



**Australian Government**

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**Department of the Environment and Heritage**

# **Assessment of the Northern Territory Timor Reef Fishery**

**Wildlife Trade and Sustainable Fisheries Branch**

**Approvals and Wildlife Division**

**Department of the Environment and Heritage**

**April 2003**

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*This document is an assessment carried out by Department of the Environment and Heritage of a commercial fishery against the Commonwealth Guidelines for the Ecologically Sustainable Management of Fisheries. It forms part of the advice provided to the Minister for the Environment and Heritage on the fishery in relation to decisions under Part 13 and 13A of the EPBC. The views expressed do not necessarily reflect those of the Minister for the Environment and Heritage or the Australian Government.*

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# Assessment of the ecological sustainability of management arrangements for the Northern Territory Timor Reef Fishery

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## EXECUTIVE SUMMARY

### Process followed in the assessment

The Northern Territory (NT) Department of Business, Industry and Resource Development (DBIRD) Fisheries Division has provided the report “*Assessing the Ecological Sustainability of the Northern Territory Timor Reef Fishery*” (the ‘submission’) addressing the Commonwealth’s *Guidelines for the Ecologically Sustainable Management of Fisheries* (the *Guidelines*) for assessment under Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Environment Australia (EA) provided comments on the draft NT submission prior to release for public comment.

The NT Timor Reef Fishery (TRF) submission was released for public comment on 6 July 2002. The public comment period ended on 6 August 2002 with a total of 5 submissions received (including one late submission). A number of responses commented that generally the TRF is managed in a precautionary manner. NT Fisheries provided a response to the issues raised. A final version of *Assessing the Ecological Sustainability of the Northern Territory Timor Reef Fishery* was submitted for assessment in April 2003.

Following the public comment period, EA drafted this assessment report of the NT TRF submission against the *Guidelines*. In addition to the NT submission and associated documents, public comments and NT Fisheries responses to them, informed EA’s assessment.

EA’s assessment report recommendations were negotiated and agreed with NT Fisheries.

### Background

The TRF is a multi-species trap and dropline fishery operating in the remote northwest corner of the NT portion of the Australian Fishing Zone (AFZ). These grounds are nearly 150 nautical miles from Darwin. Fishers use traps, droplines, handlines and mechanically assisted haul lines to land tropical snappers and emperors, primarily targeting goldband snapper (*Pristipomoides spp.*; 71% of total catch) and red snappers (*Lutjanus malabaricus* and *L. erythropterus*; 17% of total catch). The majority of commercial operators now use baited traps given improved catch rates. The remoteness of this offshore fishery currently precludes the involvement of the recreational, indigenous and fishing tour operator sectors.

Under the Offshore Constitutional Settlement agreements responsibility of management for the TRF passed to the Northern Territory in 1988. As a result of a revised OCS agreement in February 1995, management responsibility for the TRF was passed from the Northern Territory to the Northern Territory Fisheries Joint Authority (NTFJA).<sup>1</sup> The NTFJA provides for the Commonwealth and the Northern Territory to jointly manage the fishery given the likelihood of shared resources with adjacent national and international jurisdictions. The NTFJA meets annually. NT Fisheries, on behalf of the NTFJA, undertakes the day-to-day management of the fishery. Management of the recreational component of all fisheries resides with NT Fisheries.

The demersal fish resources of northern Australia were commercially exploited by Japanese stern trawlers during 1959-1963 and extensively fished by Taiwanese pair trawlers from 1971 to 1990. A summary of the NT Timor Reef Fishery is provided in Table 1.

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<sup>1</sup> Jurisdictional arrangements for the NTFJA can be found in “The arrangement between the Commonwealth of Australia and the Northern Territory” published in the Australian Government Gazette of 1 February 1995 and the NT Gazette of 1 February 1995 (No. S7).

**Table 1** Summary of Northern Territory Timor Reef Fishery<sup>2</sup>

|  |   |
|--|---|
| <b>Area</b>  | Extends from Western Australian and Northern Territory border to the northwest of Darwin and to the outer limit of the Australian Fishing Zone (11°S). <sup>3</sup>   |
| <b>Fishery status or development stage:</b>              | Fully exploited   |
| <b>Stock assessment reliability:</b>                     | Medium/Low (although there is a long time series of commercial catch and effort data, this data is poorly informative about stock status).  |
| <b>Stock Assessment method</b>                           | Analysis of time series of commercial catch and effort data. Age structure, surplus production and delay difference models.   |
| <b>Target Species</b>                                    | - Goldband snapper <sup>4</sup> ( <i>P. multidentis</i> (71% of catch), <i>P. typus</i> , <i>P. filamentosus</i> )<br>- Red snapper <sup>5</sup> ( <i>Lutjanus erythropterus</i> and <i>L. malabaricus</i> )<br>- Red emperor ( <i>Lutjanus sebae</i> )<br>- Cods (Family <i>Serranidae</i> ) |
| <b>Byproduct</b>   | Comprised 3.7% of catch for 2001  |
| <b>Gear</b>  | Traps, droplines, handlines and mechanically assisted haul lines. Majority of operators now use baited traps  |
| <b>Bait species</b>                                      | Squid (for drop lining), bait pilchards (for trapping)  |
| <b>Fleet</b>   | Vessels 15 to 24 m in length with four to six crew  |
| <b>Commercial harvest 2001:</b>                          | 360.4 tonnes  |
| <b>Value of commercial harvest 2001:</b>                 | \$1,990,541   |
| <b>Five year trend and average(commercial):</b>          | Catch: Fluctuating average 359 t.<br>Effort: stable 848 fishing days (five year average 845 days).  |
| <b>Recreational and indigenous harvest</b>               | Nil.  |
| <b>Commercial licences issued:</b>                       | 15 licences. Five licensees land 90% of catch.<br>8 restricted, 7 unrestricted licences.  |
| <b>Number of FTOs landing offshore tropical snappers</b> | Nil.  |
| <b>Management arrangements Commercial:</b>               | Limited entry, 2 for 1 licence transfer reduction scheme, gear and area restrictions (see Table 2)  |
| <b>Management arrangements Recreational:</b>             | Output controls, possession limits, FTO licensing although currently not accessed by these fishers.   |
| <b>Bycatch</b>   | Less than 1% of onboard observer data   |
| <b>Interaction with Threatened Species</b>               | None recorded   |

### Overall assessment

The material submitted by NT Fisheries indicates that the fishery operates in accordance with the Commonwealth *Guidelines for the ecologically sustainable management of fisheries*. EA concurs that the NT TRF is a well-managed fishery that is unlikely to have an unacceptable or unsustainable impact on the environment in the short to mid term. Overall, the small number of commercial fishery operators, relatively benign fishing method, small numbers of landing ports and precautionary reference points, among other measures, suggest that the fishery is being managed in an ecologically sustainable way.

