

Northern Territory aquarium fishing – display fishery

Ecological risk assessment 2019



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Contact details	Department of Industry, Tourism and Trade, Fisheries Division
Approved by	Glenn Schipp, Director Fisheries and Aquaculture
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Abbreviations	Full form
AFZ	Australian Fishing Zone
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DAWE	Department of Agriculture, Water and Environment
DITT	Department of Industry, Tourism and Trade
EMS	Environmental Management System
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
ERA	ecological risk assessment
ESD	ecologically sustainable development
IHL	interim harvest limit
ITF	Indonesian Through Flow
NDF	non-detrimental findings
NT	Northern Territory
NTSC	Northern Territory Seafood Council
WTO	Wildlife Trade Operation

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1. Executive summary

This report documents an ecological risk assessment (ERA) conducted on the Northern Territory aquarium fishing/display fishery (aquarium fishery) in 2019. The ERA updates the ecological risks posed by the fishery since the last ERA in 2014. This ERA will inform the development of a new management framework and harvest strategy for the aquarium fishery. The report provides background information on the aquarium fishery as well as information used to inform the ERA process.

This ERA assessed sixty issues relating to species, habitats and ecosystems affected by the activities of the aquarium fishery. Thirty-three issues examined were identified as negligible or low risk, predominantly due to the targeted nature of operations/collection/capture methods in the fishery having minimal interactions with non-target species. Eighteen issues were identified as moderate risk and nine as high risk. The primary reasons for the moderate and high risk ratings for selected species are lack of data on distribution and abundance of species in the Territory, and a gap in our knowledge on the ecosystem impacts of harvesting corals by the commercial aquarium industry.

2. Introduction

A significant increase in the harvest of hard corals during the 2018-19 licencing year prompted a decision to conduct another ERA on the aquarium fishery in July 2019. This followed previous ERAs on the fishery in 2006 (Territory Government, 2006) and 2014 (Territory Government, 2018).

Export approval for species collected in the fishery is contingent upon the status of the fishery and the Department of Industry, Tourism and Trade (DITT) addressing recommendations made by the Australian Government Department of Agriculture, Water and Environment (DAWE). One recommendation was to develop a harvest strategy and management plan for the aquarium fishery. The outcomes from the 2019 ERA will guide this process.

This report supports management of the aquarium fishery to be effective and efficient in the context of achieving ecologically sustainable development (ESD) outcomes. Under the Territory's *Fisheries Act 1988* (the Act), the principles of ESD are required to guide the management of fisheries and aquatic resources in the Territory, in addition to meeting the statutory requirements and national environmental legislation. This approach also provides the fishing industry and key stakeholders with an opportunity to contribute to management outcomes. The issue identification, risk assessment, and reporting process described in detail below. The format of this report is based on the National ESD Framework How To Guide (see www.fisheries-esd.com.au).

This report outlines the risks identified through the ERA and includes details of the rationale used to assign risk levels. The scope of this report includes harvested species of hard corals (Scleractinia), soft corals, live rock, giant clams, anemones, fish and hermit crabs. The incorporation of expert knowledge and the principles of ecosystem-based fisheries management provide the best available information to inform future management and research.

The following section outlines the background aquarium fishery, including a brief summary of the management history and current activity, and outlines the risk assessment methodologies used, as well as the rationale behind assigned risk levels in the fishery.

3. Background

3.1. Description of the fishery

The aquarium fishery is a small-scale, multi-species fishery that prospects freshwater, estuarine and marine habitats in the Territory to the outer boundary of the Australian Fishing Zone (AFZ). The fishery supplies a wide range of aquarium fishes and invertebrates to local, interstate and international pet retailers, wholesalers and public aquariums.

Since 2010, the fishery has transitioned from predominantly freshwater harvesting to primarily harvesting marine fish and invertebrates. Consequently, there is a lack of long-term historical data for the harvest of marine species, particularly hard corals, so precautionary harvest limits have been applied to a number of species. Reassessment of the 2016 Wildlife Trade Operation (WTO) provided a modest increase in harvest limits for eight key coral species. These increases were based on the non-detrimental findings (NDF) for the species using outcomes from the ERA conducted by the fishery in 2014.

The increase in harvest limits for key species is important to promote industry growth. The current harvest of hard corals in the Territory (2.57 tonnes in 2018-19) is small compared to that in both Western Australia (permitted harvest of 20 tonnes) and Queensland (85 tonnes in 2017-18).

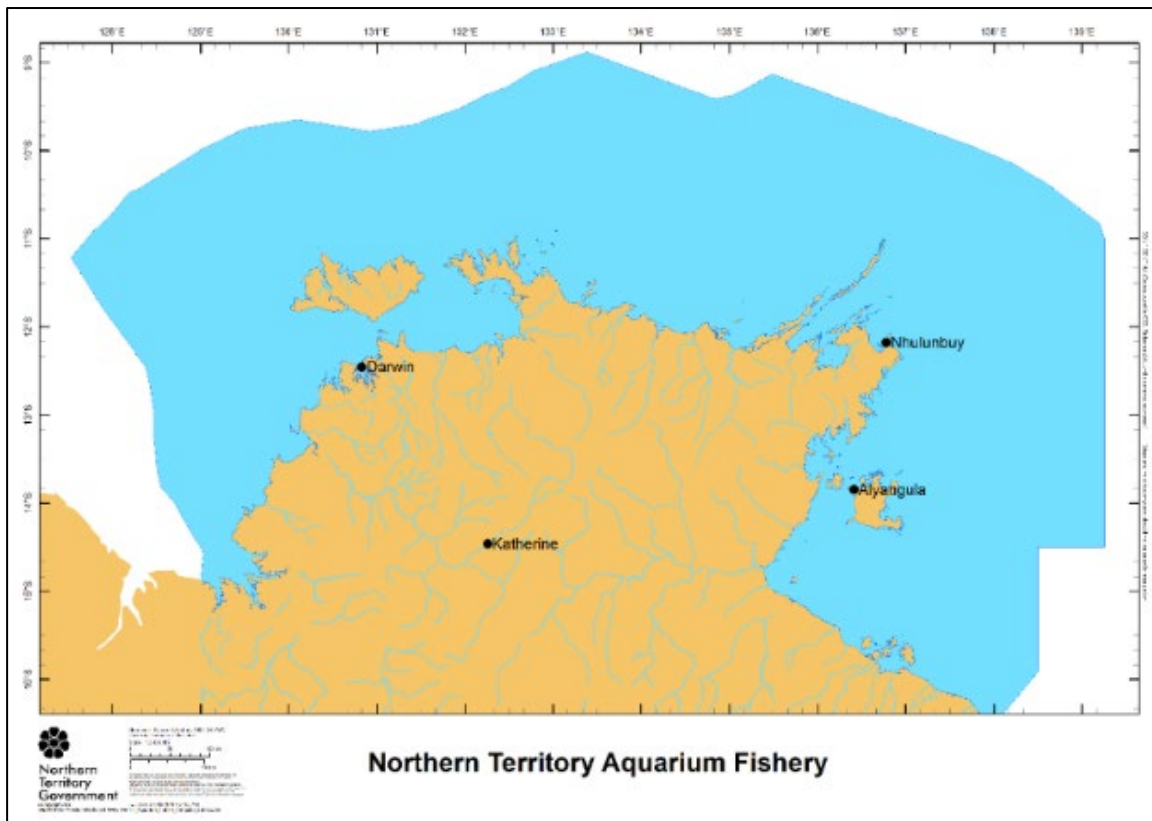
3.2. Fishery area

Aquarium fishery licensees may harvest from inland, estuarine and marine waters of the Territory to the outer boundary of the Australian Fishing Zone, covering 523,946sqkm in the marine environment (Figure 1.). The Territory comprises 10,953km of coastline shared approximately equally between the mainland (49.6 per cent) and islands (50.4 per cent), with a coastal marine area of 71,839sqkm within 3 nautical miles of the coastline (Geoscience Australia 2010).

There are six Commonwealth Marine Parks within the area of the fishery. Licensees may harvest within the Marine Park Network, except designated IUCN II National Park Zones, using hand collection, hand nets, traps, pots, and handlines subject to authorisation by Parks Australia. Additional designated protected areas within Territory territorial waters prohibit harvest of any organisms. These areas include Kakadu National Park, Doctor's Gully Aquatic Life Reserve, East Point Aquatic Reserve, Darwin Harbour, Aboriginal sacred sites, aquaculture farm leases and sanctuary zones.

Freshwater and estuarine species are generally collected close to Darwin, between the Adelaide and Daly rivers. The majority of fishing effort for marine species occurs within 100km of Darwin. However some harvesting by operators with bigger aquarium fishery mother ships does occur in more remote areas.

Figure 1. The Territory's aquarium fishery



3.3. Main target species

The primary species targeted can vary significantly and are subject to fluctuations in market demands, seasonal accessibility and availability, and the gear type used.

In 2018-19, the key components of the fishery were:

- speciality corals (including hard and soft corals)
- anemones
- live rock (that is, fragments of dead hard coral covered with other organisms, including coral rubble and coral sand)
- marine fish and invertebrates
- freshwater fish and invertebrates.

The majority of the fishery harvest comprises marine invertebrates, finfish and live rock. The invertebrate portion of the catch is dominated by hard and soft corals, and miscellaneous gastropods. The finfish catch contains a diverse mix of marine and freshwater species. Live rock is a sedimentary rock, often with numerous holes and cavities, supporting a biofilm and/or encrusting corals and algae.

3.4. Fishing activity and management decisions

Regulation of the fishery began in the 1970s, with individuals issued a C-class licence to collect, trade or culture aquarium species. C-class licences were separated into three categories (depending on the original endorsement) in 1993. The categories were:

- Aquarium fishing/display fishery licence, permitting collection, display and sale of aquarium species
- Aquarium trader licence, predominantly for importers of aquarium species
- Aquaculture licence.

Holders of an Aquarium fishing/display fishery licence were permitted to collect coral until a ban was imposed in 1994. However, exemptions were granted shortly thereafter to allow a number of aquarium licensees to take limited quantities of coral.

A moratorium on the issue of new Aquarium fishing/display fishery licences was implemented in 2001 to cap the number of licences at 12, in response to concerns raised over the impact of coral collection and the need for a comprehensive review of the fishery. As a consequence of the review, licence conditions for both the Aquarium fishing/display fishery and Aquarium trader licences were subsequently amended. The new conditions, implemented in 2005, allowed all Aquarium fishing/display fishery licence holders to collect limited quantities of coral and associated benthic species (up to a maximum trigger point) and made it possible for Aquarium trader licence holders to establish display aquaria (noting that collection of aquatic life under this licence remained prohibited).

In 2008, management of the fishery was amended to accommodate the new Public aquarium licence (to enable development of new public aquaria in the Territory), and transferability of Aquarium fishing/display fishery licences.

Historically, coral collection was reported by size class groupings and an estimated weight per size class was used to determine the total weight of coral species harvested. In 2015, new licence conditions required licence holders to report species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) by weight, in order to reduce the degree of uncertainty around the weight of species and satisfy permit conditions for export accreditation.

Prior to the 2018-19 licensing year, the harvest of corals, giant clams and live rock in the Territory had been carried out by one large-scale operator (holding and operating three licences) and one small-scale operator. The majority of other licences were either latent, targeted marine or freshwater finfish only, or only collected small quantities of specific species for display purposes in aquaria.

In 2018-19, a number of previously latent licences became active and started targeting the CITES-listed coral species, resulting in increased competition among licence holders and an increase in effort of over 50 per cent (Table 1). This additional effort culminated in a breach of prescribed harvest limits set for export accreditation for giant clams and several coral species. The DITT Fisheries Division (NT Fisheries) declared a cessation of fishing for over-harvested species for the remainder of the licensing year (until 1 July 2019).

Table 1. Number of licences collecting corals over the past three licencing years

Fishing season	Territory aquarium fishery licences granted	Licences active in harvesting corals	Days fishing for corals
2016–17	11 ¹	5 ²	84
2017–18	11 ¹	5 ²	90
2018–19	11 ¹	7 ²	142

1. The Fisheries Regulations (130) allow the Director to grant up to 12 Aquarium fishing/display fishery licences.

2. One licence collected small amounts of corals for replacements in a display aquarium.

On 22 February 2019, NT Fisheries staff met with a number of licensees to discuss licence conditions and harvest limits that had been exceeded during the previous year. Concern was raised that repeatedly exceeding prescribed limits may risk the loss of fisheries export accreditation. A suspension or cancellation of the WTO would threaten the viability of most licensees, as approximately 68 per cent of corals, giant clams and live rock harvested in the fishery are exported.

NT Fisheries, in consultation with licence holders, the NT Seafood Council and DAWE, implemented an interim harvest limit (IHL) to each licence for hard corals and clams collected in the aquarium fishery for the 2019-20 licencing year. Table 2 lists management milestones in the Territory's aquarium fishery from the 1970s to the present.

