N**	***Not Included—***This subgroup of elasmobranchs have experienced notable population declines and their distribution has experienced a significant contraction (Last *et al.*, 2016). This includes in Queensland where there is a degree of uncertainty surrounding the extent of their distribution on the east coast (D'Anastasi *et al.*, 2013; Kyne *et al.*, 2013; *Simpfendorfer*, 2013). For at least three of these species *P. pristis*, *P. zijsron* and *P. clavata* their east coast distribution (if applicable) will be confined to areas north of the Ocean Beach Fishery. While the distribution of *A. cuspidata* extends further south, the southern extent of its range is unlikely to extend beyond central Queensland (ECIFFF Bycatch Management Workshop, Townsville, 14-15 May 2019; Last *et al.*, 2016) The Ocean Beach Fishery has regional management provisions in place with the 'K8' area representing the northern-most point of the fishery (Department of Agriculture and Fisheries, 2019a). The northern boundary for the K8 fishery symbol is situated around the Noosa Heads / Inskip point in south east Queensland. Given these constraints, it is unlikely that *A. cuspidata* will interact with the Ocean Beach Fishery and all four species were excluded from the PSA for this component of the ECIF. *Note*—One interaction between a sawfish and a ring net has been recorded through SOCI. Ring net fishing shares certain similarities with the Ocean Beach Fishery and provides further insight into the type of interactions that can occur in this fishery. The key difference being that ring net fishing also occurs north of
Narrow sawfish	*Anoxypristis cuspidata*	37 025002	**N**	
Green sawfish	*Pristis zijsron*	37 025001	**N**	
Dwarf sawfish	*Pristis clavata*	37 025004	**N**	

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
				the *K*-managed areas and in regions where a sawfish interaction may occur. Ring net interactions are taken into consideration as part of the large mesh net PSA.
Bottlenose wedgefish (synonym—whitespotted guitarfish)	*Rhynchobatus australiae*	37 026005	**Y**	***Notes—***Interaction rates with *R. australiae* are expected to be low given the nature of the apparatus and the broader dynamics of the fishery. However, there is some potential for the fishery to interact with *R. australiae* in shallow water environments; particularly when the drop of the net exceeds the water depth. The inclusion of this species is considered to be precautionary and further consideration will need to be given to the potential for data deficiencies to influence the final risk rating. **A taxonomic review of these species has resulted in a change to the nomenclature. These changes have yet to be reflected in the Fisheries Regulations 2008 which still refers to the Family Rhynchobatidae. The intent of the legislation though still provides Rhynchobatus species with additional protections.*
Eyebrow wedgefish	*Rhynchobatus palpebratus*	37 026004	**N***	***Not Included—***While the diet and morphology of *R. palpebratus* is similar to *R. australiae*, the species has a more northern distribution. The species is not expected to interact with the Ocean Beach Fishery in significant quantities and the risk posed to *R. palpebratus* by this sector will be lower when compared to *R. australiae*.
Giant Shovelnose Ray	*Glaucostegus typus*	37 027010	**Y**	***Notes—***Reasons behind the inclusion of *G. typus* in the Ocean Beach Fishery PSA largely reflect those outlined for *R. australiae*. The inclusion of this species in the PSA is once again considered to be precautionary.
Estuary stingray	*Hemitrygon fluviorum*	37 035008	**N**	***Notes –***The potential for ocean beach operators to catch *H. fluviorum* is largely reduced by the area of operation. As these areas have limited overlap with the preferred habitat of *H. fluviorum (Kyne et al., 2016; Last et al., 2016)*, interactions in this sector of the ECIF are considered to be unlikely.
Maugean skate	*Zearaja maugeana*	37 031037	**N**	***Not Included—***Species is endemic to Tasmania (Last *et al.*, 2016); therefore it was not included in the Level 2 ERA.

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Marine Turtles				
Green Turtle	*Chelonia mydas*	39 020002	**Y**	**Included—***Chelonia mydas*, *Caretta* and *Eretmochelys imbricata* in the Level 2 ERA. **Excluded—***Natator depressus*, *Lepidochelys olivacea* and *Dermochelys coriacea* from the analysis Six species of marine turtle occur in Queensland waters. The known range of all six species cover the majority of the Queensland east coast and could theoretically interact with ocean beach fishing operations. However, a closer inspection of the preferred habitat and bathymetry ranges suggests that the green turtle (*C. mydas*), the loggerhead turtle (*C. caretta*) and the hawksbill turtle (*E. imbricata*) are more likely to interact with this fishery (*pers. comm.* C. Limpus, J. Meager). Green, loggerhead and hawksbill turtles frequently occur in shallow water environments in the Queensland east coast including in Moreton Bay and Hervey Bay. In comparison, the olive ridley turtle (*L. olivacea*) and the leatherback turtle (*D. coriacea*) inhabit deeper, pelagic waters (Department of the Environment, 2019l; m). While flatback turtles inhabit shallower inshore waters, their distribution has less overlap with central and southern Queensland where ocean beach fishing occurs. A limited number of *Species of Conservation Interest* (SOCI) interactions have been attributed to haul netting in Queensland. In terms of this ecological component, all of these interactions were with green and loggerhead turtles. A similar situation was observed in the ring net fishery where the majority of interactions were with green turtles, loggerhead turtles and a smaller number of hawksbill turtles. The ring net fishery shares certain similarities with the Ocean Beach Fishery and provides further insight into the type of interactions that can occur in this fishery. Given the above considerations and the low probability of the fishery encountering the flatback, olive ridley or leatherback turtle, only the green, loggerhead and hawksbill turtle were included in the Ocean Beach Fishery Level 2 ERA.
Loggerhead Turtle	*Caretta caretta*	39 020001	**Y**	
Hawksbill Turtle	*Eretmochelys imbricata*	39 020003	**Y**	
Flatback Turtle	*Natator depressus*	39 020005	**N**	
Olive Ridley Turtle	*Lepidochelys olivacea*	39 020004	**N**	
Leatherback Turtle	*Dermochelys coriacea*	39 021001	**N**	

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Dolphins (Odontocetes)				
Australian humpback dolphin	*Sousa sahulensis*	41 116014	**Y**	***Note included—***Distribution data for *S. sahulensis* indicates that the species occurs as far south as the Queensland / New South Wales border (Parra *et al.*, 2017b). While net fishing has been identified as a threatening process for the species, these threats generally relate to inshore gillnets set across creeks, rivers and shallow estuaries. To date, no dolphin interactions have been reported in the Ocean Beach Fishery or by ring net operations on the Queensland east coast. There is limited information on the number of dolphins that are caught in beach seine nets, the ability of the animal to escape containment and the number of contact without capture events. While noting these deficiencies, it is anticipated that dolphins will interact infrequently with the Ocean Beach Fishery and in low numbers. This in part is due to the location of the fishery, the comparatively short shot times and the area affected by an individual shot. In the Ocean Beach Fishery, the risk of entanglement is further reduced through mesh size restrictions (12–70mm) and provisions that limit the use of a seine net to 1 April to 31 August (inclusive). When compared to traditional gillnets, seine nets also have shorter shot times and a negligible soak period (*pers. comm*. T. Ham). This in itself reduces the interaction potential and the likelihood of the species being caught in significant numbers. While noting the above restrictions, the ocean beach sector utilises a more active fishing method *i.e.* nets are towed around a school of fish and immediately hauled in. The active nature of the fishery does increase the risk of a dolphin being caught if it is encircled within the sweep of the net including if and when it is targeting the same school of fish. Due to this reason, these two species were included in the assessment. This decision is considered to be precautionary in nature. *Note—The Australian humpback dolphin (S. sahulensis) is a relatively new species, is not currently listed as protected and may be misidentified as the Indo-Pacific humpback (S. chinensis*). *Sousa chinensis is listed as*

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
				a migratory species under CMS and the EPBC Act. As a S. sahulensis is a relatively new species and was once thought to be conspecific with S. chinensis, the species will be covered by the intent of the legislation.
Australian snubfin dolphin	*Orcaella heinsohni*	41 116010	**N**	***Note included—***While the snubfin dolphin has been reported as far south as Moreton Bay in south-east Queensland, the species is more prevalent in waters north of Keppel Bay and records south of this point are considered rare and extralimital (Parra *et al.*, 2017a). Data on the known distribution of this species and their preferred habitats (Parra *et al.*, 2017a) suggest interactions with the Ocean Beach Fishery are unlikely.
Common bottlenose dolphin (Synonym—Offshore or Atlantic bottlenose dolphin)	*Tursiops truncatus*	41 116019	**Y**	***Notes—***The situation surrounding *Tursiops truncatus* and *T. aduncus* is similar to the Australian humpback dolphin (*S. sahulensis*) and a number of the above considerations will be applicable to these species. Both are common in south east Queensland and both have the potential to interact with the Ocean Beach Fishery; therefore were included in the PSA. *Note*—There is limited information on the number of dolphins that are caught in beach seine nets, the ability of the animal to escape containment and the number of contact without capture events. While noting these deficiencies, it is anticipated that dolphins will interact infrequently with the Ocean Beach Fishery and in low numbers. This in part is due to the location of the fishery, the comparatively short shot times and the area affected by an individual shot. The active nature of the fishery does increase the risk of a dolphin being caught if it is encircled within the sweep of the net including if and when it is targeting the same school of fish. Due to this reason, these two species were included in the assessment. This decision is considered to be precautionary in nature.
Indo-Pacific bottlenose dolphin (Synonyms—Indian, inshore or spotted bottlenose dolphin)	*Tursiops aduncus*	41 116020	**Y**	
Common dolphin	*Delphinus delphis*	41 116001	**N**	***Note included—***The species has a wide distribution and are found in Queensland waters. *Delphinus delphis* have a preference for unwilling-modified waters, areas with steep sea floor relief and extensive shelf areas (Hammond *et al.*, 2008). As the Ocean Beach Fishery operates close to shore and in shallow water environments, interactions with this species are considered unlikely.

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
False killer whale	*Pseudorca crassidens*	41 116013	**N**	***Note included—****Pseudorca crassidens* is more common in tropical environments and the species are generally found in relatively deep, offshore waters (Baird, 2018). Interactions between operators in the Ocean Beach Fishery and *P. crassidens* are considered to be highly unlikely.
Fraser's dolphin	*Lagenodelphis hosei*	41 116006	**N**	***Not Included—***Research on the distribution and habitat preferences of this species indicates that it will not interact with the Ocean Beach Fishery (Department of the Environment, 2019o; Kiszka & Braulik, 2018)
Striped dolphin	*Stenella coeruleoalba*	41 116016	**N**	***Not Included –***The species Is unlikely to interact with the ECIF and the key threats for this species largely occur in waters outside of Australia (Au & Perryman, 1985; Braulik, 2019; Department of the Environment, 2019p; Reeves *et al.*, 2003).
Spotted dolphin	*Stenella attenuata*	41 116015	**N**	***Note included—***Research indicates that this species inhabits deeper water environments and will not interact with the Ocean Beach Fishery (Kiska & Braulik, 2018).
Risso's dolphin	*Grampus griseus*	41 116005	**N**	***Not Included—***Research on geographic distributions and habitat preferences suggest that this species is unlikely to interact with the Ocean Beach Fishery (Corkeron & Bryden, 1992; Department of the Environment, 2019q).
Spinner dolphin	*Stenella longirostris*	41 116017	**N**	***Not Included—***A Research on geographic distributions and habitat preferences suggest that this species is unlikely to interact with the Ocean Beach Fishery (Braulik, 2019; Department of the Environment, 2019s).
Rough toothed-dolphin	*Steno bredanensis*	41 116018	**N**	***Note included—***Research indicates that this species inhabits deeper water environments and will not interact with the Ocean Beach Fishery (Department of the Environment, 2019t).
Melon headed whale	*Peponocephala electra*	41 116012	**N**	***Note included—***Research indicates that this species inhabits deeper water environments and will not interact with the Ocean Beach Fishery (Department of the Environment, 2019u).

ECIF—Ocean Beach Fishery				
Common name	**Species name**	**CAAB**	**Include**	**Considerations**
Short-finned pilot whale	*Globicephala macrorhynchus*	41 116003	**N**	***Not Included*—**Species mostly associated with tropical and temperate oceanic waters. While the species has been reported in StandNET (Department of the Environment, 2019v; Meager, 2016; Minton *et al.*, 2018a), interactions with this species are considered to be highly unlikely in the Ocean Beach Fishery.
Killer whale	*Orcinus orca*	41 116011	**N**	***Not Included*—**Interactions with this species highly unlikely in the Ocean Beach Fishery (Department of the Environment, 2019w).
Pygmy killer whale	*Feresa attenuata*	41 116002	**N**	***Not Included* –**Interactions with this species are highly unlikely in the Ocean Beach Fishery (Department of the Environment, 2019x; Reeves *et al.*, 2003).
Pygmy sperm whale	*Kogia breviceps*	41 119001	**N**	***Not Included*—**Deeper water species that will not interact with the Ocean Beach Fishery (Department of the Environment, 2019y).
Long-finned pilot whale	*Globicephala melas*	41 116004	**N**	***Not Included*—**Species has a mostly southern distribution and it is unlikely to occur in high numbers in Queensland (Department of the Environment, 2019n; Minton *et al.*, 2018b).
Dusky dolphin	*Lagenorhynchus obscurus*	41 116008	**N**	***Not Included*—**The northernmost point of the *L. obscurus* Australian distribution lies to the south of Queensland managed waters (Department of the Environment, 2019z).
Spectacled porpoise	*Phocoena dioptrica*	41 117001	**N**	***Not Included*—**Species does not occur and/or is unlikely to occur in waters managed by Queensland (Department of the Environment, 2019b).
Commerson's dolphin	*Cephalorhynchus commersonii*	n/a	**N**	***Not Included*—**Species does not occur in waters managed by Queensland (Crespo *et al.*, 2017).
Hourglass dolphins	*Lagenorhynchus cruciger*	41 116007	**N**	***Not Included*—**Species does not occur and/or is unlikely to occur in waters managed by Queensland (Braulik, 2018a).

