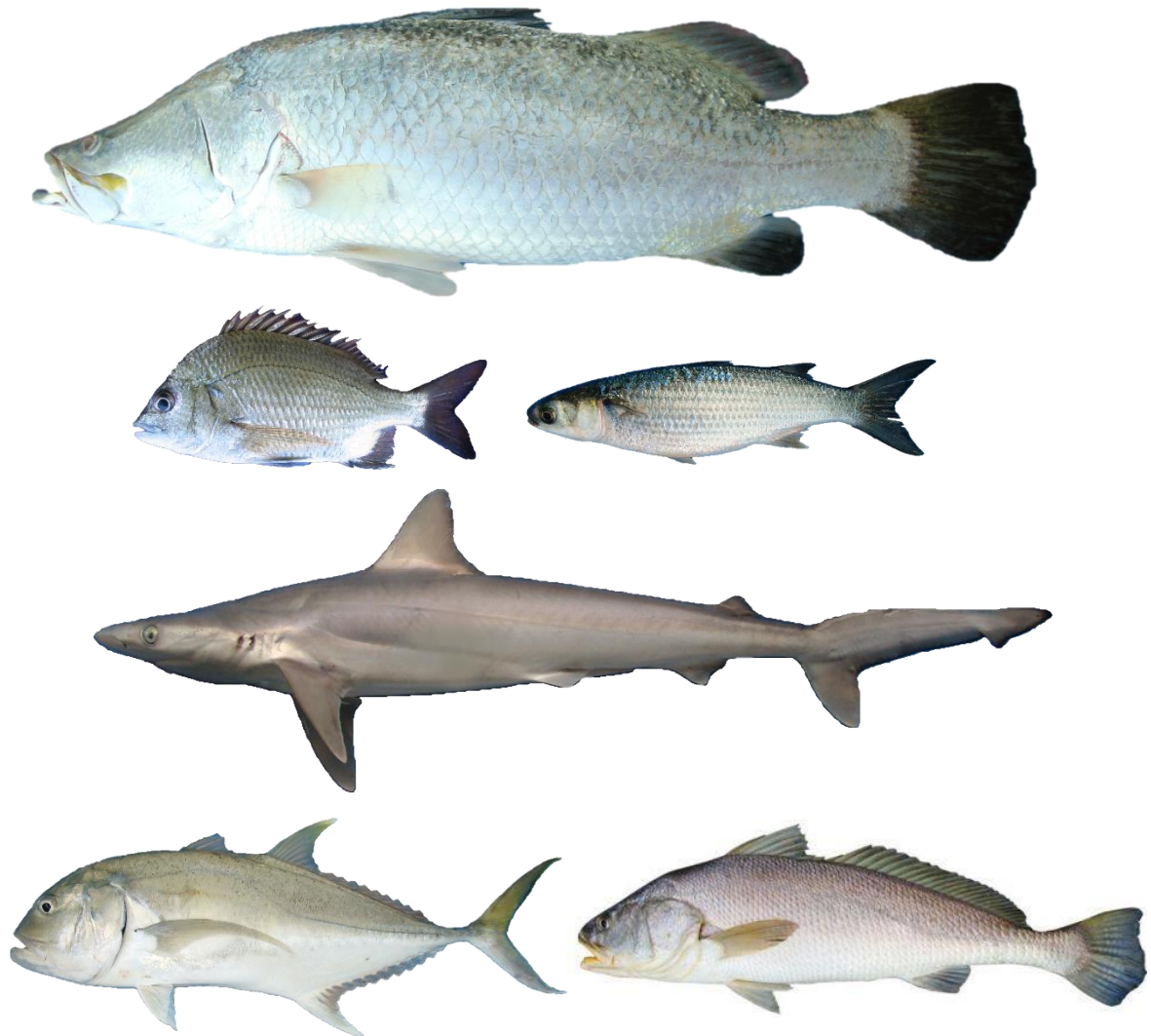# Sustainable Fisheries Strategy

2017–2027

East Coast Inshore Fin Fish Fishery
Level 1 ERA – Whole of Fishery Assessment

Level 1 Ecological Risk Assessment
East Coast Inshore Fin Fish Fishery (ECIFFF)

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Executive Summary

The Queensland Ecological Risk Assessment Guideline (the Guideline) was released in March 2018 as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017b; 2018a). This Guideline provides an overview of the strategy being employed to develop Ecological Risk Assessments (ERAs) for Queensland's fisheries. The Guideline describes a four-stage framework consisting of a Scoping Study; a Level 1, whole of fishery qualitative assessment; a Level 2, species-specific semi-quantitative or low-data quantitative assessment and; a Level 3 quantitative assessment (if applicable).

The aim of the Level 1 ERA is to produce a broad risk profile for each fishery using a qualitative ERA method described by Astles *et al.* (2006). The method considers a range of factors including the current fishing environment (*e.g.* current catch, effort and licensing trends), limitations of the current management arrangements (*e.g.* transfer of effort to already saturated markets, substantial increases in fishing mortality for key species, changing target species) and life-history constraints of the species being assessed. In the *East Coast Inshore Fin Fish Fishery* (ECIFFF) the Level 1 ERA examined fishing related risks in 16 broader ecological components including target & byproduct species, bycatch, marine turtles, sea snakes, crocodiles, dugongs, cetaceans, protected teleosts, batoids (exc. sawfish), sawfish, sharks, syngnathids, seabirds, terrestrial mammals, marine habitats and ecosystem processes.

To construct the risk profiles, seven fishing activities (*harvesting*, *discarding*, *contact without capture*, *loss of fishing gear*, *travel to/from fishing grounds, disturbance due to presence in the area, boat maintenance and emissions*) were assigned an indicative score (*e.g.* low, intermediate, high) representing the risk posed to each ecological component. Each ecological component was then assigned a preliminary risk rating based on the highest risk score within their profile. The preliminary risk ratings are precautionary and provided an initial evaluation of the low risk elements within each fishery. As this approach has the potential to overestimate the level of risk a secondary evaluation was conducted on ecological components with higher risk ratings. This evaluation examined the key drivers of risk within each profile, their relevance to the current fishing environment and the extent that a fishery contributes to this risk. The purpose of this secondary assessment was to examine the likelihood of the risk coming to fruition over the short to medium term and minimise the number of 'false positives'.

In the ECIFFF, the preliminary ratings indicated that at least eight of the ecological components were at a negligible, low or low/intermediate risk of experiencing an undesirable event. The most notable risks related to target & byproduct (high), bycatch (intermediate/high), marine turtles (high), dugongs (high), dolphins (high), batoids (high), sharks (high) and ecosystem processes (precautionary high, data deficient). While the drivers of risk varied with each ecological component, a limited capacity to control catch and effort (target & byproduct) at a whole of fishery and regional level, data limitations (bycatch, species of conservation interest) and the potential under-reporting of interactions with key species (*e.g.* species with conservation concerns) were influential in a number of the risk profiles.

After the likelihood of the risk coming to fruition was considered, the risk rating for dugongs was downgraded from a high to an intermediate/high in recognition of risk mitigation measures already in place (*e.g.* dugong protection areas, fisheries based spatial closures) and provisions contained in non-fisheries legislation that prohibits net fishing in key dugong habitats *e.g.* Marine National Parks.

The risk rating for syngnathids was also downgraded from low to negligible due to the subgroup having low interaction rates with the ECIFFF and a low potential for capture. The remaining risk ratings remained the same.

Based on the revised risk ratings, target & byproduct species, bycatch, marine turtles, dugongs, dolphins, batoids and sharks will be progressed to a finer-scale Level 2 ERA. While ecosystem processes were assigned a precautionary high risk rating, it was not progressed to a Level 2 ERA due to data limitations. The Level 1 ERA also identified key knowledge gaps in a number of the risk profiles and areas where the scope of the Level 2 ERA can be further refined. These information needs will be largely progressed through the *Fisheries Queensland Monitoring and Research Plan* for further consideration. Key information needs to refine risk profiles of ecological components that interact with the ECIFFF include:

– Providing greater differentiation between target, byproduct and bycatch species including an examination of regional variability in catch compositions and emerging market trends *e.g.* secondary target species that may experience increased fishing mortality over the short to medium term or where international demand is increasing.

– Increasing the level of information on discard rates and fates for low value target/byproduct species and non-target species including those identified as threatened, endangered and protected.

– Validating species compositions, interaction rates and catch dynamics (*e.g.* size structures, sex ratios) for the sharks and batoids ecological components.

– Increasing the level of understanding on how the fishery symbol system operates in the ECIFFF including an examination of what symbols are being used in the fishery and the amount of catch and effort being reported against each of the respective symbols *i.e.* trying to ascertain what fishery symbol a licence holder is operating under during each fishing event.

– Further assessment of regional catch and effort levels in the recreational fishing sector for key species where cumulative fishing impacts present as a higher risk.

Summary of the outputs from the Level 1 (whole of fishery) Ecological Risk Assessment for the East Coast Inshore Fin Fish Fishery (ECIFFF)

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.

Ecological Component	Level 1 Risk Rating	Progression
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 due to data deficiencies.

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Definitions & Abbreviations

Active Licence   –   The definition of an active licence is the same as that used by DAF's data reporting system. An active licence is a licence that has reported catch and effort in the ECIFFF through the logbook reporting system irrespective of the amount of catch and effort.

Bycatch   –   The portion of the catch that is discarded/returned to sea. For the purpose of this ERA, the definition of bycatch does not include unwanted target and byproduct species.

Byproduct   –   The portion of catch retained for commercial sale that was not intentionally targeted. For the purpose of this ERA, the definition of byproduct does not include any line caught product that was retained for sale in another fishery (*i.e.* the CRFFF or RRFFF). In this risk assessment, this portion of the catch is classified as 'bycatch'.

CRFFF   –   Coral Reef Fin Fish Fishery

DAF   –   Queensland Department of Agriculture and Fisheries

ECIFFF   –   East Coast Inshore Fin Fish Fishery

Ecological Component   –   Broad assessment categories that include *Target & Byproduct (harvested) species*, *Bycatch*, *Species of Conservation Concern*, *Marine Habitats* and *Ecosystem Processes.*

Ecological Subcomponent   –   Species, species groupings, marine habitats and categories included within each Ecological Component.

EPBC Act   –   *Environment Protection and Biodiversity Conservation Act 1999*.

ERA   –   Ecological Risk Assessment

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.
Fishery Symbol	–	The endorsement that permits a fishery to access a fishery and defines what gear can be used *i.e.* N = Net, L = line, T = trawl. The number of fishing symbols represents the maximum number of operators that could (theoretically) access the fishery at a single point in time.
Fishing Licence	–	Effectively a fishing platform. A Fishing Licence can have multiple symbols attached including a net (N) and line (L) fishing symbol. However, operators in the ECIFFF are not permitted to line and net fish simultaneously (one or the other).
FOP	–	Fisheries Observer Program. The FOP was operational in Queensland from 2006 to 2013 and collected independent data from a range of commercial fisheries.
GBR/GBRMP	–	Great Barrier Reef / Great Barrier Reef Marine Park
MEY	–	Maximum Economic Yield
MSY	–	Maximum Sustainable Yield
Offshore waters	–	Tidal waters that are at least 2m deep at low water.
QBFP	–	Queensland Boating and Fisheries Patrol
RRFFF	–	Rocky Reef Fin Fish Fishery
SAFS	–	Status of Australian Fish Stocks. National program coordinated by the Fisheries Research & Development Corporation to assess the status of key Australian fish stocks.
Species of Conservation Concern (SOCC)	–	Broader risk assessment category used in the Level 1 assessments that incorporates marine turtles, sea snakes, crocodiles, dugongs, cetaceans, teleosts, batoids, sharks, seabirds, syngnathids and terrestrial mammals. These species may or may not be subject to mandatory reporting requirements.

Species of Conservation Interest (SOCI)	–	A limited number of species subject to mandatory reporting requirements as part of the Queensland logbook reporting system. Any reference to 'SOCI' refers specifically to the SOCI logbook or data compiled from the SOCI logbook.
Target	–	The primary species or species groups that have been selectively fished for and retained for commercial, recreational and Aboriginal peoples' and Torres Strait Islander peoples' purposes.
TACC	–	Total Allowable Commercial Catch
WTO		Wildlife Trade Operation

1   Overview

The *East Coast Inshore Fin Fish Fishery* (ECIFFF) is one of Queensland's largest and most diverse fisheries. The commercial sector is Queensland's fourth largest in terms of GVP (approx. $16 million dollars; 2017 estimates) and key species attract a significant level of interest from recreational fishers, charter fishing and from Aboriginal peoples and Torres Strait Islander peoples. The management regime for the commercial sector is based at a whole of fishery level and consists primarily of input controls such as limited licensing, gear restrictions and spatial closures. In some instances, total allowable commercial catch (TACC) limits are imposed on a species / species groupings as well as size and in possession limits. The remaining sectors (*i.e.* recreational and charter fishing) have more less complex management regimes focusing on spatial closures, gear restrictions, size limits and in possession limits.

The ECIFFF has yet to be the subject of a detailed Ecological Risk Assessment (ERA); although a number of species have been included in targeted risk assessments (Tobin *et al.*, 2010) or vulnerability assessments (Great Barrier Reef Marine Park Authority, 2013). Similarly, a number of the key species have detailed stock assessments (Campbell *et al.*, 2008; Leigh, 2015; Leigh *et al.*, 2017) and or have been assigned an indicative stock status through the Queensland stock status and *National Status of Australian Fish Stocks* (SAFS) processes (www.fish.gov.au). These assessments focus on key target species and as a consequence the impact of the fishery on secondary target, by-product and non-target species requires further examination.

In March 2018, Queensland released the *Ecological Risk Assessment Guidelines* (the Guidelines) as part of the broader *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017b; 2018a). This Guideline provides an overview of the ERA strategy being employed by Queensland and includes a four-stage framework consisting of 1) a Scoping Study) a Level 1, whole of fishery qualitative assessment, 3) a Level 2, species-specific semi-quantitative or low-data quantitative assessment, and 4) a Level 3 quantitative assessment (if applicable).

The following represents a broader qualitative (Level 1) assessment of the risks posed by fishing activities in the ECIFFF and their potential to influence key ecological components. The Level 1 assessment follows-on from the completion of a scoping study that provides information on the current fishing environment, licencing trends and broader catch and effort analyses (Department of Agriculture and Fisheries, 2019).

2   Focus/Intent

The risk profiles for Queensland's commercial fisheries will vary and are highly dependent on the apparatus used. For example, the risk posed by line fishing activities will be lower when compared to a net or trawl fishery. Similarly, single-species fisheries like Spanish mackerel will present a lower risk when compared to multi-species or multi-apparatus fisheries. Every fishery will have elements that present a higher risk for one or more of the ecological components *i.e.* species groupings, marine habitats and ecosystem process that interact with the fishery. These risk elements will still be present in smaller fisheries including those where there is greater capacity to target individual species.

In recognition of the above point, the primary objective of the Level 1 assessments were to a) identify the key sources of risk within a particular fishery and b) the ecosystem components that are most likely to be affected by this risk. Used in this context, Level 1 ERAs produce outputs or risk

assessments that are very fishery-specific. The inherent trade off with this approach is that risk ratings cannot be compared between fisheries as the scale, extent and impact of the risk are unlikely to be equal. They will however provide insight into the areas or fishing activities within the ECIFFF that may contribute to an undesirable event for one or more of the ecological components.

In focusing on the risk within the fishery, the Level 1 ERAs will provide further insight into the level of risk each ecological component may be exposed to. In doing so, the outputs of the Level 1 assessment will determine what ecological components will progress to a finer scale assessment. Otherwise referred to as a Level 2 ERA, these assessments will focus on species, species groupings, marine habitats or ecosystem processes (if applicable) within each of the ecological subcomponents.

3   Methods

The Level 1 assessment will be used to assess risk at the whole of fishery level with the primary objective being to establish a broad risk profile for each fishery. Level 1 assessments will focus on a wide range of ecological components and will include detailed assessments for *Target & Byproduct* (harvested) species, *Bycatch*, *Species of Conservation Concern*, *Marine Habitats* and *Ecosystem Processes*.

For the purposes of this ERA, the term 'Species of Conservation Concern' (SOCC) was used instead of 'Species of Conservation Interest' as the scope of the assessment will be broader. In Queensland, the term 'Species of Conservation Interest' or SOCI refers specifically to a limited number of non-targeted species that are subject to mandatory commercial reporting requirements. The expansion of this list allows for the inclusion of non-SOCI species including those that are afforded additional legislative protections e.g. the listing of hammerheads as 'Conservation Dependent' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In the case of the SOCC, this ecological subgroup has been further divided into: marine turtles, sea snakes, crocodiles, dugongs, cetaceans, batoids, sharks, syngnathids, sea birds, protected teleosts and terrestrial mammals. The division of the SOCC ecological component recognises the variable life-history traits of this subgroup and the need to develop risk profiles for each complex.

Of the five ecological components, ecosystem processes represent the biggest challenge for management response as the viability of these processes will be influenced by factors outside of the control of fisheries management *e.g.* climate change, pollution, extractive use of the marine resources, and urban, port and agricultural development. From an ERA perspective, this makes it difficult to quantify the level of impact an individual fishery is having on these processes and by extension the accurate assignment of risk ratings. This problem is compounded by the fact that it is often difficult to identify measurable indicators of marine ecosystem processes (Pears *et al.,* 2012; Evans *et al.,* 2016). For example, what parameters need to be measured to determine if a) an ecosystem process is in decline, stable or improving and b) how much of this change can be attributed to fishing activities or lack thereof?

In order to refine the Level 1 ERA for ecosystem processes, a preliminary assessment was undertaken. The preliminary assessment examined the potential for a fishery to impact on 16 categories outlined in the *Great Barrier Reef Outlook Report 2014* (Great Barrier Reef Marine Park Authority, 2014). The specific processes examined in response to fisheries related impacts were *sedimentation*, *nutrient cycling / microbial processes*, *particle feeding*, *primary production*, *herbivory*, *predation*, *bioturbation*, *detritivory*, *scavenging*, *symbiosis*, *recruitment*, *reef building*, *competition*,

connectivity, *outbreaks of disease* and *species introductions*. Not all processes are applicable to every fishery, but all processes were considered before being eliminated. A full definition of each ecosystem process has been provided in Appendix 1.

The Level 1 ERA was modelled off of an assessment method established by Astles *et al.* (2006) and incorporates five distinct steps: *Risk Context*, *Risk Identification*, *Risk Characterisation, Likelihood* and *Issues Arising.* A brief overview of each step is provided below.

1. *Risk Context* – defines the broad parameters of the assessment including the risk that is to be analysed (*i.e.* the management objectives trying to be achieved or the nature of the undesirable events), the spatial extent of the analysis, the management regimes and the timeframes of the assessment.

