



Australian Government

Department of the Environment and Heritage

Assessment of the
Northern Territory Aquarium Fishery

June 2005

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This document is an assessment carried out by the Department of the Environment and Heritage of a commercial fishery against the Australian Government *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 Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999*. 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 the management arrangements for the Northern Territory Aquarium Fishery

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EXECUTIVE SUMMARY

Background

The Northern Territory (NT) Department of Business, Industry and Resource Development (DBIRD) has submitted a document for assessment under Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The draft document *Assessing the Ecological Sustainability of the Northern Territory Aquarium Fishery* (the submission) was received by the Department of the Environment and Heritage (DEH) in April 2005. The submission was released for a thirty-day public comment period that expired on 23 May 2005. Three public comments were received. DBIRD provided a response to the issues raised, but no changes were made to the submission as a result of public comment.

The submission reports on the NT Aquarium Fishery against the Australian Government *Guidelines for the Ecologically Sustainable Management of Fisheries*. The DEH assessment considers the submission, associated documents, public comments and DBIRD's response to the comments.

Table 1: Summary of the NT Aquarium Fishery

Area	All inland waters and waters seaward from the coastline to the outer boundary of the Australian Fishing Zone (AFZ) (Commonwealth and State waters).																								
Fishery status	Unknown.																								
Target Species	The fishery targets over 300 species of aquarium species including Giant Clams and hard coral that are listed under the Convention on International Trade of Endangered Species (CITES). A small number of EPBC Act listed species (listed marine species) have been harvested in the past including syngnathids and sawsharks.																								
By-product Species	Byproduct is not permitted.																								
Gear	Cast nets, scoop nets, hand pumps, pots, set net, drag nets and skimmer nets.																								
Season	Year round although there is an informal closure of the fishery during the wet seasons (November-April) due to unfavourable weather conditions.																								
Commercial harvest 2003	Twelve categories accounted for 91% of the 125 487 individual specimens collected in 2003: <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Hermit crabs</td> <td style="width: 33%;">50.9%</td> <td style="width: 33%;">Sole</td> <td style="width: 33%;">2.7%</td> </tr> <tr> <td>Corallimorphs</td> <td>5.2%</td> <td>Catfish</td> <td>1.7%</td> </tr> <tr> <td>Anemones</td> <td>0.7%</td> <td>Glassfish</td> <td>1.4%</td> </tr> <tr> <td>Scats</td> <td>16%</td> <td>Clownfish</td> <td>1.1%</td> </tr> <tr> <td>Archerfish</td> <td>5%</td> <td>Blue eyes</td> <td>1.1%</td> </tr> <tr> <td>Rainbowfish</td> <td>4.3%</td> <td>Tarpon</td> <td>1%</td> </tr> </table>	Hermit crabs	50.9%	Sole	2.7%	Corallimorphs	5.2%	Catfish	1.7%	Anemones	0.7%	Glassfish	1.4%	Scats	16%	Clownfish	1.1%	Archerfish	5%	Blue eyes	1.1%	Rainbowfish	4.3%	Tarpon	1%
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Rainbowfish	4.3%	Tarpon	1%																						
Value of commercial harvest	Estimated to be between \$600 000 - \$800 000.																								
Recreational harvest	Uncertain – estimated to be minimal.																								
Commercial licences issued	23 licences issued in 2003/2004. 14 permitted the wild harvest of aquarium species for trade and, of these, 3 were permitted to collect coral. In 2004/05 13 such licences were issued and new arrangements permit all of these to harvest coral and associated benthic organisms.																								

Management arrangements	Input controlled through limited entry, closed zones and gear restrictions. Output controlled through a prohibition on the take of species listed under the NT <i>Territory Parks and Wildlife Conservation Act</i> . The Fishery recently underwent review and a range of new input and output controls are in the process of being implemented.
Export	Primarily exported to Asia in live form.
Bycatch	Bycatch is believed to be minimal and to have a high chance of survival post release.
Interaction with Threatened Species	Considered negligible due to highly selective nature of harvest and low number of vessels in the fishery.

The area of the fishery includes all inland waters and waters seaward from the coastline to the outer boundary of the AFZ, excluding designated no-harvest areas and other protected areas. Harvesting of marine specimens is mainly taken in coastal waters off northeast Arnhemland and in the Darwin area and adjacent waters due to the high abundance and diversity of quality collection sites within close proximity to the fisher's ports. Part of the fishery area is in Commonwealth waters and the fishery is managed under the NT *Fisheries Act 1988*.

The fishery targets more than 300 aquarium species. Hermit crabs were the most popular species to be harvested during 2003, accounting for 50.9% of the total harvest. Corallimorphs and anemones are also among the more common marine aquatic species harvested, while the most targeted finfish species during this period included scats, archerfish, rainbowfish, sole, catfish, glassfish, blue eyes, clownfish and tarpon. The fishery also targets marine worms, other crab species and live rock.

Included among the species targeted in the fishery are some species currently listed under CITES, such as hard corals (from families including Euphyllidae, Caryophylliidae, Dendrophylliidae, Trachyphylliidae and Acroporidae) and Giant Clams. Seahorses (*Hippocampus* spp.) are also permitted to be taken but have not been harvested since 1997. Special consideration must be given to these species in this assessment to ensure that the fishery meets with the international obligations of CITES.

The fishery has also harvested EPBC Act Part 13 listed species, including syngnathids and sawsharks. While these species have not been harvested for a number of years, they must still be considered in this assessment to ensure that any future take, as permitted under licence conditions, is sustainable.

As the fishery targets such a large range of species, it is not possible to provide biological information on each species. A brief overview of the main finfish taxa targeted by the fishery, as well as information on hermit crabs, invertebrates, live rock, giant clams and coral is included in Appendix A.

Fishing for aquarium species has been permitted in NT since the 1970s under 'C class' licences, which were endorsed for aquarium trading, aquarium collection or aquaculture purposes. In 1993 these licences were separated into three individual licences; aquarium collecting (Aquarium Fishing/Display licence), aquaculture and aquarium trading. This assessment only relates to the wild harvest of aquarium specimens under Aquarium Fishing/Display licences. A moratorium on the issue of any new such licences was implemented in 2001.

Prior to 1994, all operators with an Aquarium Fishing/Display licence were permitted to collect coral, but in 1994 a prohibition on coral harvesting was imposed. Following submissions from a number of licensees, aquarium collectors were permitted to take restricted quantities of coral. In 1998 coral collection was limited to a small area, a small total harvest and to only three operators. In 2000 a proposal to increase the harvest of coral was presented to the Ministerial Committee on NT Fisheries Development Opportunities and in 2001 new management arrangements were introduced that allow all Aquarium Fishing/Display licence holders to collect coral and other associated benthic aquarium species.

In 2003/04 14 Aquarium Fishing/Display licences were issued by DBIRD and in 2004/05 just 13 were issued. Due to the large number of aquarium fish taken in the fishery it is difficult to determine the exact amount of harvest in a given period, but in 2003 twelve categories accounted for 91% of the 125 487 individual specimens collected. This catch was mainly comprised of hermit crabs (approximately 50%), and corallimorphs, anemones and finfish species.

In 1993 the NT Aquarium Fishing Industry was worth in excess of \$270 000 per annum, of which the greater proportion was comprised of marine or exotic species. By 1998 the value of the freshwater component of the fishery alone had risen to \$273 000 from less than \$100 000 in 1993/94. In 1998 the value of the total industry was estimated to be between \$600 000-700 000. It is considered that the export of live native freshwater and marine aquarium fish was a significant contributor to this increase. While data for 2004 was unavailable at the time of preparing this report, it is believed that the value of the fishery is likely to be toward the lower end of that range.

