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CASE STUDY 4
Corals
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NON DETRIMENT FINDING FOR CITES-LISTED *CORALS* IN THE QUEENSLAND CORAL FISHERY

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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1. Scientific and common names

Please see Table 1 for CITES-listed species/genera collected in, and sometimes exported from, the fishery.

1.2. Distribution

Based on the best available information (Roelofs and Silcock, 2008), all but four CITES-listed species/genera collected in the QCF have widespread distribution throughout the Indo-Pacific region. One of the four genera, *Dendrophyllia*, has a comparatively more restricted distribution, though it is commonly found throughout the West Pacific. Two other genera/species (*Duncanopsammia axifuga* and the genus *Balanophyllia*), while found throughout the West Pacific have the potential to be locally rare. The mussid *Acanthastrea lordhowensis* is thought to be regionally endemic.

1.3. Biological characteristics:

1.3.1 *General biological and life history characteristics*

Corals can be divided into two very distinct groups, based on whether or not they have a symbiotic relationship with tiny algae called zooxanthellae. *Zooxanthellate* corals derive much of their energy source from the photosynthetic products of the microalgae, consequently they require habitats with at least some exposure to light. *Azooxanthellate* corals do not have this symbiosis and can live in darker habitats – relying solely on catching plankton or absorption of nutrients from the water column for food.

There are several different genetic strains of zooxanthellae that appear to confer different levels of thermal tolerance to the corals that harbour them. Evidence is emerging that suggests corals can switch zooxanthellae to suit their particular environmental conditions (Baker, 2001) – how this process works exactly and the role that it might play in improving resilience to localised events such as increased sea surface temperatures (the main risk factor for coral bleaching) is yet to be understood.

Corals can also be divided into *hermatypic* (reef-building) or *ahermatypic* (non-reef building) types. This division prompts some debate but for the purpose of this report, the term hermatypic will be used to describe corals that contribute significantly to the calcium carbonate reef matrix, regardless of whether they are zooxanthellate or not (Schumacher and Zibrowius, 1985). Most are in fact zooxanthellate.

Corals have a wide range of reproductive and growth strategies and many species exhibit considerable flexibility in response to stress or particular environmental conditions. Only the hard corals collected in this fishery will be discussed in this report. For colonial species of hard coral there is a blurring between growth and reproduction. Coral polyps are grouped together in a limestone formation – they grow via continual calcification (accretion). Polyp density is maintained in the growing colony by continual division of polyps (particularly the polyps at the tips of branching corals or the leading edge of other growth forms).

Depending on conditions, most corals can reproduce both sexually and asexually. *Asexual reproduction* can be via *fragmenting, budding, polyp bail out* (a stress response involving just the polyps), *polyp expulsion* (occurs in apparently healthy coral and includes both the polyp and part of the skeleton), and *asexually brooded planulae* (competent larvae). *Sexual reproduction* can be equally plastic under different conditions. Corals are generally either *hermaphroditic* (both sexes in the same colony) or *gonochroic* (different sexes in different colonies)

—some corals e.g. *Porites porites* can switch sex. There are two main reproductive strategies— *brooding* or *broadcast spawning* (which can vary also in response to environmental conditions). Brooders are usually hermaphrodites and self fertilise. Broadcasters release eggs and sperm into the water column – they can be hermaphroditic or gonochroic. The slight majority of corals appear to be primarily hermaphroditic, broadcast spawners (Borneman, 2001).

Life history traits are frequently grouped as being either 'r' or 'k' strategies. For corals – *'r' strategists* are often the 'pioneer' species (e.g. the acroporids and pocilloporids) – corals that reproduce frequently, in large numbers (but with high mortality rates for the offspring), have shorter lifespans and small to medium colony sizes. The *'k' strategists* are frequently brooders and put energy into longterm growth (e.g. the faviids and *Porites* species). These species have large, long-lived colonies, less frequent sexual reproduction and lower juvenile mortality rates. However, most corals sit somewhere in between these two extremes (Borneman, 2001). In most species of hard corals, sexual maturity is reached between 3-5 years old and for most species, the onset of reproductive activity appears to be closely related to colony size, area and branch length – depending on the species (Borneman, 2001).

Given the plasticity of most life history characteristics, vulnerability indices have been generated for species in this fishery based on environmental and ecological factors (accessibility/ habitat/ ecological niche/ distribution/ susceptibility to bleaching/ relative abundance on the Great Barrier Reef) that influence their potential vulnerability to harvesting activities. This was used as a pre-assessment tool for a subsequent ecological risk assessment of the QCF (for full details see Roelofs & Silcock, 2008). The results for the CITES-listed hard corals collected in this fishery can be seen in Table 1. It is interesting to note that of the 52 genera/species collected in the fishery, 31 have a low susceptibility to bleaching.

1.3.2. *Habitat types*

Please refer to Table 1 for details. Of the 52 CITES-listed genera/species collected in the QCF, 10 are listed here as habitat specialists (that is they have a limited or defined niche). These are: *Plerogyra, Catalaphyllia, Heteropsammia, Caulastrea, Diaseris, Cycloseris, Montipora, Symphyllia, Scolymia* and *Trachyphyllia.*

Several of these genera are either solitary corals (e.g. *Cycloseris*, or are routinely found in relatively great abundance in deeper, more turbid, inter-reefal areas. The rest of the genera are identified as habitat generalists and are found in a wide range of habitats and depths –

more commonly on reefs than off. Based on the information in Table 1, 12 of the 52 CITES-listed genera/species found in the QCF are readily accessible (that is, they are found in depths less than 5-10m). With the exception of the genera *Diaseris* and *Montipora*, these are not the same genera as those that are habitat specialists (listed above).
Broad habitat types for each species/genus were included in the Vulnerability Assessment.

1.3.3 *Role of the species in its ecosystem*

A broad range of coral species is collected in this fishery —some species are hermatypic. These tend to be either fast growing species— such as the acroporids and pocilloporids, or the slower growing 'massives' such as the poritids, plus there are several other genera that contribute in various ways to constructing the fabric of a coral reef.