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Southern right whale dolphin		41 116009	**N**	***Not Included—***Species does not occur and/or is unlikely to occur in waters managed by Queensland (Braulik, 2018b).
Burrunan dolphin	*Tursiops australis*	41 116022	**N**	***Not Included—***Species does not occur in Queensland managed waters (Charlton-Robb *et al.*, 2011).
Irrawaddy dolphin	*Orcaella brevirostris*	n/a	**N**	***Not Included—****Orcaella brevirostris* is now considered to be a south-east Asian species and it is unlikely to interact with commercial fisheries in Australia (Minton *et al.*, 2017).
Indo-Pacific humpback dolphin	*Sousa chinensis*	n/a	**N**	***Not Included—***Similar profile to the Irrawaddy dolphin. Taxonomic reviews and further research has identified two distinct species, the Australian humpback dolphin (*Sousa sahulensis*) and the Indo-Pacific humpback dolphin (*S. chinensis*) (Department of the Environment, 2019r).
Strap toothed whale	*Mesoplodon layardii*	41 120009	**N**	***Not Included—***While this species has StrandNET records (Meager, 2016) it is more frequently found in deeper water environments and is not expected to interact with the Ocean Beach Fishery.
Giant beaked whale (aka Arnoux's)	*Berardius arnuxii*	41 120001	**N**	***Not Included—***Species does not occur in Queensland managed waters (Department of the Environment, 2019c)**.**
Dwarf sperm whale	*Kogia sima*	41 119002	**N**	***Not Included—***Dwarf sperm whales (*K. sima*) are not considered to be abundant in Australian waters and sightings/strandings for this species are limited (Department of the Environment, 2019d). In the unlikely event that a *K. sima* interaction does occur in the ECIF, the extent and impact of these interactions are expected to be low to negligible.
Southern bottlenose whale	*Hyperoodon planifrons*	41 120002	**N**	***Not Included—***Species does not occur in Queensland managed waters (Department of the Environment, 2019e).

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Tropical bottlenose whale (aka Longman's)	*Indopacetus pacificus*	41 120003	**N**	***Not Included—***Species does not occur in Queensland managed waters (Department of the Environment, 2019f).
Andrew's beaked whale	*Mesoplodon bowdoini*	41 120004	**N**	***Not Included—***Species does not occur in Queensland managed waters (Department of the Environment, 2019g).
Blainville's beaked whale	*Mesoplodon densirostris*	41 120005	**N**	***Not Included—***A limited number of *M. densirostris* strandings have been reported in Queensland. The species though prefers tropical (22–32 °C) to temperate (10–20 °C) oceanic regions and inhabits waters ranging from 700–1000m deep, but often adjacent to much deeper waters of 5000m (Department of the Environment, 2019h).
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*	41 120006	**N**	***Not Included—****Mesoplodon ginkgodens* are not considered to be abundant and thought to primarily occur in deep, offshore waters (Department of the Environment, 2019i).
Gray's beaked whale	*Mesoplodon grayi*	41 120007	**N**	***Not Included—****Mesoplondon grayi* is considered to be a southern species with low potential to interact with fisheries in Queensland (Taylor *et al.*, 2008c).
Hector's beaked whale	*Mesoplodon hectori*	41 120008	**N**	***Not Included—****Mesoplondon hectori* is considered to be a southern species with low potential to interact with fisheries in Queensland (Taylor *et al.*, 2008d).
True's beaked whale	*Mesoplodon mirus*	41 120010	**N**	***Not Included—***Species does not occur in Queensland managed waters (Taylor *et al.*, 2008a).
Shepard's beaked whale	*Tasmacetus shepherdi*	41 120011	**N**	***Not Included—***Species does not occur in Queensland managed waters (Braulik, 2018c).

ECIF—Ocean Beach Fishery				
Common name	***Species name***	***CAAB***	***Include***	***Considerations***
Curvier's beaked whale	*Ziphius cavirostris*	41 120012	**N**	***Not Included—***Species is more commonly found in deeper water environments (>1000m) and it is highly unlikely that it will interact with the ocean net fishery (Taylor *et al.*, 2008b).
Sirenia				
Dugong	*Dugong dugong*	41 206001	**N**	***Notes—***Dugong interactions in the Ocean Beach Fishery are expected to be low as fishers target finfish species in the Gold Coast region and the eastern coast of Fraser, Moreton and Stradbroke Islands (Department of Agriculture and Fisheries, 2019a). These areas have lower levels of overlap with the habitats preferred by dugongs and there is low probability of the fishery interacting with this species. Given the small *encounterability* potential, dugongs were omitted from the analysis. However, the species has been included in the large mesh net fishery and the Tunnel Net Fishery Level 2 ERA.

Appendix C—Residual Risk Analysis

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Target & Byproduct					
Mullet Sea mullet (*M. cephalus*)	*Maximum size* (*Productivity*)	Ocean Beach Fishery	2	1	Reports on the *maximum size* for sea mullet (*M. cephalus*) varied with some estimating it to be as high as 120cm (Froese & Pauly, 2019). In the PSA, the highest reported estimate was used as the basis of the assessment for the *maximum size* attribute. This approach aligns well with the precautionary nature of the PSA. In the RRA, further consideration was given to the suitability of this score and its relevance to the fishery on the Queensland east coast. In the two jurisdictions that harvest sea mullet, the *maximum size* is estimated at around 75cm total length (New South Wales) and 91cm total length (Queensland) (Department of Primary Industries, Undated; Queensland Government, 2018a). These estimates align more closely with what is known about the east coast sea mullet stocks (Lovett *et al.*, 2018; Smith & Deguara, 2002; Stewart *et al.*, 2018). In the RRA, these values were used to reassess the *maximum size* attribute for sea mullet. ***Key changes to the PSA scores*** The score assigned to *maximum size* was reduced from medium (2) to low (1). This score better reflects what is known about the stocks on the Queensland east coast and it is viewed as a more appropriate estimate. This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Mullet Sea mullet (*M. cephalus*)	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	1	Sea mullet (*M. cephalus*) are managed through a MLS limit, in-possession limits (recreational fishing), limited licencing and various other input controls (Stewart *et al.*, 2018). The MLS limit (30cm) is based on the *size at maturity* (25–45cm; Smith & Deguara, 2002) and increases the probability that a fish will spawn at least once before

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					recruiting to the fishery. As the management regime for sea mullet does not include a mechanism to control catch or effort it was assigned a high (3) preliminary risk score for *management strategy*. East coast mullet stocks are targeted by commercial fisheries in Queensland and New South Wales, however state-wise comparisons highlight differences in commercial catch and effort between the two jurisdictions (65% and 35%, respectively) (Stewart *et al.*, 2018). On the Queensland east coast, the majority of the sea mullet catch is reported from the Ocean Beach Fishery. This sector of the ECIF utilises a beach seine net to target schools of mullet and it will be the key driver of risk for this species. While sea mullet is caught in the large mesh net fishery, it is retained in smaller quantities. Similarly, recreational fishers retain smaller quantities of mullet for bait that is caught using small mesh nets / cast nets (Lovett *et al.*, 2018). The sustainability of the entire east coast stock has been confirmed through stock assessments (Lovett *et al.*, 2018) and indicative *sustainability assessments* (Stewart *et al.*, 2018). The species has a long catch history in Queensland, and reductions in nominal effort coupled with favourable biomass estimates (50%, 2016) has the fishery meeting key targets outlined in the *Queensland Sustainable Fisheries Strategy 2017–2027* (Lovett *et al.*, 2018; Stewart *et al.*, 2018). While further reductions in catch and effort may be required to achieve the long-term objective of 60% biomass, this target aligns more closely with MEY. ***Key changes to the PSA scores*** While sea mullet are not managed under a TACC limit, a weight-of-evidence approach suggests that the over-exploitation risk is being managed on the Queensland east coast. As a result, the risk score for the *management strategy* attribute was reduced to a low (1). This change was done in accordance with *Guideline 2: additional scientific*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					assessment & consultation, and *Guideline 5: effort and catch management arrangements for target and byproduct species.* *Note—Under the proposed harvest strategy, the ECIF will be subject to regional management and greater use of output controls. As a Tier 2 species, the management of regional sea mullet stocks will likely move to output controls e.g. a TACC limit.*
Mullet Sea mullet (*M. cephalus*)	*Recreational desirability (Susceptibility)*	Ocean Beach Fishery	3	1	While the listed species were included in the *Statewide Recreational Fishing Survey* 2013–14, all mullet species were assessed as a species grouping (57% retention, moderate confidence) (Webley *et al.*, 2015). This absence of species-specific data resulted in all four species being assigned a high (3) risk score for the *recreational desirability* attribute. Further investigation of recreational surveys and charter fishery data indicated that the listed species were less likely to be at risk from cumulative fishing pressures. The adjusted scores were based on a combination of the following factors: • MLS limits that are aligned reasonably well with the biology of these species; • The most recent recreational survey data indicates that the mullet are caught and retained in fewer numbers; • Charter data for the most recent three calendar years indicated that mullet are retained in lesser amounts; • Consultation with Fisheries Monitoring scientists indicates that mullet are caught and retained in fewer numbers; and • These species are more inclined to be caught and used as bait. ***Key changes to the PSA scores*** Default high (3) risk scores assigned to the *recreational desirability* attribute for sea mullet was reduced to medium (2). The revised score is based on the recreational

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					fishing data which shows retention rates for the complex sit at around 57% (Webley *et al.*, 2015). It is recognised that this score may still represent an overestimate for this species. This however is difficult to confirm without additional information on recreational catch compositions. These changes were done in accordance with *Guideline 1: risk rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Mullet Fantail mullet (*P. georgii*) Goldspot mullet (*L. argentea*) Diamondscale mullet (*L. vaigiensis*)	*Age at maturity* (*Productivity*)	Ocean Beach Fishery	3	1	A number of the mullet species included in the Level 2 ERA are secondary target species and, when compared to sea mullet (*M. cephalus*), are harvested in smaller quantities. The dominance of sea mullet is reflected in the amount of research that is undertaken on the biology of this species (Ibañez, 2016; Lovett *et al.*, 2018; Stewart *et al.*, 2018; Virgona *et al.*, 1998). Conversely, biological information on the remaining species is more limited. Due to these data deficiencies, three of the five mullet species were assigned a precautionary high risk rating for the *age at maturity* attribute. As mullet biology is unlikely to vary significantly, precautionary scores assigned to this attribute are likely to be an overestimate. ***Key changes to the PSA scores*** *Age at maturity* estimates for sea mullet were used as a proxy for the three species with data deficiencies. Based on the best available information, sea mullet attains sexual maturity in 2–4 years (Lovett *et al.*, 2018; Smith & Deguara, 2002). When incorporated into the risk profiles of these three species, scores assigned to this attribute were lowered from a precautionary high (3) to low (1). While it is conceivable some mullet may reach sexual maturity at >5 years of age, a weight-of-evidence approach suggests that the revised score better reflects the biology of these species. These changes were largely done in accordance with *Guideline 1:*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					rating due to missing, incorrect or out of date information and *Guideline 2: additional scientific assessment & consultation.*
Mullet Fantail mullet (*P. georgii*) Goldspot mullet (*L. argentea*) Diamondscale mullet (*L. vaigiensis*)	*Maximum age* (*Productivity*)	Ocean Beach Fishery	3	2	The situation surrounding *maximum age* is similar to *age at maturity*. Due to data deficiencies, the fantail mullet (*P. georgii*), the goldspot mullet (*L argentea*) and the diamondscale mullet (*L. vaigiensis*) were all assigned a precautionary high (3) risk rating. Anecdotal evidence suggests that the biology of these species will not differ markedly from the sea mullet (*M cephalus*) and that *maximum age* will be lower than 25 years. Accordingly, the *maximum age* reported for sea mullet (16 years) was used as a proxy. Sea mullet was used as a proxy over the bluespot mullet (*V. seheli*) as it received a higher risk score for this attribute *i.e.* will produce a more conservative risk score. ***Key changes to the PSA scores*** With sea mullet used as a proxy for *maximum age*, scores assigned to this attribute were reduced from high (3) to medium (2). While *maximum age* is unknown for these species there is a low probability that this change will contribute to a false negative result; particularly since sea mullet was used as the proxy. Changes applied to the *maximum age* attribute were done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation*.
Mullet Fantail mullet (*P. georgii*)	*Size at maturity (Productivity)*	Ocean Beach Fishery	3	2	Two mullet species, the fantail (*P. georgii*) and diamondscale (*L. vaigiensis*) did not have sufficient data to assign a risk score to the *Size at maturity* attribute. In the PSA, this resulted in the two species receiving a precautionary high risk score. In light of these deficiencies, the size of sexual maturity for sea mullet (*M. cephalus*) was used as a proxy. The *size at maturity* for sea mullet is above the cut-off for a medium risk rating

