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Ecological Risk Assessment of Queensland-managed Fisheries in the Gulf of Carpentaria

A report to the Australian Government on the ecological risk assessment requirements set out in Wildlife Trade Operation approvals for Gulf fisheries under *Environment Protection and Biodiversity Conservation Act 1999* approvals.

May 2006

Queensland Government
Department of Primary Industries and Fisheries

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The Department of Primary Industries and Fisheries (DPI&F) seeks to maximise the economic potential of Queensland's primary industries on a sustainable basis.

This publication provides information on an ecological risk assessment undertaken for a range of fisheries in the Gulf of Carpentaria.

Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
BRD	Bycatch Reduction Device
CHRIS	DPI&F's Coastal Habitat Resources Information System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEH	Australian Government, Department of the Environment and Heritage
DPI&F	Department of Primary Industries and Fisheries, Queensland
ECOTF	Queensland East Coast Otter Trawl Fishery
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
ERA	Ecological Risk Assessment
FRDC	Fisheries Research and Development Corporation
Gulf	Gulf of Carpentaria
LCW	Legal Carapace Width
LML	Legal Minimum Length
LTMP	DPI&F's Fisheries Long Term Monitoring Program
NOO	National Oceans Office
NPF	Northern Prawn Fishery
NTFTF	Northern Territory Finfish Trawl Fishery
QB&FP	Queensland Boating and Fisheries Patrol, DPI&F's fishery enforcement unit
GoCDFTF	Gulf of Carpentaria Developmental Finfish Trawl Fishery
QSIA	Queensland Seafood Industry Association
SOCI	Species of Conservation Interest
TAC	Total Allowable Catch
TRLTF	Northern Territory Timor Reef and Line Trap Fishery
WAPFTF	Western Australian Pilbara Finfish Trawl Fishery
WTO	Wildlife Trade Operation – a statutory approval under the *EPBC Act* with attached conditions and recommendations exempting product taken in a fishery from export controls

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Executive Summary

In 2004, the Queensland Gulf of Carpentaria (hereafter termed "the Gulf") commercial line, net, trawl and crab pot fisheries were each approved as a Wildlife Trade Operation (WTO) under the *Environment Protection and Biodiversity Conservation Act 1999*. The Queensland Department of Primary Industries and Fisheries (DPI&F) submitted ecological assessments on each fishery in order to demonstrate they were being managed in an ecologically sustainable manner. Continued export approval for species harvested in the fisheries was contingent upon each fishery meeting a range of recommendations made by the Australian Government's Department of Environment and Heritage (DEH).

Continued export approval is contingent upon each fishery meeting a log of recommendations from the DEH. Common across all Queensland Gulf fishery WTO approvals was a requirement to conduct a risk assessment and implement appropriate management actions to reduce species most at risk.

This Ecological Risk Assessment (ERA) report has been prepared by DPI&F to assess ecological risk levels in the Gulf fisheries and identify the existing and proposed management responses to ensure continued ecologically sustainable development of Gulf fisheries resources.

Extensive use has been made of fishery stakeholder inputs recorded at a DPI&F Workshop in Cairns on 26-27 October 2004, the Fisheries-ESD Reporting framework developed by Dr Rick Fletcher, Western Australian Fisheries, the DPI&F ecological assessments of the Queensland Gulf fisheries and fishery ecosystem reports developed by the Western Australian and Northern Territory Governments. In the report, the level of fishery interaction with shared stocks is reported across jurisdictions where appropriate.

In general, the ERA report relies heavily on publicly available commercial catch and effort data. The author was unable to provide a balanced account of relative impacts due to recreational and indigenous fishing, because available published information either doesn't exist or is not reported in sufficiently fine detail to allow reliable estimates of catches of relevant species from these sectors.

In addition, there is a general lack of available information regarding illegal fishing activity and catches by foreign fishing vessels in northern Australian waters. Intergovernmental cooperation is required to obtain illegal fishing enforcement data from Australian Government sources for the northern Australian Fishing Zone for accurate and full sustainability assessment and reporting of Gulf fishery stocks.

Forty-seven retained species components, 45 non-retained species components and 44 general ecosystem components were assessed for relative levels of risk. The ERA methodology requires that the level of management intervention for each component should be appropriate to the level of risk. Where relevant, proposed management actions are contained in the ERA report for each component, the number of ecosystem components assessed and the proportional levels of risk in the Queensland Gulf fisheries are summarised below.

The assessment reveals that based on our current level of knowledge; there is a relatively high risk to the sustainability of two target species in the Gulf net fishery compared to other retained species – guitarfish in the N3 fishery and grey mackerel in the N9 fishery. Ten other species/species groups are considered to have a moderate risk to their sustainability including Spanish mackerel, red snappers, barramundi, threadfins, sharks and mud crabs. Twenty other retained species and another 15 species have either low or negligible risk respectively, to their sustainability.

For species interacting with, but not-retained by a fishery, there were no species considered to be at high risk to their sustainability. Six species/species groups are considered to have a moderate risk to their sustainability from the net fishery (bottlenose dolphins, speartooth sharks and sawfishes), and the trawl fishery (sharks, rays and sawfishes). Six other retained species and another 34 species have low or negligible risk respectively, to their sustainability.

There were no fishery impacts considered to be high risk factors to the sustainability of the marine ecosystem supporting Gulf fisheries. However, some fisher camps in the N3 and crab fisheries were considered to have a moderate risk to the local terrestrial ecosystem. Seventeen fishery-specific impacts are considered to have a low impact on the marine ecosystem, while another 25 fishery-specific impacts have negligible impact on the marine ecosystem.

The ERA report represents Level 1 of the ecological risk assessment process recommended for other major commercial fisheries managed and assessed by the Australian Government. Minimising risk to moderate to high risk groups in each fishery requires implementation of proposed management initiatives. Otherwise each at risk group should be considered for further assessment, which may be a more finely focused Level 2 semi-quantitative Productivity Susceptibility Analysis for species assemblages where there is adequate data or if warranted, a fully quantitative “model-based” Level 3 population assessment may be undertaken for single species.

To satisfy other WTO recommendations for the Queensland Gulf fisheries, DPI&F will pursue the review and development of fishery performance indicators and reference points for high to moderate risk species during 2006 (Trawl, Net and Line fisheries) and 2007 (Mud Crab Pot fishery), making extensive use of available stock assessment and monitoring data and the outcomes and information contained in the ERA Report.

Acknowledgments

The DPI&F wishes to extend a special thanks to Dr Rick Fletcher, who facilitated the Ecological Risk Assessment Workshop of the Queensland commercial Gulf of Carpentaria Fisheries, reviewed the outputs and provided helpful advice in producing this assessment report. Contributions from the members of Gulf MAC who represented their respective fisheries and stakeholder groups are also greatly appreciated. Their practical knowledge and experience were important in providing information on species interactions with fishing gear, filling gaps in our current knowledge of these interactions and reducing uncertainty in the final risk ratings in this assessment.

Introduction

In 2004, the Queensland Gulf of Carpentaria (hereafter termed "the Gulf") commercial line, net, trawl and pot fisheries were each approved as a Wildlife Trade Operations (WTO) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Queensland Department of Primary Industries and Fisheries (DPI&F) submitted ecological assessments on each fishery in order to demonstrate they were being managed in an ecologically sustainable manner. Continued export approval for species harvested in the fisheries was contingent upon each fishery addressing recommendations made by the Australian Government's Department of Environment and Heritage (DEH).

Common across all Queensland Gulf fishery WTO approvals was a requirement to conduct a risk assessment and implement appropriate management actions to reduce impacts of fishing on species at higher risk from the fishery (Appendix 1). This report sets out the steps undertaken by DPI&F to assess ecological risk, the rationale behind assigned risk levels in the Gulf fisheries and the proposed management responses to ensure continued ecologically sustainable development of Gulf fisheries resources.

Extensive use has been made of the Fisheries-ESD Reporting framework developed by Fletcher *et al*. 2002 and other relevant fishery reports. Sources of particular significance to this assessment include the Ecological Assessments compiled by the Queensland, Northern Territory and Western Australian governments for each of their respective line, net and trawl fisheries for tropical finfish and the Queensland Mud Crab Fishery Ecological Assessment.

Risk has been assessed for fisheries harvesting shared stocks across jurisdictions where appropriate. There is however, a general lack of information regarding illegal fishing activity and catches by foreign fishing vessels in northern Australian waters. The potential for effort from large foreign fleets to heavily impact northern Australian fishery stocks is uncertain but may be significant when it is considered that the number of Australian vessels harvesting these stocks is small by comparison.

Methodology

Scope

This report is based upon the outcomes of a stakeholder Workshop held on 26 –27 October 2004 in Cairns and subsequent consultation with fishery stakeholders. A list of Workshop participants is in Appendix 2. The Ecological Assessment reports submitted to the Australian Government for the purposes of reporting publicly on Queensland Gulf fisheries management regimes[1] were important as Workshop reference sources for the following Gulf of Carpentaria fisheries:

[1] Ecological Assessment Reports for Queensland Gulf Fisheries are available on the internet at: http://www.deh.gov.au/coasts/fisheries/qld/index.html

- L4/L5 Line Fishery
- Developmental Gulf Finfish Trawl Fishery
- N9 Offshore Net Fishery
- N3 Inshore Net Fishery
- C1 Crab Pot Fishery.

Overview

There were four steps involved in completing the Ecological Risk Assessment for the Gulf of Carpentaria fisheries based upon the National ESD Reporting Framework, "*How to Guide*" (Fletcher *et al.*, 2002; Fletcher *et al.* 2005) www.fisheries-esd.com

The National ESD Risk Assessment process involves:

1. Identification of relevant issues by adapting a set of "Generic ESD Component Trees" into a set of component trees specific to the Gulf fisheries.
2. Completion of a risk assessment/prioritisation process was objectively determined which of these issues was of sufficient significance to warrant specific management actions.
3. Completion of appropriately detailed reports on each issue and justifications for assigning low priority or low risk.
4. Generation of a report on management performance on high and moderate risk rated issues which may be used to guide DPI&F in meeting its obligations under ESD.

Issue Identification (Component Trees)

The National ESD Reporting Framework has eight major components, which fall into three categories of the "contributions to the Ecosystem", "contributions to human wellbeing" and the "ability to achieve the objectives" (Figure 1). Under the recommendations of the EPBC Act approvals for the Queensland Gulf fisheries, only the "contributions to the Ecosystem" component of ESD reporting is dealt with in this report. Each of the major ecosystem components is divided into more specific sub-components for which ultimately operational objectives can be developed.

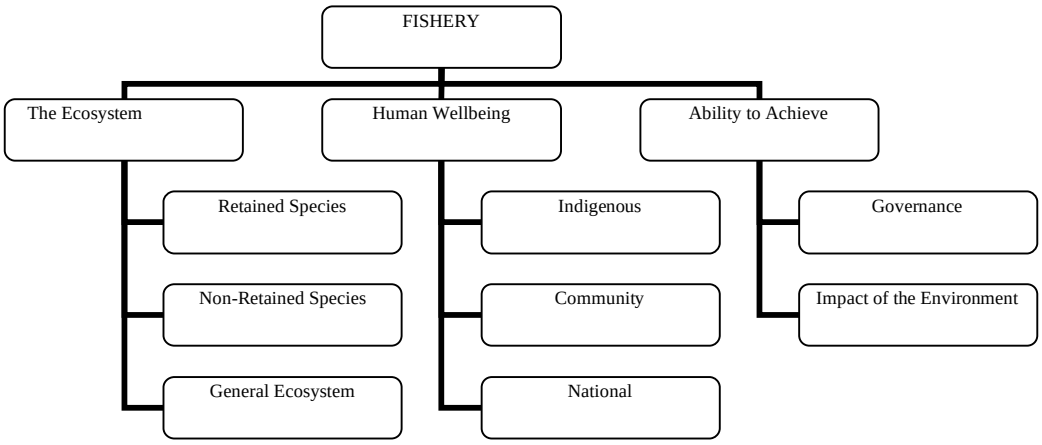


Figure 1. The eight major components of ESD for fisheries (from Fletcher *et al.* 2002)

The generic component trees developed for Fisheries ESD reporting by Fletcher *et al*. (2002) were used as the starting point for identifying the issues (Figure 2). These trees were subsequently adapted into trees specific to the Gulf fisheries by expanding (splitting) or contracting (removing/lumping) the number of sub-components as required.

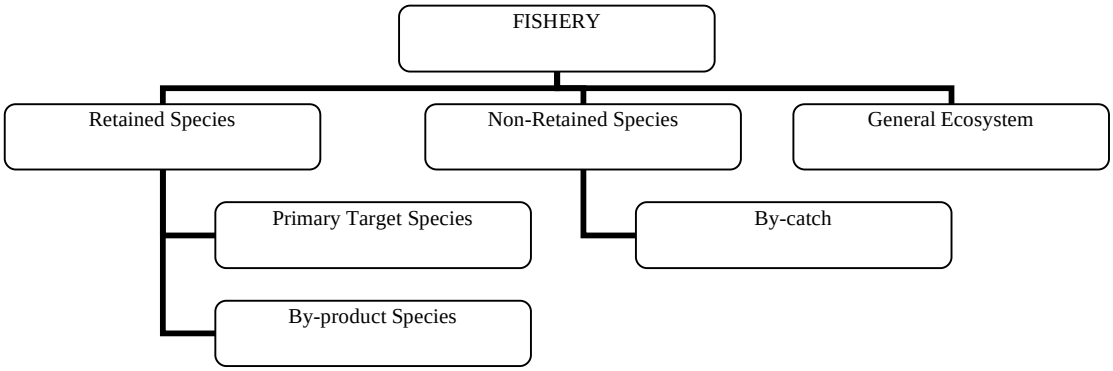


Figure 2. Generic component tree structure for ecological risk assessment

Risk Assessment / Issue Prioritisation Process

After the components/issues were identified, a process to prioritise each of these was completed using a formal risk assessment process. The risk assessment framework that was applied at the stakeholder Workshop was consistent with the Australian Standard AS/NZS 4360:1999 for Risk Management, concentrating on the risk assessment components. The general Risk Assessment process is well documented but in summary, it considers the range of potential consequences of an issue/activity and how likely those consequences are to occur. The combination of the level of consequence and the likelihood is used to produce an estimated level of risk associated with the particular hazardous event/issue in question.

An estimate of the consequence level for each issue was made by the group at the stakeholder Workshop. This level was from 0-5, with 0 being negligible and 5 being catastrophic /irreversible. This assessment was based upon the combined judgments of the participants at the Workshop, who collectively had considerable experience and expertise in the areas examined.

The level of consequence was determined at the appropriate scale for the issue. Thus for retained and non-retained species, the consequence of impact of the Gulf fisheries was assessed at a fish population level not at the level that a fishery may impact on individuals or aggregations of fishes. Similarly, when assessing possible ecosystem impacts (e.g. benthic biota) this was done at the level of the impact on the whole ecosystem or at least in terms of the entire known extent of the habitat, not at the level of individuals or patches of individuals that characterize the habitat type.

The likelihood of a consequence occurring was assigned to one of six levels from remote to likely (Appendix 3: Likelihood Definitions). In doing so, the likelihood of the "hazardous" event (consequence) actually occurring was considered based upon the expert opinion of Workshop participants, which included an understanding of the scale of impact required.

From consequence and likelihood scores, the overall risk value was calculated by multiplying the consequence and likelihood (i.e. Risk = Consequence x Likelihood), (Appendix 3: Risk Matrix). Finally, each issue was assigned a Risk Rating from one of five categories: Extreme, High, Moderate, Low and Negligible corresponding to the calculated risk score (Appendix 3: Risk Ranking Outcomes).

The relative risk ratings were presented visually by colouring the respective boxes relating to each issue in each component tree considered at the Workshop. **Red boxes** indicate the issue was considered high risk to sustainability, requiring full justification for the rating and the proposed management response. **Yellow boxes** indicate that the issue was considered moderate risk, but high enough risk to warrant detailed justification. **Blue boxes** indicate the issue was rated as a low risk requiring no specific management. A brief justification is presented for these issues. **Green boxes** are considered at negligible risk from the fishery and are dealt with in greatest detail in the risk assessment of the fishery that has the highest level of interaction (i.e. greatest impact). Consistent with their risk status, management proposals are not routinely made for issues assessed to be at *negligible risk* from the fishery, unless otherwise stated in the assessment. Specific management recommendations made on a precautionary basis at the Workshop are also reported where relevant.

Only the issues that were assigned a risk of extreme, high & moderate risk levels need a full justification of proposed management actions (Appendix 3: Risk Ranking Outcomes). Nonetheless, the rationale for classifying issues as low risk or even negligible were also documented and form part of this assessment report. This allows all stakeholders and interested parties to see why specific issues received these risk ratings.

It is important to note that the Ecological Risk Assessment involves the completion of reports that contain the completed justifications for the scores generated. Thus, the scores determined within the stakeholder Workshop by themselves are insufficient and require some contextual information to explain their significance.

Component Reports

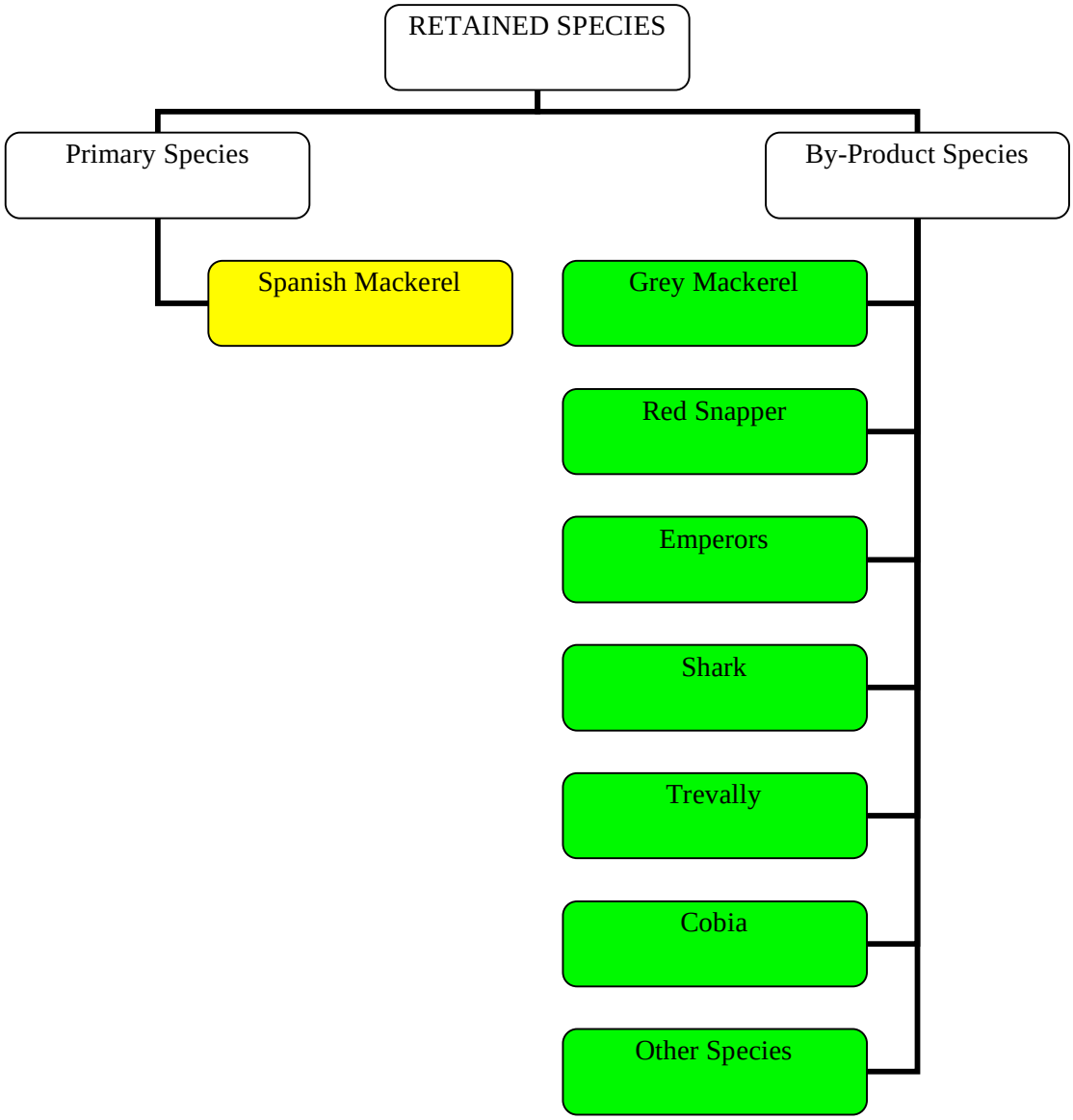
Only issues of moderate or higher risk require specific management actions. These are detailed in the following component reports for higher risk/ higher priority species. The rationale for classifying issues as low risk/low priority are also documented and forms part of the report so that stakeholders can see where all the identified issues have been ranked and how these were justified at the completion of the assessment. For each of the lowest level sub-components assessed as being of sufficient risk/priority to address, a detailed assessment of risk of the fishery to the breeding stock of a species or the ecosystem is generated where relevant.

Development of the final Ecological Risk Assessment report for the Queensland Gulf of Carpentaria fisheries was initiated in early February 2005. Progress towards completing the report was made subsequent to consultation with the Queensland Gulf fisheries manager. In late February 2005, the draft assessment was forwarded for review to Dr Rick Fletcher, Stakeholder Workshop Facilitator and later to Workshop participants and Gulf fisheries stakeholders for comment.

This document is the final report to the Australian Government, Department of Environment and Heritage (DEH), generated after the draft report was reviewed by the Gulf of Carpentaria Management Advisory Committee (Gulf MAC), Ecological Risk Assessment Workshop participants and senior DPI&F management and assessment and monitoring staff in late 2005.

Retained Species

Component Tree for Retained Species in the L4/L5 Line Fishery



Catch composition

The component tree detailing the stocks of retained species relevant for this fishery is shown above. The L4/L5 fishery area is shown in Fig 3. There are is a single primary species for this fishery. Narrow-barred Spanish mackerel (*Scomberomorus commerson*) make up about 93% of the retained catch (by whole weight) in the fishery (computed from catch data in Roelofs 2003).

Byproduct species are mainly grey mackerel, emperors, red snapper, trevally, shark, cobia and a number of other species. These combined make up only about 7% of the retained catch. This compares with the reported byproduct catch from other northern Australian commercial line fisheries targeting Spanish mackerel: i.e. about 5% of the retained catch in the WA fishery (Anon. 2004) and about 2.5 % of the retained catch in the Northern Territory fishery (O'Grady 2002).

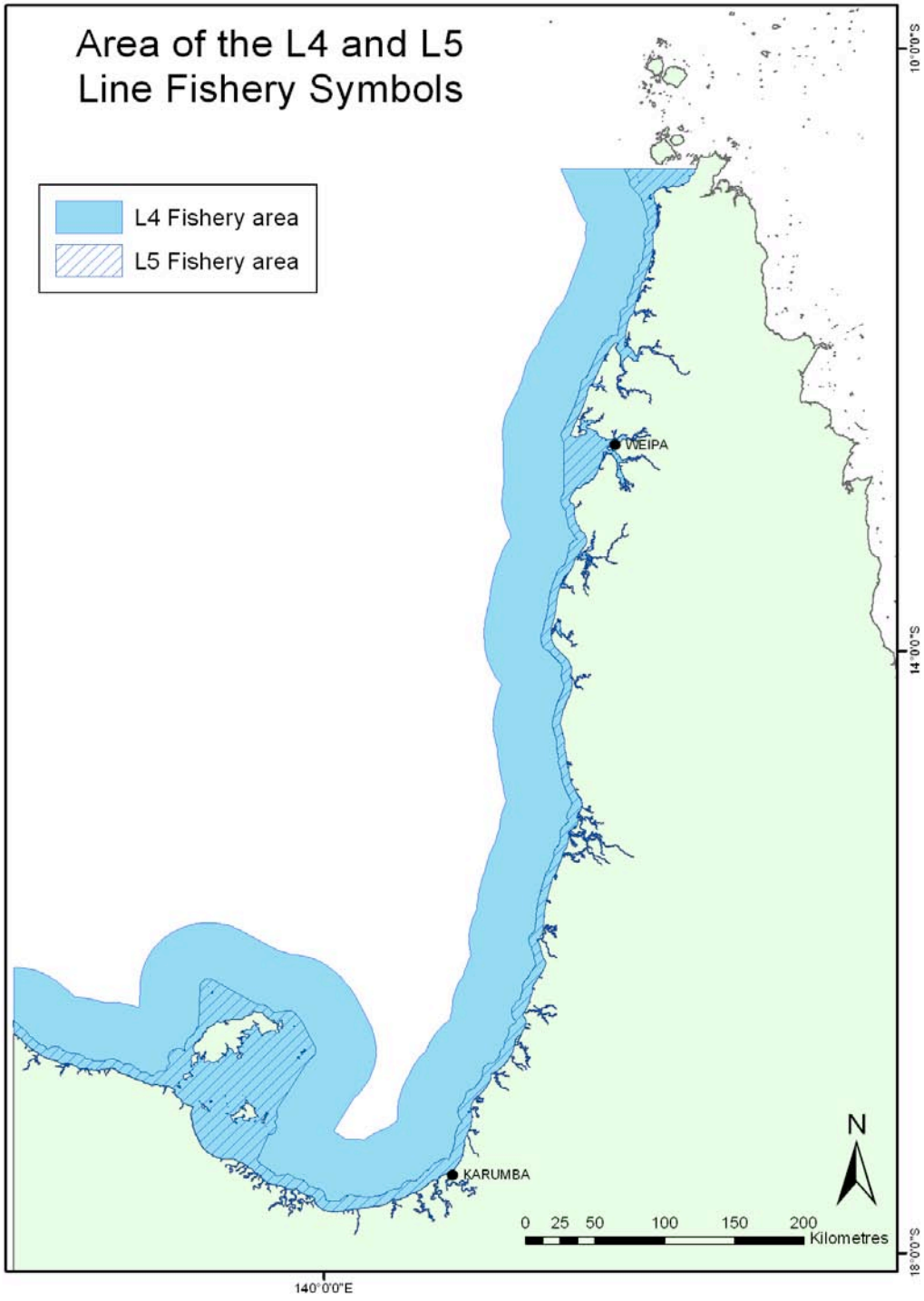


Figure 3 **Map displaying the geographical range of the L4/L5 Line fishery**

Primary Species

Spanish mackerel (*Scomberomorus commerson*)

In 2003, the total catch of Spanish mackerel in the Queensland Gulf from all sources was about 180 tonnes. The average annual commercial L4/L5 line catch of Spanish mackerel is about 150 tonnes. Harvested catch in the L4/L5 line fishery is reported from the Queensland coast out to a distance of 25 nm (Roelofs *et al.* 2003). Fishers operating beyond 25nm under Queensland Fishery Joint Authority (QFJA) also report Spanish mackerel catches through their respective logbook (Mark Doohan, DPI&F, *pers. comm*., 2004).

Spanish mackerel are also caught in the N9 offshore net fishery and the N3 inshore net fishery (a combined harvest of about 20 t/yr), the Gulf Developmental Finfish Trawl Fishery (2 t/yr) and charter fishery (1.5 t/yr) (DPI&F *unpublished data*, 2005). Catches of Spanish mackerel in the Queensland Gulf recreational line fishery are uncertain with no reliable estimates available at this time. The recreational catch appears to be concentrated around the major population centres, indicating higher fishing effort is restricted to these locations. The indigenous catch of Spanish mackerel in the Gulf is also unclear. Indigenous Spanish mackerel catches around the main population centre in the northern Gulf, Weipa, are relatively low and incidental to fishing for other species (Eddie Woodley, Chair, Peninsula Regional Council, *pers. comm*., 2004).

Spanish mackerel catch levels in the L4/L5 line fishery are notably less or of a similar magnitude to those in the Northern Territory and Kimberley region Western Australian commercial line fisheries (Table 1). The ecological risk assessment of Spanish mackerel in the Western Australian line fishery assessed the level of fishery impact on the species as moderate (Anon, 2004a). Accordingly, the Queensland Workshop discussions suggested that the impact of the L4/L5 fishery was either about the same, or slightly lower, than the risk rating assigned in the WA Fishery (i.e. low to moderate risk).

A moderate level of risk would take into account that the Queensland Gulf stock may be one of a series of relatively homogeneous northern Australian metapopulations maintained by some genetic mixing among sub-populations but which are quite distinct from Indonesian stocks as suggested by O'Grady (2002). However, the Workshop also acknowledged that while previous genetic research indicates spatial separation between Spanish mackerel stocks between Torres Strait and the Gulf, the fine scale genetic definition of the other northern Australian Spanish mackerel stocks including those found in the Gulf, are still poorly known (Roelofs 2003).

For the purposes of the L4/L5 line fishery ERA, the Spanish mackerel stock in the eastern Gulf has been assumed to behave as a single functional management unit with fishery effects mainly being confined to this part of the species' distribution. It is appropriate to take a precautionary approach to assessing the level of risk that the fishery presents to the sustainability of the Queensland Gulf Spanish mackerel stock, as its capacity to recover from overfishing is uncertain but could be limited.

Table 1. Annual Spanish mackerel catches in northern Australian commercial line fisheries based on recently reported catches

State	Management Area	Period	Estimated Mean Catch /Catch Range (tonnes)
Queensland	Eastern Gulf	1996- 2002	150[a]
Northern Territory	Western Gulf to the Northern Territory-Western Australian border	1991-2000	215[b]
Western Australia	Kimberley (WA/NT border to 121ºE Long.)	1991-2003	110-205[c]

(a) Calculated from catch data in Tables 1.1 and 1.3 (Roelofs *et al.* 2003);
(b) Calculated from catch data in Table 1 (O'Grady 2002);
(c) Reported in Anon (2004*a*).

Based on trends in the catch and effort data, there is no evidence of any stock problems. However, anecdotal information points to a possible long term decline of Spanish mackerel in some areas. For instance there now seems to be less fish than previously encountered in waters adjacent to Weipa (Greg Howard, Gulf Line fisher, *pers. obs.*, 2004). This needs to be considered in the context of a 30% reduction in line fishing effort since 1997 (CHRIS, 2005) and a commensurate reduction in boats reporting Spanish mackerel catches in the L4/L5 fishery over the 1997 to 2003 period.

There are a number of factors that may be affecting lower catches in some locations. First, there are indications that latent effort can potentially be shifted between the L4/L5 and the inshore net fishery where fishers are licensed for both line and net fishing. McPherson and Williams (2002a) reported a notable increase in Spanish mackerel catches as byproduct in the N9 offshore net fishery from 1990 to 2000 – an increase of from 5 to 20% of the total Queensland commercial Spanish mackerel harvest in the Gulf. However, it has since been confirmed that half the latent effort has been removed from the L4/L5 fishery (Mark Doohan, DPI&F, *pers. comm.*, 2004), thus reducing the likelihood of effort shifting between the Gulf line and net fisheries.

While there are no reliable catch estimates of Spanish mackerel in the Gulf recreational line fishery, the already high participation of recreational fishers in the Gulf, about 100,000 fishers in 1999 (Roelofs 2003), is likely to be increasing with visiting fishers being provided with better road access to coastal Gulf communities and facilities from which to base their fishing activities. The notion that effective effort directed at Spanish mackerel may have also increased due to technological change in commercial and recreational fisheries, can not be discounted.