2. *Risk Identification* – identifies the aspects of each fishery or the sources of risk with the potential to contribute to the occurrence of an undesirable event.

3. *Risk Characterisation* – provides an estimate (low, intermediate or high) of the likelihood that one or more of the identified sources of risk will make a substantial contribution to the occurrence of an undesirable event. Used as part of a Level 1 assessment, this stage will assign each fishing activity with an indicative risk rating representing the risk posed to each ecological component. These scores will then be use to assign each ecological component with a preliminary risk rating based on the highest risk score within the profile. In the Level 1 ERA, these preliminary risk scores will be used to identify the low-risk elements in each fishery.

4. *Likelihood* – a secondary evaluation of the key factors underpinning the preliminary risk assessments, their relevance to the current fishing environment and the potential for the fishery to contribute to this risk in the short to medium term. This step was included in recognition of the fact that preliminary scores (see *Risk Characterisation*) may overestimate the level of risk for some ecological components.

5. *Issues Arising* – examines the assigned risk levels and the issues or characteristics that contributed to the overall classifications.

The above framework differs slightly from Astles *et al.* (2006) in that it includes an additional step titled *Likelihood.* The inclusion of this additional step recognises the precautionary nature of qualitative assessments and the potential for risk levels to be overestimated in whole of fishery ERAs. This step in effect assesses the likelihood of the risk occurring in the current fishing environment and takes into consideration a) the key factors of influence and b) their relevance to the current fishing environment. In doing so, the *Likelihood* step helps to differentiate between **actual** and **potential** high risks. This aligns with the objectives of *Ecological Risk Assessment Guideline* (Department of Agriculture and Fisheries, 2018a) and helps limit the extent of 'false positives' or the misclassification of low risk elements as high risk.

While viewed as a higher-level assessment, the Level 1 ERA provides important information on activities driving risk in a fishery, the ecological components at risk and areas within the fisheries management system that contribute to the risk of an undesirable event occurring. Level 1 assessments will be undertaken for all ecological components including marine habitats and ecosystem processes which have the least amount of available data. These results will be used to

inform the Level 2 assessments and refine the scope of subsequent ERAs. Level 2 assessments will focus specifically on the ecological subcomponents including key species and species groupings.

Additional information on the four-staged qualitative assessment is provided in Astles *et al.* (2006) and Pears *et al.* (2012). A broad overview of the ERA strategy used in Queensland has been provided in the Queensland *Ecological Risk Assessment Guideline* (Department of Agriculture and Fisheries, 2018a).

4 Level 1 Qualitative Assessment

4.1 Risk Context

The risk context for the whole of fishery assessments has been framed at a higher level and takes into consideration the main purpose of the *Fisheries Act 1994* which is to: "*…provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to: apply and balance the principles of ecologically sustainable development; and promote ecologically sustainable development.*"

In line with this objective, the risk context for the Level 1 assessment has been defined as:

> *The potential for significant changes in the structural elements of the fishery or the likelihood that fishing activities in the East Coast Inshore Fin Fish Fishery will contribute to a change to the fishery resources, fish habitats, environment, biodiversity or heritage values that is inconsistent with the objectives of the Fisheries Act 1994.*

The inclusion of 'potential' in the risk definition recognises the need to take into consideration both current and historic trends and the likelihood that a fishery may deviate from these trends in the short to medium term. The reference to 'structural elements of a fishery' largely relates to the current fishing environment and the potential for it to change over the longer term *e.g.* the potential for effort to increase under the current management arrangements, effort displacements or the ability for effort to shift between regions.

In order to frame the scope of the assessment, a 20-year period was assigned to all Level 1 assessments. That is, the likelihood that the one or more of the ecological components will experience an undesirable and unacceptable change over the next 20 years due to fishing activities in the ECIFFF. In order to do this, the Level 1 assessments assume that the management arrangements for the fishery will remain the same over this 20-year period. A 20-year timeframe has previously been used in ERAs involving the East Coast Trawl Fishery (ECTF) (Pears *et al.*, 2012; Jacobsen *et al.*, 2018) and is considered to be relatively precautionary.

When reviewing the context of the Level 1 assessment, it is important to take into consideration both the complexity of the ECIFFF and the management regime history. The ECIFFF has both line and net fishing sectors that contrasts with the single apparatus approach seen in most of Queensland's fisheries *e.g.* the *East Coast Otter Trawl Fishery*, the *Coral Reef Fin Fish Fishery* (line), the *Mud and Blue Swimmer Crab Fishery* (pot). Of the two, the net fishery accounts for around 90% (89.5–94.8%) of the total catch and this sector will be the major contributor of risk in this fishery (Department of Agriculture and Fisheries, 2019). While still a factor, the risk posed by line fishing will be smaller and or concentrated on key species or species groupings.

While operators can access the ECIFFF using a wide range of net symbols (Department of Agriculture and Fisheries, 2019), the vast majority of the catch and effort is reported in the large-mesh fisheries (N1, N2, N4), the tunnel net fishery (N10) and the ocean beach fishery (K1–K8). A smaller portion of the annual ECIFFF catch is reported from the small mesh net fishery (N11) where operators use small-mesh nets to target smaller, highly fecund species. When compared to the other net symbols, the risk posed by the N11 fishery is considered to be low to negligible. In the line fishery, the majority of the catch and effort is recorded against the L1 or L2 fishery symbol. Operators with an L3 fishery symbol can retain product as part of the ECIFFF, although these symbols are often attached to licences used in non-line fisheries (*pers. comm.* S. Breen). Accordingly, the L3 fishery symbol is currently viewed as low contributor of risk in the ECIFFF.

At a whole of fishery level, the risk of the ECIFFF contributing or causing an undesirable event has declined over the last 20 years. This has been achieved through a range of management reforms designed to reduce both real and potential effort. Notable examples include a review of latent effort in the line (L1) fishery and the introduction of a broader management reform package for the net fishery (*ca.* 2008–09). Both of these had a significant impact on the number of licences that could access the fishery[1] and accelerated an already declining trend in the total number of fishing symbols.[2] For example, the total number N1, N2, N4 and K fishing symbols, the primary source of net effort, declined by 78% from 1999 ($n = 1108$) to 2017 ($n = 243$).[3] A similar trend was observed in the line fishery where the number of L1 symbols, the primary source of line effort, declined by more than 80% over the same period (Department of Agriculture and Fisheries, 2019).

Data on the number of active licences (*i.e.* the number of operators using their N or L symbol to fish in the ECIFFF) suggests the decline in symbol numbers has contributed to a change in the dynamics of the fishery. For example, the number of fishers operating in the net sector has declined from 592 (1988) to 273 (2017) with the number of active line licences showing a corresponding decrease from 585 (1997) to 320 (2017) (Department of Agriculture and Fisheries, 2019). While these declines can be attributed to a range of factors including social and economic indicators, the removal of symbols from the fishery would play a role in this process.

One of the benefits of reducing the number of active licences is that there is a direct correlation with the amount of effort utilised in the fishery. The premise is that a decrease in the number of active licences would be accompanied by a reduction in effort and a corresponding but not necessarily equal reduction in total fishing mortality. The extent of this benefit would be dependent on a range of factors including the species being targeted, improvements in fishing efficiency, fishing power increases and effort creep.

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[1] *Operators wanting to access the ECIFFF must have at least one net (N, K) or line (L) fishery symbol attached to their licence.*

[2] *The number of symbols represents the maximum number of operators or licences that could potentially access the fishery at one time. The number of 'active' licences represents the number of operators that used their net (N, K) or line (L) fishery symbol to access the fishery over the 12 month period regardless of catch and effort quantities. In Queensland a single licence or fishing platform can have multiple fishing symbols attached but operators can only fish under one net (N) or line (L) fishing symbol at a time.*

[3] *Does not include the small mesh net authorities (N11) which make a minimal contribution to the overall level of risk.*

From a risk context perspective, observed reductions in symbol numbers and active licences are important as it reduces the impact (real and potential) of the fishery on regional ecosystems. This risk however has not been mitigated completely and there is potential for effort to increase on underutilised symbols/licences. This is supported by the licensing data that shows there is still a gap between the total number of net and line symbols and the number of licences that are active in the fishery. While this gap is closing, it is still notable, particularly in the line (L3) fishery (Department of Agriculture and Fisheries, 2019).

4.2   Risk Identification

Fishing activities are frequently subdivided into categories that identify the sources of risk or potential hazards (Astles *et al.*, 2006; Astles *et al.*, 2009; Hobday *et al.*, 2011; Pears *et al.*, 2012). What constitutes a hazard can vary between ERAs and is often dependent on the specificity and scale of the assessment. For larger scale assessments, some of the more commonly used fishing activities include: *harvesting*, *discarding*, *contact without capture*, *loss of fishing gear*, *travel to and from fishing grounds*, *disturbance due to presence in the area* and *boat maintenance and emissions* (Table 1). The fishing activities outlined in Table 1 will provide the foundation of the risk profiles and will be used to assign preliminary risk ratings to each ecological component (see *Risk Characterisation*).

In Queensland, 'cumulative fishing pressures' has also been identified as key source of risk (Table 1). Used as part of a Level 1 assessment, the term 'cumulative fishing pressures' will examine the risk posed by Queensland's other commercial fisheries and sectors outside of the commercial fishing industry. This parameter was included in the Level 1 assessment in recognition of the fact that a number of Queensland's fisheries have multiple fishing sectors (*e.g.* commercial, recreational, and charter). This means that the risk posed to some species may be higher than what is observed in the commercial fishing sector *e.g.* species that attract a high level of interest from the recreational fishing sector.

In addition to the cumulative fishing pressures, this section will include a secondary examination of the cumulative risks that exist outside the control of fisheries management. These factors often have a wide range of contributors, are generally more complex and at times unavoidable. As a consequence, it can be difficult to assign an accurate rating to these factors or to quantify how much of a contribution (if any) a fishery will make to this risk. The primary purpose of including these factors in the Level 1 assessment is to provide the ERA with further context on how fisheries-specific risks relate to external factors, broader risk factors that a fishery will contribute to (*e.g.* boat strike) and factors that have the potential to negatively impact on a fishery (*e.g.* climate change, the potential for urban development to affect recruitment rates).

The inclusion of cumulative impacts in the Level 1 assessment provides further context on factors that may contribute to an undesirable event. In a fisheries-based ERA it can be difficult to account for these impacts in the final risk ratings. The main reason for this is that it can be difficult to define the extent of these impacts or quantify the level of contribution they make to an overall risk; particularly in a whole of fishery assessment (*e.g.* the impact of recreational fishing/boating activities on SOCC subgroups). Given this, final risk ratings will concentrate on commercial fishing activities with cumulative impacts (when and where appropriate) identified as an additional source of risk *e.g.* for species targeted and retained by commercial, charter and recreational fishers. In the event that one or more of the ecological components are progressed to a Level 2 assessment than the cumulative impacts (*e.g.* from other fisheries) will be given additional considerations.

Unlike the fishing activities, ratings assigned to 'cumulative risks' will not be used in the determination of preliminary risk scores (see *Risk Characterisation*). The main reason for this is that the preliminary risk scores relate specifically to commercial fishing activities.

The following provides an overview of the key fishing activities / sources of risk in the ECIFFF and for each of the respective ecological components. When and where appropriate the contributor of risk (*i.e.* the fishing activity) is also identified in the text.

*Table 1. Summary of the key fishing activities and their relation to risk. Table 1 is based on an extract from Pears et al. (2012). * Cumulative risk scores are not considered when assigning preliminary risk ratings as these values relate specifically to the commercial fishing sector.*

Sources of Risk
Harvesting: capture and retaining of marine resources for sale.
Discarding: returning unwanted catch to the sea. This component of the catch is landed on the deck of the boat or brought to the side of the vessel before its release and the reference is applied to all sectors *e.g.* commercial, recreational, charter.
Contact without capture: contact of any part of the fishing gear with an ecological subcomponent (species, habitats *etc.*), but which do not result in the ecological components being captured and landed on deck.
Loss of fishing gear: partial or complete loss from the boat of gear including lines, nets, ropes, floats etc.
Travel to/from grounds: steaming of boat from port to fishing grounds and return.
Disturbance due to presence in the area: other influences of boat on organisms whilst fishing activities take place (*e.g.* underwater sound disturbances).
Boat maintenance and emissions: tasks that involve fuel, oil or other engine and boat-associated products that could be accidentally spilled or leaked into the sea or air.
Cumulative fishing pressure: Indirect external factors, including other fisheries or fishing sectors; and non-fisheries factors that apply across fishery sectors.

4.2.1 Whole of Fishery

As the ECIFFF is a multi-species, multi-apparatus fishery, most of the activities defined in Table 1 will apply to the fishery.

Harvesting and **discarding** are considered to be the greatest contributors of risk in the net sector, with **contact without capture** and **loss of fishing gear** viewed as secondary factors of influence. Given the size of the net fishery, there is a possibility that **travel to/from fishing grounds** and **disturbance due to presence in the area** will contribute to the risk posed to one or more of the ecological components. These impacts are likely to be localised, shorter in duration and primarily associated with the setting and retrieval of nets. This is because the net sector uses a relatively passive fishing technique and relies on animals swimming into and becoming entangled in the net.

As the ECIFFF includes a number of sub-fisheries the risk profile will vary with the apparatus used and the species being targeted. However, the ability of management to compare and contrast risk profiles across net fisheries operating on the Queensland east coast is limited. The main reasons for this are:

- all holders of net fishery symbol (N or K) in the ECIFFF are permitted use of any net described under the N1 fishery symbol;[4]

- net operators are not required to nominate the symbol that they are operating under; and

- catch is assigned to the fishing method (*e.g.* tunnel nets, gill nets, ring net *etc.*) and not the fishing symbol.

While the above provisions provide net operators with a higher degree of flexibility, it makes it difficult to ascertain where the effort is being directed and the dominance of each symbol with respect to their use in the fishery.

When compared, line fishing presents as a lower risk to the ecological components that interact with the ECIFFF. The broader risk profile for line fishery varies slightly from the net fishery with **harvesting** identified as the primary source of risk followed by **discarding** and **loss of fishing gear**. While **contact without capture** is a potential source of risk, it will be less of a factor when compared to the net fishery. This risk (**contact without capture**) will primarily relate to the loss of a fish due to line breakage or predation.

4.2.2 Ecological Components.

Target & Byproduct Species (harvested)

Operators in the ECIFFF interact with a wide range of species with catch data revealing that over 100 species or species complexes were retained for sale in 2017 (**harvesting**). The majority of these are retained as byproduct with mullet, barramundi and whiting making up around half (42–59%) of the commercial ECIFFF catch. Over 90% of the total ECIFFF catch consists of just 25 species or species complexes (Department of Agriculture and Fisheries, 2019).

At least two of top 25 catch categories refer to broader species groupings and have low species resolutions such as unspecified fish and unspecified whaler shark. These two categories combined with a third generic category, unspecified shark (Department of Agriculture and Fisheries, 2019), have contributed between 29 and 1,529t (average = 593t) to the annual ECIFFF catch or between 1 and 26% (1998–2017 data). Significantly, these contributions dropped to 29–375t (1–7%) in the post-2009 period which coincides with the introduction of a broader management reform package and a more comprehensive catch reporting system. For example, the introduction of shark-specific logbook in 2009 dramatically reduced the amount of catch being reported as unspecified shark or unspecified whaler (Department of Agriculture and Fisheries, 2019). This in turn helped facilitate the development of a more detailed shark stock assessment for key species (Leigh, 2015).

Reductions in the amount of catch reported with generic identifiers demonstrates that catch reporting systems in the ECIFFF have improved through time. This has improved understanding of how the

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[4] *N2 or K1–K8 symbol are permitted use of any net described under the N1 fishery symbol. These provision are also applied to the N4 symbol but excludes set pock nets, prawn seine nets and Noosa Lakes mesh nets (Department of Agriculture and Fisheries, 2019).*

fishery interacts with key species and has assisted in the development of management arrangements that are cognisant of the current fishing environment and how it relates to ancillary assessments (*e.g.* hammerhead sharks, non-detriment findings and threatened species assessments under the *EPBC Act 1999*) (Department of Agriculture and Fisheries, 2018c). However, the multi-species nature of the fishery combined with the operational constraints of the logbook reporting system means that a higher proportion of the catch will continue to be reported as part of a complex or in broader categories. This makes it more difficult to define species-specific rates of fishing mortalities and therefore assess the risk of a species being overexploited. This risk will remain even for shark species given a) the difficulties of obtaining individual species identifications and b) a diminished capacity to validate catch in real time.

Diversity in the ECIFFF catch is attributed to net fishing (in general) having less capacity to target key species. The specificity of net fishing can be improved by altering the mesh sizes, set times, locations and the fishing apparatus (*e.g.* using a seine net in the Ocean Beach Fishery to target schools of fish or setting nets in deeper waters to target shark species). However, there is still a high probability that operators will interact with a number of unwanted species including regulated fish species or fish that fall outside of the prescribed size limits.[5] As a portion of this catch will be **discarded** in a dead or moribund state (Halliday *et al.*, 2001; Tobin, 2014; Uhlmann & Broadhurst, 2015), this has the potential to undermine the effectiveness of management arrangements used in the ECIFFF including minimum and maximum legal sizes and TACC limits.

Current trends in the ECIFFF fishing data (Department of Agriculture and Fisheries, 2019) suggests that effort levels are unlikely to increase substantially over the short term. However, a heavy reliance on input controls means that the management regime has limited capacity to deal with increasing effort at a whole of fishery, regional or species level. If effort were to increase substantially, it may translate to a higher risk for a number of the target species. The extent of any risk increase would be dependent on a range of factors including the motivations for shifting behaviour (*i.e.* changing target species, market demand, response to management changes, symbol transfers), pre-existing fishing pressures and the life history of the species. For some species this risk has been further reduced by the introduction of a competitive TACC limit, currently set at 250t for grey mackerel, 140t for spotted mackerel and 120t for tailor. While the use of TACC may not negate the risk of regional depletion, if properly set, it will ensure that a species continues to be fished against key biological reference points. The only other ECIFFF subgroup to be managed under a TACC is sharks and rays. This is a combined 600t TACC limit and it will be less effective at managing catch and effort rates for a single species.

While the use of a TACC helps to minimise the risk of a species or species complex being over-exploited (**harvesting**), the focus largely remains on the retained portion of the commercial catch. For instance, the vast majority of TACCs used in Queensland do not account for discards[6] and have limited capacity to account for changing effort/catch in non-commercial sectors. While these two factors may be accounted for in the TACC setting process, the management system used in the ECIFFF is not flexible or responsive enough to respond to changing fishing pressures (lower, higher).