In making this assessment, EA is satisfied that the information collection system, risk assessments, management arrangements and objectives are sufficient to ensure that the fishery is conducted in a manner that does not lead to overfishing and that stocks are not currently overfished. The management regime is developed through a consultative process, is underpinned by adequate objectives and includes performance criteria aimed at managing the fishery in an ecologically

<sup>2</sup> Information in this table is largely drawn from the Technical Annual Report 2000/01

<sup>3</sup> See s141C of the *Fisheries Regulations* for a complete description of the area of fishery

<sup>4</sup> Use of the term goldband snapper in this report will relate to the species indicated.

<sup>5</sup> Use of the term red snapper in this report will relate to the species indicated.

sustainable manner. The management arrangements in place are adaptable, have the ability to control the level of take from the fishery and are reviewable and enforceable.

As the fishery operates in Commonwealth waters, consideration under Part 13 of the EPBC Act is required in relation to the impact of the fishery on threatened species, migratory species, cetaceans and listed marine species. The management regime, including the NT *Fisheries Act 1988*, regulations and strategic plan for fisheries research,<sup>6</sup> were considered in the assessment of the impact on protected species in the TRF.

A number of protected species occur in the fishery area including green, hawksbill and loggerhead turtles.<sup>7</sup> However, the fishery has no interaction with these species and EA considers that the risk of impact on species protected under Part 13 of the Act is low. EA is satisfied that the monitoring of interactions, assessment of the impacts, current management responses and triggers for future management are sufficient to ensure that all persons engaged in fishing are required to take all reasonable steps to minimise impacts. EA considers that the fishery is unlikely to have an unacceptable impact on protected species. EA recommends that this fishery be accredited under Part 13 of the EPBC Act.

The assessment concludes that the fishery is managed in an ecologically sustainable way. EA recommends that the export of species taken in the fishery should be exempt from the export permit requirements of Part 13A of the EPBC Act, with that exemption to be reviewed in five years.

To further strengthen the effectiveness of the management arrangements for the TRF and to contain the environmental risks in the medium to long term, a series of recommendations have been developed and agreed with NT Fisheries. The implementation of these recommendations and other commitments made by NT Fisheries in the submission will be monitored and reviewed as part of the next Commonwealth review of the fishery in five years time. These are:

1. Inform Environment Australia of any future amendment to the management regime for the Timor Reef Fishery.
2. Report on objectives and reference points for the Timor Reef Fishery in the status reports from 2003.
3. Conduct a compliance risk assessment for the Timor Reef Fishery by December 2004.
4. Include yearly results of observer surveys (including information on target species, bycatch and protected species interactions) in the annual status report as of 2003 and implement alternative data collection validation techniques if observer trips are no longer feasible or insufficient to provide robust information on the fishery.
5. Determine spatial distribution of effort and catch in the fishery and investigate the risk of localised depletions by 2006. In the event that significant risks are identified, NT Fisheries to implement appropriate mitigation measures.
6. Formalise guidelines, including clear timeframes for implementation, for undertaking review of the fisheries management arrangements once reference points are triggered by December 2004.
7. Continue to work towards more refined yield estimates of principle target species to determine sustainable harvest levels for target species, particularly red emperor.
8. Monitor the species composition of bycatch and byproduct with a view to undertaking a more rigorous risk analysis, if there is a significant increase in the catch of individual species.
9. Undertake a risk assessment of the Timor Reef Fishery bycatch with respect to its vulnerability to fishing by December 2004 and implement appropriate measures for high risk species within 12 months of risk assessment.
10. Amend logbooks to allow recording of all protected species interactions and implement an education program to ensure industry has the capacity to make accurate reports by July 2004.

<sup>6</sup> [http://www.nt.gov.au/dbird/dpif/pubcat/books\\_reports/fishstratpln\\_revision2002/R&D%20Plan\\_wk\\_Final\\_161002.pdf](http://www.nt.gov.au/dbird/dpif/pubcat/books_reports/fishstratpln_revision2002/R&D%20Plan_wk_Final_161002.pdf)

<sup>7</sup> Sourced from Environment Protection and Biodiversity Conservation Act Online Data base accessed on 21/10/02

## PART I MANAGEMENT ARRANGEMENTS

The day-to-day management of the Timor Reef Fishery (TRF) is undertaken by NT Fisheries, Department of Business, Industry and Resource Development (DBIRD) on behalf of the NTFJA. NT Fisheries is primarily responsible for administration of the NT *Fisheries Act 1988* and Northern Territory *Fisheries Regulations*. There are a number of other documents, including research reports, scientific literature and discussion papers, which are germane to the management of the fishery. NT Fisheries are to inform EA of any significant changes to the management regime for the TRF.

EA considers that the NT TRF provides adequate mechanisms to ensure that the management regime takes into account management arrangements for TRF species in adjacent fisheries jurisdictions. Ideally, management arrangements for fisheries affecting a single stock should be under a single jurisdiction or at least be complementary. If this is not achievable, management arrangements should as a minimum take into account the harvest and management regime in other jurisdictions fishing the same population, particularly when assessing stock status and availability for harvest. The Northern Australian Fisheries Managers Workshop (NAFMW) is undertaken annually and attended by members from the three northern States/Territory, the Commonwealth, Indonesia and East Timor. These meetings are convened under a formal Memorandum Of Understanding (MOU) for cooperative management of fish stocks by adjacent resource management agencies. Strategic directions for research and management of all northern fisheries are discussed, including the TRF. NT Fisheries considers that this forum is effective in addressing cross-jurisdictional issues, particularly stock assessment and bycatch information.

A number of voluntary partnerships announced at the World Summit on Sustainable Development in 2002 included the development of the Arafura-Timor Seas Experts Forum. This is a partnership with East Timor, Indonesia and Papua New Guinea governments and research bodies to establish a new Forum to focus on the sustainable management of the Arafura-Timor Seas, looking specifically at cooperative research and arrangements to improve marine resource management. Issues to be covered by this forum include marine pollution, overfishing, illegal, unregulated and unreported fishing.