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Diamondscale mullet (*L. vaigiensis*)					and the species, along with bluespot mullet (*V. seheli*), has the highest score within the subgroup. ***Key Changes to the PSA scores*** Scores assigned to the *size at sexual maturity* attribute were reduced from high (3) to medium (2). These changes were largely done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.* As a more precautionary score was used as a proxy, the risk of this decision contributing to a false negative result is considered low.
Mullet *Bluespot mullet (V. seheli)* *Fantail mullet (P. georgii)* *Goldspot (tiger/flat tail) mullet (L. argentea)* *Diamondscale mullet (L. vaigiensis)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	1	The majority of fishing effort for *Muglidae* is directed at sea mullet with a number of secondary species making smaller contributions to the total mullet catch. Catch of these secondary species is largely listed as part of the *Mullet—unspecified* catch category (Department of Agriculture and Fisheries, 2019a; 2020a). Management strategies for secondary mullet species are less developed and, as with sea mullet (*M. cephalus*), they are not subject to commercial catch or effort limits. For this reason, all three were assigned a high (3) preliminary risk score for *management strategy*. Given their morphological and biological similarities, sea mullet is considered to be a good indicator species for this complex. Sea mullet attracts the majority of the catch/effort and stock sustainability has been confirmed through a variety of mechanisms (Lovett *et al.*, 2018; Stewart *et al.*, 2018). As secondary mullet species make a lower contribution to the total catch it is likely that regional stocks will display the same resilience to fishing pressures. ***Key changes to the PSA scores*** Following consultation with Fisheries Management, preliminary risk scores for the *management strategy* attribute were reduced to low (1) for all secondary mullet species. This change was done in accordance with *Guideline 2: additional scientific*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					assessment & consultation, Guideline 5: effort and catch management arrangements for target and byproduct species, and *Guideline 7: management arrangements relating to seasonal spatial and depth closures.*
Mullet *Bluespot mullet (V. seheli)* *Fantail mullet (P. georgii)* *Goldspot (tiger/flat tail) mullet (L. argentea)* *Diamondscale mullet (L. vaigiensis*	*Recreational desirability (Susceptibility)*	Ocean Beach Fishery	3	2	While the listed species were included in the *Statewide Recreational Fishing Survey 2013–14*, all mullet species were assessed as a species grouping (57% retention, moderate confidence) (Webley *et al.*, 2015). This absence of species specific data resulted in the bluespot mullet (*V. seheli*), fantail mullet (*P. georgii*) and diamondscale mullet (*L. vaigiensis*) being assigned a high (3) risk score for the *recreational desirability* attribute. Further investigation of recreational surveys and charter fishery data indicated that mullet were less likely to be at risk from cumulative fishing pressures. The adjusted scores were based on a combination of the following factors: • The most recent recreational survey data indicates that the species or species complex are caught and retained in fewer numbers; • Charter data for the most recent three calendar years indicated that the species or species complex are retained in lesser amounts; • Consultation with Fisheries Monitoring scientists indicates that the species or species complex are caught and retained in smaller quantities; and • These species are more inclined to be caught and used as bait. ***Key changes to the PSA scores*** Default high (3) risk scores assigned to the *recreational desirability* attribute for the listed species were reduced to medium (2). The revised score is based on the recreational fishing data which shows retention rates for the complex sit at around 57% (Webley *et al.*, 2015). It is recognised that this score may still represent an

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					overestimate for some species. This however is difficult to confirm without additional information on recreational catch compositions. These changes were done in accordance with *Guideline 1: risk rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Mullet *Bluespot mullet (V. seheli)* *Fantail mullet (P. georgii)* *Goldspot (tiger/flat tail) mullet (L. argentea)* *Diamondscale mullet (L. vaigiensis)*	*Sustainability assessments (Susceptibility)*	Ocean Beach Fishery	3	3	As noted, the majority of effort is targeted at sea mullet (*M. cephalus*); the primary target of the Ocean Beach Fishery. Sea mullet has been the subject of numerous stock assessments and indicative sustainability evaluations (Lovett *et al.*, 2018; Stewart *et al.*, 2018; Virgona *et al.*, 1998). These studies have shown that the species is being fished sustainably and has been for a considerable period of time. In the RRA, some consideration was given to assigning the bluespot mullet (*V. seheli*), the fantail mullet (*P. georgii*), the goldspot mullet (*L. argentea*) and the diamondscale mullet (*L. vaigiensis*) a low (1) risk score for the *sustainability* attribute. The premise being that if sea mullet, the species attracting the most effort, is being fished sustainably then there is a high probability that the four remaining species are also fished sustainably. After due consideration, it was determined that the preliminary scores should be retained in the final assessment. The reason being that there is not enough information on the stock structure of the secondary species and/or the contributions they make to the total mullet catch. The likely outcome of decision is the development of more precautionary assessments and an increased potential for false positive results. ***Key changes to the PSA scores*** No changes were made to the PSA. However, further consideration may need to be given to the scores assigned to this attribute if (for example) one or more of mullet species receives a score just above a risk category cut-off point *i.e.* on the border of the medium and high risk categories.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Whiting *Sand whiting (S. ciliata)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	2	Sand whiting (*S. ciliata*) is managed through a MLS limit, combined in-possession limits (recreational fishing), and various other input controls (McGilvray *et al.*, 2018a). The MLS limit (23cm) is based on size at sexual maturity and increases the probability that fish will spawn at least once before recruiting to the fishery. As the management regime for sand whiting does not include a mechanism to control catch or effort it was assigned a high (3) preliminary risk score for *management strategy*. The majority of the sand whiting catch is reported from the commercial fishery. However, the recreational fishing sector will make a notable contribution to annual harvest rates. At a complex level, whiting are one of the more prominent components of the ECIF catch (Department of Agriculture and Fisheries, 2019a). Data for this complex has poor resolution and almost all of the catch is reported as *unspecified*. While some of the sand whiting catch is reported to species level, this occurs with less frequency and provides an inaccurate account of the total harvest *e.g.* <23t per year from 2000–05 (Department of Agriculture and Fisheries, 2019a; 2020a). The sustainability of the Queensland stock has been confirmed through a detailed stock assessment (Leigh *et al.*, 2019) and indicative sustainability evaluations *e.g.* SAFS (McGilvray *et al.*, 2018a). These assessments considered fishing activities / harvest rates in both the commercial and recreational fishing sectors. The outputs of the stock assessment indicates that the equilibrium MSY for the stock sits at or around 452t which compares to annual harvest rates (commercial plus recreational) of 272t (Leigh *et al.*, 2019). Based on these outputs, the species is likely to achieve the long-term Strategy target of B_{60} in around seven years (Department of Agriculture and Fisheries, 2017). From an ERA perspective, the above is significant as it shows a) that current harvest levels (if maintained) will facilitate stock rebuilding and b) the risk posed to this species are being managed effectively under the current management regime. The notable

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					caveat being that that without an effective cap, catch and effort levels can still increase under the current management regime. ***Key changes to the PSA scores*** While sand whiting are not managed under a TACC limit, a weight-of-evidence approach suggests that the over-exploitation risk is being managed within the current fishing environment. Therefore, the risk score for the *management strategy* attribute was reduced to a medium (2). A further reduction in the risk score could not be justified due to the current absence of output controls and the potential for catch and effort to increase under the current management regime. These limitations are currently being addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017). This change was done in accordance with *Guideline 2: additional scientific assessment & consultation,* and *Guideline 5: effort and catch management arrangements for target and byproduct species.*
Whiting *Trumpeter whiting (S. maculata)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	3	The management regime for trumpeter whiting (*S. maculata*) is less developed and the commercial take of the species is not managed under output controls *e.g.* ITQs or a TACC limit. This was reflected in the PSA where the species was assigned a high (3) preliminary risk score for *management strategy*. At a species complex level, whiting are one of the more prominent components of the ECIF catch (Department of Agriculture and Fisheries, 2019a). However, catch data for whiting has poor resolution with almost all reported as *Whiting—unspecified*. Catch reporting at the species level is less frequent and provides an incomplete account of individual harvest rates (*e.g. Whiting—trumpeter* = <2t per year since 2000). While noting this deficiency, market demand is expected to favour sand whiting (*S. ciliata*) and this species is considered to be a more likely target (Leigh *et al.*, 2019). Trumpeter

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					whiting are more likely to be targeted in the recreational fishing sector (*pers. comm.* T. Ham). While sand whiting has been the subject of a detailed stock assessment (Leigh *et al.*, 2019), trumpeter whiting was not included in the assessment. There is limited information on the sustainability of the stocks and/or how current harvest rates compare to key biological reference points. This in turn makes it difficult to assess the suitability and effectiveness of the current management regime. ***Key changes to the PSA scores*** No changes were made to the PSA scores but it is recognised that a high (3) risk rating may be too precautionary for this species. A score reduction could not be justified for this species given the current absence of output controls and information on how the take of the species compares to key sustainability reference points. With the continued roll-out of the *Queensland Sustainable Fisheries Strategy 2017–2027* there may be further avenues to review this score (Department of Agriculture and Fisheries, 2017).
Whiting *Sand whiting (S. ciliata)*	*Recreational desirability (Susceptibility)*	Ocean Beach Fishery	3	2	While sand whiting were included in the *Statewide Recreational Fishing Survey*, they were assessed as part of a broader species grouping and they were assigned a precautionary high (3) risk rating for the *recreational desirability*. The popularity of whiting in the recreational sector is reflected in large catches and the sustained high retention rates. The last two surveys suggest that catch has decreased markedly across the last two periods (1,090,121 caught in 2013–14, 766,822 caught in 2019–20) (*pers. comm.* J. Webley; Webley *et al.*, 2015). While species-specific data is not available, retention rates for the broader complex sit at around 49%. If assessed on these values, the *recreational desirability* attribute for sand whiting would be assigned a medium (2) risk score.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					Of notable importance, the MLS limit for sand whiting (23cm) is based on the size at sexual maturity (17–24cm; McGilvray *et al.*, 2018a) and increases the probability that fish will spawn at least once before recruiting to the fishery. It is however recognised that a proportion of whiting (including undersized fish) will be discarded in a dead or moribund state and that cryptic mortalities will contribute to the total rates of fishing mortality. Current knowledge on discard mortality of sand whiting is limited to southern New South Wales and suggests that discard mortalities originating from the recreational fishing sector are relatively low (Butcher *et al.*, 2006; Kendall & Gray, 2009) . ***Key changes to the PSA scores*** The default high (3) risk scores assigned to *recreational desirability* was considered an overestimate and reduced to medium (2). The principal drivers behind this reduction include marked reductions in catch and effort over time, moderate retention rates at the species complex level, and research suggesting low discard mortality. Further reductions in risk scores could not be justified given the sustained recreational interest in the species over time, and the absence of species-specific catch and harvest estimates. These changes were done in accordance with *Guideline 1: risk rating due to missing, incorrect or out of data information* and *Guideline 2: additional scientific assessment & consultation.*
Bream *Yellowfin bream (Acanthopagrus australis)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	2	Yellowfin bream (*A. australis*) is managed through a MLS limit, combined in-possession limit (recreational fishing), and various other input controls (McGilvray *et al.*, 2018b). The MLS limit (25cm) is based on the *size at maturity* (19-21cm; Gray & Barnes, 2015) and increases the probability that a fish will spawn at least once before recruiting to the fishery. As the management regime does not include a mechanism to control catch the species was assigned a high (3) preliminary risk score for *management strategy*.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					While bream are one of the more prominent ECIF catch components, data for the complex has poor species resolution *e.g. Bream—unspecified* (Department of Agriculture and Fisheries, 2019a). A large proportion of this catch will consist of yellowfin bream; with secondary species like tarwhine (*R. sarba*) making varying contributions (*pers. comm.* T. Ham). While some bream catch is reported to species level, this occurs with less frequently and underestimates individual rates of harvest (Department of Agriculture and Fisheries, 2019a). In addition to the commercial fishing sector, yellowfin bream is a key target in the recreational fishing sector. Harvest rates in this sector are comparable to the commercial fishery with recreational fishers accounting for around 46% of the total yellowfin bream catch (Leigh *et al.*, 2019). At this level, recreational fishing will make a significant contribution to the cumulative fishing pressures exerted on this species. These risks are primarily managed through in-possession limits and a MLS that is aligned with the size at sexual maturity. Sustainability of the yellowfin bream stock has been confirmed through a detailed stock assessment (Leigh *et al.*, 2019) and indicative sustainability evaluations (McGilvray *et al.*, 2018b). Of notable importance, these assessments considered fishing activities / harvest rates in both the commercial and recreational fishing sectors. Based on the available data, the stock assessment indicated that the yellowfin bream MSY sits at or around 420t. This compares to an annual harvest rate (commercial plus recreational) of 242t (2013–2017). Current biomass estimates place yellowfin bream stock health at around 33.8% of the unfished biomass with current harvest rates (*e.g.* <MSY) assisting with stock rebuilding. In terms of the *Queensland Sustainable Fisheries Strategy 2017–2027*, research suggests that the stock will need to be at 50.1% to reach the long-term objective of B_{60} (Department of Agriculture and Fisheries, 2017). The stock assessment notes that it will