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[5] *This portion of the catch is typically referred to as bycatch as it cannot be retained for sale. For the purposes of this ERA, undersized or unwanted target and byproduct are assessed as part of the 'harvested species' grouping. The primary reason for this is that this ERA deals with factors that may impact on the long-term sustainability of the species.*

[6] *As on 1 January 2018, ECIFFF operators must report shark discards as part of the logbook reporting system.*

Similarly, there are few mechanisms in place to document discard rates of TACC managed species including the extent of post release mortalities (**discarding**). This again has the potential to undermine the effectiveness of a TACC and there is a risk that total catch, effort and fishing mortality (*e.g.* commercial catch plus non-commercial catch plus discards) is higher than what is presented in the commercial catch data.

In Queensland, the risk of a species exceeding a TACC limit is managed through a series of decision rules. These decision rules, increase reporting requirements and restrict the take of a quota managed species as the TACC limit is approached. For the shark species complex, the risk is further managed through the use of an *Automated Interactive Voice Response* (AIVR) system. This system monitors shark quota usage and provides a chain of auditable records that can be used to detect the possible development of a black market for illegally caught fish. Further, ECIFFF operators are required to report all non-retained/discarded sharks in their logbooks. The use of AIVR and the reporting of discards is not currently applied to grey mackerel, spotted mackerel and tailor.

While noting the above, TACC decision rules used in the ECIFFF do not include the option to close the entire fishery or to restrict effort directed towards a particular region. The primary reason for this is that the ECIFFF is one of Queensland's most diverse fisheries and enacting a decision rule of this magnitude would affect a wide range of operators including those that do not target TACC managed species. The inherent trade off with this approach is that there is a risk that one or more of TACC limits (**harvesting**) will be exceeded within a given season. The extent of this risk (low, intermediate, high) will be dependent on current catch levels for each species and the propensity for it to increase into the future (Department of Agriculture and Fisheries, 2019).

Outside of the TACC managed species, there is limited capacity within the current management regime to address changing fishing patterns or restrict the amount of effort that is directed towards an individual species or species complex. For example, management cannot prevent significant levels of effort being targeted at a species due to increased demand or an improving market value (**harvesting**). Similarly, the mesh netting symbols (N1, N2 and N4[7]) and line fishing symbols (L1, L2) can be used along wide stretches of the Queensland coastline. This means that effort can readily shift into more profitable regions irrespective of the number of licences already operating in the area (**harvesting**, **discarding**). This risk is considered to be higher in the large-mesh net fishery as the ocean beach (K symbol) and tunnel net fisheries (N10) have fewer licences, increased regional management and less capacity to expand into new areas (Department of Agriculture and Fisheries, 2019). While still present in the line (L1, L2) fishery, shifting effort patterns are considered to be less of an issue in this sector of the fishery.

In comparison to **harvesting** and **discarding**, the remaining fishing activities are expected to make smaller contributions to the overall risk levels. Risks relating to **loss of fishing gear** have been largely offset by in-attendance provisions which require the fisher (under most circumstances) to remain within 100m of the net whilst it is in operation (Department of Agriculture and Fisheries, 2019). In cases where net attendance rules are applied, there is an expectation that the commercial fisher has the capacity to reach the full length of the net(s) used in the fishing operation. While these provisions are aimed at reducing *in-situ* mortalities for larger non-target species, they help to ensure that an

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[7] *Some symbol specific restrictions apply, N2 can only be used in waters north of Kauri Creek and N4 can only be used in waters deeper than 20m deep east of longitude 142º31'49" east and north of latitude 26º south.*

operator can: a) retain control of the net; b) minimise the risk of the net becoming entangled to an extent that it cannot be retrieved and; c) prevent it from becoming a ghost net (**loss of fishing gear**). These risks will be heightened in adverse weather; although these conditions will also limit the ability of people to fish.

Illegal fishing activities present an additional risk for most fisheries. In the ECIFFF these risks will include increased fishing mortality (**harvesting;** unreported catch, the retention of regulated species), the use of unattended nets which can convert into ghost nets (**loss of fishing gear**), fishing in regulated waters and use of non-compliant apparatus. These risks are managed through the Queensland Boating and Fisheries Patrol (QBFP) who continue to enforce the current regulations. These risks are not considered to be exclusive to a particular sector and the overwhelming majority of people adhere to the regulations. However, illegal fishing activities have the potential to impact all ecological components including harvest species and are therefore relevant to this ERA. The risk posed by illegal fishing activities are expected to be more localised and sporadic in nature; although there is an increased likelihood of the apparatus being converted into a ghost net (**loss of fishing gear**).

Target species that interact with a net without capture (**contact without capture**) will either be small enough to pass through the mesh, large enough to prevent entanglement or strong enough to break free from the net. The consequence of these interactions are likely to include increased injuries, greater susceptibility to predation and increased post-interaction mortalities. In the line sector, **contact without capture** will be associated more with foul-hooks, broken lines, fish that are able to free themselves and in some instance the effects of barotrauma. In most of these instances (*exc.* barotrauma) the immediate impacts will relate to injuries sustained by the animal during the fishing event. Depending on the severity of the injuries, this type of interaction may reduce their mobility and increase the risk of predation. Line caught species may also experience longer-term complications relating to the ingestion of hooks, internal injuries and infections (Butcher *et al.*, 2012; Campbell *et al.*, 2014).

Further information on key target and byproduct species including the impact of the fishery on sharks and rays is provided in the *Species of Conservation Concern* overview. Additional information on the impact of the recreational fishing sector is contained within the 'cumulative impacts' section of this report.

Bycatch (non-SOCC)

One of the challenges of undertaking a broad-scale ERA for bycatch in the ECIFFF is trying to identify the scope and depth of the assessment. This issue largely relates to the multi-species nature of the ECIFFF and the fact that some species are retained as byproduct in very small quantities (Department of Agriculture and Fisheries, 2019). Further, the distinction between bycatch and byproduct will vary between regions, operators and fishing events.

The majority of bycatch in the ECIFFF consists of low-value teleost species[8] (Halliday *et al.*, 2001) and the risks will be similar to that observed for unwanted harvest species *e.g.* an elevated risk of *in-situ* mortalities, injuries, post release mortalities and an increased susceptibility to predation

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[8] *The definition of bycatch traditionally includes target and byproduct species that have been discarded due to economic or regulatory reasons. For the purpose of the Level 1 ERA, these impacts were assessed as part of the target & byproduct ecological component risk evaluation.*

(**discarding**). Net fishing again represents the major source of risk for this ecological component; although the level or risk will vary between sub-fisheries (Department of Agriculture and Fisheries, 2019). The risk is arguably lowest in the ocean beach fishery where operators target larger schools of tailor or sea mullet using the seine fishing method. Seine fishing tends to have a higher degree of specificity and consequently lower levels of bycatch. As catch from the ocean beach fishery will remain submerged for a high proportion of the fishing event, this sub-fishery is expected to have lower post-release mortality rates.

Tunnel nets are set in inshore environments and rely on the fish becoming trapped in the tunnel as tide recedes. While the opening of the tunnel is comparatively small (1.5–4m) the fetch of the net is relatively large and can span up to 500m at its widest point (*pers. comm.* T. Ham). As tunnel nets are set in environments with high tidal fluctuations, there is higher potential to catch unwanted demersal fish and invertebrate species. The severity of this type of interaction has been reduced through regulations which requires the fisher to extend the tunnel of the net out to sea beyond low water for at least 30m and in water at least 30cm deep (Department of Agriculture and Fisheries, 2019). These measures are designed to improve post release mortalities and, in turn, help to reduce the impact of the sub-fishery on all non-targeted species.

In the line fishing sector, bycatch (**discarding**) would consist mostly of target species that do not satisfy legal size restrictions, low value teleosts and species that are not permitted to be retained in the ECIFFF *i.e.* quota managed species from the *Coral Reef Fin Fish Fishery* (CRFFF). Line fishing provides few avoidance strategies to reduce the incidental catch of undersized or unwanted fish. The impact of this interaction will be dependent on the species, fishing depth and post capture handling procedures. The overall impact of this sector on bycatch will be lower than that observed in the net sector.

The impact of the remaining fishing activities will be similar to that observed for harvest species (target and byproduct).

Species of Conservation Concern

The ECIFFF has a large geographical distribution and interacts with a high number of the SOCC subgroups. The majority of reported interactions in the SOCI logbook come from the net fishing sector and the sample data is dominated by marine turtles (Department of Agriculture and Fisheries, 2019). As a high proportion of the SOCC subgroups cannot be retained for sale, **discarding** is considered to be the fishing activity posing most risk to these species. The notable exceptions to this are most shark and batoid species that can be retained for sale in the ECIFFF.

Marine turtles

Over three-quarters (82%) of the SOCI interactions reported from the ECIFFF between 2003 and 2017 involved marine turtles (Department of Agriculture and Fisheries, 2019). The majority of these interactions were with large mesh nets/gillnets (67%) followed by tunnel nets (18.5%) and ring/haul netting (14.5%). This data revealed that the vast majority of marine turtles were released alive with less than 1% dying as a result of their interaction with the ECIFFF. Fisheries Observer Program (FOP) data showed a similar trend recording 28 interactions between 2006 and 2012 with just one fatality—based on 344 observer days (total) (DAF, unpublished data).

As the SOCI logbooks and FOP evaluates the health of the animal at the time of its release (**discarding**), the data does not account for post-release mortalities. While a high proportion of the marine turtles were released alive, a proportion of these animals may die as a result of this this interaction. This inference is supported by the *Marine Wildlife Stranding and Mortality Database* which attributes (directly and indirectly) 2–19 turtle deaths per year to netting activities / on deck damage and 1–53 mortalities to ghost nets (2000–2011 data) (Meager & Limpus, 2012) (**discarding**)[9]. DAF notes though that these figures will include reports from commercial fishers who have reported an interaction to the *Department of Environment and Heritage Protection* (DEHP) and via the SOCI logbook.

Of significance, the *Marine Wildlife Stranding and Mortality Database* provides little insight into the origins of the apparatus or the legality of the nets. Therefore, mortalities reported in this database cannot be assigned to a particular sector (commercial/recreational) or fishery (*e.g.* ECIFFF, trawl, illegal operations, and ghost nets). It does however provide insight into the causal effects of some marine turtle deaths and suggests that net fishing is a risk for this subgroup. Comparisons between the SOCI logbooks and the *Marine Wildlife Stranding and Mortality Database* suggests that the total number of turtle interactions and mortalities (*i.e. in-situ* and post release mortalities) may be underreported in this fishery. This inference cannot be verified without additional measures to validate the catch of threatened, endangered and protected species.

Within the ECIFFF, the risk of turtle mortalities will be much lower in the ocean beach, ring net and tunnel net fisheries which account for approximately one-third of the reported interactions. Catch in the ocean beach sector will be submerged for the majority of the fishing event; enabling larger marine megafauna to be removed (**discarding**) during the sorting process (Halliday *et al.*, 2001). This in itself greatly reduces the likelihood of a turtle dying due to its interaction with the sub-fishery. Ring netting has strong similarities with the ocean beach fishery with the net shot around schooling fish. However, ring netting is not constrained through regional management and this sector has greater potential to interact with a wider array of species and (potentially) represent a greater risk (*pers. comm.* T. Ham).

The tunnel net fishery differs from ring nets and ocean beach fishing in that the net is fixed and remains in place until the tide recedes. This combined with the location of the fishery (Moreton Bay and Great Sandy Marine Parks) increases the likelihood that a marine turtle will interact with the apparatus. Importantly, tunnel net fishers use a number of measures to reduce the risk posed to marine turtles and the long-term consequences of this type of interaction. For example, the majority of tunnel net operators now install metal mesh grids or a similar bycatch reduction device at the entrance of the trap to prevent marine megafauna from entering the tunnel (**contact without capture**). However, the use of a bycatch reduction device in the tunnel net fishery is not legislated. In the event that a turtle does become trapped in the tunnel of the net, the animal can readily access the surface to breath and are protected by provisions requiring the tunnel of the net to be set at least 30m beyond the low water mark and at depths of at least 30cm. In at least one area of the tunnel net fishery, Moreton Bay, the issue of bycatch including the capture of turtles is being actively addressed through a voluntary code of best practice (available at: http://www.mbsia.org.au/mbsia_projects_tunnel_net_code.php) (Thompson *et al.*, 2012).

At a whole of fishery level, the risk posed to marine turtles is mitigated through a range of broader measures that include a complex array of spatial and temporal closures. These closures are

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[9] *Only includes records where cause of death could be confirmed.*

enshrined in fisheries-specific legislation and more generalised legislation governing the use of marine resources including within the Moreton Bay, Great Sandy and Great Barrier Reef Marine Parks. In addition to the fishing closures, net operators are required to be 'in attendance' while fishing so as to minimise harm to marine megafauna. In attendance provisions vary with the fishing method (Department of Agriculture and Fisheries, 2019) but improve the chances of an operator accessing the animal in the event that it has become entangled in the net. The benefits of these provisions include more rapid extraction from the net, fewer *in-situ* mortalities and improved post-release survival rates.

Despite the above measures, there remains considerable potential for the net sector to interact with and contribute to the risk of an undesirable event occurring for marine turtles. There is a high degree of overlap between the area fished and the distribution of key species and the fishery operates in environments where there is a higher potential for interactions. While only a small proportion of the reported SOCI interactions have resulted in the death of an animal, anecdotal evidence and post-mortem analyses suggest that total mortality (*in-situ* plus post release mortalities) may be higher in this sector of the fishery (Meager & Limpus, 2012).

In the line fishing sector, **loss of fishing gear**, **contact without capture** and **discarding** were viewed as the most significant issues for marine turtles. Marine turtles can interact with the line apparatus, through entanglements, taking bait or foul hooking (Ceccarelli, 2009; Ceccarelli & Ayling, 2010; Department of the Environment and Energy, 2017). In a high percentage of cases, the animal will survive the initial interaction and either have the hook removed, have the line cut off (**discarding**) or have the line break during the retrieval process (**contact without capture**). The initial consequences of these interactions (*i.e.* injuries) are not expected to be life-threatening; although there may be longer-term consequences related to the ingestion of hooks, internal injuries, infections and (depending on the external injuries) increased risk of predation.

Concerning the direct capture or hooking of marine turtles, evidence suggests that this issue may be more prevalent in long-line fisheries where operations have more hooks and longer soak times (Department of the Environment and Energy, 2017). The use of long-lines is not permitted in the ECIFFF and in the majority of waters fished by line operators including within the GBRMP (Department of the Environment and Energy, 2017). These prohibitions would assist in reducing the number of turtles that interact with commercial line operations in Queensland. Despite this, DAF anticipates that line fishers will, on occasion, interact with marine turtles and in some instances will contribute (directly or indirectly) to the death of the animal *e.g.* hook ingestion and post release mortalities. This inference is supported by the *Marine Wildlife Stranding and Mortality Database* (Meager & Limpus, 2012) which attributes at least one death the ingestion of a fishing hook.

When compared to the impacts of hooking, entanglement in fishing line arguably represents a greater risk to marine turtles. Entanglements can occur in line not associated with the fishing event (*e.g.* line that has been lost, cut off or discarded during a previous fishing event) or resulting from their capture (*e.g.* line that is still attached to a hook embedded or swallowed by the animal) (**contact without capture**, **loss of fishing gear**). The negative consequences of line entanglement will often be long-term and can include death due to asphyxiation and increased predation risk due to impairment or loss of an appendage (Meager & Limpus, 2012). In some instances, the impacts may be more immediate such as preventing the animal from reaching the surface if, for example, the opposite end becomes trapped on the substrate. While difficult to quantify, evidence suggests that that discarded

and lost fishing gear contributes to the number of marine turtles deaths recorded each year (Meager & Limpus, 2012).

Given the above considerations and the size and complexity of the fishery, the marine turtle subgroup will be at the higher end of the risk spectrum with respect to their potential to experience an undesirable event.

Sea snakes

Sea snakes do interact with the ECIFFF but are mostly associated with tunnel and set pocket nets. The *Fisheries Regulation 2008* imposes specific restrictions on the use of both tunnel nets and set pocket nets in Queensland. While these regulations require a net to remain below the low water mark, tunnel nets it should not prevent a sea snake from accessing the surface to breathe. Similarly, the nature of the fishing methods indicates that post release survival rates (**discarding**) would be high for these species, an inference that is supported by the SOCI data (Department of Agriculture and Fisheries, 2019).

No interactions have been reported between sea snakes and line operators within the ECIFFF, although data form the *Recreational Fishing Survey 2013–14* indicates that this type of interaction can occur (Webley *et al.*, 2015). While a sea snake could conceivably become hooked or entangled within a commercial fishing line (**discarding, contact without capture**), interactions are expected to be low in number and infrequent.

Crocodiles

There have been intermittent reports (*n* = 12) of crocodile interactions in the ECIFFF since the introduction of the SOCI logbook (Department of Agriculture and Fisheries, 2019). These interactions are more likely to occur in central and northern Queensland and when operators are fishing in inshore waters or targeting species in riverine and estuarine environments. Outside of the SOCI logbook there is limited information on the extent of interactions between crocodiles and commercial fisheries on the Queensland east coast. Crocodiles are not included in the *Wildlife Stranding and Mortality Database* and no interactions were reported as part of the FOP.

There is some potential for crocodile interactions to be underreported in the ECIFFF; particularly in more remote areas, in instances where an animal has interacted with fishing gear (net & line) without capture (**contact without capture**) or has preyed upon a captured fish. Even so, the risk of these species experiencing an undesirable event due to fishing activities in the ECIFFF is considered to be low when compared to northern Australia where there are higher population numbers and more frequent interactions (Read *et al.*, 2004; Department of Primary Industry and Resources, 2016; Department of Agriculture and Fisheries, 2019).

Dugongs

From 2003 to 2017 (inclusive) ECIFFF operators reported 37 dugong interactions through the SOCI logbooks that included 16 mortalities (43%) (**discarding**). While the fishery averaged 2–3 dugong interactions per year, more than half of all interactions occurred in just three years: 2010, 2013 and 2017 (Department of Agriculture and Fisheries, 2019). All but one of the reported interactions were recorded in the large mesh / gill net fishery and most likely by operators utilising nets under the N1 or N2 fishery symbol. Data from the FOP reports the capture of a single dugong which died as a result of the interaction (based on 344 observer days completed between 2006 and 2013).

The *Marine Wildlife Stranding and Mortality Database*, which includes reports from the commercial fishing industry, has a higher number of net-related dugong mortalities. This database pre-dates the introduction of the SOCI logbooks but shows that at least 29 deaths[10] occurred due to netting activities on the Queensland east coast from 2003–2015 (Meager, 2016b) (**discarding**, **contact without capture**). Twenty-three of these deaths occurred on the Queensland east coast with Moreton Bay, Hervey Bay – Great Sandy Strait, Rockhampton – Shoalwater Bay, Townsville and Cairns regions featuring prominently in the data (Meager, 2016b). It is recognised that all of these deaths cannot be attributed to (legal) commercial net fishing as illegal fishing operations and ghost nets may have been contributing factors. The available data though helps demonstrate the potential risk posed by net fishing to this SOCC subgroup.