Unlike Queensland and Western Australia where there are size limits (eg. Coral trout 45cm WA, 38cm Qld, Red emperor 41cm in WA, 45cm in Qld), under the current NT TRF management regime there are no size limits on fish species. Research has shown that most of the Goldband snapper taken by line in the TRF are mature when they are recruited to the fishery. Preliminary studies since the transition to traps indicates that almost all fish caught are mature. Size limits are an ineffective management tool in the Timor Reef fishery. The fishery operates in depths between 80-100m. All species landed suffer from varying degrees of barotrauma preventing release. In addition almost all species landed are mature and marketable.

There are no regional or international management regimes to which Australia is a party, of direct relevance to the fishery. The prime international regime affecting the fishery is the United Nations Convention on the Law of the Sea (UNCLOS). The management regime essentially complies with this.

Currently there is no specific fishery management plan for the TRF. The documents relating to the management regime, as listed above, are available from the DBIRD and online at the NT Fisheries website.<sup>8</sup> Prior to entering the fishery, commercial fishers are provided with a copy of these documents and briefed on the management arrangements. EA is satisfied that the management regime for the TRF is adequately documented, publicly available and transparent.

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<sup>8</sup> DBIRD website [www.dbird.nt.gov.au](http://www.dbird.nt.gov.au)

Any discussion papers or proposals for amendments to the TRF management arrangements are distributed widely to stakeholder groups and other interested individuals.

An annual Status Report<sup>9</sup> is published and distributed to all stakeholder groups to ensure that management advice is transparent and that the community is fully informed about the current and predicted future status of the resource. An annual Technical Report<sup>10</sup> details all research and technical work undertaken by the DBIRD. NT Fisheries produces Fishery Assessment Reports, every 3-4 years, identifying historical and current stock assessments and implications for the management arrangements of the fishery. Currently only an interim Fishery Assessment Report has been published for the TRF (November 1999).

The recently established Timor Reef Fishery Management Advisory Committee (TRFMAC) representing commercial fishers, fisheries manager, fisheries researcher, an independent chair and a compliance officer, will formally review and make recommendation to the NT Fisheries Group on appropriate management arrangements for the fishery. There are no recreational or indigenous representatives, as the fishery is not utilised by these groups.

EA and the Northern Territory believe that it is beneficial to include an environmental representative on MACs, as occurs in other jurisdictions in Australia using the MAC model, the advantage being that all parties concerned with the fishery can be fully exposed to the views of other parties. NT Fisheries consider that environmental representatives received far more consultation with the NT Fisheries Director than in other jurisdictions. Environment groups and non-government organisations are advised and consulted on TRF issues through monthly advisory meetings with senior fisheries officers and the Director of Fisheries. NT Fisheries and environment groups consider this to be a more effective method of communication rather than a specific representative on the MAC, due to the low level of environmental representatives available. Public comments did not identify any concerns with the current MAC structure.

Stock assessment workshops, involving specialised scientists, broad stakeholder representatives including non-government organisations and advisory members, were convened in 1996 and 2000. Outcomes are publicised through technical reports, annual status reports and in the NTFJA annual report.

EA is satisfied that sufficient opportunity is provided to all interested and affected parties, including the general public, to contribute to the development of the management regime, and that an appropriate range of expertise and community interests are involved in the fishery management committee and during the stock assessment process.

The *Northern Territory Fisheries Act 1988* provides overarching objectives for management of fish and aquatic life resources of the Territory including the TRF which include:

- Ensuring that the fisheries of the Territory are not endangered or over exploited and
- Ensuring that the habitat of fish or aquatic life and the general environment is not detrimentally affected.

These overarching objectives are strategically assessed through the annual NAFMW.

The TRF is managed by the NTFJA with NT Fisheries undertaking the day-to-day management. The Commonwealth *Fisheries Management Act 1991* provides that in undertaking the management responsibilities the Joint Authority must pursue the objectives, which include:

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<sup>9</sup> <http://www.nt.gov.au/dbird/dpif/fisheries/aqresman/pdf/OffshoreSnapper00.pdf>

<sup>10</sup> Technical Annual Report 2000/01 Technical Bulletin No. 295 <http://www.nt.gov.au/dbird/dpif/pubcat/pdf/tar01.pdf>

“Ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, in particular the need to have regard to the impacts of fishing activities on non-target species and the marine environment.”

NT Fisheries have developed a management regime for the TRF that includes specific objectives that cover target, byproduct, bycatch protected species and ecosystem impacts. The key objective for the management of the TRF is to ensure that the overall landings of target species do not exceed the annual estimates of yield. Catch triggers, as outlined in Table 3 (see Principle 1, Objective 1), are the performance criteria used to measure the effectiveness of the management arrangements. NT Fisheries considers that the current performance indicators are appropriate given the scale and scope of the fishery. NT Fisheries have committed to report on the objectives and reference points for the Timor Reef Fishery in Status Reports from 2003.

Harvest in the TRF is controlled by a range of input controls (see Table 2) which includes limiting the number of operators, a licence reduction scheme and gear restrictions. NT Fisheries contend that the low number of operators (6 active of the 15 licences in 2002) is sufficient to control the level of harvest and there is no need for extensive input and output controls used in other fisheries with high participation rates. In addition, a range of trigger values has been set which trigger a review of the fishery (see Table 3). The licence reduction scheme is aimed at reducing licensing numbers and latent effort and thereby reducing the potential for overexploitation. Latent and active licences are surrendered under the 2:1 licence reduction scheme, therefore effort (both latent and active) has been reduced. These management measures are discussed in more detail under Objective one. EA considers that these management controls should be capable of controlling the level of harvest in the fishery in the short to mid term.

**Table 2** Input controls used in the Northern Territory Timor Reef Fishery

| <b>Control</b>           | <b>Description</b>   |
|--------------------------|--|
| Licence reduction scheme | Requires new entrants to surrender 2 restricted licences for the issuance of an unrestricted licence or acquire an unrestricted licence. The aim is to reduce capacity from 22 to 11 entitlements (15 licences as of 2002) |
| Gear restrictions        | operators are restricted to the use of traps (45 per licence), lines, droplines and scoop net or gaff.   |
| Defined fishery area     | aligned to the distribution of goldband snapper.   |
| Catch restrictions       | TRF licence holders are not allowed to take barramundi, threadfin salmon, Spanish mackerel, shark or mud crab.   |

EA considers that the management regime for the TRF contains the means of enforcing critical aspects of the management arrangements. The Marine and Fisheries Enforcement Unit (MFEU) of the NT Police, Fire and Emergency Services undertake compliance on behalf of NT Fisheries. Enforcement and compliance is enhanced through the use of a single port by operators. Patrols will now be able to be carried out in the fishery region with the recent leasing of a 20m police boat. The NT submission concludes that the enforcement and compliance operations for the TRF are appropriate to the scale and scope of the fishery. NT Fisheries have committed to conduct a compliance risk assessment for the TRF by December 2004.