Table 2. Chronology of management arrangements for the Territory's aquarium fishery

Year/s	Management control
1970s	<ul style="list-style-type: none"> Regulation of the Territory's aquarium fishery began with requirement for a licence
1994	<ul style="list-style-type: none"> Ban on collecting coral with exemptions granted shortly after, allowing certain aquarium collectors to take limited quantities of coral
2001	<ul style="list-style-type: none"> Moratorium on the issue of new aquarium fishing/display fishery licences, capping the number of licences at 12.
2005	<ul style="list-style-type: none"> New conditions allowed all Aquarium fishing/display fishery licence holders to collect limited amounts of coral and benthic species.
2006	<ul style="list-style-type: none"> First ERA undertaken
2008	<ul style="list-style-type: none"> Introduction of Public aquarium licences
2010	<ul style="list-style-type: none"> WTO triggers set
2014-15	<ul style="list-style-type: none"> New licence conditions introduced including revised catch limits for a number of species
2014	<ul style="list-style-type: none"> Second ERA undertaken
2015	<ul style="list-style-type: none"> New logbooks introduced
2016	<ul style="list-style-type: none"> Current WTO harvest limits set
2019	<ul style="list-style-type: none"> Electronic logbooks introduced Interim harvest limits applied as conditions on each licence Third ERA undertaken Aquarium Fishery Management Advisory Committee appointed

The IHL is now in place for each commercial licence for the species that have a prescribed harvest level as part of export accreditation for the fishery. This measure was introduced to ensure the harvest of any species with a prescribed limit could not be exceeded.

WTO provisions require NT Fisheries to consult with DAWE prior to a change to the management arrangements for a CITES or *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) listed species being implemented, and as part of reporting requirements. NT Fisheries liaises with DAWE and advises of any proposed amendments to the management of the fishery via direct communications and the Aquarium Fishery Annual Report.

3.4.1. Fishing method

Hand collection is the principal fishing method used by those collecting marine and freshwater invertebrates. Scoop and cast nets are the primary means of catching marine and freshwater fish species. Drag nets, handlines and traps are also used.

3.4.2. Retained species

The fishery collected, caught and retained 294 four different species of vertebrates, invertebrates and aquatic plants, plus 1.7 tonnes of live rock during the 2018-19 licensing year (see Table 3).

Table 3. Species harvested by the aquarium fishery in 2018-19

Category	Species	Number/weight
Hard coral (Scleractinia)	152	2,572kg
Soft coral	10	2,490
Live rock	N/A	1,717.5kg
Land hermit crabs	1	7,450
Marine fish	77	3,545
Crustaceans	4	1,742
Anemones	7	1,899
Marine snails	6	12,514
Gorgonian	3	310
Other marine inverts	11	2,692
Green algae		35.45kg
Freshwater fish	17	1,462
Invertebrates	6	639

Licensees aim to supply good quality live product to their markets and, therefore, employ non-destructive and highly selective methods when harvesting. There is no by-catch within the fishery.

3.5. Legislation

The Act provides the statutory framework for the sustainable management of the Territory's aquatic resources. In the administration of the Act, the Minister for Fisheries must pursue the following objectives as outlined in Section 2A:

- a) to manage the aquatic resources of the Territory in accordance with the principles of ecologically sustainable development
- b) to protect the environment, people and economy of the Territory from the introduction and spread of aquatic pests and diseases
- c) to maintain a stewardship of aquatic resources that promotes fairness, equity and access to aquatic resources by all stakeholder groups, including:
 - (i) indigenous people
 - (ii) commercial operators and aquaculture farmers
 - (iii) the commercial fishing and fishing tourism industries
 - (iv) amateur fishers
 - (v) others with an interest in the aquatic resources of the Territory
- d) to promote the optimum utilisation of aquatic resources to the benefit of the community.

Subordinate to this are the Territory's Fisheries Regulations 1992 and associated aquarium fishery licence conditions that detail its commercial regulations.

3.6. Current management controls

3.6.1. Commercial

A combination of input and output management controls are used regulate the commercial sector of the aquarium fishery. The harvest levels set as part of export accreditation, and applied as IHLs to individual licences, are used as the main management control to limit catch. IHLs (or IHL portions) can be bought, sold, leased or transferred on an annual basis upon written application to the Director of Fisheries. Table 4 lists the current management controls in the aquarium fishery.

Table 4. Current management controls for the aquarium fishery

Management tool	Control
Limited entry	No more than 12 licences may be granted
Vessel and tender restrictions	<ul style="list-style-type: none"> • One mother ship and two tenders per licence. • All vessels (mother ship and tender operating under a licence) must be within 2m of each other during operations. • A licensee must not use a mother ship that is surveyed at more than 25m long. • Tenders must not be more than 6.2m long. • A mother ship must have an operating vessel monitoring system (VMS).
Permitted gear	<p>Licensees are entitled to be in possession of and use:</p> <ul style="list-style-type: none"> • five cast nets • 20 scoop nets <ul style="list-style-type: none"> – maximum length of net to be in use is 20m with a maximum length of any single net section not exceeding 10m at any one time – mesh size may range from 5mm to 50mm – total of 40m of spare net may also be stored on board the mother ship. This net must be bundled in such a way that it is not available for immediate use • two drag nets, each to have a maximum length of 60m and a maximum mesh size of 10mm, only one of which shall be in the water at any one time • two hand pumps • one fish trap • 25 pots. A maximum of 5 only shall be in the water at any one time in no-freshwater environments • hand tools (such as small hammers and levers) • four hand lines or fishing rods in total <ul style="list-style-type: none"> – maximum hook size of 2/0 to be used on any hand line or fishing rod • skimmer net.
Diver restrictions	<ul style="list-style-type: none"> • No more than four divers may operate at any one time. A maximum of three other assistants may work with the licensee during the fishing operations carried out under this licence.
Catch and effort data	<ul style="list-style-type: none"> • Daily logbook returns submitted via electronic logbooks within five days of returning to port. • All coral pieces must have their weight recorded in the fishery catch and effort logbook returns.
Pre-departure notice	At least two hours prior to undocking, specifying time and location of departure point.
Prior landing notice	At least two hours prior to docking, specifying time and location of docking or retrieval at boat ramp.
Interstate unloading	<ul style="list-style-type: none"> • Written permission from the Director of Fisheries is required before any product taken under this licence can be unloaded outside the Territory. <ul style="list-style-type: none"> – The permission application must be submitted to the Director at least three working days before planned docking and include date, time and location of docking.

Management tool	Control
	<ul style="list-style-type: none"> The licence holder is responsible for costs incurred for interstate inspection of product unloaded.
Prohibited species	<p>It is an offence to be in possession of or sell fish or aquatic life described in:</p> <ol style="list-style-type: none"> NT Fisheries Regulations Schedule 1 – Aquatic Pests (as listed) NT Fisheries Regulations Schedule 1 – Noxious Fish (as listed)
Catch restrictions	<ul style="list-style-type: none"> Interim harvest limits have been applied to eligible licences for hard coral species and giant clams (<i>Tridacna squamosa</i> and <i>Tridacna maxima</i>). The total of all IHLs for each species is equivalent to the WTO NDF harvest limits for each species for the fishery. The maximum size limit for <i>T. squamosa</i> is 250mm. The maximum size limit for <i>T. maxima</i> is 150mm. Licensees are entitled to take a maximum of 1,000 undersized barramundi for sale for aquarium use only. The licensee must provide specific details on the electronic logbook returns, including number, location and date these barramundi were harvested. Written approval from the Director of Fisheries is required before broodstock may be collected under an Aquarium fishery licence.
Closed areas	<ul style="list-style-type: none"> Darwin Harbour, landwards of a line from Charles Point to Lee Point, Gove Harbour, north-east of a line from Dundas Point to Drimmie Head. No fish or aquatic life may be taken from Doctors Gully Aquatic Life Reserve or East Point Aquatic Reserve. No barramundi may be taken from the Mary River Management Zone. No fishing or harvest under this licence is permitted in Manton Dam, or from any tributaries flowing into the dam, unless the required permit is obtained from the controlling authority.

3.6.2. Recreational

Recreational take in the fishery is the collection or capture of animal and plant species for possession or keeping at home in private aquaria.

Legislation governing the possession of threatened and endangered species applies to recreational fishers. In addition, recreational size and personal possession limits apply for fish, crustaceans and molluscs where people are collecting for private aquaria. Permitted gear includes hand lines or rod and reel, float line, troll line, complying freshwater or marine pot, dilly pot, amateur drag net, cast net, scoop net and knife.

The amateur possession limits do not apply at a person’s place of permanent residence, that is, the possession limits no longer apply once the organisms are in the private aquaria at a person’s permanent place of residence.

3.6.3. Aboriginal traditional

The Aboriginal traditional fishing sector is entitled to use the resources of an area of land or water in a traditional manner. However, this entitlement does not extend to commercial fishing without a licence. Commercial engagement by the Aboriginal sector is encouraged through the purchase of a commercial licence, currently one Aquarium fishery licence is held by an Aboriginal corporation.

3.7. Monitoring

Commercial sector fishing activity is monitored through mandatory catch and effort logbooks. Fishers are required to record fishing details on a daily basis during fishing operations. These details include fishing hours, location, fishing method, quantity of fish and estimated weights (commercial only). Electronic logbooks (e-logs) were introduced to the commercial sector of the fishery in the 2018-19 licencing year and are now mandatory for all licensees. Additionally, licensees collecting marine product must submit electronic logbook returns within five days of returning to port. Catch and effort logbook information is verified by random checks on landed species and observer trips.

A VMS is required on all vessels collecting, live rock, giant clams and hard corals, and commercial fishers are required to notify authorities of their departure and landing details prior to leaving port. Written permission is required from the Director, Fisheries if a commercial operator wants to unload at a port outside the Territory.

There is no formal monitoring system in place to monitor recreational or Aboriginal traditional fishers or requirements to report their catch and effort.

3.8. Sectoral catch

There is no data available on the take of aquarium species in the recreational or Aboriginal traditional sectors.

3.9. Industry initiatives

The Aquarium Licensee Committee was established in 2003 by the Northern Territory Seafood Council (NTSC) to represent aquarium fishery licensees. The Aquarium Licensee Committee works in collaboration with NT Fisheries to identify future development opportunities and management arrangements for the industry within the principles of ecologically sustainable development.

To demonstrate commitment to sustainable best practice, industry has prepared a voluntary Code of Practice (NTSC, 2012), Environmental Management System (EMS) (NTSC, 2012) and fish collectors' diving guidelines. The EMS was initiated in 2006 and revised in 2012.

3.10. Constraints

In an effort to minimise sector conflict, NT Fisheries and the Aquarium Licensee Committee have negotiated the closure of Darwin and Gove harbours (Nhulunbuy) to commercial collection of coral and associated benthic species.

The environmental conditions and remoteness of the Territory can present many challenges to dive-based hand collection fisheries. A number of economic and environmental factors constrain effort in the fishery, affording corals and associated benthic species some protection from the effects of harvesting. These factors include:

- very selective individual hand collection of healthy specimens, driven by the fickle nature of aquarium enthusiasts
- wide distribution of many species across the 500,000sqkm available to the fishery
- distribution of many species beyond the depths of commercial diving (at present)
- extended distance to market and transport networks

- interaction between high-risk collectors and predators, such as crocodiles and some species of sharks
- large tidal variations that restrict effort
- difficulty locating specimens due to poor visibility underwater inshore
- weather-induced limits on fishing activity, such as monsoonal weather conditions that render large portions of the Territory's inland and coastal waters inaccessible or unsafe for several months each year.

The remoteness of collection sites and extended distance to distribution networks impose economic constraints on aquarium fishery operators and tend to concentrate effort around Darwin. These two factors alone strongly influence the high degree of protection from commercial or recreational exploitation required to extensive areas of coastline.

4. Environment

4.1. Climate

The climate of Northern Australia is tropical monsoonal, with two distinct seasons, a summer wet season that occurs broadly between October and March, and a winter dry season between April and September. The winters in Northern Australia are influenced by easterly winds generated over inland Australia, resulting in dry and warm conditions with very little rainfall and low relative humidity.

The high humidity and thunderstorm activity of the wet season is caused by steady west to north-west winds, bringing moisture from the Timor and Arafura seas. Cyclones may develop in the region between December and April, resulting in severe storms with gale force winds. Typically, cyclones form south of the equator in the Timor or Arafura seas when sea temperatures are greater than 26.5°C. The monsoonal weather pattern is a major driver of important ecological processes in the marine environment and is a significant factor influencing recruitment of estuarine and coastal fishes in the Territory.