A wide range of gear types is permitted in the NT Aquarium Fishery including cast nets, scoop nets, hand pumps and freshwater pots. DBIRD report that it is not uncommon for set nets, drag nets, pots and fish traps to also be included on licence conditions. Individual licences specify the conditions, limitations and type of gear permitted. The use of skimmer nets has also been trialled in the fishery and it is anticipated that they will be included for use in the fishery in the second half of 2005.

Of the methods available to operators in the NT Aquarium Fishery, cast nets were the most popular in 2003, accounting for 28.4% of the aquarium take (excluding hermit crabs), while scoop nets accounted for 16.8% of the total harvest. Licence conditions have not, to date, specified gear permitted to be used for coral harvesting, although this is typically done by hand using hand tools.

Direct information on bycatch in the fishery has mainly been gained from an observer program that is in place in the fishery and it is generally considered that bycatch is not significant in the NT Aquarium Fishery. The impact of the fishery on bycatch species is likely to be minimal due to the relatively small scale of harvest, the low number of operators in the fishery, and the fact that any bycatch taken is likely to have a high chance of survival.

Some species impacted by this fishery are currently listed protected species under the EPBC Act. While incidental interactions with protected species such as marine turtles and cetaceans are possible through boat strikes, they are unlikely due to the limited number of vessels permitted in the fishery. The NT Aquarium Fishery has harvested some EPBC Act listed species in the past as targeted catch, however this only occurred in extremely low numbers and has not occurred for a number of years. These interactions are assessed under Principle Two of this report.

Take of NT Aquarium Fishery species by the indigenous and recreational sectors is not believed to be significant. However, no specific management controls are in place to limit recreational take of aquarium species, apart from some recreational possession limits and minimum size limits, and

DBIRD acknowledge that some private collectors living close to coral areas would collect their own organisms rather than buy them.

The NT Aquarium Fishery is managed under Part 8, Division 12 of the NT *Fisheries Regulations 1993*, under the legislative framework of the NT *Fisheries Act 1988*.

Overall assessment

The material submitted by DBIRD demonstrates that the management arrangements for the NT Aquarium Fishery meet most of the requirements of the Australian Government *Guidelines for the ecologically sustainable management of fisheries*.

While the fishery is relatively well managed, DEH has identified a number of risks that must be managed to ensure that their impacts are minimised:

- lack of fishery specific performance indicators and performance measures for key target species, and for those species listed as EPBC Act protected species and CITES listed species;
- inadequate recording of catch and effort to a fine enough spatial scale or to species level;
- inadequate information on elements of species biology and maximum sustainable limits for key target species;
- potential risk of localised depletion of some species; and
- lack of information on the ecosystem effects of harvesting corals, corallimorphs and hermit crabs that may provide habitat for other species.

Recommendations to address these issues have been developed to gain better information on the likely impacts of the fishery and to ensure that the risk of impact is minimised in the longer term. Through the implementation of the recommendations and the continuation of a responsible attitude to the management of the fishery, management arrangements are likely to be sufficiently precautionary and capable of controlling, monitoring and enforcing the level of take from the fishery while ensuring the stocks are fished sustainably.

The management regime aims to ensure that fishing is conducted in a manner that does not lead to over-fishing and for fishing operations to be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

The operation of the fishery is consistent with the objects of Part 13A of the EPBC Act. Given the relatively small size of the fishery and DBIRD's commitment to address the above risks through the implementation of recommendations contained throughout this report, DEH considers that the fishery will not be detrimental to the survival or conservation status of the taxon to which it relates in the short term. Similarly, it is not likely to threaten any relevant ecosystem in the short term. DEH therefore recommends that the fishery be declared an approved Wildlife Trade Operation (WTO) with the actions specified in the recommendations to be undertaken by DBIRD to address potential environmental risks in the long term. DEH considers that the fishery, as managed in accordance with the management regime is not likely to cause serious or irreversible ecological damage over the period of the export decision. Specifically, the WTO declaration would allow the export of product from the fishery for a period of 3 years. The WTO declaration will require annual reporting on the progress of implementing the recommendations of this report and other managerial commitments. The implementation of the recommendations will be monitored during the life of the declaration and reviewed as part of the next DEH review of the fishery in 3 years time.

As the fishery area encompasses Commonwealth as well as State waters, consideration under Part 13 of the EPBC Act is required regarding the impact of the fishery on listed threatened species, listed migratory species, cetaceans and listed marine species. Various offence provisions of the EPBC Act state that it is an offence to kill, injure, recklessly take, trade, keep, or move a member of a listed marine species, if the member was taken in or on a Commonwealth area. It is also an offence to kill, injure, recklessly take, trade, keep, or move members of listed threatened species, listed migratory species and cetaceans. Sections 208A, 222A, 245 and 265 of the EPBC Act state that the Minister may accredit a plan of management for a fishery if satisfied that the plan requires persons engaged in fishing under the plan to take all reasonable steps to ensure that members of listed threatened species, listed migratory species, cetaceans and listed marine species are not killed or injured as a result of the fishing. Syngnathids and sawsharks, which have both been harvested in the NT Aquarium Fishery in small numbers in the past, are listed marine species under Part 13 of the EPBC Act. The NT Aquarium Fishery does not contain any management arrangements that prohibit the targeted take of these species in Commonwealth waters, nor do they prohibit the targeted take of listed threatened species, listed migratory species or cetaceans. Consequently, accreditation of the fishery under Part 13 of the EPBC Act cannot be granted at this time. If operators in the NT Aquarium Fishery wish to target members of listed marine species in Commonwealth waters in the future, a wildlife conservation plan will need to be negotiated between DBIRD and DEH to allow such harvest to take place. This arrangement has been included as a condition on the WTO declaration for this fishery.

The assessment also considered the possible impacts on species harvested in the NT Aquarium Fishery which are listed under CITES. As a party to the Convention, Australia must apply all CITES provisions of the EPBC Act to hard coral, giant clam and *Hippocampus* species imports and exports as appropriate. Under these provisions, export of CITES specimens may only occur where a permit, supported by a non-detriment finding, has been issued by the CITES Management Authority of the country of export. As Part 13A of the EPBC Act incorporates the requirements of CITES, there are no changes to the criteria for export approval, aside from administrative changes to the permits issued. As a result of the listing, specimens of hard coral, giant clam and *Hippocampus* (which may only be harvested from State waters) taken from the wild, may only be exported under a single use CITES permit, while specimens bred in captivity may be exported under either a single use or a multiple use CITES permit.

Given the precautionary trigger point for corals that has been implemented by DBIRD, their commitment to the development of performance indicators, performance measures and sustainable yield limits for CITES species including giant clams, as well as the extremely low number of syngnathids taken in the fishery in the past, DEH considers that the harvest of these species from the fishery will not be detrimental to the survival of the taxon in the wild.

The implementation of recommendations and other commitments made by DBIRD in the submission will be monitored and reviewed as part of the next DEH review of the fishery in 3 years time.

Recommendations

1. DBIRD to advise DEH of any material change to the Northern Territory Aquarium Fishery's management arrangements that could affect the criteria on which EPBC decisions are based, within 3 months of that change being made.