However, there are many other species that, while they are found on coral reefs, are more commonly described as ahermatypic corals. Some species in this group are free-living e.g. fungiids, while others are more likely to form colonies (or live as clusters of individuals) in inter-reefal waters – generally these are sandy or muddy environments, sometimes with some semi-submerged hard (rock) substrate present. Little is known about the explicit ecosystem function of these species, other than they contribute to the biodiversity of the system and, at a smaller scale than true reef-building coral species, provide habitat for other species. Some species are able to survive well across a range of habitats. See Table 2 for a summary of the reef-building status of hard coral genera/species in the QCF. The majority of the species exported in any quantity[1] from this fishery are ahermatypic (12/19 species).

Inter-reefal habitats have traditionally received minimal research attention so little is known about the ecosystems they support. Because most coral scientists focus on reef communities and particularly the reef building or fast growing species of coral, other species that are infrequently encountered on coral reefs have, in the past, been labelled as rare. In many cases this apparent rarity is belied by anecdotal reports that these same species can be extremely prolific in specific kinds of inter-reefal habitats (see section 1.3.2.)

On the Great Barrier Reef, recent research on the habitat impacts of the otter trawl fishery has produced thousands of hours of towed video transects of the seafloor (Pitcher *et al*., 2008). While this research was unrelated to the coral fishery it has provided insight into the

[1] More than 100 pieces over two years.

nature of the various inter-reefal habitats and does corroborate the existence of extensive beds of ahermatypic corals – however the footage needs further spatial and taxonomic analysis if it is to be used quantitatively for estimating stock status of various species in the Queensland coral fishery.

1.4. Population:

1.4.1. *Global Population size*

This is difficult to estimate given current lack of published information on actual regional stocks of each species across all habitats in the area. Results from a recent assessment of the conservation status of 845 zooxanthellate hard coral species[2] provide a valuable means of setting priorities for biodiversity conservation at a coarse global scale. Of the 704 species with sufficient information to attempt a classification under this risk-based framework, 32% were classified as having an elevated risk of extinction, due, primarily, to global loss of coral reef habitat.
However, the approach does have limitations that include:

- Application to ahermatypic[3] corals. Many species that occur regularly in the aquarium trade, and appear to be found in greatest abundance in inter-reefal areas are not generally considered hermatypic. Note, on the Great Barrier Reef, coral reef extent represents only about 6% of the total area (~20,724km^2) – the rest is composed of a range of inter-reefal habitats. Because scientists and other divers (except the aquarium collectors) rarely go to these places (due, in part, to scientific diving depth regulations, turbidity, and for recreational users – lack of interesting 3-D structure), independent corroboration of these anecdotal accounts of extensive inter-reefal stocks of several species has been, and remains, difficult in most parts of the world.
- Inability to use 'local knowledge'. The IUCN approach relies heavily on scientific expertise and published information – most of which does not cover the species in the aquarium trade in any detail. Currently, this approach does not appear to incorporate regional, unpublished "local" (non-scientific) knowledge into the consensus process, although the methodology could allow it to do so.

[2] This study used the IUCN Red List criteria, current information on global hard coral cover and reef extent, and the best available scientific consensus to adjust this physical proxy at a species level (based on specific life-history characteristics and known vulnerability to various disturbances e.g. bleaching, COTS etc.) to classify the conservation status of a significant number of hard coral species. For details see Carpenter et al., (2008).

[3] non-reef building corals – as previously defined.

It is worth noting that coral reefs are naturally dynamic places and coral cover varies enormously at both temporal and spatial scales, even on relatively healthy reefs (see data from the Australian Institute of Marine Science Long Term Monitoring Program[4]). Therefore, care needs to be exercised in making assumptions when using information on reef-based coral cover.

There is no doubt that coral reef ecosystems are particularly vulnerable to various forms of disturbance and the cumulative impact of poor water quality, coastal development, anchor and diver-related damage from high levels of recreational use and the removal of critical components of the ecosystem due to assorted fishing activities. However, assumptions that published results from sometimes relatively small coral cover surveys (potentially targeted around known damaged sites at reefal habitats) represent a good regional picture may result in a significant underestimate of coral ecosystem health and indeed individual species status at a regional scale. It may also have implications for making a CITES non-detriment finding at either a species or (multispecies) fishery level for a region.

1.4.2 *Current global population trends*

___increasing _X_decreasing _X_stable (regional scale) ___unknown

It is difficult to generalise across the broad range of species used in the aquarium trade. Based on current available information, at a global scale, coral cover and reef area appear to be declining. However, at a regional scale, some places (like the Great Barrier Reef) appear to be relatively stable[5].

Actual status of any given region depends on recent incidence of disturbance (e.g. COTS, bleaching, coral disease, cyclones) and relative resilience of the ecosystem in the face of other cumulative pressures (e.g. how diverse the ecosystem is, how intact the trophic structure is given local fishing pressure, what impact coastal development has had, plus relative coastal water quality given historic and current land use practices etc).

The real concern is: given the range of current predictions for climate change impacts on coral reef ecosystems (including increased sea surface temperature and increased ocean acidification – what state will regional coral reef ecosystems be in, in 10-20 years time? The

[4] http://www.aims.gov.au/source/research/monitoring/pdf/status-report-08-20080616.pdf.

[5] Compared with other reefs; noting the dynamic nature of coral reefs and previous comments about a general lack of information on inter-reefal habitats in global coral ecosystems.

opportunity before us is to determine how the CITES framework can be strengthened (and integrated with other international conventions) to empower people to improve local scale stewardship and thus ensure that coral ecosystems are more resilient to future threats.

1.5 Conservation status

1.5.1 *Global conservation status* (according to the IUCN Red List)

___Critically endangered	_X__Near Threatened
_X_Endangered	_X__Least concern
_X_Vulnerable	_X__Data deficient

CITES –listed species collected in the QCF range from 'least concern' to 'endangered', and some are data deficient (see Table 2). Species that are frequently exported from the QCF are mostly listed as near threatened under the IUCN *classification. Where only genera are identified (the second part of the Table)* in the QCF the full range of IUCN listings are provided. Four genera in this section include listings of endangered (EN) and one genus includes a listing of critically endangered (CR). This result requires further investigation, however it is unlikely that these classifications are true for the Great Barrier Reef region (see Roelofs, 2008).

1.5.2. *National conservation status for the case study country*

All Scleractinia (hard corals) plus Helioporidae (blue corals), Milleporidae (fire corals), Stylasteridae (lace corals) and Antipatharidae (black corals) are listed under Appendix II of CITES, and, therefore are covered by the *Environmental Protection and Biodiversity Conservation Act* (the primary Australian environmental legislation and the legal instrument to give effect to CITES obligations).