EA is satisfied that the management regime for the TRF provides for the periodic review of the performance of the fishery management arrangements, including the management strategies, objectives and criteria. The TRF is reviewed at meetings of TRFMAC and through annual desktop reviews by NT Fisheries resulting in the production of annual Technical and Status Reports. Fishery Assessment Reports, produced every 3-5 years, identify historical and current stock assessments and implications of the management arrangements for the fishery. Strategic management directions of the TRF are also reviewed and assessed at the NAFMW.

Periodic workshops, in which all stakeholders and the community participate, review and undertake an assessment of the fishery in line with the current management strategy and objectives. Outcomes are publicised through technical reports and the annual report of the NTFJA.

The NT submission concludes that the characteristics of the TRF, such as the use of passive gear, remoteness of the area fished and the low number of operators, reduced the potential risk for any adverse impacts on the marine ecosystem in which the fishery operates.

An analysis of the fishery's capacity for assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates is contained under Principle Two of this report.

There are currently no threat abatement plans, recovery plans or bycatch action strategies that relate specifically to the TRF. The NT submission details that the TRF management plan would be amended to facilitate the requirements of a threat abatement/recover/bycatch action strategy if one becomes relevant to the fishery.

### **Conclusion**

EA considers that the Northern Australian Fisheries Managers Workshop provides an adequate forum for discussion of cross-jurisdictional fisheries management and assessment. The management regime for the TRF is adequately documented, publicly available and transparent and generally complies with relevant international regimes to which Australia is a party. Indonesia and other relevant jurisdictions are directly involved in discussions with NT Fisheries, on a regular basis.

EA considers that the consultative process employed by NT Fisheries in the development and review of the management regime provides opportunity to all interested and affected parties, including the general public, to engage in the consultation process. EA considers that the range of input controls and reference points used in the TRF should be capable of controlling the level of harvest during the period of data collection and analysis associated with improved stock assessment.

EA concurs with NT's submission that the limited launch or docking sites together with a dedicated fisheries enforcement unit are sufficient to enforce the critical aspects of the management arrangements.

EA considers that review of performance of the fishery is sufficiently covered via TRFMAC reviews, development of annual technical and status reports, the NAFMW and stock assessment workshops.

There are no threat abatement/recovery/ bycatch action strategies currently relevant to the fishery. The NT submission details that the TRF management regime would be amended to facilitate a threat abatement/recover/bycatch action strategy should one become relevant to the fishery.

Further analysis of specific aspects of the management regime is contained in Part II of this report.

### **Recommendations**

- Inform Environment Australia of any future amendment to the management regime for the Timor Reef Fishery.
- Report on the objectives and reference points for the Timor Reef Fishery in Status Reports from 2003.
- Conduct a compliance risk assessment for the Timor Reef Fishery by December 2004.

## **PART II      GUIDELINES FOR THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF FISHERIES**

### **Stock Status and Recovery**

Principle 1: *“A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.”*

### **Maintain ecologically viable stocks**

Objective 1: *“The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.”*

### **Information requirements**

#### ***Fishery Dependent***

Commercial fishers are required to complete daily logbook data, which is submitted monthly. Logbooks record fishing method (droplines or traps), catch (numbers and species), effort (numbers of shots and fishing time), depth fished and fishing location (latitude and longitude). Fisher are not required to record individual goldband snapper species due to difficulties in identification. Species composition is determined through observer monitoring. The NT submission asserts that the level and reliability of the information collected via the logbook program is appropriate given the size and extent of the fishery.

Market returns, which are required to be submitted with catch and effort logbooks, also serve to audit catch returns. NT Fisheries comment that the occurrence of any discrepancy is low. These returns detail target and byproduct species catch and their sale destinations. NT Fisheries are in the process of refining the logbook data entry process together with the validation of market returns. EA considers that data verification in this fishery is particularly important given the small number of operators and hence the possibility of correspondingly large contribution of information error by each operator.

Fishing Tour Operators (also known as charter operators) are required to record daily logbook returns on all catch (retained or released), effort and locations details. These are submitted monthly. To date there has been no FTO catch in the fishery area.

On board monitoring by observers has been undertaken on commercial boats since 1990.<sup>11</sup> Observer trips, undertaken two to three times a year, document vessel and gear information, location and depth fished, fishing practices, catch composition and where possible, measure all species landed.<sup>12</sup> Analysis of length frequency composition has not shown any change in size over time.<sup>13</sup> Research has shown that most of the goldband snapper taken by line are mature when they are recruited to the fishery.<sup>14</sup> The transition from lines to traps has increased the size range of fish caught. However, the age structure is only marginally variable. Preliminary studies indicate that almost all fish caught via traps are mature. The NT submission provides no clear information on the observer program on monitoring rates, proportion of catch monitored and statistical reliability of the information obtained. Observer coverage should be designed so that it is distributed across the

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<sup>11</sup> Clarke and Lloyd 2002

<sup>12</sup> Lloyd *et al* 1999

<sup>13</sup> Lloyd *et al* 1999

<sup>14</sup> Lloyd *et al* 1999

span of the fishery such that it can detect seasonal events. NT Fisheries has committed to include yearly results of observer surveys (including information on target species, bycatch and protected species interactions) in the annual status report as of 2003 and implement alternative data collection validation techniques if observer trips are no longer feasible or are insufficient to provide robust information on the fishery.

### ***Fishery Independent***

Two key fishery independent research projects have been undertaken in the fishery.

1. The TRF was assessed as part of the wider Timor Sea, looking at demersal trawl surveys in 1990. The results of the survey provided information on the relative abundance and biomass of major fish species in the Timor and Arafura Seas. This information was used to review yield estimates and resources management strategies for the major red and goldband snapper species.
2. The concern for reliable estimates of goldband snapper stocks identified the need to develop a repeatable sampling strategy to provide an independent index of species abundance for long term monitoring using droplines and trammel nets.<sup>15</sup> The results showed that trammel nets are a practical independent sampling tool with the advantage that they can sample the full size range within a population in comparison to baited hooks which are size selective. The intention is to now examine the effectiveness of smaller mesh trammel nets in deeper water to assist in confirming aging techniques and estimates.