2. Within 1 year, DBIRD to develop fishery specific performance indicators and performance measures, linked to the existing objectives, for CITES listed species, EPBC Act listed species, Group A Finfish species and hermit crabs.
3. DBIRD to incorporate the performance measures into existing management arrangements once developed. Within 3 months of becoming aware of a performance measure not being met, DBIRD to finalise a clear timetable for a review of management arrangements and the implementation of appropriate management responses.
4. DBIRD to implement finer spatial recording of catch and effort information, and recording of catch to a species level for key target species, CITES listed species and EPBC Act listed species in compulsory commercial logbooks.
5. Within 1 year DBIRD to develop precautionary sustainable limits for hermit crabs, Group A finfish species, EPBC Act listed species¹ and CITES listed species based on existing knowledge. DBIRD to pursue research into the stock status, biology and ecology of these species on an ongoing basis within resource constraints.
6. Within 2 years DBIRD to investigate the potential for localised and serial depletion of target species within the fishery and to implement management measures to mitigate any risks identified where necessary.
7. DBIRD to conduct an ecological risk assessment on the fishery within 12 months and to develop appropriate responses to any high risks identified.

¹ 'EPBC Act listed species' relates to those species taken in the fishery that are classified as 'listed marine species' under Part 13 of the EPBC Act (ie, syngnathids and sawsharks). These species are only permitted to be harvested in State waters, not in Commonwealth waters. It should be noted that DEH does not permit the targeted harvest of cetaceans or species listed as threatened or migratory under the EPBC Act, in any part of the NT Aquarium Fishery area.

PART I - MANAGEMENT ARRANGEMENTS

The NT Aquarium Fishery is managed by the Fisheries Group of DBIRD.

The management regime is described in the following documents, all of which are, or will be publicly available:

- Part 8, Division 12 of the NT *Fisheries Regulations 1993* as a component of the *Fisheries Act 1988*;
- annual status reports for the NT Aquarium Fishery; and
- relevant Gazetted notices and licence conditions.

A number of other documents, including research reports, scientific literature and discussion papers are integral to the management of the fishery.

DEH considers it important that management arrangements remain flexible to ensure timely and appropriate managerial decisions. Because of the importance of the management regime and documents referred to above to DEH's assessment of the fishery, an amendment could change the outcomes of the assessment and decisions stemming from it. Decisions resulting from this assessment relate to the arrangements in force at the time of the decision. In order to ensure that these decisions remain valid, DEH needs to be advised of any changes that are made to the management regime and make an assessment that the new arrangements are equivalent or better, in terms of ecological sustainability, than those in place at the time of the original decision. Since DEH acts as the Australian CITES Management Authority and enforces EPBC Act legislation, DEH also needs to be advised of any changes to the management arrangements for CITES and EPBC Act listed species.

Recommendation 1: *DBIRD to advise DEH of any material change to the Northern Territory Aquarium Fishery's management arrangements that could affect the criteria on which EPBC decisions are based, within 3 months of that change being made.*

The current management regime for the NT Aquarium Fishery was developed through a consultative process, as were the recent review of the fishery and the current proposed management arrangements. These arose out of a discussion paper circulated to industry and community groups in 2001. The Aquatic Resource User Group (ARUG) forum also provides a structured process for key user groups to participate in discussions regarding the fishery. Members of ARUG include two representatives from the Fisheries Group of DBIRD, three from the Northern Land Council, one from the Tiwi Land Council, one from the Anindilyakwa Land Council, three from the Amateur Fisherman's Association of the NT and three from the NT Seafood Council. An Aquarium Committee involving commercial fishers has also recently been established to provide advice to and air concerns with DBIRD.

Although ARUG membership does not include conservation organisations, these groups are consulted and advised of fisheries issues, including issues regarding the Aquarium Fishery, through monthly meetings with DBIRD. In addition, community members are provided the opportunity to participate in and provide their views on the fishery through the release of public discussion papers.

As noted above, ARUG membership includes a number of Indigenous groups. In addition to this, DBIRD has recognised the specific cultural needs of indigenous stakeholders and has established a separate consultative process for these groups. Regional consultative committees provide formal advice in an appropriate forum for discussions with indigenous members on all aspects of fishing, including the Aquarium Fishery.

Further, the status of the NT Aquarium Fishery is discussed each year at the Northern Australian Fisheries Management Workshop. Membership of this group includes state, territory and Commonwealth fisheries managers, researchers and compliance staff.

DEH commends DBIRD on the consultative mechanisms they have established for the NT Aquarium Fishery and considers the level of consultation for the general fishery to be adequate. DEH also considers that appropriate expertise is involved in the management of the fishery and is confident that DBIRD will continue to ensure interested, and appropriate, parties are adequately consulted.

The NT *Fisheries Act 1988* contains a number of objectives that are applied to all NT fisheries. DBIRD considers that these objectives are achieved in the Aquarium Fishery through the management arrangements that are in place. DEH acknowledges that the relatively small size of the NT Aquarium Fishery and the benign harvesting methods used are likely to minimise impacts arising from the fishery. DEH also acknowledges that a number of management objectives specific to the Aquarium Fishery have been developed for target species, protected species and the general ecosystem. DEH considers that these objectives are sound, but is concerned that no fishery specific performance measures and performance indicators are currently in place (apart from a 60 tonne per annum trigger for coral). DEH believes that such indicators and measures for target species need to be developed to ensure that the performance of the fishery can be measured and management action taken as required. In particular, performance measures should be capable of detecting and responding to changes in stock status. Initially, DEH considers that the development of performance measures should focus on species listed under CITES, species listed under the EPBC Act, Group A Finfish² and hermit crabs.

Recommendation 2: *Within 1 year, DBIRD to develop fishery specific performance indicators and performance measures, linked to the existing objectives, for CITES listed species, EPBC Act listed species, Group A Finfish species and hermit crabs.*

Once developed, these performance measures and indicators should be regularly reviewed and made publicly available. A clear process for responding to a performance measure not being met is also required to ensure that where such an event is determined to be the result of fishery impact prompt management action is taken to address any threats to sustainability. DEH notes that DBIRD has identified a process to be followed in the event that a trigger value is reached, but is concerned that it is not linked to a timeframe for implementation.

Recommendation 3: *DBIRD to incorporate the performance measures into existing management arrangements once developed. Within 3 months of becoming aware of a performance measure not being met, DBIRD to finalise a clear timetable for a review of management arrangements and the implementation of appropriate management responses.*

Management of the fishery is based on a mixture of input and output controls. Such controls include:

- limited entry;
- catch restrictions;
- area and gear restrictions;
- prohibition on the take of protected species listed under the *Territory Parks and Wildlife Conservation Act*; and
- a catch trigger limit of 60 tonnes per annum for coral.

² Group A Finfish refers to those species that have an average annual catch of >2000 individuals per year.

The NT Aquarium Fishery has recently been reviewed and, as a result, a number of proposed changes to the management arrangements have arisen. These new arrangements, which were developed to improve the management regime of the fishery, are in the process of being implemented through licence conditions and fishery regulations.

Compliance with the Aquarium Fishery management arrangements is enforced under the *Fisheries Act 1988* by the Police, Marine and Fisheries Enforcement Unit (PMFEU) of the NT Police, Fire and Emergency Services. The PMFEU enforces the management arrangements of the NT Aquarium Fishery through on-the-spot inspections of harvesting activities and through targeted enforcement programs with fishers and traders. This includes verification of catch returns against processor returns. The PMFEU also has the power to investigate the premises, vessels or records of wholesalers and licensees.