In the Great Barrier Reef Marine Park (GBRMP) and World Heritage Area, the *Great Barrier Reef Marine Park Act* and *Regulations* list <u>all</u> corals (all species of the classes Anthozoa and Hydrozoa) as no-take, except via a permit. This position is consistent with State Marine Park Legislation (see 2.1.3.).

1.5.3 *Main threats within the case study country:*

___No Threats
_X_Habitat Loss/Degradation (human induced- coastal development & inshore habitat loss)
___Invasive alien species (directly affecting the species)
___Harvesting [hunting/gathering]
_X_Accidental mortality (e.g. e.g. anchor damage/ship groundings)

___Persecution (e.g. Pest control)
_X_Pollution (affecting habitat and/or species –water quality and sediment load from land-based activities)
_X_Other: Climate change (bleaching/flooding/acidification/sea level rise/increased Sea Surface Temperature (SST)/coral disease)
___Unknown

2. SPECIES MANAGEMENT WITHIN THE COUNTRY FOR WHICH CASE STUDY IS BEING PRESENTED

2.1. Management measures

2.1.1. *Management history*

- Coral has been collected for various reasons from the Great Barrier Reef for more than 100 years.
- Historically (at least between the 1840s and the beginning of World War II) thousands of tonnes of coral were mined and removed from nearshore waters, along with considerable quantities of coral sand (this was mostly done under a rudimentary permitting system). Generally, the coral was crushed (and sometimes burnt) to produce lime to fertilise the adjacent acid sulphate soils that were farmed extensively (along much of the Queensland coast) for sugar cane; some was used as a setting agent to manufacture raw sugar. Prior to 1900, coral was used for construction (refer to Daley, 2005 for historic details and evidence of extensive modification of nearshore reefs and coral cays and islands during this period).
- As tourism developed on the Great Barrier Reef – considerable quantities were souvenired by visitors, from popular locations. Some coral was transplanted also, to improve amenity values around at least one of the early tourist resorts (Daley, 2005).
- Significant research collections were made and sent to museums and research institutions around the world – particularly pre-1960 (Bowen and Bowen, 2002). In modern times, researchers continue to collect coral from the GBR for research purposes, under a permitting system.
- A 'fishery' has been regulated since 1932 by the State of Queensland (Harriott, 2001). It has been limited entry and quota-based since 1997.
- Up until the 1990s the vast majority of the coral collected in the fishery was the fast growing acroporid and pocilloporid species favoured for the ornamental trade. Over the last 20 years advances in aquarium technology (and reductions in the cost of aquarium equipment) have shifted the market focus towards small colourful species

of coral (often the large-polyped/solitary hard corals and, increasingly, the soft corals, zooanthids and corallimorphs) and coral rubble/rock for the live aquarium trade.

- In 1975, the Australian government established the Great Barrier Reef Marine Park (GBRMP) via legislation and set up the Great Barrier Reef Marine Park Authority to manage the conservation, sustainable use, understanding and enjoyment of all the natural resources within the marine park boundaries. At this time all mining, including oil and coral mining, was banned in the marine park.
- The GBRMP covers an area of 345,400 km^2, of which around 6% is coral reef habitat[6]. Since its establishment, a system of zoning has been progressively implemented to ensure that all activities in the GBRMP (e.g. tourism, recreation, fishing, shipping, etc) are managed, based on their relative levels of impact. The zoning system includes substantial representative areas that are no-take, and in some cases, no-entry. Currently about 33% of the marine park is closed to all forms of fishing – this includes a minimum of 20% protection for each of the total area of some 70 bioregions (unique benthic habitats). The Australian and State governments work together to implement the day-to-day compliance framework for these multiple layers of management.
- In 2000, closure of the coral fishery was considered, following calls from the tourism industry. Detailed investigation (including an independent review – see Cartwright *et al.*, 2002) identified that the fishery was poorly understood and management arrangements were inadequate, based on current practices (noting the shift to species of coral used in aquaria) but there were no sustainability grounds for closure[7]. The outcome was that over about four years, managers from the GBRMPA, the DPI&F and the EPA worked closely with the fishers and other interested parties to completely restructure the management arrangements for the fishery.
- The policy giving effect to the new arrangements was implemented in July 2006 by the DPI&F. All catch information presented in this report relates to the new management arrangements. The policy framework for the coral fishery allows for adaptive management

[6] The remainder includes significant inter-reefal areas and a range of other habitats.

[7] It is important to note that while management arrangements were out of step with collection practices by the 1990s, corals were still afforded protection on the GBR through the following management: no recreational take and commercial collection that was restricted to a small number of operators in shallow, site-specific areas with a small fixed quota per location.

and in early 2008, a review of the new policy was completed, based on 18 months of detailed logbook data. As a consequence of the review, some changes have been recommended and these are currently going through a process of public consultation prior to implementation.

- At the time the Coral Policy was implemented, the new arrangements for the fishery were assessed also under the national Environmental Protection and Biodiversity Conservation Act[8] and given export approval, for the first time since hard corals were listed under CITES. This EPBC Act 'sustainable fisheries' assessment process is also the legal instrument by which the CITES NDF assessment is completed (See Table 3 and http://www.environment.gov.au/coasts/fisheries/publications/pubs/guidelines.pdf for more details). The sustainable fisheries assessment process is risk-based and intended to promote adaptive management, based on sound information.

2.1.2 *Purpose of the management plan in place*

Coral collection in the GBRMP operates under multiple management layers – consequently, to address this item, the stated purpose of each is listed individually below. However, to understand the management arrangements, the layers should be regarded as an integrated package.

State Management arrangements – see http://www2.dpi.qld.gov.au/extra/pdf/fishweb/coralreefpolicy.pdf for details of the current version of the policy *(DPI&F Policy for the Management of the Coral Fishery[9])*:

- To provide for ecologically sustainable use of coral – particularly to ensure that a precautionary approach is taken to the risk of localised depletion[10] if all collection was concentrated in a given area and to ensure that not all the 200 tonne quota is taken as "live" coral (the species favoured in the aquarium sector of the fishery)
- Reduce conflict with other user groups
- Enhance potential export opportunities

[8] This legislation (Part 13A of the *EPBC Act*) is used to meet CITES obligations – the Act also provides an assessment framework for every Australian Fishery that exports native product and every fishery that interacts with national listed protected species, regardless of whether product is exported or not. National standards have been developed to guide the ecologically sustainable management of fisheries.