NT Fisheries are committed to seek funding to continue this research. The size and scale of the fishery does not justify internal funding for this research.

EA concurs that the logbook information provided by commercial fishers and fishing tour operators, together with biological information gathered by commercial fishers and fisheries research observers, is reliable and appropriate to the size and scale of the fishery. EA has concerns with the lack of ongoing commitment to fishery independent data collection.

### **Assessment**

Some species taken in the TRF are relatively robust to fishing pressure; such as the common coral trout and some parrot fish, due to their life cycle and behavioural characteristics. However, cods (Family Serranidae) and tropical snappers (Family Lutjanidae) are particularly vulnerable to fishing pressure due to their biological characteristics of early growth to maximum size, long life, relatively large size at sexual maturity, sex changing reproductive strategy and low natural mortality. Consequently, a cautious approach to harvesting these fish is required to ensure sustainability.

Assessment and review of the TRF is undertaken via the production of annual status reports and through stock assessment workshops. An annual status report prepared by NT Fisheries is published and distributed to all stakeholder groups and the wider community to ensure all stakeholders with an interest in the fishery are fully informed about the current and predicted future status of the resource. The status report provides current information on catch/effort, stakeholder participation, research, compliance and management together with major issues that have occurred throughout the year. The snapper status report 2000 reports that the stock assessment reliability is low and that although there is a long time series of commercial catch and effort data, this data is poorly informative about stock status.

The NTFJA annual report provides information on the status of northern fisheries jointly managed by the Commonwealth and the NT, including the TRF, and is available from NT Fisheries.

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<sup>15</sup> Lloyd 1995

A stock assessment undertaken in 1991 examined historic logbook and observer data from the foreign and domestic commercial vessels and the independent demersal trawl survey data, to estimate biomass in different management zones.<sup>16</sup> Resource estimates in 1992 and 1994, although focusing on the Arafura Sea, provided an indication of the likely red snapper harvest levels across northern Australia.

NT Fisheries convened fisheries stock assessment workshops, led by internationally and nationally recognised stock assessment scientists, in 1996 and 2000. The workshops involved industry, scientist and fishery managers from NT, Qld, WA and the Commonwealth. The current stock assessment model used to assess the goldband snapper stocks in the TRF was developed through the 1996 stock assessment workshop and reviewed in the 2000 workshop. Key recommendations from the 1996 workshop<sup>17</sup> were a recommended harvest level of 10-15% per year of the stock and a biomass estimate for goldband snapper of between 3,000 to 20,000t (depending on the how catch rates, age and survey details are interpreted) with a biomass estimate of 9,000t determined to be a more realistic figure for modelling and management purposes.

Assessments undertaken in 2000 and 2001 could not determine any new biomass estimates for the TRF due to the recent change in fishing method from dropline to trap. A stock assessment workshop for the fishery, as part of an Australian Centre for Agricultural Research (ACIAR) workshop, will be undertaken throughout the approval period. The stock assessment workshop will consider all available data, including the shift from lines to trap.

NT Fisheries comments that should the composition of the catch change significantly as a result of one of the reference points being breached (Table 3), management arrangements and research priorities can be altered to provide greater protection for these species.

NT Fisheries have recently reviewed the strategic research needs for all NT fisheries, including the TRF, and developed the *Northern Territory Strategic Plan for Fisheries Research and Development 2002 to 2006*.<sup>18</sup> The NAFMW reviews the current stock assessment estimates and research priorities for all NT fisheries.

The NT submission has identified that a key issue for the fishery is the degree of mixing of goldband (*Pristipomoides spp*) and red snapper (*L. malabaricus* and *L. erythropterus*) stocks between Australia, Indonesia and East Timor across a shared continental shelf area known as the Sahul Banks. Assessments by Australian and Indonesian managers and researchers indicate that uncontrolled fishing effort, applied to either the Australian, Indonesian or East Timor component of the fishery, may cause a gradual decline in stocks. The NT submission comments that due to this stock sharing NT Fisheries will continue to take a precautionary approach to management and work towards complementary management with Indonesia.

Recent research has indicated that *P. multidens* (which comprises 80% of the goldband snapper catch) consists of several separate adult stocks across northern Australia, Indonesia (Kupang), East Timor and Papua New Guinea.<sup>19</sup> The research implies that there is unlikely to be substantial movement of fish between these distinct adult assemblages.

An ACIAR project entitled *Biology, stock assessment and management of shared snapper fisheries in northern Australia and eastern Indonesia*, due to be completed in 2003, aims to identify the population dynamics, stock structure and biology of goldband and red snappers relevant to the cooperative management of stocks shared between Australia, Indonesia and East Timor. The NT submission advises that preliminary results of the ACIAR project suggest that red snapper stocks in

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<sup>16</sup> see Ramm 1994

<sup>17</sup> Ramm 1997b

<sup>18</sup> [http://www.nt.gov.au/dbird/dpif/pubcat/books\\_reports/fishstratpln\\_revision2002/R&D%20Plan\\_wk\\_Final\\_161002.pdf](http://www.nt.gov.au/dbird/dpif/pubcat/books_reports/fishstratpln_revision2002/R&D%20Plan_wk_Final_161002.pdf)

<sup>19</sup> Lloyd *et al* 2000

the TRF are now unlikely to be shared between Australia and Indonesia. Goldband snapper samples collected from the continental shelf adjacent to Timor (Indonesia) are dissimilar to those of the Australian fishery on the Sahul Banks.<sup>20</sup> The degree of mixing across the Sahul Banks shared with Indonesia has not been determined. However, otolith data on northern Australia goldband snapper populations indicate that adult goldband snapper stocks are sedentary.<sup>21</sup> EA strongly supports this cooperative research and suggests that the results of this project be provided to the TRFMAC and appropriate management measures put in place.