This assessment concludes that from a precautionary standpoint if the Spanish mackerel stock under consideration is not restricted to the Queensland Gulf but is shared with the Northern Territory; there may be an increased risk to its sustainability (see Table 1 for comparative catch estimates). On the other hand, if the mixing capacity between spatially separate Queensland and Northern Territory Gulf stocks is limited, the level of impact on the Spanish mackerel stock in the eastern Gulf is probably not as great. Given the uncertainty in the stock structure and that there may be some remaining latent commercial and recreational effort issues unresolved, it was

considered possible (Likelihood score=4) under the current management arrangements that this stock may sustain major impact from the fishery, for example; become overfished (Consequence score=3). The product of these scores results is a Moderate level of risk to the sustainability of the stock from its interaction with the fishery.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions
In response to the risk assessment for the L4/L5 fishery the following management actions are proposed:

- Regularly assess Spanish mackerel catches (i.e. total catch, catch rates and catch distribution) in the Queensland and Northern Territory managed areas of the Gulf.
- Consider the results of current research into fine-scale variability of the northern Australian Spanish mackerel stock structure in future management decisions affecting the species.
- Review the existing Gulf Spanish mackerel management arrangements upon the outcomes of genetics research and appropriate catch assessments becoming available.

Byproduct Species

Each of the byproduct species / species groups in the L4/L5 Line fishery has been assessed in appropriate detail in other sections of this report dealing with the other Gulf fisheries.

Grey Mackerel and byproduct species excluding 'Other Species'

Grey mackerel (*Scomberomorus semifasciatus*) and sharks taken in the L4/L5 Line Fishery makes up less than 1% of the total grey mackerel and shark catches from all Queensland commercial Gulf fisheries combined. These species are dealt with in the risk assessment of the N9 fishery which takes a high proportion of the Queensland commercial catch of these species in the Gulf. Other species listed in the component tree are also at negligible risk from this fishery due to the limited quantities taken and are dealt with in the other Gulf fishery risk assessments: e.g. red snappers and emperors in the Queensland Gulf of Carpentaria Developmental Finfish Trawl Fishery assessment.

ERA Risk Rating: Impact on breeding stocks (*Negligible Risk)*

Proposed Management Actions
No specific management actions are proposed at this time.

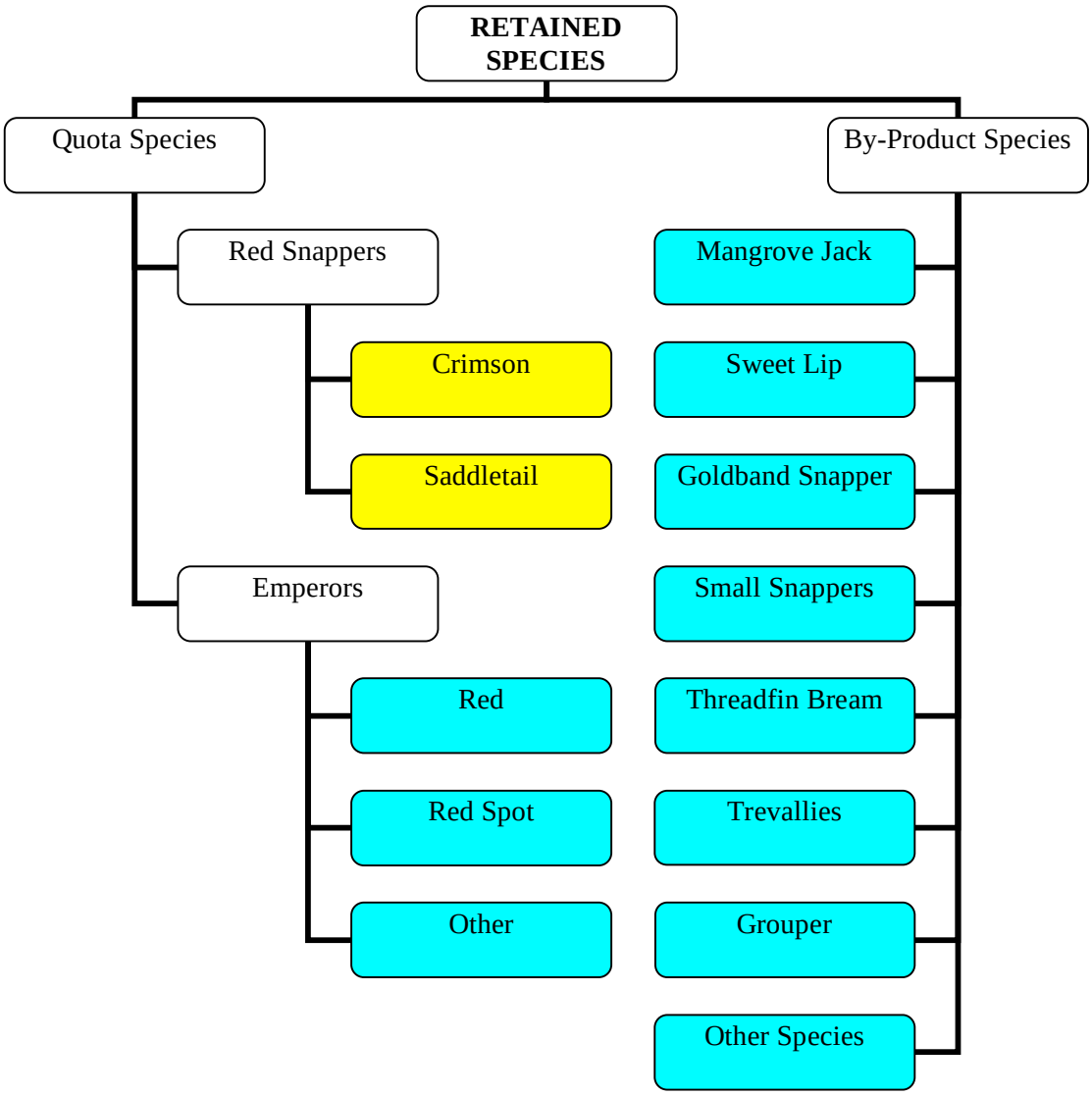
Other species

Only very small catches are taken of other species including coral trout, cod, jewfish, catfish and other mackerel. The size of catches are difficult to quantify because they are so low - in the order of kilos. The annual Workshop therefore considered that the fishery poses no more than a negligible risk to these species.

ERA Risk Rating: Impact on breeding stocks (*Negligible Risk)*

Proposed Management Actions
No specific management actions are proposed at this time.

Component Tree for Retained Species in the Finfish Trawl Fishery



Species composition

The component tree detailing the stocks of retained species relevant to the Queensland Gulf of Carpentaria Developmental Finfish Trawl Fishery (GOCDFTF) is fishery is shown above. The geographical extent of this fishery is shown in Fig. 4. There are several primary species managed by annual quota in this fishery. Together these make up about 70% of the total retained catch (Roelofs and Stapley 2004). The estimated combined annual catch of Queensland quota managed species in the Northern Territory Finfish Trawl Fishery (NTFTF) and the GOCDFTF is about 900 t (Appendix 4). The red snappers are the largest component of the catch. *Lutjanus erythropterus* (crimson snapper or small-mouthed nannygai) and *Lutjanus malabaricus* (saddletail snapper or large-mouthed nannygai) make up about 38% and 23% of the retained catch (by whole weight) respectively (Roelofs and Stapley 2004). Together tropical snappers make up about 80% of the retained catch in the fishery. Other quota managed species in order of decreasing proportion of the catch by weight

are Red Spot Emperor (*Lethrinus lentjan*) 4%, red emperor (*Lutjanus sebae*) 2%, and small quantities of other emperor species (mainly *L. nebulosus* and *L. fraenatus*).

Byproduct species are made up of a variety of snapper (Lutjanidae), Cod (Epinephelidae), threadfin bream (Nemipteridae), grouper (Serranidae), trevally (Carangidae) species and other species - mainly mackerel, butterfish, hairtail and lizardfish (Roelofs and Stapley 2004).

Major byproduct component species make up 30% of the retained catch (Roelofs and Stapley 2004). Their percentages by weight of the total retained catch are: mangrove jack (*Lutjanus argentimaculatus*), 15%; sweetlip (*Diagramma labiosum*), 6%; goldband snapper (*Pristipomoides* spp.), 3%; other small snapper species [e.g. golden snapper (*Lutjanus johnii*), moses perch (*L. russelli*) and stripeys (*L. carponotatus*)], 3%; and Spanish mackerel (*Scomberomorus commerson*), 2%. Other byproduct species make up only about 4% of the total retained catch.

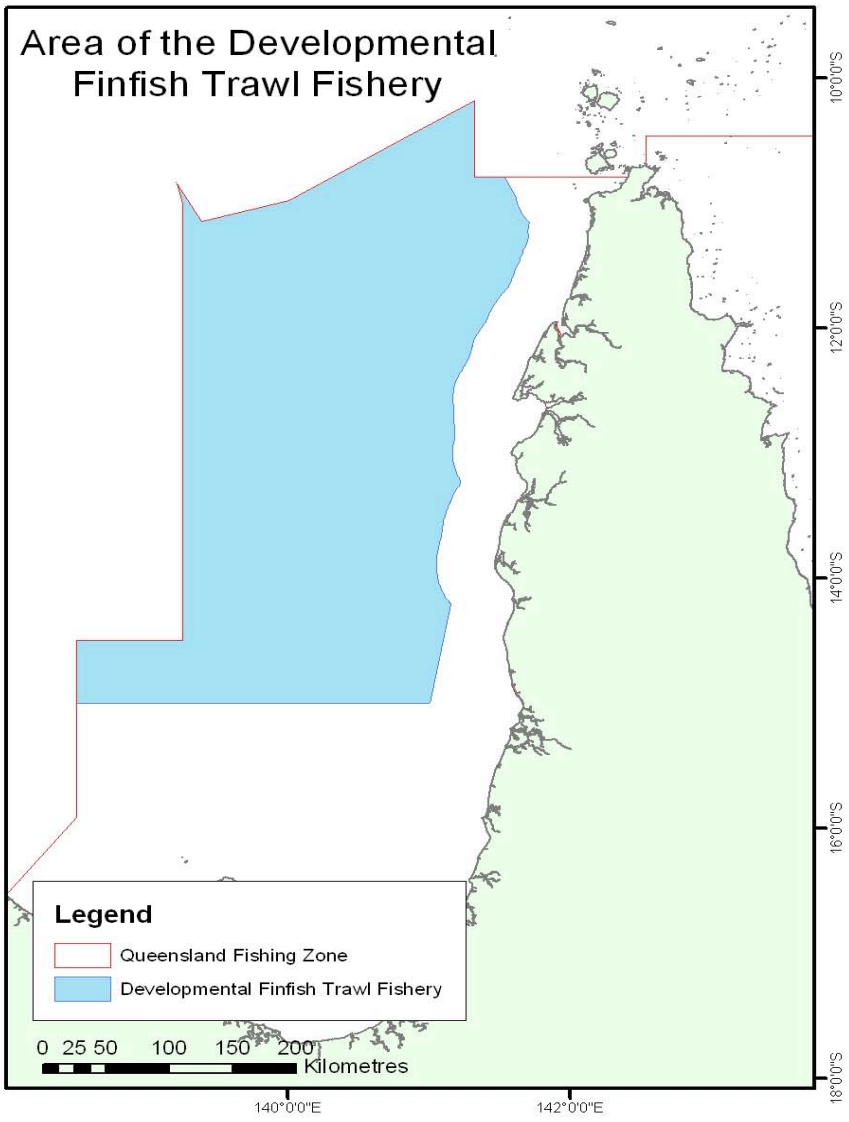


Figure 4 **Map displaying the geographical range of the Developmental Finfish Trawl fishery.**

Primary Species

Crimson Snapper (*Lutjanus erythropterus*)

An ACIAR project completed during the early 1990's determined the basic biology for crimson snapper. The study found that it is an aggregating species and sometimes occurs in mixed schools with other red snapper species (*Lutjanus malabaricus* and *L. sebae* (Ramm, 1994). No age structure data or information on large-scale movements is available. Stock assessment for the Arafura Sea stock has been limited, but it is assumed that biology was similar to that of crimson snapper inhabiting Northern Territory waters. Migration and recruitment patterns are unknown.

The range of crimson snapper extends into Indonesian waters. M+ DNA genetics work has not yet excluded the possibility that there may be a single mixed shared stock across northern Australia (ACIAR Workshop 2003: cited in Sly *et al.* 2003*a*). Despite the evidence that there may be some separation at the adult stages, if only one gene pool exists there could be a danger of overfishing when all possible sources of exploitation are considered.

In addition to harvesting by Australian fishers, the impact of continued fishing effort on this species from foreign fleets has the potential to be high. Preliminary estimates indicate that 4000 - 6000 Indonesian fishing boats operate near the northern boundary of the AFZ and, while harvest levels of *L. erythropterus* are not well known, their cumulative impact may be significant in terms of fishing pressure on the stock (Roelofs, *pers. com* 2006).

From 1980 to 1989, it is estimated that Taiwanese and Thai-Australian trawl fleets took an average combined "red snapper" catch of about 3000t / yr from northern waters of the AFZ (Ramm *et al.* 1991). Since 1987, the domestic finfish trawl fleet has operated in AFZ waters (Timor Sea, Arafura Sea and Gulf of Carpentaria: Kailola *et al.* 1993). By 1991, foreign trawl fleets were excluded from continued access to red snappers in the northern AFZ, amid sustainability concerns and increased interest from domestic operators. In 1990-91, the total catch of red snappers and red emperor (combined red snappers) from the fishery was about 500 t (McLoughlin *et al.* 1994).

At the 1994 Australia-Indonesia Northern Fisheries Workshop, red snapper resources were reviewed and their sustainable harvest assessed (Sly *et al.* 2003a). An estimated annual sustainable yield for combined red snapper species[2] was between 3000 and 9000 t in the Gulf of Carpentaria and between 4000 and 7000 t in the Arafura Sea (McLoughlin *et al.* 1995, cited in Sly *et al*. 2003a). In 1996, the Arafura Sea yield estimate was revised downward to 1500-2500 t/yr (Walters *et al*. 1997).

In 1997, Total Allowable Catches (TACs) for quota managed species[3] in the GOCDFTF were set at 2500 t in Commonwealth - Northern Territory Joint Authority waters consisting of the Arafura Sea and western Gulf of Carpentaria and 1500 t in Commonwealth - Queensland Joint Authority waters of the eastern Gulf. Crimson snapper stocks are fished in Western Australian, Northern Territory, Queensland and

[2] Combined red snappers consist of *Lutjanus erythropterus*, *L. malabaricus* and *L. sebae*
[3] Quota managed species in the Gulf of Carpentaria Finfish Trawl Fishery are listed in Appendix 1

Australian Government - Northern Territory and Australian Government – Queensland jointly-managed commercial fisheries.

The total annual crimson snapper catch from all northern Australian commercial fisheries is about 570 t (Appendix 4) and about half the commercial catch is taken in the Western Australian Pilbara Finfish Trawl Fishery (PFTF). Moderate amounts of crimson snapper are also taken in the Western Australian and Northern Territory trap and drop line fisheries. In the Gulf of Carpentaria and adjacent Northern Territory AFZ waters, the catch is in the order of 220 tonnes, 150 t from the NTFTF, and 70 t from the GOCDFTF (Appendix 1). By comparison the catches of this species reported in the Queensland L4/L5 (Line), N9 (Offshore Net), Gulf charter fisheries and in the NPF (Northern Prawn Fishery) are negligible.

Industry believes the current TAC set at 1500 t in the Queensland part of the Gulf of Carpentaria and 2500 t for AFZ waters adjacent to the Northern Territory may be too high and would like it reviewed.[4] Only 25% of the waters in the fishery area are fished so interference with Northern Prawn Fishery (NPF) is negligible. The limited area of operations may cause local depletions if adults do not move substantially. Catch records indicate that size grades are increasing. The significance of this is uncertain but it could be an indication of increasing stock size or a reduction in recruitment levels. Operators discard approximately 10-20% of the catch of these species due to size limits. The Minimum Legal Size (MLS) was reduced recently to inhibit discarding.

While the Gulf of Carpentaria combined red snapper take (about 1000 t/yr) is substantially lower than the most conservative annual sustainable yield estimate for combined Gulf red snapper species (about 3000 t), there is considerable uncertainty in the latter estimate. The Workshop considered that there was only a possibility (Likelihood = 4) that the stock may be overfished (Consequence = 3). With new management arrangements proposed (see below), combined red snapper species are not considered at high risk because of the restrictions already in place and the available catch data that do not indicate there are serious declines.
Illegal catch by foreign fishing vessels is uncertain but could be significant.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions

- The developmental status of the fishery is under review.
- In late 2006, a Gulf Joint Authority review of the current TAC will be held and will consider options for appropriate reference point/s for sustainable management quota managed species in the fishery);
- By December 2006, DPI&F will develop fishery specific objectives, performance indicators and precautionary performance measures for this species. Data collection programs appropriate to monitor the performance measure/s will be implemented.

[4]ACIAR Project FIS/1997/165 is updating the results of the 1996 sustainable yield estimate for red snappers (Walters *et al.* 1997)

- Increased observer monitoring in the fishery is proposed – the data to be collected will include age and length of crimson snapper and discarding rates - discarding practices will be reviewed if rates are too high.
- Temporal closure of fishing grounds during spawning is being considered.

Saddletail Snapper (*Lutjanus malabaricus*)

Minor differences in productivity between red snapper species have been observed. Saddletail snapper generally exhibit slower growth than crimson snapper (Fishbase).

The annual total catch from all sources of saddletail snapper in the Gulf and adjacent Northern Territory waters is about 800 tonnes (Appendix 4). Much larger quantities are retained in the NTFTF than in the GOCDFTF and PFTF (Appendix 4). Moderate amounts of saddletail snapper are also taken in the Western Australian and Northern Territory trap and drop line fisheries. The reported catch of this species in NT and WA waters fished by the NPF is negligible.

It is likely that multiple genetic sub-stocks of saddletail snapper occur around the Arafura Sea (Sly *et al.* 2003*a*). From the data available, it appears that Australian fishery stocks are not closely associated with Indonesian stocks and movement across the Arafura Sea is thought to be limited (Sly *et al.* 2003*a*). For example, some level of spatial separation is likely to exist between the Western Australian sub- stock and Indonesian stocks based on electrophoresis of allozymes and parasite data (Rik Buckworth, NTDPI&F, *pers. comm*. 2004). Mt DNA analysis of populations from the North West Shelf, Gulf of Carpentaria and east coast of Queensland suggest the presence of multiple stocks in northern Australian waters (Elliot, 1996).

The species was assessed as part of the ACIAR (FIS/97/165) Tropical Red Snapper Project which indicated that in conjunction with crimson snapper, considerable uncertainty still exists about large-scale movement and recruitment patterns between AFZ and Indonesian waters. In view of the potentially high impact of Indonesian bottom set long-line and net fishing on the stocks, the extent to which Australia acts as a donor region for small red snappers to Indonesia is an important one for their sustainability but is unresolved (Northern Territory Government 2005).

The Workshop considered that there was only a possibility (Likelihood = 4) that the stock may be overfished (Consequence = 3). With new management arrangements proposed (see below), combined red snapper species are not considered at high risk because of the restrictions already in place and the available catch data do not indicate there are serious declines in the Gulf stock harvested in the GOCDFTF (Roelofs and Stapley 2004). Since 2000, red snapper catch rates have been declining, warranting further close monitoring of the catches of these species.
Illegal catch by foreign fishing vessels is uncertain but could be significant.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions
Because the species occurs in mixed schools with other red snappers, the fishery management will be similar for saddletail snapper, crimson snapper and red emperor.

Proposed management actions for saddletail snapper will be the same as for crimson snapper (i.e. review the TAC, develop objectives and performance measures for the fishery, implement additional fishery (i.e. length and age data) monitoring and consider temporal closures to protect the spawning stock).

Red Emperor (*Lutjanus sebae*)

Relatively large catches of red emperor are taken in northern WA commercial fisheries and the Northern Territory Timor Reef and Line Trap Fishery (TRLTF) (Appendix 4). By comparison red emperor catches of less than 10 t occur in the NTFTF. GOCDFTF catches of red emperor are even lower (Appendix 4). Similar small amounts are taken by Qld Gulf charter tour operators, reporting a total catch of about 1 t in 2002 (Roelofs *et al.* 2003). The remaining Gulf recreational catch for this species is uncertain but is considered to be negligible.

The retained catch data across jurisdictions show that commercial red emperor catches are much larger in WA waters than in the Gulf and the species is only a very small part of the catch in the GOCDFTF and Qld Gulf of Carpentaria commercial fisheries in general. Compared to the higher catch WA and NT fisheries, it is considered unlikely (Likelihood = 3) that the catch from the Qld Gulf fisheries would have more than a minimal impact (Consequence = 1) on the northern Australian breeding stock.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
The species occurs in close association with the red snappers, making it difficult for the species to be targeted specifically. Management will be similar to that for other red snappers. See the proposed management actions for crimson and saddletail snappers for further details.

Red Spot Emperor (*Lethrinus lentjan*)

Catches are estimated at around 40t/yr for the Gulf and adjacent NT waters (Appendix 4). The catch is characterised by high numbers of fish with low individual weights. The NTFTF and the GOCDFTF appear to be the only fisheries that catch this species in the Gulf, although the species is not specifically targeted by these fisheries. Redspot emperor is widely distributed from the Gulf of Carpentaria to the North-West Shelf (CSIRO CMR Data Warehouse, 2005). They are also taken as byproduct in the TRTLF in small quantities (Appendix 4) and as bycatch in the NPF (Stobutzki et al, 2001). While relatively little is known of this species biology, the Workshop considered that it may be similar to that of other emperors (lethrinids) and, based on the Stobutzki et al 2001, risk assessment, that trawling had a relatively low risk to its sustainability.

ERA Risk Rating: Impact on breeding stock (*C1 L5 Low*)

Proposed Management Actions
It has been proposed that observers collect biological information on this species.

Other Emperors (*Lethrinus spp.*)

The Workshop noted that, when combined, the 2003 catches of other emperor species in the DGFTF was about 10t/ year and similar in quantity to the total red spot emperor harvest in this fishery (Appendix 4). This is a very small catch compared to the annual commercial catch of single emperor species taken in other jurisdictions. For example, spangled emperor (*Lethrinus nebulosus*) is targeted in northern Western Australian trap, line and trawl fisheries (Penn *et al.* 2005) with a total annual catch of about 130t (Appendix 4). Spangled emperor, a quota species, probably makes up a significant part of the total emperor catch (Roelofs & Stapley, 2004). The impact of the fishery on individual emperor species is therefore likely to be minor. The target red snapper species are considered more likely to be at greater risk.

ERA Risk Rating: Impact on breeding stock (*C1 L6 Low*)

Proposed Management Actions

The catch levels and species composition of emperors will be monitored to detect any persistent change that may require additional management.

Byproduct Species

Mangrove Jack (*Lutjanus argentimaculatus*)

The mangrove jack catch is relatively high compared to other byproduct species taken in the fishery (see below).

The total annual catch of mangrove jack in the Gulf and adjacent Northern Territory waters is about 40 t. The GOCDFTF takes about three-quarters of the catch from waters beyond 25 nm of the Queensland coastline. Catches of about one tonne/yr are also taken in the Northern Territory Demersal Line and Trap Fishery (Appendix 4), and the Queensland Gulf Charter Tour Line Fishery (Roelofs *et al.* 2003). A reliable recreational catch estimate for this species in the Gulf is not currently available.

Juveniles inhabit inshore and estuarine waters before maturing and migrating offshore at sizes of between 324mm and 430 mm SL (Russell *et al.* 2003). DPI&F electrofishing surveys of Queensland east coast streams located 1-2 year recruits and large numbers of juveniles in the upper tidal and lower freshwater sections of streams in north east Queensland (Russell *et al*. 2003).

Anecdotal reports have been received that this species may become less abundant in the northern Gulf around Weipa with recreational catches declining as a result. However, little is known about whether this may is a result of natural changes or recruitment is being affected. Changes in the recreational catch may be due to a number of factors including other species increasing in abundance, increased effort in the inshore fishery or habitat degradation. There are no data to indicate whether the first two of these factors have had an effect on inshore mangrove jack catches in the Gulf. No apparent disturbance of this species' inshore and offshore habitats has been reported. From the available information, it appears that a localised depletion is most likely.

While there is uncertainty with regard to the stock status of mangrove jack in the Gulf, recent research suggests that in Queensland and possibly throughout Australia, the species exhibits high levels of gene flow between locations and probably is made up of a single genetic stock (Russell *et al.* 2003). In addition, inshore exploitation rates of mangrove jack are higher than those offshore on the Queensland east coast, indicating that the breeding population is substantially protected there (Russell *et al.* 2003). It is not known how well fishing mortality estimates based on Queensland east coast catches are representative of mangrove jack in the Gulf. However, waters inside 25nm of the Queensland Gulf coastline and large areas of the southern Gulf are closed to finfish trawling and potentially provide significant protection for the adult stock.

Despite uncertainties about the level of protection provided by the current management regime during the breeding period, it is considered that changes to mangrove jack catch rates in the GOCDFTF while detectable, are unlikely to be a factor affecting the population size of the whole of the stock.

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions
Precautionary management may be needed to minimise local stock depletions. Monitoring mangrove jack in the catch through on-board observers is recommended. Particular attention should be paid to assessment of the size of fish in the catch. Appropriate management should be considered where middle-size classes of fish are being poorly represented in the catch.

Painted Sweetlip (*Diagramma labiosum*)

The annual combined catch of sweetlip in the Gulf and adjacent Northern Territory waters is about 40 t (Appendix 4). While the sweetlip catch in the GOCDFTF has not been reported to species level (Roelofs and Stapley 2004), it appears likely that the most abundant species in the catch is painted sweetlip. This is based on its presence in observer monitored catches in the fishery (Roelofs and Stapley 2004); in the personal catch records held by the most historically active permit holder in the fishery (Mr W. Passey, Finfish Trawl Operator, *pers. obs.*, 2002) and reporting in the NTFTF catch data (Sly *et al.* 2003*a*).

There appears to be no significant recreational catch of this species in the Gulf. The species has a wide tropical distribution in Australian waters from southern Queensland to Western Australia (Grant 1985). It inhabits shallow estuaries and lagoons (juveniles) and along reef slopes as adults, but is considered at less risk than other species retained in the fishery. Given the relatively low combined catch of sweetlip in trawl fisheries within its Australian distribution, the GOCDFTF is unlikely to have other than minimal impact on the size of the stock.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
Precautionary management may be needed to address the moderately high catch compared to other byproduct species in the fishery and declining catch rates in the GOCDFTF. Annual monitoring of catch and effort indicators is proposed to detect change in the abundance of this species.

Goldband Snapper (*Pristipomoides* spp.)

Catches of *Pristipomoides multidens* and *P. typus* make up almost all goldband snapper catches in northern Australia (Roelofs and Stapley 2004). Commercial catches occur in water depths exceeding 50 m, up to 360 m (Kailola *et al.* 1993). The Queensland finfish trawl fishery takes a smaller quantity of goldband snappers relative to other trawl and demersal fisheries targeting these species (Appendix 4). Extensive genetic research has been conducted on *P. multidens* in WA and NT waters, indicating there is genetic dissimilarity between stocks across northern Australia (Ovenden *et al.* 2002). Catches of goldband snapper outside of the Gulf will therefore unlikely affect goldband snapper stocks inside the Gulf and vice versa. Since 2002, annual GOCDFTF catches and catch rates of goldband snapper have been increasing.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
Annual monitoring of catch is proposed to detect targeting of this species and possible changes in the local abundance of goldband snappers in the Gulf region.

Other species

Small catches of other species are taken in the GOCDFTF (Roelofs and Stapley 2004) but are considered to be at minor or lower risk from fishing practices in the fishery. The highest catch category appears to be the small snappers (*Lutjanus johnii*, *L. russelli*, *L. vitta* and *L. lemniscatus*), estimated to make up a combined average annual catch of about 2 tonnes between 1998 and 2002[5] followed by Spanish mackerel with an average annual catch of about 2 t between 1998 and 2003 (Roelofs and Stapley 2004). Threadfin bream (*Nemipterus* spp.); trevallies (Carangidae) and grouper (*Epinephelus* spp.) are the other notable byproduct species. The "Other" box in the "byproduct-species" section of the component tree includes negligible numbers of goatfish (Mullidae), grunter (Haemulidae), black jewfish (*Protonibea diacanthus*), blacktip shark (*Carcharhinus tilstoni*) and spotted mackerel (*Scomberomerus munroi*).

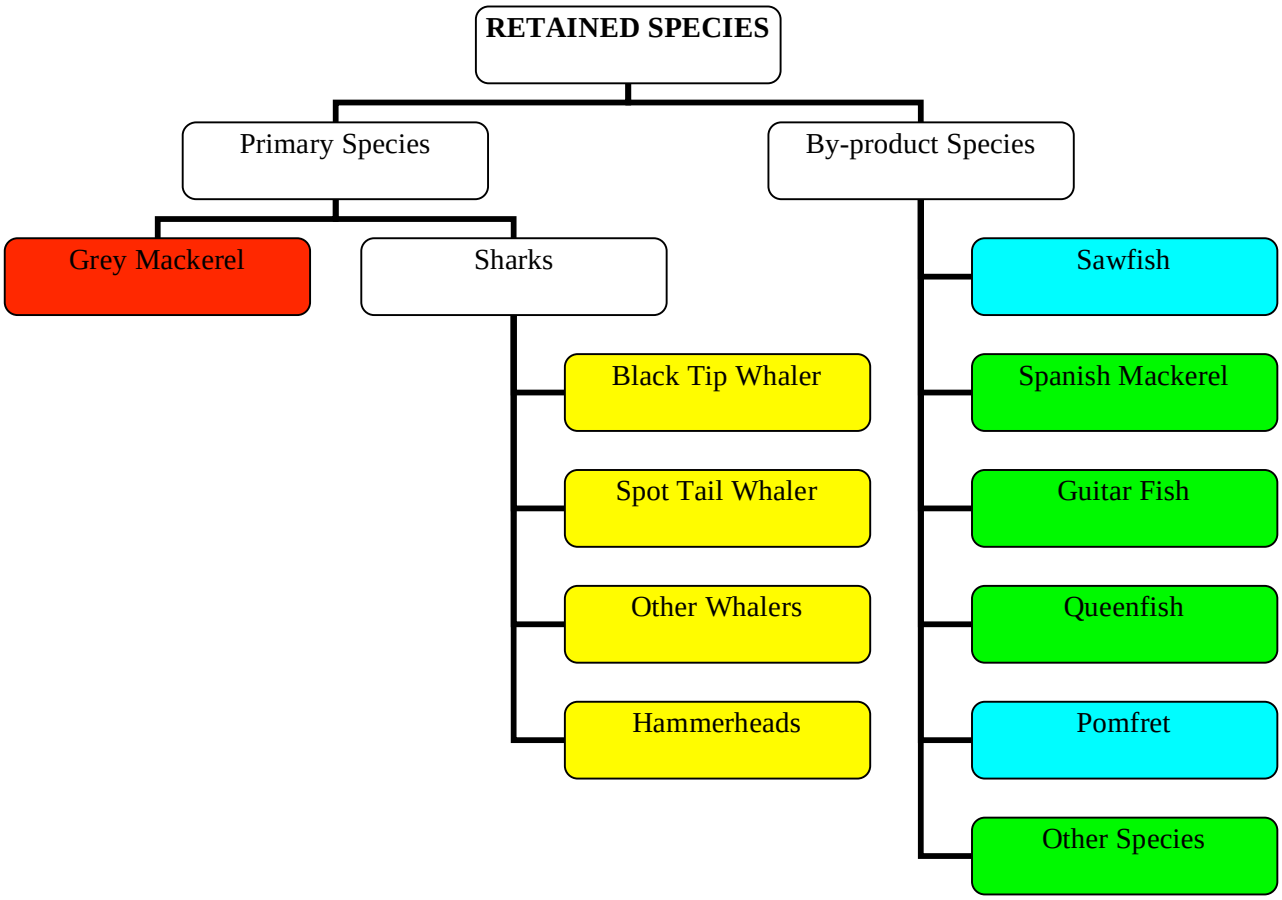
Trawling has been reported to pose relatively low to moderate risk to the sustainability of a number of these species recorded as bycatch in the NPF (Stobutzki *et al*. 2001). Given the relatively low risk to these species determined in that study, it is unlikely that the GOCDFTF impact on these species would be considered to be anything other than minor.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
Annual monitoring of the catch is proposed to detect changes in species composition. Golden Snapper (*Lutjanus johnii*) are similar in biology to mangrove jack and may be vulnerable to inshore fishing as juveniles and offshore fishing as adults. Catches should be monitored for possible major changes in targeting and/or abundance of this species.