[9] The Coral Policy has recently been reviewed, minor amendments have been recommended and these proposals are currently out for public comment.

[10] Now termed 'ecologically unsustainable harvest'

GBRMPA arrangements (permits issued jointly with the State EPA) and jurisdictional framework:

- To ensure that the natural resources of the marine park are conserved, that any use is ecologically sustainable (and equitable), and that the ecosystem is understood and enjoyed
- That cross jurisdictional arrangements are well integrated and complementary
- To ensure that all use of coral is monitored (because hard coral is listed under CITES and hence is addressed under the *EPBC Act*) – the collection may only occur via permitting, which carries with it reporting requirements.[11] For this reason, no recreational (unpermitted) take is allowed in the GBRMP.

2.1.3 *General elements of the management plan*

In combination, the current range of multi-jurisdictional and non-legislative management arrangements is as follows:

- Under both the GBRMP and State marine park legislation, all take of coral must be done under a permit. Permits can be issued for the purpose of a limited entry fishery; for conducting research; dredging shipping channels/removal for permitted works in the marine park; and limited coral transplantation to improve amenity value for site-based tourism activities). Permit applications for other purposes will be assessed on a case-by case basis but are unlikely to be granted. This means there is no 'as of right' (recreational) take of coral in the GBRMP World Heritage Area. The State Environmental Protection Agency (EPA) and the Great Barrier Reef Marine Park Authority (GBRMPA), have a collaborative assessment and permitting process for coral collection for the purposes previously identified.
- Under the Queensland *Fisheries Act and Regulations* coral is defined as a 'fish' and can be collected via a limited entry fishery (using Hookah or SCUBA gear) and recreationally (where only a snorkel may be used). Because recreational collection is prohibited in all marine parks including the GBRMP, there are very few areas where recreational Limited entry —59 licences (however there are only about 24 operators in the GBRMP as several hold multiple licences— this means that the overall "footprint" of the fishery is very small).
- Limits on the number of boats and collectors that can operate under a licence at any given time

[11] Note also the early history of coral mining/souveniring on the GBR – the introduction of the GBRMP was partly to ensure that such a level of these activities never occurred again.

- Collection by hand or handheld implements (e.g. hammer and chisel) only
- Catch reporting via mobile phone, prior to landing (to enable compliance checks on arrival in port and to allow real-time quota debiting to minimise quota slippage)
- Detailed logbook reporting, to the level of dive site.
- Catch and catch composition is monitored collaboratively by managers to the level of reef (dive sites if necessary) and to the best taxonomic resolution available through the logbooks. Noting that many species of coral require microscopic examination to finalise identification - species have been grouped to the finest resolution that is possible/reliable through field-based identification. This ensures that fishers are more likely to complete the detail required in the logbook, which, in turn, allows managers to have confidence in the quality of the fishery-dependent information. However, this approach does not, in all cases, achieve the level of reporting specified under CITES
- A comprehensive Ecological Risk Assessment (ERA) tool that takes account of accessibility, vulnerability to disturbance, life history characteristics and collection pressure, then calibrates against local and scientific knowledge systems and provides a risk ranking collection can occur in Queensland.

COMMERCIAL FISHERY

- Total Allowable Catch (TAC) of 200 tonnes per year. This TAC is further split into: 70% can be taken as coral rock/rubble or fast growing coral species (acroporids or pocilloporids only) and 30% taken from all other coral species. The 30% cap includes species that may be relatively uncommon, or have more complex life history characteristics that could make them vulnerable to high levels of collection. It also includes soft corals, zooanthids, corallimorphs and other species that are not CITES-listed. It is worth putting the scale of collection in this fishery in perspective - 1 tonne of live rock represents approximately 25m^2 (equivalent to the size of one car parking space at a shopping centre). Normal functioning coral reef systems produce significant quantities of live rock due to natural processes every year (see ecological risk assessment for live rock in: Roelofs, 2008). Harvest of live hard corals in the QCF represents a miniscule fraction of what naturally accretes in a year on the Great Barrier Reef.
- Defined fishery area (between latitudes 10o41'S and 24o30'S) that amounts to 345,400 km^2 of coral reef ecosystem (Figure 3). Subject to GBRMP zoning rules – around 60% of this area is available to

collectors. Two areas of relatively concentrated collection within the GBRMP have been further defined (see Figures 4 & 5)[12]. Review reference points (of 43 tonnes and 36 tonnes respectively) have been established for each of these areas to provide a transparent tool to assess fishery performance and, if needed, a mechanism to further constrain catch to minimise the risk of localised depletion.

- with respect to depletion for each species of coral collected in the QCF. The first iteration in late 2007 indicated that one genus of hard coral was ranked as moderate risk (*Montipora*)[13] – everything else emerged as a low vulnerability risk. It is intended that this assessment will be reviewed as more information becomes available. The report describing this assessment is currently being finalised and will be publicly available from the DPI&F website in the near future. This tool will be explained in detail at the workshop.
- A Performance Measurement System (PMS) – this harvest strategy tool is currently under development. This will prescribe review reference points and response frameworks to ensure that species identified with any risk rating (in this case, low risk) and export species are closely monitored spatially and temporally. Other species can be monitored as required. The PMS will be reviewed regularly. This tool will be explained in detail at the workshop.
- An Environmental Stress Response Plan – also in development. Essentially this is a cross cutting tool that grew out of a localised, but extensive, bleaching event on the Great Barrier Reef and subsequent public concern about whether coral collectors might be further impacting already damaged reefs. It is designed to assist managers, fishers and the public to take a transparent, structured, objective approach at a local scale (over and above existing management measures) whenever a significant disturbance event occurs. Note disturbance can be caused by a range of factors such as bleaching, freshwater incursions, flooding, cyclone damage and Crown of Thorns starfish (COTS) infestations. It relies on recognised external monitoring programs (such as the GBRMPA's 'Bleachwatch' (http://www.gbrmpa.gov.au/corp_site/key_issues/climate_change/management_responses/bleach_watch2.html) and "Eye on the Reef" type programs, (e.g. http://www.gbrmpa.gov.au/corp_site/doing_your_bit/become_involved_and_help_protect_the_reef) to identify

[12] Aquarium trade collection requires land-based holding facilities and good access to air freight. Historically, collectors have focussed their efforts around places where suitable habitat is found close to the coast and to major urban centres with reasonable sized airports.