4.2. Tides

Tidal types change across the Territory between semi-diurnal (two high and two low tides per day), and diurnal (one high and one low per day) that occurs in both the north of the Arafura Sea and in the south of the Gulf of Carpentaria (Webb 1981). Considerable variation in tidal range is experienced along the Territory's coast, with ranges exceeding 7m in the western areas during the spring tide, to less than 2m in areas of the Gulf of Carpentaria. The vast tidal movement and major inputs of fine silt sediments from numerous rivers create vast areas of high turbidity and light attenuation, restricting inshore diving for marine species, which is primarily conducted during the neap tidal phase.

4.3. Ocean circulation

Ocean circulation across the Northern Australian Shelf is dominated by strong tides and influenced by inflow from the Indonesian Through Flow (ITF). Inter-annual variability in current strength is driven by wind stress from monsoon and trade winds (Condie 2011; Schiller 2011). Wind and current strength are strongest during the monsoon season between November and March, a period with strong north-westerly winds and active cyclogenesis. For the remainder of the year, wind direction reverses and the ITF current strength diminishes (Church and Forbes 1983; Wolanski 1993).

5. Methodology

5.1. Ecological risk assessment methodology

The outcomes documented here follow the guidelines for risk assessments developed by NT Fisheries (NT Fisheries, 2019). An ERA workshop was facilitated by NT Fisheries in July 2019 to conduct a technical review by experts specialising in corals and other aquarium-related species, followed by a stakeholder review in collaboration with the technical experts. Aquarium fishery licence holders, operators and representatives, environment sector, Aboriginal councils, and the Northern Territory Water Police attended the stakeholder review. All stakeholders provided advice on the risk ratings and, where necessary, opened discussions with the technical expert panel to review preliminary risk assessments given their professional and personal experiences. The workshop results were collated into this report and referred back to the experts and stakeholders for final comment. A list of workshop attendees can be found in Appendix 1.

5.2. Scope

This report encompasses significant issues and associated risks identified by a technical expert panel, licensees and stakeholders.

Each risk Assessment section in this report reflects the ecological wellbeing component of ESD, including contemporary risks of harvesting activities on the retained species and broader impacts of the activities on the environment (general ecosystem).

5.3. Species and issue identification

Issues were identified based on the current knowledge of species biology, distribution and abundance, as well as historic harvest limits and the advice of research experts and commercial fishers. As a result, the workshop assessed:

- both species of CITES listed giant clam species that are harvested under licence
- all CITES-listed species of corals harvested at or more than 75 per cent, of their prescribed harvest limits in the 2018-19 licencing year
- a number of soft corals and anemone species
- a number of fish species with one or more of the following attributes:
 - limited knowledge of biology abundance and distribution
 - restricted distributions
 - a dependant relationship with other host species that are also harvested.

There were 71 species issues (including live rock) assessed that were deemed to be affected by the activities of the aquarium fishery. The workshop assessed three issues as negligible risk, and two issues as a low risk, predominantly because the targeted nature of collection and capture methods in the fishery have minimal interactions with non-target species. There were 55 issues identified as a moderate risk and 11 issues identified as a high risk. The combination of limited data on the distribution and abundance of species and the impact of harvesting on recruitment and habitat were the primary drivers for identifying 66 risks as either moderate or high.

5.4. Risk assessment and prioritisation of issue

Assessment and prioritisation of risks and opportunities facing the aquarium fishery were considered in the context of high-level management objectives and desired ESD outcomes described in the Act and Commonwealth environmental legislation.

Assessment and prioritisation of risks were reviewed within the existing management arrangements for the aquarium fishery. The ESD assessment and reporting process applied under the national ESD framework is consistent with the Australian and New Zealand Standard AS/NZS ISO 31000:2009 Risk management - Principles and guidelines.

What is risk analysis?

Risk analysis is a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study the impacts and consequences and to examine the controls that exist (ISO 31000:2009)

The overall purpose of ISO 31000 is the integration of the management of risk into a strategic and operational management system.

The technical expert panel reviewed confidential catch data to conduct a qualitative risk assessment for a prioritised list of species collected in the fishery. A consequence level for each issue was determined and scored from 0-4, with 0 being negligible and 4 being major (see Appendix 3 for details of the risk consequence tables).

The technical panel then assessed the likelihood of a consequence occurring, from remote (1) to likely (5) based on a judgement by on the probability of the events, or chain of events, occurring that could result in a particular adverse consequence. See Appendix 2 for details of the likelihood table.

From the consequence and likelihood scores, the overall risk value (risk = consequence X likelihood), was calculated. The calculated score determined the final risk rating for each issue, and required management response (Table 5).

Table 5. Risk ranking definitions used in the ERA

Risk rating	Risk value	Management response required
Negligible	0-1	Nil
Low	2-5	None specific
Moderate	6-10	Specific management actions required in harvest strategy to ensure risk does not increase to a high rating
High	12-20	Specific management actions required to reduce risk

The national ESD reporting framework suggests that only issues scored as moderate or high risk need to have full ESD performance reports completed. However the rationale for scoring is provided for all issues identified and forms part of these reports. Issues scored as either low or negligible have also been documented to encourage transparency and help stakeholders to understand the basis for risk scores.

5.5. ESD performance reports for higher risk issues

Central to any ESD performance report are the proposed management actions to deal with higher risk/priority issues, including the operational objectives, indicators and performance measures. This is recommended in the ESD Framework’s How To Guide but a comprehensive ESD performance report was not prepared for higher risk/priority issues identified in this process.

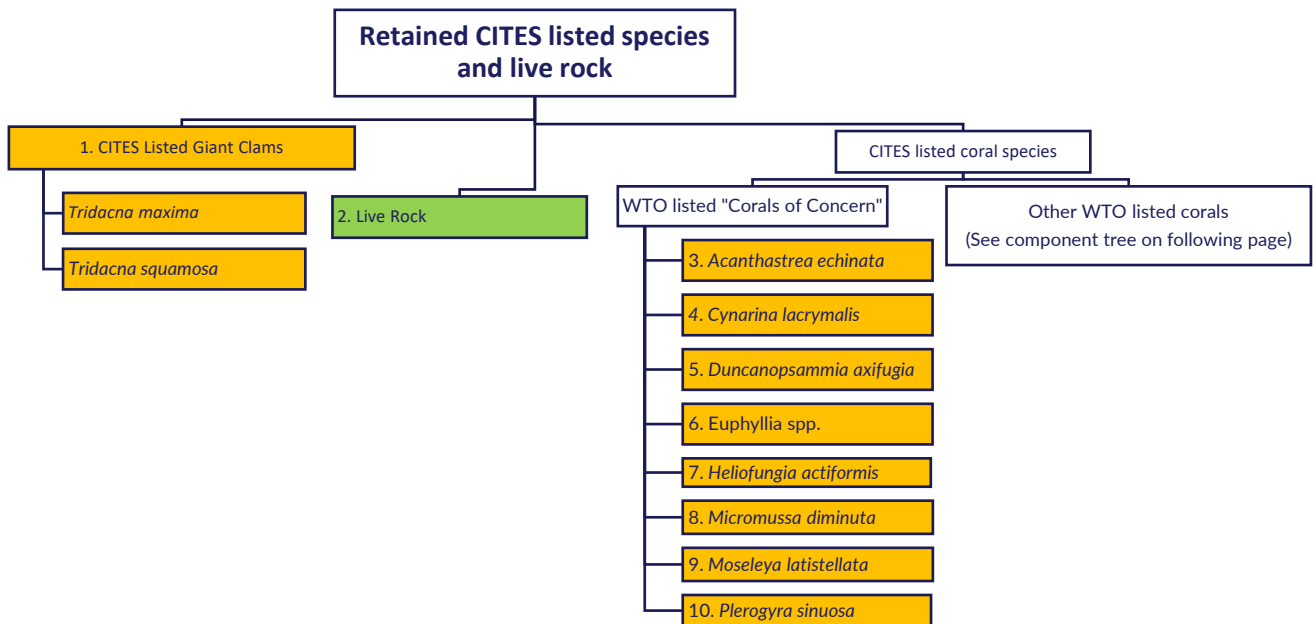
The higher risk/priority issues identified through this process will be addressed when the harvest strategy and management plan for the aquarium fishery is being developed. This will include implementing operational objectives, performance indicators, reference points, and pre-determined management actions.

6. Performance reports

Component trees were developed for retained and non-retained species caught by the fishery, as well as general ecosystem effects. The risk rating, and subsequent colour of the box depicted in the component trees, indicates the level of risk for each issue as determined by the expert panel. Boxes that are blue or have no colour indicate that the issue was rated as negligible. Those that are green are rated as **low** risk and no specific management is required. Risks rated **moderate** indicate that a specific management action is warranted in the harvest strategy to ensure risk does not increase to a high rating. Risks rated **high** require specific management actions to reduce the risk. Species are listed in the order they were assessed during the ERA workshop.

6.1. Retained CITES-listed species and live rock

Figure 2. Component tree for issues related to the retained CITES-listed species in the aquarium fishery



6.1.1. CITES-listed giant clams

Objective

Ensure the Elongated Giant Clams (*Tridacna maxima*) and Fluted Giant Clams (*T. squamosa*) resource in the aquarium fishery is harvested within ecologically sustainable limits.

The following issues were identified as sources of risks to *T. maxima* and *T. squamosa* in the Territory.

- The species are easily harvested by fishers.
- There is illegal, unknown, unreported and unregulated harvesting.

Statement of considerations

The following issues were considerations when assessing the risks to *T. maxima* and *T. squamosa* stocks in the Territory.

- Stocks are widespread across the Territory’s coastal and offshore marine environment.
- There are stocks on isolated offshore reefs and at inaccessible diving depths.
- Management controls currently in place include:
 - interim harvest limits with overall aquarium fishery limits of: *T. maxima* (80 individuals) and *T. squamosa* (200 individuals);
 - maximum size limits of 150 mm for *T. maxima* and 250mm for *T. squamosa*
 - electronic logbook reporting and reduced reporting timeframes
 - VMS on all vessels to verify impact on collection areas.

Issue 1. Elongated Giant Clam (*Tridacna maxima*) and Fluted Giant Clam (*Tridacna squamosa*)

Risk analysis

Table 6. Risk rating for the impact of the aquarium fishery on breeding stocks of *Tridacna maxima* and *T. squamosa* (Appendix 2, tables 1 and 5).

Justification	Risk rating
The impact of the harvest of giant clams by the aquarium fishery was considered to be at maximum levels (moderate consequence (C2)) because this species is prone to illegal harvest by non-commercial operators. Given that the harvest of this species is tightly controlled under a total allowable catch, it was considered that the likelihood populations were being negatively impacted by the fishery was only possible (L3)	Moderate (6)

6.1.2. Live rock

Objective

Ensure that the live rock resource in the aquarium fishery is harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to live rock in the Territory:

- localised depletion of easily accessible and/or known fishing grounds
- illegal, unreported and unregulated harvest.

Statement of considerations

The following issues were considerations when assessing the risks to live rock in the Territory:

- management controls currently in place, including:
 - interim harvest limit of live rock totalling (6000kg)
 - VMS on all vessels to verify impact on collection areas
 - electronic logbook reporting and reduced reporting timeframes.
- research being undertaken to estimate size of resource using modelling from aerial photographs
- the relatively large resource size comparative to current collecting rates.

Issue 2. Live rock

Risk analysis

Table 7. Risk rating for the impact of the aquarium fishery on live rock (Appendix 2, tables 1 and 5).

Justification	Risk rating
The impact of the harvest of live rock by the aquarium fishery was considered to be minor (C1) because only very small amounts are harvested. However, given that this group is not well defined and could potentially have other species growing on the surface it was suggested that it was possible (L3) the harvest could be having a negative impact.	Low (3)

6.1.3. Corals listed as ‘Corals of Concern’ in 2016 Wildlife Trade

Operation non-detriment findings:

<i>Acanthastrea echinata</i>	<i>Euphyllia ancora</i>	<i>Heliofungia actiniformis</i>
<i>Cynarina lacrymalis</i>	<i>Euphyllia glabrescens</i>	<i>Micromussa diminuta</i>
<i>Duncanopsammia axifuga</i>	<i>Euphyllia paraancora</i>	<i>Moseleya latistellata</i>
		<i>Plerogyra sinuosa</i>

Objective

Ensure that corals listed as ‘Corals of concern’ in the 2016 Wildlife Trade Operation NDFs are harvested within ecologically sustainable limits. Appendix III contains the NDF findings and fishery harvest limits for these species.

Sources of risk

The following were identified as sources of risks to corals of concern in the Territory:

- illegal, unreported and unregulated take
- environmental events:
 - cyclones
 - extreme temperatures, bleaching events
- localised depletion of easily accessible and/or known fishing grounds.