The NT Aquarium Fishery is reviewed annually through the development of an Annual Status report. It is also reviewed at the Northern Australia Fisheries Management Workshop and through other, more localised, fora. DEH is supportive of DBIRD's current process of reporting annually on a fishery-by-fishery basis, but considers that these reports could be enhanced by specific reporting against management objectives, performance measures and performance indicators. DEH has made a recommendation regarding the development of these (see **Recommendation 2**) and notes that DBIRD has reportedly implemented such a reporting technique since the 2004 reporting year.

Fishery-dependent data relating to the target species is collected on a regular basis in the fishery. Some fishery independent information is also collected. Discussion of the information collection system can be found in Part II of this report.

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.

A number of the species harvested in the NT Aquarium Fishery have wide distributional ranges and stocks may be shared with other jurisdictions including Western Australia and Queensland. DEH therefore encourages DBIRD to pursue complementary management arrangements and joint research opportunities with relevant states, where appropriate.

DEH considers that the current management arrangements comply with all relevant threat abatement and recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy. DEH expects that DBIRD will also ensure compliance with any future plans or policies as they are developed.

No regional or international management regimes, to which Australia is a party, are of direct relevance to the fishery. The prime international regime affecting the fishery is the United Nations Convention on the Law of the Sea. The management regime essentially complies with this. Other international regimes are applicable to fisheries management but do not explicitly involve this fishery, for example the 1992 Convention on Biological Diversity and in particular the 1995 Jakarta Mandate requiring that, in relation to the sustainable use of marine and coastal biological diversity, the precautionary principle should apply in efforts to address threats to biodiversity. While these agreements are not specifically addressed in the Submission, the fishery's compliance with their requirements can be assessed by examination of Part II of this report. The application of the International Convention for the Prevention of Pollution from Ships to vessels operating in the fishery is addressed under Principle 2, Objective 3.

DEH considers it is incumbent on all authorities to develop a thorough understanding of the framework of national, regional and international agreements and their applicability to export-based fisheries for which they are responsible.

Conclusion

DEH considers that the NT Aquarium Fishery management regime is documented, publicly available and transparent, and is developed through a consultative process. The management arrangements are adaptable and underpinned by appropriate objectives, and DEH has recommended the development of performance criteria by which the effectiveness of the management arrangements can be measured, enforced and reviewed.

The management arrangements are capable of controlling the harvest through a combination of input and output controls appropriate to the size of the fishery. Periodic review of the fishery is provided for, as are the means of enforcing critical aspects of the management arrangements.

DEH considers that there is scope to further refine the management arrangements and has provided a number of recommendations for improvements in the longer term.

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 data are obtained through compulsory monthly logbooks. Such data has been collected from fishers operating in the NT since 1983. The logbooks must be completed for each location that harvesting takes place and include information on fishing method, catch, effort (days fishing time) and fishing location (grid number). Logbooks are required to be returned by the 28th day of the following month. At the same time, fishers are also required to provide marketing details including point of sale, number of individuals sold or the combined weight of individual species sold. This requirement allows DBIRD to validate the catch reported in commercial logbooks with that reported in the market returns. The fishery-dependent information collected for the NT Aquarium Fishery is monitored regularly using the Fisheries Database. The data is monitored for catch, effort and catch-per-unit-effort (CPUE) data by species and area.

DEH considers that the logbooks used in the NT Aquarium Fishery are likely to provide a good source of information for use in fishery status reports, but has some concern that the catch may not be reported at a fine enough spatial scale. DEH notes that the majority of fishing effort occurs in 6 grids and that during 2003 over 88.6% of effort was concentrated in just two grids. DEH considers that reporting on a grid-based level does not allow DBIRD to adequately monitor the distribution of effort in, and take from, the fishery. This is of particular concern in the NT Aquarium Fishery given that a number of harvested species are limited in distribution or are not very mobile and therefore may be at risk of localised depletion (see following section). DEH is also concerned that existing reporting requirements do not require recording of catch to a species level. The submission notes that DBIRD will continue to refine the logbook data entry process, and DEH considers that reporting of catch at a finer spatial scale, and to species level, would be beneficial to management of the fishery.

Recommendation 4: *DBIRD to implement finer spatial recording of catch and effort information, and recording of catch to a species level for key target species, CITES listed species and EPBC Act listed species in compulsory commercial logbooks.*

Observer trips have also been undertaken in the NT Aquarium Fishery to document vessel and gear details, location, fishing practices, catch composition and biological assessment of species taken. Information on the effect of fishing operations on the wider ecosystem is also collected opportunistically as part of these observer trips. In 2004, three observer trips of one day each were conducted and, prior to 2004, were undertaken opportunistically. DBIRD has confirmed that this observer program will be ongoing in the NT Aquarium Fishery and DEH commends DBIRD for implementing such a program that provides additional validation of catch and effort in the NT Aquarium Fishery.

Limited fishery-independent data is collected for the NT Aquarium Fishery due to the relatively small size of the fishery. The submission reports that a field trip undertaken in 2003 provided baseline data for the general status and health of coral within the Gove Peninsula. Fisheries officers also visited Nhulunbuy in 1999 to assess the reef in the local area. However, neither of these trips included a structured resource survey and there has been no ongoing fishery independent monitoring. DBIRD justify this lack of research on the perceived lack of threat to resources targeted in the NT Aquarium Fishery based on the low number of participants in the fishery.

This conclusion concerns DEH given that the number of participants, and in particular the number of licensees permitted to harvest coral, has increased and is likely to increase into the future as the fishery develops. In addition, the submission acknowledges that coral reefs in the vicinity of the fishery are already subject to other human impacts such as boating and fishing activity, recreational pursuits and non-commercial collection. It is also acknowledged that the most significant issue in relation to the harvesting of coral in the NT is the limited information on the extent of the coral reef systems and associated species. According to the submission, there is also limited information on growth rates, regeneration and recruitment of aquarium species. DEH considers that such knowledge gaps need to be addressed given that the NT Aquarium Fishery is developing and likely to expand in the future. However, DEH acknowledges the small size of the NT Aquarium Fishery relative to other fisheries and considers that, in the first place, DBIRD should develop precautionary sustainable limits for key target species such as hermit crabs and Group A finfish and for CITES and EPBC Act listed species based on existing knowledge. DEH also considers that knowledge gaps regarding the stock status, biology and ecology of these species should be addressed within the constraints of available resources.

Recommendation 5: *Within 1 year DBIRD to develop precautionary sustainable limits for hermit crabs, Group A finfish species, EPBC Act listed species and CITES listed species based on existing knowledge. DBIRD to pursue research into the stock status, biology and ecology of these species on an ongoing basis within resource constraints.*

Overall, given the range of fishery dependent data gathered by DBIRD and the commitment to implement **Recommendations 4 and 5**, DEH considers that there will be a reliable information collection system in place appropriate to the scale of the fishery.