[13] Note this genus is not a dominant catch component; however it will be monitored closely over time.

the extent of the problem and therefore trigger the response plan. Depending on the severity of the impact, a range of possible actions (including various levels of voluntary non-collection and temporary regulatory closures) and timeframes are identified in the response plan. Importantly, the mechanisms to monitor the situation and review actions are also defined – so in the event of reef recovery, voluntary or mandatory actions can be removed in a timely manner. This tool will be explained in detail at the workshop.

- In addition, the fisher's representative body Pro-Vision Reef Inc. has compiled a Code of Conduct that identifies their current approaches to best practice collection and voluntary response plans for various levels of disturbance (the Approach taken in developing the Environmental Stress Response Plan complements this initiative). This is part of a comprehensive industry-developed stewardship approach that ultimately will form the backbone of an auditable accreditation program. Another industry initiative is currently being trialled - a pilot monitoring program that tracks anemone numbers and densities and monitors recovery of bleached corals in the vicinity of coral collecting dive sites.

2.1.4. *Restoration or alleviation measures*

RESTORATION

No *fishery-focussed* restoration measures are required at this time. The level of take is miniscule relative to the area of reef (and inter-reefal) habitats available to collect from, noting that more than 30% of the fishery area is protected in a comprehensive network of no-take zones as well. It is important to acknowledge that coral ecosystems do exhibit considerable natural variation in species composition and per cent coral cover at a range of spatial and temporal scales. Based on information from the Australian Institute of Marine Science Long Term Monitoring Program the majority of reefs in the GBR are in reasonable condition, though this fluctuates at a regional scale over time and depends (primarily) on the status of COTS and coral disease in the area (http://www.aims.gov.au/source/research.monitoring/pdf/status-report-08-20080616.pdf). Current management measures for the GBRMP are focussed on maintaining ecosystem health and minimising the impact of use to ensure that under current conditions, restoration is not needed.

However, if required, site-based tourism programs do have limited access to strictly controlled coral transplantation permits. This process has been set up to deal with situations when the amenity value at designated tourism sites deteriorates (for a range of reasons including

COTS outbreaks) and small-scale transplantation is deemed to be the most appropriate and least impacting solution (as opposed to relocating the program to another undamaged location). This approach has been used only rarely, is extremely costly and has a strict management framework in place to ensure that it is a last resort after other measures have been explored. Guidelines have been developed to ensure that donor areas (must be within 500m of the recipient site and on the same reef to prevent translocation) have healthy levels of coral cover to begin with and will be minimally impacted by removal of coral for the recipient site (http://www.gbrmpa.gov.au/corp_site/key_issues/tourism/management/policies/coral_transplantation).

Alleviation

This is an area that is likely to receive increasing attention as the effects of climate change become more apparent (e.g. increased frequency and severity of bleaching). As previously mentioned, at the policy level – the GBRMP is managed for ecosystem resilience. This approach is embedded in legislation and all operational procedures. To explicitly address climate change concerns a broad-based vulnerability assessment has been completed based on the best available scientific information (Johnson & Marshall, Eds., 2007) and a GBRMP-wide Climate Change Action Plan has been developed (http://www.gbrmpa.gov.au/__data/assets/pdf_file/0012/22620/climate-change-action-plan.pdf).

Over the next 12-18 months, a specific Fisheries and Climate Change Action Plan is expected to be developed and implemented for the GBRMP region. The Environmental Stress Response Plan outlined in Section 2.1.3 is an early step on that pathway, where the focus is firmly on empowering people to be part of the solution. It is anticipated that this approach will be a powerful and practical tool to assist with balancing ecosystem and human needs, at a local scale. The Environmental Stress Response Plan will be an iterative process that evolves as more knowledge comes to hand. It is likely also that there will be increasing focus on developing better relationships between different sectors in the community and generating local agreements/partnerships to address specific local impacts and compliance issues.

At a global scale, Australia strongly supports the call for significant reductions in global carbon emissions as a critical step for improving the long-term prospects for the environment – including the fate of coral ecosystems. Federal government planning is in place to introduce a national carbon-trading scheme by 2010, to contribute to the global process.

2.2. Monitoring system

2.2.1. *Methods used to monitor harvest*

As outlined under 2.1.3, for the first time there is comprehensive spatial information on catch. A detailed logbook was developed with support from the fishers and this is used as a proxy for a monitoring program. Nearly two years of data are now available and it is likely that the logbook will retain a similar level of detail under the reviewed Policy.

Presently, there is no capacity for formal fishery-independent monitoring although several community-based monitoring programs (e.g. Reefcheck) are being considered. The main problem lies in developing appropriate user-friendly (low cost) methodology that addresses the wide-range of species and their spatial diffusion on reefs as well as the species that are abundant in patches of inter-reefal habitat (that is often deep and/or turbid). Analysis of existing towed video footage of the seafloor is being considered to generate a baseline to describe at least some of these inter-reefal habitats.

A small pilot project is currently underway for fishers and other members of the community to monitor the distribution and abundance of a few species of anemones (that have been identified in an ERA as being particularly vulnerable to bleaching and relatively uncommon) at one high-use location that was heavily bleached in 2006. At the same time some fishers are keeping 'Bleachwatch' records to track recovery at specific dive sites over time (see section 2.1.3).

2.2.2. *Confidence in the use of monitoring*

Because the new management arrangements were developed from the bottom-up, in partnership with stakeholders (fishers, managers, and compliance officers) and in consultation with various sectors of the general public, there is wide acceptance of the new approach. In turn, this fosters stewardship and an increasing interest in peer regulation is emerging. Many fishers are keen to support effective compliance to protect their good reputations and develop a global marketing edge based on stewardship and best practice.

Prior reporting the catch greatly assists compliance capacity to monitor catch components and quota compliance at the time of offloading.

In some high use areas of the GBRMP, community partnerships are developing where local 'eyes and ears' (across several sectors including fishers) are contributing to the management knowledge base on reef health. This includes information on local bleaching, COTS outbreaks and other disturbances to coral habitat, as well as general compliance matters.