Statement of considerations

The following were considerations when assessing the risks to corals of concern stocks in the Territory:

- stocks widespread across the Territory coastal marine environment
- management controls currently in place, including:
 - interim harvest limits of CITES-listed hard corals contained in Appendix III) reduces the likelihood that harvest limits will be exceeded
 - electronic logbook returns and reduced reporting timeframes
 - VMS on all mother ships
 - pre-departure and prior landing notices
- limited harvest access due to environmental factors, tides, weather and crocodiles.
- conservative harvest limits set in WTO NDF and subsequently as IHL for eligible aquarium fishery licensees.

Issue 3. *Acanthastrea echinata*

Risk analysis

Table 8. Risk rating for the impact of the aquarium fishery on stocks of *Acanthastrea echinata* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Acanthastrea echinata</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 4. *Cynarina lacrymalis*

Risk analysis

Table 9. Risk rating for the impact of the aquarium fishery on stocks of *Cynarina lacrymalis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Cynarina lacrymalis</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 5. *Duncanopsammia axifuga*

Risk analysis

Table 10. Risk rating for the impact of the aquarium fishery on stocks of *Duncanopsammia axifuga* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Duncanopsammia axifuga</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 6. *Euphyllia* spp.

Risk analysis

Table 11. Risk rating for the impact of the aquarium fishery on stocks of *Euphyllia ancora*, *E. glabrescens* and *E. paraancora* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Euphyllia</i> spp. by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 7. *Heliofungia actiniformis*

Risk analysis

Table 12. Risk rating for the impact of the aquarium fishery on stocks of *Heliofungia actiniformis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Heliofungia actiniformis</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 8. *Micromussa diminuta*

Risk analysis

Table 13. Risk rating for the impact of the aquarium fishery on stocks of *Micromussa diminuta* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Micromussa diminuta</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 9. *Moseleya latistellata*

Risk analysis

Table 14. Risk rating for the impact of the aquarium fishery on stocks of *Moseleya latistellata* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Moseleya latistellata</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

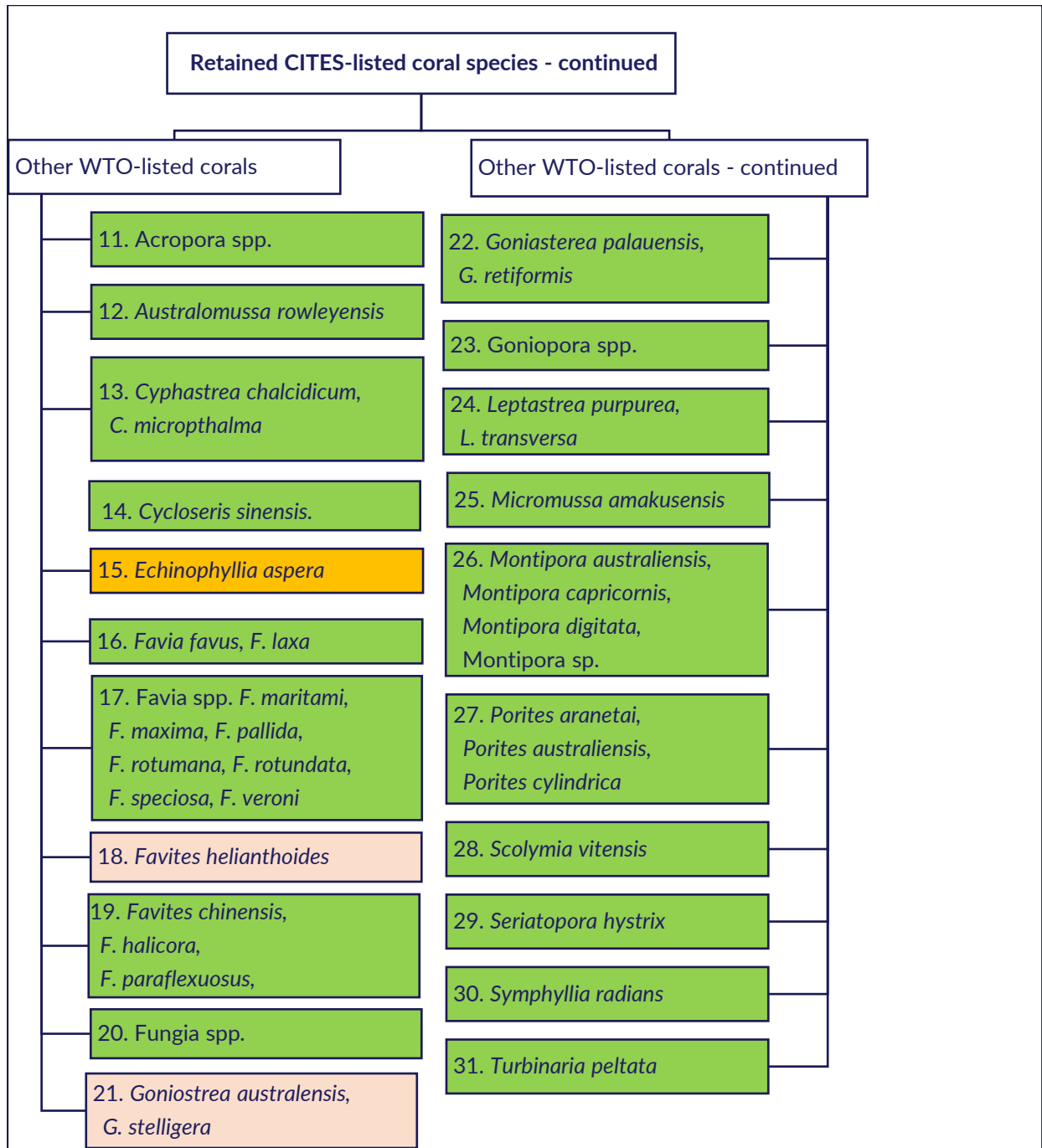
Issue 10. *Plerogyra sinuosa*

Risk analysis

Table 15. Risk rating for the impact of the aquarium fishery on stocks of *Plerogyra sinuosa* (Appendix 2, tables 1 and 34).

Justification	Risk rating
The impact of the harvest of <i>Plerogyra sinuosa</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Figure 3. Component tree for issues related to the retained CITES-listed species in the aquarium fishery (continued from Figure 2).



6.1.4. Other corals listed in the WTO NDF that had harvests of 75 per cent or greater of the fishery harvest level in the 2019-20 licencing year:

<i>Acropora</i> spp.	<i>Favites chinensis</i>	<i>Leptastrea purpurea</i>
<i>Australomussa rowleyensis</i>	<i>F. halicora</i>	<i>Leptastrea transversa</i>
<i>Cyphastrea chalcidicum</i>	<i>F. pentagona</i>	<i>Micromussa amakusensis</i>
<i>C. microphthalmalma</i>	<i>Fungia</i> spp.	<i>Montipora</i> spp.
<i>Cycloceris sinensis</i>	<i>Fungia sinensis</i>	<i>M. australiensis</i>
<i>Echinophyllia aspera</i>	<i>Goniastrea retiformis</i>	<i>M. capricornis</i>
<i>Favia</i> spp.	<i>Goniopora</i> spp.	<i>M. digitata</i>
<i>F. fавus</i>	<i>G. djiboutiensis</i>	<i>Porites aranetai</i>
<i>F. laxa</i>	<i>G. lobata</i>	<i>P. australiensis</i>
<i>F. maxima</i>	<i>G. norfolkensis</i>	<i>P. cylindrica</i>
<i>F. rotumana</i>	<i>G. pandoraensis</i>	<i>Scolymia vitiensis</i>
<i>F. speciosa</i>	<i>G. somaliensis</i>	<i>Seriatopora hystrix</i>
<i>F. veroni</i>	<i>G. stokesi</i>	<i>Symphyllia radians</i>
	<i>G. tenuidens</i>	<i>Turbinaria peltata</i>

Objective

Ensure that corals listed in the 2016 Wildlife Trade Operation NDFs that were harvested at 75 per cent or more of the fishery harvest limit are harvested within ecologically sustainable limits.

Sources of risk

The following were identified as sources of risk to these corals in the Territory:

- illegal, unreported and unregulated take
- localised depletion of easily accessible and/or known fishing grounds
- environmental events:
 - cyclones
 - extreme temperatures, bleaching events.

Statement of considerations

The following issues were considerations when assessing the risks to corals of concern stocks in the Territory:

- stocks widespread across the Territory coastal marine environment
- management controls currently in place:
 - interim harvest limits for CITES-listed hard corals (overall fishery harvest contained in Appendix III)
 - decreased likelihood of exceeding harvest limits due to interim harvest limits recently applied to each licence.
 - electronic logbook returns and reduced reporting timeframes

- VMS on all mother ships
- pre-departure and prior landing notices
- limited harvest access due to environmental factors, tides, weather and crocodiles.

Issue 11. *Acropora* spp.

Risk analysis

Table 16. Risk rating for the impact of the aquarium fishery on stocks of *Acropora* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Acropora</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Low (2)

Issue 12. *Australomussa rowleyensis*

Risk analysis

Table 17. Risk rating for the impact of the aquarium fishery on stocks of *Australomussa rowleyensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Australomussa rowleyensis</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Low (2)

Issue 13. *Cyphastrea chalcidicum* and *C. microphthalma*

Risk analysis

Table 18. Risk rating for the impact of the aquarium fishery on stocks of *Cyphastrea chalcidicum* and *C. microphthalma* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Cyphastrea chalcidicum</i> and <i>C. microphthalma</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Low (2)

Issue 14. *Cycloseris sinensis*

Risk analysis

Table 25. Risk rating for the impact of the aquarium fishery on stocks of *Cycloseris sinensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Cycloseris sinensis</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 15. *Echinophyllia aspera*

Risk analysis

Table 19. Risk rating for the impact of the aquarium fishery on stocks of *Echinophyllia aspera* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Echinophyllia aspera</i> by the aquarium fishery was considered to be severe (C3) as catches have exceeded the NDF for this species. However, new catch limits have been introduced meaning that this negative impact was likely to be rare (L2).	Moderate (6)

Issue 16. *Favia favus* and *F. laxa*

Table 20. Risk rating for the impact of the aquarium fishery on stocks of *Favia favus* and *F. laxa* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Favia favus</i> and <i>F. Laxa</i> by the aquarium fishery was considered to be moderate (C2) as catches have been between 50 and 100 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Low (4)

Issue 17. *Favia* spp., *F. maxima*, *F. maratimi*, *F. pallida*, *F. rotumana*, *F. speciosa*, *F. rotundata* and *F. veroni*

Risk analysis

Table 22. Risk rating for the impact of the aquarium fishery on stocks of *Favia* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Favia</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Low (2)

Issue 18. *Favia helianthoides* and *Favia stelligera*

Risk analysis

Table 23. Risk rating for the impact of the aquarium fishery on stocks of *Favia helianthoides* and *F. stelligera* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Favia helianthoides</i> and <i>F. stelligera</i> by the aquarium fishery was considered to be negligible (C0) as catches are below 10 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Negligible (0)

Issue 19. *Favites chinensis*, *F. halicora* and *F. paraflexuosus*

Risk analysis

Table 24. Risk rating for the impact of the aquarium fishery on stocks of *Favites* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Favites</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 20. *Fungia* spp.

Risk analysis

Table 25. Risk rating for the impact of the aquarium fishery on stocks of *Fungia* spp. and *F. sinensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Fungia</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 21. *Goniastrea australensis*

Table 26. Risk rating for the impact of the aquarium fishery on stocks of *Goniastrea australensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Goniastrea australensis</i> by the aquarium fishery was considered to be negligible (C0) as catches are below 10 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be only rare (L2).	Negligible (0)

Issue 22. *Goniastrea palauensis*

Risk analysis

Table 27. Risk rating for the impact of the aquarium fishery on stocks of *Goniastrea palauensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Goniastrea paulauensis</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (3)

Issue 23. *Goniopora* spp.

Risk analysis

Table 28. Risk rating for the impact of the aquarium fishery on stocks of *Goniopora* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Goniopora</i> spp. by the aquarium fishery was considered to be Minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 24. *Leptastrea purpurea* and *L. transversa*

Risk analysis

Table 29. Risk rating for the impact of the aquarium fishery on stocks of *Leptastrea purpurea* and *L. transversa* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Leptastrea purpurea</i> and <i>L. transversa</i> by the aquarium fishery was considered to be moderate (C2) as catches are between 50 and 100 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (4)

Issue 25. *Micromussa amakusensis*

Risk analysis

Table 30. Risk rating for the impact of the aquarium fishery on stocks of *Micromussa amakusensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Micromussa amakusensis</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 26. *Montipora australiensis*, *M. capricornis*, *M. digitata* and *Montipora* spp.