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					take (approximately) 25 years for the stock to reach B_{60} under the current rates of harvest. From an ERA perspective, confirmation of stock sustainability through qualitative assessments and a weight-of-evidence approach suggests that the risk posed to this species is being managed within the current fishing environment. The available data indicates that the fishery is being fished below MSY and stock health will improve under the current fishing conditions. This is being done without the use of a TACC limit and suggests that criteria used in the Level 2 ERA is less suited to this species. The notable caveat being that without a cap, catch and effort can increase and potentially exceed MSY under the current management regime. ***Key changes to the PSA scores*** While yellowfin bream are not managed under a TACC limit, a weight-of-evidence approach suggests that the over-exploitation risk is currently being managed. As a result, the risk score for the *management strategy* attribute was reduced to a medium (2). This change was done in accordance with *Guideline 2: additional scientific assessment & consultation,* and *Guideline 5: effort and catch management arrangements for target and byproduct species.* As the fishery continues to operate without a cap on catch or effort, further reductions in the risk score were not supported. The score assigned to this attribute may need to be reviewed if or when harvest rates approach MSY limits. The need to review this score will reduce with the introduction of an ECIF-specific harvest strategy that relies more heavily on the use of management controls and output controls (Department of Agriculture and Fisheries, 2020c)..
Bream	*Recreational desirability (Susceptibility)*	Ocean Beach Fishery	1	2	Recreational bream catch on the east coast is dominated by yellowfin bream (*A. australis*), with tarwhine (*R. sarba*) targeted to a lesser extent. As both yellowfin bream

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Yellowfin bream (Acanthopagrus australis) *Tarwhine (Rhabdosargus sarba)*					and tarwhine have low retention rates (28% and 32%, respectively, *pers. comm.* J. Webley) they were assigned low risk ratings for the *recreational desirability*. The popularity of bream in the recreational sector is reflected in the large catches of yellowfin bream and their sustained targeting across periods (1,667,000 caught in 2010–11; 1,156,000 caught in 2013–14). Tarwhine contributes less to the overall recreational bream harvest (24,000 fish caught in 2013–14), although legal sized fish are likely to be taken in conjunction with yellowfin bream. This is one of the reasons why the two are managed under a combined 30 fish in-possession limit (Department of Agriculture and Fisheries, 2018c). The MLS limit (23cm) for yellowfin bream is based on the *size at maturity* (McGilvray *et al.*, 2018b) and increases the probability that the species will spawn at least once before recruiting to the fishery. Though bream retention rates are comparatively low, these species are taken in larger numbers and discard mortality will be a risk for this complex (Broadhurst *et al.*, 2005). For instance, research on recreational fishing activities recorded bream mortality rates up to 36.6%, with hook location shown to be a key predictor for survival (Broadhurst *et al.*, 2005). This risk will be of particular relevance to fish that fall below the MLS and will contribute to the total rate of fishing mortality. The majority of recreational data is obtained through voluntary localised collection of data (*e.g.* the boat ramp survey program, the Fisheries Monitoring Program) and a more expansive voluntary recreational fisher survey (Webley *et al.*, 2015). It can however be difficult to obtain accurate information on participation rates, regional catch trends, and species assemblages for the recreational fishing sector. These limitations make it difficult to assess how recreational fishing pressures vary between and within years. From an ERA perspective, it increases a level of uncertainty that supports the adoption of a more conservative approach.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					Key changes to the PSA scores Based on the available information, preliminary scores assigned to the *recreational desirability* attribute were increased from low (1) to medium (2). The decision to increase risk scores assigned to this attribute was precautionary and takes into consideration the broader popularity of these species, and an inability to monitor catch/harvest rates effectively between and within years. While the increased score may represent a risk over-estimate, it aligns with the precautionary approach adopted for the Level 2 assessments. These changes were done in accordance with *Guideline 2: additional scientific assessment & consultation,* and *Guideline 5: effort and catch management arrangements for target and byproduct species.*
Bream *Tarwhine (Rhabdosargus sarba)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	3	Tarwhine (*R. sarba*) are primarily managed through a MLS limit and a combined in-possession limit (recreational fishing). The MLS limit (25cm) is based on the *size at maturity* (15–21cm; Hughes *et al.*, 2008) and increases the probability that a fish will spawn at least once before recruiting to the fishery. As the management regime does not include a mechanism to control catch or effort, tarwhine were assigned a high (3) preliminary risk score for *management strategy*. Information on the catch of bream species presents similar issues to whiting. At a species complex level, bream are one of the more prominent components of the ECIF catch. However, catch data for bream has poor species resolution and a considerable proportion is reported as *unspecified*. Catch reporting at the species level is less frequent and provides an incomplete account of individual harvest rates (Department of Agriculture and Fisheries, 2019a). While yellowfin bream has been the subject of a detailed stock assessment, tarwhine was not included in this evaluation. There is limited information on the sustainability of the stocks and/or how current harvest rates compare to key biological reference points.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					This makes it is difficult to ascertain if the risk posed to this species is being managed effectively under the current management regime. ***Key changes to the PSA scores*** No changes were made to the PSA scores but it is recognised that a high (3) risk rating may be precautionary. A score reduction could not be justified for this species given the current absence of output controls and information on how the take of the species compares to key sustainability reference points. These limitations are currently being addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017). With the continued roll-out of the Strategy there may be further avenues to review and (potentially) reduce this score.
Dart Snubnose dart (*T. blochii*)	*Age at maturity* (*Productivity*)	Ocean Beach Fishery	3	1	No ageing data was available for the snubnose dart (*T. blochii*) and the species was assigned a precautionary high (3) score for this attribute. In the RRA the *age at maturity* attribute was reassessed using age and growth data for the swallowtail dart (*T. coppingeri*). Research indicates that the swallowtail dart is fast growing and reaches sexual maturity before five years of age. ***Key changes to the PSA scores*** The *age at maturity* risk score for the snubnose dart was reduced from a precautionary high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Dart Snubnose dart (*T. blochii*)	*Maximum age* (*Productivity*)	Ocean Beach Fishery	3	2	As data was not available for the snubnose dart (*T. blochii*), the swallowtail dart (*T. coppingeri*) was again considered for use as a proxy for the *maximum age* attribute. Research indicates that the swallowtail dart is fast growing and that the *maximum age* for this species is less than 10 years. The snubnose dart is a larger species and there

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					is a possibility that the *maximum age* for this species is larger. For this reason, it was determined that a more precautionary approach should be adopted for this species. ***Key changes to the PSA scores*** The preliminary score for *maximum age* was reduced from a precautionary high (3) to medium (2). The decision to reduce this score was informed by ageing studies involving the swallowtail dart and takes into consideration a) the potential for the species to live to more than 10 years and b) the unlikely probability that the species will exceed 25 years. The RRA were largely done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation*.
Dart Snubnose dart (*T. blochii*)	*Size at maturity (Productivity)*	Ocean Beach Fishery	3	2	Snubnose dart (*T. blochii*) were assigned a precautionary high (3) risk rating for *size at maturity* due to an absence of data. Given what is known about this family, a high risk rating is considered to be an overestimate for this species and the attribute was re-assessed as part of the RRA. ***Key changes to the PSA scores*** The use of proxy data resulted in a score downgrade from high (3) to medium (2). While information suggests that the swallowtail dart (*T. coppingeri*) attains sexual maturity at <40cm, the snubnose dart attains a larger total length. As such, a more precautionary approach was adopted for this species. Changes made as part of the RRA were done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Dart	*Maximum size* (*Productivity*)	Ocean Beach Fishery	2	1	Reports on the *maximum size* for snubnose dart (*T. blochii*) varied with some estimating it to be as high as 110cm (Froese & Pauly, 2019). In the PSA, the highest

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Snubnose dart (*T. blochii*)					reported estimate was used as the basis of the assessment for the *maximum size* attribute. This approach aligns well with the precautionary nature of the PSA. In the RRA, further consideration was given to the suitability of this score and its relevance to the fishery on the Queensland east coast. In most instances, *maximum size* for the snubnose dart is reported as around 65cm (Food and Agriculture Organization, 2020; Randall *et al.*, 1990; Smith-Vaniz & Williams, 2016). In Queensland, the species has a reported *maximum size* of 75cm (Queensland Government, 2018c). While dart >100cm total length cannot be ruled out completely, *maximum size* estimates of <80cm are considered to be more appropriate for the Ocean Beach Fishery and the broader ECIF. Accordingly, the *maximum size* attribute was reassessed as part of the RRA using the revised (<80 cm) estimate. ***Key changes to the PSA scores*** The score assigned to *maximum size* was reduced from medium (2) to low (1) as <100cm total length is viewed as a more appropriate estimate for this attribute. This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Dart *Snubnose dart (T. blochii)* *Swallowtail dart (T. coppingeri)*	*Management strategy (Susceptibility)*	Ocean Beach Fishery	3	2	When compared to other species, the management regime for dart is less developed. The complex is managed at a whole-of-fishery level and they are not currently subject to minimum legal size limits. However, the take of these species in the recreational fishing sector is restricted by a combined Carangidae species in-possession limit (*Fisheries Declaration 2019*). As the management regime does not include a mechanism to control catch or effort, dart were assigned a high (3) preliminary risk score for *management strategy*. On the Queensland east coast, the majority of the dart is reported from the Ocean Beach Fishery. While dart is retained for sale in the large mesh net fishery (gillnets,

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					ringnets), it is typically viewed as a byproduct species. Catch data for dart has poor species resolution and the majority is reported as *unspecified* (Department of Agriculture and Fisheries, 2019a). This portion of the catch is comparatively small with an average of 24t of dart being reported from the entire ECIF (2017–19 inclusive); 19t of this comes from the Ocean Beach Fishery. This catch will include a mixture of swallowtail dart (*T. coppingeri*) and snubnose dart (*T. blochii*). While dart have not been the subject of a detailed stock assessment and/or managed under a TACC limit, there are fewer concerns surrounding the sustainability of these species. Research also suggests that Trachinotus spp. are fast-growing, serial spawners with a protracted spawning season that display ranging behaviour (McPhee, 1999). These factors combined with low (overall) catches suggest dart are a) less-susceptible to over-exploitation, and b) are being effectively managed under a broader management framework. ***Key changes to the PSA scores*** While dart are not managed under a TACC limit, a weight-of-evidence approach suggests that these species are more resilient to current fishing pressures. This data also suggests that the risk of over-exploitation is being managed on the Queensland east coast and that the PSA overestimated the risk for this attribute. Accordingly, the risk score for *management strategy* was reduced to a medium (2). It is recognised that this may still represent a precautionary assessment. However, a further reduction in the risk score could not be justified due to the lack of output controls and limitations in the monitoring and assessment data. These limitations are currently being addressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017).