While the total number of interactions is lower than both turtles and sawfish (Department of Agriculture and Fisheries, 2019), the reproductive rate for dugongs is exceptionally low. Research has shown that female dugongs do not breed until between seven and 17 years and calve only once in every three to six years (Marsh *et al.*, 2011; Meager, 2016b). This combined with a higher risk of interactions ending in mortality increases the risk that a regional dugong population will experience an undesirable event due to fishing activities in the ECIFFF. This risk is expected to be present even at low levels of fishing mortality and is one of the reasons why dugongs are often classified as a high-risk species.

In Queensland, the risk posed by net fishing is reduced through the use of *Dugong Protection Areas* (DPA). Introduced in 1997, Queensland has two types of DPAs: Zones A and Zone B. Zone A has more stringent controls over netting practices and prohibits the use of foreshore set nets and offshore set and drift nets. In Zone B mesh netting is permitted but with restrictions on the type, size and location of nets plus in attendance provisions (Queensland Government, 2002). In addition to the DPAs, dugongs are afforded protection through a complex array of spatial closures contained within the fisheries legislation, zoning plans for the *Moreton Bay, Great Sandy* and *Great Barrier Reef Marine Park* (Grech *et al.*, 2008) and complimentary state based arrangements such as *Great Barrier Reef Marine Coast Marine Park*. The species would also yield benefits from broader management initiatives including in-attendance provisions for net operators and observed reductions in licence numbers and effort usage.

Despite the above protections, there is still considerable potential for dugongs to interact with sections of the ECIFFF. Based on the available data and the distribution of fishing effort in each sector, the large mesh net fishery will be the major contributor of risk to this subgroup with the tunnel nets, ring nets and ocean beach fishing having a smaller impact on regional populations. The extent of this risk differential will need to be taken into consideration as part of the Level 2, species-specific ERA.

Cetaceans (dolphins and whales)

There have been 13 reports of a cetacean interacting with an ECIFFF operation since the introduction of the SOCI logbooks (2003–2017); six dolphins (two unspecified, two off-shore bottlenose and two Australian snubfins) and seven humpback whales. While all humpback whales were released alive, four of the dolphins died as a direct result of the fishing event including two geographically restricted Australian snubfins (Department of Agriculture and Fisheries, 2019). No cetacean interactions were recorded from the FOP during its time of operation (2006–2013).

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[10] *Only includes records where cause of death could be confirmed.*

Logbook reports compiled by DAF are lower than that reported in in the *Wildlife Stranding and Mortality Database* where 17 cetacean-net interactions (*exc.* the Queensland Shark Control Program) and 22 cetacean-line entanglements were recorded between 2006 and 2015 (Meager, 2016a). This report also links net and line fishing activities to a number of cetacean mortalities where the cause of death could not be confirmed definitively. The challenge with this data, as with marine turtles and dugongs, is that the interactions and mortalities often cannot be assigned to a sector (recreational or commercial), separated into legal and illegal fishing activities or into active nets and ghost nets. This makes it difficult to draw inferences on the total number of interactions that are occurring in the ECIFFF and the proportion of mortalities that occurred post-release. However, this data combined with the SOCI logbook data indicates that fishing activities in the ECIFFF (commercial and recreational) will be a risk factor for some species in this subgroup.

In the ECIFFF, the most serious interactions will involve the capture of dolphins and the entanglement of whales in nets. Due to the size discrepancy, the capture of dolphins arguably represents the greatest risk in this fishery particularly for species with restricted ranges. From an operational perspective, these interactions could occur through passive means (*i.e.* swimming into a net that was not detected by the animal) or through more direct measures (*i.e.* feeding on fish already caught in the net or lines, vessel collisions). While whales have the potential to interact with both the net and line apparatus, these are likely to be as a result of them being caught up in a net while passing through the fished area. DAF anticipates that the size and mass of whale species encountered in Queensland would help to minimise the number of *in-situ* deaths. These interactions though may result in longer-term complications including the strangulation of appendages overtime *e.g.* tail ropes (**contact without capture, loss of fishing gear**).

Risk mitigation measures employed for cetaceans are similar to that observed for dugongs. The complex is afforded a comparatively high level of protection through spatial closures with net-attendance provisions helping to minimise interaction times and reduce mortality rates. These measures though do not mitigate this risk completely as cetaceans tend to be more active and more inclined to travel in and out of the spatial closures.

Based on the above information and the life constraints of some species, the ECIFFF will present as a risk to this subgroup, particularly dolphins. The extent of this risk in the fishery will vary considerably and the complex will be exposed to fishing activities across a wide array of inshore and offshore fishing environments. These nuances will need to be taken into consideration as part of a Level 2 assessment.

Protected teleost (bony) fish

There are four species of teleost with SOCI reporting requirements: the humphead Maori wrasse (*Cheilinus undulatus*), the potato rockcod (*Epinephelus tukula*), the Queensland groper (*Epinephelus lanceolatus*) and barramundi cod (*Chromileptes altivelis*). While SOCI data indicates that only four Queensland groper were caught in the ECIFFF, there is some potential for the fishery to also interact with the remaining three species.

Quantifying teleost (SOCI) interactions in the ECIFFF can be difficult as line fishing symbols (L1, L2, L3) can be used in the CRFFF and *Rocky Reef Fin Fish Fishery* (RRFFF). These three line fisheries (ECIFFF, CRFFF, RRFFF) are differentiated by the species being retained *verse* a fishery symbol or separate areas of operation. If for example an operator retained a snapper and a shark species in a

single fishing event, they would be theoretically fishing in both the CRFFF and ECIFFF. This is because the snapper would be reported against the RRFFF and the shark would be reported against the ECIFFF. Due to this anomaly, some protected species interactions in the ECIFFF may have been attributed to another fishery.

While recognising the potential under-reporting, ECIFFF operators are not expected to have significant long-term impact on the four protected teleosts. This inference is largely based on the fact that it is a net-dominated fishery and protected teleosts mostly interact with the line apparatus.

Batoids

Batoids, unlike other subgroups included in the SOCC ecological component, can be retained by ECIFFF operators and a small proportion is sold as byproduct. An average of 4t of batoid product has been retained in the fishery each year since the introduction of the S symbol in 2009 (Department of Agriculture and Fisheries, 2019). However, total catch for this subgroup is likely to be higher as batoid discards have not previously been reported through the logbook system. Catch records including bycatch analyses (Halliday *et al.*, 2001) show that the majority of interactions in the ECIFFF are with stingrays (Family Dasyatidae), shovelnose rays (Family Rhinobatidae) and guitarfish (Family Rhynchodatidae). Less frequent interactions are reported with eagle rays (Family Myliobatidae), devil and manta rays (Family Mobulidae) and sawfishes (Family Pristidae) (Department of Agriculture and Fisheries, 2019).

The distribution of fishing effort in the ECIFFF overlaps with a wide range of batoids inhabiting both inshore (<2 m) and offshore (>2 m) waters. The species that interact with the fishery will vary from south to north and from shallow water to deeper water environments (Last & Stevens, 2009; Last *et al.*, 2016). Similarly, the risk posed to these species will vary depending on the spatial extent of their distribution, the overlap with fishing effort, their life-history constraints and their ability to survive a fishing event. For instance, smaller benthic batoids are expected to be more resilient to net entanglements when compared to larger, pelagic species that rely on ram ventilation (Ellis *et al.*, 2016).

Batoid interactions in the ECIFFF are expected to be higher in the tunnel net fishery and for large-mesh nets set in inshore (<2 m) waters. These sectors have longer soak times and the fished area overlaps with the preferred habitats and feeding grounds of numerous stingrays, shovelnose rays and guitarfish (Last & Stevens, 2009; Last *et al.*, 2016). While the ocean beach fishery and ring netting will interact with these species, comparatively short net set, soak and retrieval times will help to minimise the number of interactions. In these two sectors, the impacts will be more direct as any batoid within the swept area has a higher probability of being caught. At a whole of fishery level, the drivers of risk for this subgroup will vary with **contact without capture**, **disturbance due to presence in the area** and entanglement leading to **harvesting** or **discarding** all considered to be contributing factors.

Netting in habitats with a higher abundance of batoids does increase the risk that one or more of the species will experience an undesirable event. In the tunnel net fishery, this risk has been reduced through the voluntary use of grids that prevent larger animals from entering the net, the requirement for the tunnel of the net to remain submerged for the duration of the fishing event and the sorting of catch in shallow water environments. While these measures will not completely mitigate the risk of injury or death, they will help to reduce the number of batoid mortalities. Mortalities in large mesh net fisheries are likely to be higher as there is greater probability of the animal becoming entangled in the

net and sustaining injuries or dying as a result of the interaction. This risk will extend beyond the initial interaction to include post-release mortalities; something that is difficult to quantify in the marine environment.

The risk posed to this subgroup will be partly mitigated through the use of spatial closures along the Queensland east coast *e.g.* fisheries closures, Moreton Bay, Great Sandy and Great Barrier Reef marine parks. Of the batoids that inhabit Queensland's waters, demersal species with restricted home ranges would benefit most from these closures. The level of protection afforded to these species would be dependent on the extent of their home ranges and the propensity of the species to move outside this refuge. More broadly, the management of batoid take in Queensland is less developed; particularly when compared to other target and byproduct species. In the ECIFFF, the risk of overexploitation is largely managed through in-possession limits which are set at one for the recreational fishing sector, four for commercial line fishers that do not hold a 'S' fishery symbol and 10 for net fishers that do not hold an 'S' fishery symbol (**harvesting**). The commercial take of shovelnose and guitarfish rays are also restricted to a combined limit of five (*Fisheries Regulation 2008*). Unlike sharks, the take of batoids is not subject to a minimum and maximum size restriction with poor marketability considered the largest constraint on current catch levels.

At a finer scale, sawfish (Family Pristidae) are one of the few elasmobranch families afforded full protection in Queensland waters. Sawfish distributions have contracted through time and populations on the Queensland east coast (for some species) may now be extirpated; particularly in southern Queensland (D'Anastasi *et al.*, 2013; Kyne *et al.*, 2013; Simpfendorfer, 2013). Of the commercial fisheries operating on the Queensland east coast, the ECIFFF has the highest number of reports and greatest potential to interact with sawfish species. Given their contracted geographical range and the context of this ERA, there is a high risk of these species experiencing an undesirable event (*e.g.* further range contraction) due to fishing activities in the ECIFFF.

Outside of sawfish, manta rays[11] are the only other batoid group afforded full protection under fisheries legislation; although a number of devilrays are classified as 'no-take' in the Great Barrier Reef Marine Park. In 2016 the Pygmy devilray (*Mobula eregoodootenkee*)[12], the Japanese devilray (*M. japonica*)[13] and the Bentfin devilray (*M. thurstoni*) were classified as migratory species under the *EPBC Act 1999*. This classification resulted in all three being afforded full protection in the GBRMP and they were included in Queensland's SOCI reporting scheme. These species though are not protected under fisheries legislation as no-take provisions only apply to manta ray species– the reef manta ray (*Mobula alfredi*, formally *Manta alfredi*) and the giant manta ray (*Mobula birostris*, formally *Manta birostris*). As a consequence, *M. eregoodootenkee*, *M. japonica* and *M. thurstoni* can still be retained in state waters outside the marine park. Despite this, records indicate that the majority of devilrays that interact with the ECIFFF are not retained and are released alive. (Department of Agriculture and Fisheries, 2019).

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[11] *A recent review of the Family Mobulidae (devilrays) reclassified the genus 'manta' as a synonym of the genus 'Mobula' (Last et al., 2016).*

[12] *The Longhorn or Pygmy devilray (M. eregoodootenkee) is now considered to be the same species as the Kuhl's devilray (M. kuhlii) with the later considered to be the valid name (Last et al., 2016).*

[13] *The Japanese devilray (M. japonica) is now considered to be the same species as the giant devilray (M. mobula) with the later considered to be the valid name (Last et al., 2016).*

Overall, ECIFFF operators are more likely to interact with and have the potential to retain a wide range of batoid species. Catch composition data has poor species resolution and there is limited understanding of discard rates and fates. As a consequence, there is limited understanding of the fishing mortality rates for individual species and/or how this may impact on regional populations. While only a small number of batoids are afforded additional protections, there is an elevated risk that one or more species within the subgroup will experience an undesirable event due to fishing activities in the ECIFFF.

Sharks

Assessing risk ratings to shark species is more complicated as they are retained for sale in the ECIFFF as both target and byproduct species. This situation is further complicated by the fact that some shark species (*e.g.* the shortfin mako, *Isurus oxyrinchus*; the longfin mako, *Isurus paucus*) are afforded full protection in the GBRMP but can be retained for sale in state waters.

At a whole of fishery level, the ECIFFF interacts with a wide range of sharks (Department of Employment Economic Development and Innovation, 2011; Harry *et al.*, 2011) with **harvesting** considered to be the primary source of risk followed by **discarding**. At present, the risk of overfishing is managed through a series of input and output controls that includes a 600t TACC limit and the use of a shark or 'S' fishery symbol[14]. The primary purpose of the 'S' fishery symbol is to limit the number of operators that can retain sharks in larger quantities (**harvesting**). Commercial net and line operators who do not hold an S fishery symbol are restricted by in-possession limits (net = 10, line = 4) and a maximum legal size limit (Department of Agriculture and Fisheries, 2019). These size limits are used in conjunction with mesh size restrictions and help reduce the impact of the fishery on larger animals.

While the S symbol limits the number of operators that can retain sharks in higher quantities, it does not prevent the capture of unwanted animals and therefore will contribute to total discard rates. If for example a net or line fisher without an S fishery symbol reaches their in-possession limit they will need to discard the surplus animals. As a proportion of the catch will be returned in a dead or moribund state (Department of Employment Economic Development and Innovation, 2011), the **discarding** of these animals will contribute to total fishing mortality. This problem is compounded by the fact that operators without an S symbol can still operate in areas where sharks are likely to be caught in higher numbers *e.g.* offshore, deeper water environments. In these examples, operators will be targeting alternate species like grey mackerel and would be required to discard excess sharks irrespective of their fate (*e.g.* dead, moribund or alive). These dynamics combined with a lack of information on discards and post-release survival rates increases the risk that one or more shark species will experience an undesirable event.

The TACC limit was introduced at the same time as the S symbol (2009) and only applies to the Queensland east coast. Since its inception, the ECIFFF has continued to operate below this limit (296–526t) and it is unlikely to exceed this cap in the short term (Department of Agriculture and Fisheries, 2019). Additional research also suggests that a number of the species targeted by ECIFFF operators are being fished sustainably (Leigh, 2015; Johnson *et al.*, 2016). This research was presented with a number of important caveats including the need to improve the level of information on catch compositions, catch dynamics (*e.g.* size, sex ratios etc.), discard rates and species-specific fishing mortalities (Leigh, 2015). Similar caveats were identified in an early risk assessment that

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[14] *This 600t TACC incorporates a 100t complex-specific TACC for hammerhead sharks.*

assigned 11 of 14 shark species with indicative risk ratings of low to intermediate (Tobin *et al.*, 2010). The remaining three, the blacktip reef shark (*Carcharhinus melanopterus*), the pig eye shark (*C. amboinensis*) and the Australian black tip shark (*C. tilstoni*) were classified as higher risk (Tobin *et al.*, 2010). While the level of information has improved through time, these deficiencies in the catch data still remain.

In the past, catch reporting mechanisms (including the TACC) for sharks only concentrated on the retained portion of the catch. This deficiency is being actively address in Queensland with operators now required to report all shark catch (retained and discarded) through the compulsory logbook reporting system. However, there are limitations with the logbook reporting system and information on shark catch compositions (retained and discarding) is still lacking for the ECIFFF. The significance of this issue is reflected in the fact that the development and implementation of shark monitoring strategies has been included as a priority in the *Fisheries Queensland Monitoring and Research Plan* (Department of Agriculture and Fisheries, 2018e). Further, a dedicated shark monitoring project has been established within DAF to assist in this process and identify mechanisms to improve the level of information on catch rates and compositions.

As the fishery operates under a competitive TACC, effort can readily shift between shark species or complexes. This means that some species could experience a significant increase in fishing mortality without the fishery exceeding the prescribed catch limits. This is viewed as a considerable risk for sharks as the current reporting system relies heavily on the use of logbooks to collect catch composition data. The resolution of logbook data will vary as it includes both species-specific and complex specific categories. For example, the majority of the shark TACC is reported in the 'blacktip sharks' complex which incorporates the Australian blacktip shark *C. tilstoni*, the common blacktip shark *C. limbatus* and the spottail shark *C. sorrah*.

Sharks are often collectively described as long-lived species with delayed maturity and long gestation periods. While broadly true, research has shown that this picture is more complicated and that some species will be more resilient to fishing pressures. In the above example, research has shown that there are notable differences in the biology of *C. tilstoni*, *C. limbatus* and *C. sorrah* (Harry *et al.*, 2012; Harry *et al.*, 2013). These differences are likely to have a bearing on the ability of each species to resist or rebound from decline due to fishing activities. The difficulty with the ECIFFF is that there is limited information on the broader dynamics of the fishery including size classes, sex compositions and maturity status. This combined with limitations in the catch composition data makes it difficult to identify how key species may respond to changing fishing pressures and areas (*e.g.* regions, species) where fishing activities may present a higher sustainability risk.

Worldwide, the finning of sharks or removing the fins and discarding the body is considered to be a significant risk to shark populations. This risk is well managed within Australian jurisdictions and the practice of finning is prohibited across State and Commonwealth jurisdictions. In the ECIFFF, operators are permitted to process sharks at sea providing they maintain the relevant ratio of fin sets to trunks (or fillet equivalent). This differs from some jurisdictions which operate under a 'fins attached' policy which places further restrictions on the processing of sharks at sea. From an operational perspective, the fins ratio policy is more functional, but has been identified as a concern in third party sustainability assessments (Department of the Environment and Energy, 2016). The main concern being that a fins ratio policy is more difficult to enforce and is more prone to non-compliance. Non-

compliance with these provisions presents a substantial risk as this proportion of the catch will go unreported.

On a species-specific level, interactions between ECIFFF operators and shark species classified as SOCI are expected to be low. This in part is due to the low number of species afforded full protection in Queensland waters: river sharks (*Glyphis* spp.), grey nurse shark (*Carcharias taurus*), the sandtiger shark (*Odontaspis ferox*) and the white shark (*Carcharodon carcharias*). The distribution of the *Glyphis* spp. on the Queensland east coast 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). Of the remaining species, interactions with *C. taurus* (if at all) and *C. carcharias* are expected to be low and infrequent (Department of Agriculture and Fisheries, 2019). However, the presence of both species in the Shark Control Program (SCP) data suggests that there is potential, albeit comparatively low, for both of these species to interact with the fishery. *Odontaspis ferox* inhabits deep water environments and is unlikely to interact with this fishery (Last & Stevens, 2009).