Assessment

No formal stock assessments are undertaken for the NT Aquarium Fishery and, as a consequence, no sound estimate of the potential productivity of the fished stocks and the proportion that could be sustainably harvested is available. DEH has recommended that DBIRD develop precautionary sustainable yield limits for key target species in the fishery such as hermit crabs and Group A finfish species, as well as for CITES listed and EPBC Act listed species (**Recommendation 5**). For the NT Aquarium Fishery, logbook data is used to produce catch and effort data which DBIRD uses for fishery assessment purposes. Such data is reviewed and annually reported as part of the fishery status reports. DEH has some concerns with the capacity of CPUE data to reflect changes in the status of stocks for this fishery, particularly given the difficulties in standardising effort as a result of the varied nature of the species targeted and the gear types used. The submission reports that CPUE increased from 220 fish/fishing day in 1999 to approximately 265 fish/fishing day in 2003. However, DEH does not consider that this provides a good indication of the status of the fishery since it is possible that the catch composition could have changed over this period while still maintaining a level, or increasing, total catch. DEH suggests that the use of CPUE data for fishery assessments would be more useful if it were used on an individual species basis. DEH recognises that the large number of species taken in the NT Aquarium Fishery would make this impractical for

every species harvested, but suggests that this technique would be most important for hermit crabs and Group A finfish species, which are reported by DBIRD to comprise approximately 50% and 24% of the total take in the NT Aquarium Fishery respectively.

Research into the distribution and spatial structure of species targeted in the NT Aquarium Fishery has not been extensive. Generally, finfish, coral species and invertebrates targeted in the fishery have a wide distribution throughout Australia and are found in a wide array of habitat types. However, DBIRD states that in 2003 over 88.6% of effort was concentrated within two grids and that in the same period 89.8% of the total catch was also collected from these same grids. Further, of the 606 158 hermit crabs harvested in the fishery from 1995-2003, 89.4% were harvested within just one grid. Within this grid, two areas reportedly accounted for 65.2% of the total hermit crab take. This pattern of collection sites is also repeated for corallimorphs, coral and anemones. While the majority of species targeted in the fishery are widespread, highly fecund and abundant, a number of species targeted may be at risk of localised and serial depletion, including corals, giant clams, syngnathids and hermit crabs. DEH considers that DBIRD needs to identify those species that are susceptible to localised depletion and investigate the potential for localised depletion in the NT Aquarium Fishery.

Recommendation 6: *Within 2 years DBIRD to investigate the potential for localised and serial depletion of target species within the fishery and to implement management measures to mitigate any risks identified where necessary.*

DEH notes that DBIRD's ability to identify areas at risk of localised depletion is dependent on adequate recording of catch and effort in the fishery. DBIRD claims that the current logbooks utilised in the fishery provide spatial information on fishing effort and catch rates. DEH has concerns regarding the ability of the existing logbooks to adequately monitor the distribution of fishing effort and has recommended that DBIRD ensure catch and effort is recorded at a finer scale in the future (see **Recommendation 4**).

Potential removals from the target stocks of the NT Aquarium Fishery include direct harvest by operators in this fishery and in similar fisheries in adjacent jurisdictions, removals of the same species by other dedicated NT fisheries, and recreational and Indigenous harvest.

As noted in the previous section, commercial catch is recorded in the NT Aquarium Fishery in compulsory logbooks and through observer trips. All commercial fish traders are licensed by DBIRD and are also required to complete compulsory logsheets identifying the quantity and source of any product traded. DEH considers that this enables validation of information recorded in fisher's logbooks and therefore accurate estimations of stock removals by the commercial sector.

Dedicated marine aquarium fisheries operate in jurisdictions adjacent to the NT, however stocks are unlikely to be shared across State and Territory borders. Regardless, DEH believes it would be beneficial for DBIRD to pursue cross-jurisdictional actions to address any issues common across aquarium fisheries. DEH notes that some restrictions are imposed for species taken in other NT fisheries including mud crabs, Spanish mackerel and barramundi and commends DBIRD for taking account of removals from other NT Fisheries in managing the NT Aquarium Fishery.

Recreational collection of aquarium specimens is believed to be insignificant. Neither the Fishcount 95 survey (Coleman, 1998) nor the National Recreational and Indigenous Fishing Survey (Henry and Lyle, 2003) of recreational fishers detected aquarium fish collection, despite specifically asking a question about this type of aquatic resource use. Specific management controls to limit recreational take of aquarium species is limited to some recreational possession limits and minimum

size limits. DBIRD acknowledges that some private collectors living close to coral areas would collect their own organisms rather than buy them, and this take should be factored into any fishery assessments undertaken by DBIRD. DEH acknowledges that DBIRD has attempted to quantify take by this sector in the past, and encourages DBIRD to continue those surveys undertaken in 1995 and 2000 into the future.

Management response

A number of management measures are utilised in the NT Aquarium Fishery to control the level of take including limited entry, gear restrictions, area restrictions and catch restrictions. DEH notes that entry to this fishery was limited to 14 licences in 2003/04 that enabled participants to collect aquarium specimens. However, DEH also notes that as a result of recent licence reviews, all Aquarium Fishery/Display Licence holders are now able to collect coral, sea fans, anemones, corallimorphs, living rock, coral rubble, sand and sponges, whereas previously only 3 operators were permitted to harvest these species. DEH is concerned that, while the total number of participants in the NT Aquarium Fishery may be limited, the amount of effort and targeted species harvested is not limited as long as DBIRD expands the permitted species available for harvest under existing licences. DEH is also concerned that this recent increase in operators able to target some species was not accompanied by a risk assessment or other precautionary decision tool to guide such a management change. Given the lack of data on the status of most species taken in the fishery, it is not possible to determine how this management change would affect the sustainability of species taken in the fishery, however DEH has recommended that DBIRD develop precautionary sustainable yield limits for key target species and CITES and EPBC Act listed species (**Recommendation 5**) to determine the ecological sustainability of the current level of take. DEH has also recommended that DBIRD advise DEH of any changes to management arrangements of the fishery, particularly changes to management of CITES or EPBC Act listed species, in the future (see **Recommendation 1**).

While the fishery area is large, only a small proportion of this total area is utilised in the fishery. This is mainly because there are resources available in close proximity to population centres which provides an economic incentive for fishers to target those areas while leaving areas further from population centres largely untouched. In addition, while all inland waters are included in the fishery area, there is only limited access to more than 70% of these areas as a result of restrictions imposed by Indigenous and private ownership of land, Nature Parks and NT Conservation Park regulations, and marine exclusion zones. Formal spatial closures of some areas are also enforced, while informal closures occur as a result of unfavourable weather conditions during the monsoon season. DEH considers that such closures allow protection of large portions of the total aquarium fishery stocks, but is concerned that as a result, fishing effort is highly concentrated into a small area. This has the potential to lead to localised depletion of some species, and DEH has recommended that DBIRD address this issue as a priority (see **Recommendation 6**).

No reference points to trigger management action are currently in place for the NT Aquarium Fishery as a result of the multi-species nature of the fishery and large fluctuations in catch for individual species from year to year. DEH acknowledges the difficulty in assigning reference points to individual species when hundreds of taxa are targeted in any one year but notes that DBIRD has established two Groups (Group A and Group B) for finfish species based on their annual catches from 2000-2003. Group A species have an average annual catch of >2000 individuals per year and contributed to 23.9% of the total harvest for the fishery during 2003. Given that the fishery targets a number of CITES listed species (corals and giant clams), has taken EPBC Act protected species in the past (syngnathids and sawsharks) and has a large proportion of the total catch comprised of hermit crabs, DEH considers it is necessary for performance measures to be developed and has suggested they be developed for CITES and EPBC Act listed species, hermit crabs and Group A

finfish species (**Recommendation 2**). DEH notes that an interim reference point of 60 tonne annual catch has been set for all coral and associated benthic species and that industry is reportedly committed to developing more specific triggers for these species. DEH commends DBIRD for taking this first step and considers that more specific reference points will be developed as part of the implementation of **Recommendation 2**.

No byproduct is taken in the NT Aquarium Fishery.

