DEPARTMENT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES

Non-Detriment Finding for the Export of CITES-Listed Coral Species Harvested from the Queensland Coral Fishery

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Contents

Executive Summary

Obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are given effect domestically by the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act requires that, *inter alia*, an export permit for a CITES listed species may only be issued by the Minister if satisfied that the export will not be detrimental to, or contribute to trade which is detrimental to, the survival or recovery of the species, or a relevant ecosystem. This is known as a non-detriment finding (NDF).

This assessment has been developed to inform the Minister's consideration of this matter and support his decision on whether to declare a Wildlife Trade Operation (WTO) for the Queensland Coral Fishery (QCF) to allow export from the fishery, and also to inform individual decisions about whether to grant export permits for CITES listed coral species taken in the fishery.

The QCF extends from the tip of Cape York to the Queensland/New South Wales border. This fishery has been a leader in the development and implementation of a risk assessment and management framework intended to adaptively manage coral harvest so that it is maintained within sustainable limits. This included the development of a Vulnerability Assessment, Ecological Risk Assessment, and a Performance Measurement System for the harvest of coral in the fishery, as well as voluntary industry initiatives. While this management framework positions the fishery well in terms of ensuring that on-going harvest can be found to be non-detrimental to CITES-listed species, there remain a number of challenges to be overcome.

In particular, the fishery has changed and developed substantially since the time when this management framework was developed, and as a result the management measures in place are no-longer ideally suited to adaptively manage the breadth of harvest in the fishery. For example, the management framework was designed to a large extent on the basis of 2006/07 data from the fishery, at which time much of the effort of coral fishers was focussed within the Cairns and Keppel regions, however, more recently harvest from outside these regions has increased in significance. Both the volume and number of coral species reported as exported from Queensland has also steadily increased over the past six years from just over 90 different species initially to in excess of 200 in 2009/10. As a result of these changes, the existing arrangements for managing the harvest of coral species within the fishery may no longer be appropriate to monitor the breadth of species taken in the fishery and adaptively manage their harvest.

Additionally, there is limited information on the local distribution and population status of specific coral species. Coral surveys independent of the fishery often have the objective of examining reef health on a macro scale, rather than assessing the local status of individual species inside and outside of harvested areas. As a result, surveys generally report only percentage cover and the most common families of corals, rather than abundances of individual species. This represents a significant information gap in determining a NDF, particularly for rare or inherently vulnerable species or those species harvested in large volumes.

In the absence of comprehensive information on individual species' population status and trends in the area of the fishery, this NDF assessment examined harvest and export trends in parallel with what is known about species vulnerability to determine a list of species of potential concern within the fishery. This list included those species that had experienced marked change in either export or reported harvest, and those with higher risk ratings within the QCF Ecological Risk Assessment or the IUCN Redlist. These species then formed the focus for more detailed analysis, including through examination of temporal and spatial patterns of harvest where data were available, to identify areas of management or particular species requiring attention for on-going harvest to be considered non-detrimental.

With these data limitations and management issues identified, this assessment has considered the scheduled review and revision of adaptive management procedures to be progressively implemented in the QCF within the specified timeframes over the coming three years, for the duration of the WTO. In relation to the management of all CITES-listed species taken in the fishery, but with a particular focus on the subset of species identified as of potential concern, this assessment has highlighted a series of issues that are required to be addressed in the revision of the QCF Vulnerability Assessment, Ecological Risk Assessment and Performance Measurement System to form the basis of NDFs for export from the fishery.

On the understanding that the review and revision of the fishery's assessment and management practices address the management and data needs identified in the conclusions of this document, Australia's Scientific Authority for Marine Species is able to conclude that the harvest of CITES listed coral from the QCF is unlikely to be non-detrimental to the species in question. This assessment is time limited, and is only considering the environmental impact of harvest for the coming three years, for the duration of the WTO. During this time period, the revised management practices should allow the fishery to continue to operate with appropriately constrained harvest whilst allowing the QCF to gather more specific information on species harvested, which will be required to inform subsequent NDFs.

Introduction

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

All species of hard corals are listed in Appendix II of CITES. Appendix II includes species not necessarily threatened with extinction, but for which trade must be controlled in order to avoid utilisation incompatible with their survival.

Before a species listed in Appendix II may be exported, the CITES Scientific Authority of the State of export must determine that the proposed export will not be detrimental to the survival of the species. This is called a non-detriment finding (NDF). The document "Guidance for CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports"[1] specifies that a NDF is when the sum of all harvests of the species is sustainable, "…in that it does not result in unplanned range reduction, or long-term population decline, or otherwise change the population in a way that might be expected to lead to the species being eligible for inclusion in Appendix I".

[1] Rosser, A. & Haywood, M., *Guidance for CITES Scientific Authorities – Checklist to assist in making non-detriment findings for Appendix II exports, IUCN Species Survival Commission*, Occasion Paper No. 27, 2002

Rosser and Haywood (2002) also note that a Scientific Authority “must consider total national harvest” when making a NDF. Provided the export is not detrimental to the survival of the species and the specimen was legally obtained, the Management Authority of a CITES Party may issue a permit authorising the export of the specimen.

Commonwealth legislation

The EPBC Act gives effect to CITES requirements domestically. Under section 303CA of the Act, the Environment Minister must establish a list of CITES species, which enables domestic application of CITES requirements. Under certain circumstances, the Minister may grant permits for the export and import of species on this list.