Syngnathids

There are few reports of syngnathids (seahorses, pipefish and seadragons) interacting with the ECIFFF (Department of Agriculture and Fisheries, 2019) and there are no reports of them as bycatch (Halliday *et al.*, 2001) or within the FOP data. In the event that a seahorse, pipefish and seadragon interacted with the net apparatus, their body structure would allow them to past through the mesh or extract themselves with relative ease. Similarly, syngnathids are unlikely to interact (directly or indirectly) with a line apparatus and the risk of an individual being foul hooked or injured as a result of **contact without capture** is considered to be very low.

Seabirds

Data obtained from the SOCI logbooks identified 81 seabird interactions from 2003–2017. Seventy-three of these interactions occurred in a single year (2004) with the majority ($n = 69$) reported from ring netting operations (Department of Agriculture and Fisheries, 2019). All but 11 of the seabird interactions were with pelicans and the majority of birds (96%) were released alive. Current SOCI logbooks define an interaction as any physical contact an individual has with a protected species including being caught on/in fishing gear (hooked, netted, entangled) and collisions with an individual of these species. The broadness of this definition combined with the propensity of some seabirds to target fish caught in ring nets may have contributed to the over-representation of interactions reported 2004 (Department of Agriculture and Fisheries, 2019).

From an ERA perspective, ring netting presents a low risk to seabirds as the animals can be extracted (**discarding**) from the catch with relative ease. At a whole of fishery level, the risk of fishing activities contributing to an undesirable event may be marginally higher as the majority of these interactions are likely to occur when the bird is feeding. This increases the risk that a) the animal will get caught in the net and not be able to access the surface or b) they will be caught or foul hooked on a fishing line. When compared to other SOCI subgroups though, the risk posed to seabirds is considered to be relatively low.

Terrestrial mammals

The false water rat *Xeromys myoides* is a small native mammal that has a semi-aquatic lifestyle. This animal feeds on small crabs, shellfish, and worms found in coastal mangrove forests, and hunts on mud flats on an outgoing tide. Interactions between ECIFFF operators and this species are highly unlikely and the fishery presents a negligible risk to this subgroup.

Marine Habitats

The ECIFFF operates in a diverse range of inshore and offshore environments. While there is potential for this fishery to have an impact on regional marine habitats, it will be far smaller when compared to more active fishing methods such as trawl fishing. The extent of the impacts will depend on a range of factors (*e.g.* soak times, the concentration of fishing effort and repetition) but will be higher in inshore and estuarine environments where nets are more likely to interact with the sea floor. Likely impacts may include progressive declines in regional vegetation and/or increased sediment suspension around the affected area. These areas though also experience a higher degree of natural disturbance (*e.g.* storms, tidal flows *etc.*) and would be more resilient to this type of disturbance.

Net fishing, as a whole, is a relatively passive exercise that relies on fish swimming into and becoming entangled within a net. In some instances nets will be set in place or in locations where it will connect with the sea floor. Likely impacts of these events include temporary and localised disruption to the substrate, increased turbidity and sediment resuspension. Most of these actions will occur during the net setting and retrieval process and will have negligible long-term implications. These impacts though may accumulate through time in areas that are regularly subjected to net fishing operations. Depending on the species being targeted, some operators will set nets above harder substrate. These nets tend to be set with sufficient buoyancy to minimise the risk of it becoming entangled or snared on hard surfaces.

Of the fishing activities identified, **loss of fishing gear** has the greatest potential to impact the marine environment. Apart from being a hazard to a range of animals, lost or ghost nets have the potential to cause significant damage to regional environments including (for example) acting as a sediment trap and smothering benthic assemblages, becoming entangled in the substrate/vegetation and localised damage and degradation as they move with tidal fluctuations. In attendance provisions reduce the risk of mesh nets becoming lost; although the potential for equipment to be lost in this fishery (as with all fisheries) is still present. Examples of where this may occur include in deteriorating weather conditions, due to the actions of a third party (*e.g.* gear being run over by a larger vessel), loss of markers due to entanglement with marine megafauna and illegal fishing activities.

In the tunnel net and ocean beach fisheries, the primary risks to the marine habitats relate to regional disturbance and the removal of biomass from local areas. Setting of the net and sorting of the catch will result in increased regional disturbance, increased turbidity, sediment resuspension and damage to regional vegetation. The impact of these activities will be minimal as they tend to occur in environments with sandy substrates, lower levels of vegetation and high levels of natural disturbance (*e.g.* tidal fluctuations, storm surges *etc.*). Ecological communities within these areas also tolerate a higher degree of ecological instability. Given these factors, the ocean beach and tunnel net activities are not expected to have significant or long-term implications for these habitats.

When compared to the net sector, the impact of the line fishery will be more localised. This sector of the fishery as a collective (*i.e.* commercial, recreational, charter) has the potential to damage regional habitats through general boating activities, anchoring, fishing effects including the loss of gear and

pollutants. The persistence of fishing line enables it to accumulate in habitats over time, thus even no-take areas can have significant burdens of discarded line. Fishing line poses a risk of physical damage to sessile benthic organisms, such as coral, and there are longer term implications with respect to longevity of some of the equipment including weights and sinkers.

Ecosystem Processes

Of the ecosystem processes taken into consideration as part of this Level 1 assessment (Appendix 1), the most significant risks will be associated with the removal of predators and its potential to impact recruitment rates.

A large proportion of the species targeted in the ECIFFF occupy top positions in the marine food web and are often classified as tertiary consumers including the majority of the shark species (Cortés, 1999), a number of the key teleost species (Ceccarelli & Ayling, 2010) and occasional ray species (Jacobsen & Bennett, 2013). Given this, one of more likely risks associated with this fishery will be the removal of top order predators and other (secondary consumers) from the food chain (Appendix 1). At a whole of fishery level, this risk will be due to their retention for commercial sale (**harvesting**) and the discarding of animals in a dead or moribund state due to their low value or where regulations prohibit their retention. For one of the more prominent species in this group, sharks, this risk will be highly relevant to non-S fishery symbol holders who are restricted through in-possession limits.

The management regime for the ECIFFF includes a range of measures to protect larger individuals with higher reproductive potential *e.g.* minimum legal size limits, mesh size restrictions. These management initiatives are more developed for key species and minimum and maximum legal size limits often account for the size at sexual maturity. These measures increase the likelihood that an individual will reproduce at least once before they are harvested and will help to maintain long-term recruitment rates. These measures though will be less effective in the net fishery where there is increased potential for operators to interact with cohorts outside the prescribed size limits. Similarly, maximum legal size limits for sharks will be less influential as they do not apply to net operators with an 'S' fishery symbol. This is largely done to minimise the level of waste/discards in the fishery. The effective management of stocks will depend on a range of factors and the capture of individuals above or below the prescribed size limits does not automatically equate to a species being unsustainably fished. However, in the context of this (and future) ERAs this issue does present a risk as it has the potential to undermine the effectiveness of key management arrangements and or have an effect on recruitment rates for some species.

Of the remaining ecosystem processes, the ECIFFF will have limited influence over the remaining categories with scavenging and connectivity the only other components to receive a rating higher than 'low' (Appendix 1). Scavenging relates more to the **discarding** of unwanted product and its potential to alter the behaviour of some species (Pears *et al.*, 2012). Risks associated with 'connectivity' primarily relate to potential phases shifts in species assemblages due to the continued targeting of key species including larger predators.

4.3 Cumulative Impacts

A significant portion of fisheries-based ERAs are dedicated to understanding the potential impacts and risks posed by commercial fishing activities. There will however be a range of factors that contribute to an ecological component experiencing an undesirable event including the presence and

size of other fishing sectors, broader environmental trends and operations that are not managed within the fisheries framework.

For the purpose of this assessment, the cumulative impacts section has been subdivided into 'Fisheries Related Impacts' and 'External Risks'. The inclusion of Fisheries Related Impacts as a cumulative fishing pressure reflects the fact that most of Queensland's fisheries have multiple sectors e.g. commercial, recreational, charter. These sectors, for the most part, are managed alongside the commercial fishery and are subject to management regimes managed by the Department of Agriculture and Fisheries. The inclusion of Fisheries Related Impacts in the Risk Characterisation process reflects DAF's ability to mitigate potential risks through the broader management structure.

The establishment of a secondary cumulative risks category, External Risks, recognises that there are factors outside the control of DAF that have the potential to contribute to an undesirable event occurring for one or more of the ecological components. These risks represent an accumulation of issues or activities that span across stakeholders, fisheries and often state and federal management bodies. Of those that are identified, fishing activities are considered to be a contributing factor but are unlikely to be the primary source of risk and/or cannot simply be resolved through a fisheries context e.g. climate change.

External Risks are addressed in Queensland through a wide variety of forums and by various departments. Given the wide-ranging nature of these risks, these risks will not be addressed directly within Queensland's ERA framework. They have however been included in the Level 1 assessment as they have the potential to either impact on fishery (i.e. pose a risk to the fishery) or are a factor that the fishery contributes to (i.e. risks posed by the fishery). When and where appropriate, the Queensland Government will contribute to these discussions including (among others) participating in the Reef Plan 2050 process, broader management reform initiatives, national plans of action and recovery strategies. In these instances, DAF will continue to participate and represent the fishing interests of the State.

4.3.1 Fisheries Related Impacts

Other fisheries

The risk posed by the recreational fishing and charter fishing sectors will be significantly different to the commercial netting risks. As these operations are line-based, the types of risks will be similar to that observed in the commercial line sector. From a risk management perspective, the cumulative impacts of these fishing activities will be highly dependent on the species and its broader appeal within the recreational fishing sector. These cumulative fishing pressures are likely to be greater for species that featured prominently in the Statewide Recreational Fishing Survey including (among others) yellowfin bream, whiting, tailor, flathead, trevally and barramundi (Webley et al., 2015).

It can be difficult to obtain accurate information on participation rates, regional catch trends and species assemblages for the recreational fishing sector. These limitations may make it difficult to estimate the total level of fishing mortality (commercial plus recreational/charter) and therefore assign a level of risk. Data obtained through the recreational fishing survey revealed that a considerable portion of the recreational catch is released (**discarded**) (Webley et al., 2015). However, this survey also showed that the recreational harvest for some species can exceed that of the commercial fishery e.g. the dusky flathead (McGilvray et al., 2018). This indicates that cumulative fishing pressures will be a significant contributor of risk for some species; particularly within the Level 2 ERAs.

More broadly, the recreational and charter fishing sectors will contribute to the overall risk ratings through **harvesting**, **discarding** and **loss of fishing gear**. Most of these impacts will relate the **harvesting** of targeted species and the **discarding** of unwanted or prohibited fish. Given the popularity of recreational fishing (including charter), the sector also has the potential to interact (directly and indirectly) with the SOCC ecological component. Examples may include a) interactions with marine turtles where research has shown there to be a higher propensity for entanglement in lost fishing gear and b) bird entanglements due to the inadequate disposal of unwanted fishing line (**loss of fishing gear**).

Risks relating to the harvest of ECIFFF species by Aboriginal peoples and Torres Strait Islander peoples is more difficult to assess as there is less information on catch and effort rates. Gear restrictions for aspect of the fishery may be less stringent and take into account the importance of traditional fishing rights. Catch and effort rates for this sector have yet to be quantified and the level of overlap with key species is relatively unknown. At a whole of fishery level, catch and effort from Aboriginal peoples and Torres Strait Islander peoples will (most likely) present a lower risk for a number of the ecological components including harvest species, bycatch and marine habitats because of low numbers. This risk though will be highly dependent on the species and their significance to this sector.

It is acknowledged that Aboriginal peoples and Torres Strait Islander peoples will interact with a high number of the species in the SOCC subgroup. There are however significant differences between SOCC interactions in this sector and those that occur in the commercial, recreational and charter fishing sectors.

4.3.2 External Risks

Shark Control Program

The responsibility for managing the Shark Control Program (SCP) on behalf of the Queensland government lies with DAF. The purpose of the SCP is to minimise the risk of shark attack at Queensland beaches The main method of achieving this is by the removal of large and potentially dangerous sharks in the immediate vicinity of 85 popular beaches along the Queensland coastline (Department of Agriculture and Fisheries, 2017c).

While targeting larger sharks, the SCP interacts with a range of non-targeted species including batoids (devilrays, eagle rays, shovelnose rays, guitarfish), marine turtles, cetaceans and some teleosts (Department of Agriculture and Fisheries, 2018f). Impacts on species vary regionally and mortality rates are highly variable between species.

Minimising impacts on SOCI species has long been a priority for the SCP. Some of the strategies implemented include using drumlines wherever possible, the removal of all nets from the GBRMP, using bait that doesn't attract dolphins and turtles, fitting all nets with electronic warning devices (pingers) to warn whales and dolphins of the presence of nets and releasing non-target species including non-target sharks as soon as possible.

In addition, Marine Animal Release Teams (MART) have been established at the Gold Coast, Sunshine Coast, Mackay and Airlie Beach. MART release entangled animals from SCP gear, mainly humpback whales during the whale migration season (May–October). MART members are well-trained, highly-skilled officers and are equipped with tools specifically designed for purpose (DAF,

2017c). These strategies will continue to reduce the impact of the SCP on non-target species and by extension, the risk posed to one or more of the ecological components.

The SCP has established a Scientific Working Group (Department of Agriculture and Fisheries, 2017c) as required by the permit to operate in the GBRMP. The group is to:

(a) Develop research priorities relevant to Queensland shark control activities in the Great Barrier Reef Marine Park;

(b) Consider research proposals consistent with these research priorities;

(c) Co-ordinate research associated with the above activities; and

(d) Provide advice to the Program Manager and the Deputy Director General, Fisheries and Forestry, Department of Agriculture and Fisheries on published research and reports relevant to shark control activities.

The above measures help to reduce the impact of the SCP on non-target species and by extension the cumulative risks. Despite this, the SCP will continue to contribute to overall risk levels and for some species or regions may represent a more prominent risk than the commercial and recreational fishing sectors.

Climate change

Anthropogenic climate change is expected to have significant and lasting effects on the marine environment. These will likely impact fisheries operations, with some effects already perceptible in recent years. In Queensland, the severity of storms, tropical cyclones and extreme rainfall events are predicted to increase by the end of the century (Steffen *et al.*, 2017). In the past, these events have led to population reductions in affected areas and reduced fish catchability for extended periods after these events (Holbrook & Johnson, 2014). Further to this, increased warming of the atmosphere also leads to increased sea surface temperatures. Temperatures have been steadily increasing around Australia, and globally. This increase in temperature has been responsible for several largescale mass die-offs of coral, mangroves and seagrass (Hoegh-Guldberg *et al.*, 2007; Duke *et al.*, 2017; Arias-Ortiz *et al.*, 2018), which are critical spawning and nursery grounds for many species.

Changes in temperature and oceanic chemistry have been reported to affect physiology, growth and reproduction of fisheries species as well as the primary production that many of these species depend on (Sumaila *et al.*, 2011). This can lead to widespread shifts in fish and ecosystem productivity and stock distributions. There is also evidence of increased ocean acidity. Increased carbon dioxide in the atmosphere decreases the pH of seawater (*i.e.* increased acidity), leading to ocean acidification and dissolution of calcium based reef-building corals, molluscs and crustaceans (Hoegh-Guldberg *et al.*, 2007). Within this context, sustainably managed fisheries will be in a better position to respond to the effects of climate change. Fisheries already under significant stress due to, for example, overfishing, pollutants, and habitat degradation, may not have the resilience to deal with such a largescale threat (Sumaila *et al.*, 2011).

While DAF is currently unable to manage for the effects of climate change, due to the largely unquantifiable nature of largescale climatic effects on the ECIFFF these issues are important to consider when identifying risks and future management decisions for the fishery. The Queensland Government will continue to address these issues through a range of forums.

Boat strike

The effects of vessel use are similar regardless of whether they are used for commercial or recreational fishing, or some other form of recreational use. Therefore, despite the direct impacts being relatively low for ECIFFF, these impacts, when analysed in context of the all vessel activity, may be a higher risk than initially perceived.

For most air breathing species, the general probability of boats strikes is low, but become more likely depending on habitat use and vessel traffic. Turtle interactions are more likely in internesting habitats and whilst travelling through shallow coastal foraging areas *i.e.* traveling to or from the fishing grounds (United Nations Environment Program, 2014). Dugongs are also vulnerable in shallow coastal foraging areas. Boat strikes are considered a major risk to turtles; particularly in areas like Moreton Bay. In the Queensland stranding database, stranded turtles with mortalities attributed to vessel strikes greatly outnumber fishing related mortalities. The greatest risk for humpback whales occurs in offshore areas around major ports and the offshore area between the Whitsundays and Shoalwater Bay (Department of Environment and Energy, 2015).

The risk associated with boat strike mortalities is significant as it will be much larger than fisheries as it will involve a wide range of recreational and commercial services. It is for this reason that boat strike mortalities will present a higher risk than commercial fishing in some areas. For example, the *Marine Wildlife Stranding and Mortality Database* attributed between 60 and 116 turtle mortalities per year to boat strike or fractures (2000–2011 data) (Meager & Limpus, 2012). This is compared to the estimated 19 turtle deaths per year to netting activities/on deck damage and one to 53 mortalities attributed to ghost nets (2000–2011 data) (Meager & Limpus, 2012).

Urban development & changes in land use

Stemming from Queensland's increasing population, which is highly concentrated along the coast, urban development remains a key issue for terrestrial and marine habitats that connect to fisheries. Impacts of urban development may include, but are not limited to, land/vegetation clearing, pollution/sediment run-off, and alteration of natural hydrogeological processes, pollutions originating from residential, industrial and agricultural sources. Key implications of these activities with respect to fisheries is the loss or damage to freshwater and marine habitats, including those that are critically important nursery habitats. Quantifying the full effect of urban development on Queensland's fisheries and their ecological components is inherently difficult. The extent of these impacts will arguably be more significant for fisheries that target species in inter-tidal waters or species that utilise these environments for nursery areas before recruiting to the fishery.

Farming, particularly sugarcane and grazing, and urban development in GBR catchment areas are the largest contributors to land based runoff. Excess nutrients, fine sediments and pesticides have substantially increased in the GBR since pre-development levels, and significantly reduce the overall water quality of the whole GBR region (Waterhouse et al., 2017). Reduced water quality leads to loss of corals and seagrass cover, population declines in mega fauna i.e. dugongs, increased crown of thorns outbreaks, and overall degradation to the GBR (Brodie et al., 2017).