The NT submission states that due to the small number of commercial operators they are able to relocate to alternative fishing grounds if catch rates decline. Thus the likelihood of localised depletion is reduced. Current logbook data provides spatial information on effort and catch rates to a very fine resolution (Global Positioning System location). The recent transition from droplines to traps has extended the area of the fishery. In line with this change NT Fisheries is seeking funding from FRDC to use time series data, to examine the spatial distribution of fishing effort using Geographical Information System (GIS). The development of a GIS will increase the ability to incorporate and analyse complex environment data, data from varied sources and the spatial aspects of fish distribution. The study will provide the spatial statistics for analysis of fisheries data to refine trigger points, which in turn will identify risks and lead to more effective management. The initial pilot project did not determine any indication of fish-downs on an industry wide basis. NT Fisheries have undertaken to determine spatial distribution of effort and catch in the fishery and investigate the risk of localised depletions by 2006 and in the event that significant risks are identified implement appropriate mitigation measures.

Concerns were raised during public comment regarding the targeting of spawning aggregations of reef fish. NT Fisheries advise that the principle target species in the TRF are serial batch spawners, which means they have an irregular and extended spawning period rather than a more protracted single spawning period. NT Fisheries advise that preliminary investigations suggest that the targeting of spawning aggregations is not a concern for this fishery. The current ACIAR project will provide greater understanding of the distribution and biology, including spawning of the target species.

The NT submission does not comment on the whether the red snappers taken in the NT demersal and finfish trawl fisheries are the same stock as the TRF and if so how these catches are taken into account in the assessment of the stock.

Overall EA is satisfied that NT Fisheries is seeking to determine the distribution and spatial structure of the TRF species and to factor this information into management.

The NT submission asserts that reliable estimates of total removals by commercial operators is provided from logbooks and monitored by fishery observers. The logbook data is also validated by comparison with processor/trader returns.

Estimates of illegal Indonesian fishing effort in the fishery and estimates of removals by legal Indonesian fishers operating on the Indonesian component of the Sahul banks are determined by Coastwatch flights and interviews with detained and legal skippers respectively. These estimates are provided as information for review at stock assessment workshops and, where possible, incorporated into stock assessment monitoring. As noted previously, the remoteness of the fishery currently precludes the involvement of the recreational, indigenous and FTO sectors. EA is satisfied that there are reliable estimates of commercial and illegal catch based on the above and that these estimates are taken into account in stock assessment monitoring where possible.

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<sup>20</sup> Overden *et al.*, 2002

<sup>21</sup> Newman *et al.* 2000

Sustainable yield estimates for goldband snapper and red snapper have been determined from catch and effort information gathered from Taiwanese, Thai and Chinese trawlers, trawl research surveys and details provided by the Timor Reef and finfish trawl fishers. Potential productivity for these species has been converted into reference points as outlined in Table 3. These estimated sustainable yields assumed a sustainable harvest rate of 10-15% per year of the standing stock.

NT Fisheries comments that there are no biomass estimates for the targeted red emperors and cods and byproduct species due to the size and scale of the fishery. This has resulted in stock assessment directed more towards the targeted goldband and red snappers. As a result NT Fisheries has set precautionary reference points for the aforementioned species as outlined in Table 3.

The NT submission details that biomass estimates and associated sustainable harvest estimates will be refined as results on the degree of mixing between Australian and Indonesian stocks, information on fishing effort and fishery independent techniques become available.

EA is satisfied that there are sound estimates of the potential productivity for the target species, and for the other species where there is limited information precautionary reference points have been set.

### **Management response**

Reference points for the TRF are outlined in Table 3. NT Fisheries has taken the precautionary approach and have set the reference points at the lower estimates of yields for goldband snapper and red snapper. If any of the reference points are breached, the NT Fisheries Director will respond by directing the TRFMAC to review management arrangements of the fishery to determine further management interactions to be implemented to maintain catches at sustainable levels. NT Fisheries has commented that setting reference points does not preclude the management agency from taking action prior to the reference point being reached if necessary. EA recognises the significant step forward that NT Fisheries has taken in ensuring the long-term sustainability of the TRF through the development of reference points for the fishery.

Additionally, the TRFMAC or the NT Fisheries Director can request the NT Minister to declare emergency changes under the provisions of the NT *Fisheries Act 1988*.<sup>22</sup> Under this section the Minister may:

- Halt all or any fishing in that fishery or any specified part of the fishery;
- Restrict the number of vessels used in relation to fishing in the fishery;
- Restrict the amount of fish or aquatic life which may be taken from that fishery; or
- Restrict the quantity or nature of fishing gear that may be used in the fishery.

A notice containing brief reasons for the restrictions must be given for a period of 28 days and advertised in a newspaper circulating within the area.

NT Fisheries has committed to formalising guidelines, including timeframes for implementation, for undertaking a review of fisheries management arrangements once reference points are triggered by December 2004.

The NT submission notes that the catch of red emperor has increased significantly with the shift from line fishing to baited traps. NT Fisheries comment that as yield estimates become more refined, through regular stock assessments, a sustainable harvest level, if appropriate, may be introduced. NT Fisheries have committed to work towards more refined yield estimates of principle target species to determine sustainable harvest levels, particularly for red emperor.

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<sup>22</sup> Section 29 *Fisheries Act 1988*

NT Fisheries implemented a reference point such that if catch declines by 30% over the next calendar year for any of the target species (goldband snapper or red snapper), a review of the management arrangements will be undertaken.

**Table 3** Summary of the Northern Territory Timor Reef Fishery reference points

| <b>Species</b>   | <b>Reference point (calendar year)</b> | <b>Catch for 2001</b> |
|------------------|--|-----------------------|
| Goldband snapper | 900 tonnes                             | 209t                  |
| Red Snapper      | 1300 tonnes                            | 75t                   |
| Red Emperor      | 25% of total annual catch              | 8.72%                 |
| Cods             | 10% of total annual catch              | 4%                    |
| Byproduct        | 10% of total annual catch              | 3.7%                  |
| Bycatch          | 10% of total annual catch              | 1%                    |

The TRF is managed via input controls, as outlined in Table 1, coupled with the reference points as discussed above. NT Fisheries consider that on the basis of available information, that present precautionary management arrangements provide ample protection and are adequate given the current scale and capacity of the fishery. NT Fisheries asserts that current management arrangements and input controls are adequate to ensure overall landings in the fishery are below current estimated sustainable yields.

Concern was raised during public comment with the targeting of hump headed wrasse in the fishery. NT Fisheries advised that there has been no recorded incidence of this species within the fishery.

EA considers that the management strategies in place, including the input controls and performance triggers, should be capable of controlling the level of take in the fishery.