Risk analysis

Table 31. Risk rating for the impact of the aquarium fishery on stocks of *Montipora* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Montipora</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 27. *Porites aranetai*, *P. australiensis* and *P. cylindrica*

Risk analysis

Table 32. Risk rating for the impact of the aquarium fishery on stocks of *Porites* spp. (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Porites</i> spp. by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for these species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 28. *Scolymia vitensis*

Risk analysis

Table 33. Risk rating for the impact of the aquarium fishery on stocks of *Scolymia vitensis* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Scolymia vitensis</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 29. *Seriatopora hystrix*

Risk analysis

Table 34. Risk rating for the impact of the aquarium fishery on stocks of *Seriatopora hystrix* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Seriatopora hystrix</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 30. *Symphyllia radians*

Risk analysis

Table 35. Risk rating for the impact of the aquarium fishery on stocks of *Symphyllia radians* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Symphyllia radians</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

Issue 31. *Turbinaria peltata*

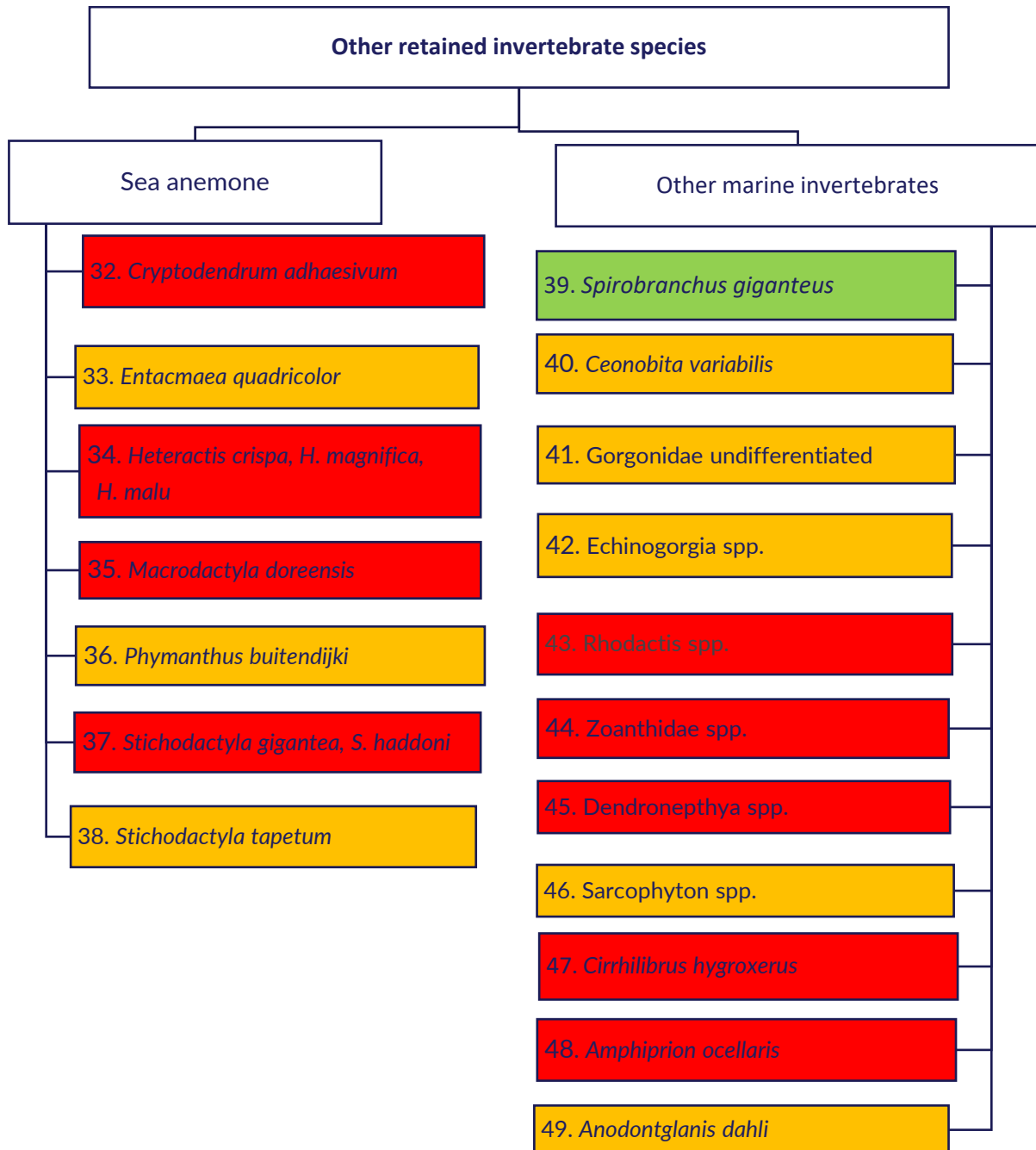
Risk analysis

Table 36. Risk rating for the impact of the aquarium fishery on stocks of *Turbinaria peltata* (Appendix 2, tables 1 and 4).

Justification	Risk rating
The impact of the harvest of <i>Turbinaria peltata</i> by the aquarium fishery was considered to be minor (C1) as catches have remained below 50 per cent of the NDF for this species. Additionally, new catch limits have been introduced meaning that negative impacts from this harvest are likely to be rare (L2).	Low (2)

6.2. Other retained invertebrate species

Figure 4. Component tree for issues related to other retained invertebrate species in the aquarium fishery



6.2.1. Sea anemones:

<i>Cryptodendrum adhaesivum</i>	<i>Heteractis crista</i>	<i>Phymanthus buitendijki</i>
<i>Entamacea quadricolor</i>	<i>H. magnifica</i>	<i>Stichodactyla gigantean</i>
	<i>H. malu</i>	<i>S. haddoni</i>
	<i>Macroactyla doreensis</i>	<i>S. tapetum</i>

Objective

Ensure that the anemone resource in the aquarium fishery is harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to anemones in the Territory:

- limited distributions of some anemone species
- some species of anemones naturally rare
- illegal, unreported and unregulated harvesting
- market demand/fluctuations for certain species may lead to increased harvesting of those species.

Statement of considerations

The following issues were considerations when assessing the risks to anemone stocks in the Territory:

- life spans of the species
- recruitment rates, methods of reproduction
- abundance and distribution
- collection of some species also affects anemone fish abundance.

Issue 32. *Cryptodendrum adhaesivum*

Risk analysis

Table 37. Risk rating for the impact of the aquarium fishery on stocks of *Cryptodendrum adhaesivum* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Cryptodendrum adhaesivum</i> by the aquarium fishery was considered to be severe (C3) as this species is rare and has vulnerable life history characteristics (long-lived with low recruitment). Because this species tends to be targeted due to its high value it was considered likely (L5) that this harvest would have a negative impact.	High (15)

Issue 33. *Entacmaea quadricolor*

Risk analysis

Table 38. Risk rating for the impact of the aquarium fishery on stocks of *Entacmaea quadricolor* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Entacmaea quadricolor</i> by the aquarium fishery was considered to be moderate (C2) as it is abundant but is heavily targeted by fishers. Because little is known about this species in the Territory, the likelihood of a negative impact was raised from possible to occasional (L4).	Moderate (8)

Issue 34. *Heteractis crispa*, *H. magnifica* and *H. malu*

Risk analysis

Table 39. Risk rating for the impact of the aquarium fishery on stocks of *Heteractis* spp. (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Heteractis</i> spp. by the aquarium fishery was considered to be severe (C3) as these species are rare and have vulnerable life history characteristics (long-lived with low recruitment). Because these species are heavily targeted due to their high value it was considered likely (L5) that this harvest would have a negative impact.	High (15)

Issue 35. *Macroactyla doreensis*

Risk analysis

Table 40. Risk rating for the impact of the aquarium fishery on stocks of *Macroactyla doreensis* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Macroactyla doreensis</i> by the aquarium fishery was considered to be severe (C3) as this species is rare and has vulnerable life history characteristics (long-lived with low recruitment). Because this species tends to be targeted due to its high value it was considered likely (L5) this harvest would have a negative impact.	High (15)

Issue 36. *Phymanthus buitendijki*

Risk analysis

Table 41. Risk rating for the impact of the aquarium fishery on stocks of *Phymanthus buitendijki* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Phymanthus buitendijki</i> by the aquarium fishery was considered to be Moderate (C2) as it is abundant but is heavily targeted by fishers. Because little is known about this species in the Territory the likelihood of a negative impact was raised from possible to occasional (L4).	Moderate (8)

Issue 37. *Stichodactyla gigantea* and *S. haddoni*

Risk analysis

Table 42. Risk rating for the impact of the aquarium fishery on stocks of *Stichodactyla gigantea* and *S. haddoni* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Stichodactyla</i> spp. by the aquarium fishery was considered to be severe (C3) as these species are rare and have vulnerable life history characteristics (long-lived with low recruitment). Because these species tend to be targeted due to their high value it was considered likely (L5) that this harvest would have a negative impact.	High (15)

Issue 38. *Stichodactyla tapetum*

Risk analysis

Table 43. Risk rating for the impact of the aquarium fishery on stocks of *Stichodactyla tapetum* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Stichodactyla tapetum</i> by the aquarium fishery was considered to be moderate (C2) as it is abundant but is targeted by fishers. Because little is known about this species in the Territory, the likelihood of a negative impact was raised from possible to occasional (L4).	Moderate (8)

6.2.2. Christmas Tree Worm *Spirobranchus giganteus*

Objective

Ensure that the Christmas Tree Worm resources in the aquarium fishery are harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to the other 'Other invertebrate' species in the Territory considered in the ERA:

- illegal, unreported and unregulated harvesting
- market demand and increased harvesting/collecting
- no volume or spatial limits on collecting.

Statement of considerations

The following issues were considerations when assessing the risks to anemone stocks in the Territory:

- abundance and distribution
- high reproductive biology of the species
- current management controls on aquarium fishery.

Issue 39. *Spirobranchus giganteus*

Risk analysis

Table 44. Risk rating for the impact of the aquarium fishery on stocks of *Spirobranchus giganteus* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Spirobranchus giganteus</i> by the aquarium fishery was considered to be minor (C1) as it can occur in very high densities. It was considered that this harvest was unlikely to cause a negative impact but because little is known about this species in the Territory the likelihood of a negative impact was raised from rare to possible (L3).	Moderate (3)

6.2.3. Hermit crabs *Coenobita variabilis*

Objective

Ensure that the hermit crabs resources in the aquarium fishery is harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to the other 'Other Invertebrate' species in the Territory considered in the ERA:

- illegal, unreported and unregulated harvesting
- susceptibility to baiting and collection
- market demand/fluctuations for hermit crabs
- currently no volume or spatial limits on collecting.

Statement of considerations

The following issues were considerations when assessing the risks to anemone stocks in the Territory:

- abundance and distribution
- high reproductive biology of the species
- current management controls on aquarium fishery
- market demand could lead to increased harvesting/collecting.
- reproductive biology of the species means numbers recovery quickly.

Issue 40. *Coenobita variabilis*

Risk analysis

Table 45. Risk rating for the impact of the aquarium fishery on stocks of *Coenobita variabilis* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Coenobita variabilis</i> by the aquarium fishery was considered to be moderate (C2) as it is harvested in relatively high numbers. Because this species is highly vulnerable to capture, it was considered that the fishery could potentially have a negative impact on the stock (possible – L3).	Moderate (8)

6.2.4. Soft corals:

Gorgoniidae undifferentiated Rhodactis spp Dendronephthya spp.
Echinogorgia spp. Zoanthidae undifferentiated Sarcophyton spp.

Objective

Ensure that the species of the *Corallimorphia* and *Zoantharia* orders and the *Octocorallia* Subclass are harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to these corals in the Territory:

- no limits on the harvest of these species in the Territory
- illegal, unreported and unregulated take
- localised depletion of easily accessible and/or known fishing grounds
- damage caused by cyclones
- damage caused by extreme temperatures/bleaching events.

Statement of considerations

The following issues were considerations when assessing the risks to Corals of Concern stocks in the Territory:

- widespread stocks across the Territory's coastal marine environment
- management controls currently in place:
 - electronic logbook returns and reduced reporting timeframes
 - VMS on all mother ships
 - pre-departure and prior landing notices
 - limited time and scope of areas accessed due to environmental factors, tides, weather and crocodiles.

Issue 41. Gorgoniidae undifferentiated

Risk analysis

Table 46. Risk rating for the impact of the aquarium fishery on stocks of Gorgoniidae undifferentiated (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of Gorgoniidae by the aquarium fishery was considered to be moderate (C2) as there are no limits on harvest. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	Moderate (8)

Issue 42. Echinogorgia spp.

Risk analysis

Table 47. Risk rating for the impact of the aquarium fishery on stocks of Echinogorgia spp. (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of Echinogorgia spp. by the aquarium fishery was considered to be moderate (C2) as there are no limits on harvest. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	Moderate (8)

Issue 43. Rhodactis spp.

Risk analysis

Table 48. Risk rating for the impact of the aquarium fishery on stocks of Rhodactis spp. (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of Rhodactis spp. by the aquarium fishery was considered to be severe (C3) as there are no limits on harvest and they are targeted by fishers. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	High (12)

Issue 44. Zoanthidae undifferentiated

Risk analysis

Table 49. Risk rating for the impact of the aquarium fishery on stocks of Zoanthidae undifferentiated (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of Zoanthidae by the aquarium fishery was considered to be severe (C3) as there are no limits on harvest and they are targeted by fishers. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	High (12)

Issue 45. *Dendronephthya* spp.