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					The above changes were done in accordance with *Guideline 2: additional scientific assessment & consultation,* and *Guideline 5: effort and catch management arrangements for target and byproduct species.*
Dart *Snubnosed dart (Trachinotus blochii)* *Swallowtail dart (Trachinotus coppingeri)*	*Recreational desirability (Susceptibility)*	Ocean Beach Fishery	3	2	While snubnose and swallowtail dart (*T. blochii and T. coppingeri,* respectively) were included in the *Statewide Recreational Fishing Survey 2013–14*, they were assessed as part of a broader species grouping (32.4% retention) (Webley *et al.*, 2015). Due to an absence of species-specific data, both dart species received a precautionary high (3) risk rating for *recreational desirability*. Recreational catch of dart has increased across the last two survey periods (288,613 caught in 2010–11, 352,000 caught in 2013–14) (Taylor *et al.*, 2012; Webley *et al.*, 2015), though harvest rates have remained the same. While *post-capture mortality* of *Trachinotus* species is unknown, the species is most commonly found in the surf zone and shallow inshore waters where barotrauma is viewed as less of an issue. While the recreational catch has increased, dart are fast growing and have protracted spawning seasons. This coupled with low retention rates indicate that regional stocks can withstand elevated fishing pressures. ***Key changes to the PSA scores*** The default high (3) risk scores assigned to the *recreational desirability* attribute was reduced to medium (2) as part of the RRA. The principal drivers behind this reduction include low retention rates and research suggesting that the complex may be more resilient to fishing pressure. Further reductions in risk scores could not be justified given the absence of species-specific catch and harvest estimates. These changes were done in accordance with *Guideline 1: risk rating due to missing, incorrect or out of data information* and *Guideline 2: additional scientific assessment & consultation.*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Species of Conservation Concern					
Marine turtles Loggerhead turtle (*C. caretta*)	*Fecundity (Productivity)*	Ocean Beach Fishery	3	2	The precautionary nature of the PSA meant that preliminary scores for the *fecundity* attribute were based on the most conservative values published for the number of eggs per year, years between reproductive events, and number of batches per reproductive season. For some species, these values were well below the mean and therefore were considered to be an unrealistic account of the species *fecundity*. To address these discrepancies, the number of offspring per year was recalculated using mean values for number of eggs per clutch, number of years between reproductive events, and number of clutches per season. ***Key changes to the PSA scores*** As a result of the above amendments, the score assigned to *fecundity* for the loggerhead turtle (*C. caretta*) was reduced from a high (3) to medium (2). This was done in consultation with members from the scientific community (*pers. comm.* C. Limpus & J. Meager) and in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Marine turtles Loggerhead turtle *(C. caretta)*	*Maximum size (Productivity)*	Ocean Beach Fishery	1	2	The loggerhead turtle (*C. caretta*) was initially assigned a low (1) risk score for this attribute. During the consultation process, it was advised that this score was inaccurate and should be increased (*pers. comm*. C. Limpus). ***Key changes to the PSA scores*** Due to this feedback, the score assigned to this attribute was increased from low (1) to medium (2). This change was done in accordance with *Guideline 1: rating due to*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					missing, incorrect or out of date information and *Guideline 2: additional scientific assessment & consultation.*
Marine turtles *Green turtle (C. mydas)* *Loggerhead turtle (C. caretta)* *Hawksbill turtle (E. imbricata)*	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	2	For most species, the *encounterability* attribute was assessed on two key components: 1) the habitat preferences of the species being assessed when it is an adult, and 2) its bathymetric preferences. These measures are overridden for air-breathing species which, based on the ERAEF, are assigned a default high risk (3) score for this attribute (Hobday *et al.*, 2007). The premise being that air-breathing animals need to access the surface and therefore have a higher potential of interacting with the gear across the entire fishing event *e.g.* during the net setting, soak and retrieval processes (Hobday *et al.*, 2007). In-line with this methodology, all marine turtles were assigned a preliminary risk score of high risk (3) score as part of the PSA. While noting the justifications used for assigning a high risk rating, the likelihood of the Ocean Beach Fishery encountering a marine turtle is less uniform. It is acknowledged that marine turtles are found across a wide range of habitats and bathymetries including areas where ocean beach fishing occurs. The use of seine and haul nets though is largely confined to the eastern coastlines of South and North Stradbroke Island, Moreton Island, Bribie Island and Fraser Island plus sections of the Gold Coast and Sunshine Coast (Department of Agriculture and Fisheries, 2019a). These areas, while not universal, are more exposed and are often viewed as high-energy environments *e.g.* subject to increased wave activity, greater disturbance, more frequent disturbance. From an ERA perspective, areas accessed in the Ocean Beach Fishery are not considered to be priority marine turtle habitats. While it is recognised that marine turtles are found in these areas, the probability of encountering these species is expected to be higher in protected embayments like Moreton Bay and the Great Sandy Marine Parks and around key nesting/internesting sites (Department of the Environment and

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					Energy, 2017; Limpus, 2007; 2008; 2009; Read & Limpus, 2002). In the case of key nesting / internesting sites, a high proportion of these are already protected from net fishing activities or occur outside of the prescribed area for the Ocean Beach Fishery. This inference is partly supported by the SOCI data, data from the historic Queensland Fisheries Observer Program, and an absence of ocean beach fishing records in the StrandNET data (Department of Agriculture and Fisheries, 2019a; Department of Environment and Science, 2017). ***Key changes to the PSA scores*** Given the areas where ocean beach fishers operate and habitats preferred by marine turtles, scores assigned to the *encounterability* attribute were reduced from high (3) to medium (2). The above changes were largely done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information,* specifically out-of-date data (*pers. comm.* C. Limpus). The changes also align with *Guideline 2: additional scientific assessment & consultation.* While scores assigned to this attribute were reduced, it may still be an overestimate for this fishery. When compared to gillnets and tunnel nets, the number of marine turtle interactions are expected to be lower in the Ocean Beach Fishery. There is however limited information on the extent of SOCI interactions in this sector and limited capacity (at present) to validate catch records reported through the logbook program. With improved information and catch monitoring scores assigned to this attribute could be reduced further.
Marine turtles *Green turtle (C. mydas)*	*Post-capture mortality (Susceptibility)*	Ocean Beach Fishery	3	1	Data submitted through the logbook program provides limited insight on SOCI interactions in the Ocean Beach Fishery. From 2003 to 2017 (inclusive), 28 green turtles, one loggerhead turtle, one cormorant and a sea snake interaction were all

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Loggerhead turtle (C. caretta) *Hawksbill turtle (E. imbricata)*					reported from beach seine and haul nets. Based on the data provided, all of these animals were released alive. Thirty of the 31 SOCI interactions from the Ocean Beach Fishery (incl. both seine and haul netting) were reported from 2004 and 2005. The only other record was for a sea snake that was caught in 2015. At present, there is limited capacity to verify the veracity of the SOCI data or account for non-report years. This is the primary reason why the *post-capture mortality* attribute was assigned a precautionary high (3) rating in the PSA. In net fisheries, the probability of a marine turtle interaction ending in a mortality will increase with the length of the interaction due to increased entanglement, reduced access to the surface and exhaustion and stress. While this has been identified as a key risk in large mesh net fishery (*e.g.* gillnets and ring nets), it is viewed as less of an issue in the Ocean Beach Fishery. When compared to gillnets that are set in place and allowed to soak, seine or haul netting is a more active form of fishing. Nets are operated from the shoreline where one end has been anchored. The other end is then towed out in a wide arc around a school of fish before it is returned to the beach. Fish caught within the sweep of the net are then hauled into shallow waters or back onto the beach where they are sorted. This process (excluding sorting) is completed over a relatively short period with the net setting and retrieval process often lasting <30 minutes (*pers. comm*. T. Ham). In the event that a turtle is caught in the sweep of the net, the short shot times will limit the length of the interaction. For most of this period the turtle will still be able to access the surface to breath until it is released from the net. In addition to a shorter shot times and fishing events, seine nets must have a mesh size of at least 12mm but no more than 70mm. This compares to most nets used under the N1, N2 and N4 fishery symbols which, depending on the area of operation, have mesh size range of between 160 and 215mm (Department of Agriculture and Fisheries,

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					2019a). While the use of a smaller mesh size does not completely mitigate the risk of a marine turtle becoming entangled, it will reduce it. This again increases the likelihood of the animal surviving the fishing event. If and when a marine turtle is caught in a seine net, net attendance provisions requiring the net to be operated by a minimum of one commercial fisher and two to four assistant fishers would help to identify their capture within the net. ***Key changes to the PSA scores*** Based on the above considerations, scores assigned to the *post-capture mortality* attribute were reduced from high (3) to low (1). These amendments were done in accordance with *Guideline 2: additional scientific assessment & consultation* and *Guideline 6: Management arrangements to mitigate against the level of bycatch*.
Dolphins *Australian humpback dolphin (S. sahulensis)*	*Age at maturity (Productivity)*	Ocean Beach Fishery	3	2	Information on the biology and life-history constraints of the Australian humpback dolphin (*S. sahulensis*) is limited. As a consequence, the species was assigned a precautionary high (3) risk score for the *age at maturity* attribute as part of the PSA. Subsequent consultation on the biology of dolphin species found in Queensland waters indicated that the *age at maturity* for this species would be less than 15 years (*pers. comm.* J. Meager). ***Key changes to the PSA scores*** Based on the advice provided, the preliminary score assigned to this attribute in the PSA was reduced from high (3) to medium (2) as part of the RRA. This amendment was done in accordance with *Guideline 2: additional scientific assessment & consultation*.
Dolphins	*Size at maturity (Productivity)*	Ocean Beach Fishery	3	2	In the PSA, the Australian humpback dolphin (*S. sahulensis*) was assigned a precautionary high (3) risk rating for the *size at maturity* attribute. Subsequent

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Australian humpback dolphin (S. sahulensis)					consultation on the dolphin species that occur in Queensland waters and their biology indicated that the size of maturity for this species would be ≤2m (*pers. comm.* J. Meager). ***Key changes to the PSA scores*** Based on the advice provided, the preliminary score assigned to this attribute in the PSA was reduced from high (3) to medium (2) as part of the RRA. This amendment was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Dolphins *Common bottlenose dolphin (T. truncatus)*	*Size at maturity (Productivity)*	Ocean Beach Fishery	3	3	*Age at maturity* for the common bottlenose dolphin (*T. truncatus*) was not known and the species was assigned a precautionary high (3) risk score for this attribute as part of the PSA. Subsequent consultation on dolphin species that occur in Queensland waters and their biology indicated that there were no age studies for Australian populations. However, studies on other populations provided estimates of around 2.8–2.9m. Further consultation confirmed that *size at maturity* is likely to be >2.7m (*pers. comm.* J. Meager). ***Key changes to the PSA scores*** No changes required.
Dolphins *Common bottlenose dolphin (T. truncatus*) *Indo-Pacific dolphin* *(T. aduncus)*	*Availability (Susceptibility)*	Ocean Beach Fishery	3	1	Regional distribution maps were not available for the common bottlenose (*T. truncatus*) or the Indo-Pacific bottlenose dolphin (*T. aduncus*). Accordingly, the species were assessed under the alternate criteria for the *availability* attribute: '*Global distribution & stock proxy considerations*'. Under the ERAEF methodology (Hobday *et al.*, 2007), barriers to dispersal are given significant weighting and additional considerations are given to geographic barriers, temporal barriers, ecological barriers, behavioural barriers

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					and early life history barriers. When the bottlenose dolphins were assessed through these criteria, they were both allocated a precautionary high risk rating for this attribute. While noting the high risk rating and the justifications used, these values were considered to be an overestimate for the Ocean Beach Fishery. This inference was supported by data on the global distribution and abundance of both species. To address this issue, distribution maps were sourced from the IUCN and the *availability* attribute recalculated. As the IUCN maps are based at a global level, they provide limited information on the distribution of the species in Australian waters. The maps though were considered to be more representative of the current situation (*verse* the alternate criteria). ***Key changes to the PSA scores*** Based on the revised *availability* assessments, the following amendments were made to the preliminary scores assigned to the *availability* attribute: - Common bottlenose dolphin (*T. truncatus*): score downgraded from high (3) to low (1). - Indo-Pacific bottlenose dolphin (*T. aduncus*): score downgraded from high (3) to low (1). The above changes were largely done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*
Dolphins	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	1	For most species, the *encounterability* attribute is assessed on two components: 1) the habitat preferences of the species being assessed when it is an adult, and 2) its bathymetric preferences. These measures are overridden for air-breathing species which, based on the ERAEF, are assigned a default high risk (3) score for this attribute