Conclusion

DEH considers that the management regime in the NT Aquarium Fishery is appropriately precautionary and provides for the fishery to be conducted in a manner that does not lead to overfishing. DEH considers that the information collection system and management arrangements generally are sufficient to ensure that the fishery is conducted at catch levels that maintain ecologically viable stock levels with acceptable levels of certainty.

DEH considers that there is scope to further refine some of the existing information collection, assessment and management responses and has provided a number of recommendations for improvements in the longer term.

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’*

This objective is not applicable to the fishery at present. Management arrangements are in place to prevent overfishing of species in the NT Aquarium Fishery, and performance measures and performance indicators will be developed in the fishery in accordance with **Recommendation 2**.

Conclusion

DEH considers that the NT Aquarium stock is not below a defined reference point but should that occur in the future, the fishery is conducted such that there is a high degree of probability the stock would recover to ecologically viable stock levels within nominated timeframes.

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

DBIRD state that the restrictions on gear and the highly selective fishing methods employed are unlikely to result in bycatch being taken in the NT Aquarium Fishery. Consequently, no information collection system is in place explicitly for recording bycatch. However, an observer program has been implemented in the NT Aquarium Fishery, and information on bycatch abundance and composition is collected as part of this program. Given the wide range of fishing gear permitted to be used in the fishery such as set nets, drag nets, a fish trap and marine and freshwater pots, DEH considers that potential exists for bycatch to be taken and commends DBIRD for implementing such a reliable system for the monitoring of bycatch in the fishery.

Assessment and Management response

Due to the perceived low risk of taking bycatch in the NT Aquarium Fishery, no bycatch risk assessment has been conducted and no specific management measures are currently in place. Generally, the hand harvest of specimens limits bycatch to those organisms living on or within specimens targeted in the fishery. DEH has noted, however, that a wide range of gear types are permitted in this fishery and some of them could result in the capture of bycatch species. DEH does not consider that impacts on bycatch would be significant, particularly given the likely high survivability of any bycatch species and notes that the observer program currently in place in the NT Aquarium Fishery provides an excellent means of monitoring bycatch taken in the fishery. DEH expects that, if the results of this observer program indicated a significant change in the composition or abundance of bycatch, DBIRD would implement appropriate management measures.

Conclusion

DEH considers that there is a high likelihood the fishery is conducted in a manner that does not threaten bycatch species. Should this situation change, or a risk assessment process indicate otherwise, DEH expects that DBIRD would undertake appropriate actions to ensure that bycatch species are not threatened by this fishery.

Protected species and threatened ecological community protection

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

Protected species occurring in the area include cetaceans, sawsharks and sawfish, syngnathids, sea snakes and marine turtles. No interactions with endangered, threatened or protected species have been recorded to date, with the exception of syngnathid, sawshark and sawfish harvest, and harvest of CITES listed corals and giant clams.

A number of species listed under the EPBC Act have been recorded in commercial logbooks as targeted catch including a seahorse, sawfish and sawsharks. DEH sees it as encouraging that such interactions are being reported to DBIRD and considers it is likely to be a result of DBIRD's commitment to raising awareness of the requirement to report interactions. DBIRD has initiated a number of measures to raise awareness, improve identification skills and facilitate reporting of threatened species within all NT Fisheries including the Aquarium Fishery including:

- issuing commercial logbooks that include information detailing reporting requirements for all interactions with endangered, threatened or protected species under the EPBC Act and relevant contact details;
- producing and widely circulating to fishers an additional information sheet detailing reporting requirements and providing relevant contact details; and
- providing fishers with a copy of the "Protected Marine Species Identification Guide" produced by Oceanwatch (which also details reporting requirements).

In addition to the circulation of educational material, DBIRD continually emphasises with fishers the need to be aware of and to report all interactions with threatened, endangered or protected species through industry meetings and in the course of ongoing consultations.

Assessment

With the exception of those protected species that have been harvested as targeted species in the NT Aquarium Fishery, limited data are available on protected species interactions in the NT Aquarium Fishery and an assessment of the impact of the fishery on protected species has not been done. DEH considers that the most likely negative impact on protected species, apart from the harvest of syngnathids, sawfish and sawsharks, and CITES listed species, would be boat strikes. Given the limited number of participants in the NT Aquarium Fishery, boat strikes are likely to only occur infrequently and would be unlikely to constitute a significant impact on protected species.

DEH notes that some protected species have been harvested as targeted species in the NT Aquarium Fishery in the past. This has included one syngnathid, one sawfish and one sawshark in 1997 and an additional sawshark in 2001. DEH notes that, while this harvest has been extremely low and has not occurred for a number of years, there are currently no management arrangements in place for the NT Aquarium Fishery that limit the take of these species. DEH has recommended that DBIRD determine sustainable yield limits for a number of species, including those listed marine species that have been harvested in the fishery (**Recommendation 5**). Because there are currently no management arrangements for the NT Aquarium Fishery that prohibit the targeted take of listed marine species in the Commonwealth Marine Area, or the take of listed threatened species, listed migratory species and cetaceans, DEH is unable to accredit the fishery under Part 13 of the EPBC Act. Consequently, if fishers wish to target syngnathids, sawsharks or any listed marine species in the Commonwealth Marine Area in the future, a wildlife conservation plan will need to be negotiated between DBIRD and DEH and implemented. This arrangement has been included as a condition of export for this fishery. DEH considers that, in the event that such a wildlife conservation plan is implemented, the precautionary sustainable yield limits that are to be developed for these species, as well as the requirement for fishers to record all catch in compulsory logbooks, will ensure that the harvest of these species is monitored and ecologically sustainable.

No assessment on the impact of harvest on giant clams or corals has been conducted to date. This concerns DEH given that most populations of giant clams are considered to be seriously depleted (Willan and Dredge, 2004) and there is a general lack of knowledge regarding coral reef systems in the NT. However, DBIRD has committed to developing sustainable yield limits for key target species, and for these CITES listed species (**Recommendation 5**). DEH considers that the implementation of these recommendations will help to demonstrate that the NT Aquarium Fishery is not detrimental to the survival of these species in the wild, as required under the EPBC Act.

No listed ecological communities are found in the fishery area.

Management response

Measures to manage the impact of the NT Aquarium Fishery on protected species are limited, since DBIRD consider the significance of interactions to be negligible given the low number of protected species harvested in the fishery. DEH acknowledges that the current level of harvest of these species is low, but is concerned that there are currently no measures in place to limit the take of these species in the event that increased effort was directed onto them. However, DEH considers that the development of performance indicators and performance measures for EPBC Act listed and CITES listed species (**Recommendation 2**), the development of precautionary sustainable yield limits for these species (**Recommendation 5**), and the requirement for a wildlife conservation plan to be developed and implemented prior to the harvest of listed marine species in Commonwealth waters being permitted, will assist in obtaining further information on the impact of harvest on protected species and improve management strategies to protect these species.

Apart from interactions with protected species caused by direct harvest, there is limited potential for incidental interactions with protected species through capture as bycatch or through boat strike. DEH considers that DBIRD has provided sufficient material to industry and communicates with industry effectively enough to ensure that interactions will continue to be reported and expects that, if such interactions were to increase in the future, DBIRD would respond through the implementation of appropriate management measures.

Conclusion

DEH notes that there are minimal interactions with protected species in the NT Aquarium Fishery (apart from the permitted harvest of some CITES listed and EPBC Act listed species) and considers that 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. Should this situation change, or a risk assessment process indicate otherwise, DEH suggests that appropriate actions be undertaken to ensure the fishery avoids mortality of, or injury to, these species and avoids or minimises impacts on threatened ecological communities.