2.3. Legal framework and law enforcement

See previous discussion at sections 1.5.2, 2.1.2 and 2.1.3. Hard corals are listed on Appendix II of CITES; as native species they are subject to export control under national environmental protection legislation (*EPBC Act and Regulations);* listed as no-take species unless a permit is held, under GBRMP legislation and defined as a 'fish' under State Fisheries legislation. Primary enforcement for both fisheries and marine park legislation is done by officers from the Queensland Boating and Fisheries Patrol, and supported by compliance staff from the GBRMPA and the State EPA.

At a national level, the *EPBC Act and Regulations* are the legal instruments for implementing and enforcing Australia's obligations as a signatory under international environmental agreements such as CITES. All export and import of hard coral is subject to *EPBC Regulations*. Because coral is defined as a fish under fisheries legislation in the three States or Territories in which coral is found in Australia (in Queensland, Western Australia and the Northern Territory), determination of an NDF to allow export is made at a State fishery level, based on the management arrangements, during the *EPBC* sustainable fisheries assessment process outlined under section 2.1.1. Live rock is collected also in limited quantities from the Coral Sea region by two aquarium fish collectors – the Coral Sea fishery is a small, mixed sector, offshore fishery managed by the Australian Government, (Note - live rock product currently supplies the domestic market only).

As previously described, all Australian fisheries that export product require assessment against national guidelines for ecosystem-based management. This is a process of continuous improvement based on the best available information. The guidelines aim to ensure that rigorous and transparent assessments are conducted in close cooperation with fisheries agencies, the various fishing sectors and the broader community. Reassessment of each fishery occurs every 3-5 years and usually results in acknowledgement that good progress has been made since the last assessment and that an export accreditation is granted. However, because some corals are CITES-listed, an NDF is required under CITES – the *EPBC* assessment process provides the NDF but in addition, individual export permits are required for every shipment from an accredited fishery like the QCF to ensure that all product trade is monitored. Export permits are applied for as required and then acquitted following shipment.

Compliance for the *EPBC* export process is as follows: Australian Customs officers check product/paperwork at point of departure. Desktop audits are periodically conducted on permitted exporter's

records and occasionally site visits/audits are completed on land-based components of the business (sometimes in conjunction with the Australian Federal Police). On-water compliance is addressed through compliance mechanisms established for the specific fishery management arrangements.

3. UTILIZATION AND TRADE FOR RANGE STATE FOR WHICH CASE STUDY IS BEING PRESENTED

3.1. **Type of use** (origin) **and destinations** (purposes)

For the last two quota reporting years, only half of the quota has been collected and most of this (79 tonnes) was taken as wild-caught, hand-collected, loose 'live rock' for the domestic market. Strong local market demand, low product value and high transportation costs currently preclude this from being exported. The remaining catch of 24 tonnes (also wild caught and hand collected) was split between:

- Supplying the domestic and export live aquarium markets through the careful selection of small, high quality, colourful specimens from a wide range of taxa (13 tonnes). Size and beauty are all important which means that much of the population at any given site is unsuitable and therefore not collected. The majority of the hard corals collected in this sector are large-polyped, solitary, not generally considered to be hermatypic and often found in inter-reefal habitats. A significant proportion of this catch includes soft corals, zoanthids and corallimorphs – none of which are CITES-listed.
- Supplying the domestic and export ornamental and interior design, markets (11 tonnes) – collection is focussed on a limited number of larger/heavier pieces of mainly fast growing, abundant, reef building corals (e.g. acroporids, pocilloporids, *Turbinaria* species and *Heliopora coerulea*).
- Medical Research: a small quantity of unknown species of hard corals is used to supply domestic research into bone grafting/repair – few details are currently available.

A taxonomic comparison of the number of pieces collected versus the number of pieces exported can be seen at Figure 6. Export species/genera represent a limited range of the species collected in the fishery. It is also evident that many key target species are not CITES-listed species.

The main export destinations for Queensland coral are the USA, the UK, the Netherlands and France (see Figure 7); around 21,000 pieces were exported from the QCF over the last two years.

When considering the role of trade and whether it helps or hinders the ecological status of coral ecosystems it is important to acknowledge the potential educational and conservation value of tropical marine aquaria in raising public awareness about the intrinsic importance of corals and their current plight. Very few people get to dive/snorkel on coral reefs yet first-hand experience brings understanding and appreciation. Without this, the motivation to bring about the change necessary to look after coral ecosystems is unlikely.

Several hundred million people visit public aquaria every year (Bartley, 2000) – countless more will be exposed to private aquaria – all are moved by the experience. When the organisms on display have been collected (or grown) in an ecologically sustainable manner and there are appropriate ecological and conservation messages provided at point of sale or display, this medium can be a powerful tool for improving the resilience of coral ecosystems into the future[14].

A further benefit from the ecologically sustainable collection of coral for use in aquariums is the huge, mostly unpublished, knowledge base held by aquarists. Most of the corals grown in aquaria have received little scientific attention. It may well be that our understanding of critical processes in coral reef ecosystems (and the role that species from deeper water 'refugia' can play) can be substantially improved by accessing this information on species from inter-reefal habitats.

To date, all coral from the QCF is wild-caught, however various separate research endeavours are exploring aquaculture options for a number of species. The current research is mostly focussed around anemones (such as *Heteractis quadricolour*) that are relatively uncommon in the wild, found in shallow water and prone to bleaching.

3.2. Harvest:

3.2.1. *Harvesting regime*

Harvesting is done by hand or hand-held implement such as a hammer and chisel. Depending on the species, it is either fully extractive (e.g. solitary/free living species or small colonies of coral are completely removed) or is "non-extractive" in the sense that generally only a small portion of a large colony is removed – over time this would normally regrow. Again, depending on species – the demographic seg-

[14] In Range States with few economic opportunities, ecologically sustainable aquarium collection could represent one of the few viable options. If the system can be organised to reward the collectors and not the middle-men – this too would be a driver for reef stewardship.

ment that is harvested is likely to be smaller solitary/free living individuals (which presumably equates to less mature/juvenile members of the population). For colonial species – small, perfectly shaped colonies are generally targeted for fast growing species (e.g. *Acropora* or *Turbinaria* species – again, juvenile or subadult stages) or else small segments from much larger colonies (e.g. *Duncanopsammia axifuga*) are removed – in this case a significant portion of an adult colony is left to regrow.