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Australian humpback dolphin (S. sahulensis)					(Hobday *et al.*, 2007). The premise being that air-breathing animals need to access the surface and therefore have a higher potential of interacting with the gear across the entire fishing event *e.g.* during the net setting, soak and retrieval processes (Hobday *et al.*, 2007). In-line with this methodology, all dolphin species were assigned a preliminary risk score of high risk (3) score as part of the PSA. The Australian humpback dolphin (*S. sahulensis*) is widely considered to be an inshore species and is often associated with shallow water environments (<20m) in close proximity to river mouths and estuaries (Parra *et al.*, 2006a; Parra *et al.*, 2006b). This contrasts with the Ocean Beach Fishery where schools are fish are targeted in open water environments exposed to greater disturbance. These differences, while not mitigating the risk completely, reduces the likelihood that the species will be encountered in this fishery. Based on their habitat preferences, Australian humpback dolphins are more likely to be encountered by gillnets and ring nets operating in the GBRMP or along the adjacent coastline. South of the GBRMP, fishers are more likely to encounter and interact with the humpback dolphin including in sheltered areas of the *Great Sandy* and *Moreton Bay Marine Parks* (Department of Environment and Science, 2018a; b). ***Key changes to the PSA scores*** Given the areas where ocean beach fishers operate and the habitats preferred by this species, scores assigned to the *encounterability* attribute were reduced from high (3) to low (1). Changes made as part of the RRA were done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment & consultation.*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Dolphins *Common bottlenose dolphin (T. truncatus)* *Indo-Pacific bottlenose dolphin (T. aduncus)*	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	2	The common bottlenose dolphin (*T. truncatus*) and the Indo-pacific bottlenose dolphin (*T. aduncus*), as with the Australian humpback dolphin (*S. sahulensis*), where assigned the highest score for the *encounterability* attribute. This again was due to the ERAEF methodology which assigns a default high risk (3) score to this attribute for all air breathing species (Hobday *et al.*, 2007). In Australia, the common bottlenose dolphin is more frequently observed in deeper water environments (>30m) (Allen *et al.*, 2016; Corkeron & Martin, 2004; Department of the Environment, 2019j; Hale *et al.*, 2000). Seine/haul nets are set from the shore line in an arc and are retrieved in a relatively short period of time; <30 minutes (*pers. comm.* T. Ham). These factors reduce the depth profile of the fished area and the extent of the overlap with areas where an interaction with this species is more likely to occur. The Indo-Pacific bottlenose dolphin inhabits shallow coastal waters on the continental shelf, around islands, estuaries and reefs (Cribb *et al.*, 2013; Department of the Environment, 2019k; Hale *et al.*, 2000). The species is commonly observed in the Moreton Bay and Great Sandy Marine parks and it is prevalent in south-east Queensland. These factors, again, suggest that the species may interact with the Ocean Beach Fishery or be encountered. This potential though is counterbalanced by the species' general preference for sheltered habitats, bays and estuaries (Cribb *et al.*, 2013; Fury & Harrison, 2008) ***Key changes to the PSA scores*** Given the areas where ocean beach fishers operate and the areas where the two bottlenose dolphins are more likely to be observed and encountered, scores assigned to this attribute were reduced from high (3) to medium (2). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation*—specifically on the dynamics and operational constraints of the fishery.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					It is conceivable that a medium risk (2) score for this attribute still overestimates the encounterability potential for these two species. There are however limited avenues to verify interaction rates in this fishery including (potential) contact without capture events *e.g*. the animals actively engaging with the net or escaping before the net is hauled into shallow water environments. Improving the level of information on dolphin interactions in this fishery and catch monitoring techniques could facilitate further reductions in the risk score for this attribute and/or support the removal of these species from subsequent ERAs.
Dolphins *Australian humpback dolphin (S. sahulensis)* *Common bottlenose dolphin (T. truncatus)* *Indo-Pacific bottlenose dolphin (T. aduncus)*	*Selectivity (Susceptibility)*	Ocean Beach Fishery	3	2	Seine and haul nets are more reliant on the trapping fish within the enclosed net or bag *verse* gillnets which rely on a fish swimming into and become entangled in the net. A more active form of fishing, seine and haul nets are highly effective as animals encircled by the net have a high probability of the being caught. While noting this probability, the *selectivity* risk will be highest in shallow water environments and during the net retrieval process. Prior to the net retrieval process, the *selectivity* risk will vary and will be lower for more mobile species like dolphins due to their increased ability to avoid the net or escape the area immediately impacted by the fishing event *e.g.* leaving the fished area before the net has come full circle, swimming underneath the net during the net setting process. The meshing potential for nets used in the Ocean Beach Fishery is also smaller with current regulations restrict the mesh size of seine nets to between 12 and 70mm (Department of Agriculture and Fisheries, 2019a). This compares to the N1, N2 and N4 fishery symbols (gillnets and ring nets) where, depending on the location and symbol, have a mesh size range of 160 to 215mm (Department of Agriculture and Fisheries, 2019a). While the use of the smaller mesh does not completely mitigate the risk of a dolphin becoming entangled in the net, it will reduce it.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					Due to these reasons, the risk score assigned to this attribute as part of the PSA was considered to be an overestimate. ***Key changes to the PSA scores*** Scores assigned to the *selectivity* attribute were reduced from high (3) to medium (2) all three species. These amendments were done in accordance with *Guideline 2: additional scientific assessment & consultation*—specifically on the dynamics and operational constraints of the fishery. It is acknowledged that this score may still represent an overestimate for these species. This inference is partially supported by an absence of records on dolphin interactions in the Ocean Beach Fishery. Further reductions in this score though are unlikely without additional supporting evidence and/or improved measures to validate catch compositions and SOCI interaction rates (or lack thereof).
Dolphins *Australian humpback dolphin (S. sahulensis)* *Common bottlenose dolphin (T. truncatus)* *Indo-Pacific bottlenose dolphin (T. aduncus)*	*Post-capture Mortality (Susceptibility)*	Ocean Beach Fishery	3	1	SOCI data for the Ocean Beach Fishery does not include any dolphin interactions and there is limited data on how they interact with beach seines; hence the preliminary high risk (3) score for this attribute. The fishery does operate in nearshore/inshore waters and targets species that are preyed on by dolphins. To this extent there is some potential for dolphins to interact with this sector of the ECIF. While noting this potential, preliminary scores assigned to this attribute were considered to be a risk overestimate. When compared to gillnets that are set in place and allowed to soak, seine or haul netting is a more active form of fishing. Nets are operated from the shoreline where one end has been anchored. The other end is then towed out in a wide arc around a school of fish before it is returned to the beach. Fish caught within the sweep of the net are then hauled into shallow waters or back onto the beach where they are sorted. This process (excluding sorting) is completed over a relatively short period with the net

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					setting and retrieval process often lasting <30 minutes (*pers. comm*. T. Ham). In the event that a dolphin is caught in the sweep of the net, the short shot times will limit the length of the interaction. For most of this period the dolphin will still be able to access the surface to breath until it is released from the net. In addition to a shorter shot times and fishing events, seine nets must have a mesh size of at least 12mm but no more than 70mm. This compares to most nets used under the N1 and N2 fishery symbols which, depending on the area of operation, have a mesh size range of between 160 and 215mm (Department of Agriculture and Fisheries, 2019a). While the use of a smaller mesh size does not completely mitigate this risk, it will reduce it. This again increases the likelihood of the animal surviving the interaction. If and when a dolphin is caught in a seine net, net attendance provisions requiring the net to be operated by a minimum of one commercial fisher and two to four assistant fishers would help to identify their capture within the net. ***Key changes to the PSA scores*** Based on the above considerations, scores assigned to the *post-capture mortality* attribute were reduced from high (3) to low (1). These amendments were done in accordance with *Guideline 6: Management arrangements to mitigate against the level of bycatch* and *Guideline 2: additional scientific assessment & consultation*.
Batoids *Bottlenose wedgefish (R. australiae)*	*Age at maturity (Productivity)*	Ocean Beach Fishery	3	2	There is limited information on the age and growth of *R. australiae* including on their age of sexual maturity. This was reflected in the preliminary scores assigned as part of the PSA. A limited study on the age and growth of a broader *Rhynchobatus* complex indicates that this species grows to at least 12 years of age with males reaching maturity at an estimated 3–5 years (Rigby, 2019; Simpfendorfer *et al.*, 2019; White *et al.*, 2014). As this estimate is based on a combined male sample, it is difficult to determine how these

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					results translate to different *Rhynchobatus* species and or to females. With that said, there is considerable evidence that most batoids will reach sexual maturity before 15 years of age—the cut off for a high risk rating (Jacobsen & Bennett, 2011; Last *et al.*, 2016; Smith *et al.*, 2007; White *et al.*, 2014; White & Dharmadi, 2007; White *et al.*, 2006). ***Key changes to the PSA scores*** To accommodate the above considerations, the score assigned to the *age at maturity* attribute was downgraded from high (3) to medium (2). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation*. With additional information the scores assigned to this attribute could be reduced further. Further reductions *i.e.* to low risk (1) were not considered to be an option in this ERA given a) uncertainty surrounding the age at sexual maturity for females and b) an absence of species-specific data.
Batoids *Bottlenose wedgefish (R. australiae)*	*Availability (Susceptibility)*	Ocean Beach Fishery	3	1	Distribution maps were not available for the bottlenose wedgefish (*R. australiae*) and the species was assigned a high (3) risk ratings as part of the initial PSA. In the RRA, this score was refined and recalibrated using an alternate map from the IUCN (Kyne *et al.*, 2019b). ***Key changes to the PSA scores*** The preliminary score assigned to this attribute in the PSA was decreased from high (3) to low (1) based on the revised map assessment. This amendment was primarily done in accordance with *Guideline 2: additional scientific assessment & consultation.* Given the size and distribution of the Ocean Beach Fishery, this change is unlikely to result in a false positive result.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Batoids *Bottlenose wedgefish (R. australiae)* *Giant shovelnose ray (G. typus)*	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	2	Habitat descriptions for both the bottlenose wedgefish (*R. australiae*) and the giant shovelnose ray (*G. typus*) are relatively broad. Both species occur from close inshore waters to depths up to 100m on the continental shelf (Kyne *et al.*, 2019a; Kyne *et al.*, 2019b). In the PSA, preliminary scores were assigned on the basis of the broader habitat and bathymetry preferences of the bottlenose wedgefish and the giant shovelnose rays. These preliminary scores recognise that the distribution of the two species in inshore waters / inter-tidal habitats, and the potential for the species to be encountered in by ocean beach fishers. While noting the preliminary risk scores, a high (3) rating for the *encounterability* attribute was considered to be an overestimate for this sector of the ECIF. As the two species prefer inshore waters, they will invariably interact with the Ocean Beach Fishery. However, the area of operation combined with the comparatively high-energy nature of the fished area suggest that interaction rates will be lower in this fishery (*pers. comm.* T. Ham). This is of particular relevance when the *encounterability* potential of the Ocean Beach Fishery is compared to other sectors of the ECIF (*e.g.* gillnets, tunnel nets) and inshore trawl fisheries. ***Key changes to the PSA scores*** Preliminary scores assigned to the *encounterability* attribute were reduced from high (3) to medium (2). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation* with consideration given to *Guideline 4: at risk in regards to level of interaction/capture with a zero or negligible level of susceptibility.* The amended scores may still represent an overestimate of the risk posed to these two species. With improved information on catch rates and species compositions, the score assigned to this attribute could be reduced further.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Batoids *Bottlenose wedgefish (R. australiae)* *Giant shovelnose ray (G. typus)*	*Selectivity (Susceptibility)*	Ocean Beach Fishery	3	2	The *selectivity* of a seine/haul net will be highest during the net retrieval process and in shallow water environments *i.e.* when the drop of the net and water depth are more closely aligned. It is during this time that the probability that an animal within the encircled area will be retained within the net. It is within this context that the bottlenose wedgefish (*R. australiae*) and the giant shovelnose ray (*G. typus*) were assigned a higher risk rating for the *selectivity* attribute as part of the PSA. While noting this risk, scores assigned in the PSA are considered to be an overestimate of the *selectivity* risk for these species. As the Ocean Beach Fishery targets schools of fish at or around the surface (*e.g.* tailor, mullet), the net is more likely to be set at a location where the water depth will be larger the than the drop of the net. As shovelnose rays and guitarfish live a largely benthic existence (Last *et al.*, 2016), nets set in deeper waters are more likely to pass over the ray. As the net is hauled into shallow water environments and closer to the shoreline, the *selectivity* risk will increase and shovelnose rays / guitarfish caught in the sweep of the net will have a higher probability of being caught. A proportion of these rays though will still be able to escape the net by (*e.g.*) swimming under it or burying themselves in the substrate. ***Key changes to the PSA scores*** Preliminary score assigned to the *selectivity* attribute was reduced from high (3) to medium (2) for both the bottlenose wedgefish and the giant shovelnose ray. These changes recognise that a) net *selectivity* for these species will vary with water depth, and b) the species are more likely to escape under the net due to their benthic existence. Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation* with consideration given to *Guideline*

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					4: at risk in regards to level of interaction/capture with a zero or negligible level of susceptibility. It is acknowledged that the amended scores may still represent an overestimate of the risk posed to these two species. This inference though will be difficult to support without further information on the extent of shovelnose ray / guitarfish interactions in this fishery including the number of animals that are caught in the fishery. With improved information, there may be avenues to further reduce the scores assigned to this attribute.
Batoids *Bottlenose wedgefish (R. australiae)* *Giant shovelnose ray (G. typus)*	*Post-capture Mortality (Susceptibility)*	Ocean Beach Fishery	3	2	Under the current regulations, the bottlenose wedgefish (*R. australiae*) and the giant shovelnose ray (*G. typus*) can be retained for commercial sale. Both species are managed under a maximum size limit of 1.5m and the catch of guitarfish and shovelnose rays is further restricted by a combined in-possession limit of five individuals (Department of Agriculture and Fisheries, 2019a). Under the PSA criteria all species that can be retained for sale are assigned the highest score for the *post-capture mortality* attribute. While noting the reasons behind this assessment (Australian Fisheries Management Authority, 2018; Hobday *et al.*, 2007), this criterion is less suited to the Ocean Beach Fishery. The main reasons for this are: 1) Both species are taken in comparatively small amounts across the entire ECIF; 2) The large mesh net fishery (*e.g.* gillnets and ring nets) which has a larger footprint will account for the majority of this catch. They can however be retained for sale by ocean beach fishers; 3) The Ocean Beach Fishery primarily targets schools of mullet and tailor and shovelnose / guitarfish are not viewed as primary targets;

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					4) While discards will be a factor, these animals are expected to have high post-interaction survival rates due to the nature of the apparatus and the (comparatively) low entanglement potential. ***Key changes to the PSA scores*** Based on the above considerations, preliminary score assigned to the *post-capture mortality* attribute were reduced from high (3) to medium (2). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation.* As with the encounterability attribute, the revised scores may still overestimate the level of risk for this attribute. There is however an absence of data on the total catch (retained plus discards) of these species and/or limited capacity to validate catch compositions from the Ocean Beach Fishery. While overall catch levels for these species are likely to be low, this absence of information restricted the extent of the attribute score reduction.
Sharks *Scalloped hammerhead shark (S. lewini*) *Great hammerhead shark (S. mokarran)*	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	2	The *encounterability* attribute for the scalloped hammerhead shark (*S. lewini*) and the great hammerhead shark (*S. mokarran*) was difficult to assess. The great hammerhead is defined as a solitary, coastal, and semi-oceanic pelagic species that occurs close inshore and well offshore to depths of 300m (Rigby *et al.*, 2019a). Habitat descriptions for the scalloped hammerhead are similarly diverse: a coastal and semi-oceanic pelagic shark, found over continental and insular shelves and nearby deep waters ranging from the intertidal and surface to 275m (Rigby *et al.*, 2019b). This diversity of habitats and bathymetries were reflected in scores assigned to the *encounterability* attribute for these two species. While noting the justifications behind the PSA scores, it is considered to be an overestimate for the Ocean Beach Fishery. When compared to other sectors of the