Risk analysis

Table 50. Risk rating for the impact of the aquarium fishery on stocks of *Dendronephthya* spp. (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Dendronephthya</i> spp. by the aquarium fishery was considered to be severe (C3) as there are no limits on harvest and they are targeted by fishers. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	High (12)

Issue 46. *Sarcophyton* spp.

Risk analysis

Table 51. Risk rating for the impact of the aquarium fishery on stocks of *Sarcophyton* spp. (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Sarcophyton</i> spp. by the aquarium fishery was considered to be moderate (C2) as there are no limits on harvest. Because this group represents a large number of species, the likelihood was increased from possible to occasional (L4).	Moderate (8)

6.2.5. Fish

*Cirrhilabrus hygroxerus**Amphiprion ocellaris**Anodontiglanis dahli*

Objective

Ensure that fish in the aquarium fishery are harvested within ecologically sustainable limits.

Sources of risk

The following issues were identified as sources of risks to aquarium targeted fish in the Territory:

- limited knowledge of the biology, distribution and abundance of Toothless Catfish (*A. dahli*) and Monsoon Fairy Wrasse (*C. hygroxerus*)
- limited distribution of Western Clown Anemonefish (*A. ocellaris*)
- illegal, unreported and unregulated harvesting
- market demand/fluctuations for these species.

Statement of considerations

The following issues were considerations when assessing the risks to the stocks of these fish in the Territory:

- abundance and distribution
- collection of anemone fish that can affect host anemones.

Issue 47. *Cirrhilabrus hygroxerus*

Risk analysis

Table 52. Risk rating for the impact of the aquarium fishery on stocks of *Cirrhilabrus hygroxerus* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Cirrhilabrus hygroxerus</i> by the aquarium fishery was considered to be severe (C3) as there are no limits on harvest and there is limited knowledge on their biology. Because of the limited knowledge on its biology and abundance and distribution the likelihood was increased from occasional to likely (L5).	High (15)

Issue 48. *Amphiprion ocellaris*

Risk analysis

Table 53. Risk rating for the impact of the aquarium fishery on stocks of *Amphiprion ocellaris* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Amphiprion ocellaris</i> by the aquarium fishery was considered to be major (C4) as this species has a very limited distribution and is heavily targeted by fishers. Because of the limited knowledge on its biology the likelihood was increased from occasional to be likely (L5).	High (20)

Issue 49. *Anodontiglanis dahli*

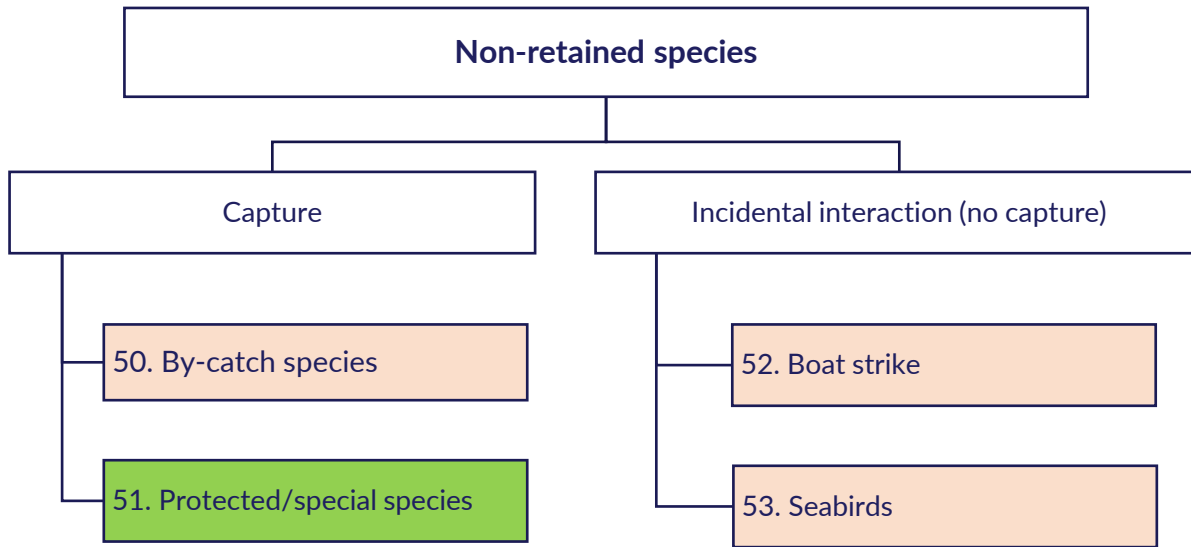
Risk analysis

Table 54. Risk rating for the impact of the aquarium fishery on stocks of *Anodontiglanis dahli* (Appendix 2, tables 1 and 3).

Justification	Risk rating
The impact of the harvest of <i>Anodontiglanis dahli</i> by the aquarium fishery was considered to be moderate (C2) as there are no limits on harvest. Because this species has a large distribution it was considered the likelihood of a negative interaction was only possible (L3).	Moderate (6)

6.3. Non-retained species

Figure 5. Component tree for issues related to the non-retained species of the aquarium fishery



6.3.1. Capture

Issue 50. By-catch species

Table 55. Risk rating for the impact of the aquarium fishery on bycatch species (Appendix 2, tables 1 and 3).

Justification	Risk rating
Only a very small number of species are discarded when handlines, scoop nets, pots and traps are used and most of these are released alive. The consequence of this harvest was considered to negligible (C0) on these species and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 51. Protected/special species

An analysis of the commercial logbook data indicated that no interactions with threatened and endangered species (TEPS) have been recorded in this fishery since 1990 (the NT Fisheries commercial fisheries database goes back to 1990).

Table 56. Risk rating for the impact of the aquarium fishery on protected/special species (Appendix 2, tables 1 and 5).

Justification	Risk rating
Since 1990, logbook data for the aquarium fishery has reported no TEPS interactions. Consequently, it was considered that this impact was (C0) on these species and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

6.3.2. Incidental interaction (no capture)

Issue 52. Boat strikes

Boat strikes cause direct and indirect disturbance to marine wildlife, particularly surface breathing marine animals such as dugongs, turtles and cetaceans, as well as crocodiles. Many of these species are protected under the EPBC Act and listed under CITES. Direct contact with propellers may sever tissue and/or organs causing immediate death, debilitating the animal or transmitting infection leading to a slow, distressing death. Feeding and breeding grounds may also be disturbed as a result of boat access within a region. Populations may be restricted to feeding areas that do not correspond with high vessel traffic in order to evade threat and disturbance, limiting their habitat and increasing competition for limited resources.

Table 57. Risk rating for the impact of boat strikes in the aquarium fishery on protected/special species (Appendix 2, tables 1 and 5).

Justification	Risk rating
The number of vessels in the fishery is low (up to 13) and there have been no reports of boat strikes by operators since 1990. Consequently, it was considered that this impact was negligible (C0) on these species and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 53. Sea birds

Forty-three seabird species listed under the EPBC Act are known to occur within the North Marine Region (DSEWPAC 2011). The region is considered to be particularly important for four species as substantial proportions of their populations use the region and adjacent waters for breeding, foraging and other life-history phases. This includes the Bridled Tern and Roseate Tern, primarily distributed across Arnhem Land and the southern Gulf of Carpentaria, which breed on islands adjacent to the waters of the aquarium fishery.

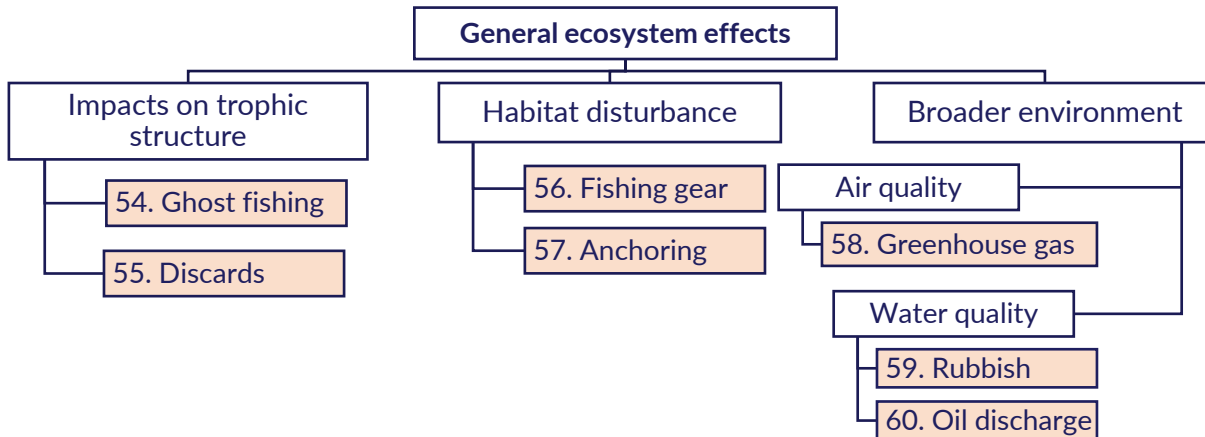
A review of logbook data indicates there were no reported interactions with seabirds in the fishery since 1990. This suggests that this fishery is conducted in a manner that avoids mortality of, or injuries to, seabirds.

Table 58. Risk rating for the impact of the aquarium fishery on seabird populations (Appendix 2, tables 1 and 5).

Justification	Risk rating
The number of vessels in the fishery is low (up to 13) and there have been no reports of interactions with sea birds by operators since 1990. Consequently, it was considered this impact was negligible (C0) on these species and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

6.4. General ecosystem effects

Figure 6. Component tree for issues related to the general environment impacts of the aquarium fishery



6.4.1. Impacts on trophic structure

Issue 54. Ghost fishing

Table 59. Risk rating for the impact of ghost fishing in the aquarium fishery on trophic levels (Appendix 2, tables 1 and 7).

Justification	Risk rating
Hand collection is the main method used in the aquarium fishery. Scoop nets, cast nets, drag nets, pots, traps and handlines are used in fresh water and marine environments and, on occasion, may become snagged on reef substrate and lost. There is potential for this gear to continue fishing after being lost, especially while it remains baited for a short time afterwards. However, the impact of this type of ghost fishing is considered to be negligible (C0) due to the relatively low quantity of this gear used and the very low effort in the fishery. Similarly, the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 55. Discards

Because of the low number of operators and targeted nature of hand collection and hand nets, with relatively low numbers of scoop, drag, and cast nets, pots and traps, the level of discarding in the aquarium fishery is very low and the resultant impact on trophic levels is negligible.

Table 60. Risk rating for the impact of discards in the aquarium fishery on trophic levels (Appendix 2, tables 1 and 7).

Justification	Risk rating
Because of the small number of operators and the targeted nature of hand collection and hand nets, the level of discarding in the aquarium fishery is near zero and the resultant impact on trophic levels is considered to be negligible (C0). Similarly, the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

6.4.2. Habitat disturbance

Issue 56. Fishing gear

Table 61. Risk rating for the impact of fishing gear in the aquarium fishery on habitats (Appendix 2, tables 1 and 6).

Justification	Risk rating
Due to the low number of operators and generally hand-operated fishing gear, it was considered this fishery would have a negligible (C0) impact on habitats. Similarly, the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 57. Anchoring

Table 62. Risk rating for the impact of anchoring in the aquarium fishery on trophic levels (Appendix 2, tables 1 and 6).

Justification	Risk rating
The low number of vessels in the fishery and the fact that anchoring tends to occur on sandy substrate meant the impact on habitats from this activity was considered negligible (C0). Similarly, the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

6.4.3. Broader environment

Issue 58. Greenhouse gas

Table 63. Risk rating for the impact of greenhouse gas/carbon emissions in the aquarium fishery on the broader environment (Appendix 2, tables 1 and 6).

Justification	Risk rating
The majority of vessels operating in the fishery are relatively small (that is, less than 6m) and utilise fuel-efficient, modern four-stroke engines that produce minimal exhaust gases. Only three vessels are larger (16m) and diesel-powered. As a result, the amount of greenhouse gases in the fishery was considered negligible (C0) and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 59. Rubbish

Table 64. Risk rating for the impact of rubbish in the aquarium fishery on the broader environment (Appendix 2, tables 1 and 6).