[5] Small snapper landings increased to about 28 t/year in 2003 and 2004 (DPI&F, unpublished data)

Component Tree for Retained Species in the N9 Offshore Net Fishery



Primary Species

Grey Mackerel (*Scomberomorus semifasciatus*)

The range of grey mackerel extends from Shark Bay in Western Australia, through southern Papuan waters and southward to northern NSW in predominantly marine waters to 100m depth (Froese and Pauly 2005). The north Australian stock appears to be genetically distinct from the east Australian stock (Cameron and Begg 2002). The northern stock supports commercial mixed fisheries for this and other mackerel species in WA, NT and Queensland (Cameron and Begg 2002). It is not known whether these fisheries access the same or separate stocks. A FRDC project to investigate the genetic composition of the north Australian stock is under way and preliminary results should be available shortly.

The Commercial N9 fishery area is shown in Figure 5. The total average annual catch of grey mackerel in the Queensland Gulf during the period 1994 to 2002 was about 300 t. The species makes up about 40% of the N9 catch (Roelofs 2003). The Northern Territory catch averaged 122t/yr in the period 1983 to 2000 - about 1/3 of the Queensland Gulf recorded catch, however, their commercial grey mackerel harvest increased considerably to 750t in 2002. The L4/L5 line fishery takes on average only

about one tonne of grey mackerel/year. There are no reliable recreational catch data for this species from the Gulf, but the catch is not likely to be significant.

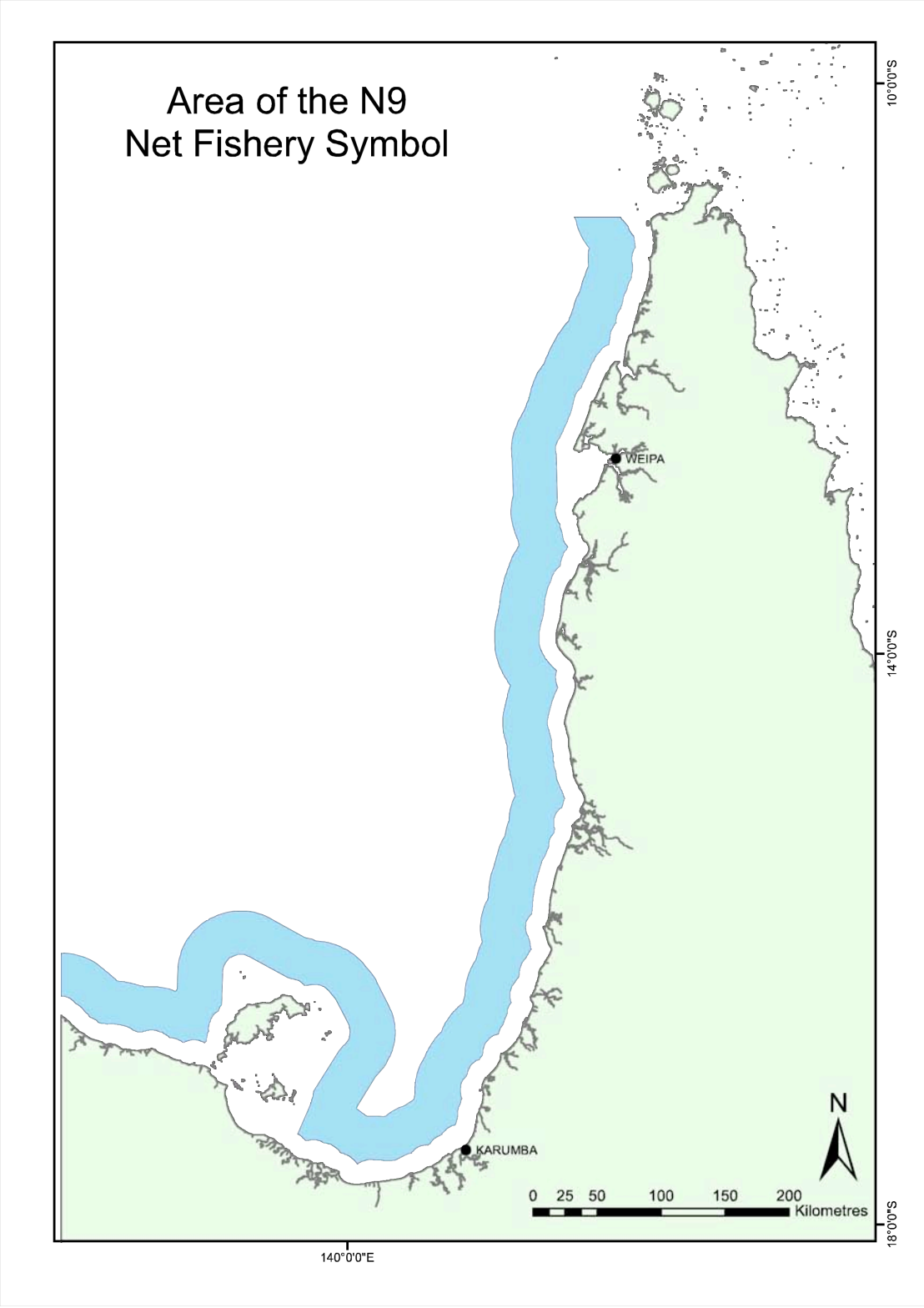


Figure 5 **Map displaying the geographical range of the N9 Net fishery**

Since 1994, the N9 net fishery catch rates have been steady, averaging about 300 kg/day (Cameron and Williams 2002).[6] The NT fishery is a mixed species fishery and it is not known whether this species is targeted, making it difficult to interpret the significance of the NT grey mackerel catch rate data.

In the Queensland Gulf, about 30 commercial fishers now report grey mackerel catches each year. N9 fishers make up about 80% of the fishers reporting the grey mackerel catch. Line fishers make up the other 20%. There are also 5 operations under QFJA licences that can fish outside the 25nm seaward limit of the N9 fishery. Only one of these is currently utilised (2004).

It was considered appropriate to assign a precautionary high risk rating to the take of this species by the fishery based on a number of factors:

- the species is likely endemic to north-eastern Australia;
- the species is fished across its entire range and is susceptible to targeted gill net fishing;
- effort for this species has increased significantly in the Gulf since 1995 (Cameron and Begg 2002) and
- Currently little is known about the basic biology of the species including the age structure of the population, growth rate of individuals, reproduction period and fecundity (Dr S. Griffiths, CSIRO, *pers. comm*. 2005).
- Illegal catch by foreign fishing vessels is uncertain but could be significant.

The Workshop considered that full exploitation of the stock was occurring on at least an occasional basis and that there is likelihood that fishing could be affecting recruitment at these times.

ERA Risk Rating: Impact on breeding stock (*C3 L5 High*)

Proposed Management Actions
An investigation into the northern Australian grey mackerel stock structure is a high priority for research. The following management actions are proposed:

- New management arrangements will be introduced to address fishing impacts in the QFJA fishery.
- New entry criteria for target fishing of this species are being developed.
- In-possession limits to address incidental catch for non-authorised vessels are proposed.
- An Operational Plan for this and other north Australia species is being developed to coordinate research, compliance and progress complementary management of shared stocks.

Sharks

An estimated 1700 t/yr of tropical shark species is harvested in the Northern Shark Fishery (AFFA 2005). About 20% (300t/yr) is taken in Queensland managed waters of the Gulf (Table 2). The reported Queensland catch is dominated by mesh net fisheries (McPherson and Williams 2002). In 2003, the N9 fishery harvested 45% and the N3 fishery harvested 55% of the Queensland Gulf shark catch respectively

[6] This estimate is exclusive of the exceptionally high catch rate in 2000, when 526 t was harvested at a rate of 536 kg/day.

(Gribble *et al*. 2004). The L4/L5 line fishery reported harvest is only about 2t/yr or 1% of the total catch in that fishery (Roelofs *et al.* 2003). Small species of shark and immature specimens of large shark species have also been reported as bycatch in the NPF (Stobutzki *et al*. 2002). Sharks are also harvested by indigenous fishers (Coleman *et al.* 2003).

Table 2. Estimated shark catch in the Northern Shark Fishery

Joint Authority Managers	Australian and Northern Territory Governments	Australian and Western Australian Governments	Australian and Queensland Governments
Estimated Annual 2002/3 Catch (tonnes)	900	500	300

Source: AFFA 2005

Blacktip whalers (*Carcharhinus tilstoni and C. limbatus*)
Commercial shark catches in the Northern Shark Fishery are about 180 t for the Western Australia-managed fishery (Gaughan *et al.* 2005) and 400 t for Northern Territory-managed fishery (Buckworth and McKey, 2004).[7] Based on preliminary observer data, two species, the Australian blacktip whaler (*C. tilstoni*) and the common blacktip whaler (*C. limbatus*) make up about 60% of the N9 shark catch (about 130 t in 2003) and a much smaller part of the N3 shark catch (McKey and Buckworth 2004). A preliminary ecological risk assessment on Queensland Gulf coastal sharks was conducted in May 2004 (Gribble *et al.* 2004). Both blacktip species were found to have the highest productivity of the 23 species assessed and had low to moderate susceptibility to net fishing mortality relative to other Gulf shark species.

However, large knowledge gaps exist for blacktip whalers taken in northern Australian fisheries including the extent of incidental catch in other Australian fisheries, the catch by Indonesian fishers both in Indonesian and Australian waters, the degree to which stocks are shared and current status of these stocks (AFFA 2005). From a precautionary viewpoint, the Workshop considered it was possible that widespread longline and mesh net harvesting throughout their ranges could be having an impact on blacktip shark recruitment.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions
The Queensland Government is providing information for use in an ACIAR project on northern Australian shark stocks.

Management arrangements for these species will be reviewed once the ACIAR research project findings become available. An Operational Plan for northern sharks has been developed with objectives that include consistent management arrangements,

[7] The reported species composition of the blacktip shark catch in Western Australia is unspecified while the Northern Territory catch consists of *C. tilstoni* and *C.sorrah* reported together as "blacktip sharks".

coordinated research and possession limits for non-shark fishing. An extension of finning regulations is being proposed to include all elasmobranchs caught in Queensland fisheries. Illegal catch by foreign fishing vessels is uncertain but could be significant.

Spot tail whalers (*Carcharhinus sorrah*)

The spot tail whaler (*C. sorrah*), makes up about 10% of the shark catch in the N9 fishery, about 20 t in 2003, (Gribble *et al.* 2004). Like *C. tilstoni* it has a tropical inshore to mid-outer shelf distribution between northern Western Australia and central Queensland (Last and Stevens 1994). It is one of the more productive Carcharhinid species found in northern Australia and moderately susceptible to fishing mortality relative to other tropical sharks (Gribble *et al.* 2004). From a precautionary viewpoint, the Workshop considered it was possible that spot tail whaler recruitment could be affected at current harvesting levels in northern Australian shark fisheries.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions

Management arrangements for this species are similar to those of black tip whalers and will be reviewed once the ACIAR research project findings become available.

Other whalers (Carcharhinidae)

An estimated 15% of the N9 shark catch is made up of other whaler species. The top three species in terms of numerical abundance in the catch (*Rhizoprionodon acutus, C. brevipinna* and *C. dussumieri*), are at moderate risk to their sustainability from the N9 fishery, while other shark species appear to be caught in very low numbers in the fishery (Gribble *et al.* 2004). From a precautionary viewpoint, the Workshop considered it was possible that recruitment levels of other whalers could be affected at current harvesting levels.

Illegal catch by foreign fishing vessels is uncertain but could be significant.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions

Management arrangements for this species are similar to those of black tip and spot tail whalers and will be reviewed once the ACIAR research project findings become available. An interim precautionary management objective to maintain the catch of other whaler shark species at the current low catch levels is proposed.

Hammerheads (Sphyrnidae)

Three hammerhead species have been identified in the N9 (and N3) catch (Gribble *et al.* 2004). Hammerhead catches in the Queensland Gulf net fisheries are uncertain but based on limited observer catch data are thought to be mainly taken in the N9 fishery. Hammerhead species make up a similar proportion of the total shark catch to the spot tail whaler catch, about 10% of the N9 shark catch or about twenty tonne per year (Gribble *et al.* 2004). A combined total of about 100 t of hammerheads are harvested annually from Western Australian commercial fisheries (Penn *et al.* 2005), including 40 t taken in the northern Western Australian-managed and Joint Authority managed-long-line fisheries (Gaughan *et al.* 2005). Significant catches of hammerheads are also

taken in the Northern Territory Joint Authority–managed shark fishery McKey and Buckworth (2005).

While the hammerhead catch in the Queensland Gulf net fisheries is probably not more than in other State- or Joint– managed commercial shark fishery, they are harvested widely throughout their northern Australian range by net and longline fisheries. Also, illegal catch by foreign fishing vessels is uncertain but could be significant.
This prompted the Workshop to consider it was possible that recruitment may be affected at current harvesting levels.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions
Proposed management arrangements for hammerhead species are similar to those of whalers as outlined above. Queensland Net Fishery logbooks are under revision to better discriminate between hammerhead and whaler species in the catch (J. Higgs, DPI&F, *pers. comm*., 2005). An interim precautionary management objective to maintain their catch at the current low levels is proposed. Illegal catch by foreign fishing vessels is uncertain but could be significant.

Byproduct Species

Sawfish (Pristidae)

Sawfish systematics is unresolved (Compagno and Cook 1995). However four sawfish species have been recorded in Queensland Gulf waters. These species include *Pristis microdon*, *Pristis clavata*, *Pristis zijsron* and *Anoxypristis cuspidata* (Peverell *et al.* 2004; Gribble *et al*., 2004; Stobutzki *et al*., 2002). Sawfish are caught in Gulf net and trawl fisheries incidental to the capture of target species. They have a high conservation status and are currently listed as protected marine species under the Commonwealth EPBC Act (*Pristis microdon*) or have been nominated for listing. The extent of the incidental sawfish catch in the Queensland Gulf fisheries is largely unknown, although a review by Peverell (2005*b*) indicates that their abundance is low and their distribution patchy.

In their risk assessment of net-caught Gulf elasmobranchs, Gribble *et al.* (2004) found sawfishes are in general, susceptible to capture by net fishing. This is mainly because of their toothed rostrum and preference for inshore marine and brackish waters in rivers and bays (Simpfendorfer 2000). From DPI&F observer data only one sawfish species has been reported in N9 fishery catches (Gribble *et al.* 2004).

The narrow sawfish (*Anoxypristis cuspidata*) appears to be at highest risk among sawfish of interacting with the Gulf net fisheries, being captured in both the N9 and N3 fisheries. However, the N9 catch of this species is only about one-quarter of that in the N3 fishery where it is moderately susceptible to net capture (Gribble *et al.* 2004). The relative impact of the N9 fishery on this species is therefore considered to be lower than in the N3 fishery.

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions
The Queensland Government will maintain the observer presence in the N9 fishery and continue to record individual sawfish species catches during fishing operations. Best practice standards, relating to the safe handling and release of sawfishes, have been developed for the fishery (Peverell 2005*a*). DPI&F is actively encouraging their adoption by N9 fishers through the on-board observer program. Fishers are also being encouraged to participate in research and assessment surveys of sawfish in order to gain a better understanding of the true status of sawfish populations in the Gulf (Peverell 2005*a*).

CSIRO are currently undertaking a pilot tagging exercise using Pop-up Archival Transmitting (PAT) tags to determine vertical and horizontal movement, and post-capture survival of narrow sawfish (*Anoxypristis cuspidata)* in the N9 (Dr. S. Griffiths, CSIRO, *pers. comm*., 2005). These results may provide a preliminary indication of fishing mortality and catchability by the N9 fishery.

Since the Workshop, additional information has been received regarding potential interaction of the N9 fishery with other sawfish species (S. Peverell, DPI&F, *pers. comm*. 2005). In 2006 DPI&F will again assess sawfish catch data collected through the observer program in the N9 fishery and determine whether the current risk rating needs to be reviewed and further management considered.

Spanish mackerel (*Scomberomorus commerson*)

Only about 10% of the total Gulf Spanish mackerel catch is harvested by net. The Gulf catch of this species is dominated by the line fishery (see the Line Fishery Risk Assessment for details).

ERA Risk Rating: Impact on breeding stock (*Negligible Risk)*

Proposed Management Actions
See the Line Fishery Risk Assessment for details.

Guitarfish (*Rhynchobatus*)

Guitarfishes (*Rhynchobatus* spp.) are recognised benthic species and have little interaction with the N9 fishery because nets in this fishery are set in the upper part of the water column (Roelofs 2003). Guitarfishes are caught more frequently in the N3 fishery where nets are more commonly fishing the full water column (see the N3 Net Fishery Risk Assessment for details).

Given the top set deployment of the net and benthic habits of guitarfishes, the Workshop considered that the opportunity for interaction was negligible compared to the N3 fishery.

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

Proposed Management Actions

None proposed in the N9 fishery, but guitarfish were rated by Gribble *et al.* (2004) as at a relatively high level of risk to their sustainability compared to most other shark species recorded in the N3 fishery. Proposed management actions relate primarily to the higher risk to the species sustainability in that fishery (see the N3 Net Fishery Risk Assessment for details).

Queenfish (*Scomberoides commersonnianus*)

Relatively small catches of queenfish are recorded in the logbook data. About 25 t /yr are harvested in the N3 and N9 fisheries combined (L. Williams, DPI&F, *unpublished data*). Higher catches are taken in the N3 than in the N9 fishery (see the N3 Net Fishery Risk Assessment for details). Small incidental catches of juveniles have also been reported in the Northern Prawn Fishery (Stobutzki *et al.* 2001).

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

Proposed Management Actions
No specific management actions are proposed at this time. However, a joint CSIRO/NOO project (Principal Investigator Shane Griffiths) is currently underway investigating the age structure, growth and reproductive dynamics of the species in the Weipa region, which will provide data for any proposed future assessments.

Pomfret (*Parastromateus niger*)

The species is widely distributed but has low abundances throughout the gill net fishery grounds. The combined annual N3 and N9 catch averages about 4 t (L. Williams, DPI&F, *unpublished data*). Small incidental catches are also reported in the Northern Prawn Fishery (Stobutzki *et al.* 2001).

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions
No specific management actions are proposed at this time.

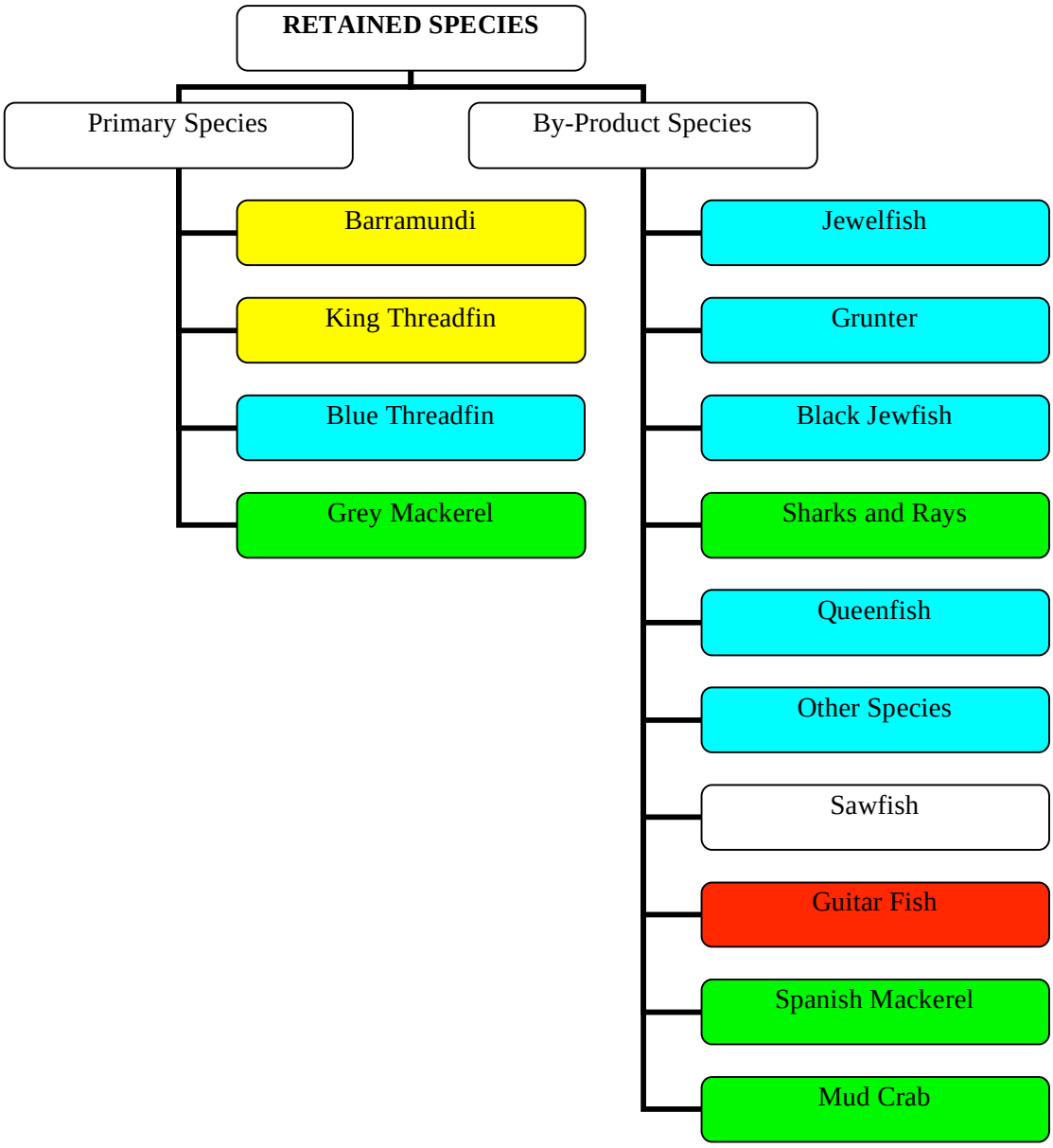
Other species

Relatively small catches of other species are harvested in other Gulf fisheries ranging between 7 and 35 t/yr depending on the species, are reported in the N9 fishery. In order of decreasing catch, these include Spanish and spotted mackerels (5% of the N9 catch), trevally (3%), tropical snappers (3%) and other minor species that combined make up less than 1% of the N9 catch (Roelofs *et al.* 2002).

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

Proposed Management Actions
No specific management actions are proposed in this fishery for these species. Specific management proposals for these species is outlined in the risk assessments of the fisheries that harvest the majority of the catch (see the Risk Assessments for the Gulf line and trawl fisheries).

Component Tree for Retained Species in the N3 Inshore Net Fishery



Primary Species

Barramundi (*Lates calcarifer*)

Barramundi are distributed widely throughout the west Indo-Pacific region, including rivers, lagoons, swamps and estuaries across northern Australia from the Noosa River in Queensland to the Ashburton River in Western Australia (Kailola *et al*. 1993). Barramundi are targeted by commercial, recreational and indigenous fishers throughout their Australian range including the Gulf of Carpentaria; the extent of this

fishery in Gulf waters is displayed in Figure 6. The total Australian commercial barramundi catch in 2003/4 was 1600 t (ABARE 2005).

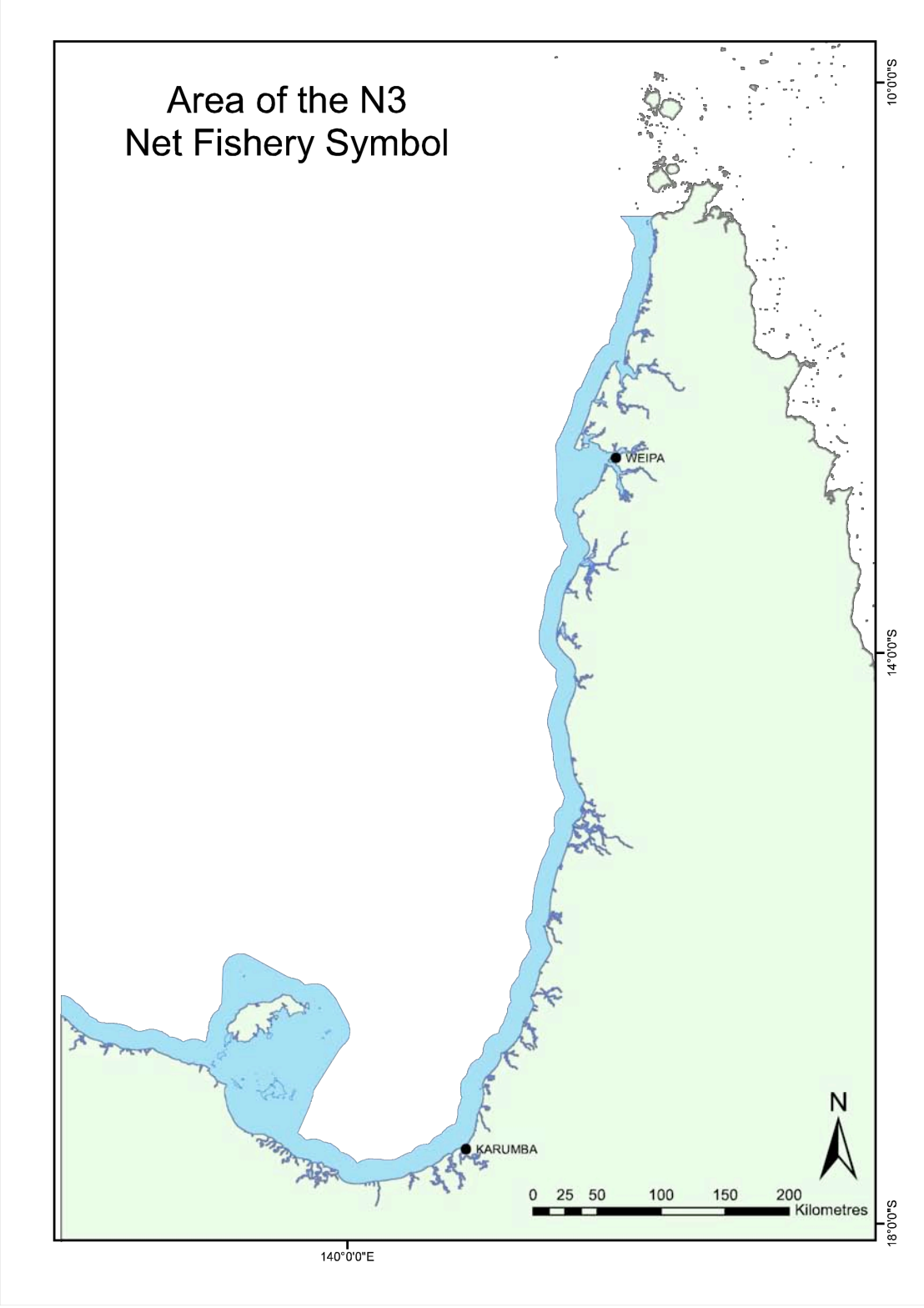


Figure 6 Map displaying the geographical range of the N3 Net fishery

Queensland has the highest commercial barramundi catch of the Australian jurisdictions that occur within its range (Table 3). The average Queensland

commercial harvest, comprising of 60% from the Gulf and 40% from the east coast, is approximately 900t annually and (Garrett and Williams 2002). From 1998 to 2003, the Queensland Gulf commercial harvest ranged between about 500 t and 700 t (L.Williams, DPI&F, *unpub. data*, 2005). The Gulf recreational barramundi harvest is estimated to be 10% of the Queensland commercial harvest (Roelofs 2003) however, the indigenous harvest of this species in the eastern Gulf is uncertain.

Table. Australian commercial barramundi harvest

	Annual Harvest (t)	**Average Harvest (t)**
Queensland	923*	911**
Northern Territory	701*	780**
Western Australia	45[#]	40 [#]

* 2003/4 harvest reported in ABARE 2005
** 2001/2 – 2003/4 reported harvest in ABARE 2005
# 2003 reported harvest in Newman & Harvey. 2005

The Workshop noted that Queensland Gulf and East Coast barramundi stocks are currently being harvested at sustainable levels (Garrett and Williams 2002; Roelofs 2003). It is therefore likely that current management is effective in ensuring long-term recruitment and natural dynamics of the Gulf barramundi stock (e.g. seasonal flood-cued spawning) are largely unaffected by the fishery.

ERA Risk Rating: Impact on breeding stock (*C2 L6 Moderate*)

Proposed Management Actions
The Queensland Government is undertaking and will continue fishery independent monitoring of this species in key Gulf rivers that support commercial barramundi fishing (i.e. the Mitchell, Archer and Staaten Rivers).

King Threadfin (*Polydactylus macrochir*)

Within its northern Australian distribution, king threadfin are taken by commercial, recreational and indigenous fishers. The average commercial catch in the Queensland net fisheries is about 400 t /year (DPI&F 2005*a*). An estimated 300 t is harvested annually in Queensland-managed waters of the Gulf of Carpentaria[8] and 100 t on the Queensland east coast. Similar quantities of king threadfin are taken in the commercial net fisheries managed by the Northern Territory (ABARE 2005). Western Australia also reports significant commercial catches of threadfins. In 2003, the combined blue and king threadfin catch reported in the Kimberley Gillnet and Barramundi Fishery was about 90 t (Newman and Harvey 2005). Based on DPI&F 2002 recreational fishing survey catch data and other anecdotal information from the GoC fishers (Steve Parker *pers coms.* 2006), conservative estimate of the Queensland Gulf recreational combined king and blue threadfin catch is around 15t/year. Recreational and indigenous fishers account for 90% and 10% respectively of the non-commercial threadfin catch in Northern Australia (Lyle *et al.* 2003).

The status of this species is uncertain, but commercial catches in the Gulf have been increasing steadily since 1994 while fishing effort has remained relatively stable

[8] N3 and N9 catches combined

(Roelofs *et al*. 2003). Although catch and catch rate analysis indicate the Gulf stock is not under any immediate threat from current fishing levels (Welch *et al.* 2002), the species is heavily fished across its entire inshore Australian distribution. From a precautionary viewpoint, the Workshop considered the possibility that together, commercial, recreational and indigenous fisheries could be having an effect on king threadfin recruitment levels.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions
Notwithstanding recent DPI&F research efforts (e.g. Welch *et al.* 2002), information about king threadfin biology is limited compared to other major Gulf net harvested species (e.g. barramundi). A research funding proposal to investigate the structure of Queensland- and Northern Territory-managed stock/s and their aggregations in the Gulf is currently up for consideration with FRDC. However, there are no other specific management actions proposed for this species.

Blue Threadfin (*Eleutheronema tetradactylum*)

Similar to king threadfin, blue threadfin are harvested by all fishing sectors across northern Australia. The average commercial catch in the Queensland net fisheries is about 190 t /year (DPI&F 2005*a*). On average an estimated 120 t is harvested annually in Queensland-managed net fisheries of the Gulf of Carpentaria[9] and 70 t from the Queensland east coast net fishery. Inshore net fisheries of the Northern Territory and northern Western Australia also report commercial catches of blue threadfin. The quantities taken in these jurisdictions are uncertain, but based on available information, when combined could be similar in quantity to the Queensland Gulf catch.