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					ECIF, namely the large mesh net fishery (gillnets and ring nets), ocean beach fishing occurs over a smaller area and for a shorter period of time. This is because the net is set and retrieved in a single event; meaning soak times for this fishery are comparatively low (*e.g.* <30 minutes, *pers. comm.* T. Ham). This contrasts with gillnets that are set in place and allowed to soak for (on average) 6 hrs before they are retrieved. This additional soak time increases the likelihood of a hammerhead shark being encountered in the fishery; something that is reflected in the catch data (Appendix B). Shorter fishing events will limit interactions with this subgroup and restricts hammerhead shark interactions to the immediately fished area. This contrasts with the large mesh net fishery that target sharks within the immediate area and those that pass through a fished area for the duration of the soak time. ***Key changes to the PSA scores*** The preliminary score assigned to the *encounterability* attribute was reduced from high (3) to medium (2). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation*—specifically on the dynamics and operational constraints of the fishery. While the above factors reduce the *encounterability* potential, hammerhead sharks may still interact with this aspect of the ECIF. Hammerhead shark interaction rates are expected to be low in the Ocean Beach Fishery. However, there is limited data on the composition of the total seine net catch and/or the prevalence on non-target species in this fishery. With improved data on a) overall catch compositions and b) the frequency of interactions with non-target species, scores assigned to this attribute could be reduced further. With improved data, further consideration could be given to excluding these species form the Ocean Beach Fishery altogether.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Sharks *Smooth hammerhead shark (S. zygaena*)	*Encounterability (Susceptibility)*	Ocean Beach Fishery	3	1	While the distribution of the smooth hammerhead shark (*S. zygaena*) extends into Queensland, it is primarily found in temperate waters. Encounters with the smooth hammerhead are more likely to occur in south-east Queensland and New South Wales. While the species has been observed north of these areas, they are generally found in lower numbers and smaller densities (*pers. comm.* C. Simpfendorfer). This was reflected in the assessment of the *availability* attribute. In the PSA assessment, the species was assigned the highest risk score as it inhabits a range of inshore and pelagic environment. As the ocean beach fishery operates (approximately) from the northern tip of Fraser Island to the Queensland – New South Wales border, the species may interact with this aspect of the ECIF. The extent of these interactions though will be limited by the depth profile of the fishery and nature of the apparatus; particularly since the gear is set and retrieved from the beach. This combined with the species preference for more temperate waters suggests that the species, while still observed, will not be encountered in the fishery in significant quantities. ***Key changes to the PSA scores*** Due to the above considerations, the preliminary score assigned to the *encounterability* attribute was reduced from high (3) to low (1). Changes made as part of the RRA were done in accordance with *Guideline 2: additional scientific assessment & consultation*—specifically on the dynamics and operational constraints of the fishery. These changes recognise the current distribution of effort and the fact that interactions with this species will be confined to a small section the Queensland coastline. In the context of this ERA, further information on hammerhead shark interaction rates and catch compositions would help inform discussions surrounding the need to include these species in subsequent assessments.

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
Sharks *Hammerhead shark (S. mokarran)* *Scalloped hammerhead shark (S. lewini*) *Smooth hammerhead shark (S. zygaena*)	*Selectivity (Susceptibility)*	Ocean Beach Fishery	3	2	The RRA of scores assigned to the *selectivity* attribute for the hammerhead sharks shares similarities with that reported for the three dolphin species. Seine and haul nets are more reliant on the trapping fish within the enclosed net or bag *verse* gillnets which rely on a fish swimming into and become entangled in the net. A more active form of fishing, seine and haul nets are highly effective as animals encircled by the net have a high probability of the being caught. While noting this probability, the *selectivity* risk will be highest in shallow water environments and during the net retrieval process. Prior to the net retrieval process, the *selectivity* risk will vary and will be lower for more mobile species due to their increased ability to avoid the net or escape the area immediately impacted by the fishing event *e.g.* leaving the fished area before the net has come full circle, swimming underneath the net during the net setting process. Research has shown that the morphology of the hammerhead shark cephalofoil makes them more susceptible to net entanglements (Harry *et al.*, 2011a; Tobin *et al.*, 2010). This is considered to be less of a risk in Ocean Beach Fishery where mesh sizes for seine nets must be at least 12mm but no more than 70mm (Department of Agriculture and Fisheries, 2019a). This compares to the N1, N2 and N4 fishery symbols (gillnets and ring nets) where, depending on the location and symbol, have a mesh size range from 160 and 215mm (Department of Agriculture and Fisheries, 2019a). These restrictions will not completely mitigate the entanglement risk, particularly for smaller animals. It will however reduce the *selectivity* risk for larger animals that are encircled by the net. ***Key changes to the PSA scores*** Preliminary scores assigned to the *selectivity* attribute was reduced from high (3) to medium (2) for all three species. Changes made as part of the RRA were done in

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					accordance with *Guideline 2: additional scientific assessment & consultation* and *Guideline 4: management arrangements to mitigate against the level of bycatch.* Hammerhead shark interaction rates are expected to be low in the Ocean Beach Fishery. However, there is limited data on the composition of the total seine net catch and / or the prevalence on non-target species in this fishery. With improved data on a) overall catch compositions and b) the frequency of interactions with non-target species, scores assigned to this attribute could be reduced further.
Sharks *Smooth hammerhead shark (S. zygaena*) *Scalloped hammerhead shark (S. lewini*) *Great hammerhead shark (S. mokarran)*	*Post-capture mortality (Susceptibility)*	Ocean Beach Fishery	3	2	While hammerhead sharks can be retained for sale in the ECIF, only licence holders with a shark (S) fishery symbol can retain them in higher quantities. The remaining net and line symbol holders are restricted by shark and ray in-possession limits. Of the licences with a K fishing symbol attached, only five have a complimentary S fishery symbol and can retain sharks in larger quantities. These fishers though are unlikely to retain shark product in higher quantities when using a seine/haul net. The main reason being that these operations primarily target schools of sea mullet and tailor. Under the PSA criteria all species that can be retained for sale are assigned the highest score for the *post-capture mortality* attribute. While noting the reasons behind this assessment (Australian Fisheries Management Authority, 2018; Hobday *et al.*, 2007), this criterion is less suited to the Ocean Beach Fishery. The main reasons for this are: 1) Hammerhead sharks are primarily retained for sale in the large mesh net fishery (gillnets & ring nets) which has a larger footprint and accounts for the majority of the catch; 2) The Ocean Beach Fishery primarily targets schools of mullet and tailor using short shot times that are less likely to interact with a higher number of hammerhead sharks;

Species	Attribute	Sub-fishery	PSA Score	RRA Score	Justifications and Considerations
					3) While discards will be a factor, these animals are expected to have high post-interaction survival rates due to the nature of the apparatus, the (comparatively) low entanglement potential. Research has shown that the morphology of the hammerhead shark cephalofoil makes them more susceptible to net entanglements (Harry *et al.*, 2011a; Tobin *et al.*, 2010). This problem is further compounded by the fact that hammerhead sharks have a low tolerance for net entanglements and are more likely to die without relatively rapid intervention (Harry *et al.*, 2011b). This is considered to be less of a risk in Ocean Beach Fishery where mesh sizes for seine nets must be at least 12mm but no more than 70mm (Department of Agriculture and Fisheries, 2019a). This compares to the N1, N2 and N4 fishery symbols (gillnets and ring nets) where, depending on the location and symbol, have a mesh size range from 160 and 215mm (Department of Agriculture and Fisheries, 2019a). While the above restrictions will not completely mitigate the entanglement risk, particularly for smaller hammerhead sharks, it will help to limit the number of *in-situ* mortalities. This is considered to be of particular relevance in the Ocean Beach Fishery where hammerheads are not considered to be a target species and therefore will be discarded with more regularity when compared to other sectors of the ECIF. ***Key changes to the PSA scores*** Based on the above considerations, preliminary scores assigned to the *post-capture mortality* attribute were reduced from high (3) to medium (2) for all three species. Changes made as part of the RRA were primarily done in accordance with *Guideline 2: additional scientific assessment & consultation* and *Guideline 4: management arrangements to mitigate against the level of bycatch.*

Appendix D—Supplementary Risk Assessment: Likelihood & Consequence Analysis

1. Overview & Background

The *Productivity & Susceptibility Analysis* (PSA) includes a number of elements to minimise the risk of a 'false negative' result *i.e.* high risk species being incorrectly assigned a lower risk rating. However, the PSA tends to be more conservative and research has shown that it has a higher potential to produce 'false positives'. That is, low risk species being assigned a higher risk score due to the conservative nature of the method, data deficiencies etc. (Hobday *et al.*, 2011; Hobday *et al.*, 2007; Zhou *et al.*, 2016). In the Level 2 Ecological Risk Assessment (ERA), false positives are addressed through the *Residual Risk Analysis* (RRA) and the assignment of '*precautionary'* risk ratings.

To inform the assignment of *precautionary* risk ratings, each species was subjected to a *Likelihood & Consequence Analysis* (LCA). The LCA, in essence, provides a closer examination of the magnitude of the potential consequence and the probability (*i.e.* likelihood) that those consequences will occur given the current management controls (Fletcher, 2014; Fletcher *et al.*, 2002; Fletcher *et al.*, 2005). A flexible assessment method, the LCA can be used as a screening tool or to undertake more detailed risk assessments (Fletcher, 2014).

In the Level 2 ERA, a simplified version of the LCA was used to provide the risk profiles with further context and evaluate the applicability of the assessment to the current fishing environment. More specifically, the LCA was used to assist in the allocation of *precautionary* risk ratings which are assigned to species with more conservative risk profiles. The benefit of completing a fully qualitative assessment following a more data-intensive semi-quantitative assessment is the reduction of noise in the form of false-positives. This was considered to be of particular importance when identifying priority risks for this fishery.

As the LCA is qualitative and lacks the detail of the PSA, the outputs should not be viewed as an alternate or competing risk assessment. To avoid confusion, the results of the PSA/RRA will take precedence over the LCA. The LCA was only used to evaluate the potential of the risk coming to fruition over the short to medium term.

2. Methods

The LCA was constructed using a simplified version of the *National ESD Reporting Framework for Australian Fisheries* (Fletcher, 2014; Fletcher *et al.*, 2002; Fletcher *et al.*, 2005) and focused specifically on the *Risk Analysis* component. It is recognised that the *National ESD Reporting Framework* incorporates additional steps including ones that establish the context of the assessment and identifies key risks. As these steps were fulfilled with the completion of a *Scoping Study* (Department of Agriculture and Fisheries, 2019a) and whole-of-fishery (Level 1) assessment (Jacobsen *et al.*, 2019), they were not replicated for the Level 2 ERA. For a more comprehensive overview of the *National ESD Reporting Framework for Australian Fisheries* consult Fletcher *et al.* (2002) and Fletcher (2014).

Risk Analysis considers a) the potential consequences of an issue, activity or event (Table D1) and b) the likelihood of a particularly adverse consequence occurring due to these activities or events (Table D2). Central to this is the establishment of a Likelihood *x* Consequence matrix that estimates the risk based on scores assigned to each component (Table D3).

***Table D1**. Criteria used to assign scores to the Consequence component of the analysis.*

Level	Score	Definition
Negligible	0	Almost zero harvest / mortalities with impact unlikely to be detectable at the scale of the stock/regional population.
Minor	1	Assessed as low risk through the PSA and/or fishing activities will have minimal impact on regional stocks or populations.
Moderate	2	Assessed as a medium risk through the PSA / harvest levels or mortalities at, near or approaching maximum yields (or equivalent).
Severe	3	Species assessed as high risk through the PSA / harvest or mortalities at levels that are impacting stocks and/or has high vulnerability and low resilience to harvest.
Major	4	Species assessed as high risk through the PSA / harvest levels or mortalities has the potential to cause serious impacts with a long recovery period required to return the stock/population to an acceptable level.

***Table D2**. Criteria used to assign indicative scores of the likelihood that fishing activities in the Ocean Beach sector of the East Coast Inshore Fishery (ECIF) will result in or make a significant contribution to a Severe or Major consequence.*

Level	Score	Definition
Likely	5	Expected to occur under the current fishing environment / management regime.
Occasional	4	Will probably occur or has a higher potential to occur under the current fishing environment / management regime.
Possible	3	Evidence to suggest it may occur under the current fishing environment / management regime.
Rare	2	May occur in exceptional circumstances.
Remote	1	Has never occurred but is not impossible.