Justification	Risk rating
The disposal of solid, non-degradable waste in Territory coastal waters is regulated through the <i>Marine Pollution Act 1999</i> . There are substantial penalty provisions for non-compliance with these regulations so fishers store rubbish on board for disposal on return to port. The commercial sector is aware of these issues and, in 2006, the Northern Territory Aquarium Committee developed the Territory's aquarium fishery EMS and Code of Practice. The EMS was updated in 2012 and the Code of Practice in 2013. As a result, the amount of rubbish disposed of by the fishery was considered negligible (C0) and the likelihood of a negative impact was considered to be remote (L1).	Negligible (0)

Issue 60. Oil discharge

Table 65. Risk rating for the impact of oil discharge in the aquarium fishery on the broader environment (Appendix 2, tables 1 and 6).

Justification	Risk rating
<p>The majority of vessels operating in the fishery are relatively small (that is, less than 6m) and utilise fuel-efficient, modern four-stroke engines that produce minimal exhaust gases. Only three vessels are larger (16m) and diesel-powered. As a result, the amount of oil disposed by the fishery was considered negligible (C0) and the likelihood of a negative impact was considered to be remote (L1).</p>	<p>Negligible (0)</p>

7. References

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8. Appendices

Appendix I: ERA Workshop attendees

Technical Expert Panel workshop attendees – Wednesday 24 July 2019

Dr Stephen Newman, Principal Scientist, Fisheries and Agriculture Resource Division, Department of Primary Industry and Regional Development, Western Australia

Prof. Morgan Pratchett, Reef Research Leader: Coral Reef Ecology, James Cook University, Townsville, Queensland

Dave Carlisle, Assistant Director Commercial assessments team (WA, SA, Vic, Tas, NSW, Commonwealth fisheries), Wildlife Trade Assessments Section, CITES Scientific Authority of Australia, Department of the Environment and Energy, Canberra, ACT

Fiona Keen, Wildlife Trade Assessments Section, Biodiversity Conservation Division, Department of the Environment and Energy, Canberra, ACT

Paula Kalinowski, Fisheries Management Officer, Fisheries and Agricultural Resource Division, Sustainability and Biosecurity, Department of Primary Industries and Regional Development, Perth, WA

Dr Thor Saunders, Principal Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker)

Dr Shane Penny, Senior Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory

Evan Needham, Manager Marine Ranger and Biosecurity Support, Department of Primary Industry and Resources, Darwin, Northern Territory (Former Manager Northern Territory Aquarium Fishery)

Lewis Christensen, Graduate Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker for ERA Table in Excel)

Michael Usher, Wildstock Fishery Manager, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory

Brian Boyle, Wildstock Fishery Manager (Aquarium Fishery), NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker)

Apologies were received from:

Anthony Roelofs, Fisheries Queensland, Department of Agriculture and Fisheries, Queensland

Danielle Stewart, Fisheries Queensland, Department of Agriculture and Fisheries, Queensland

Stakeholder workshop attendees – Thursday 25 July 2019

Detective S/C Chris Killian, Water Police Section, Northern Territory Police

Sean Slattery, Northern Territory Aquarium Fishery licence holder

Daniel Kimberley, Monsoon Aquatics, Northern Territory Aquarium Fishery licence holder (Aquarium Fishery Management Advisory Committee)

Jaime Beard, NT Corals, Northern Territory Aquarium Fishery licence holder (Aquarium Fishery Management Advisory Committee)

Ryan Donnelly, Chief Finance Officer, Cairns Marine Coral Holdings (Aquarium Fishery Management Advisory Committee).

Cameron Bee, Approved Operator, Cairns Marine Coral Holdings

Lyle Squire Jnr, Cairns Marine Coral Holdings, Northern Territory Aquarium Fishery licence holder (Aquarium Fishery Management Advisory Committee, (attended meeting from 10:00am by phone hook-up)

Katherine Winchester, CEO NT Seafood Council

Dr Rik Buckworth, Fisheries expert (Chair, Aquarium Fishery Management Advisory Committee)

Jason Fowler, Australian Marine Conservation Society (Aquarium Fishery Management Advisory Committee)

Dave Wilson, Aqua Green, Aquarium Fishery Licence lessee (Aquarium Fishery Management Advisory Committee)

William Pretty, Indo-Pacific Marine

Dr Stephen Newman, Principal Scientist, Fisheries and Agriculture Resource Division, Department of Primary Industry and Regional Development, Western Australia

Prof. Morgan Pratchett, Reef Research Leader: Coral Reef Ecology, James Cook University, Townsville, Queensland

Dave Carlisle, Assistant Director Commercial assessments team (WA, SA, Vic, Tas, NSW, Commonwealth fisheries), Wildlife Trade Assessments Section, CITES Scientific Authority of Australia, Department of the Environment and Energy, Canberra, ACT

Fiona Keen, Wildlife Trade Assessments Section, Biodiversity Conservation Division, Department of the Environment and Energy, Canberra, ACT

Paula Kalinowski, Fisheries Management Officer, Fisheries and Agricultural Resource Division, Sustainability and Biosecurity, Department of Primary Industries and Regional Development, Perth, WA

Dr Thor Saunders, Principal Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker)

Dr Shane Penny, Senior Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory

Evan Needham, Manager Marine Ranger and Biosecurity Support, Department of Primary Industry and Resources, Darwin, Northern Territory (Former Manager Northern Territory Aquarium Fishery)

Lewis Christensen, Graduate Scientist, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker for ERA Table in Excel)

Michael Usher, Wildstock Fishery Manager, NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory

Brian Boyle, Wildstock Fishery Manager (Aquarium Fishery), NT Fisheries, Department of Primary Industry and Resources, Darwin, Northern Territory (note taker)

Apologies were received from:

Anthony Roelofs, Fisheries Queensland, Department of Agriculture and Fisheries, Queensland

Danielle Stewart, Fisheries Queensland, Department of Agriculture and Fisheries, Queensland

Appendix 2: Likelihood, consequence and risk matrix tables

Table 1. Likelihood definitions

Level	Score	Definition
Likely	5	Expected to occur
Occasional	4	Will probably occur
Possible	3	Evidence to suggest it may occur
Rare	2	May occur in exceptional circumstances
Remote	1	Has never occurred but is not impossible

Consequence categories for the target and main retained species

Table 2. Primary and key secondary species consequence definitions

Level	Score	Definition
Negligible	0	Impact unlikely to be detectable at the scale of the stock
Minor	1	Minimal impact on the stock (biomass above 60% of unfished levels)
Moderate	2	Harvest levels at maximum yields (biomass 40-60% of unfished levels)
Severe	3	Harvest levels are impacting stock levels (biomass 20-40% of unfished levels)
Major	4	Harvest levels are significantly impacting stock and recruitment levels (biomass <20% of unfished levels)

Table 3. Secondary, tertiary and bycatch species consequence definitions

Level	Score	Definition
Negligible	0	Almost zero harvest with impact unlikely to be detectable at the scale of the stock
Minor	1	Minimal impact on the stock (LOW risk in SAFE/PSA assessment)
Moderate	2	Harvest levels at maximum yields (MEDIUM risk in SAFE/PSA assessment)
Severe	3	Harvest levels are impacting stock levels (HIGH risk in SAFE/PSA assessment) or species have high vulnerability and low resilience to harvest
Major	4	Harvest levels are causing very serious impacts with a long recovery period required to return the stock to an acceptable level (HIGH risk in SAFE/PSA assessment)

Table 4. Harvestable species of concern

Level	Score	Definition
Negligible	0	Zero or near zero harvest (<10% NDF)
Minor	1	Low harvest levels with low or undetectable impacts (10-100% NDF)
Moderate	2	Harvest levels are >100% of NDF levels or the impact of harvest is unknown
Severe	3	Harvest levels significantly exceed NDF levels or there is indications of population declines
Major	4	Indication of serious declines in populations

Table 5. Threatened, endangered and protected species (TEPS) consequence definitions

Level	Score	Definition
Negligible	0	Near zero interactions with impact unlikely to be detectable at the scale of the population
Minor	1	Low interaction levels with minimal impact on the population
Moderate	2	Levels of impact are at maximum levels
Severe	3	Interaction levels are causing further population declines
Major	4	Interaction levels are causing very serious declines or extinctions

Table 6. Habitat consequence definitions

Level	Score	Definition
	Score	Definition
Negligible	0	Insignificant impacts to habitat or populations of species making up the habitat which is unlikely to be measurable against background variability. (<1% of the habitat impacted)
Minor	1	There are measurable impacts in localised areas (<5% of habitat impacted)
Moderate	2	Levels of impact are measurable at larger scales (5-20% of habitat impacted)
Severe	3	The area impacted is sufficient that loss of habitat function is possible (20-50% of habitat impacted)
Major	4	Levels of impact are causing loss of habitat function and there is a risk of the entire habitat being impacted/ removed (>50% of habitat impacted)

Table 7. Ecosystem consequence definitions

Level	Score	Definition
Negligible	0	Insignificant impacts on harvested or bycatch species and/or habitats resulting in effects on the ecosystem that are unmeasurable against background variation.
Minor	1	Levels of impact on harvested or bycatch species and/or habitats are significant but these are unlikely to affect ecosystem function
Moderate	2	Levels of impact are severe on harvested or bycatch species and/or habitats but these are unlikely to affect ecosystem function
Severe	3	Severe impacts on harvested or bycatch and/or habitats are causing measurable changes in ecosystem function (for example, species replacements and community shifts)
Major	4	There are major impacts on most of the ecosystem components resulting in major regime shifts in ecosystem function (for example, different species groups and/or habitats exist in the impacted area)

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

Appendix 3

Summary of 2016 non-detriment findings for the Territory aquarium fishery – hard corals, giant clams

Obligations under CITES are given effect domestically by the EPBC Act. This act requires that export permits for CITES-listed species must not be issued unless the minister is satisfied export will not be detrimental to, or contribute to trade that is detrimental to, the survival or recovery of the species or relevant ecosystem.

This document provides a summary of NDFs made for the harvest of hard corals and giant clams in the NT aquarium fishery in December 2016. These NDFs are a revision of the previous findings made in 2012 and 2014¹, and take into account additional years of catch data. The 2016 NDFs have been developed to inform the Minister's consideration of whether to declare a new wildlife trade operation (WTO) for the NT aquarium fishery including CITES-listed species, to allow continued export of these species from the fishery.

The harvest limits proposed in the 2016 NDFs are based on catch data (2010-16), the outputs of an ERA workshop for the fishery held in September 2015, and a request from the former Department of Primary Industry and Fisheries (DPIF), for an increase in limits for certain species, accompanied by further information on catch of these species. For most species, the harvest limits have not changed from those set in 2014.

The 2015 ERA workshop was attended by experts, including commercial fishers, researchers, managers from DPIF and other state government fishery agencies, and representatives from the former Australian Government Department of the Environment. There is very limited fishery-independent information available on the local distribution or abundance of many of these species. However, experts at the workshop agreed that fishing effort is low relative to the area of the fishery, and fishing activity is naturally limited by water depth, water clarity, tidal activity, diver safety concerns (sharks and crocodiles) and weather as monsoonal weather conditions render areas of the Territory inaccessible or unsafe for a significant period each year.

The 2015 ERA workshop used an ERA for the Effects of Fishing Approach (Hobday *et al.*, 2007 and 2011). This proceeds through four stages of analysis: scoping, expert judgment analysis (Scale Intensity Consequence Analysis), empirically-based analysis (Productivity Susceptibility Analysis) and modelling. Final risk categories were validated and agreement sought from all members at the workshop. All species assessed during the workshop returned a risk assessment of low. This is consistent with the initial assessment of species during the Scale Intensity Consequence Analysis. A full justification supporting risk categories is documented in a draft ERA workshop report provided to the Department of the Environment and Energy.

The CITES Scientific Authority considers that, based on the outcomes of the ERA and supporting views expressed by coral reef scientists at the workshop, harvest of species at the 2014 NDF levels poses a low risk to those species. At the completion of the ERA workshop, participants held an informal discussion regarding the implications of increasing harvest levels for a limited number of species considered to be economically important. Consensus was reached between the workshop participants that doubling the current harvest limits for these species would not be likely to alter the risk rating as determined in the ERA, given the relatively small quantity of coral pieces harvested.

¹ The 2012 and 2014 NDF reports are commercial-in-confidence due to the small number of active operators in the fishery.

Hard corals

A number of scleractinian coral species or species groups previously identified in the 2012 and 2014 NDF findings are harvested in the Territory's aquarium fishery. These coral species were considered in the 2015 ERA workshop, which concluded that the current harvest limit (set by the 2014 NDF) posed a low risk to the sustainability of the assessed hard coral species in the wild.

A subset of species harvested in the fishery considered to be economically important were further discussed at the conclusion of the workshop. The participants agreed that doubling harvest limits (as set by the 2014 NDF) would not likely increase the risk to these species. DPIF also provided a submission to the Department requesting an increase in harvest limits for some economically important species. This submission provided evidence harvest effort for these species has been spread over a larger area of the fishery than harvest considered in the 2014 NDF, reducing the likelihood of localised depletion of those species. Based on this information, the outcomes of the ERA and discussions at the ERA workshop, the CITES Scientific Authority has decided to increase the NDF harvest limit for these species as requested, up to a maximum of double the 2014 NDF harvest limits for these identified species.