The species is targeted only occasionally in the Queensland-managed Gulf net fisheries and market demand influences the size of the harvest. Due to limited storage capacity, spoilage of the catch can sometimes be a problem, potentially reducing the quantity of blue threadfin that can safely be marketed.

The Workshop concluded that it was unlikely that long term recruitment of blue threadfin was being adversely affected at current exploitation rates in the N3 and N9 fisheries.

ERA Risk Rating: Impact on breeding stock (*C2 L3 Low*)

Proposed Management Actions
The FRDC application for research funding into the stock structure for Gulf king threadfin includes a proposal for similar work on blue threadfin, however, there is no specific management actions proposed for this species.

Grey Mackerel (*Scomberomerus semifasciatus*)

Grey mackerel are primarily a pelagic, oceanic species that numerically makes up not more than about 5% of the inshore N3 net fishery catch (Halliday *et al.* 2001; Roelofs

[9] N3 and N9 catches combined

2003). This species is a major target species in the N9 offshore net fishery (see the *Retained Species* section in the N9 fishery assessment for details). The Workshop concluded that the impact of the N3 fishery was unlikely to be measurable against background natural variability in the Gulf grey mackerel stock.

ERA Risk Rating: Impact on breeding stock (*Negligible Risk)*

Proposed Management Actions
There are no proposed management actions for this species in the fishery.

Byproduct Species

Jewelfish (*Nibea squamosa*)

Jewelfish are not specifically targeted in the N3 fishery. An average annual commercial catch of approximately 50t/year is taken in the eastern Gulf or 2% of the N3 harvest (Roelofs 2003). The Workshop considered fishery impact to be equivalent to blue threadfin in terms of risk to the sustainability of this species.

ERA Risk Rating: Impact on breeding stock (*C2 L3 Low*)

Proposed Management Actions
There are no specific management actions for this species in the fishery.

Grunter (*Pomadasys kaakan, Pomadasys argenteus*)

Grunter is not specifically targeted by commercial fishers in the eastern Gulf. The main commercial catch occurs in the N3 fishery. Commercial harvesting has increased in recent years from 20 t/year during the mid-1990's to an average of 30 t/year from 2001 – 2003 (DPI&F 2005*a*). Grunter is a popular recreational species in the eastern Gulf where their harvest is estimated at 40-50 t/yr. Because they inhabit inshore waters and estuaries, grunter are also likely to be caught by indigenous fishers. *P. kaakan* has been reported in the Gulf Finfish Trawl Fishery bycatch (Roelofs and Stapley 2004). Stobutzki *et al.* 2001 reported *P. kaakan* and *P. argenteus* juveniles in the NPF bycatch; they assessed that there might be a moderate risk to the sustainability of both species.

There are anecdotal reports that this species is also heavily targeted by recreational fishers in some areas (e.g. in the south east Gulf). Concerns over local depletion in areas readily accessible to recreational fishers have not been supported by the available tag/recapture data from tagging studies done at these locations.

The Workshop concluded that the N3 fishery may be having a detectable but minimal impact on the population size grunter stocks, but due to the regionalised genetic pools of *P. kaakan* stocks and possibly *P. argenteus* stocks in the Gulf (Garrett 2002), the additional impact from the recreational and indigenous fisheries might require closer management.

ERA Risk Rating: Impact on breeding stock (*C1 L5 Low*)

Proposed Management Actions

Recent concerns over the sustainability of this species from inshore and offshore fishing are acknowledged by the Queensland Government. Further measures to obtain better data to inform sustainable management of grunter in the Gulf are being considered including changes to the DPI&F LTM program to include monitoring of grunter stocks and development of regional scale recreational fishing surveys to provide improved data for future stock assessment.

Black Jewfish (*Protonibea diacanthus*)

Harvested in significant quantities in the Northern Territory Coastal Line Fishery (Phelan and Hay 2004) but only in limited quantities (approximately five tonne per year) in northern Western Australian inshore net fisheries (Penn *et al.* 2005). In the Queensland Gulf net fisheries, the black jewfish forms only an occasional (<5 t/year) part of the N3 fishery catch (DPI&F 2005*a*). Together with other sciaenid fishes (excluding jewelfish: see above), black jewfish make up about 1% of the catch retained in the N3 fishery. Stobutzki *et al.* 2001 reported juveniles of this species in the NPF bycatch and assessed that there might be a moderate risk from that fishery to its sustainability.

The Workshop considered that the take and area of capture by the N3 fishery is small compared the known area of black jewfish distribution across the whole of tropical northern Australia. The impact of the N3 fishery upon the known stock is therefore considered to be minor.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
There are no proposed management actions for this species in the fishery.

Sharks and Rays (Lamniformes and Rajiformes)

An annual harvest of about 350 t of sharks and 10 t of rays are taken in the Qld Gulf net fishery (DPI&F 2005*a*). The relative risk to the sustainability of shark and ray species captured in the N3 fishery has recently been assessed (Gribble *et al.* 2004). A few carcharhinid shark species (*Carcharhinus cautus, C. leucas, C. amboinensis* and the Great Hammerhead, (*Sphyrna mokarran*) appear to be the most at risk from inshore net fishing (*op. cit*.). Several other carcharhinids including *C. macloti, Hemigaleus microstoma* and *Negaprion acutidens*, the hammerheads (*S. lewini* and *Eusphyra blochii*) and the ray, *Aetobatus marinari* have been assessed to be at moderate risk. Shark species considered to be at relatively low risk from the N3 fishery are *C. amblyrhychoides, C. limbatus, Rhizoprionodon taylori* and *R. oligolinx* (*op. cit*.).

ERA Risk Rating: Impact on breeding stock (*see* Gribble *et al.* 2004 for risk ratings of individual species)

Proposed Management Actions
Gribble *et al.* (2004) proposes the following measures to address the sustainability of high risk species in the fishery:

- collaborative management of Indonesian, PNG and Australian tropical shark fisheries because these fisheries access stocks shared between these jurisdictions;
- urgent acquisition of data on catch composition, stock structure, biology and optimal harvesting of high risk Gulf shark species (especially *Carcharhinus leucas, Sphyrna mokarran* and *Stegostoma fasciatum*);
- development of effort standardisation to measure effort creep in Gulf net and line fisheries throughout the catch/effort data series;
- a further review of the sustainability of Gulf sharks in April 2006.

Queenfish (*Scomberoides commersonnianus*)

Queenfish are not specifically targeted in the N3 fishery, but the annual harvest since 2000 appears to be increasing. Queenfish is a target species in the Northern Territory Coastal Net fishery harvesting a combined species average annual catch of about 35 t.[10] (Phelan 2004). Negligible commercial landings, < 1 t/year, from Western Australia (Penn *et al.* 2005) and small incidental catches of juvenile fish in the Northern Prawn Fishery (Stobutzki *et al.* 2001) have also been reported.

About 25 t of queenfish are harvested commercially each year in the Queensland Gulf net fisheries (L. Williams, DPI&F, *in prep.*, 2005). Commercial net catches of queenfish on the Queensland east coast were steady at about 45t/yr between 1996 and 2000 before increasing. Higher catches are taken in the N3 than in the N9 fishery. There is a high level of queenfish discarding when large numbers are caught simultaneously. About 20 t are caught by Gulf recreational fishers each year.

The Workshop considered that based upon the catches in the Queensland Gulf net fisheries compared to the total reported landings from all sources, that the N3 and N9 fisheries may have a detectable but minimal impact on the queenfish population size.

ERA Risk Rating: Impact on breeding stock (*C1 L5 Low*)

Proposed Management Actions

Annual monitoring of N3 catch composition is proposed to detect trends in the commercial catch of this and other species. Since the Workshop, research indicates that queenfish may be subject to growth overfishing in the Gulf (Dr. S. Griffiths, CSIRO, *unpub. data*). DPI&F will assess queenfish catch data from each of the fishing sectors and other relevant information and determine whether the current risk rating needs to be reviewed and further management considered.

Other Species

Relatively small amounts of a number of estuarine species including golden catfish (*Arius thalassinus*), snub-nosed dart (*Trachinotus blochii*) and steelback (*Leptobramma muelleri*) (Halliday *et al.* 2001) are also harvested in the N3 fishery (making up a total annual harvest of about 15 tonnes.

[10] Estimated total landings made up of 40 species

The Workshop considered that the capture areas of these species in the N3 fishery represent only a small part of their known distributions (Froese and Pauly 2005). It was concluded that impacts from the small catches of this group of fishes in the N3 fishery was unlikely to be detectable at the stock level, therefore the risk to the sustainability of these species was considered to be relatively low.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
Annual monitoring of catch composition to detect changes in commercial catch of these species.

Sawfish (Pristidae)

Several tonnes of sawfish are reported in the annual commercial catches of Western Australian fisheries (Penn *et al.* 2005). Sawfish have also been reported in the NPF catch and their relative sustainability assessed among other elasmobranchs captured in that fishery (Stobutzki *et al*. 2002). Small quantities of the wide sawfish (*Pristis microdon*) were retained in the N3 fishery in the past, but this has ceased since its listing under the EPBC Act 1999. Most sawfish are now released upon capture. Gribble *et al.* (2004) have undertaken a more detailed assessment of the risk to sustainability of sawfish in the Queensland Gulf fisheries (see the N3 Fishery Non-Retained Listed Species assessment and the N9 Retained Species assessment for further details).

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
Please see Proposed Management Actions for Pristidae in the previous N9 section for details.

Guitarfish (*Rhynchobatus*)

Guitarfishes (*Rhynchobatus* spp.) make up about 5% of the shark catch in the N3 fishery (Gribble *et al.* 2004). It is a moderately productive species in terms of its size at maturity and maximum size (moderate regeneration time and moderate vulnerability to over-exploitation). There is however, a high degree of uncertainty regarding its natural mortality, age at maturity and fecundity, making existing sustainability estimates for the species precautionary in nature (Gribble *et al*. 2004). It appears to be moderately susceptible to capture in the N3 and N9 fisheries relative to other northern Australian commercial fisheries. Sustainability of this species is potentially at risk (*op. cit.*).

ERA Risk Rating: Impact on breeding stock (*Moderate to High Risk*)

Proposed Management Actions
Guitarfish have been assessed by Gribble *et al.* (2004) to be at relatively high sustainability risk in the east coast commercial fisheries. The assessment concluded that management intervention be considered for east coast guitarfish. Any future management changes for this species on the east coast will also be considered in the context of sustainable management of guitarfish in the Gulf. Gribble *et al*. (2004)

have pointed out stocks of some shark species captured in Queensland's Gulf net fisheries are shared with other jurisdictions. Consequently any efforts to sustainably manage the stocks should be conducted jointly among Queensland, Northern Territory and Western Australia governments. In order to achieve this, information is urgently required on the catch composition, stock structure, growth and reproduction and optimal harvesting of Gulf shark species.

To progress this agenda, DPI&F is addressing the taxonomic uncertainty over guitarfishes captured in the Gulf net fisheries. Genetic material has been compiled and a project proposed to investigate taxonomic uncertainties within this group. A taxonomic review of guitarfishes is planned for 2006 (Jenny Ovenden DPI&F Geneticist *pers. comm*. 2005).

Spanish Mackerel (*Scomberomerus commerson*)

The N3 and N9 fisheries have a combined annual catch of Spanish mackerel of about 10% of the Gulf line fishery catch. Management of this species is therefore directed primarily at the Line Fishery (see the *L4/L5 Line Fishery Retained Species* assessment for details). By comparison the impact of the net fishery catch on the stock is considered to be negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

Proposed Management Actions
There are no proposed management arrangements for this species in the N3 fishery.

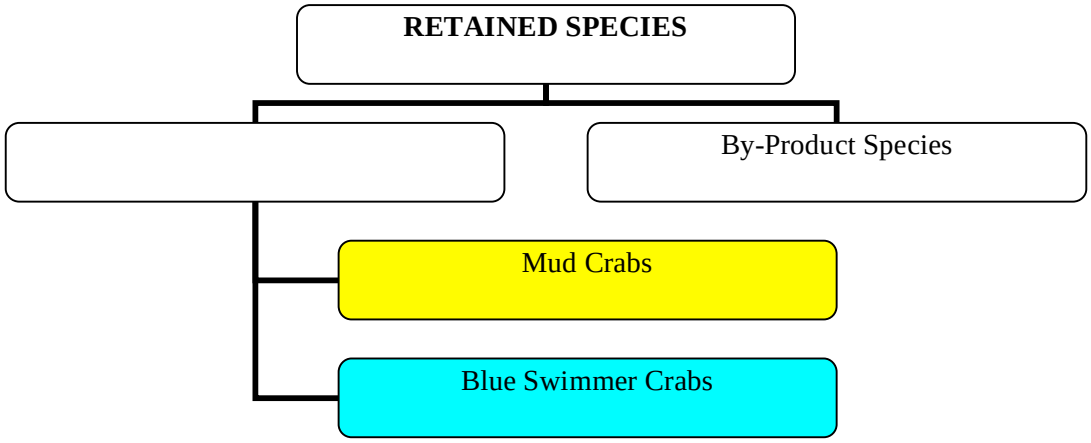
Mud Crabs (*Scylla serrata*)

The total annual Queensland mud crab fishery harvest is about 1000 t (Ryan *et al.* 2003). Approximately 15% of the harvest is taken from the Gulf and 85% from the east coast (DPI&F 2005*a*). The N3 fishery has an average mud crab harvest of only one tonne /yr (DPI&F 2005*a*). Management of this species is therefore directed primarily at the Gulf Pot Fishery (see the *Mud Crab Pot Fishery Retained Species* assessment for details).

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

Proposed Management Actions
There are no proposed additional management arrangements for this species in the N3 fishery.

Component Tree for Retained Species in the C1 Crab Pot Fishery



Primary Species

Mud Crabs (*Scylla serrata*)

Three mud crab species are recognised inhabiting the Gulf. Only 2 species are landed and retained in the C1 mud crab fishery. Nearly all crab caught are *Scylla serrata*. The other species, *Scylla olivacea*, has a limited distribution in brackish estuaries of the North east Gulf (Ryan *et al.* 2003) and rarely attain 15 cm carapace width, the current minimum legal size (MLS). Commercial effort is largely concentrated from Weipa to Karumba, the fishery area is displayed in Figure 5. The fishery is therefore managed as a *S. serrata* fishery. The commercial harvest by the C1 fishery in the Gulf is about 150 t.

In Queensland, mud crabs are targeted by commercial and recreational fishers and taken by indigenous fishers. In 1996 the commercial catch was about 500 t, increasing to about 1,000 t in 2002. Catches in the Gulf net fisheries are low (see the *N3 Retained Species* risk assessment). The annual commercial harvest in Northern Territory and NSW is about 400 t and 200 t respectively. The Northern Territory commercial Gulf mud crab harvest is about 300 t. Mud crabs are only a very minor part of the commercial estuarine catch in Western Australia, about two tonne/ yr (Anon. 2003).

The total Queensland recreational mud crab harvest is estimated to be about 70% of the national recreational harvest (Lyle *et al.* 2003) however, the recreational catch specifically for the Gulf has not been defined in this report. A need exists for refining estimates of total recreational mud crab (and other species) catch in the Gulf. Anecdotal information suggests recreational catches have been poor in the last few years in some areas. The Queensland Gulf indigenous catch is uncertain, based on rough calculations from the catch estimates of Coleman *et al*. (2003) it may be in the vicinity of 5 t/ year.[11]

[11] The estimated indigenous mud crab catch for northern Australia is about 100 t/year (Coleman *et al.* 2003)

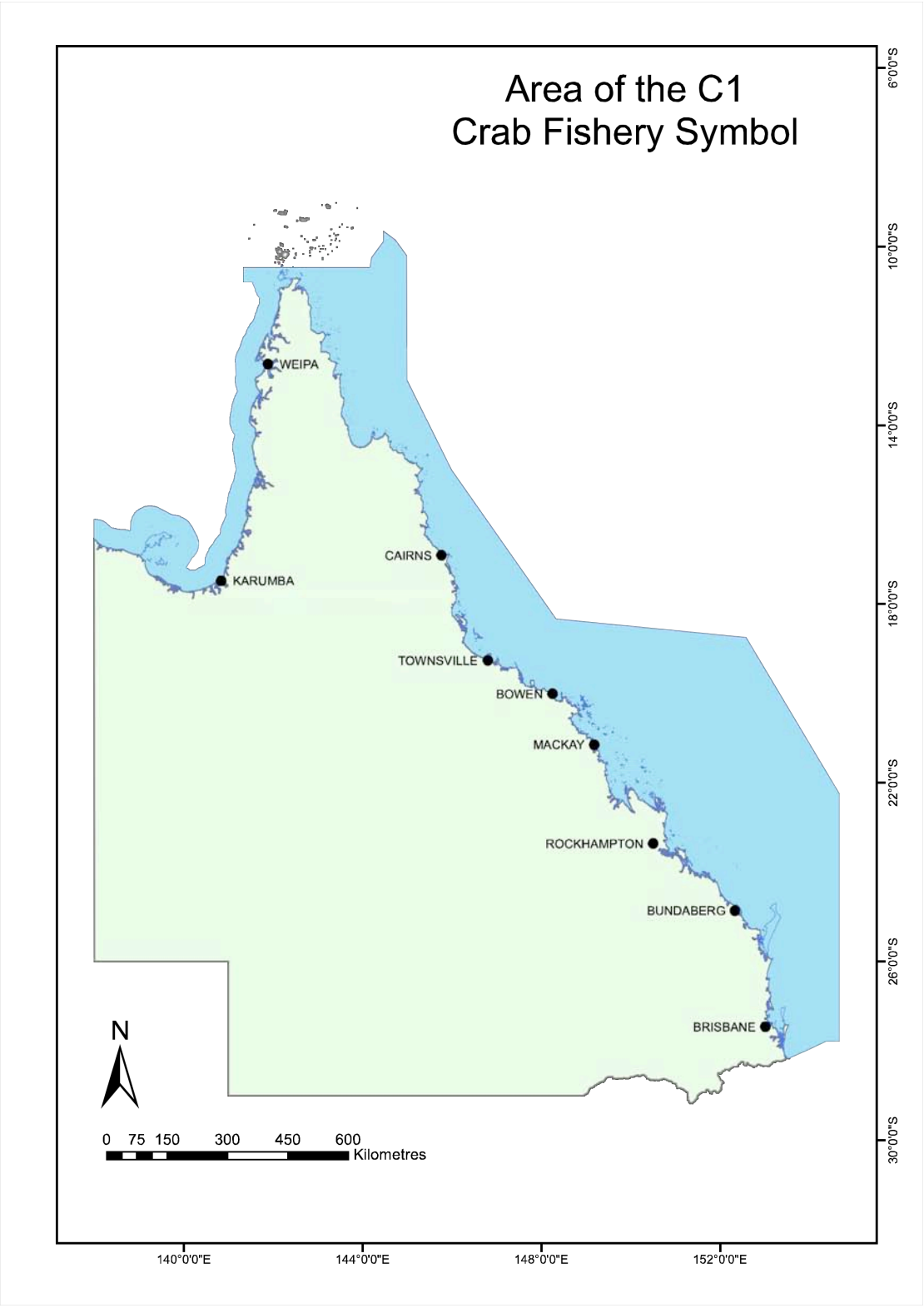


Figure 7 Map displaying the geographical range of the C1 Crab Pot fishery

Different management arrangements apply between Queensland and Northern Territory mud crab fisheries. Specifically, a different MLS applies in each jurisdiction and only males can be taken legally in Queensland, while both sexes may be taken in the Northern Territory.

Recent, anecdotal reports suggest there may be increasing levels of parasitism among mud crabs in the Gulf. Mud crabs are considered a highly robust species and not prone to overfishing. The Workshop considered that the existing MLS regulations and ban on taking females in Queensland are adequate measures to ensure that the stock, if fully exploited, will be protected without adversely affecting long term recruitment to the fishery. It was also noted that there is no current indication the fishery may be having an adverse effect on the stock. However, commercial effort in the fishery is increasing and catch levels have stabilised in recent years. When viewed in the context of a significant commercial mud crab harvest in the Northern Territory Gulf and probably a significant Gulf recreational mud crab catch, a moderate risk rating has been assigned to ensure appropriate action is taken to sustainably manage the stock.

ERA Risk Rating: Impact on breeding stock (*C2 L4 Moderate*)

Proposed Management Actions
Removal of latent effort in the mud crab fishery (Gulf and East Coast) is proposed. The impact of the fishery licence and fee changes to be implemented for July 2006 on latent effort will be monitored and additional management actions amended if required. Long-term monitoring of catch rates is currently underway to address concerns about reduced mud crab catches around Weipa. Future assessment of the Gulf mud crab fishery stocks should consider the possible influence of localised depletion, recruitment failure, evidence of parasitism and seasonal/annual variability relating to environmental variability, in driving changes in catch levels.

Blue Swimmer Crabs (*Portunus pelagicus*)

Blue swimmer crabs are harvested in all mainland Australian State waters excluding Victoria. Australian commercial fisheries harvest about 1500 t /yr (Kumar 1997) and appear to have the potential to increase harvesting levels further (Sumpton *et al.* 2003). They are a highly robust species not prone to overfishing. Commercial, recreational and indigenous fisheries exist in Queensland. Blue swimmers crabs are targeted by commercial and recreational pot or dilly fishers or are harvested as byproduct in Queensland east coast otter and beam trawl fisheries. The total Queensland commercial catch was about 450 t in 1996 increasing to about 850 t in 1999. The estimated commercial harvest in 2000 was 630 t and the recreational harvest is about one-third of that (Sumpton and Williams 2002). The Western Australian commercial catch for this species was 1,000 t in 2002/03 (Penn *et al.* 2005).

Only about 200 kg of blue swimmer crabs are reported annually in the commercial Gulf Mud Crab Pot Fishery. The Gulf recreational harvest is also thought to be extremely low. Catches appear to be increasing slightly in the N3 net fishery over past few years and though a market exists for the species, the resource is not exploited by the Queensland Gulf net fisheries. Catches in the N9 net fishery are discarded. A significant catch occurs in Queensland east coast commercial pot and trawl and recreational pot fisheries –approximately 1000 t/yr.

Given the relatively small area of the Gulf Mud Crab Pot Fishery with respect to the extensive range of blue swimmer crabs, and the extremely low catch level in this fishery compared to other commercial and recreational fisheries, the Workshop considered the fishery was likely to have an insignificant impact on the population of this species. Any impact from this fishery was unlikely to be measurable against background variability in the blue swimmer crab population.

ERA Risk Rating: Impact on breeding stock (*Negligible Risk*)

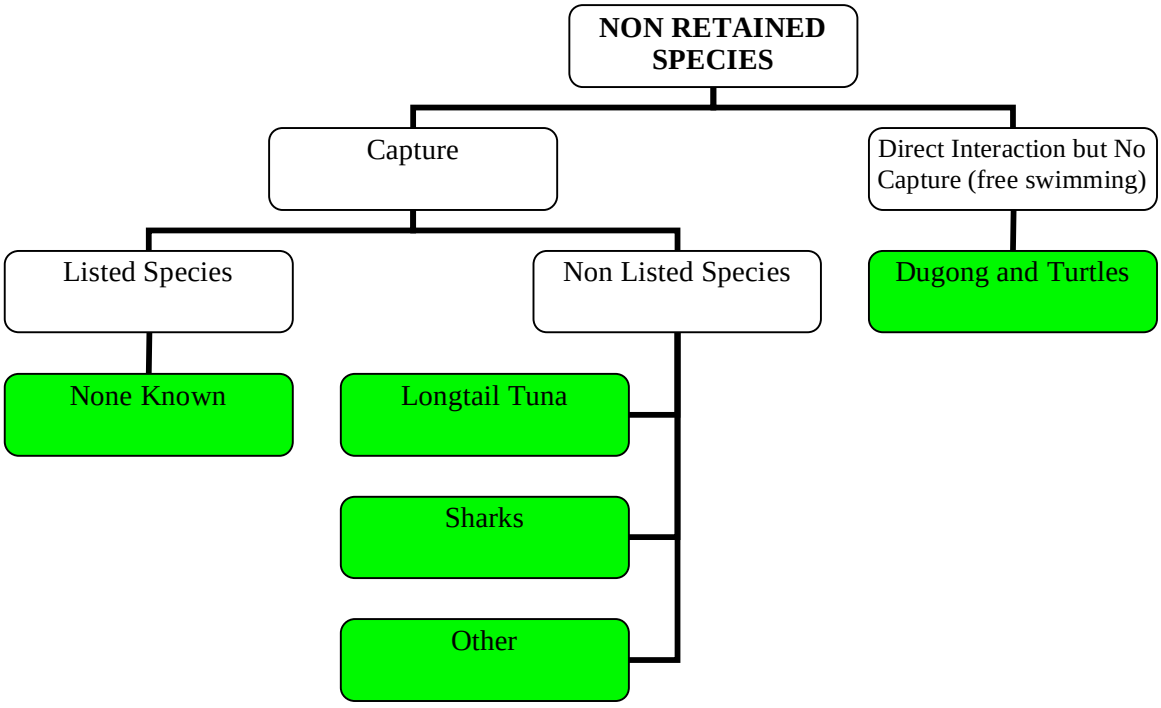
Proposed Management Actions
Continue to monitor the annual catch of this species in the Gulf Mud Crab Pot and N3 Net Fisheries.

Byproduct Species

There is no recognised byproduct species caught in the fishery.

Non-Retained Species

Component Tree for Non-Retained Species in the L4/L5 Line Fishery



Captures

Little research has been conducted specifically on bycatch in the L4/L5 Line Fishery. The methods employed by the commercial operators are in essence, the same as used in Spanish mackerel fisheries in the Northern Territory and on the Queensland east coast, as well as the demersal hand line fishery in the Coral Reef Fin Fish Fishery that operates throughout the Great Barrier Reef (Roelofs *et al.* 2003). However, due to the nature of targeting fish in the L4/L5 Line Fishery, bycatch is considered to be negligible (G. McPherson, QDPI Fisheries Biologist *pers. comm*. 2003). The fishing gear and species targeting practices limit the take of species other than Spanish mackerel. Fishing methods include the use of troll lines and hand lines, which are always tended during fishing. Species that are caught incidentally can therefore be released alive (Roelofs *et al.* 2003).

Bycatch in the Northern Territory Spanish mackerel fishery is also negligible (O'Grady 2002). The gear types and methods used, effectively target Spanish mackerel and catch few incidental fish species. The major by-product species in the NT fishery are sharks which are released alive (Roelofs *et al.* 2003).

Listed Species

Few or no interactions with species listed under the *Environment Protection and Biodiversity Act 1999* are known in this fishery, therefore the fishery was considered to be at negligible risk.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Non Listed Species

Longtail Tuna (*Thunnus tonggol*)

Tunas are sometimes caught on troll lines, including the long tail tuna (*Thunnus tonggol*), which is a Commonwealth regulated fish species and not permitted to be retained in the L4/L5 Line Fishery. Given the low incidental catch of tuna, the Workshop considered impact of the fishery on long-tail tuna stocks was negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Sharks

As for longtail tuna, catches of non-marketable species including large sharks are very small and the fish are released alive (Roelofs *et al*. 2003). Similar to the east coast Spanish Mackerel Line Fishery (Ryan 2004), sharks are rarely caught and retained during trolling. Sharks may be landed while preying on hooked Spanish mackerel. Hooked sharks invariably break the troll lines and/or are released live by the operator. The survival rate is probably high for released sharks as the tinned hooks used in the fishery would ultimately rust and fall out (Roelofs *et al*. 2003).

Supported by observations from DPI&F officers on the east coast, fishers will generally relocate at the first sign of sharks in a Spanish mackerel school due to the considerable loss of product involved (D. Rose, DPI&F, *pers. comm*., 2003). Based on the available information, the Workshop considered that the fishery was having a negligible impact of shark stocks and that other Gulf fisheries were more likely to have a greater impact. The largest impact on the sustainability of marketable (retained) shark species is covered in the N3 and N9 fishery risk assessments.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Other Species

Research on bycatch from Spanish mackerel fisheries on the Queensland east coast and in the Northern Territory can be broadly applied to L4/L5 Line Fishery (Roelofs *et al*. 2003). Similar to these other Spanish mackerel fisheries (Ryan *et al*, 2004), small quantities of reef associated species are captured while fishing around shallow reefs and shoals in the L4/L5 Line Fishery. Barracuda (*Sphyraena* spp.) are likely to be the dominant other bycatch species when using troll lines (G. McPherson, DPI&F, *pers.comm.* 2003).