***Table D3**. Likelihood & Consequence Analysis risk matrix used to assign indicative risk ratings to each species: blue = negligible risk, green = low risk, orange = medium risk and red = high risk.*

		Consequence				
Likelihood		**Negligible**	**Minor**	**Moderate**	**Severe**	**Major**
		0	1	2	3	4
Remote	1	0	1	2	3	4
Rare	2	0	2	4	6	8
Possible	3	0	3	6	9	12
Occasional	4	0	4	8	12	16
Likely	5	0	5	10	15	20

For the consequence analysis (Table D2), criteria used to assign scores (0–4) were based on the outputs of the semi-quantitative assessment (*e.g.* PSA/RRA results outlined in section 4, Table 7). In the likelihood assessment (Table D1), scores reflect the likelihood of the fishery causing or making a significant contribution to the occurrence of the most hazardous consequence (Fletcher *et al.* 2002). Once scores are assigned to each aspect of the LCA, they are used to calculate an overall risk value (Risk = Likelihood *x* Consequence) for each species (Table D3).

As the Level 2 ERA uses the LCA as a supplementary assessment, risk scores and ratings were not linked to any operational objective; as per the *National ESD Reporting Framework* (Fletcher, 2014; Fletcher et al., 2005). Instead, these issues are addressed directly as part of the Level 2 ERA through fisheries-specific recommendations. Criteria used to assign scores for likelihood and consequence are outlined in Table D1 and D2 respectively. The Likelihood *x* Consequence matrix used to assign risk ratings is provided as Table D3.

3. Results & Considerations

When compared to the PSA/RRA, risk estimates generated through the LCA were generally lower. This was to be expected as the LCA gives greater consideration and equal waiting to the probability (likelihood) of a fishery contributing to or causing a severe or major event under the current conditions (*e.g.* catch, effort and interaction trends). In a number of instances, the outputs of the LCA supported the assignment of *precautionary* risk ratings.

Teleosts (Target & Byproduct Species)

Risk estimates compiled as part of the LCA risk assessed all 11 teleosts as low risk. However, matrix scores for trumpeter whiting, tarwhine, snubnose dart and swallowtail dart were all at the higher end of the spectrum (Table D4). All mullet species, yellowfin bream and sand whiting had LCA estimates that aligned with the PSA/RRA; the remainder were below that reported in the main report.

The results of the LCA reflect the small-scale nature of the Ocean Beach Fishery in terms of having a retracted fishing area and shorter fishing season. Three of the 11 teleost species have stock assessments confirming stocks are not being fished beyond their reference points (Leigh *et al.*, 2019; Lovett *et al.*, 2018), while the others (*i.e.* mullet other than sea mullet) will make minor contributions to overall catch. For these reasons, it is likely the LCA results support the outcomes of the PSA/RRA in that none of the harvested teleost species are at high risk from ocean beach fishing activities.

Marine turtles (SOCC)

All LCA risk estimates for the marine turtles were lower than the PSA/RRA (Table D4). Factors that contributed to low LCA estimates included the comparatively small size of the Ocean Beach Fishery relative other net sectors (in terms of number of active licences), the highly selective nature of the operation, and the lower likelihood of marine turtles interacting with the gear. In addition, in attendance provisions will mean that any marine turtles that are captured will likely be released alive. The LCA risk ratings for marine turtles are reflective of the PSA/RR results in that this group is not likely to experience an undesirable event from ocean beach fishing activities.

Dolphins (SOCC)

The three dolphin species were all assessed as low risk in the LCA and supported the assignment of *precautionary* risk ratings (Table D4). These results reflect the likelihood of an undesirable event

occurring for these species due to fishing activities in the Ocean Beach Fishery. Of the three, the Australian humpback dolphin and the Indo-Pacific bottlenose dolphin were assigned marginally higher scores due to an increased overlap with the fished area and their preferred habitats.

Sharks (retainable SOCC)

The shark LCA mirrored that of the marine turtle and dolphin complexes, in that risk estimates were lower than in the PSA/RRA (Table D4). The notable difference between these two complexes is that hammerhead sharks can be retained for sale in the ECIF.

The Ocean Beach Fishery footprint will have a smaller overlap with hammerhead shark species distributions and preferred habitats, particularly smooth hammerheads (*S. zygaena*) which have a distribution that extends south. These factors were reflected in the likelihood scores and contributed to the species receiving lower overall risk scores and ratings (Table D4). Similarly, a stock assessment indicates that the great (*S. mokarran*) and scalloped (*S. lewini*) are being fished below MSY (Leigh, 2015). This was given considerable weighting in the consequence analysis.

The outputs of the LCA support the assignment of *precautionary* risk ratings to the three hammerhead shark species.

Batoids (retainable SOCC)

The LCA of the batoid risk assessment supported the assignment of *precautionary* risk ratings for both species (Table D4). While shovelnose rays and guitarfish can be retained for sale in the ECIF, the complex is managed under fairly stringent in-possession limits (*n* = 5 combined). These measures prevent the species being targeted in significant quantities and/or significant levels of effort being directed at the complex *e.g.* due to changing market demand. The low risk ratings from the LCA support the *precautionary medium* results of the PSA/RRA (Table D4).

***Table D4**. Results of the Likelihood & Consequence Analysis for species assessed as part of the Ocean Beach Fishery within the ECIF Level 2 ERA.*

Common name	Species name	Likelihood	Consequence	Matrix score	Risk category
Teleosts					
Sea mullet	*Mugil cephalus*	2	1	2	Low
Bluespot mullet	*Valamugil seheli*	1	1	1	Low
Fantail mullet	*Paramugil georgii*	1	1	1	Low
Goldspot mullet	*Liza argentea*	1	1	1	Low
Diamondscale mullet	*Liza vaigiensis*	1	1	1	Low
Trumpeter whiting	*Sillago maculata*	2	2	4	Low
Sand whiting	*Sillago ciliata*	2	1	2	Low

Common name	Species name	Likelihood	Consequence	Matrix score	Risk category
Yellowfin bream	*Acanthopagrus australis*	2	1	2	Low
Tarwhine	*Rhabdosargus sarba*	2	2	4	Low
Snubnose dart	*Trachinotus blochii*	2	2	4	Low
Swallowtail dart	*Trachinotus coppingeri*	2	2	4	Low
Marine turtles					
Green turtle	*Chelonia mydas*	2	2	4	Low
Loggerhead turtle	*Caretta caretta*	2	2	4	Low
Hawksbill turtle	*Eretmochelys imbricata*	2	2	4	Low
Dolphins					
Australian humpback dolphin	*Sousa sahulensis*	2	2	4	Low
Common bottlenose dolphin	*Tursiops truncatus*	1	3	3	Low
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	1	2	2	Low
Sharks					
Great hammerhead	*Sphyrna mokarran*	1	3	3	Low
Scalloped hammerhead shark	*Sphyrna lewini*	1	3	3	Low
Smooth hammerhead shark	*Sphyrna zygaena*	1	2	2	Low
Batoids					
Bottlenose wedgefish	*Rhynchobatus australiae*	2	2	4	Low
Giant shovelnose ray	*Glaucostegus typus*	2	2	4	Low

Appendix E—Summary of the marine turtle interaction data reported through the *Species of Conservation Interest* (SOCI) logbook.

Data compiled through the *SOCI* logbook on the total number interactions and their release fate. Data represents all of the marine turtle records reported from the *East Coast Inshore Fishery* (ECIF) and that compiled for each of the respective marine turtle species.

All marine turtle records										
	Gill netting		**Ring netting**		**Seine/Haul netting**		**Tunnel netting**		**Total**	
State	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**
2003	40	0	1	0	0	0	6	0	47	0
2004	673	4	18	0	19	0	228	0	938	4
2005	201	0	0	0	10	0	189	0	400	0
2006	220	1	0	0	0	0	0	0	220	1
2007	180	1	0	0	0	0	0	0	180	1
2008	291	12	0	0	0	0	0	0	291	12
2009	132	2	0	0	0	0	0	0	132	2
2010	96	1	0	0	0	0	0	0	96	1
2011	42	0	0	0	0	0	0	0	42	0
2012	8	0	46	0	0	0	0	0	54	0
2013	7	2	9	0	0	0	0	0	16	2
2014	3	0	31	0	0	0	0	0	34	0
2015	1	1	52	0	0	0	7	0	60	1
2016	20	0	117	0	0	0	102	0	239	0
2017	15	0	140	0	0	0	70	0	225	0
Total	1929	24	414	0	29	0	602	0	2974	24

Green turtles (Chelonia mydas)										
	Gill netting		**Ring netting**		**Seine/Haul netting**		**Tunnel netting**		**Total**	
State	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**
2003	33	0	1	0			6	0	40	0
2004	618	1	16	0	18	0	223	0	875	1
2005	169	0			10	0	187	0	366	0
2006	167	0							167	0
2007	125	0							125	0
2008	276	0							276	0
2009	131	1							131	1
2010	81	1							81	1
2011	40	0							40	0
2012	4	0	45	0					49	0
2013	4	2	8	0					12	2
2014	0	0	31	0					31	0
2015	0	1	52	0			7		59	1
2016	15	0	110	0			102		227	0
2017	1	0	128	0			70		199	0
Total	1664	6	391	0	28	0	595	0	2678	6

Appendix E cont.—*Summary of the marine turtle interaction data reported by operators in the ECIF through the Species of Conservation Interest (SOCI) logbook. Data separated by species, fishing method and release state.*

Loggerhead turtles (Caretta caretta)										
	Gill netting		Ring netting		Seine/Haul netting		Tunnel netting		Total	
State	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
2003	7	0							7	0
2004	11	0	2	0	1	0	5	0	19	0
2005	0	0					1	0	1	0
2006	22	1							22	1
2007	8	0							8	0
2008	11	12							11	12
2009	0	1							0	1
2010	13	0							13	0
2011	0	0							0	0
2012	3	0	1	0					4	0
2013	0	0	1	0					1	0
2014	2	0							2	0
2015	0	0							0	0
2016	1	0	7	0					8	0
2017	9	0	11	0					20	0
Total	87	14	23	0	1	0	6	0	117	14

Hawksbill turtle (Eretmochelys imbricata)										
	Gill netting		Ring netting		Seine/Haul netting		Tunnel netting		Total	
State	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
2003	0	0							0	0
2004	30	3							30	3
2005	4	0					1	0	5	0
2006	0	0							0	0
2007	0	0							0	0
2008	1	0							1	0
2009	0	0							0	0
2010	0	0							0	0
2011	0	0							0	0
2012	0	0							0	0
2013	3	0							3	0
2014	0	0							0	0
2015	0	0							0	0
2016	2	0							2	0
2017	0	0	1	0					1	0
Total	40	3	1	0	0	0	1	0	42	3

Appendix E cont.—*Summary of the marine turtle interaction data reported by operators in the ECIF through the Species of Conservation Interest (SOCI) logbook. Data separated by species, fishing method and release state.*

Flatback turtle (Natator depressus)										
	Gill netting		Ring netting		Seine/Haul netting		Tunnel netting		Total	
State	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
2003	0	0							0	0
2004	0	0							0	0
2005	0	0							0	0
2006	0	0							0	0
2007	0	0							0	0
2008	0	0							0	0
2009	0	0							0	0
2010	0	0							0	0
2011	0	0							0	0
2012	0	0							0	0
2013	0	0							0	0
2014	1	0							1	0
2015	0	0							0	0
2016	2	0							2	0
2017	0	0							0	0
Total	3	0	0	0	0	0	0	0	3	0

Leatherback turtle (Dermochelys coriacea)										
	Gill netting		Ring netting		Seine/Haul netting		Tunnel netting		Total	
State	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
2003	0	0							0	0
2004	2	0							2	0
2005	0	0							0	0
2006	0	0							0	0
2007	0	0							0	0
2008	0	0							0	0
2009	1	0							1	0
2010	0	0							0	0
2011	0	0							0	0
2012	0	0							0	0
2013	0	0							0	0
2014	0	0							0	0
2015	0	0							0	0
2016	0	0							0	0
2017	3	0							3	0
Total	6	0	0	0	0	0	0	0	6	0

Appendix E cont.—*Summary of the marine turtle interaction data reported by operators in the ECIF through the Species of Conservation Interest (SOCI) logbook. Data separated by species, fishing method and release state.*

Olive ridley turtle (Lepidochelys olivacea)										
	Gill netting		**Ring netting**		**Seine/Haul netting**		**Tunnel netting**		**Total**	
State	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**
2003	0	0							0	0
2004	0	0							0	0
2005	0	0							0	0
2006	0	0							0	0
2007	0	0							0	0
2008	0	0							0	0
2009	0	0							0	0
2010	1	0							1	0
2011	0	0							0	0
2012	0	0							0	0
2013	0	0							0	0
2014	0	0							0	0
2015	0	0							0	0
2016	0	0							0	0
2017	2	0							2	0
Total	3	0	0	0	0	0	0	0	3	0

Species unknown / Not specified										
	Gill netting		**Ring netting**		**Seine/Haul netting**		**Tunnel netting**		**Total**	
State	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**
2003	0	0							0	0
2004	12	0							12	0
2005	28	0							28	0
2006	31	0							31	0
2007	47	1							47	1
2008	3	0							3	0
2009	0	0							0	0
2010	1	0							1	0
2011	2	0							2	0
2012	1	0							1	0
2013	0	0							0	0
2014	0	0							0	0
2015	1	0							1	0
2016	0	0							0	0
2017	0	0							0	0
Total	126	1	0	0	0	0	0	0	126	1