Ten species identified as being of concern in the 2012 NDF are highlighted in Table 1. These species were discussed at length at the 2015 ERA with no concerns raised and all these species assessed as being at low risk. Recommended harvest limits for each of the hard coral species harvested in the fishery are provided in the final column of Table 1.

Table 1. Harvest of target hard coral species in the Territory aquarium fishery (kg)

Species or genus	2014 NDF	Average harvest 2010-2016	NT DPIR requested increase - 2016	Proposed 2016 NDF
<i>Acanthastrea echinata</i>	50	44.24	100	100
<i>Acanthastrea lordhowensis</i>	40	0.15	n.a.	40
<i>Acanthastrea maxima</i>	40	0.13	n.a.	40
<i>Acanthastrea micromussa</i>	40	2.28	n.a.	40
<i>Acanthastrea sp</i>	40	6.53	n.a.	40
<i>Acropora efflorescence</i>	40	4.15	n.a.	40
<i>Acropora elseyi</i>	40	0.11	n.a.	40
<i>Acropora millepora</i>	40	2.82	n.a.	40
<i>Acropora sp</i>	40	29.21	n.a.	40
<i>Alveopora sp</i>	40	8.70	n.a.	40
<i>Astreopora sp</i>	40	5.04	n.a.	40
<i>Australogyra zelli</i>	40	0.38	n.a.	40
<i>Australomussa rowleyensis</i>	40	6.10	n.a.	40
<i>Balanophyllia sp</i>	40	2.88	n.a.	40
<i>Blastomussa wellsii</i>	40	1.48	n.a.	40
<i>Ctenactis albitentaculata</i>	40	0.00	n.a.	40
<i>Ctenactis sp</i>	40	0.93	n.a.	40
<i>Cynarina lacrymalis</i>	20	11.73	n.a.	20
<i>Cynarina sp</i>	40	10.69	n.a.	40
<i>Cyphastrea sp</i>	40	3.56	80	80
<i>Dendrophyllia sp</i>	40	1.91	n.a.	40
<i>Duncanopsammia axifuga</i>	40	63.18	100	80

Species or genus	2014 NDF	Average harvest 2010-2016	NT DPIR requested increase - 2016	Proposed 2016 NDF
<i>Duncanopsammia sp</i>	40	7.82	n.a.	40
<i>Echinophyllia sp</i>	40	32.47	100	80
<i>Echinopora hirsutissima</i>	40	0.02	n.a.	40
<i>Euphyllia ancora</i>	40	40.19	100	80
<i>Euphyllia glabrescens</i>	40	33.20	100	80
<i>Euphyllia paraancora</i>	200	239.76	300	300
<i>Euphyllia sp</i>	40	8.07	n.a.	80
<i>Favia sp</i>	40	38.63	n.a.	40
<i>Favia speciosa</i>	40	1.44	n.a.	40
<i>Favites abdita</i>	40	1.16	n.a.	40
<i>Favites complanata</i>	40	0.58	n.a.	40
<i>Favites flexuosa</i>	40	0.37	n.a.	40
<i>Favites pentagona</i>	40	0.79	n.a.	40
<i>Favites sp</i>	40	8.01	n.a.	40
<i>Fungia sp</i>	40	9.91	n.a.	40
<i>Galaxea astreata</i>	40	0.17	n.a.	40
<i>Galaxea fascicularis</i>	40	2.11	n.a.	40
<i>Galaxea sp</i>	40	0.96	n.a.	40
<i>Goniastrea edwardsi</i>	40	0.02	n.a.	40
<i>Goniastrea sp</i>	40	1.16	n.a.	40
<i>Goniopora sp</i> ¹	80	76.67	*	*
• <i>Goniopora columna</i>	40	-	80	80
• <i>Goniopora minor</i>	40	-	80	80
• <i>Goniopora stokesi</i>	40	-	80	80
• <i>Goniopora tenuidens</i>	40	-	80	80
<i>Heliofungia actiniformis</i>	200	95.55	n.a.	200
<i>Heliofungia sp</i>	40	25.48	n.a.	40
<i>Herpolitha limax</i>	40	3.66	n.a.	40
<i>Heteractis crispa</i>	40	0.07	n.a.	40
<i>Heteractis magnifica</i>	40	0.08	n.a.	40
<i>Heteractis malu</i>	40	0.01	n.a.	40
<i>Hydnophora sp</i>	40	4.90	n.a.	40
<i>Leptastrea sp</i>	40	2.13	n.a.	40
<i>Leptogorgia virgulata</i>	40	0.28	n.a.	40
<i>Lithophyllon edwardsi</i>	40	0.22	n.a.	40
<i>Lithophyllon sp</i>	40	0.64	n.a.	40
<i>Lobophyllia hemprichii</i>	40	1.54	n.a.	40
<i>Lobophyllia sp</i>	40	7.33	n.a.	40
<i>Merulina ampliata</i>	40	0.05	n.a.	40
<i>Micromussa amakusensis</i>	40	5.25	n.a.	40

Species or genus	2014 NDF	Average harvest 2010-2016	NT DPIR requested increase - 2016	Proposed 2016 NDF
<i>Micromussa diminuta</i>	80	32.03	n.a.	80
<i>Micromussa sp</i>	40	18.92	n.a.	40
<i>Montipora digitata</i>	40	3.60	n.a.	40
<i>Montipora sp</i>	40	13.76	n.a.	40
<i>Moseleya latistellata</i>	20	14.95	n.a.	20
<i>Moseleya sp</i>	40	4.43	n.a.	40
<i>Mycedium elephantotus</i>	40	2.40	n.a.	40
<i>Mycedium sp</i>	40	0.11	n.a.	40
<i>Pavona sp</i>	40	0.04	n.a.	40
<i>Physogyra lichtensteini</i>	40	0.23	n.a.	40
<i>Platygyra lamellina</i>	40	3.11	n.a.	40
<i>Platygyra sp</i>	40	5.37	n.a.	40
<i>Plerogyra sinuosa</i>	20	18.48	100	40
<i>Plesiastrea sp</i>	40	0.06	n.a.	40
<i>Plesiastrea versipora</i>	40	0.07	n.a.	40
<i>Pocillopora damicornis</i>	40	1.03	n.a.	40
<i>Pocillopora sp</i>	40	1.33	n.a.	40
<i>Podabacia crustacea</i>	40	0.04	n.a.	40
<i>Polyphyllia sp</i>	40	0.05	n.a.	40
<i>Porites lobata</i>	40	3.97	n.a.	40
<i>Porites solida</i>	40	3.42	n.a.	40
<i>Porites sp</i>	40	12.47	n.a.	40
<i>Psammocora sp</i>	40	0.14	n.a.	40
<i>Scolymia sp</i>	40	0.01	n.a.	40
<i>Seriatopora hystrix</i>	40	6.79	n.a.	40
<i>Stylophora sp</i>	40	0.99	n.a.	40
<i>Stylophora subseriata</i>	40	6.10	n.a.	40
<i>Symphyllia sp</i>	40	3.06	n.a.	40
<i>Trachyphyllia geoffroyi</i>	40	0.08	n.a.	40
<i>Trachyphyllia sp</i>	40	1.26	n.a.	40
<i>Tubastrea sp</i>	40	5.76	n.a.	40
<i>Tubipora musica</i>	40	0.28	n.a.	40
<i>Turbinaria peltata</i>	40	3.01	n.a.	40
<i>Turbinaria reniformis</i>	40	4.22	n.a.	40
<i>Turbinaria sp</i>	40	0.75	n.a.	40

n.a.: not available

1. The 2014 harvest limit of 80kg for *Goniopora sp* was based on the information submitted by NT DPIF that two species in the genus were harvested in the fishery (i.e. equivalent of 40kg for each of the two species). Since 2014, the reporting of take of *Goniopora sp* is now occurring at the species level and four species have been recorded as harvested. As per the ERA outcome that doubling of selected species posed a low risk, each of these species has had their limit increased from 40kg to 80kg.

Coral species not previously included in the 2012 or 2014 NDFs

Coral taxa listed in Table 2 have been identified by fishers as occurring in the fishery. The discovery of previously unreported taxa in a developing fishery is not unexpected, therefore the precautionary harvest limit of 40kg annually for these species is considered appropriate, as per the final column in Table 2.

There are additional scleractinian coral species permitted to be harvested in the NT aquarium fishery. There has been negligible take of these species as they have not been of significant commercial interest. For these additional species, annual harvest up to a limit of 40kg per species is not likely to be detrimental. In their recent application for a WTO, NT DPIR included *Leptoseris scabra* and *Blastomussa merletti* as examples of additional species expected to be harvested.

Should additional taxa be identified over the period of this NDF, the CITES Scientific Authority should be notified.

Table 2. Harvested hard coral species (kg) reported by NT DPIF in 2016 and not identified in catch records provided to the CITES Scientific Authority during the 2014 NDF assessment

Species or genus	Average harvest (2013-16)	2016 NDF
<i>Blastomussa merletti</i>	-	40
<i>Caulastrea sp</i>	0.32	40
<i>Catalaphyllia jardinei</i>	0.25	40
<i>Leptoseris explanata</i>	0.56	40
<i>Leptoseris scabra</i>	-	40
Merulinidae undifferentiated	0.26	40
<i>Oxypora sp</i>	0.598	40
<i>Porites australiensis</i>	6.8	40

Live rock

Live rock (also known as coral rock) is hard consolidated material that may contain pieces of dead coral, coralline algae and other sedimentary rocks, to which are attached live specimens of invertebrates and coralline algae. Live rock is treated by Australia as though it is listed under Appendix II of CITES, and export permits are issued providing harvest remains within annual sustainable limits.

The 2015 ERA workshop concluded that doubling the current harvest limits would not raise the risk rating, compared to 2014 harvest levels. In its request for an increase in harvest limits, NT DPIR states that anecdotal evidence suggests vast quantities of live rock are available. Therefore, the CITES Scientific Authority has decided that doubling the total annual harvest limit for live rock from the limit in the 2014 NDF to 6,000kg (rounded to the nearest 1000kg) is not likely to be detrimental.

The harvest limit from the 2014 NDF report and the proposed limit from 2016 is shown in Table 3.

Table 3. Harvest limit for live rock, 2014 and 2016 NDF assessments

Species	Average harvest 2010-2016	2014 NDF	2016 NDF
Live rock	2371	2750	6000

Giant clams

Despite the global distribution and status of giant clams not being clearly defined, Othman *et. al* (2010) noted a wide distribution with varying levels of population densities of giant clams throughout the Asia and Oceania region. The 2012 NDF noted that sites surveyed in 2009 at north-east Arnhem Land and Groote Eylandt by a PhD candidate of Charles Darwin University indicate that giant clams occur at a relatively high density (between one and three orders of magnitude greater) compared to the areas surveyed by Othman (2010). It is also possible that the densities reported in the Charles Darwin University study represent an underestimate of clams present in the areas surveyed as a result of the sampling methods used.

The outcomes of the 2015 ERA workshop support continuing the 2014 NDF limit set for giant clams as it was found that continuing the current harvest at the prescribed NDF limit would result in low risks for both *T. squamosa* and *T. maxima*.

Recommended harvest limits for each of these species are provided in the final column of Table 4 and are based on harvest records in the Territory aquarium fishery for 2006 to 2016.

Table 4. Tridacnid clams NDF harvest limits for 2016

Species	Average harvest 2010-16	2014 NDF	2016 NDF
<i>Tridacna squamosa</i>	189	200	200
<i>Tridacna maxima</i>	40	80	80

It should also be noted that the Territory Government has been running an aquaculture program involving culture of giant clams. It is anticipated this program will lessen the need for future increases for the harvest of specimens from the wild in the Territory.

Conclusion

This 2016 NDF for the Territory aquarium fishery has been based on information provided by the NT DPIF and previous NDFs. The information provided comprised historical harvest data, harvest locations for hard coral and giant clams, and the outcomes of an ERA workshop. Further management arrangements for the Territory aquarium fishery are described in the Department's assessment report to inform a new WTO declaration for 2016 and include conditions relating to reporting and compliance. This NDF remains current until it is reviewed.

Review of harvest levels

The harvest levels detailed in this document have been developed based on available harvest information and other relevant available information. Harvest levels can be reviewed if new information becomes available from trade and fishery data, ecological risk assessments or other research.

Appendix 3: References

Department of the Environment (2014) Summary of 2014 Non-Detriment Findings for the Northern Territory Aquarium Fishery – hard corals and giant clams.

Department of Sustainability, Environment, Water, Population and Communities (2012) Assessment for the export of giant clams, *Tridacna maxima* and *T. squamosa* from the Northern Territory Aquarium Fishery, Australia (confidential report - due to very small number of active operators in the fishery.)

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