Any species can be retained in the TRF, other than barramundi, threadfin salmon, Spanish mackerel, shark or mud crab as these species are the subject of other NT commercial fisheries. EA concurs with NT Fisheries that the current performance indicators for catch, byproduct and bycatch are sufficient to detect a shift in effort to a new or previously lightly targeted species. Byproduct species comprised 3.7% of the commercial catch for 2001.<sup>23</sup> A reference point is set so that a review will be undertaken if the proportion of byproduct should increase to 10% of the total annual catch for the fishery. NT Fisheries comment that species landed as byproduct in the TRF are landed as target species elsewhere in the country. This highlights the comparatively low levels landed in the TRF and the minimal threat such landings may cause to byproduct stocks. The low take coupled with the reference point should ensure minimal risk to the sustainability of byproduct stocks in the fishery. This reference point does not look at shifts in targeting specific species within the 10%. As such NT Fisheries have undertaken to monitor the species composition of byproduct and bycatch with a view to undertaking a more rigorous risk analysis, if there is a significant increase in the catch of individual species.

An indication of byproduct composition and species is provided in Appendix 7 of the NT submission that provides the observer data catch composition 1990 – 2001.

NT Fisheries believe that if current catch levels are maintained and there is limited movement of target species between Australia and Indonesian waters, the probability of achieving the objective of sustainability is high. However, it is difficult to speculate about the long-term viability without improved biomass estimates and movement rates of fish into Indonesian waters.<sup>24</sup>

<sup>23</sup> See appendix 7 of the NT report for a detailed list of byproduct species

<sup>24</sup> Ramm 1997b

## Conclusion

EA is satisfied that there are reliable estimates of commercial and illegal catch and that these estimates are taken into account in stock assessment monitoring where possible.

EA is satisfied that NT Fisheries are addressing the issue of potential localised depletions and distribution of effort in the fishery through the GIS project and have committed to implementing remedial management measures in the event that a significant risk is identified.

EA is satisfied that there are adequate reference points, with a trigger for a 30% decline for the target species, to ensure that the fisheries is being conducted at catch levels that should maintain ecologically viable levels. EA understands that refinement of the biologically sustainable yield estimates for the TRF will only be possible with improved understanding of the level of mixing between Australian and Indonesian fisheries, details on fishing effort in both jurisdictions and refinement of fishery independent survey techniques. This information will be provided through the current FRDC and ACIAR projects.

## Recommendations

- Include yearly results of observer surveys (including information on target species, bycatch and protected species interactions) in the annual status report as of 2003 and implement alternative data collection validation techniques if observer trips are no longer feasible or are insufficient to provide robust information on the fishery.
- Determine spatial distribution of effort and catch in the fishery and investigate the risk of localised depletions by 2006. In the event that significant risks are identified, NT Fisheries to implement appropriate mitigation measures.
- Formalise guidelines, including clear timeframes for implementation, for undertaking review of the fisheries management arrangements once reference points are triggered by December 2004.
- Continue to work towards more refined yield estimates of principle target species to determine sustainable harvest levels, particularly for red emperor.
- Monitor the species composition of byproduct and bycatch with a view to undertaking a more rigorous risk analysis, if there is a significant increase in the catch of individual species.

## Promote recovery to ecologically viable stock levels

Objective 2: *“Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.”*

## Management Response

NT Fisheries believe that based on stock assessment workshops, the TRF is unlikely to be operating at or below the biological or effort bottom line. The reference points in place, particularly the 30% decline, should be sufficient to allow enough time for consultation and adjustment of appropriate management controls before the fishery becomes threatened. The *NT Fisheries Act 1988* provides for a management response, including emergency measures if required. As mentioned previously NT Fisheries have committed to formalising guidelines, including clear timeframes for implementation, for undertaking review of the fishery management arrangements once reference points and triggers are reached. Overall EA concurs with this assessment.

## **Ecosystem Impacts**

Principle 2: *“Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.”*

## **Bycatch Protection**

Objective 1: *“The fishery is conducted in a manner that does not threaten bycatch species.”*

### **Information requirements**

Records taken by onboard observers since the inception of the fishery in 1995, confirm that bycatch is less than 1% of total catch. An indication of bycatch species and composition is provided in Appendix 7 of the NT submission that provides the observer data catch composition 1990 – 2001. Onboard monitoring is approximately 2-3 trips per year. As the level of bycatch in the fishery is low, NT Fisheries asserts that it is appropriate to monitor bycatch by independent observers rather than through the commercial fisher logbooks. EA concurs with this response but, as discussed previously, suggests that observer survey bycatch results be published in the status report and that alternative data collection validation techniques be developed if observer trips are no longer feasible or not sufficient to provide robust information on bycatch in the fishery.

### **Assessment**

The annual review of the fishery, through the production of the Annual Technical Report and Status Report, assesses the levels of bycatch in the fishery.

The NT submission states that due to the low levels of bycatch in the TRF the risks of significant impact on bycatch species is negligible. However, bycatch species may be vulnerable to overfishing due to localised distribution, life history characteristics or other factors. NT Fisheries has committed to undertake a risk assessment of the TRF bycatch with respect to its vulnerability to fishing by December 2004 and implement appropriate measures for high risk species within 12 months of the risk assessment.

Survival of bycatch from barometric trauma, particularly given the depths from which the fish are taken (80-160m for droplines and 80-120m for traps), is likely to be small. However, virtually all species caught are sold as part of the combined multi species catch resulting in the low bycatch levels as discussed.

### **Management response**

As outlined in Table 3, a review of the management arrangements for the fishery will be initiated if bycatch levels rise to 10% of the total catch. The objective of the review will be to ensure that fishing operations do not threaten the sustainability of bycatch species. As previously mentioned NT has committed to monitoring the species composition of bycatch with a view to undertaking a more rigorous risk analysis, if there is a significant increase in the catch of individual species.

NT raised the possibility of ghost fishing being an issue in the fishery with the move to the use of traps. To date there has only been one report of ghost fishing. NT Fisheries have undertaken to review the issue of ghost fishing in consultation with industry with a view to minimising the risk. All options, including sacrificial anodes will be considered. Anodes corrode over a period of time allowing the trap door to open. EA supports this consultation and looks forward to the results of the review.

The *Guidelines* suggest that an indicator group of bycatch species is monitored with associated decision rules that trigger additional management measures when there are significant perturbations

in the indicator species numbers. Monitoring an indicator species would also facilitate the best possible use of monitoring resources. NT Fisheries considers that, given there are low quantities of any single bycatch species caught, it is not practical to designate a single indicator group of bycatch species. EA concurs with this response.