A current industry initiative is to document best practice harvest strategies (for a range of species) within a code of conduct. An independent research project is planned to put some scientific rigour into testing these best-practice assumptions.

For most sectors in this fishery freight costs are a driving factor in determining what is collected – Australia is a large and geographically isolated country so the majority of product is airfreighted to all markets (domestic and export). This means that packing 'live' product in 20kg polystyrene boxes is an industry standard – consequently, it is more cost effective to pack multiple small pieces per box than to pack a larger, single piece of either live rock or live coral.

The exception to this approach is the pieces collected for the ornamental market. Here coral is collected and treated (bleached) close to the point of collection and then transported by road, dry, at a later date to the domestic wholesale market, and by sea or air to international markets. CITES personal baggage permits are frequently used by retail clients to take a limited number of individual purchased pieces of coral to their home country for their personal use.

Corals are collected by divers using Hookah or SCUBA. The use of hand held implements such as a chisel and hammer aids the targeted selection of specific pieces and reduces the incidence of damage to neighbouring corals. Live rock is collected as loose pieces, by hand.

The combination of Australian commercial diving rules and fishery management arrangements (including significant reporting requirements), spatial closures under the GBRMP zoning plan, the market demand for small perfect pieces of coral and the frequent vagaries of weather means that there are significant limitations to what is actually collected from the GBRMP. Even though collection occurs year-round, only about half the quota was collected in each year since the new management arrangements were introduced. Vessel size ranges from small (<10m) boats used for day trips to large vessels (>20m) capable of travelling to the outer shelf of the Great Barrier Reef.

Additional harvest – as previously noted, there is limited harvest available for coral transplantation for amenity improvement at significant fixed-operation tourism sites (though the management focus is

firmly on maintaining the health and resilience of the site in the first place). Coral is taken for research purposes under permit only – applications are assessed by all three management agencies on a case-by-case basis. Distribution of collection tends to be associated with island-based research stations (there are four main research stations on the GBR). It is estimated that total research collection in any given year would not exceed 10 tonnes. Research permits also carry reporting requirements but linkage of the two permitting systems is done only on a qualitative basis at present. Export of research specimens does occur, however it is permitted individually and the quantities are very small.

Coral is periodically removed from the GBRMP for the purpose of dredging shipping channels and developing port facilities. This activity is managed via permits issued by GBRMPA and the EPA – specific details are assessed via a rigorous environmental impact assessment framework (sometimes with public consultation – depending on the scale of operations) on a case-by-case basis and permitted and supervised accordingly. While this form of harvesting is not factored into the fishery management arrangements it is managed to minimise localised impact to the ecosystem.

3.2.2. *Harvest management/ control*

Collection occurs year-round, though access to most collection areas is very weather dependent. See sections 2.13 and 3.2 for details.

3.3. Legal and illegal trade levels:

A total of 20,931 pieces of coral were legally exported from the QCF during the period July 2006 to May 2008.

Recreational take of coral (for use in personal aquaria) and indigenous take for cultural purposes is thought to be minimal in Queensland and is unlikely to constitute a significant illegal trade concern. Souveniring of beach-washed coral by local residents and tourists is an ongoing and, to date, unquantified problem. Beach-washed coral is regularly confiscated from passengers (departing from Australian ports) on entry into adjacent international ports such as Auckland, in New Zealand.

Small coral fisheries exist in two other States in Australia – the Northern Territory (NT) and Western Australia (WA). The amount taken in each of these is fairly limited, ~2.8 tonnes of live rock and ~5.1 tonnes of hard coral in WA[15] and about 1 tonne of coral and 0.5 tonne of live rock in 2006 in the NT. To date, there has been no export record-

[15] These are draft figures for 2007.

ed from the Northern Territory and 15,770 pieces of coral have been reported as exported from Western Australia (in the period July 2006 –May 2008). The level of souveniring from these regions is unknown.

The Northern Territory has significant inhibitors to expansion of the coral fishery – large tidal range, turbid water and healthy crocodile populations, and a recent court decision awarding indigenous title to the majority of the coastal foreshores.

Western Australia has a very different geomorphology than either Queensland or the Northern Territory. Large tracts of sub-fossilised coral rubble dunes run parallel to, and inland from, large sections of the coast and the current reef systems, while each is quite extensive they are more geographically discrete\ than reefs on the GBR. WA has a small quota-based fishery and is currently developing new management arrangements for the wild catch – in the meantime the collection of *Catalaphyllia jardinei* has been banned in one of the collecting areas. Consultation on a coral aquaculture discussion paper is still underway.

II. Non-detriment finding procedure (NDFs)

The following section outlines the process used to evaluate hard corals when making a non-detriment finding for corals taken in the QCF; to minimise repetition, relevant information from earlier sections is cross-referenced here.

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFs?

No – the explicit radar plots recommended under the IUCN checklist were not used to make the NDF. The IUCN checklist is intended to be completed at a species level – yet there are more than 350 species of hard coral found on the GBR – of these, 52 genera/species are routinely collected and a further 23 are exported in some numbers (the remainder are exported infrequently or not at all). The Australian sustainable fisheries assessment (see sections 2.11 and 2.3) satisfies the intent of the NDF framework. According to the 2006 assessment (and associated recommendations placed on the Queensland Coral Fishery by the Australian Government, http://www.environment.gov.au/coasts/fisheries/qld/coral/assessment.html) the management arrangements, practices and processes being established meet or exceed the NDF checklist. Explicit species-level management is not considered necessary at this time because the package of management arrangements is so precautionary.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

Please see Table 3 for an outline of criteria, parameters and indicators used to assess the fishery and how these relate to the NDF guidelines. The process used for making the NDF for the QCF complements the 'Addis Ababa Principles and Guidelines for Sustainable Use of Biodiversity' described in Rosser (2008).

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

The main source of data for making and reviewing the NDF assessment is detailed logbook information, supported by an Ecological Risk Assessment (ERA). The ERA is an adaptive management tool that is to be reviewed regularly and as new information comes to hand. A literature review and expert advice is used to compile the biophysical information that underpins a vulnerability assessment. Following this, an expert consensus workshop (using scientific, local and management knowledge) is convened to ground-truth the information for different regions on the GBR and conduct an ecological risk assessment (see also comments at 2.1.3).