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

No studies have been undertaken to document and quantify the impacts on the ecosystem of activities associated with the NT Aquarium Fishery, with the exception of some observations of harvested areas from video recording in December 2003. The submission acknowledges that currently little to no information is collected on the effects of commercial collection of aquarium species on the general ecosystem. While aware of the lack of information collection and research covering the fisheries impact on the ecosystem and environment generally, DEH understands that this lack of information is the case across a range of Australian and International fisheries and, until appropriate research techniques and programs are developed and implemented, this will continue to be the case. DEH strongly supports research in this area.

Assessment

No risk assessment of impacts on the ecosystem from the NT Aquarium Fishery has been conducted, although the potential of the fishery to impact unacceptably and unsustainably on the

environment generally is considered to be low, due to its relatively small size, low catch and effort, and area restrictions.

DEH considers that the most significant impact is likely to be derived from the removal of species targeted in the fishery. Given that the total catch in the fishery is spread across a large number of species, the impact to most individual species and associated food chains is likely to be low. While there is potential for such impacts to be exacerbated by the small spatial distribution of fishing effort, DEH considers that the implementation of **Recommendation 6** will help to address the risk of localised depletion.

DEH notes that during 2003, hermit crabs made up 50.9% of the total take in the NT Aquarium Fishery while corals, corallimorphs and anemones also make up a significant proportion of the total catch. The harvest of species such as these is of concern to DEH given that, as hermit crabs are harvested, so too is habitat (ie, their shells), which is then unavailable to future generations of hermit crab. Similarly, corals and anemones are likely to provide important habitat for a range of species occupying the area of the NT Aquarium Fishery. DEH considers that a risk assessment, focusing on the impacts of removing the major target species, should be conducted using available information on the fishery, to identify and respond to any significant risks caused by the fishery to ecological communities and habitats.

Recommendation 7: *DBIRD to conduct an ecological risk assessment on the fishery within 12 months and to develop appropriate responses to any high risks identified.*

Water quality and air quality are not considered to be at significant risk from the NT Aquarium Fishery operators due to the gear used and small number of vessels operating in the fishery.

Management response

No management measures are in place to specifically minimise the effects of harvesting aquarium species on the wider ecosystem although section 29 of the *Fisheries Act 1988* enables the NT Minister to take appropriate remedial actions in the event that a significant impact on the ecosystem is detected. DEH notes that current management measures to protect the target species, including limited entry, gear restrictions, area restrictions and some catch restrictions, may provide some mitigation for the ecosystem effects of harvesting aquarium species.

DEH considers that there is a potential risk of localised depletion for a number of species targeted in the fishery, which could have subsequent impacts on the ecosystem. DEH has made a recommendation (**Recommendation 6**) to address the issue of localised depletion and serial depletion, which should also address potential ecosystem impacts and ensure that the impact of removal of the species on the ecosystem is minimised.

The National Oceans Office is currently leading a regional marine planning process in the area of the fishery. The planning process aims to ensure the ecologically sustainable use of the resources in the planning area and will help to integrate management across jurisdictions and sectors. It will also identify potential candidate areas for the National Representative System of Marine Protected Areas. The regional marine planning process is a potential vehicle for pursuing sustainable fisheries objectives, particularly where cross-sectoral or cross-jurisdictional approaches are required. DBIRD should continue to engage in the process as far as practical. More information is available at www.oceans.gov.au.

Conclusion

DEH considers that the fishery is conducted in a sufficiently precautionary manner to minimise the impact of fishing operations on the ecosystem generally. Recommendations have been developed to ensure that the risk of significant impact by the fishery on the marine environment generally is minimised in the longer term.

REFERENCES

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Henry, G.W. and Lyle, J.M. (eds) 2003. *National Recreational and Indigenous Fishing Survey*. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.

Willan, R. and Dredge, M. (2004) Molluscs. In: National Oceans Office. *Description of Key Species Groups in the Northern Planning Area*. National Oceans Office, Hobart, Australia.

LIST OF ACRONYMS

AFZ	Australian Fishing Zone
ARUG	Aquatic Resource User Group
CITES	Convention on the International Trade of Endangered Species
CPUE	Catch-per-unit-effort
DBIRD	Department of Business, Industry and Resource Development
DEH	Department of the Environment and Heritage
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
NT	Northern Territory
PMFEU	Police, Marine and Fisheries Enforcement Unit

APPENDIX A

Species distribution and biology (modified from NT submission *Assessing the Ecological Sustainability of the Northern Territory Aquarium Fishery*)

Aquarium Finfish Species

***Ambassis agrammus* (Sail-fin Glassfish)**

A. agrammus is quite common and is found in the NT and the Cape York Peninsula. This species inhabits rivers and streams, sometimes in stagnant pools or slow flowing areas. It can also be found in swamps, along margins of lakes and shelters amongst aquatic vegetation. Both sexes are sexually mature at the length of 30 - 35 mm. Spawning of the Magela Creek population occurs in freshwater at the start of the wet season. Females can produce up to 1000 eggs.

***Amniataba percoides* (Banded Grunter)**

Capable of tolerating a wide range of habitats and water conditions, *A. percoides* is widely distributed in Northern Australia and is commonly found in all major river systems. Spawning occurs from mid August through to mid March in a variety of habitats with females capable of producing up to 125,000 small eggs. *A. percoides* may grow to 25 cm with males reaching maturity at an approximate length of 77 mm and females at 88 mm. Females between the weights of 70 and 90 g are capable of laying 40,000 – 77, 000 small eggs.

***Arius berneyi* (Berney's Catfish)**

The Australian range for *A. berneyi* is from the Mary River system, NT through to the Gulf of Carpentaria drainage, Queensland and is commonly found in rivers, smaller streams, slow flowing waters of turbid conditions. In the NT, *A. berneyi* is usually found in the Roper River area however, is not abundant. *A. berneyi* can grow up to 30 cm in length. Breeding season is usually between September to October and may occur in January to February if fish are in good condition.

***Amphiprion ocellaris* (False-Common Anemonefish)**

Occurring in the NT, northwest of Australia and throughout South East Asia, *A. ocellaris* inhabits coral reefs and is associated with large sea anemones. *A. ocellaris* are protandric hermaphrodites which first reach sexual maturity as males and which can later change into females if the dominant female dies.

***Brachirus selheimi* (Freshwater Sole)**

B. selheimi is found in Northern Australia from the Gulf of Carpentaria drainage in Queensland through to Darwin in the NT. It has a patchy distribution and is found in clear or brackish waters with rocky or sandy substrates. Little is known about this species biology or reproduction.

***Craterocephalus stercusmuscarum* (Flyspecked Hardyhead)**

C. stercusmuscarum is common and abundant throughout the Gulf and Timor drainage within the NT. They are found in a variety of habitats including rivers, small streams, lakes and ponds and in some habitats can have seasonal abundance. Chromatic dimorphism is displayed near spawning and breeding season can run from mid October through to mid February. Larvae hatch at length of approximately 3.5mm and have to capacity to grow to a length of 100mm as adults.

***Glossamia aprion* (Mouth Almighty)**

G. aprion is wide spread across Northern Australia being a solitary fish commonly found amongst still waters with dense aquatic vegetation. Spawning within the NT is believed to occur throughout the year, with up to 250 eggs being laid and brooded within the males mouth. *G. aprion* can grow up to 20cm in length and sexual maturity is believed to be reached at a length of 7.5cm.