Marine debris & pollutants

Discarded and lost fishing gear from both commercial and recreational fishing is abundant in the marine environment. Nylon and other synthetic materials are extremely persistent in the marine

environment. Plastic marine debris is a significant problem for the health of all marine ecosystems, through the degradation of habitats, ingestion by organism and entangling marine life. In addition to fishing activities, plastic debris originates from tourism, both land and sea based, land based runoff and shipping (Bergmann *et al.*, 2015). Discarded fishing line, and other plastic debris, will degrade into microplastics, which are easily ingested by many species, including species harvested for human consumption. These microplastics are highly mobile and able to interact with species from all trophic levels (Bergmann *et al.*, 2015).

Discharge of garbage from a marine vessel is illegal in all Australian waters. However, boating causes the discharge of a number of pollutants. The major pollution sources associated with recreational and small to medium fishing vessels is fuel and oil. Although, antifouling paints, exhaust fumes including greenhouse gases and PAHs, and heavy metals are also released into the marine environment through boating activities (Burgin & Hardiman, 2011). Many of these pollutants are bioaccumulative, i.e. they build up in the environment due to their persistence. Discarding and loss of fishing related debris also occur in this fishery. This includes both deliberate and incidental release. Aside from lost fishing gear, the most significant sources of fishing related marine debris are bait bags and cigarette butts, and food packaging (Byrnes *et al.*, 2016).

Farming, particularly sugarcane and grazing, and urban development in catchment areas are the largest contributors to land based runoff (Waterhouse *et al.*, 2017). Excess nutrients, fine sediments and pesticides have substantially increased in the coastal marine environments since pre-development levels, and significantly reduce the overall water quality of the whole GBR region (Waterhouse *et al.*, 2017). Reduced water quality leads to loss of corals and seagrass cover, population declines in mega fauna i.e. dugongs, increased crown of thorns outbreaks, and overall degradation to the GBR (Brodie *et al.*, 2017).

The ECIFFF is likely to represent a comparatively small, but consistent, source of marine pollution. However, these risks are very difficult to quantify and almost impossible to assign to a particular sector or activity, due to the multifaceted sources of this risk. For example, marine pollutants can be sourced from land-based runoff and boat emissions, from not only fishers but also recreational boat users and commercial shipping as well. Marine pollutants and emissions present a somewhat unique situation in that they are a risk to the fishery whilst risk is simultaneously increased by fishing activity.

4.4   Risk Characterisation

Used as part of the Level 1 assessment, the primary purpose of the *Risk Characterisation* stage is to assign a qualitative value to each fishing activity that represents the potential (low, Intermediate or high) for it to contribute to an undesirable event for each of the ecological components and SOCC subcomponents (Table 2). In doing so, the *Risk Characterisation* stage aims to identify the key sources of risk from each fishery in order to inform finer scale assessments. If, for example, an ecological subcomponent is identified as 'high risk' in the Level 2 *Productivity, Susceptibility, Analysis* (PSA) or a *Sustainability Assessment for Fishing Effects* (SAFE), the results of the Level 1 assessment will identify the activities within the fishery that are contributing to this risk.

Table 2. Summary of preliminary risk scores for the ECIFFF including the impact of the main fishing activities on key ecological components.

Ecological Component	ECIFFF – Risk Profiles							Preliminary Risk Rating	Cumulative fishing impacts
	Harvesting	Discarding	Contact without capture	Loss of fishing gear*	Travel to/from grounds	Disturbance due to presence in area	Boat maintenance & emissions		
Target & Byproduct	H	I/H	L	L	L	L	L	H	H
Bycatch (non-SOCC)	-	I/H	L		L	L	L	I/H	I
Species of Conservation Concern (SOCC)									
Marine turtles	-	H	I	L	L/I	L/I	L	H	I
Sea snakes	-	L	L	L	L	L	L	L	L
Crocodiles	-	L	L	L	L	L	L	L	L
Dugongs	-	H	I	L	L/I	L/I	L	H	I
Cetaceans									
- whales	-	L/I	L/I	L	L/I	L/I	L	L/I	L/I
- dolphins	-	H	L/I	L	L/I	L/I	L	H	L/I
Protected teleosts	-	L	L	L	-	L	L	L	H
Batoids	I	H	L	L	L	L	L	H	L/I
Sharks	H	H	L	L	L	L	L	H	L/I
Syngnathids	-	L	-	-	-	L	L	L	-
Seabirds	-	L	-	-	-	-	-	L	H
Ter. mammals	-	-	-	-	-	-	-	-	-
Marine Habitats	-	L	L/I	L	L	L/I	L	L/I	I
Ecosystem Processes**	H	I	-	L	-	L	-	H	I

Represents the risk that gear will be lost. However, the impacts of lost gear i.e. ghost nets will be much higher.

** Preliminary risk assessment for the ecosystem processes ecological component provided in the Appendix.

The scores assigned to each ecological component (excluding Ecosystem Processes) and SOCC subcomponent are based on the issues raised during the *Risk Identification* process (refer section 4.3). To this extent, they take into consideration the current fishing trends (*e.g.* current catch, effort and licensing), limitations of the current management regime (*e.g.* the ability for effort to be

transferred to already saturated markets, substantial increases in fishing mortality for key species, changing target species) and the consequences of the interaction. While the majority of SOCC are classified as bycatch they have been assessed as separate entities in recognition of their complex life histories. Risk scores assigned to ecosystem processes are based on the preliminary assessment (Appendix 1) and represent the maximum score assigned to that particular fishing activity.

While the ECIFFF includes a number of sub-fisheries (*e.g.* large mesh net, tunnel net, ocean beach, ring net and line), the fishery is managed as a broader entity. Accordingly, risk ratings outlined in Table 2 are based at the whole of fishery level. It is noted though that the risk profile of each sub-fishery will show considerable variability. This variability and the potential for each sub-fishery to impact on species, marine habitats (if applicable) and ecosystem processes (if applicable) will be addresses as part of the Level 2 ERA.

Outputs of the Risk Categorisation stage, excluding cumulative impacts, were used to assign each ecological component with a preliminary risk rating based on the highest risk score in the profile (Table 4). If for example an ecological component received a 'high risk' for one or more of the fishing activities, it would be reflected in the preliminary risk ratings (Appendix 3). These preliminary risk ratings are conservative in nature and provide the first opportunity to remove low risk elements from the assessment process. Scores assigned to the cumulative risks were not considered as the preliminary risk scores are only applicable to the commercial fishery. The cumulative impacts scores though provide insight into the potential for ancillary risks to impact each of the respective ecological components.

In line with the above approach, the preliminary assessments indicated that at least eight of the ecological components were at a negligible, low or low/intermediate risk of experiencing an undesirable event (syngnathids, terrestrial mammals, sea snakes, crocodiles, protected teleosts, seabirds, whales and marine habitats) (Table 2; Appendix 2). The remaining eight ecological components were assigned preliminary risk ratings of intermediate/high or high: bycatch (high/intermediate), target & byproduct (high), marine turtles (high), dugongs (high), dolphins (high), batoids (high), sharks (high) and ecosystem processes (precautionary high, data deficient).

While not universal, data limitations and an inability to validate catch rates and discards (*e.g.* SOCI data) were factors of influence in a number of the higher risk ratings (Appendix 2). A full account of the preliminary risk ratings, the key considerations and risk factors have been provided in Appendix 2. However, the following provides a general overview of the key findings of the risk characterisation stage:

- target and byproduct species received higher risk ratings due the absence of an overarching control on catch or effort, poor species resolution in the catch data and the cumulative fishing pressures including an elevated risk of *in-situ* and post release mortalities;

- data limitations including on discards and total fishing mortality was a contributing risk factor for a number of subgroups including within the SOCC ecological component *e.g.* sharks, marine turtles and dugongs;

- net fishing specificity combined with an elevated risk of *in-situ* and post release mortalities was a factor of influence for a number of the ecological subgroups including the discarding of target and byproduct species, bycatch and the SOCC;

- the fishery presented an intermediate to high risk to a number of the SOCC subgroups due to both direct (**discarding**) and indirect (**contact without capture**, **loss of fishing gear**) impacts;

- the highest risk ratings assigned to batoids was largely driven by the fishery's potential to interact with sawfish;

- dolphins were identified as a higher risk than whales given their (smaller) morphology and greater susceptibility to entanglement;

- the removal of predators and recruitment were identified as the key drivers of risk for the ecosystem processes ecological component;

- the SCP was considered to be a factor of influence with respect to the 'cumulative fishing pressure' exerted on a number of the key subgroups including sharks, batoids and of other SOCC.

4.5 Likelihood

The *Risk Characterisation* stage takes into consideration what is occurring in the fishery and what can occur under the current management regime. This provides a more holistic account of the risks posed by the fishery and provides the Level 1 ERA with greater capacity to address the (potential) long-term consequences of a risk. The inherent trade off with this approach is that some of the ecological components may be assigned more conservative risk ratings. Otherwise known as 'false positives', these values effectively overestimate the level of risk posed to an ecological component or subcomponent. In other words, preliminary risk ratings compiled in the *Risk Characterisation* stage may represent a potential risk—something that is discussed at length in the *Ecological Risk Assessment Guideline* (Department of Agriculture and Fisheries, 2018a).

False positives should not be discounted as they point towards areas where further monitoring and assessment may be required. However, triggering management changes or progressing an ecological component to a Level 2 (species-specific) ERA based on a conservative whole of fishery (Level 1) assessment may be unwarranted. This places added importance on examining the preliminary risk ratings and determine if they represent a **real** or **potential** high risk (Department of Agriculture and Fisheries, 2018a).

In order to address the potential overestimation of risk for some ecological components, a secondary qualitative review of the preliminary risk ratings were undertaken. This review examined factors underpinning each assessment, their relevance to the current fishing environment and areas where this risk may be overestimated. The purpose of the secondary review is not to dismiss the preliminary findings of the *Risk Characterisation* stage. Rather, this secondary assessment aims to assess the likelihood of the risk coming to fruition over the short to medium term. This in itself will aid in the identification of priority risk areas and help to inform broader discussions surrounding the development of risk management strategies for key species. Given the extent of fisheries reforms outlined in the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017b) and the available resources, this was considered to be an important and necessary step.

When mitigation measures and risk likelihood are given further consideration, the preliminary risk rating for dugongs was amended from high to intermediate/high (Table 3; Appendix 2). While the species has notable life history constraints and historical population declines, the management framework for dugongs is more advanced. For example, the management regime for the ECIFFF already includes a range of measures designed specifically to reduce the impact of the fishery on this subgroup *e.g.* dedicated *Dugong Protection Areas* and gear limitations in key areas. The species is also afforded additional protections under legislation governing the use of resources in State and Commonwealth marine parks. The downgrading of the preliminary risk rating from high to intermediate/high reflects the advanced nature of mitigation measures targeted at dugongs (Appendix 2). These measures though do not mitigate this risk completely and options to further reduce the overall risk rating were limited by an absence of information on fine-scale effort movements and an inability to validate interaction rates in this fishery. While dolphins would benefit from the same mitigation measures, they are (generally) more mobile species with larger home ranges. Accordingly, the preliminary risk rating for this subgroup was retained (Appendix 2).

In addition to dugongs, the risk rating for syngnathids was downgraded from low to negligible due to the subgroup having a very low interaction rate and low probability of capture. The remaining risk ratings remained the same.

A summary of the key findings of the Level 1 ERA have been provided in Table 3. Additional information on the Level 1 risk ratings including key considerations of both the preliminary risks and mitigation measures has been provided in Appendix 2.

Table 3*. Level 1 risk ratings for the ecological components and subcomponents interacting with the East Coast Inshore Fin Fish Fishery (ECIFFF) taking into consideration the likelihood of the risk coming to fruition in the short to medium term. .*

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Target & Byproduct **Target & Byproduct**	High	• Moderate to high risk to this ecological component depending on whether the species is a target (high) or a byproduct species (moderate) and ancillary factors like market demand *e.g.* black jewfish catch has tripled within 12 months due to increased market demand. • Mesh size controls, use of spatial closers, best management and handling practices already implemented in the fishery. However key risk factors relate to the absence of effective control on catch and effort at a whole of fishery, regional and species level. • A number of management and monitoring changes are being considered for the fishery including changes to the stock assessment process, increased use of ITQs and TACs, catch triggers and incidental	Yes

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
	■	catch allowances to reduce wastage. A high proportion of these measures though have yet to be implemented and are still being worked up through the harvest strategy process. • Improved catch reporting processes, including the introduction of electronic logbooks to improve catch composition data and electronic observation are also being investigated as part of the *Sustainable Fisheries Strategy 2017–2027*. • Cumulative risks including the impact of recreational and charter fishing will be a broader risk factor for some species in this subgroup.	
Bycatch (non-SOCC)	Intermediate/High	• High likelihood as the capture of non-target species would occur daily across the majority, if not all, of the apparatus used in the ECIFFF. • Extent of these interactions and therefore the associated risk will vary between species, regions and gear types. • Information on bycatch rates and compositions unlikely to improve without further measures to validate catch. However, the amount of bycatch discarded may be lower as ECIFFF retains a high number of species. • Mitigation measures including mesh size controls, net in attendance provisions, spatial closures and best management and handling practices already implemented in the fishery. • The effectiveness of the above mitigation measures varies across the ECIFFF and will be less effective for some species.	Yes
Species of Conservation Concern (SOCC)			

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Marine turtles	High	• Moderate to high risk, depending on the location and apparatus used. Overall risk will vary between sectors but there is still considerable potential for subgroup to interact with a range of ECIFFF sectors. • Mitigation measures already in place include mesh size restrictions, net attendance provisions, use of a bycatch reduction device in tunnel nets (not mandated). • Subgroup would derive considerable benefit from marine parks provisions that prohibit net fishing in key habitats. This level of protection will be less when compared to dugongs. • As air-breathing species, there is a higher potential for an interaction to result in a mortality and the subgroup has notable life-history constraints. Marine turtles are also particularly susceptible to cumulative impacts/risks including those related to boat strike. • There are inherent limitations on the amount of available data, the ability to validate SOCI data and obtain an accurate account on the total number of interactions / fishing mortalities. This risk may transfer to a compliance issues with non-reporting of SOCI interactions considered to be a risk for this subgroup. • While electronic observation being considered for some fisheries, the feasibility and applicability of this method is still being determined.	Yes
Sea snakes	Low	• Low interaction rates and (generally) restricted to methods that have lower post release mortality rates (*e.g.* set pocket nets, ring nets). • If best management and handling practices followed a high percentage of these animals will be released alive.	No
Crocodiles	Low	• Low number of reported interactions; although interaction rates may be higher in northern Queensland.	No

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
		• Majority of crocodile population occurs outside of the prescribed fishing area of the ECIFFF and outside key fishing and outside of key fishing areas with higher concentrations of effort. • While interactions can result in mortalities, the number of reported interactions are not expected to have a significant, long-term impact on the crocodile population.	
Dugongs *Dugongs*	Intermediate/High	• There is high potential for this subgroup to interact with the ECIFFF and there is a high risk of an interaction resulting in a mortality. • Risk to this subgroup unlikely to be uniform and will depend on the netting location and apparatus. To this extent, the risk posed to this subgroup will vary between ECIFFF sub fisheries. • Subgroup has considerable life-history constraints and has already experienced substantial population declines. These factors exasperate the risk and mean that low interaction rates and mortalities will still present a risk. • Significant mitigation measures in place including Dugong Protection Areas and other spatial closures. Subgroup would also derive considerable benefit from marine parks provisions that prohibit net fishing in key habitats *e.g.* Moreton Bay. • Other risk mitigation measures in place include mesh size restrictions, net attendance provisions and use of a bycatch reduction device (BRD) in tunnel nets. However, the ability of net-attendance provisions to prevent mortalities has yet to be tested and the use of a BRD not mandated for the tunnel net fishery. • There are inherent limitations on the amount of available data, the ability of management to validate SOCI data and obtain an accurate account on the total number of interactions / fishing mortalities. This risk may transfer to a compliance issues with non-	Yes

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
		reporting of SOCI interactions considered to be a risk for this subgroup. • While electronic observation is being considered, the feasibility and applicability of this method is still being determined. • This subgroup is particularly susceptible to cumulative risks including and boat strike.	
Cetaceans	Whales Low/Intermediate	• Risk posed to this subgroup will be highly dependent on the morphology of the species and the potential for interaction to result in a mortality. • Whale interactions less likely to result in direct mortalities with dragging of equipment considered to be a more likely outcome than mortalities due to entanglement. • Greatest risk to whiles will be longer term injuries (*e.g.* tail ropes); although net attendance provisions would reduce this risk and reduce the interval of any interaction.	No
Cetaceans	Dolphins High	• Risk posed to dolphins will be elevated due to subgroup tending to smaller and having a higher potential for entanglement. • Risk for the dolphin subgroup unlikely to be uniform and will be highly dependent on the species, the location and the type of netting activity being undertaken. • The dolphin subgroup also contains species with significant life-history and geographical constraints. As with dugongs, this means that low levels of fishing mortality may have long-term implications for regional populations or key species (*e.g.* snubfin dolphins). • There are inherent limitations on the amount of available data, the ability of management to validate SOCI data and obtain an accurate account on the total number of interactions / fishing mortalities. This risk may transfer to a compliance issues with non-	Yes

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
		reporting of SOCI interactions considered to be a risk for this subgroup. • While electronic observation is being considered, the feasibility and applicability of this method is still being determined.	
Protected Teleosts	Low	• Interaction rates expected to be lower due to prevalence of net fishing activities. While ECIFFF has a line fishing component, risk is likely to be more prevalent in the *Coral Reef Fin Fish Fishery* or *Rocky Reef Fin Fish Fishery*. • The prominence of net fishing in the ECIFFF combined with the preferred habitats of the protected species help to limit this risk. • Protected teleosts would derive considerable benefit from marine parks provisions that prohibit net fishing in key habitats. • SOCI reporting is mandatory but difficult to validate at this point in time. Interactions in the ECIFFF may also be inadvertently attributed to other line fisheries.	No
Batoids	High	• High likelihood of interactions and most species can be retained for sale in the ECIFFF. The fishery also interacts with a range of non-target species including sawfish which had a significant bearing on the overall risk rating. • Sawfish have considerable life-history constraints and have experienced notable contractions in their distribution on the Queensland east coast. This means that low levels of fishing mortality may have long-term implications for regional populations and for the species as a whole. • While batoids are not retained in substantial quantities there is considerable potential for this	Yes