While not specific to the species in the coral fishery, nor to most of the collection areas, coral cover and general reef health information from the Australian Institute of Marine Science Long Term Monitoring Program (http://www.aims.gov.au/docs/research/monitoring/reef/reef-monitoring.html) was also considered to provide a broad contextual measure of reef health and resilience at the scale of regions and the GBR as a whole. Broad results from the recent Seabed Biodiversity Study (Pitcher et al, 2008) provided an assessment of relative levels of protection (no-take zoning) of different habitats in the GBRMP and demonstrated (qualitatively) that considerable areas of inter-reefal habitat do, in fact, support substantial stocks of some key species in the coral fishery.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

While mindful that data is mainly fishery-dependent, the system has several important checks and balances:

- All decision-making is risk-based (where the risk framework meets or exceeds the Australian risk-assessment standard). Under this framework, expert consensus is sought from local knowledge holders, scientific experts and managers to ground truth information that is fed into decision-making.
- The TAC is very small relative to the standing stock in the fishery area (the whole GBRMP); quota is direct debited on landing catch

via an at-sea telephone reporting system. This mechanism allows compliance officers to target inspections if they wish to meet the boat as it arrives in port and inspect catch prior to landing (to validate data records).

- More than 33% of the GBRMP is closed to all fishing; further areas are completely or partially inaccessible either due to weather or depth.
- Managers have a close working knowledge of the fishers and their practices – most practices are tightly driven by economics or relatively consistent market demands. Understanding these drivers helps ensure that managers are conversant with new practices as they evolve and allows for an adaptive management approach to ensure that best practice is maintained.
- Management arrangements were developed from the ground-up with fishers over a considerable period of time. Because of this partnership between management, fishers and compliance officers, arrangements are pragmatic, achievable and enforceable.
- Partnership has resulted in a greater sense of ownership and a greater willingness for personal stewardship.
- About 70% of the catch is live rock, which is very easy to monitor and carries a low environmental risk on the GBR.
- Logbook information is mapped and monitored collaboratively across three agencies, at very fine spatial scales – catch composition can be tracked against individual fishers if necessary. Export information is broadly tracked against catch data, noting that much of the market is domestic.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF

- The species-level NDF checklist does not readily "fit" a complex multi-species group like coral. The huge number of species, the diverse life history features from one species to the next and the considerable plasticity and variation within a species, contribute to this problem.
- Corals listed under CITES do not just include live or recently dead coral – the issue of coral-derived rock (live rock) and whether it is modern (weeks to hundreds of years old and captured by CITES definitions) or whether it is fossilised (and therefore exempt from CITES) has yet to be effectively resolved. Because live rock is not currently exported from this fishery, this issue has not been addressed in detail in this report.
- Coral taxonomy provides another level of complexity to the NDF process. Many coral species cannot be identified to species level

reliably in the field even by experts. This drives the level at which data can be collected through logbooks – which in turn determines to what level export records are accurate. While the CITES framework provides some concessions on species level reporting for trade purposes (acknowledging the problem) – our experience with this fishery suggests it does not go far enough. Consequently the integrity of export records – at least for some species groups will be compromised.

- Units of measure for monitoring and reporting how much coral is removed at point of collection present further problems. Many species of coral are highly 'plastic' depending on whether their polyps are inflated or retracted so accurate weighing is next to impossible – this presents a significant compliance challenge. Depending on species, it may be more useful to report figures and for others, volume. In almost all cases, conversion factors will be required. To complicate things, export trade figures are only given as numbers which conveys no information about total volume and can be misleading (100 pieces could represent a few kilograms or it could represent a few tonnes).
- The question of scale – with respect to making an NDF. Clearly removing coral from a one metre square area will likely result in significant localised depletion. However, at what scale does this actually become important for the health of the coral ecosystem? When does concentrated removal of any fisheries resource begin to affect the ability of the natural system to bounce back? This is a global fisheries issue for which there does not appear to be any adequate working definition of 'localised depletion' and few effective tools to address the problem.
- The question of ecosystem function - with respect to making an NDF for corals. At what scale does removal begin to significantly compromise ecosystem function – given that many of the corals in trade are not reef building and that, providing biodiversity is maintained, there is likely to be considerable functional redundancy or at least overlap, within an ecosystem.
- The question of relative biodiversity - the GBR is fortunate to be one of the southern-most extensions of the 'Coral triangle'[16] (Figure 8). The GBR also represents an extraordinary latitudinal range of highly connected reefs, inter-reefal habitats and shoal grounds, which currently confer reasonably high levels of ecosystem resilience. This is not the case for most coral reefs where natural diversity is much

[16] The Coral Triangle is the global hotspot of coral biodiversity.

reduced to begin with (and likely further modified by significant anthropogenic impacts). On the GBR, species mix varies at small spatial scales and some high disturbance areas (e.g. inshore, shallow, bleaching and flood-prone) do have reduced biodiversity and are impacted from anthropogenic activities. However, compared with the global situation, the GBR coral ecosystem is in relatively good condition.

- The question of cumulative impact – under CITES the main point of leverage revolves around what can be traded and ensuring that trade doesn't significantly impact on population status at a species level. However, in most parts of the world it is very likely that the amount of coral removed for the aquarium and curio trade is small relative to the combined impacts of poor water quality (from land use practices), coastal development, destructive fishing practices and industrial scale removal for the construction and agricultural (production of lime) industries. Overlaid on this is the prospect of significant climate-induced changes. The CITES framework does not, at this stage, explicitly address these matters.

6. RECOMMENDATIONS

- Noting that species of coral are rarely collected in isolation, it is recommended that consideration is given to how the preceding matters might be better addressed under a coral-specific, ecosystem-based NDF framework. From our experiences with the QCF – it is suggested that a risk-based, adaptive management framework is a relatively simple, yet pragmatic solution to the complexities outlined.
- That tools such as the ERA, the PMS and the Environmental Stress Response Plan developed for the QCF, could be customised to suit individual range states or regional collections/fisheries. A more consistent and risk-based framework would give CITES scientific and management authorities greater capacity to evaluate and compare coral NDFs across range states.
- To ensure that any risk assessment methodology uses all available information (including scientific, management and local knowledge) together with a process for regular, transparent review. This is an effective mechanism to ground-truth knowledge on the many habitats and species for which very little information is published.

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