***Hypseleotris compressa* (Empire Gudgeon)**

H. compressa is widely distributed throughout Australia and is commonly found in NT coastal waters. Both males and females are mature to reproduce at lengths of 40 to 50 mm with the potential to grow up to 110 mm in length. Sexual dimorphism is displayed and breeding occurs during the wet season. Females can lay up to 3000 eggs per batch and up to 40,000 eggs within a breeding season.

***Lates calcarifer* (Barramundi)**

L. calcarifer is found in all the large coastal river systems of northern Australia and inhabits rivers, creeks and mangrove estuaries in clear to turbid waters. Breeding season is between September to March with two peaks during November to December and February to March. Females can lay millions of tiny free-drifting eggs which hatch at a length of 1.5 mm and grow rapidly to 20 cm within 10 months and can grow to 50 cm within 3 years. Sexual maturity is reached at an age of 3 to 4 years or length 55 – 70 cm. Males at age 5 years undergo a rapid post spawning sex transition to females.

***Melanotaenia nigrans* (Black-Banded Rainbowfish)**

M. nigrans has a wide and patchy distribution within the NT. It usually inhabits coastal streams within 40 km of the sea, in a wide range of habitat types, and is generally absent from the main streams of larger river systems. Females and males grow to a length of 6 and 7 cm respectively. These fish have been successfully bred and raised in aquaria, but their breeding habits in the wild are unknown.

***Melanotaenia splendida australis* (Western Rainbowfish)**

Melanotaenia splendida australis have a discontinuous distribution and are found in isolated populations in Western Australia and the NT. Males grow to an approximate length of 9 cm and females grow to a length between 7.5 and 8 cm. These fish may breed at any time of the year but there appears to be a peak in spawning during the early wet season.

***Melanotaenia splendida inornata* (Chequered Rainbowfish)**

M. splendid inornata are found from the Mary River system eastwards to the Jardine River on Cape York. They are found in a wide variety of habitats and are among the most common freshwater fishes. Females and males grow to 9 and 10 cm respectively. These fish may breed at any time of the year but there appears to be a peak in spawning during the early wet season.

***Melanotaenia trifasciata* (Banded Rainbowfish)**

M. trifasciata has discontinuous distribution in the NT and is also found in Cape York. They are usually found in small streams and waterholes with clear to moderately turbid waters, amongst vegetated areas or logs. Females and males grow up to 10 and 11 cm in length respectively. Little is known about spawning outside captivity.

***Mogurnda mogurnda* (Purple Spotted Gudgeon)**

M. mogurnda can be found in a number of freshwater systems such as dams, billabongs, bores, rivers, muddy swamps or sandy creeks. They have a wide range of physiological tolerances that enable them to inhabit such a range of environments. Their distribution within Australia is from the Fitzroy River, Western Australia to the Gulf of Carpentaria drainage of Queensland and the Lake Eyre drainage system. Breeding takes place between November and February, with sexual dimorphism exhibited. Females can lay up to ten batches of eggs within the breeding season with each batch containing between 100 to 150 eggs. Males remain to guard the eggs and fan them with a current of water until they have hatched, which takes approximately 9 days.

***Monodactylus argenteus* (Silver Batfish)**

M. argenteus has a wide range within coastal drainage areas and is commonly found in estuaries and lower reaches. It is a schooling fish (which can grow up to 28 cm).

***Porochilus rendahli* (Rendahl's Catfish)**

P. rendahli is found in coastal river systems in the NT and is commonly found in large schools. Preferred habitat is floodplain lagoons and creeks where vegetation is thick and the bottom muddy. Adults can reach a maximum length of approximately 20 cm and breeding occurs in the early wet season producing approximately 900 small eggs.

***Scleropages jardinii* (Saratoga)**

S. jardinii has patchy distribution from the Gulf of Capentaria through to the Adelaide River system. Preferred habitat is billabongs, clear and quiet streams often with dense vegetation and are not found where tidal influence is present. Adults generally grow to a size between 50 – 70 cm, and are able to breed at the approximate length of 45cm or 5 years old. *S. jardinii* are mouth brooders and breeding season is between October and November with 50-90 eggs being laid at a time. No sexual dimorphism is displayed.

Scats

Scatophagus argus and *Selenotoca multifasciata* have a wide range within Australia and other Indo-Pacific areas. They inhabit harbours, brackish mangrove estuaries and lower reaches of freshwater stream habitats. Species reach at least 100 cm in length, but specimens caught in freshwater are usually 30 – 50 cm. Little is known on the reproductive biology or growth of *S. argus* or *S. multifasciata*. Large schools of *S. argus* juveniles have been sighted during the wet season.

***Toxotes chatareus* (Common Archerfish)**

T. chatareus is common throughout far northern Australia, found in mangrove estuaries and freshwater streams from Derby, Western Australia to Townsville, Queensland. It is known to travel up to 200 km upstream from the sea. The species is frequently found in schools patrolling near banks or overhanging vegetation. Studies on NT populations indicate that there is no sexual dimorphism. Maturity of males and females is attained at lengths of approximately 200 mm and between the age of 1 and 2 years. Gonads rapidly mature late in the dry season and breeding season begins in the early wet. *T. chatareus* spawns in freshwater producing tens of thousands of eggs each spawning. Growth is fastest during the first wet season, where individuals reach lengths of 70 to 90 mm after 6 months and up to 80 – 110 mm within the first year.

Corals

All hard and black corals are listed in appendix II of CITES and as such an export permit or re-export certificate issued by the Management Authority of the State of export or re-export is required. From discussions with taxonomists, the aquarium industry, and monitoring agencies, it seems that there can be a high degree of difficulty in identifying many corals to the species level. There are no clear boundaries in the definition of coral and a particular species may vary significantly from one location to another. Several species look similar and can be separated only by examination of the skeleton.

Hermit Crabs

Hermit crabs inhabit a wide range of habitat types including open sandy beaches, rocky platforms, sand and mud flats and mangrove forests. Hermit crabs inhabit shells to protect their abdomens, which lack an exoskeleton. Inshore seas and coastal regions of Darwin support very large populations of hermit crabs, both aquatic and terrestrial. Nineteen species of hermit crabs have been recorded within the Darwin and Port Essington area and three species from other areas within the NT. Two families of aquatic hermit crabs commonly found in the NT are Paguridae and Diogenidae

and terrestrial hermit crabs comprise the family Coenobitidae. Very little is known about the life history or biology of Australian hermit crabs.

Live Rock / Sand

Living rocks are mostly pieces of dead hard coral detached from reefs and colonized by other organisms, including other corals, sponges and coral morphs. They are an attractive aquarium display and some of the attached organisms are useful in maintaining the quality of aquarium water. Coral rubble and sand are a result of the breakdown of dead coral and are used for decoration, and as a substrate in aquaria.

Giant Clams

Giant Clams are bivalve molluscs. They obtain food by filtering microscopic plants (phytoplankton) from the surrounding water. The clams are also able to obtain nutrients from small algae (zooxanthellae) that live in their mantle. The zooxanthellae produce food by photosynthesis (using sunlight). Giant clams are protandric hermaphrodites: they mature first as males in two to three years, then develop gonads with both sperm and egg releasing components. Size and age at maturity varies with species and geographical location. After the eggs hatch, the larvae develop through several stages while drifting in the water column until they settle on the substrate, normally within ten days of being released. The clams attach themselves to the sea floor by sticky strings called byssal threads. Larger species lose this attachment as they grow to adults.