The Workshop considered that due to the highly selective nature of mackerel line fishing, catches of other bycatch species were insufficient in the L4/L5 Line Fishery to pose anything other than minimal risk to the sustainability of their stocks.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Non-Captures

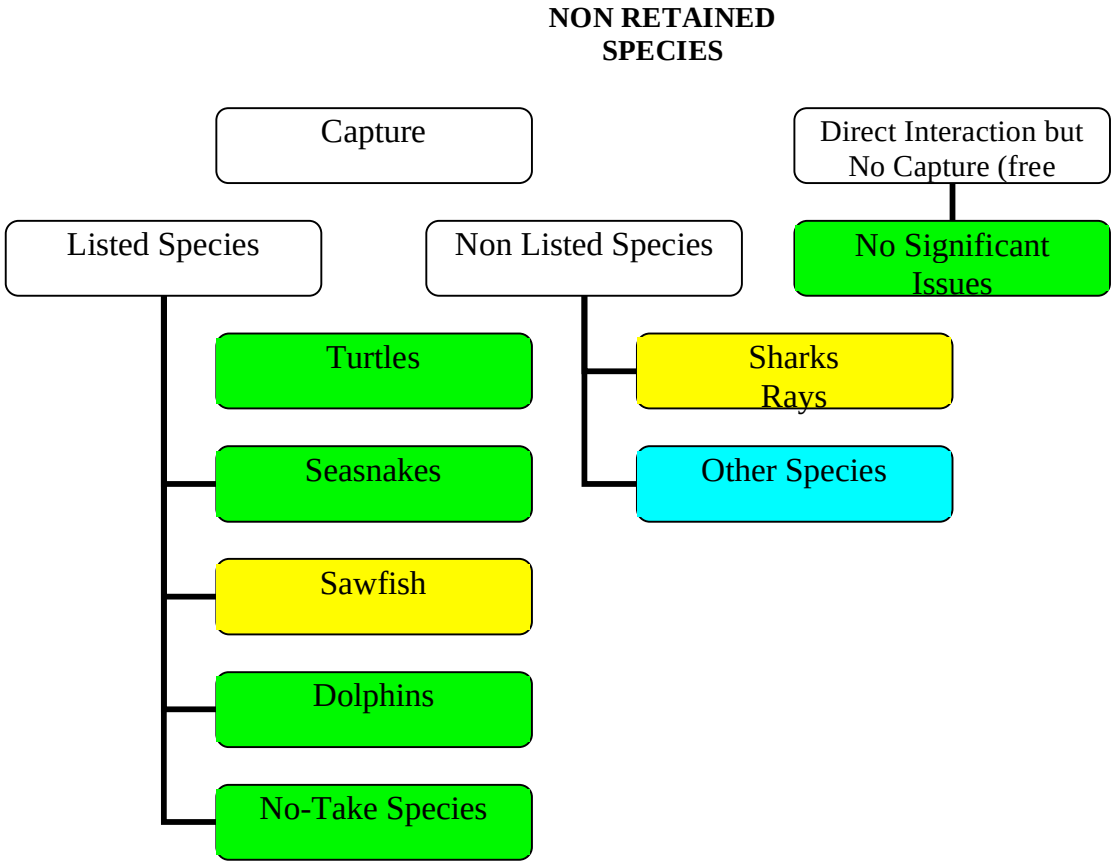
Dugong and Turtles

There is minimal likelihood of boat strikes on dugongs because these species do not occur in high numbers in the same areas as major effort in the fishery (viz. up to 25 nm offshore from Weipa, Karumba and Mornington Island).[12] Turtle populations in the Queensland Gulf have been surveyed by Marsh *et al.* and were found to occur in higher numbers along the western shore of Cape York Peninsula north of the Holroyd River and offshore from Mornington Island, potentially interacting with the fishery in these areas. However, the combination of low maximum speed of displacement hull vessels (compared to faster, planing hull vessels), selective fishing gear and their naturally evasive behaviour mean there is minimal risk to the sustainability of dugong and turtles from non-capture interactions with L4/L5 fishing vessels.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

[12] Marsh *et al*. 2002 confirmed that the regions in the vicinity of Weipa and Karumba are not particularly important dugong habitat and that the most important region for dugongs in the Gulf was the shallow (< 3 metres deep) waters inshore of the Wellesley Islands

Component Tree for Non-Retained Species in the Developmental Fin Fish Trawl Fishery



Captures

Listed Species

Turtles (Chelonidae)

The six species of sea turtles listed in the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* have been reported by Marsh *et al. 1998,* to be present in Queensland waters of the Gulf of Carpentaria. Their 1997 survey of the coastal waters of the Queensland Gulf found turtles were abundant.[13] Numbers were significantly higher in two distinct regions. The nearest of these to the fishery area was the western shore of Cape York Peninsula, north of the Holroyd River, lying 25 nm inshore of the fishery area. The fishery area is also about 200 nm from the other major turtle population area offshore from the Wellesley Islands. Since this workshop convened, the fishery area has been extended to 15˚S latitude. Possible leatherback (*Dermochelys coriacea*) turtle nesting activity has been observed on the south-east Gulf coast.[14] But is well outside of the fishery area. Observer data from a boat currently permitted in the fishery suggest that approximately 10 turtles may be caught per year. With only two boats operating in the fishery, potentially 20 turtles per year may be caught. However, it cannot be assumed that all of these turtles die. Observer

[13] An estimate of between 14,500 and 17,000 turtles (all species combined) was derived from survey data

[14] Marsh *et al* suggested leatherback turtles may nest in the vicinity of Kowanyama

reports indicate that the condition of trawled turtles can be difficult to assess by the presence/absence of movement alone and that survival depends on when the turtle was caught during the shot. Turtles are generally more likely to survive when entering a trawl net late in the shot. Observers report that most turtles observed were released alive (M. Hicks *pers com.* 2006)

Turtle species most likely to be caught are Olive Ridley turtles (*Lepidochelys olivacea*) and Green turtles (*Chelonia mydas*) (M. Read, EPA, *pers. comm.*, 2004). Recent observer reports have confirmed Olive Ridley interactions with this fishery (J. Stapley, DPI&F, *pers. comm.*, 2005).

The considerable distances between the fishery area and areas of high turtle density suggest that the likelihood for interaction is quite low. The Workshop considered that relative to a population estimate of some 14,000 to 17,000 turtles, the 20 turtles caught in the fishery each year (most probably olive ridley and possibly a number of green turtles) would have a negligible impact on their respective populations. Further evidence of the relatively low impact of the fishery upon turtles is provided when the reported annual 2003 catch of 27 turtles in the NPF is considered (Caton and McLoughlin 2005). The NPF is recognised as a well managed fishery that is generally conducted in a manner that aims to minimise and avoid death or injuries to protected species (including turtles) and that is unlikely to have an unacceptable or unsustainable impact on the environment in the short to mid term (DEH 2003).

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
Turtle resuscitation techniques developed through cooperation between DPI&F and industry are available through the Queensland Seafood Industry Association (QSIA).

In 2005, a DPI&F Protected Species Education Program (DPI&F 2005*b*) was delivered to industry, modifying existing and developing new educational material to improve awareness among commercial and recreational fishers of techniques to minimise interactions with protected species (including turtles) and to demonstrate methods of careful and safe handling of protected species post-capture to maximise their survival. DPI&F expects that these procedures will be adopted by operators in this fishery and are committed to ensuring they are reinforced with fishers through the DPI&F observer program.

In addition, as part of licensing conditions, all master fishermen are required to undertake a protected species awareness course. DPI&F will continue to monitor SOCI logbook returns for catch trends of all protected species.

Note: This proposed management action applies to all listed species referred to in this risk assessment.

<u>Sea snakes (Hydrophiidae)</u>
Risk assessment of seasnakes in the Gulf fisheries is limited to the finfish trawl fishery on the basis that, due to the gear deployed, other Gulf fisheries are unlikely to impact on these species.

Commercial logbook data records indicate six seasnakes were caught in 2002. More recent observer reports confirm a very low level of seasnake interactions with this fishery (J. Stapley, DPI&F, *pers. comm*., 2005). Thirty species are known to occur in Gulf waters as reported through CSIRO research (Milton 2001). Results from research on the relative risks to seasnakes from trawling in the Gulf and Queensland east coast are not yet available (FRDC Project "Reducing the impact of Queensland's trawl fisheries on protected sea snakes"). Ongoing attempts at mitigation of trawl impacts on high risk seasnake species in the NPF and the ECOTF are being monitored for their relevance to sustainable management of seasnake bycatch in the Gulf Finfish Trawl Fishery.

Given the low levels of effort and observer reported seasnake interaction with the fishery, the Workshop considered the current impact of the fishery on sea snakes was negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
The frequency of seasnake catches is monitored in the observer program for the fishery. Data from this source is regarded as reliable. Because the observed incidental catch is very low, there are no additional management actions proposed at this time. Further management of sea snake bycatch will be informed by the results of FRDC Project No. 2004/051 expected to be available by mid-2007.

Sawfish (Pristidae)
The narrow sawfish (*Anoxypristis cuspidata*) was the only sawfish species reported in offshore N9 net fishery catches by Gribble *et al*. (2004) and has been caught in depths up to 40 m in the Gulf. Low numbers are caught in the finfish trawl fishery, with 8 animals, recorded by observers, caught in 2002 (2 specimens were caught on the same trip). A moderate risk rating given to this sawfish in the inshore N3 net fishery and low risk rating given in the offshore N9 net fishery suggests there is a low to moderate risk to the sustainability of this species from the finfish trawl fishery. However, there are other sawfish species not positively identified that also occur in the catch. There could be green sawfish (*Pristis zijsron*), dwarf sawfish (*P. clavata*) or freshwater sawfish (*P. microdon*). Most sawfish caught in the fishery are returned to the water alive (J. Stapley, DPI&F, *pers. obs*., 2004).

The Workshop considered that there was a possibility that the catch of sawfish species could be higher than the relatively low observed catch, it was appropriate to assign a higher level of risk to the sustainability of sawfish on a precautionary basis.

ERA Risk Rating: Impact on breeding stock (*Moderate*) - see N3 and N9 risk assessments

Proposed Management Actions
- Sawfish catches will continue to be monitored through an onboard observer catch monitoring program.
- A guide to careful and safe handling and release of sawfish was published by DPI&F and copies provided to GOCDFTF fishers in 2005.

- BRDs are already subject to testing in the Western Australian finfish trawl fishery (Bill Passey, Gulf Finfish Trawl Operator, *pers. comm.*, 2004). The Queensland Government will investigate the potential use of BRDs in the fishery by December 2007.

Dolphins (Delphinidae and Monodontidae)

Bottlenose dolphins (*Tursiops truncatus*), Indo-Pacific (*Sousa chinensis*), and Irrawaddy dolphins (*Orcaella brevirostris*) have been identified in aerial surveys of Gulf coastal waters by Marsh *et al.* The Workshop noted that during the life of the DPI&F observer program, none of these or any other dolphin species not identified in the surveys, are known to have been caught in the fishery. Interactions have been reported in other Gulf fisheries (see the N3 and N9 risk assessments for details).

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions

No specific management actions are proposed.

No-take Species[15]

Captured live Queensland grouper (*Epinephelus lanceolatus*) have the swim bladder deflated prior to release to assist recovery from barotrauma. Less than 20 are estimated to be caught per year (J. Stapley, DPI&F observer, *pers. comm.*, 2004). On occasion catches of barramundi cod (*Cromileptes altivelis*) are also taken in the fishery (J. Stapley, DPI&F, *pers. comm.*, 2005). The Workshop did not consider the impact of these catches to be more than negligible on the populations of these species. Both have extensive tropical Indo-Pacific and Western Pacific distributions respectively of which the fishery area is only a very small part.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions

No specific management actions are proposed at this time. However, data in Fishbase (Froese and Pauly 2005) indicate the resilience of these species to exploitation is low, with minimum population doubling times up to 14 years for barramundi cod and more than 14 years for Queensland grouper. DPI&F will continue to monitor catches of these species and consider whether current management is appropriate when the Draft Bycatch Action Plan for the Gulf of Carpentaria Fisheries (DPI&F 2004) is reviewed.

Non Listed Species

Sharks and Rays (Lamniformes and Rajiformes)

A range of shark and ray species are captured by the fishery (Roelofs and Stapley 2004). The annual catch of sharks and rays in the fishery is estimated at a few tonnes per year. A nil in-possession limit for sharks and rays has been applied to operators in the fishery (M. Doohan, DPI&F, *pers. comm.*, 2004). Impacts on the stocks are due to incidental mortality before discarding and considered to be similar to the impact on

[15] No-take species are regulated fish under the Qld Fisheries Legislation. All harvesting is totally prohibited

sharks and rays from interactions in the N9 offshore net fishery (see Offshore Net Fishery assessment).

ERA Risk Rating: Impact on breeding stock (*Moderate*)

Proposed Management Actions
Management similar to sawfish is proposed (see Proposed Management Actions for sawfish in this fishery for details).

Since the Workshop, it has been suggested that the current estimate of shark bycatch in the fishery may need to be reassessed based on shark catches in the NPF prior to the introduction of turtle excluder devices (Dr. S. Griffiths, CSIRO, *pers. comm.*, 2005). DPI&F will assess elasmobranch catch composition and catch trend data collected through the DPI&F observer program and determine whether the current risk rating needs to be reviewed and further management considered.

Other Species
The annual catch of all other bycatch species combined is estimated to be about 30t/yr in total. Squirrelfish (Holocentridae) and trevally (Carangidae) make up the bulk of the other bycatch species.

The Workshop considered that given the large number of species (e.g. 20 carangid species alone in DPI&F observer catch data that are regarded as bycatch: Roelofs and Stapley 2004), the 'Other Species' catch was relatively small compared to the catch of the target and byproduct species. The area of capture of these species (the fishery area) is also limited by comparison with their known catch distributions (CSIRO 2005). It was therefore considered unlikely that the impact of this fishery on these stocks was unsustainable at current catch levels.

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

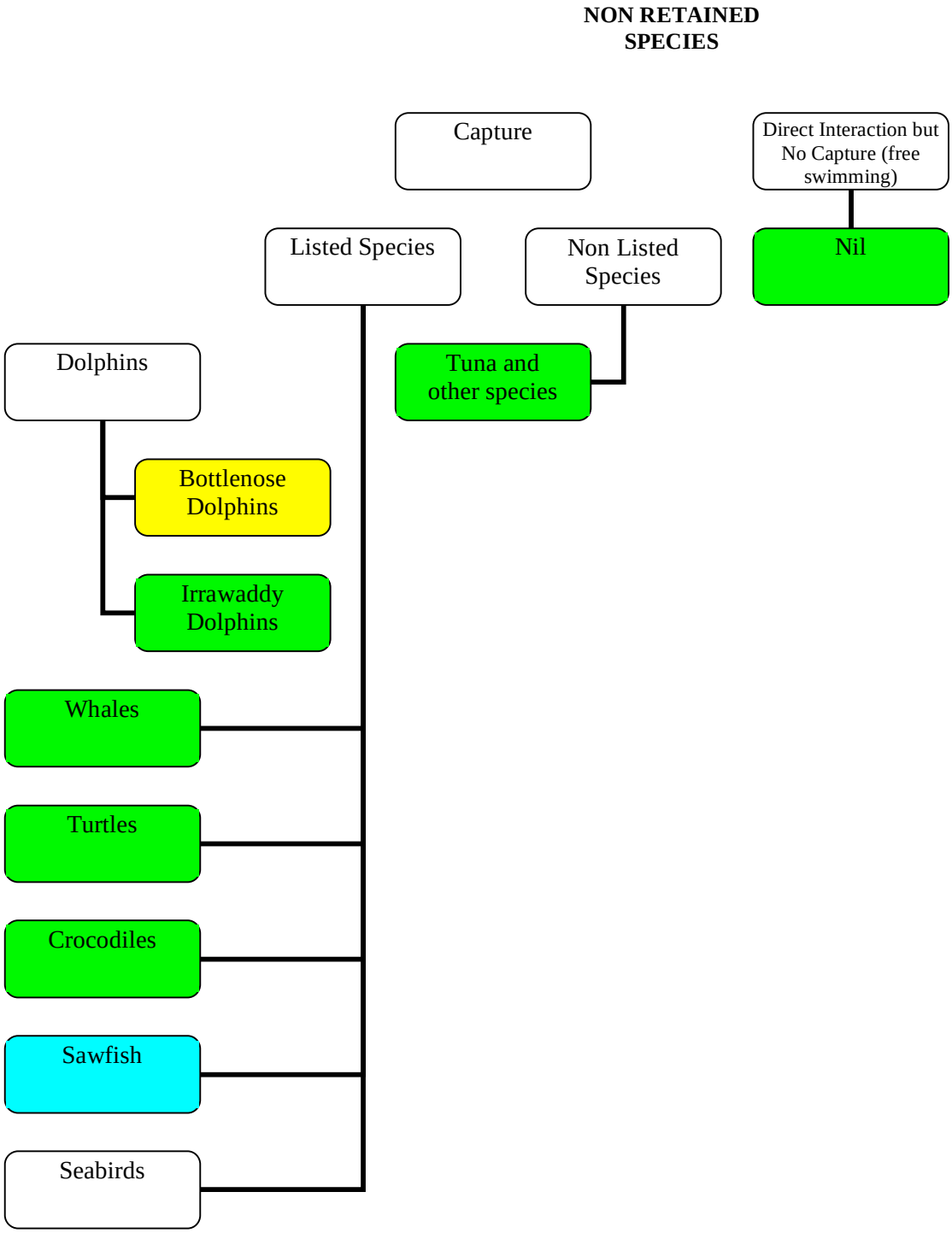
Proposed Management Actions
No specific management actions are proposed at this time. Since the Workshop recent observer data indicates undersized specimens of several lutjanid, lethrinid, scombrid and serranid species are discarded in some finfish trawl operations (J. Stapley, DPI&F, *pers. comm.*, 2005). DPI&F will continue to monitor bycatch species and consider whether current management is appropriate when the Draft Bycatch Action Plan for the Gulf of Carpentaria Fisheries (DPI&F 2004) is reviewed in 2006.

Non-Captures

No significant risk to any species from non-capture interactions was identified at the Workshop.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Component Tree for Non-Retained Species in the N9 Offshore Net Fishery



Captures

Listed Species

Bottlenose Dolphins (*Tursiops truncatus*)

The DPI&F Observer Program recorded five bottlenose dolphin captures over a six year period (Jason Stapley, DPI&F, *pers. comm*., 2004). Observer trips make up 50 days for a season (i.e. 7% of the total fishing days in the fishery). It is estimated that the potential range of captures may be 10-25 per year. This species is reported to commonly interact with N9 fishing gear and is abundant in the Gulf.[16] Acoustic pingers have being trialled in the fishery to assist dolphins avoid the net.

Consulting the *Protected Species Consequence Table A3.3* (Appendix 3), the Workshop considered the risk from the fishery to the bottlenose dolphin population was moderate, (i.e. the level of impact is currently at a maximum acceptable level).

ERA Risk Rating: Impact on breeding stock (*C2 L4 Moderate*)

Proposed Management Actions

Fishers tend to avoid areas where dolphins and other protected species are located (Gulf Fishers Code of Conduct). DPI&F is continuing to encourage fishers to take further precautions to reduce interactions with dolphins through the Protected Species Education Program for fishers (see *Proposed Management Actions for Non-Retained Species: Turtles* in the Finfish Trawl Fishery Assessment).

Irrawaddy Dolphins (*Orcella brevirostris*)

During 1997 aerial surveys, relatively small numbers of Irrawaddy dolphins were observed and these were limited to inshore locations (Marsh *et al*.1998) outside the fishery area.[17] During 2004, a single capture of an Irrawaddy dolphin was observed in the DPI&F Observer Program (J. Stapley, DPI&F, *pers. obs.*). Sightings have been made offshore, however the species usually inhabits inshore waters. The DPI&F observer reported the animal to be in an advanced state of decay, suggesting the dolphin was probably dead before capture and was carried into the net by prevailing currents.

There are no data to indicate that the GOCDFTF is having an impact on the population of this species because their area of occurrence and the fishery area do not significantly overlap. The Workshop considered that any impact would be minimal.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions

DPI&F is continuing to encourage all fishers to take further precautions to avoid interactions with Irrawaddy dolphins through its Protected Species Education Program for fishers (see above: *Proposed Management Actions for Bottlenose dolphins*).

[16] From aerial survey data, the Queensland Gulf population was roughly estimated at about 750 bottlenose dolphins in 1997.

[17] The N9 fishery lies from between 7 nm and 25 nm offshore (Roelofs *et al.* 2003)

Whales (Odonticeti, Balaenopteridae, Balaenidae)
Although pilot and false killer whales (Delphidae, Ziphiidae) are known to inhabit Gulf waters (C. Limpus, QPWS, *pers. Comm.* 2005), DPI&F has no observer or logbook data indicating that toothed, beaked or baleen whales have an interaction with this fishery. The Workshop considered the impact of this fishery on whale populations to be minimal on the basis that most of these species are oceanic preferring deeper waters of the continental slope. The Workshop considered the N9 fishery area to be outside of the main known migratory pathways of Australian east and west coast baleen whales and so poses no risk to these species.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Turtles (Chelonidae)
Low numbers of green turtles have been observed in the N9 bycatch. Most are returned to the water alive. Other turtle species may potentially be captured but have not been reported by DPI&F observers.

Attendance rules apply to this fishery.[18] There are small number of turtles reported in catches by independent DPI&F observers, which are probably Green and Olive Ridley turtles (Mark Read, QPWS, *pers comm*. 2006) and possible other turtle species in the Queensland Gulf (for details see the Risk Assessment for Non-Retained Species in the Queensland Gulf Developmental Finfish Trawl Fishery). The Workshop considered the impact of the fishery on turtle species in general was minimal. The existing attendance rules, protected species awareness course and GoC fishers Code of Conduct (see Roelofs, 2003) further reduce turtle interactions in the fishery.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
Additional data from observer activities are needed to assess relative risk among turtle species that inhabit the Gulf.

Crocodiles (*Crocodylus porosus*)
DPI&F observers report there have been no offshore sighting of crocodiles and no reports of their capture in the N9 fishery. The Workshop considered the impact of this fishery on the saltwater crocodile population to be minimal.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

[18] A maximum 'in attendance' distance of 100 meters is required for a set net in offshore waters in the N9 fishery

Sawfish (Pristidae)
DPI&F observers recorded isolated catches of sawfishes in the N9 fishery. The risk to sawfishes are reported under the *Retained Species* section of the N9 Fishery assessment where the Workshop considered the current catch in the N9 fishery posed a low risk to the sustainability of sawfish stocks in general, and in particular, inshore species (*Pristis zjizron, Pristis clavata,* and *P. microdon*) which have not been recorded as part of the offshore N9 net fishery catch (Peverell 2005).

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions
Future management of sawfishes will be revised regularly, based upon data received through the DPI&F Observer Program. See the *Retained Species* section of the N9 Fishery assessment for details.

Seabirds
Impacts on seabirds in the N9 fishery were not specifically considered at the Workshop.

Non Listed Species

Tuna and other species
Longtail tuna (*Thunnus tonggol*) and trevallies are the major non-EPBC Act listed bycatch species caught in the N9 fishery. Five to ten tonnes of tuna and three to five tonnes of trevallies are captured each year. The Workshop considered that the N9 fishery area was only a small proportion of extensive Indo-Pacific or endemic northern Australian distributions of the reported trevally bycatch species (Froese and Pauly 2005). The corresponding catch in the N9 fishery was considered to be insignificant in terms of having an impact upon the populations of these species.

Catches of other bycatch species in much lesser quantities (Roelofs 2003) were also considered to have minimal impact upon their respective stocks (e.g. tarpon, herring. batfish and catfish).

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
Bycatch species will continue to be monitored in the DPI&F Observer Program for catch trends. An in-possession limit of 10 tuna is in place for State licensed fishers. This limit has been proposed for consideration when the Management Plan is reviewed to address concerns about dumping of fish caught incidentally.

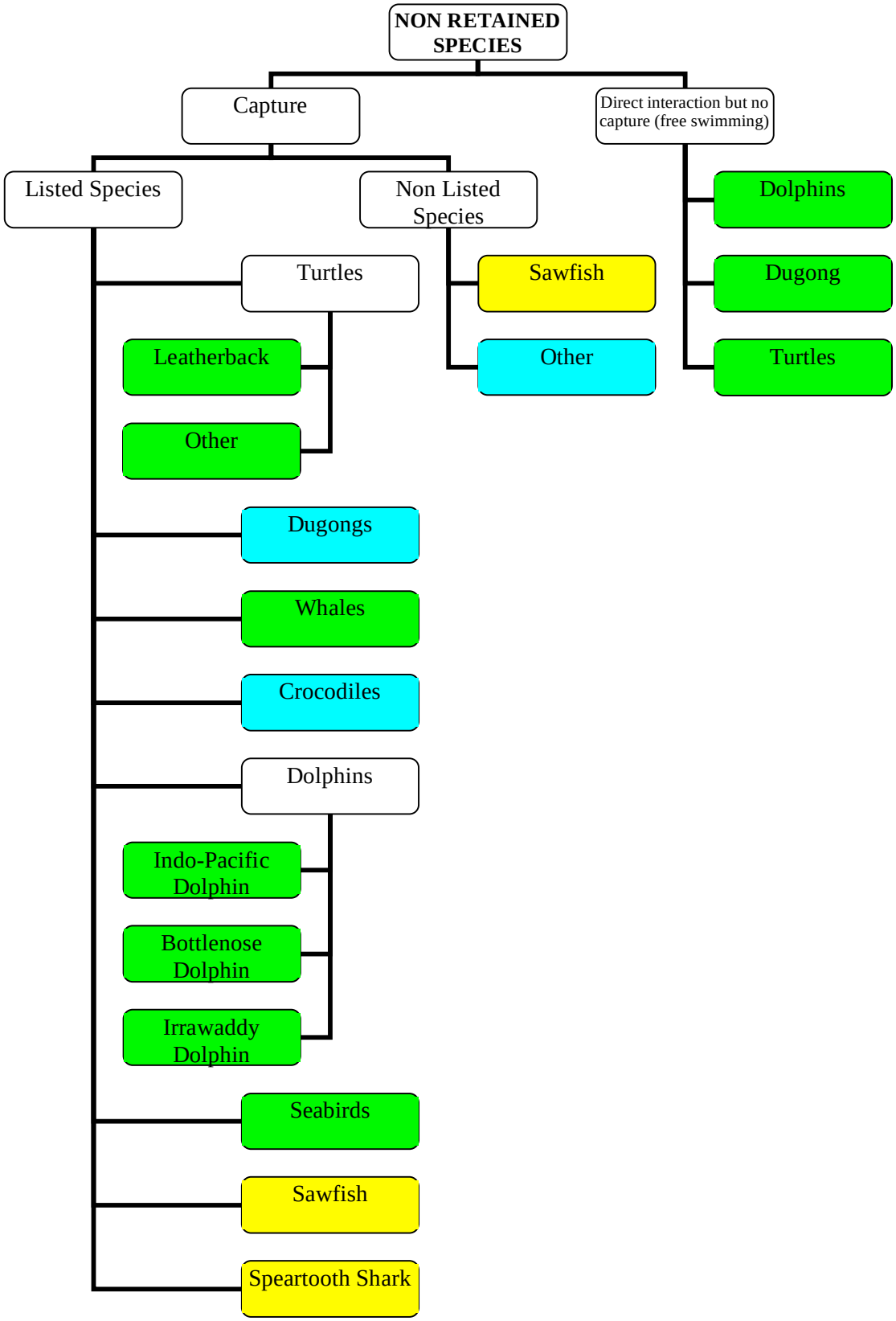
Non Captures

The Workshop considered there is little likelihood of non-capture interactions with other free-swimming marine life occurring in the offshore fishery area.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Component Tree for Non-Retained Species in the N3 Inshore Net Fishery



Captures

Listed Species

Sawfish (Pristidae)

Four sawfish species are captured incidentally in the N3 fishery (*Pristis zijsron*, *P. clavata*, *P. microdon*, and *Anoxypristis cuspidata* (Gribble *et al.* 2004; Peverell 2005) and most are reported to be released alive. Results of the ecological risk assessment for Gulf sharks (Gribble *et al.* 2004) indicated all sawfish species have relatively low productivity and are moderately susceptible to net capture among the suite of elasmobranch species caught in the fishery.

Only *P. microdon* is currently listed under the EPBC Act, but other pristid species have been nominated for listing. Species identification by fishers is improving, aided by the recent release of a field guide. To assist reliable data collection on the relative capture rates among sawfish species, there is a need for further fisher education on pristid identification.

There is some indication that since 1980, the annual barramundi closure (full moon in October to 1 February) may be providing a level of protection to sawfishes during their pupping season (S. Peverell, DPI&F, *pers. comm*., 2004). This is likely to benefit both the breeding females and their offspring (Peverell 2005*b*).

The Workshop considered it was unlikely that the N3 fishery area occupies more than 50% of the species depth distributions. This concurs with the results of the risk assessments by Gribble *et al.* 2004. However, their generally low productivity and high susceptibility to capture by net fishing compared to other elasmobranchs, indicate that there is at least a moderate level of risk to the sustainability of these species in the N3 fisheries.

ERA Risk Rating: Impact on breeding stock (*C3 L4 Moderate*)

Proposed Management Actions

The Queensland Government is eager to see the risks to the sustainability of pristids minimised. Handling procedures advising fishers about safe release practices for live sawfish are contained in the DPI&F publication “A guide to releasing sawfish” (Peverell 2005*a*). Confirmation is needed that existing seasonal closures are effective in protecting gravid females and their young as suggested by Peverell (2005*b*).

Speartooth Shark (*Glyphis* sp. A)

The speartooth shark is an inshore species inhabiting rivers and estuaries in far north Queensland and the Northern Territory, although its range could be much wider and include New Guinea and Borneo (Last and Stevens 1994) and the Gulf. Based on a single report from a DPI&F observer in the N3 fishery, the species may be captured incidentally during estuarine fishing operations in the northern Gulf (S. Peverell, DPI&F, *unpub. data*, 2005). The reported catch in March 2005, post-dates the Workshop by several months. Subsequently, this species was not assessed for risk at the Workshop.

Due to the catchability of sharks in general in the N3 fishery (Gribble *et al.* 2004), the uncertainty surrounding this species biology and distribution, the status of other non-target elasmobranchs in the N3 (viz. listing under the *Environment Protection and Biodiversity Protection Act 1999*), and the risk level assigned to these species (e.g.. sawfish), it is considered appropriate on a precautionary basis to assign a moderate level of risk to this species.

ERA Risk Rating: Impact on breeding stock (*Moderate*)

Proposed Management Actions
The Queensland Government would like to see any risk the fishery may pose to the sustainability of the speartooth shark minimised. DPI&F onboard observers will continue to educate fishers on the correct identification of this species, monitor the catch frequency and obtain biological samples and data where appropriate. The implementation of Species of Conservation Interest (SOCI) logbooks has been proposed for this fishery.

Leatherback Turtles (*Dermochelys coriacea*)
The incidence of leatherback captures in normal fishing operations is very low. Fishers state that reports about historical catch rates have been inflated due to requests from researchers to target this species for research. Since its inception in 1998, there is no record of captures of this species from any N3 fishery Observer activities. The Workshop considered there was no evidence the fishery was impacting this species, thus any effect on the stock would be negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
In view of reports of potential leatherback activity in the south-east Gulf (Marsh *et al.*), DPI&F observers will promote increased fisher awareness to minimise possible interactions, and monitor SOCI logbook returns for catch trends of this species.

Other Turtles
Coleman *et al.* 2003 reported that substantial numbers of sea turtles are harvested by indigenous communities in northern Australia including Queensland Gulf communities. Only 3 turtles have been seen interacting with N3 fishing gear by DPI&F Observers– green (*Chelonia mydas*) and flatback turtles (*Nattator depressus*). All were captured and released alive in good condition.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
DPI&F is promoting increased fisher awareness of possible interactions to minimise turtle capture and mortality through its Protected Species Education Program (DPI&F 2005*b*). DPI&F will monitor SOCI logbook returns for catch trends of turtle species.

Dugong (*Dugong dugon*)
Coleman *et al.* 2003 reported that substantial numbers of dugong are harvested by indigenous communities in northern Australia including Queensland Gulf communities. DPI&F observer programs have not reported any interaction with

dugongs. The workshop suggested there is anecdotal evidence of net captures and one or two interactions over the past 2 years.

Management tools are already in place to ensure that dugong captures are minimised (i.e. attendance rules). If and when captures occur, they are acted upon quickly to enhance post-capture survival of the animal. Net fishing is excluded from some potential dugong feeding habitats. For example, the seagrass meadows at the mouth of the Norman River in the South East Gulf are permanently closed to netting. Despite this, data from the aerial surveys of Marsh *et al.* in 1997 indicated that the regions near the main Gulf ports of Weipa and Karumba were not regarded as significant dugong habitat. Net modifications are in place in waters adjacent to the Wellesley Islands, a region known to support significant dugong habitat Marsh *et al.*

The fishery has attendance rules including the requirement that fishers to be within a 5 nm radius of a set net and fishers avoid resident dugong herds where possible. Dugong interactions are mitigated in the main Gulf dugong habitat of the Wellesley Islands through specific gear modifications that minimise the incidence of dugong drowning. Given these actions, and due to the low reported incidence of interaction with dugongs in the N3 fishery, the Workshop considered that it was highly unlikely that the fishery was having more than a minor impact upon the dugong population.