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Batoids		portion of the retained catch to increase under the right market conditions.	
		• The risk posed to this subgroup will vary between species and region but will arguably be more prevalent in inshore waters.	
		• Limited information on catch compositions and fishers not required to report discard compositions or fates for non-SOCI species.	
		• Some mitigation measures in place including mesh size controls for commercial fishers, in possession limits for the recreational sector and combined commercial limits for key groupings.	
		• While a maximum size length applies to this subgroup, it was primarily developed for shark species and shark-like rays (*e.g.* shovelnose rays, guitarfish). As a consequence, it will not be effective for the majority of ray species including eagle rays, stingrays and devilrays.	
		• Spatial closures will provide a level of protection from fishing mortality. The extent of these benefits will depend on the home range of the species in question.	
		• While electronic observation is being considered, the feasibility and applicability of this method is still being determined.	
		• Risk will vary between sectors with post-release survival rates anticipated to be higher in the tunnel net and ocean beach fishing sectors.	
Sharks	High	• Risk profile for sharks is complicated as it includes species that can be targeted and retained for sale, no-take species and species afforded additional protections under the EPBC Act and GBRMP legislation.	Yes
		• The fishery interacts with a wide range of species and risk levels will be highly dependent on the	

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Sharks		species, their biological constraints and their marketability.	
		• Overarching TACC in place for sharks and rays which incorporates a hammerhead shark TACC. TACC has not been reached since its inception but information is limited on how fishing mortalities relate to key species.	
		• Risk artificially mitigated to some extent by big reductions in the shark meat and fin markets. However this situation can be readily reversed depending on market depend.	
		• Stock assessment for key species indicates that they are sustainably fished but contains caveats around the quality of data.	
		• While a number of the species have been classified as sustainably fished (based on the available data), these species can be fished above MSY under the TACC. Further, the TACC does not have an overarching decision rule that prevents the targeting or capture of shark species once the limit has been reached.	
		• While catch data for this subgroup has improved through time, some of the data continues to be reported in generic catch categories. This problem is compounded by an inability to validate catch compositions and discard rates.	
		• Mitigation measures include mesh size controls, net attendance provisions and best management and handling practice in place. The effectiveness of these measures may vary between species, regions and apparatus.	
		• A range of measures are currently being considered as part of the *Sustainable Fisheries Strategy 2017–2027* but have yet to be implemented fully. These include:	

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Sharks	(Red)	- A proposed three tiered system of ITQs, TACs, catch triggers to manage risk where species can move up the tiers based on fishery data. - Incidental catch allowances to reduce wastage given the number species and net selectivity issues. - Increasing the number of stock assessments to support tier 1 and 2 species. - Improving catch reporting processes, including the introduction of electronic logbooks to improve catch composition data and electronic observation. • While electronic observation is being considered, the feasibility and applicability of this method is still being determined.	
Syngnathids	Negligible	• N/A as interaction rates (if applicable) are unlikely to have long term implications for regional populations.	No
Seabirds	Low	• Interactions with this subgroup low with the majority resulting in the animal being released alive. • Net attendance provisions and best management/handling practices reduces the extent of this risk. • Line fishing presents a higher risk to this subgroup. While ECIFFF has a line component, the majority of catch and effort is reported from the net fishery. • The risk to this subgroup will be higher in line-only fisheries (commercial and recreational)	No
Terrestrial Mammal	Negligible	• N/A as interaction rates (if applicable) are unlikely to have long term implications for regional populations.	No
Marine Habitats	Low	• The fishery will typically have a low level of impact on regional environment but may depend on the netting activity, netting frequency and location. • Fishery operates under controls that determine how nets are used and where they can be set.	No

Ecological Component	Level 1 Risk Rating	Considerations/Justifications	Level 2 ERA Required?
Marine Habitats		• Area most impacted (*e.g.* inshore waters) would experience varying degrees of natural disturbance (*e.g.* natural tidal fluctuations). • Use of vessel tracking systems being expanded across Queensland's commercial fisheries and will improve the level of understanding of net usage and its potential to impact regional marine habitats. • Net attendance provisions will help to prevent gear loss and minimise risks associated with ghost nets.	
Ecosystem processes**	Precautionary high; data deficient	• Risk levels uncertain due to data deficiencies. • Fishery interacts with a wide range of trophic levels and fishing activities will transverse a number of the ecological components. • Ecosystem processes most likely to be influenced by fishing activities in the ECIFFF include predation, recruitment and scavenging. • Measures being implemented to improve the management of key species including proposals that increase the use of ITQs and TACs would help to manage this risk.	Not progressed due to data deficiencies.

4.6 Issues Arising

Shifting catch and effort

While the fishery as a whole may not experience a significant increase in effort, there is considerable potential for effort to increase at a regional level and between species. This is partly due to an absence of regional management in the large mesh net fishery (N1, N2 and N4), provisions that allow all N2, N4 and K symbol holders the use of apparatus permitted for use in the N1 fishery and the absence of effective controls on catch and effort.

The potential for catch and effort to increase beyond acceptable levels will be present in most fisheries managed under input controls. In the ECIFFF this risk will be of particular relevance to high value species or species that experience higher levels of effort from multiple fishing sectors. The ability of management agencies and the Fisheries Working Group (FWG) to manage this risk will be dependent on the species in question and in some instances the affected region. Quantifying this risk across the entire ECIFFF will be problematic given the number of species that are retained for sale in the fishery and the resolution of the catch data. From the perspective of a Level 2 (PSA or SAFE)

ERA, this may result in a species being assigned more conservative risk scores (Department of Agriculture and Fisheries, 2018a) .

Under the current management arrangements operators can hold multiple fishing symbols (*e.g.* N1 and N2 or K1, N1, N2) but are not required to nominate the symbol they are fishing under. Operators with an N2, N4 and K fishery symbol can also fish using any apparatus permitted under the N1 fishery symbol. While these provisions provide fishers with greater flexibility, it makes it more difficult to construct a broader picture of the dynamics of the fishery and creates a level of uncertainty regarding the type of gear being used (*i.e.* ocean beach fishing, general netting) and the species being targeted. From an ERA perspective, obtaining information of symbol usage, gear configurations and regional effort distributions provides additional insight into fisher intentions and helps refine aspects of the Level 2 ERA dealing with selectivity and encounterability. This information will also assist in assessing the suitability, applicability and effectiveness of alternate management arrangements. For example, determining how changes to management of an individual fishing symbol will impact on effort levels at a whole of fishery and regional level.

Of significance, a number of initiatives being undertaken as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* that will greatly assist in the monitoring and mitigation of this risk. The most notable of these is the expansion of *Vessel Tracking* to include all commercial fishing boats by the end of 2020 (Department of Agriculture and Fisheries). This requirement alone will help to improve the accuracy of Level 2 ERA and help to quantify the level of risk associated with the movement of catch and effort within the fishery. It will however take time to both implement this policy and obtain the level of data needed to inform the ERA process.

Species composition data

In multi-gear, multi-species fisheries like the ECIFFF the acquisition of better catch data will continue to be of high priority. While the use of more generic categories has reduced, the fishery continues to report (by necessity) a proportion of the catch as species complexes or generic categories. This will make it difficult to assess the level of exploitation each species is exposed to and therefore the potential for one or more of the species within the complex to experience an undesirable event.

Refinements to the logbook reporting system have improved the level of data on ECIFFF catch compositions through time. This is most notable in the amount of catch being reported in generic categories like *unspecified fish*, *unspecified shark* and *unspecified whaler* (Department of Agriculture and Fisheries, 2019). In the past this catch has been partly validated through a Fisheries Observer Program. This program ceased in the ECIFFF in 2012 due to operational constraints and the focus of data validation is now based on data analysis, limited range checks at the data entry point and outlier reports generated once the data has been entered. Cross checking of logbook data through catch disposal records and prior and unload reporting also occurs where links have been identified (Department of Agriculture and Fisheries, 2018b).

From an ERA perspective, the quality of the species composition data will have a bearing on the accuracy of the Level 2 ERAs. This will be of particular importance to the shark and batoid ecological components where the life-history strategies tend to be more conservative. While the Level 2 ERAs allow for use of proxies, both the PSA and SAFE deal with data deficiencies in a precautionary manner. For species with limited data, this increases the probability of that they will be assigned more conservative scores and present in the Level 2 ERA as higher risk elements.

'*Improved Monitoring & Research*' was included in the *Queensland Sustainable Fisheries Strategy 2017–2027* as one of four foundational reforms. The improvement of commercial fishing data is now being addressed through a dedicated *Fisheries Data Validation Plan* and through the *Monitoring and Research Plan* (Department of Agriculture and Fisheries, 2018e). These reforms along with the expansion of the vessel tracking program will improve the accuracy of Queensland's catch and effort data. These measures though will take time to develop and implement; therefore will take time to filter through to the ERA process.

Discard and non-retention rates

The overwhelming majority of data compiled through the logbook reporting system relates to the retained portion of the catch. As discards are not accounted for in the logbook data for most species, the reporting systems may mask the true extent of fishing mortality in the ECIFFF. This heightens the risk that one or more of the ecological components or their subcomponents will experience an undesirable event due to fishing activities. The extent of this risk will be highly dependent on the species, how it interacts with the fishery (*e.g.* net or line, shallow water or deep water) and its resilience with respect to surviving a fishing event.

A lack of data on discards and post-release mortalities will be a risk factor in a number of Queensland's commercial fisheries. However, the multi-species and multi-faceted nature of the ECIFFF combined with the above limitations in species composition data will factor heavily in the Level 2 assessments. Going forward, obtaining additional data on discard and mortality rates will be of central importance to understanding and mitigating this risk. Improved data on all three parameters (species compositions, discards, and total mortality) will also help to quantify the level of risk in each sub-sector and help to direct resources towards areas and species with a higher risk potential.

Efforts are already being undertaken in the ECIFFF to improve the level of information on discard rates for some species. As of 1 January 2018 all commercial net and line fishers in the ECIFFF are required to report all shark catch (retained and discarded) through the logbook system. Discard data for this complex will initially be collected at a higher level and will require additional validation measures. While the scope of this data will be limited, it is the first step towards estimating discard rates for an important complex in this fishery. Information on discard rates for other species including key teleosts will remain limited until they are addressed through the *Fisheries Data Validation Plan* or the *Monitoring and Research Plan* (Department of Agriculture and Fisheries, 2017a).

Use and effectiveness of TACC limits

Based on historical catch trends, the risk that the retained catch will exceed a TACC is currently considered to be low. The integrity of the TACC limits have been safeguarded through active reductions in the number of fishing symbols, broader declines in fishing effort and a series of decision rules designed to reduce catch as the limit approaches (Department of Agriculture and Fisheries, 2019). Despite this, the effectiveness of the TACC limits in the ECIFFF is restricted by a) a lack of capacity to accurately account for discards and b) the capacity of management to stop fishing once the TACC limit has been reached.

The development of harvest strategies for key species is one of the key objectives of the *Queensland Sustainable Fisheries Strategy 2017–2027*. As part of this process, the suitability and applicability of TACCs will be discussed for a wide range of species. As the closure of the ECIFFF in its current form remains impracticable, the risk of total catch (retained commercial catch, catch from non-commercial

sectors plus post release mortalities) exceeding a TACC limit will remain. Evidently, this risk will apply to any multi-species, multi-faceted fishery like the ECIFFF where there is a need to accommodate a diverse range of fishing operations.

It is important to note that the above risks do not make TACC limits unsuitable for this fishery or imply that the current limits are ineffective. The challenge going forward will be how best to account for things like discards in the TACC setting process and the management framework (decision rules) required to minimise this risk. Under the *Queensland Sustainable Fisheries Strategy 2017–2027*, these challenges will be principally dealt with through the FWGs, the *Fisheries Data Validation Plan* and the *Monitoring and Research Plan Fisheries Data Validation Plan* (Department of Agriculture and Fisheries, 2018e).

Shark & batoid catch data

The life history constraints of elasmobranch species and the role they play in regional ecosystems has seen this subgroup receive a considerable level of attention. This attention will continue into the future as more species are subject to broad-scale sustainability assessments including those conducted through the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS) and the *EPBC Act 1999*. From a fisheries perspective, these types of assessments can have important implications for how shark resources are managed in Queensland.

One of the key criticisms levelled at the ECIFFF is that there is insufficient information on the composition and structure of the shark catch. As the resilience capabilities of this complex will vary between species, the fisheries reliance on catch and effort data may mask interspecific differences in the amount of effort / fishing mortality each species is exposed to. This increases the risk that one or more species will experience an undesirable event due to fishing activities in the ECIFFF. In the Level 2 assessments, the absence of biological data on the retained catch combined with poor species differentiation may result in some species receiving more conservative risk ratings.

SOCI interactions

Species of Conservation Interest or SOCI are a group of species that are afforded additional protections in Queensland waters. Often no-take species, this group includes marine turtles, whales, dolphins, crocodiles, seabirds, sawfish plus a small number of sharks, rays, teleosts and syngnathids. This group formed the basis of the broader *Species of Conservation Concern* (SOCC) ecological component that was assessed as part of this Level 1 ERA. In Queensland, all commercial operators are required to report interactions with these species in a dedicated SOCI logbook.

Comparisons with information contained within the *Marine Wildlife Stranding and Mortality Database* suggests that the number of interactions with some species may be higher than what is reported in the SOCI logbooks (Department of Agriculture and Fisheries, 2019). The extent of any under-reporting will be difficult to quantify as external information sources do not differentiate between legal and illegal fishing activities or (often) between sectors. Similarly, *Marine Wildlife Stranding and Mortality Database* includes unverified interaction reports from members of the public and entanglements where the animal appears to have freed itself (**contact without capture**). Due to these confounding factors direct comparisons cannot be made between the SOCI data and the

Marine Wildlife Stranding and Mortality Database. It does however provide some insight into the potential for post-release mortalities to occur in this fishery and the broader impacts of net fishing.[15]

Obtaining accurate information on SOCI interactions will be of significant importance to the Level 2 assessments for this fishery. Level 2 assessments are precautionary in nature meaning species with low or inaccurate data sets may be assigned a more conservative risk scores. The provisions of more accurate SOCI data enables risk assessments to be refined and provides managers and the FWG with greater capacity to differentiate between real and potential risks—refer to the *Ecological Risk Assessment Guidelines* (Department of Agriculture and Fisheries, 2018a). In a fishery like the ECIFFF where SOCI interactions cover a range of subgroups this will be important as it ensures that resources are directed towards species that require risk mitigation measures.

At a whole of fishery level, the commercial fishing sector already has the mechanisms in place to improve the level of information on SOCI interactions. In terms of the conditions imposed on the export approval and third-party assessments, there is arguably greater impetus for this sector to improve the quality of the SOCI logbook data. With that said, further information is also required on the potential for other sectors to interact with these species including recreational line fishers.

Recreational fishing data

The historical data for the Queensland recreational fishing sector is poor with state wide surveys only commencing in 1997. This lack of historical catch, effort and distribution data contributes to significant difficulties in managing risk within the fishery, particularly as fishing effort is not directly regulated in the recreational sector. However, management measures do include in possession limits, gear restrictions, size limits and spatial closures.

The majority of information on ECIFFF species 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 surveys (Webley *et al.*, 2015). However, these measures are limited and, for some species, have poor species resolution due to lack of sampling power. Although limited, the data do indicate that in many fisheries the catch from the recreational sector is as high, or higher, than the commercial sector. Given these factors, the extent of fishing mortality resulting from the recreational fishing requires further investigation.

Latent effort (line)

Management initiatives implemented on the Queensland east coast has greatly reduced the risk of latent licences becoming reactivated in this fishery. While a gap remains between the number of primary fishing symbols (N1, N2, N4, N10, K1–K8, L1 and L2) and the number of licences operating (active) in the fishery, there is a now a higher probability that management reforms will affect real effort (Department of Agriculture and Fisheries, 2019). The notable exceptions are the small mesh net (N11) fishery symbol which remain underutilised and the L3 fishery symbol which was not included in previous latent effort reviews.

Of the two, the N11 fishery symbol is restricted (net length, smaller mesh sizes *etc.*) and makes a much smaller contribution to the overall risk ratings. However, the L3 fishery symbol operates under similar provisions as the L2 and can be used in a similar fashion to the remaining east coast line

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[15] *Post release mortalities example turtle mortalities in the Boyne River during the 2011 fishing season (http://statements.qld.gov.au/Statement/Id/74570)*

symbols. The key difference being that only one tender boat is permitted for use under an L3 fishery symbol *vs.* four for the L2 fishery symbol. At present, a high proportion of the L3 fishery symbols are connected to licences (platforms) used in other fisheries *e.g.* the East Coast Trawl Fishery (*pers. comm.* S. Breen). These symbols though can be transferred to other licences for use in the commercial line fishery.

Given the size of the line sector in the ECIFFF, the transfer and activation of latent L3 fishery symbols will present a greater risk in the *Rocky Reef Fin Fish Fishery*. In the ECIFFF, the risk from this activity will be lower but may be more influential for species that have a higher cumulative risk due to their targeting in both the commercial net and line sectors as well as the recreational fishing sector.

5 Summary & Recommendations

When the outcomes of the preliminary risk assessment and the secondary evaluation of likelihood (Table 3. Appendix 2) are taken into consideration, seven ecological components will be progressed to a Level 2 assessment: target & byproduct species, bycatch, marine turtles, dugongs, dolphins, batoids and sharks. While ecosystem processes were assigned a precautionary high risk rating, it was not progressed to a Level 2 ERA due to data limitations.

Under Queensland's ERA framework (Department of Agriculture and Fisheries, 2018a), SOCC subgroups will be prioritised for Level 2 assessments followed by the target & byproduct species ecological component and the bycatch ecological component. DAF notes though that the scope of the initial Level 2 ERAs may be expanded to include a small number of non-SOCC species. The extent of this expansion will depend on a range of factors including discussions held as part of the *East Coast Inshore Working Group* and ancillary projects being undertaken as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017b).

Outside of these ecological components, the Level 1 ERA identified a number of information gaps which a) contributed to the level of uncertainty and b) produced more conservative/precautionary risk evaluations. To address these issues and help refine a number of the risk profiles, the following avenues should be pursued through the *Fisheries Queensland Monitoring and Research Plan* (Department of Agriculture and Fisheries, 2018c), the *Fisheries Data Validation Plan* (Department of Agriculture and Fisheries, 2018b) and through the development of harvest strategies for key species and fisheries (Department of Agriculture and Fisheries, 2018d). Specifically:

– Providing greater differentiation between target, byproduct and bycatch species including an examination of regional variability in catch compositions and emerging market trends *e.g.* secondary target species that may experience increased fishing mortality over the short to medium term or where international demand is increasing.

– Increasing the level of information on discard rates and fates for low value target/byproduct species and non-target species including those identified as threatened, endangered and protected.

– Validating species compositions, interaction rates and catch dynamics (*e.g.* size structures, sex ratios) for the sharks and batoids ecological components.

– Increasing the level of understanding on how the fishery symbol system operates in the ECIFFF including an examination of what symbols are being used in the fishery and the

amount of catch and effort being reported against each of the respective symbols *i.e.* trying to ascertain what fishery symbol a licence holder is operating under during each fishing event.