NT Fisheries consider that the management response for bycatch in the TRF is appropriate given the scale and scope of the fishery.

### **Conclusion**

EA considers that the TRF meets Objective 1, and is conducted in a manner that does not threaten bycatch species. EA considers that low bycatch levels and the combination of management arrangements, information collection and proposed research provides confidence in the fishery's ability to minimise the impact on bycatch species.

### **Recommendations**

- Undertake a risk assessment of the Timor Reef Fishery bycatch with respect to its vulnerability to fishing by December 2004 and implement appropriate measures for high risk species within 12 months of the risk assessment.

### **Protected species and threatened ecological communities**

Objective 2: *“The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.”*

### **Information requirements**

Information on protected species interactions is collected through the commercial fishers logbooks, observers and technical and research officers. NT considers that the information gathered from these sources is reliable and appropriate to the scale of the fishery. NT Fisheries have committed to amending the commercial fishers logbooks to allow recording of all protected species interactions and implementing an education program to ensure industry has the capacity to make accurate reports by July 2004. As mentioned previously NT Fisheries has committed to include yearly results of observer surveys (including information on protected species interactions) in status reports. Under the EPBC Act<sup>25</sup> commercial fishers operating in Commonwealth waters are required to notify EA of an interaction with a protected species within 7 days.

There are currently no threatened ecological communities identified in NT waters.

### **Assessment**

The NT submission concludes that information collected from commercial fishers' logbooks, independent observers and technical and research officers have not indicated any interaction with endangered, threatened or protected species. EA agrees with NT's conclusion that given the lack of any reported interaction with endangered, threatened or protected species, the risks of significant impact by the TRF on these populations is minimal.

### **Management response**

Due to the lack of interaction currently reported in the fishery the management regime does not include any management responses specifically aimed at minimising or mitigating interaction with endangered, threatened or protected species. Should an interaction with endangered, threatened or

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<sup>25</sup> See part 13 of EPBC Act

protected species be recorded either by fishers or by onboard observers, the NT *Fisheries Act 1988* has provisions to implement appropriate management measures.<sup>26</sup>

## Conclusion

EA's assessment, based on reports from the fishery and observers, is that the current and potential risk of impacts of the fishery on endangered, protected and threatened species is low. EA is also satisfied that the fishery is not likely to adversely affect the survival or recovery in nature of any threatened species or the conservation status of any protected species and that adaptive management arrangements are in place if an interaction were to be detected.

## Recommendations

- Amend logbooks to allow recording of all protected species interactions and implement an education program to ensure industry has the capacity to make accurate reports by July 2004.

## Minimising ecological impacts of fishing operations

Objective 3: *“The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.”*

### Information requirements

Data collection related to target, byproduct, bycatch and protected species within the fishery is described under objectives one and two of principle two. Video recording of the fishing methods is used to determine impact on benthic communities.

### Assessment

Droplines are used on soft coral/sand mud reefs. Video analysis has shown that fishing takes place predominately in muddy sands with benthic species, including burrowing species and the occasional sponge or gorgonian, attached to the substrate. The NT submission reports that there is little published literature on the impacts of the type of fishing used in the TRF on ecological communities. It is assumed that any impact due to the operations of the TRF is confined to the localised area where the trap or anchor contacts that sea floor. The recent trend for fishers to concentrate on using traps in this fishery may necessitate projects to assess possible damage to reefs by traps.

The main environmental impact of the fishery is the direct removal of a portion of the mature/recruited biomass of the target species, with consequent impacts on length/age/size composition and overall abundance. The effect of removing a portion of the upper level predators in a fish community is not well understood and research specifically to address this question is yet to be undertaken. NT Fisheries comments that due to the relatively small size of the TRF, research into ecologically related, associated or dependant species has not been undertaken. Research has focused on the target species only. NT Fisheries contends that although no specific research has been undertaken on the impacts of the TRF on the associated ecosystem, the relatively low number of vessels, the method of fishing, gear restrictions and the extent of the fishing area limits the potential of a significant impact.

All demersal fishing methods, including trawling, are prohibited within the area of the TRF.

The vast area covered and small number of vessels limits the likelihood of any significant impact on water quality.

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<sup>26</sup> s. 28 and 29 *Fisheries Act 1988*

### **Management response**

The NT submission comments that if a threat or significant impact to the ecosystem associated with the TRF is detected through the logbook data or observer data, then there are provisions under the NT *Fisheries Act 1988* that enable the NT Minister to take appropriate action to prevent or reduce the impact and subsequent damage to such ecosystems.

NT Fisheries concludes that although no specific research has been undertaken on the impacts of the operations of the TRF on the associated ecosystems, the relatively low number of vessels (currently 6 active) operating in the fleet, the method of fishing, gear restrictions and the extent of the fishing area, limits the potential of significant impact.

### **Conclusion**

EA considers the risk of impact of the fishery on food webs, ecologically related species and water column communities to be low due to the low participation rates and fishing methods. Similarly, there is no significant risk to the physical environment. The management arrangements and information collection systems should ensure the impact of the TRF on the ecosystem remains minimal.

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**Table 4** Acronyms

|        |   |
|--------|---|
| ACIAR  | Australian Centre for Agricultural Research               |
| AFANT  | Amateur Fishermen's Association of the Northern Territory |
| AFZ    | Australian Fishing Zone                                   |
| DBIRD  | Department of Business, Industry and Resource Development |
| EA     | Environment Australia                                     |
| FRDC   | Fisheries Research and Development Corporation            |
| FTO    | Fishing Tour Operators                                    |
| GIS    | Geographical Information System                           |
| GPS    | Global Positioning System                                 |
| NAFMW  | Northern Australian Fisheries Management Workshop         |
| NTFJA  | Northern Territory Fisheries Joint Authority              |
| NT     | Northern Territory  |
| NTSC   | Northern Territory Seafood Council                        |
| OCS    | Offshore Constitutional Settlement                        |
| MFEU   | Marine and Fisheries Enforcement Unit                     |
| MOU    | Memorandum Of Understanding                               |
| QLD    | Queensland  |
| TRF    | Timor Reef Fishery  |
| TRFMAC | Timor Reef Fishery Management Advisory Committee          |
| UNCLOS | United Nations Convention on the Law of the Sea           |