ERA Risk Rating: Impact on breeding stock (*C1 L2 Low*)

Indo-Pacific Humpback Dolphin (*Sousa chinensis*)
Research in Great Barrier Reef waters suggests that the distribution and habitat requirements for dugong and *S. chinensis* are similar (Corkeron *et al.* 1997). If humpback dolphins and dugong are similarly distributed in the Queensland Gulf, a similar low level of interaction with the fishery would be expected (see above). From a limited number of records it appears that within the Queensland Gulf, humpback dolphins are significantly fewer than dugong (Marsh *et al*.), further decreasing the chance of interactions with the fishery. Reports indicate very low numbers of these dolphins being caught in the N3 fishery. In fact, DPI&F observers have reported only a single dolphin death from a probable interaction with a net. Given the low risk the N3 poses to the sustainability of dugong, that humpback dolphins are fewer in number than dugongs and the minimal number of interactions with humpback dolphins species substantiated by independent observer reports, the Workshop considered that there was little evidence to indicate that the N3 fishery was having other than a negligible impact on the Qld Gulf population.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Irrawaddy Dolphin (*Orcaella brevirostris*)
There have been few reports of entanglement with this species in N3 fishing gear and given the very low number of substantiated reports of interaction with this species, the Workshop considered there was little evidence the N3 fishery was having an impact on the Qld Gulf population that was more than negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Bottlenose Dolphin (*Tursiops spp.)*
There are no data indicating interaction of these species with the N3 fishery. Marsh *et al.* reported these species to be relatively abundant among the cetacean species surveyed in coastal waters of the Queensland Gulf.[19] The Workshop considered that there was likely to be a higher level of impact on these species in the N9 fishery.[20] Little evidence exists indicating the N3 fishery is having other than a negligible impact on the Qld Gulf population.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions for Dugong and Cetaceans
Through its Protected Species Awareness Program, the DPI&F is promoting increased fisher awareness of possible interactions with bottlenose dolphins and recommending to fishers methods to avoid or minimise interactions to obtain positive outcomes (DPI&F 2005*b*). DPI&F will monitor SOCI logbook returns for catch trends of this species.

Whales (Balaenopteridae and Delphinidae)
In the Ecological Assessment of the fishery, Roelofs (2003) listed only three whale species that potentially have distributional overlaps with the N3 fishery area. Over the six year life of the N3 Observer Program, only a single whale has been reported caught in a N3 net (*ca.* in 2002).

Given the fishery area covers shallow inshore and estuarine habitats generally unsuitable for the long-term residency of large migratory whales, and the fishery area lies far from their main migratory paths, the Workshop considered the fishery would have no effect upon either the Australian east or west coast stocks of humpback whales (*Megaptera novaeangliae*). Similarly, While Bryde's whale (*Balaenoptera edeni*) and the killer whale (*Orcinus orca*) may also occur in the fishery area, there are no data indicating the N3 fishery is having other than a negligible impact on the populations of these species.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
DPI&F will monitor SOCI logbook returns for the incidence of interactions with these and other whale species.

Crocodiles (*Crocodylus porosus*)
Interactions with saltwater crocodiles appear to be increasing in the N3 fishery. Crocodiles above 1 m in length are most frequently caught. Where possible they are returned to the water alive, but larger crocodiles can't be handled safely. DPI&F observers report that seven crocodiles have been caught since 1999. Three of these were returned to the water alive. Anecdotal information suggests more are caught than reported. Crocodiles appear to learn how to interact with the nets. The low incidental

[19] Bottlenose dolphins made up 78% of the dolphins identified
[20] See the N9 fishery assessment for details

catch of large crocodiles suggests they may be able to free themselves from the mesh nets used in the fishery. Although the general belief from members of the workshop was that the overall population of saltwater crocodile is increasing, there may still be potential for localised depletion in areas where interactions are relatively high.

Considering that Gulf crocodile numbers may be increasing, the Workshop considered the current low level of interaction between the N3 fishery and *C. porosus* was having a negligible impact on their population.

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions
Through its Protected Species Awareness Program, the DPI&F is promoting increased fisher awareness of possible interactions with crocodiles and recommending to fishers methods to avoid or minimise interactions to obtain positive outcomes (DPI&F 2005*b*). DPI&F will monitor SOCI logbook returns for catch trends of this species.

Seabirds
Incidental capture of seabirds in the fishery appears to be an uncommon event. However, marine raptors, for example the Brahminy Kite (*Haliastur indus*) and osprey (*Pandion haliaetus*) can sometimes feed on fish in the net at low tide and can become entangled. Captured birds remain alive but are generally immobilised until freed by the fisher retrieving the catch. The Workshop considered there are no data to suggest the N3 fishery is having greater than a negligible impact on the populations of these species.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Proposed Management Actions
Through its Protected Species Awareness Program, the DPI&F is promoting increased fisher awareness of possible interactions with marine raptors and other seabirds, recommending to fishers methods to avoid or minimise interactions and ways of caring for and handling seabirds to enhance their survival (Gillespie 2005). DPI&F will monitor SOCI logbook returns for catch trends of seabird species.

Non Listed Species

Sawfish (Pristidae)
Issues associated with risk to the sustainability of non-EPBC Act listed sawfish and Gulf sawfish in general from interactions with the N3 fishery, are considered in the *Non Retained Listed Species* section of the N3 fishery assessment.

Other species
Other species taken as bycatch have been reported in Roelofs (2003). Catfish (*Arius* spp.), bony bream (*Nematalosa erebi*), sharks and rays are the dominant bycatch species, making up about 40%, 20% and 20% respectively of the total N3 bycatch by number. A further 20 or so species comprise the remaining 20% of the bycatch, with scats (Scatophagidae) and diamondfish (*Monodactylus argenteus*) the most numerous, but no species representing more than 1% of the total catch (Halliday *et al.* 2001).

Other northern Australian commercial, recreational and indigenous fisheries are also likely to catch substantial quantities of a number of these species. For example the most recent data available indicates Western Australian commercial fisheries in 2003/4 reported a 10 t catch of catfish (Penn *et al*. 2005). The Queensland Gulf recreational catfish catch could be about 2 t / year (DPI&F, unpublished 2001 RFISH survey data). After mullet, catfish species had the highest total indigenous catch reported in the National Recreational and Indigenous Fishing Survey (Coleman *et al.* 2003). Based on these data, about 10, 000 catfish / year could be harvested by indigenous communities in the Qld Gulf.[21]

The Workshop considered that given the percentage of bycatch species in the total N3 catch was quite low (only 13%) in terms of the total number of fish caught in the fishery (Halliday *et al*. 2001), and that when all catches of EPBC Act listed and non-listed marine species and major bycatch species are removed from the bycatch, the fishery is probably discarding relatively small quantities of the remaining 20 or so individual bycatch species. In conclusion the Workshop considered the fishery has a relatively small impact upon the bycatch species excluding sharks, rays, sawfish and guitarfish[22] reported in Halliday *et al.* 2001 and that the risk to their sustainability from the N3 fishery was negligible.

ERA Risk Rating: Impact on breeding stock (*C1 L3 Low*)

Proposed Management Actions
No specific actions proposed. Monitoring and education programs are in place.

Non Captures

Dolphins (Delphinidae)

The assessable dolphin component is part of the *Non-retained Species Component Tree* but was not specifically discussed at the Workshop. Due to their high mobility and rapid swimming speed, the risk from boat strikes from typically displacement hulled vessels used in the N3 fishery is probably non-existent. The Workshop considered that the risk from non-capture impacts from this fishery on dolphins would be negligible.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Dugong (*Dugong dugon*) and Turtles (Chelonidae)

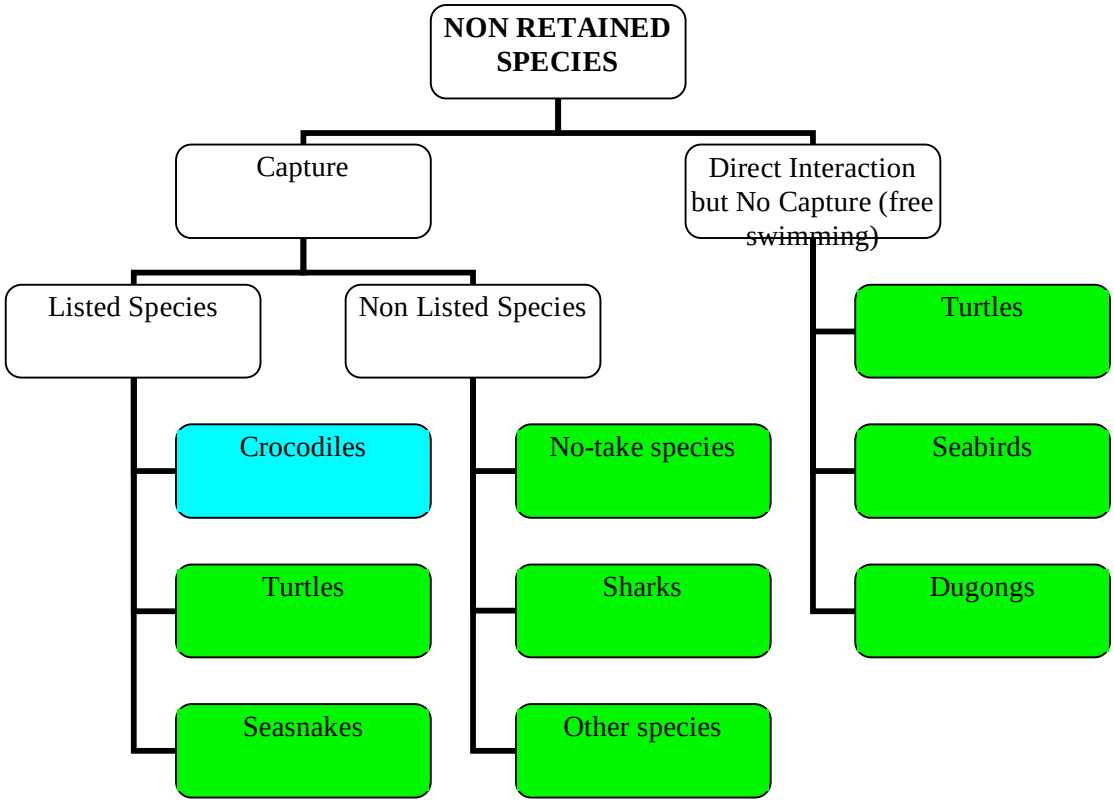
Non-capture interactions (e.g. boat strikes) are uncommon given the small numbers and displacement hull design of N3 boats. This issue may be more significant in the recreational and charter fishing sectors where typically high speed planing hull vessels are employed. The Workshop considered that the risk to sustainability of the dugong population from non-capture impacts in this fishery would be negligible.

[21] Assuming that the indigenous take in the Queensland Gulf is half of the total northern Queensland indigenous catch reported in Coleman *et al*. (2003) and the Queensland north east indigenous take accounts for the other half

[22] These species are specifically considered elsewhere in the assessment

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Component Tree for Non-Retained Species in the Crab Pot Fishery



Listed Species

Crocodiles (*Crocodylus porosus*)

On the east coast of Queensland, around 20 saltwater crocodiles are captured in the Mud Crab Pot Fishery annually. Crocodiles are caught less frequently in the Queensland Gulf Pot Fishery. Commercial crabbing effort on the east coast is five times higher than in the Gulf, so crocodile catches in the Gulf should be considerably less. The workshop participants generally believe that the Gulf crocodile population is increasing, which infers the fishery is having a sustainable impact on the population. The frequency of fishery interactions in future may increase if crocodile numbers continue to increase.

The Workshop considered that it is possible that the Gulf Mud Crab Pot Fishery is impacting crocodiles in the Gulf but at the low catch levels reported it is likely there is no significant impact on the Gulf crocodile stock.

ERA Risk Rating: Impact on breeding stock (*C1 L4 Low*)

Proposed Management Actions

DPI&F will continue to monitor interactions with crocodiles through the SOCI logbook. No specific management actions are proposed.

Turtles (Chelonidae)

In three years of DPI&F observer records, a total of 223 fishing days, as well as during the Tropical Resource Assessment Program (TRAP) Phase II, 1998-2001, there have been no reports of any turtles in crab pots in this fishery. Turtles have also not been reported in fishery independent crab pot surveys of several Queensland Gulf estuaries within the fishery area (Jebreen *et al.* in prep.). Pot capture of turtles in the Northern Territory mud crab fishery is also not recorded. Considering that available data provide no evidence of turtle catch in this fishery, the Workshop considered the risk to turtle populations is likely to be negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions

In response to general public concerns regarding possible turtle entrapments in crab pots, DPI&F are considering a proposal to modify pots to reduce the potential for turtles to get trapped. Regulatory changes to fishing gear are subject to extensive public consultation. The Workshop noted that the significance of any reduction in perceived impact on turtles overall will be proportional to the number of turtles interacting with this fishery compared to other fisheries in a whole of Gulf assessment.

Sea Snakes (Hydrophiidae)

Some fishers have seen estuarine seasnakes in pots, probably attracted by the scent of flesh baits. While in the pot, the animals may not be trapped as they have the potential to leave the pot by swimming through the entrance openings. The Workshop considered that these interactions constitute no more than a negligible impact on Gulf seasnake stocks.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions

DPI&F will continue to monitor interactions with seasnakes through the SOCI logbook. No specific management actions are proposed.

Non Listed Species

No-Take Species

Queensland grouper (*Epinephelus lanceolatus*) are mainly recovered during pot lifts alive unless trapped or enmeshed. It appears that their numbers are increasing throughout the Queensland Gulf (S. Peverell, DPI&F, *pers. comm*., 2005). The Workshop considered that given their numbers appear to be increasing these interactions would constitute no more than a negligible impact on Gulf Queensland grouper stocks.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Sharks (Lamniformes)
A few small sharks are captured in crab pots but it is considered to be an uncommon event and negligible by comparison with the take in the N3 and N9 fisheries.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Other Species
Catfish (*Arius* spp.) were identified as a major part of the bycatch in the Ecological Assessment for the N3 net fishery and this pot fishery respectively (Roelofs 2003; Ryan *et al.* 2003) and according to fishery independent data from LTMP bycatch samples surveyed in Gulf estuaries, are the most abundant crab pot bycatch species group (Jebreen *et al.* in prep.). Other N3 bycatch species are also reported in the fish bycatch of Gulf LTMP crab pot samples including sciaenids (black jewfish and jewelfish), scats (Scatophagidae) and pikey bream (*Acanthopagrus berda*) (Jebreen *et al.* in prep.). However, based on the LTMP data, individual species comprizing the bycatch, varies among estuaries. In the fishery, it is reported that because the fish do not mesh in the pots, most incidental captures are released alive.

The Workshop considered that 'Other species' in the N3 bycatch could be grouped based on the relatively low level of risk to the sustainability of their breeding stock (see the N3 Non-Retained species assessment). Based on the LTMP data can be relied upon as indicative of fish bycatch in the Queensland Gulf Crab Pot Fishery, then the bycatch species composition in this fishery appears to be similar to that of the N3 net fishery, although the quantities discarded and detrimental outcomes of the interaction with crab pots compared to mesh nets are likely to be much lower. The Workshop considered that the risk to the sustainability of 'Other Species' in the bycatch of this fishery was lower than the "low risk" associated with the N3 'Other Species' bycatch category. The impact of the fishery on the breeding stocks of these species was therefore likely to be negligible.

ERA Risk Rating: Impact on breeding stock (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Non Captures

Dugong

Boat strikes may occur in this fishery, but there are no data to indicate there is a risk to dugong sustainability. Generally there is a disjunction between crab fishing areas and dugong habitats. For example there are high levels of crabbing effort around Weipa and Karumba and between Staaten River and Cape Keer Weer – regions that do not support significant dugong numbers (Marsh *et al.*). The major region for potential interactions is inshore of the Wellesley Islands where both dugong numbers and effort are relatively high (Marsh *et al.*; DPI&F 2005*a*).

The Workshop considered that the slow moving, displacement hull vessels employed in the fishery would be unlikely to cause frequent injury to dugong. In addition, only a slight overlap occurs between the major dugong habitat and high fishing effort areas. Given also the likely significant indigenous dugong catch, the impact of this fishery on dugongs in the Queensland Gulf appears to be negligible.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Proposed Management Actions
No specific management actions are proposed. However, the DPI&F will continue to monitor interactions with this species through its Observer and Long Term Monitoring Programs.

Seabirds

There is a low incidence of seabirds observed near pots at low tide. There is no evidence that crab fishing gear leads to their mortality in this fishery. The Workshop considered there was no indication that the fishery was having any more than a negligible impact on seabird populations of the Queensland Gulf.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Proposed Management Actions
No specific management actions are proposed. However, the DPI&F will continue to monitor interactions with seabirds through its Observer and Long Term Monitoring Programs.

Turtles (Chelonidae)

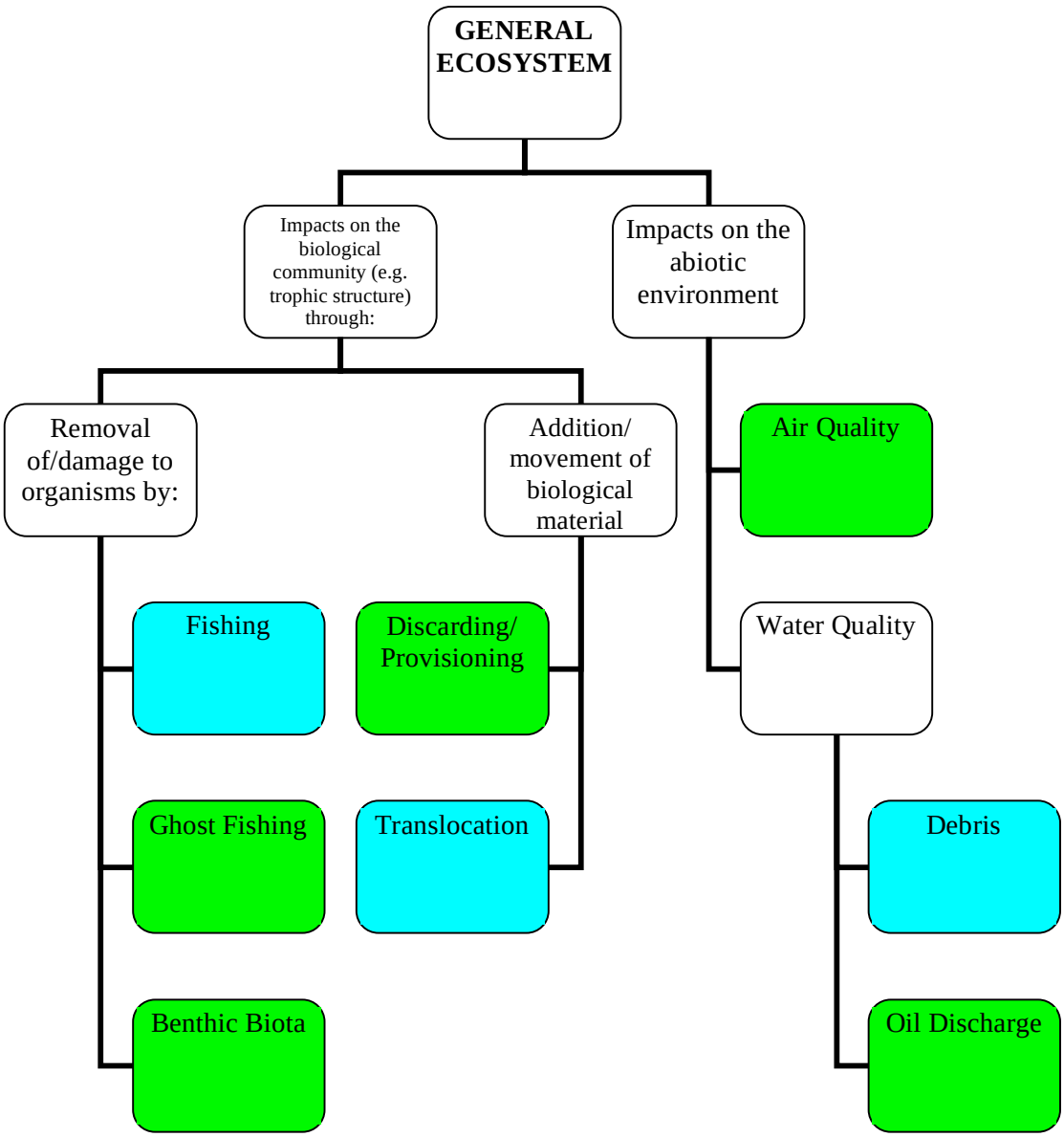
There is a possibility for turtle entanglement in pot lines, however, this interaction has not been known to occur in the Gulf. Although turtles dragging pots has been observed on the east coast, this has not been reported in the Gulf. Boat strikes with small tender vessels are possible, however, occur only rarely and with this level of interaction are unlikely to cause a significant impact on turtles. The Workshop considered that without data to indicate otherwise, the impact of the fishery upon turtle populations was likely to be negligible.

ERA Risk Rating: Impact on breeding stocks (*Negligible*)

Proposed Management Actions
No specific management actions are proposed. However, the DPI&F will continue to monitor interactions with turtles through its Observer and Long Term Monitoring Programs.

General Ecosystem

Component Tree for General Ecosystem Impacts in the L4/L5 Line Fishery



Trophic Level Interactions

Removal of/ damage to organisms by fishing

Spanish mackerel are the predominant species taken in the fishery. The species has a relatively wide diet of fish, squid and prawns. In turn, sharks and larger pelagic species (including dolphins) prey on mackerel. The predator-prey relationships between these species and mackerel are size dependent and no species is the exclusive predator or prey of Spanish mackerel. The Workshop considered that no individual species or trophic groups would be seriously disadvantaged by the removal or capture

related injury of that part of the fishable Spanish mackerel stock affected at the current harvesting levels (i.e. about 150 tonnes per year in the Queensland fishery). It was therefore concluded that that this species does not play a keystone role within the Gulf marine ecosystem and that it was possible only minor changes to the abundance of other ecosystem components could be expected at the current rate of its removal.

ERA Risk Rating: Impact on the Ecosystem (*C1 L4 Low*)

Proposed Management Actions
DPI&F would encourage research efforts into detection of fishery impacts on the trophic structure of the Gulf marine ecosystem. However, no specific management actions are proposed.

Removal of/ damage to organisms by ghost fishing
A limited number of fishers operate in the fishery. Twenty-four boats reported line-caught Spanish mackerel in the Queensland Gulf in 2000 (McPherson and Williams 2002). Though a small amount of gear is lost, this is usually from shark bite-offs. Minimal or no bottom fishing occurs. The potential for ghost fishing is limited to lost lines and hooks. There is some potential for species such as turtles and sea birds to become entangled, but this is considered to be minimal as the gear lost includes small rope fragments and very thick (viz. whipper snipper line thickness) fishing line that doesn't twist or knot easily. Much of the discarded fishing gear found on Gulf beaches is of foreign origin and not generated by this fishery.

Given these factors, it does not appear likely that ghost fishing by L4/L5 line gear is posing more than a negligible risk to the maintenance of the populations of target and non-target species in the Gulf marine ecosystem.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Removal of/ damage to benthic biota
Spanish mackerel fishing is essentially trolling with lines. With almost no demersal fishing, hence there is no interaction with the bottom. Boats drift offshore but inshore, fishers sometimes use temporary moorings that causes minimal disturbance to the seabed. Anchorages may also be used for protection depending on the weather conditions. Some minor disturbance of sediments is possible, but impact is considered transient and localised to anchor divots in relatively soft sediments.

The Workshop considered that given the limited number of boats in the fishery, (27 reported catch in 2003 DPI&F 2005*a*), the predominantly pelagic nature of trolling and temporary impact of anchor imprints over sandy and muddy substrates with relatively little sedentary epifauna compared to hard substrates, the fishery does not pose an unacceptable impact to benthic biota. When major disturbance of the seabed by strong mixing of the water column due to regular tropical storms which occur in the region is considered, the impact of the fishery on benthic biota was regarded as negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Addition/ movement of biological material

Discards Provisioning
Most of what is captured is kept. Discards represent approximately 30% of the total take for the fishery (i.e. about 50 t /year). Mackerel frames discarded during processing are likely consumed by sharks, dolphins and crabs. Some seasonal provisioning of seabirds may also occur. The Workshop considered that this level of discarding may create some localised enhanced feeding opportunities for some marine predators, and scavengers, however, over a large fishery area spanning seven degrees of latitude and over four degrees of longitude (about 50,000 km^2), it is likely to be a negligible addition to food resources for Queensland Gulf populations of these species.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Translocation
It is unlikely that long distance translocation of biological material occurs as most boats in this fishery operate and remain within Gulf waters. The Workshop therefore considered the risk of translocating organisms outside their natural distributions was low.

ERA Risk Rating: Impact on the Ecosystem (*C1 L3 Low*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Impacts on the abiotic environment

Air Quality
The Workshop considered that alone the Queensland Gulf commercial fisheries are likely to have a negligible impact upon local air quality. Given the relatively small size and power requirements of commercial fishing vessels, exhaust emissions are considered to be no greater than for shipping or coastal vessel traffic.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Debris
Pollution of the marine environment by ships of all types, including fishing vessels, is strictly controlled by the International Convention for the Prevention of Pollution

from Ships (known as MARPOL 73/78). Australia is a signatory to this convention, which is now enforced in over 100 countries. The Australian Maritime Safety Authority (AMSA) applies the Convention in Australian waters. Its regulations are implemented through Commonwealth and State/NT legislation (AMSA 2005).

Marine animals (including target fish species) can die as a result of becoming entangled in or ingesting discarded plastic packing straps; netting of all kinds; monofilament line; nylon rope; plastic and polyweave bags and sheeting; bait holders and foam items. Plastics which shatter into smaller fragments are mistaken for food or ingested accidentally (AMSA 2005).

Fishing vessels unable to incinerate their rubbish need sufficient storage space and equipment (e.g. cans, drums, bags or other containers) to retain all plastics for disposal ashore. If operating within 12 nautical miles of land, all garbage must be retained for disposal ashore (AMSA 2005).

Under the Queensland *Transport Operations (Marine Pollution) Act 1995*, it is an offence to deliberately discharge garbage into Queensland coastal waters (inshore of 3 nm) irrespective of the size of the vessel. Severe penalties apply (MSQ 2005).

No bait packaging bands are generated and discarded in the fishery. Fishers catch and use their own bait locally. Solid waste is disposed of in port at Karumba or Weipa. In addition, the Workshop considered that the impact of dumping biodegradable material at sea was considered to be localised and not measurable at the scale of the total fishery area.

ERA Risk Rating: Impact on the Ecosystem (*C1 L3 Low*)

Proposed Management Actions
No further specific management actions are proposed at this time.

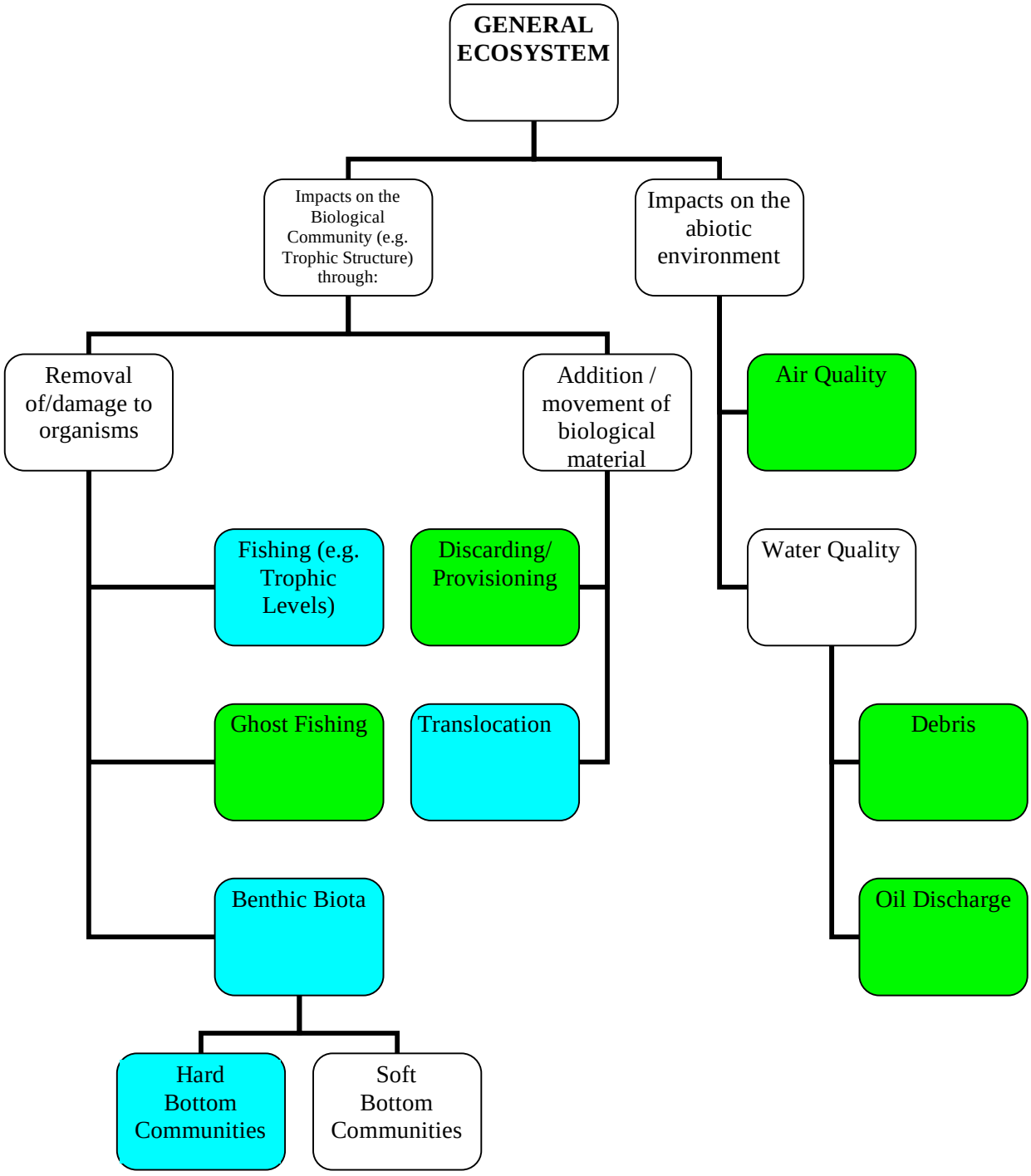
Oil Discharge
MARPOL regulations apply to all the Queensland Gulf fisheries that prohibit the discharge of oily mixtures into the sea in Australian waters (AMSA 2005). Within 3nm of the coastline the *Transport Operations (Marine Pollution) Act 1995* and regulations protect Queensland's marine and coastal environment by minimising deliberate and negligent discharges of ship-sourced pollutants into coastal waters. It is an offence to deliberately discharge garbage, oil and chemicals into the marine environment and severe penalties apply (MSQ 2005).

The Workshop considered oil pollution not to be a significant problem in the fishery. Waste oil and oily water generated during fishing operations is managed appropriately onboard in accordance with the respective Commonwealth and Queensland laws. Vessels discharge in ports with facilities designed to receive this waste, e.g. Weipa and Karumba.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Component Tree for General Ecosystem impacts in the Fish Trawl Fishery



Trophic Level Interactions

Removal of/ damage to organisms by fishing

Tropical snappers and emperors are the major retained species in the fishery. These species are consumers in the middle trophic levels and are prey in the diets of larger fish (e.g.. sharks and cod). Fish trawling does not normally come into heavy contact with the seabed. It is relatively specific for large and semi-pelagic species (Poiner *et al.* 1998), compared to prawn trawling which takes a higher proportion of benthic species. It is therefore likely to cause minimal removal of or damage to benthic fish and invertebrates, although some detachment of larger sessile benthic fauna has been reported in other tropical finfish trawl fisheries (e.g. Stephenson *et al.* 2005) and may be expected to occur in this fishery.

Compared to other northern Australian fish trawl fisheries, the GOCDFTF is considered to have lower impact on the trophic structure of the ecosystem. This is based on an a comparative assessment of the fishery catch and effort estimates with that of the Western Australian Pilbara Finfish Trawl Fishery (WAPFTF), where the effect of the WAPFTF on the food chain of the North West Shelf was recently reported to be at an acceptable level (Stephenson *et al.* 2005).

While the composition of the retained species caught in the WAPFTF and the GOCDFTF are similar, the catches in the former fishery are either about the same or exceed those of the latter fishery by up to four times, depending on the species. The Northern Territory Finfish Trawl Fishery also takes substantially more of the major retained species than the GOCDFTF (Appendix 4). In addition, effort levels in the WAPTFT (four vessels) are higher and probably twice that in the GOCDFTF (two vessels), although the GOCDFTF is about 20% larger in area.