- – Further assessment of regional catch and effort levels in the recreational fishing sector for key species where cumulative fishing impacts present as a higher risk.

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Appendix 1 – Ecological Processes Preliminary Assessment

A1 – Ecological Processes Categories

Categories taken into consideration as part of the Level 1 preliminary ERA for the Ecological Processes ecological component. Definitions adopted from the Great Barrier Reef Outlook Report (Great Barrier Reef Marine Park Authority, 2014) and Pears *et al* (2012).

CATEGORY	DESCRIPTION
SEDIMENTATION	The inflow, dispersion, resuspension and consolidation of sediments
NUTRIENT CYCLING / MICROBIAL ACTION	The input, export and recycling of nutrients within the ecosystem. Removal of animals through harvesting is a direct loss of nutrients to the ecosystem
PARTICLE FEEDING	Feeding process targeted at particles suspended in the water column, or deposited on submerged surfaces
PRIMARY PRODUCTION	The conversion of the sun's energy into carbon compounds that are then available to other organisms
HERBIVORY	The consumption of plants
PREDATION	Includes the removal of mid and top order predators from the marine environment and the potential for animals to be subject to increase predation
BIOTURBATION	The biological reworking of sediments during burrow construction and feeding and bioirrigation (mixing of solutes) leading to the mixing of oxygen-bearing waters into sediments
DETRITIVORY	Feeding on detritus (decomposing organic matter)
SCAVENGING	Predators eating already dead animals
SYMBIOSIS	The interdependence of different organisms for the benefit of one or both participants
RECRUITMENT	The impact of the fishery on the ability of a species replenishment populations
REEF BUILDING	The process of creating habitats composed of coral and algae and includes the creation of all biogenic (i.e. of living origin) habitats
COMPETITION	Interactions between species that favour or inhibit mutual growth and functioning of populations
CONNECTIVITY	Migration, movement and dispersal of propagules between habitats at a range of scales; and functional connectivity which represents ontogenetic cycles of habitat use
OUTBREAKS OF DISEASE	The spread or introduction of disease to organisms or ecosystems
SPECIES INTRODUCTIONS	The introduction of exotic species and their spread once established

A2 – Ecosystem Processes Preliminary Assessment

Due to the difficulty of assessing the impacts of a fishery on ecosystem processes, a precautionary approach was adopted for the Level 1 assessment. In line with this approach, an initial or preliminary assessment was undertaken for 16 ecosystem processes that may be influenced by fishing activities. As with risk scores for the whole of fishery assessment (Table 2) each category was assigned a risk rating of Low (L), Intermediate (I), High (H), or negligible (-). This risk score describes the potential for each the fishing activity to impact negatively on the ecosystem process category.

For the Level 1 ERA, each fishing activity was assigned a final risk score that corresponded with the maximum risk rating assigned in the preliminary assessment. If for example 'Predation' received an 'H', than the final risk score for harvesting will be 'H'. To this extent, the final risk scores assigned to each fishing activity present the highest potential risk and therefore may not be applicable to all of the ecosystem processes categories. Used in this context, the Level 1 assessment for ecosystem processes should be considered as both precautionary and preliminary in nature. The following presents a summary of the preliminary risk scores assigned to the main fishing activities in the ECIFFF.

Ecosystem Processes Categories	Fishing – Main activities of the Fishery							Cumulative impacts	Other fisheries
	Harvesting	Discarding	Contact without capture	Loss of fishing gear	Travel to/from grounds	Disturbance due to presence in	Boat maintenance &		
Sedimentation	-	-	-	L	-	L	-		L
Nutrient cycling / Microbial action	L	L/I	-	-	-	-	-		-
Particle feeding	-	-	-	-	-	-	-		-
Primary production	-	-	-	L	-	-	-		-
Herbivory	L	-	-	L	-	-	-		-
Predation	H	L/I	-	L	-	-	-		I
Bioturbation	-	-	-	-	-	L	-		-
Detritivory	-	-	-	-	-	-	-		-
Scavenging	L/I	I	-	L	-	-	-		L
Symbiosis	-	-	-	-	-	-	-		-
Recruitment	I	-	-	L	-	-	-		L/I
Reef Building	-	-	-	-	-	-	-		-
Competition	L	-	-	L	-	-	-		L
Connectivity	L/I	-	-	-	-	-	-		L
Outbreaks of disease	-	L	-	-	-	-	-		L
Species introductions	-	-	-	-	-	-	-		-
EP (overall)	H	I	-	L	-	L	-		I

Appendix 2 – Risk Ratings and Outputs.

The primary objective of the Level 1 assessments were to a) identify the key sources of risk <u>within</u> a particular fishery and b) the ecosystem components that are most likely to be affected by this risk. Preliminary risk ratings developed as part of the *Risk Characterisation* stage take into consideration the current fishing environment (*e.g.* current catch, effort and licensing trends) <u>and</u> risk factors associated with the current management regime (*e.g.* transfer of effort to already saturated markets, substantial increases in fishing mortality for key species, changing target species). Depending on the fishery, broader risk factors may also contribute to an ecological component receiving a more conservative risk rating. These preliminary rates are precautionary or more conservative in nature and provide a more holistic account of a) risks posed by the fishery and b) provide the Level 1 ERA with greater capacity to address the (potential) long-term consequences of a risk. The trade-off with this approach is that the preliminary risk may overestimate the level of risk posed to an ecological component or be a reflection of the 'potential risk'. Otherwise known as a 'false positive', these values effectively overestimate the risk posed to an ecological component or subcomponent.

The potential for large-scale qualitative ERAs to produce 'false positives' places added importance on examining the likelihood of the risk coming to fruition in the short to medium term. The following provides an overview of the preliminary risk ratings and an assessment of the likelihood of it occurring in the ECIFFF. Depending on the species and the current fishing pressures, preliminary risk ratings may be amended to reflect the current fishing environment.

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Target & Byproduct	• Complex, multi-species fishery with a large footprint. • Fishery dominated by net fishing that has (generally) a lower degree of selectivity. • Absence of effective controls on catch and effort at a whole of fishery, regional and species level.	High	*Likelihood* • Moderate to high. *Mitigation Measures & Considerations* • Proposing a three tiered system of ITQs, TACs, catch triggers to manage risk. Species can move up the tiers based on fishery data.	High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Target & Byproduct	• Reduced effectiveness of TACC limits in a multi-species, multi-sector fisheries. • Poor species resolution in some of the catch composition data including the use of generic catch categories. • Higher potential for within net and cryptic mortality (*e.g.* post-release mortalities) of individuals that fall outside the prescribed size limits.		• Proposed incidental catch allowances to reduce wastage given the number species and net selectivity issues. • DAF examining ways to increase the number of stock assessments to support tier 1 and 2 species. • Improved catch reporting processes, including the introduction of electronic logbooks to improve catch composition data and electronic observation. • Mesh size controls, use of spatial closures and best management and handling practices already implemented in the fishery.	
Bycatch (non-SOCC)	• Fishery has higher potential to interact with non-target species. • Limited information on bycatch compositions and diversity. • Risk posed to non-target species will vary with fishing method and sorting procedures.	Intermediate/High	*Likelihood* • High. *Mitigation Measures & Considerations* • Extent of these interactions and therefore risk will vary between regions and gear types.	Intermediate/High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Bycatch (non-SOCC)	• High potential for *in-situ* and cryptic mortality (*e.g.* post-release mortalities). • Limited avenues to collect information or validate bycatch levels within the ECIFFF.		• The amount of bycatch discarded may be lower as ECIFFF retains a high number of species. • Information on bycatch rates and compositions unlikely to improve without improved catch validation. • Mesh size controls, net in attendance provisions, spatial closures and best management and handling practices already implemented in the fishery. • Electronic observation being considered. • Best management and handling practice in place. • Spatial closures.	
Species of Conservation Concern (SOCC)				
Marine turtles	• Comparatively high interaction rates for this subgroup.	High	*Likelihood* • Moderate to high.	High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Marine turtles	• Higher potential for *in-situ* and cryptic mortality to occur (*e.g.* post-release mortalities). • High degree of spatial overlap between key fishing grounds and preferred habitats. • Subgroup (generally) has more conservative life-history traits. • Subgroup also susceptible to entanglements in fishing line including discarded/lost line from all (commercial and recreational) sectors. • Limited capacity to validate interaction rates with this subgroup, the impact of under-reporting and/or assess the effectiveness of net attendance provisions.		*Mitigation Measures & Considerations* • Mitigation measures already in place include mesh size restrictions, net attendance provisions, use of a bycatch reduction device in tunnel nets (not mandated) and requirement for tunnel nets to be submerged for duration of the fishing event. • Electronic observation being considered. • Best management and handling practice in place. • Spatial closures.	
Sea snakes	• Low levels of reported interactions. • Total mortality (within net, post release) mortality unknown but not expected to	Low	*Likelihood* • Low.	Low

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Sea snakes	impact significantly on regional populations. • While fishery overlaps with preferred habitats, reported interactions are largely restricted to tunnel nets and set pocket nets. • Escapement capabilities (*e.g.* contact without capture) expected to be good for this subgroup.		*Mitigation Measures & Considerations* • Best management and handling practice in place. • SOCI logbooks. • Electronic observation being considered.	
Crocodiles	• Low levels of reported interactions. • Limited spatial overlap between key fishing grounds and preferred habitats (possibly in FNQ). • Behavioural patterns (*i.e.* rolling) may increase the risk of animals dying as a result of the interaction. • Total mortality due to legal fishing activities largely unknown but not expected to impact significantly on crocodile populations in northern Australia.	Low	*Likelihood* • Low to moderate. *Mitigation Measures & Considerations* • Best management and handling practice in place. • SOCI logbooks. • Electronic observation being considered. • Spatial closures.	Low

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Dugongs	• Low but consistent interactions in the ECIFFF. • Higher potential for an interaction to result in a mortality. • Limited information on total mortality rates (within net plus post-release mortality rates). • Limited capacity to validate interaction rates with this subgroup, the impact of under-reporting and/or assess the effectiveness of net attendance provisions. • Some mitigation measures in place (*e.g.* DPA); although overlaps still exist between fished area and preferred fishing grounds. • Fragmented populations and significant life-history constraints increases the risk for this species. • Low levels of fishing mortality may have regional implications.	High	*Likelihood* • Moderate to high. *Mitigation Measures & Considerations* • Significant mitigation measures in place including Dugong Protection Areas and other spatial closures. • Subgroup would also derive considerable benefit from marine parks provisions that prohibit net fishing in key habitats *e.g.* Moreton Bay. • Mitigation measures already in place include mesh size restrictions, net attendance provisions, use of a bycatch reduction device in tunnel nets (not mandated) and requirement for tunnel nets to be submerged for duration of the fishing event. • Electronic observation being considered. • The above was not considered to be significant enough to reduce the overall risk rating below Intermediate/High.	Intermediate/High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Cetaceans	• Complex includes a diverse range of species with varying geographical and life-history constraints. • High degree of spatial overlap between key fishing grounds and preferred habitats. • Risk dependent on size of animal and susceptibility to entanglement. • Limited information on post-release mortality rates and the effectiveness of net attendance provisions. • Fishery will present a greater risk to dolphin species. • For some species, low levels of fishing mortality may have regional or national implications. • Limited capacity to validate interaction rates with this subgroup and/or assess the extent (if applicable) of underreporting.	Whales Low/Intermediate Dolphins High	*Likelihood* • Low to moderate. *Mitigation Measures & Considerations* • Mesh size controls. • Net attendance provisions. • Best management and handling practice in place. • Electronic observation being considered. • Bycatch reduction devices used in some sectors *e.g.* the tunnel net fishery. • SOCI reporting. • Spatial closures.	Whales Low/Intermediate Dolphins High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Protected teleosts	• Higher potential for interactions to occur in the line sector. • Risk anticipated to be higher in other line fisheries due to habitat preferences of species targeted in the ECIFFF. • Limited information on total fishing mortality or species compositions. • Number of interactions may be inadvertently attributed to other fisheries.	Low	*Likelihood* • Low. *Mitigation Measures & Considerations* • Mesh size controls, spatial closures and no-take provisions in place. • Subgroup would derive considerable benefit from marine parks provisions that prohibit net fishing in key habitats. • SOCI reporting is mandatory but difficult to validate at this point in time. Interactions in the ECIFFF may also be inadvertently attributed to other line fisheries. • Best management and handling practice in place.	Low
Batoids	• One of two SOCC subgroups that can be retained for sale in the ECIFFF. • Some protections for key species and subgroups; namely sawfish and manta rays.	High	*Likelihood* • High but variable. *Mitigation Measures & Considerations* • While not retained in substantial quantities, most of this subgroup can be	High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Batoids	• High degree of spatial overlap between key fishing grounds and preferred habitats; particularly in inshore waters. • While species can be retained, a higher proportion are discarded/returned as unwanted bycatch. • Limited information on species compositions and post-release mortality rates. • The life history and distribution of some species (*e.g.* sawfish) may place them at higher risk. • Limited capacity to validate interaction and mortality rates with this subgroup. • Few reporting requirements in the current monitoring system which is primarily targeted at sharks and teleosts.		sold commercially; providing there is a market. • Limited information on catch compositions, discard rates and discard fates. • Discards not required to reported for most species (excluding SOCI) • Mitigation measures include mesh size controls, net attendance provisions and best management and handling practice in place. • Electronic observation being considered. • Bycatch reduction devices used in some sectors *e.g.* the tunnel net fishery. • Spatial closures in place but unlikely to be batoid specific.	
Sharks	• Key target species with high interaction rates.	High	*Likelihood* • Low to high depending on the species. *Mitigation Measures & Considerations*	High

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Sharks	• High degree of spatial overlap between key fishing grounds and preferred habitats. • Substantial capacity for catch and effort to increase for one or more species under the 600t shark TACC which incorporates a 100t hammerhead shark TACC. • While managed as a single entity, the biology of key species can vary considerably including between closely related species. • The life history and distribution of some species within this complex may place them at higher risk. • Limited ability to monitor and validate total catch (retained plus discards) in this fishery. • Catch composition data lacks resolution for some species / high proportion of catch reported in broader categories *e.g.* blacktip shark, whaler unspecified.		• Artificially mitigated to some extent by big reductions in the shark meat and fin markets. However this situation can be readily reversed depending on market demand. • Overarching TACC in place for sharks and rays which incorporates a hammerhead shark TACC. • TACC has not been reached since its inception but information is limited on how fishing mortalities relate to key species. • Stock assessment for key species indicates that they are sustainably fished but contains caveats around the quality of data. • Proposing a three tiered system of ITQs, TACs, catch triggers to manage risk. Species can move up the tiers based on fishery data.	

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Sharks	• Use of an S-fishery symbol only relates to retained product *i.e.* operators without an S symbol can still catch and discard sharks in higher quantities. • In possession limits (line = 4; net = 10) for licence holders without an S fishery symbol may increase discard rates / the risk of non-reporting. • Maximum legal size limits are not applied to net fishers operating under an S fishery symbol. • The effectiveness of the maximum legal size limit will be reduced by within-net / post release mortalities; particularly for net fishers who do not hold an S fishery symbol.		• Proposed incidental catch allowances to reduce wastage given the number species and net selectivity issues. • Increased number of stock assessments to support tier 1 and 2 species. • Improved catch reporting processes, including the introduction of electronic logbooks to improve catch composition data and electronic observation. • Mitigation measures include mesh size controls, net attendance provisions and best management and handling practice in place. • Electronic observation being considered. • Bycatch reduction devices used in some sectors *e.g.* the tunnel net fishery. • Spatial closures in place but unlikely to be batoid specific. Spatial closures.	
Syngnathids	• Negligible interactions and limited spatial overlap with the fishery.	Low	*Likelihood* • Low.	Negligible

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
			Mitigation Measures / FWG Discussions • N/A as interaction rates (if applicable) are unlikely to have long term implications for regional populations.	
Seabirds	• Small number reported through SOCI logbooks and interaction rates anticipated to be low. • Higher risk associated with indirect impacts and cumulative fishing pressures *e.g.* discarded fishing line. • Risks likely to be more relevant to diving species.	Low	*Likelihood* • Low. *Mitigation Measures & Considerations* • Net attendance provisions and best management / handling practices reduces the extent of this risk. • Electronic observation being considered.	Low
Terrestrial mammal	• Negligible interactions or spatial overlap.	Negligible	*Likelihood* • Low. *Mitigation Measures & Considerations* • N/A as interaction rates (if applicable) are unlikely to have long term implications for regional populations. SOCI reporting.	Negligible

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Marine Habitats	• Limited information on fine-scale effort distributions. • Impacts of net fishing expected to be localised and most obvious during the net setting and retrieval process. • The extent of the impacts will depend on a range of factors including soak times, the concentration of fishing effort and repetition. • Overall risk will be higher in inshore and estuarine environments where nets are more likely to interact with the sea floor for extended periods. • However, inshore and estuarine waters also experience a high degree of natural disturbance (*e.g.* storms, tidal flows *etc.*). • The risk posed by offshore gill netting or operations fishing in water depths greater than the drop of the net would be low. • While ghost nets may have a greater impact on the marine habitats, this risk is	Low/Intermediate	*Likelihood* • Low. *Mitigation Measures & Considerations* • Fishery operates under controls that determine how nets are used *e.g.* where they can be set. • Area most impacted (*e.g.* inshore waters) would experience varying degrees of natural disturbance (*e.g.* natural tidal fluctuations). • Use of vessel tracking systems being expanded across Queensland's commercial fisheries. This will improve the level of understanding of regional net usage and its potential to impact marine habitats. • Net attendance provisions to prevent gear loss.	Low

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Marine Habitats	minimised in the ECIFFF through in attendance provisions. • ECIFFF will contribute to the amount of discarded fishing line which can persist in the environment for a considerable period of time.			
Ecosystem Processes	• Has the potential to influence a range of ecosystem processes. • Key risks relate to the removal of predators from the system, the potential to influence/impede recruitment and scavenging. • Difficult to assess because of: a) the multi-gear/multi-species nature of the fishery; and b) an absence of data on the influence of external factors not related to commercial fishing.	Precautionary high; data deficient	*Likelihood* • Uncertain. *Mitigation Measures & Considerations* • Proposing a three tiered system of ITQs, TACs, catch triggers to manage risk. Species can move up the tiers based on fishery data. • Proposed incidental catch allowances to reduce wastage given the number species and net selectivity issues. • Increased number of stock assessments to support tier 1 and 2 species. • Improved catch reporting processes, including the introduction of electronic	Precautionary high; data deficient

Ecological Component	Key Issues / Sources of Risk	Risk Characterisation (Preliminary rating)	Considerations of Likelihood	Level 1 Risk Rating
Ecosystem Processes			logbooks to improve catch composition data and electronic observation. • Mesh size controls. • Spatial closures.	