Discards are estimated to be about one-quarter of the catch in the GOCDFTF, about 110 t/ year. Annual discards in the WAPFTF are in excess of 1,000 t, but the level of impact on the bycatch species is considered to be low (Stephenson *et al.* 2005). With only two operators currently active in the fishery and a relatively small Total Allowable Catch of the major retained species[23], the level of discarding is not considered to be a major cause for concern and impact on the ecosystem from their removal is considered to be minor.

Given that the removal of benthic biota in the GOCDFTF is likely to be relatively low compared to the overall impact of the NPF prawn trawling, that effort, retained species and bycatch in the GOCDFTF are at levels well below those considered by Stephenson *et al* (2005) to be acceptable for the sustainability of the ecosystem in other major tropical finfish trawl fisheries, the Workshop considered the GOCDFTF was unlikely to cause measurable change in ecosystem components and that only minor changes in relative abundance of other species dependent on species in the catch were expected. Consequently, the fishery is considered to pose a low risk to the functioning of the ecosystem.

ERA Risk Rating: Impact on the Ecosystem (*C1 L3 Low*)

[23] In 2005, the Total Allowable Catch for all species retained in the fishery was a total of 1250 t, made up of individual catch quotas of 750 t, 250 t and 250 t. One 250 t quota is currently inactive.

Proposed Management Actions
No further specific management actions are proposed at this time.

Removal of/ damage to organisms by ghost fishing
Fishing nets abandoned at sea may cause entanglement and the subsequent death or crippling of marine life. Incidence of net loss is very low in the fin trawl fishery. Only one net has been known lost in the Gulf in 15 years of fishing. It has been assumed the net would sink to the sea floor and not continue to fish. Trawl uses large mesh net with stiff, thick diameter (3-4 mm) line. Few species are likely to be meshed in this material. The fishery trawls up significant amounts of gear lost from other fishing operations (W. Passey, Finfish Trawl Operator, *pers. comm.,* 2004). Most abandoned fishing gear found in northern Australian waters is of south east Asian origin (DEH 2004).

Given the prevalence of discarded foreign fishing nets, low participation in the fishery (only two operators are currently active) and therefore a limited potential for net loss, the low reported incidence of actual net loss in the fishery and the relatively common incidence of recovery of nets from other sources, the Workshop considered that on the rare occasion a net was lost in the fishery, it was unlikely that impact on populations of susceptible species within the fishery area would be significant.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Benthic Biota

Since the workshop met, new data from seabed surveys has been collected which identifies isolated patches of hard coral reef in the southern Gulf (Peter Harvis, Geoscience Australia, 2005). Reefs also occur on depth soundings near Cape Keer Weer (approximately 14˚S lat) and some may be subjected to trawl impacts (Jason Stapley, DPI&F Observer, unpublished, 2005). Only two boats are currently permitted to operate in the fishery using semi-pelagic trawls. About 50% of the eastern Gulf can potentially be trawled. In a year, about 25% of the total fishery area is trawled. An estimated 10% of the eastern Gulf would have been fished to date and flexible sled-type BRDs are being tested by at least one operator (W. Passey, Finfish Trawl Operator, *pers. comm.,* 2004). Similar to the WAPFTF, the main benthic impact appears to be on large sponges brought up in the trawls (see section on removal of/ damage to organisms by fishing).

Given that effort in the GOCDFTF is lower compared to the WAPFTF[24], the Workshop considered that the impact of benthic habitat would also be lower. The fishery was therefore assessed to have only a minor impact on benthic habitat within the fishery area (see section on removal of/ damage to organisms by fishing).

ERA Risk Rating: Impact on the Ecosystem (*Low*)

[24] Stephenson *et al.* 2005 reported the WAPFTF as having a moderate level impact on benthic habitat

Proposed Management Actions

- Monitor the spatial arrangements of where trawling is occurring to ensure that there is no serial depletion to benthos (especially sponges) and target species.
- Assess the effectiveness of BRDs (e.g. flexible sleds) upon their introduction.
- Monitor the frequency of heavy ground gear use in the fishery.
- Support research proposals for seabed biodiversity mapping in the Gulf
- Consider whether the current review event for bycatch is appropriate.

Addition/movement of biological material

Discards Provisioning

Trawl fisheries typically discard bycatch that are consumed by a variety of predatory and scavenging species. Discards in the fishery are mainly finfish, but also include some cephalopods, crustaceans and elasmobranchs. The total discard rate in the fishery is estimated to be about 100t/year. This is an order of magnitude lower than discarding in the WAPFTF, estimated to be about 1,000 t annually. At this level of discarding, the WAPFTF is considered to have an acceptable level of impact upon the marine food chain of the North West Shelf (Stephenson *et al.* 2005). Consequently, the GOCDFTF is likely to have a relatively low impact on trophic interactions involving bycatch species.

About 70% of the bycatch is thought to be returned to the water dead where it is consumed by sharks, dolphins and sea birds (mostly likely terns and boobies: Poiner *et al*. 1998). Research into the feeding behaviour of Moreton Bay bottlenose dolphins (Chilvers and Corkeron 2001), indicates that populations may be segregated into sub-groups that do, and sub-groups that do not, consume trawl discards and this may be related to the proximity of their ranging behaviour to trawling. If similar dolphin social structuring occurs in the Gulf, it may be expected that only a sub-group of the total dolphin population will demonstrate behavioural modification to the extent of adopting feeding strategies associated with trawling.

The Workshop considered that although there may be some localised benefit to these species from additional food availability, it would be unlikely that a change at the population level would be measurable against the background variability that is likely to exist from year-to-year. The impact of discard provisioning upon the ecosystem was therefore considered to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

Introduction of hoppers is proposed to improve bycatch survival rates. Increased investment in the fishery to upgrade to the use of hoppers will be a condition of more secure access to the resource when management of the fishery is reviewed and formalised.

Translocation

Movement of biological material from one place to another (translocation) probably occurs within fishing grounds but is unlikely to result in successful establishment of

most species over greater distances or outside their range. In the GOCDFTF, there are only two vessels operating. One vessel operates on other trawl grounds across northern Australia. The other vessel moves seasonally between the Queensland east coast and the Gulf. At the scale of annual movements taken in and out of the fishery area by these two vessels, the risk of translocating species outside of their natural distribution is considered to be low compared to other higher effort trawl fisheries.

For example, in 2004 there were 510 trawlers in the Queensland East Coast Otter Trawl Fishery (ECOTF). Vessels in the ECOTF may seasonally change their fishing location to target alternate species, potentially navigating nearly 18º of latitude or about 1,000 nm (i.e. the whole Queensland east coast). Over these large distances, it is expected that only a few species resistant to desiccation could remain viable and be capable of colonising a site outside of their distribution. Coles *et al.* (1987) suggested that temporary establishment of some species (e.g. seagrass) may occur as a result of being carried on trawl ground tackle. However, for a species to persist at a new site, environmental conditions must be favourable. There are no data to suggest that this occurs even in larger trawl fisheries like the ECOTF, which has many more boats actively fishing and therefore a much greater number of opportunities for species to be moved considerable distances and possibly on occasions too locations outside their native range.

On the basis of the information given above, the Workshop considered that while it was likely that most species would not translocate over large distances and persist in the environment outside their native range, there was some indication that at least on a temporary basis, species could occasionally be established outside their native range but that an inability to adapt to altered environmental conditions would cause the decline of these species in the long term. Consequently it was considered that there was only a remote likelihood that translocation in this fishery was facilitating the occurrence of new species outside their historical range.

ERA Risk Rating: Impact on the Ecosystem (*C3 L1 Low*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Impacts on the abiotic environment

Air Quality
The Workshop considered that compared to the total number of commercial non-fishing vessels (including ships, barges, dredges and launches) and recreational vessels (including speedboats and personal watercraft) plying Gulf coastal waters, Queensland Gulf fisheries in general would have a negligible impact upon local air quality.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Debris

Pollution by deliberately disposing of solid non-degradable waste in Australian marine waters is strictly controlled by the International Convention for the Prevention of Pollution from Ships (known as MARPOL 73/78) and in Queensland coastal waters by the Queensland *Transport Operations (Marine Pollution) Act 1995* (see General Ecosystem Impacts in the L4/L5 Line fishery assessment for details).

All solid non-degradable waste is stowed and disposed of in port at Karumba or Weipa. Given the penalty provision that apply to offences under both Commonwealth and Queensland legislation, the Workshop considered that in view of the substantial penalty provisions for non-compliance, compliance was likely to be high. In addition, the Workshop considered that the impact of dumping biodegradable material at sea was considered to be localised and not measurable at the scale of the total fishery area.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No further specific management actions are proposed at this time.

Oil Discharge

MARPOL regulations apply to all the Queensland Gulf fisheries that prohibit the discharge of oily mixtures into the sea in Australian waters (AMSA 2005). Within 3nm of the coastline the *Transport Operations (Marine Pollution) Act 1995* and regulations protect Queensland's marine and coastal environment by minimising deliberate and negligent discharges of ship-sourced pollutants into coastal waters. It is an offence to deliberately discharge garbage, oil and chemicals into the marine environment and severe penalties apply (MSQ 2005).

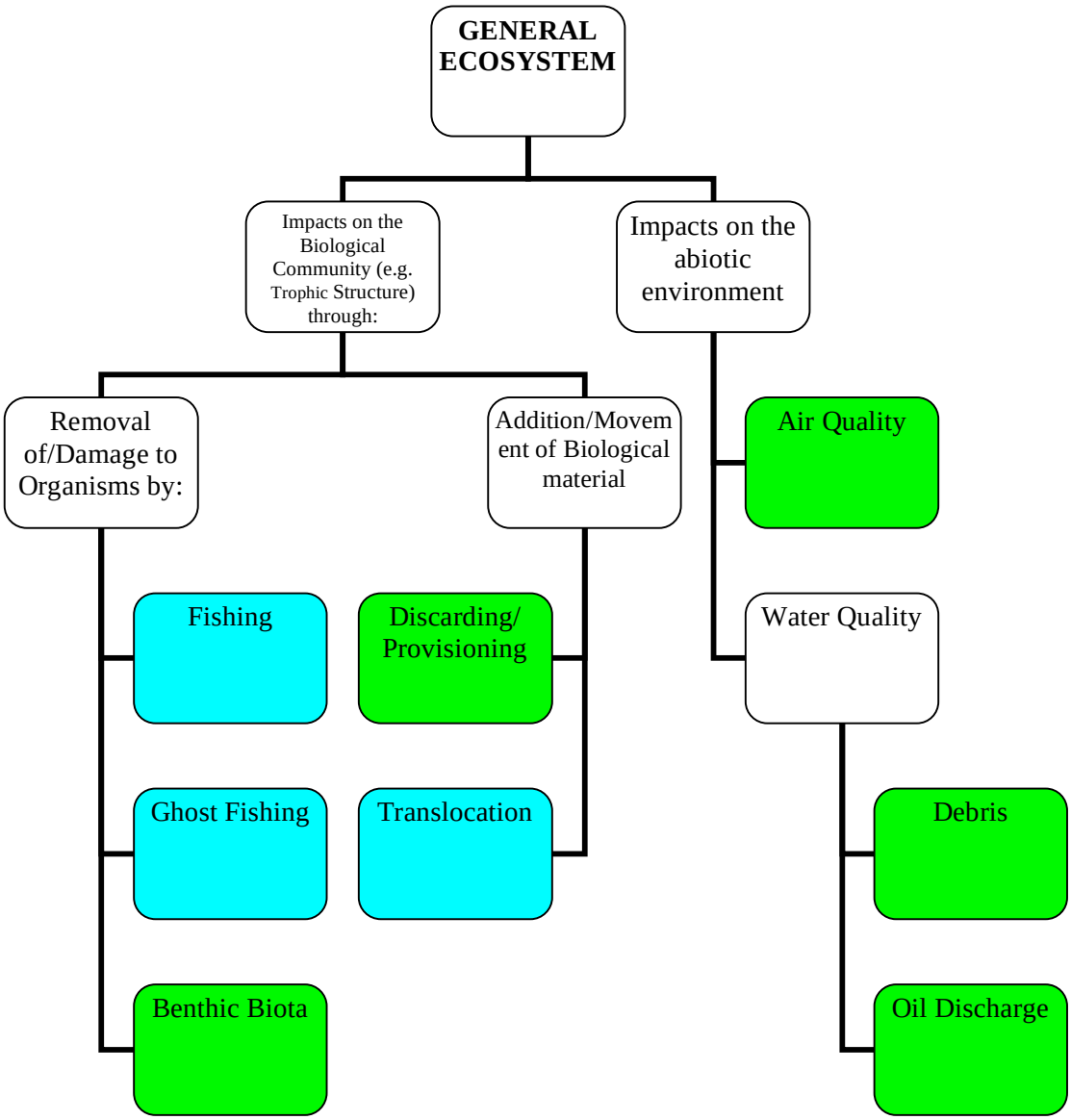
The Workshop considered oil pollution not to be a significant problem in the fishery. Waste oil and oily water generated during fishing operations is managed appropriately onboard in accordance with the respective Commonwealth and Queensland laws. Vessels discharge in ports with facilities designed to receive this waste, e.g. Weipa and Karumba.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No further specific management actions are proposed at this time.

Component Tree for General Ecosystem impacts in the N9 Offshore Net Fishery



Trophic Level Interactions

Removal of/ damage to organisms by fishing

The total average annual catch of shark, grey mackerel and other species in the N9 fishery was about 650 t in 2001/02. The harvested catch is made up of about 90% shark and grey mackerel in approximately equal amounts and 10% of other species mainly other mackerel species, trevally and snappers (Roelofs 2003). The Workshop considered that overall the relative impact on the ecosystem was low and either at or below risk levels for these species in similar northern Australian commercial fisheries (for details see below).

ERA Risk Rating: Impact on the Ecosystem (*C1 L3 Low*)

Sharks
In comparison to other northern Australian fisheries targeting shark, the N9 fishery harvest is somewhat lower.[25] However, when combined with the shark catch from the N3 fishery, the Queensland Gulf shark catch is at a level similar to that of other lower catch shark fisheries. For example in 2002/03 the Western Australian North Coast Shark Fishery and the Western Australian managed part of the Joint Authority Northern Shark Fishery had a combined shark catch of similar species of about 470 tonnes.[26]

Based on the similar characteristics of the Queensland Gulf and northern Western Australian shark fisheries in terms of catch level and the species landed, it is considered that impacts on the ecosystem of the Queensland Gulf net fisheries with respect to sharks will also be similar. Gaughan *et al*. (2005) reported that the northern Western Australian shark fisheries take a relatively small amount of catch. The catch is spread across a large number of species, each of which has a wide diet. Therefore the fishery is considered to be having only a negligible effect on trophic interactions within the region. Based on this analogy, the Queensland Gulf net fisheries are likely to be having a similar level of impact, consequently it is considered the N9 and N3 combined are having a negligible impact on trophic interactions within the Queensland Gulf region.

In addition, recreational and indigenous shark catches in the Gulf are uncertain based on the available data,[27] but when considered together their combined removals may comprise a significant part of the shark harvest.

Grey Mackerel
In comparison to other commercial northern Australian fisheries reporting grey mackerel landings, the N9 fishery harvest (about 370 t in 2003)[28] is considerably lower than the Northern Territory catch (about 770 tonnes in 2003, up from 480 tonnes in 2002)[29] but higher than Western Australian commercial fishery landings of only 30 t/ year (Penn *et al*. 2005). Using the Western Australian fisheries taking grey mackerel as reference points, it appears that there is a negligible to low risk to the sustainability of the ecosystems supporting grey mackerel catches in these fisheries (Mackie and Kennedy 2005; Gaughan *et al*. 2005).

Other species
Other mackerel (Scombridae), trevally (Carangidae) and snappers (Lutjanidae) make up almost all the byproduct species in the N9 harvest (Roelofs 2003). In 2003, Queensland Gulf net catches for these species were in the order of 20 t of Spanish mackerel (*Scomberomorus commerson*) and negligible quantities of trevally and snappers (DPI&F 2005*a*). Compared to the L4/L5 fishery, the Spanish mackerel catch in the Gulf net fishery is negligible (only about 10% of the L4/L5 Spanish mackerel

[25] The Northern Territory shark catch in 2003 was 898 tonnes (McKey and Buckworth 2004)
[26] The combined N3 and N9 shark catch in 2003 was 420 t (Gribble *et al.* 2004)
[27] Catch data reported in Lyle *et al*. 2003 and in Coleman *et al.* 2003
[28] Total Queensland Gulf commercial net harvest (DPIF 2005a)
[29] Catches in both years were higher than historical levels (McKey and Buckworth 2004)

catch). Higher quantities of this species removed from by the L4/L5 fishery, are not expected to have a significant impact on the ecosystem (for details see the assessment of General Ecosystem Impacts in the L4/L5 Line Fishery).

Bycatch
With the exception of sawfishes and bottlenose dolphins, the N9 fishery is having only a negligible impact on bycatch species populations (for details see the assessment of Non-Retained Species in this fishery). Where the fishery impact on bycatch populations is negligible, it follows that the level of impact on the trophic interactions involving these species should also be negligible.

While the Workshop considered the fishery impact on sawfish was currently low risk to their sustainability, the levels of impact on the ecosystem due to their removal in terms of trophic interactions is more uncertain. Information received subsequent to the Workshop, in a risk assessment of sawfish catches in the north Western Australian mesh net fishery (Newman and Harvey 2005), indicates sawfish are at low risk at low levels of net fishing effort. However, the effort in the Queensland Gulf net fishery appears to be substantially higher than in the Western Australian fishery, suggesting that consideration be given to reviewing the risk rating attributed to N9 fishery impacts on sawfish populations and thus the trophic interactions involving sawfish.

Proposed Management Actions
Since the Workshop, advice has been received that the risk ratings for interactions with sharks, grey mackerel and sawfish in the N9 fishery may need to be reassessed (Dr. S. Griffith, CSIRO, *pers. comm*., 2005). As part of the impending review of the fishery management arrangements under the *Fisheries (Gulf of Carpentaria Inshore Finfish) Management Plan 1999*, the DPI&F will consider reviewing the risk ratings attributed to N9 fishery impacts on these species and thus the trophic interactions involving these species.

<u>Removal of/ damage to organisms by ghost fishing</u>
Nets are lost occasionally in the N9 fishery, particularly during adverse weather conditions. Some fishers have recently started using bigger floats to enhance the chance of finding lost nets. Most of the net found on Gulf beaches is from foreign fishing fleets and cannot be attributed to abandonment in this fishery (see the assessment of General Ecosystem Impacts in the Fish Trawl Fishery for details).

Notwithstanding the prevalence of discarded foreign fishing nets, the Workshop considered:

- the higher participation in the fishery compared to the GOCDFTF, and hence higher potential for net loss than in the N9 fishery and
- a potential for mesh nets to catch more fish when fishing passively than trawl nets,

and concluded that the impact on the structure and functioning of the ecosystem from net loss in the N9 fishery could be more significant than might occur from net loss in the GOCDFTF. However, the greater level of impact on the ecosystem was no more than a remote possibility due to fisher intervention in making nets more visible and recoverable by the attachment of bigger floats. The risk of net loss in the N9 fishery to the ecosystem is therefore considered to be low and at a similar risk level to net loss in

the GOCDFTF (see the assessment of General Ecosystem Impacts in the Fish Trawl Fishery for details).

ERA Risk Rating: Impact on the Ecosystem (*C1 L4 Low*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Removal of/ damage to benthic biota
Nets are surface set and anchored to a mud bottom. Nets only interact with seabed biota in depths less than 12 metres (the maximum drop of nets used in the fishery). Offshore waters reach about 50 m in depth. Only a small percentage of nets set would have contact with the seabed in areas inshore of the inshore (7 nm from the coast) boundary of the fishery. The Workshop considered within the whole N9 fishery area, it was unlikely that mesh nets were having a significant impact on benthic habitats or populations of benthic species. Consequently the risk to the ecosystem was considered to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Addition/ movement of biological material

Discards Provisioning
Discards make up about 10-15% of the total catch by number or 5% of the catch by weight (about 32 t/ year). Relatively small quantities such as this discarded in remote offshore areas are not considered to provide an additional food source to many species with the exception of sharks and dolphins. The Workshop considered that the relatively low discarding rate in the N9 fishery compared to other Gulf fisheries (see assessments of General Ecosystem Impacts for the other fisheries for details), was unlikely to have a measurable impact on the populations of species consuming the discards over the background variability expected in the abundance of these species. Consequently the risk to the ecosystem was considered to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Translocation
It is unlikely that long distance translocation of biological material exists in the fishery. Almost all N9 vessels operate and remain within Gulf waters during and in between fishing operations. While translocation may cause the incidence of species outside their historical range, given the strong tendency for N9 vessels to remain within the fishery area, the Workshop considered that there was only a remote likelihood this would occur in the N9 fishery and consequently the risk to the integrity of the ecosystem was considered to be low.

ERA Risk Rating: Impact on the Ecosystem (*C3 L1 Low*)

Proposed Management Actions
No specific management actions are proposed.

Impacts on the abiotic environment

Air Quality
The Workshop considered that compared to the total number of commercial non-fishing vessels (including ships, barges, dredges and launches) and recreational vessels (including speedboats and personal watercraft) plying Gulf coastal waters, Queensland Gulf fisheries in general would have a negligible impact upon local air quality.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Debris
Pollution by deliberately disposing of solid non-degradable waste in Australian marine waters is strictly controlled by the International Convention for the Prevention of Pollution from Ships (known as MARPOL 73/78) and in Queensland coastal waters by the Queensland *Transport Operations (Marine Pollution) Act 1995* (see General Ecosystem Impacts in the L4/L5 Line fishery assessment for details).

All solid non-degradable waste is stowed and disposed of in port at Karumba or Weipa. Given the penalty provision that apply to offences under both Commonwealth and Queensland legislation, the Workshop considered that in view of the substantial penalty provisions for non-compliance, compliance was likely to be high. In addition, the Workshop considered that the impact of dumping biodegradable material at sea was considered to be localised and not measurable at the scale of the total fishery area.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No further specific management actions are proposed at this time.

Oil Discharge
MARPOL regulations apply to all the Queensland Gulf fisheries that prohibit the discharge of oily mixtures into the sea in Australian waters (AMSA 2005). Within 3nm of the coastline the *Transport Operations (Marine Pollution) Act 1995* and regulations protect Queensland's marine and coastal environment by minimising deliberate and negligent discharges of ship-sourced pollutants into coastal waters. It is an offence to deliberately discharge garbage, oil and chemicals into the marine environment and severe penalties apply (MSQ 2005).

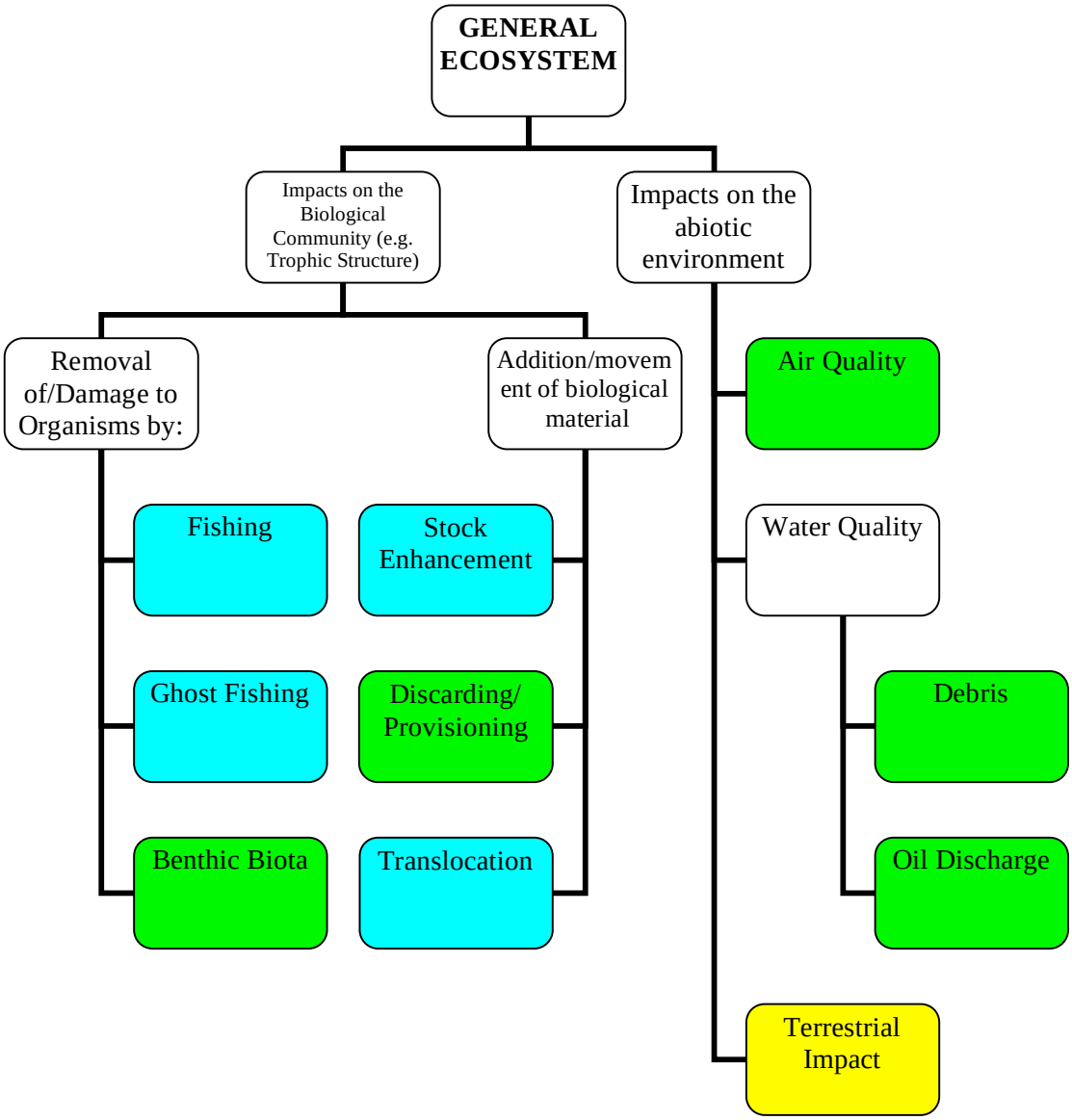
The Workshop considered oil pollution not to be a significant problem in the fishery. Waste oil and oily water generated during fishing operations is managed appropriately onboard in accordance with the respective Commonwealth and Queensland laws.

Vessels discharge in ports with facilities designed to receive this waste, e.g. Weipa and Karumba.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Component Tree for General Ecosystem impacts in the N3 Inshore Net Fishery



Trophic Level Interactions

Removal of/ damage to organisms by fishing

Given that current and proposed management of N3 fishery retained species is commensurate with the relative risk to their sustainability after all fishery related impacts within their northern Australian distributions are taken into account, the Workshop considered that overall, the effect of the N3 fishery on its retained species was relatively low and that it was only possible that harvesting at current levels was causing changes to the relative abundance of these and dependent or competing species. Similar to retained species, the Workshop considered that the low level of bycatch in the fishery was also unlikely to cause a major change in their relative abundance (for details see below).

ERA Risk Rating: Impact on the Ecosystem (*C1 L4 Low*)

Retained Species
The annual N3 fishery harvest is about 1,500 tonnes (Roelofs, 2003). In 2003, the harvest of the major retained species appears to have increased slightly, to about 1,700 tonnes (DPI&F 2005*a*). Estimated indicative annual landings from the N3 fishery and landings of these species in other northern Australian commercial fisheries are summarised in Table 4. These data demonstrate that the N3 fishery landings of retained species are at or below the harvest levels of these species in other northern Australian fisheries. The level of ecological impact is likely to be commensurate with the level of their removal of these species.

For example, the 2003 commercial barramundi harvest from the Northern Territory was about one-quarter higher than the Queensland Gulf barramundi harvest. The Northern Territory fishery is regarded to be well within its estimated range of overall sustainable harvest levels (O'Grady and de Lestang 2004). The Workshop noted that Queensland Gulf barramundi stocks are currently being harvested at sustainable levels. It is therefore likely that current management is effective in ensuring that long-term recruitment and natural dynamics of the Gulf barramundi stock (e.g. seasonal flood-cued spawning) are largely unaffected by the fishery (see assessment of Retained Species in the N3 Inshore Net Fishery). While the fishery harvest of barramundi remains at sustainable levels the effect of their removal[30] from the ecosystem is also considered to be sustainable.

For retained species with substantial harvests occurring in the N3 fishery and other northern Australian commercial fisheries (e.g. sharks, guitarfish and rays, grey mackerel and threadfins), the possibility of a significant ecological impact due to their removal is reflected in the risk levels assigned these species at the Workshop (see the respective N3 and N9 retained species assessments for risk levels associated with the harvest of these species).

Other retained species taken in minor quantities in the N3 fishery, but in much higher quantities in other northern Australian commercial fisheries, for example, black jewfish (Table 4), are considered to have a low risk to their sustainability within the Queensland Gulf, and therefore are unlikely to cause ecosystem dysfunction by their removal at current harvesting levels in the N3 fishery.

For other N3 retained species with emerging information indicating that stocks may need an increasing management focus (e.g. grunters and queenfish), the DPI&F proposes to consider the issues relevant to each species and ascertain whether the current risk rating needs to be reviewed and further management considered.

[30] Controlled by appropriate minimum and maximum legal lengths, recreational bag limits and seasonal spawning closures

Table. Indicative annual commercial landings (tonnes) of major species retained in the fishery, 2002 - 2003

Species	N3/Qld Gulf* (incl. N9 landings)	Northern Territory**	Western Aust.***
Barramundi	500/500	700	50
Threadfins	400/400	450	150
Sharks, guitarfish, Sawfish and rays	200/400	900	500
Grunter	20/40	?	10
Grey mackerel	80/500	800	25
Jewelfish and black jewfish	50/50	150	5
Queenfish	20/20	?	1
Spanish mackerel	20/200	350	500

Data sources: * DPI 2005*a*; ** Northern Territory Fishery Status Reports 2003 at http://www.fisheries.nt.gov.au; *** Penn *et al.* 2005

There are a number of species retained species in the N3 fishery ecosystem with similar dietary requirements of fish and prawns. There appears to be considerable predator redundancy among the higher trophic levels of the N3 fishery ecosystem and strong interspecific competition for prey. Juveniles of the retained species are consumed by other predatory fish, birds and crocodiles, so maintenance of their relative abundance is largely mediated during early ontogenetic development by non-fishery drivers. The current management arrangements for these species each seek to minimise the negative effects of fishing on the respective breeding adult stocks, ultimately ensuring that fish populations are sustainable and that trophic relationships among the retained and non-retained species in the fishery ecosystem are maintained.

Non-Retained Species

The Workshop considered that for turtles, whales, dolphins and seabirds the N3 fishery is having only a negligible impact on bycatch species populations (for details see the assessment of Non-Retained Species in this fishery). Where the fishery impact on non-retained populations is negligible, it follows that the level of impact on the trophic interactions involving these species should also be negligible. The Workshop also considered that there was only a slightly greater risk to the sustainability of dugong and crocodiles and other finfish bycatch in the N3 fishery (see assessment of Non-Retained Species in this fishery).

It concluded that due to the relatively low levels of interaction and the unique trophic status of dugong and crocodiles (i.e. grazing herbivore and top order predator) there was no more than only a possibility that the fishery was causing more than minor changes in the relative abundance of other ecosystem components. Similarly, it was

concluded that due to the relatively low bycatch of non-retained finfish species in the fishery (see assessment of Non-Retained Species in this fishery), there was no more than only a possibility that the fishery was causing more than minor changes in the relative abundance of other dependent species and competing species.

Overall, given the management actions proposed to address sustainability issues for lower risk non-retained species and for sawfishes and speartooth sharks (see assessment of Non-Retained Species in this fishery), the impact of the current level of interaction with the fishery was unlikely to cause a major change in ecosystem function.

Proposed Management Actions
Management actions are as proposed (for details see the assessment of Non-Retained Species in this fishery).

An interesting theory was put forward at the Workshop regarding possible predatory release of catfish populations due to barramundi removal. Since the Workshop, there has been no subsequent validation of this supposed relationship by the proponent. Further follow up at the expense of managing higher risk issues in the fishery (see assessments of Retained and Non-Retained Species) in the short to medium term would appear unlikely.

Removal of/ damage to organisms by ghost fishing
The impact of lost nets depends on where they are lost. In offshore waters, nets will fish for a short time before either being rolled up by water currents or they get destroyed by predators. Nets lost in inshore waters tend to beach themselves and become entangled in mangroves. All lost nets will fish for a time, but the loss of nets is uncommon in the N3 fishery. Problems associated with washed up nets used by foreign fleets is widely recognised throughout northern Australia and has been the focus of a recent NHT funded project to locate and remove derelict fishing gear from Gulf beaches. Discarded nets from the N3 fishery pose only a minor consequence of localised depletion - not a stock level depletion.

The Workshop considered that derelict fishing nets were not a serious threat, to the extent that there was no more than only a possibility that the fishery was having more than a minor effect on the relative abundance of ecosystem components.

ERA Risk Rating: Impact on the Ecosystem (*C1 L4 Low*)

Proposed Management Actions
An issue of other sectors using lost nets is a separate issue and may need to be assessed in an appropriate manner by the relevant levels of government.

Removal of/ damage to benthic biota
N3 nets are top set, with minimal impact on the seabed. Some minor impact to mangroves may occur through the practice of tying off net ends and boats used to manage the net. The Workshop considered the impact of these activities and netting operations in general were unlikely to have anything other than a negligible impact on benthic biota and marine habitats.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Addition/ movement of biological material

Stock Enhancement
An estimated 100,000 fingerlings are released each year into Queensland tropical rivers, including streams emptying into the Gulf. Broodstock are sourced from the same rivers as those to be stocked. Expert guidance in the selection of the stocking sites is provided by DPI&F scientific staff. About 60% of fingerlings are put into rivers and 40% into impoundments. Fish are not marked as artificially reared. Queensland east coast trials suggest 1 in 10-20 barramundi caught may be stocked (R. Garrett, DPI&F, *pers. comm*. 2004). This can be a significant contribution to the total catch, recognising the numbers stocked. Gulf stocked fish are probably making a lower contribution to the catch than on the east coast. Stocking by local groups is undertaken according to their stocking schedule/management plans. There is no indication that wild barramundi stocks have declined in stocked rivers.

The Workshop considered that given the rigorous DPI&F field trials to assess stock suitability and current safeguards regarding appropriate genetic stock selection and release sites, it was expected that only in exceptional circumstances would the ecosystem be altered to the extent that stocking may cause a disease outbreak among wild populations or genetic variant to displace the native stock.

ERA Risk Rating: Impact on the Ecosystem (*C3 L2 Low*)

Proposed Management Actions
DPI&F will ensure that hatchery and stocking management protocols currently in place will be maintained to minimise genetic distortion and disease risks to wild fish stocks.

Discards Provisioning
The N3 fishery is similar to N9 offshore fishery in terms of the relatively low quantity of bycatch discarded (see assessment of General Ecosystem Impacts for the N9 fishery for details). About 170 t (or 13% by number) of the catch is discarded (Halliday *et al.* 2001). Most discards are consumed by catfish, crocodiles, sharks and other marine predators.

Because the discarding rate is quite low, the Workshop considered that the N3 fishery was unlikely to have a measurable impact on the populations of species consuming the discards over the background variability expected in the abundance of these species. Consequently the risk to the ecosystem was considered to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Translocation
Little likelihood of long distance translocation of biological material exists in the N3 fishery. Almost all N3 vessels operate and remain within Gulf waters during and in between fishing operations. While translocation may cause the incidence of species outside their historical range, given the strong tendency for N3 vessels to remain within the fishery area, the Workshop considered that there was only a remote likelihood this would occur and consequently the risk to the integrity of the ecosystem was considered to be low.

ERA Risk Rating: Impact on the Ecosystem (*C3 L1 Low*)

Proposed Management Actions
No specific management actions are proposed.

Impacts on the abiotic environment

Air Quality
The Workshop considered that compared to the total number of commercial non-fishing vessels (including ships, barges, dredges and launches) and recreational vessels (including speedboats and personal watercraft) plying Gulf coastal waters, Queensland Gulf fisheries in general would have a negligible impact upon local air quality.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Debris
Pollution by deliberately disposing of solid non-degradable waste in Australian marine waters is strictly controlled by the International Convention for the Prevention of Pollution from Ships (known as MARPOL 73/78) and in Queensland coastal waters by the Queensland *Transport Operations (Marine Pollution) Act 1995* (see General Ecosystem Impacts in the L4/L5 Line fishery assessment for details).

All solid non-degradable waste is stowed and disposed of in port at Karumba or Weipa. Given the penalty provision that apply to offences under both Commonwealth and Queensland legislation, the Workshop considered that in view of the substantial penalty provisions for non-compliance, compliance was likely to be high. In addition, the Workshop considered that the impact of dumping biodegradable material at sea was considered to be particularly localised and not measurable at the scale of the total fishery area.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Oil Discharge

MARPOL regulations apply to all the Queensland Gulf fisheries that prohibit the discharge of oily mixtures into the sea in Australian waters (AMSA 2005). Within 3nm of the coastline the *Transport Operations (Marine Pollution) Act 1995* and regulations protect Queensland's marine and coastal environment by minimising deliberate and negligent discharges of ship-sourced pollutants into coastal waters. It is an offence to deliberately discharge garbage, oil and chemicals into the marine environment and severe penalties apply (MSQ 2005).

The Workshop considered oil pollution not to be a significant problem in the fishery. Waste oil and oily water generated during fishing operations is managed appropriately onboard in accordance with the respective Commonwealth and Queensland laws. Vessels discharge in ports with facilities designed to receive this waste, e.g. Weipa and Karumba.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No specific management actions are proposed.

Terrestrial Impact

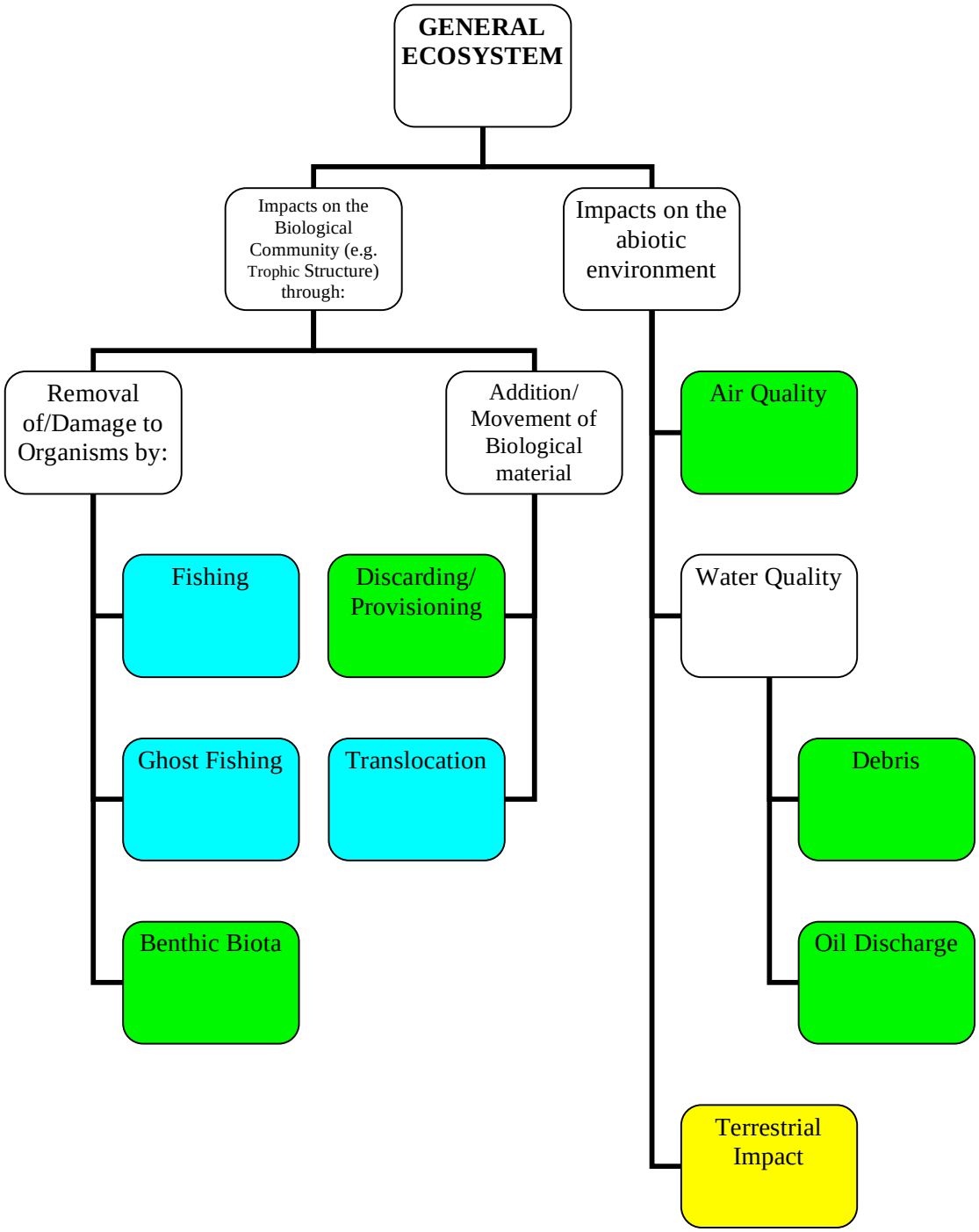
Some land camps used by N3 fishers are well maintained and some are not. This is a visual amenity consequence rather than an ecological one, but has been included in this assessment as it generated some concern at the Workshop. It was argued that at least within the local environs, there could be measurable changes to ecosystem components due to human impact. The Workshop agreed there was adequate anecdotal information to suggest that a moderate risk rating on this issue was appropriate.

ERA Risk Rating: Impact on the Ecosystem (*C3 L3 Moderate*)

Proposed Management Actions

This issue is not managed by the DPI&F. No specific fishery management actions are proposed.

Component Tree for General Ecosystem impacts in the Crab Pot Fishery



Trophic Level Interactions

Removal of/ damage to organisms by fishing

At least 75% of the Queensland mud crab population is not harvested (M. Doohan, DPI&F, *pers. comm*., 2004). Assuming an even gender ratio and that all female crabs and all crabs below the legal carapace width (LCW) are returned to the water alive, only half of one half of the available fishable stock (i.e. only males at or above the LCW are harvested. The Workshop considered that displacement of, or damage to the major part of the catch returned to the water, was likely to be minimal with only minor changes in the relative abundance of predator, dependent or competing species expected.

ERA Risk Rating: Impact on the Ecosystem (*C1 L3 Low*)

Proposed Management Actions

No specific management actions are proposed.

Removal of/ damage to organisms by ghost fishing

Based on research into ghost fishing in the Queensland blue swimmer crab fishery, there is a risk that crab pots retain incidental catch after being lost although the bait may have been eaten (Sumpton *et. al.* 2003). However, fishers report that few pots are lost in the commercial fishery. The incidence of lost pots in the recreational fishery is unknown and needs assessment. The Workshop considered that due to the reported low rate of pot loss in the fishery, there was only a slight possibility that lost pots in the commercial fishery were having anything more than a minor impact on the relative abundance of captured species or other associated ecosystem components.

ERA Risk Rating: Impact on the Ecosystem (*C1 L4 Low*)

Proposed Management Actions

The Workshop identified the following information needs to better define the extent of mud crab pot loss and ghost fishing in the Queensland Gulf:

- assess the level of the recreational pot loss and
- ascertain the relative incidence of pot loss compared to pot theft.

The Workshop also considered incorporating technological improvements to pot design (e.g. a biodegradable exit panel), that would minimise fishing efficiency of unattended pots over the long-term.

Removal of/ damage to benthic biota

Benthic impacts in the Queensland Gulf mud crab fishery was not discussed at the Workshop, but crab pots are static fishing gear and are not considered by DPI&F to have a significant impact on typically muddy bottom estuaries. The physical impact of a pot resting temporarily on estuarine sediments upon the ecosystem is considered to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No specific management actions are proposed.

Addition/ movement of biological material

Discards Provisioning

Mud crabs are detritivores, one of a number of such species processing organic matter in mangrove-dominated tropical estuarine communities. Mud crabs are preyed on by large predatory fishes (notably sharks), which are significant components of the N3 and N9 fishery catches. There is some spatial separation between inshore and offshore shark species that prey on mud crabs. Therefore their removal is more likely to affect the inshore species and less likely to impact upon shark species retained only in the N9 offshore net fishery.

Given that three-quarters of the mud crab catch is returned to the water alive (see assessment of Removal of/ damage to organisms by fishing in this fishery), the impact of removal of one-quarter of the fishable stock upon inshore sharks (which are themselves removed by the N3 fishery), was considered by the Workshop to be insignificant and not measurable against natural variability ion their populations.

Uneaten bait discarded from crab pots is consumed by marine scavengers and detritivores (including mud crabs, fish and prawns). Live undersized and female crabs are discarded into generally shallow turbid water, where their ability to hide from most predators and survival is expected to be high. The Workshop considered that the impact on the ecosystem of discarding this part of the catch to the water alive soon after capture, was likely to be negligible.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No specific management actions are proposed.

Translocation

Little likelihood exists of long distance translocation of biological material outside its native distribution within the fishery area. Most boats operate and remain within Gulf waters, with harvest product being air or road freighted to southern markets. Some crabbers are based on the Queensland east coast and move live crabs to market in Cairns. This may increase slightly the possibility of mud crab translocations to the east coast. For other species incidentally brought onboard during a pot lift, under normal operating conditions the likelihood of successful translocation would seem to be remote because of the long distances and transit times involved and the expected low potential of translocated species to withstand desiccation within stowed crab pots and then successfully adapt to new environmental conditions if pots were then deployed on the east coast.

The Workshop considered that it was only a remote possibility that translocation of viable biological material from Gulf pot captures would lead to permanent establishment of a species on the east coast and outside its native range.[31]

ERA Risk Rating: Impact on the Ecosystem (*C3 L1 Low*)

Proposed Management Actions
No specific management actions are proposed.

Impacts on the abiotic environment

Air Quality
The Workshop considered that compared to the total number of commercial non-fishing vessels (including ships, barges, dredges and launches) and recreational vessels (including speedboats and personal watercraft) plying Gulf coastal waters, Queensland Gulf fisheries in general would have a negligible impact upon local air quality.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

Debris
Pollution by deliberately disposing of solid non-degradable waste in Australian marine waters is strictly controlled by the International Convention for the Prevention of Pollution from Ships (known as MARPOL 73/78) and in Queensland coastal waters by the Queensland *Transport Operations (Marine Pollution) Act 1995* (see General Ecosystem Impacts in the L4/L5 Line fishery assessment for details).

All solid non-degradable waste is stowed and disposed of in port at Karumba or Weipa. Given the penalty provision that apply to offences under both Commonwealth and Queensland legislation, the Workshop considered that in view of the substantial penalty provisions for non-compliance, compliance was likely to be high. In addition, the Workshop considered that the impact of dumping biodegradable material at sea was considered to be reasonably localised and not measurable at the scale of the total fishery area.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions
No specific management actions are proposed.

[31] It is expected that a high proportion of Gulf species would have a natural range that extends to the tropical north east coast of Queensland

Oil Discharge

MARPOL regulations apply to all the Queensland Gulf fisheries that prohibit the discharge of oily mixtures into the sea in Australian waters (AMSA 2005). Within 3nm of the coastline the *Transport Operations (Marine Pollution) Act 1995* and regulations protect Queensland's marine and coastal environment by minimising deliberate and negligent discharges of ship-sourced pollutants into coastal waters. It is an offence to deliberately discharge garbage, oil and chemicals into the marine environment and severe penalties apply (MSQ 2005).

The Workshop considered oil pollution not to be a significant problem in the fishery. Waste oil and oily water generated during fishing operations is managed appropriately onboard in accordance with the respective Commonwealth and Queensland laws. Vessels discharge in ports with facilities designed to receive this waste, e.g. Weipa and Karumba.

ERA Risk Rating: Impact on the Ecosystem (*Negligible*)

Proposed Management Actions

No specific management actions are proposed.

Terrestrial Impact

Some land camps used by N3 fishers are well maintained and some are not. This is a visual amenity consequence rather than an ecological one, but has been included in this assessment as it generated some concern at the Workshop. It was argued that at least within the local environs, there could be measurable changes to ecosystem components due to human impact. The Workshop agreed there was adequate anecdotal information to suggest that a moderate risk rating on this issue was appropriate.

ERA Risk Rating: Impact on the Ecosystem (*C3 L3 Moderate*)

Proposed Management Actions

No specific management actions are proposed.

Future Directions

The results of this Ecological Risk Assessment (ERA) have been produced with the assistance of the Gulf of Carpentaria Management Advisory Committee (Gulf MAC) as an integral part of planning for the future sustainability of the Gulf fisheries managed by the Queensland Government. The outcomes of this ERA will provide the basis for future informed decision making by management, in addition to identifying those issues requiring better information to ensure sustainability.

The assessment undertaken in this report comprises Level 1 of the ecological risk assessment process recommended in the Ecological Risk Assessment for the Effects of Fishing: Final Report Stage 1 (Hobday 2004). Mitigation of risk to moderate to high risk groups in each fishery needs to be undertaken by way of management initiatives, or each at risk group be considered for further assessment, which may be a more tightly focused Level 2 semi-quantitative Productivity Susceptibility Analysis for species assemblages or fully quantitative "model-based" Level 3 population assessments for single species.

Sustainable Development Reference Systems for Queensland Gulf fisheries will be developed during 2006, making extensive use of authoritative scientific literature that describes theoretical frameworks and practical examples for their implementation. However, good information including the outcomes of this ERA, regular DPI&F quantitative stock assessments of higher risk species and data collected through the DPI&F Long Term Monitoring Program will also assist in the appropriate selection and application of objectives, indicators, performance measures and management responses for the Gulf fisheries and other Queensland fisheries.

With a strong Queensland Government focus and drive for sustainability, it is of growing concern that there is a general lack of information regarding illegal fishing activity and catches by foreign fishing vessels in northern Australian waters. The potential for effort from widely dispersed foreign fleets to target Australian fishery stocks may be significant when the large number of vessels is considered. An agreement is required to obtain illegal fishing enforcement data from Australian Government sources for the northern Australian Fishing Zone for stock sustainability assessment and reporting purposes. This will assist fishery management agencies and fishery stakeholders in putting into perspective, the magnitude of fishing impacts on fishery stocks from legal and non-legal sources.

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Appendix 1

DEH recommendations for ecological risk assessment of Queensland Gulf of Carpentaria fisheries under EPBC Act approvals

Fishery	DEH Recommendations	Delivery Date
Gulf of Carpentaria Developmental Finfish Trawl Fishery	DPI&F to implement appropriate management measures for species identified through the risk assessment as being high risk within 12 months of completion of the risk assessment.	31-Dec-05
Gulf of Carpentaria Inshore Finfish Fishery	Within 18 months, DPI&F to undertake a risk assessment, in conjunction with other relevant jurisdictions where possible, to identify target, byproduct and bycatch species most at risk from the fishery and areas at risk from overfishing. Actions seeking to reduce risk to be implemented as appropriate within a further 12 months (See Gulf line also).	31-Mar-06
Gulf of Carpentaria Line Fishery	Within 18 months, DPI&F to undertake a risk assessment, in conjunction with other relevant jurisdictions where possible, to identify target, byproduct and bycatch species most at risk from the fishery. Actions seeking to reduce risk to be implemented as appropriate within a further 12 months. (See Gulf Inshore also)	31-Mar-06
Queensland Mud Crab Fishery	DPI&F to conduct a risk assessment to determine the likely impact of protected species interactions in the fishery (including the recreational sector) within two years. In the event that a species is found to be at risk, DPI&F will investigate measures to mitigate interaction with the species, to ensure that any risks to protected species can be minimised.	30-Sep-06

Appendix 2

Participants in the Queensland Gulf of Carpentaria Commercial Fisheries Ecological Risk Assessment Workshop

NAME	EXPERTISE	AFFILIATION
Dr Rik BUCKWORTH	Acting Principal Research Scientist	Northern Territory Fisheries, DARWIN
Mr Russell BUTTERWORTH	Commercial Fisher	N9 Net Fishery
Mr Rick CROSSLAND	Commercial Fisher	N3 Net and Crab Fisheries
Mr Mark DOOHAN	Principal Fisheries Manager	DPI&F, BRISBANE
Dr Rick FLETCHER	Workshop Facilitator	FRDC – ESD Sub-Program Leader, Department of Fisheries, North Beach, WESTERN AUSTRALIA
Mr Rod GARRETT	Researcher	DPI&F, CAIRNS
Ms Sue GOULD	Community environmental interests	Weipa Catchment Co-ordinating Group Inc.
Dr Neil GRIBBLE	Researcher	DPI&F, CAIRNS
Dr Shane GRIFFITHS	Gulf Fisheries Researcher	CSIRO Marine Research, CLEVELAND QLD
Ms Sue HELMKE	DPI&F Longterm Monitoring Program	DPI&F, CAIRNS
Mr Greg HOWARD	Commercial Fisher	Gulf Line Fishery
Ms Frances HUMPHRIES	Gulf Fisheries Policy Officer	DPI&F, BRISBANE
Mr Bill NASON	Fishery Compliance	QBFP TOWNSVILLE
Mr Stephen PARKER	Recreational Fisher	Sunfish MAREEBA QLD
Mr Bill PASSEY	Commercial Fisher	Developmental Finfish Trawl Fishery
Mr Stirling PEVERELL	DPI&F Observer Program	DPI&F, CAIRNS
Mr Allan PHILLISKIRK	Operator	Charter Fishery, WEIPA
Dr Mark READ	Conservation Manager	EPA, CAIRNS
Mr Anthony ROELOFS	Assessment and Monitoring	DPI&F, CAIRNS
Mr Bob RUSSELL	Fishery Compliance	QBFP Weipa
Mr Steve SLY	NT Fisheries	Northern Territory Fisheries, DARWIN
Mr Jason STAPLEY	DPI&F Observer Program	DPI&F, CAIRNS
Mr Eddie WOODLEY	Indigenous interests	Chairperson Peninsula Regional Council, CAIRNS
Mr Brad ZELLER	Workshop Coordinator	DPI&F, BRISBANE

Appendix 3

Ecological Risk Assessment Consequence and Likelihood Criteria used in the assessment (from Fletcher *et al.* 2002).

Table A3.1 Consequence categories for the impact of a fishery on **Major Retained /Non-Retained Species**

Level	Ecological (Retained: target/Non-retained: major)
Negligible (0)	Insignificant impacts to populations. Unlikely to be measurable against background variability for this population.
Minor (1)	Possibly detectable, but minimal impact on population size and none on dynamics.
Moderate (2)	Full exploitation rate, but long-term recruitment/dynamics not adversely impacted.
Severe (3)	Affecting recruitment levels of stocks/or their capacity to increase.
Major (4)	Likely to cause local extinctions, if continued in longer term (i.e. probably requiring listing of species in an appropriate category of the endangered species list (e.g. IUCN category).
Catastrophic (5)	Local extinctions are imminent/immediate

Table A3.2 Consequence categories for the impact of a fishery on **By-Product Species/Minor Non-retained species**

Level	Ecological (RETAINED: By-product/Non-retained: other)
Negligible (0)	Area where fishing occurs is negligible compared to where the relevant stock of the species resides (< 1%)
Minor (1)	Take in this fishery is small (< 10%), compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small, compared to known area of distribution (< 20%).
Moderate (2)	Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits.
Severe (3)	No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species Relative levels of capture/susceptibility suspected/known to be greater than 50% and species should be examined explicitly
Major (4)	N/A Once a consequence reaches this point it should be examined using Table A1.
Catastrophic (5)	N/A (See Table A1).

Table A3.3 Consequence categories for the impact of a fishery on **protected species**.

Level	Ecological (RETAINED: By-product/Non-retained: other)
Negligible (0)	Almost none are impacted
Minor (1)	Some are impacted but there is no impact on stock
Moderate (2)	Levels of impact are at the maximum acceptable level
Severe (3)	Same as target species
Major (4)	Same as target species
Catastrophic (5)	Same as target species

Table A3.4 Consequence categories for the impact of a fishery on the **general ecosystem/trophic levels**.

Level	Ecological (ECOSYSTEM)
Negligible (0)	General - Insignificant impacts to habitat or populations, Unlikely to be measurable against background variability Ecosystem: Interactions may be occurring but it is unlikely that there would be any change outside of natural variation
Minor (1)	Ecosystem: Captured species do not play a keystone role – only minor changes in relative abundance of other constituents.
Moderate (2)	Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components).
Severe (3)	Ecosystem: Ecosystem function altered measurably and some function or components are locally missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Recovery measured in years.
Major (4)	Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture) Recovery period measured in years to decades.
Catastrophic (5)	Ecosystem: Total collapse of ecosystem processes. Long-term recovery period may be greater than decades.

Table A3.5 Consequence levels for the impacts of a fishery on **habitat**.

Level	Ecological (HABITAT)
Negligible (0)	Insignificant impacts to habitat or populations of species making up the habitat – probably not measurable levels of impact. Activity only occurs in very small areas of the habitat, or if larger area is used, the impact on the habitats from the activity is unlikely to be measurable against background variability. (Suggestion- these could be activities that affect < 1% of original area of habitat or if operating on a larger area, have virtually no direct impact)
Minor (1)	Measurable impacts on habitat(s) but these are very localised compared to total habitat area. (Suggestion – these impacts could be < 5% of the original area of habitat)
Moderate (2)	There are likely to be more widespread impacts on the habitat but the levels are still considerable acceptable given the % of area affected, the types of impact occurring and the recovery capacity of the habitat. (Suggestion – for impact on non-fragile habitats this may be up to 50% [similar to population dynamics theory] - but for more fragile habitats, to stay in this category the percentage area affected may need to be smaller, e.g. 20%)
Severe (3)	The level of impact on habitats may be larger than is sensible to ensure that the habitat will not be able to recover adequately, or it will cause strong downstream effects from loss of function. (Suggestion - Where the activity makes a significant impact in the area affected and the area > 25 - 50% [based on recovery rates] of habitat is being removed)
Major (4)	Substantially too much of the habitat is being affected, which may endanger its long-term survival and result in severe changes to ecosystem function. (Suggestion this may equate to 70 - 90% of the habitat being affected or removed by the activity)
Catastrophic (5)	Effectively the entire habitat is in danger of being affected in a major way/removed. (Suggestion: this is likely to be in range of > 90% of the original habitat area being affected).

Table A3.6 Likelihood Definitions

Level	Descriptor
Likely	It is expected to occur
Occasional	May occur
Possible	Some evidence to suggest this is possible here
Unlikely	Uncommon, but has been known to occur elsewhere
Rare	May occur in exceptional circumstances
Remote	Never heard of, but not impossible

Table A3.7 Risk Matrix

Risk Matrix

		Consequence					
		Negligible	**Minor**	**Moderate**	**Severe**	**Major**	**Catastrophic**
Likelihood		0	1	2	3	4	5
Remote	1	0	0	0	1	1	2
Rare	2	0	1	1	2	2	2
Unlikely	3	0	1	2	2	2	3
Possible	4	0	1	2	3	3	4
Occasional	5	0	1	2	3	3	4
Likely	6	0	1	2	3	4	4

Table A3.8 Risk Matrix

Risk Ranking Outcomes

RISK	**Likely Management Response**		**Reporting**
Negligible	0	Nil	Short Justification Only
Low	1	None Specific	Full Justification needed
Moderate	2	Specific Management Needed	Full Performance Report
High	3	Possible increases to management activities needed	Full Performance Report
Extreme	4	Likely additional management activities needed	Full Performance Report

Appendix 4

Indicative annual catches of target and byproduct species in the Queensland Gulf Finfish Trawl Fishery and other northern Australian commercial fisheries

Species	Fishery	Estimated Catch (tonnes)
Crimson snapper[#]	Western Australia Pilbara Finfish Trawl[§]	280
	Northern Territory Finfish Trawl*	150
	Queensland Finfish Trawl**	**70**
	Western Australia Pilbara Trap[§§]	40
	Northern Territory Timor Reef Line and Trap[$]	20
	Northern Territory Demersal Line and Trap[$$]	5
	Queensland Line (L4/L5)****	2
	Queensland Offshore Net (N9)	1
	Northern Prawn Fishery***	<1
Saddletail snapper[#]	Northern Territory Finfish Trawl	630
	Western Australia Pilbara Finfish Trawl	80
	Queensland Finfish Trawl	**70**
	Western Australia Northern Demersal Line and Trap[§§§]	60
	Northern Territory Timor Reef Line and Trap	30
	Western Australia Pilbara Trap	10
	Northern Prawn Fishery	<1
Goldband Snapper[##]	Northern Territory Timor Reef Line and Trap	300
	Western Australia Northern Demersal Line and Trap	150
	Western Australia Pilbara Finfish Trawl	100
	Northern Territory Demersal Line and Trap	70
	Western Australia Pilbara Trap	40
	Northern Territory Finfish Trawl	30
	Queensland Finfish Trawl	**10**
Red Emperor[#]	Western Australia Northern Demersal Trap and Line	100
	Western Australia Pilbara Finfish Trawl	80
	Western Australia Pilbara Trap	40
	Northern Territory Timor Reef Line and Trap	40
	Northern Territory Demersal Line and Trap	5
	Western Australia Snapper Line	5
	Northern Territory Finfish Trawl	5
	Queensland Finfish Trawl	**2**
	Queensland Line (L4/L5)	**1**
	Northern Prawn Fishery	<1
Red Spot Emperor[#]	Northern Territory Finfish Trawl	30
	Queensland Finfish Trawl	**10**
	Northern Territory Timor Reef Line and Trap	2
Other Emperors[#]	Western Australia Pilbara Trap	60
	Western Australia Northern Demersal Trap and Line	40
	Western Australia Pilbara Finfish Trawl	20
	Queensland Finfish Trawl	**10**
	Western Australia Snapper Line[§§§§]	5
Mangrove Jack[##]	**Queensland Finfish Trawl**	**30**
	Northern Territory Finfish Trawl	5
	Northern Territory Demersal Line and Trap	1
Sweetlip[##]	Northern Territory Finfish Trawl	30
	Queensland Finfish Trawl	**10**

[#] Quota managed species in the Qld Finfish Trawl Fishery

[##] Non-quota managed species in the Qld Finfish Trawl Fishery

[§] Anon. 2004*b*

[§§] Anon. 2004*c*

[§§§] Anon. 2004*d*

[§§§§] Anon. 2002

[*] Estimated from data in Sly *et al.* 2003*a*

[**] Roelofs and Stapley 2004

[***] Combined NT and WA catch (AFMA 2003)

[****] Roelofs *et al.* 2003

[$] Estimated from data in Sly 2002

[$$] Estimated from data in Sly *et al.* 2003*b*