Relevantly, paragraph 303CG(3)(a) of the EPBC Act provides that the Minister must not issue a permit for the export or import of a CITES specimen unless the Minister is satisfied that:

a) the action or actions specified in the permit will not be detrimental to, or contribute to trade which is detrimental to:

i) the survival of any taxon[2] to which the specimen belongs; or

ii) the recovery in nature of any taxon to which the specimen belongs; or

iii) any relevant ecosystem (for example, detriment to habitat or biodiversity).

This assessment has been developed to inform the Minister’s consideration of this matter for individual decisions about whether to grant a WTO for the QCF.

Legislation and management in Queensland

The fisheries in Queensland are subject to the *Queensland Fish Resources Management Act (1994)*, and *Fish Resources Management Regulations (1995)* and are managed by the Queensland government’s Department of Fisheries.

[2] Under section 528 of the EPBC Act, Taxon “means any taxonomic category (for example, a species or a genus), and includes a particular population”.

Queensland Coral Fishery

The QCF includes tidal waters from the tip of Cape York to the QLD NSW border (Figure 1) and covers corals species from the *class* Anthozoa. This NDF has been made to cover all CITES-listed coral species currently known to be exported from Australia for which the species' distribution extends into this region. A full list of the species considered in this assessment is presented in Table 3 at Annex A.

Coral Collection Areas

The QCF harvests corals from three different "Coral Collection Areas" (CCAs), Cairns CCA, Keppel Islands CCA and "Other". The definition of "Other" is any coral collected outside of the Cairns and Keppel CCAs. As outlined above and shown in Figure 1, the commercial fishery includes tidal waters from the tip of Cape York to the QLD NSW border, however, coral harvest is only allowed to the southern extent (24° 30' south) of the Great Barrier Reef Marine Park (GBRMP), apart from 2 small areas south of this which require special permits.

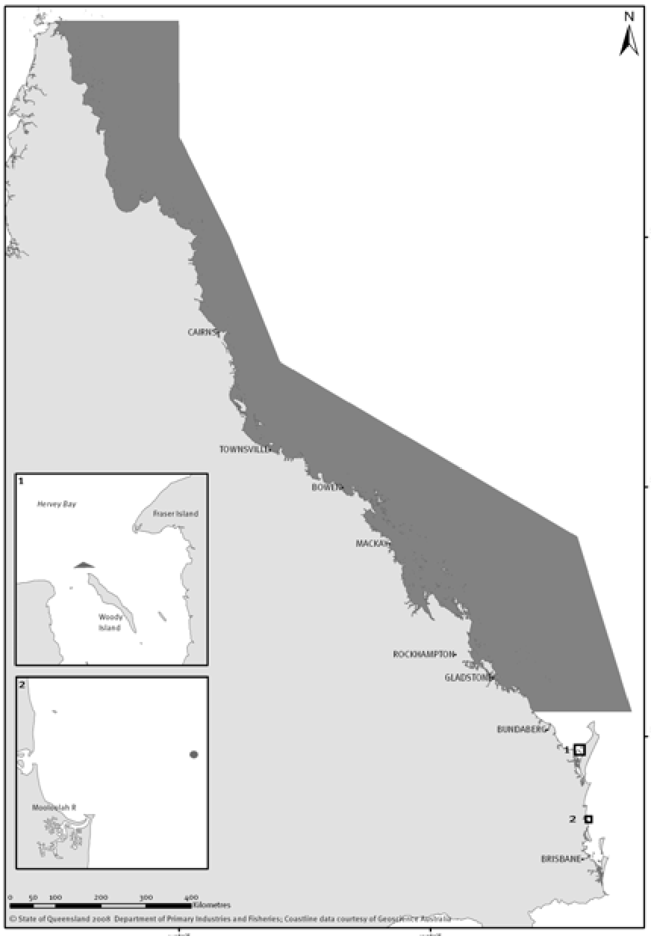

Figure 1 - Fishery Area

Overview of Current Management Arrangements and Policies

The current management of the QCF is guided by the 'Policy for the Management of the Coral Reef Fishery- January 2009' (referred to as "the Coral Policy") and the 'Performance Measurement System' which was developed following two assessments – the 'Vulnerability Assessment of Coral Taxa collected in the Queensland Coral Fishery' and the 'Ecological Risk Assessment of the Queensland Coral Fishery' both of which were completed in 2008.

The Coral Policy outlines how the fishery will be managed, including where the CCA boundaries are, what size and weight categories of coral there are, as well as definitions of what constitutes different coral categories. This policy also outlines how the information is to be reported in the Annual Status Reports. Further to this regulated management regime, there is a voluntary management regime in the Great Barrier Reef (GBR) administered by "Provision Reef". This industry initiative has developed the Stewardship Action Plan, which contains "best practice" harvest methods and penalties for members who do not comply with the standards set out in the plan. In the QCF, 88% of licensee holders are members of the Stewardship Action Plan.

Additionally, the QCF is also unique in that a Coral Stress Response Plan is in place. This plan, in combination with the Stewardship Action Plan, direct that if severe environmental perturbation occurs, such as bleaching, then scaled management responses, up to and including a total moratorium on collecting, can be put in place quickly in the affected area.

Great Barrier Reef Characteristics

On the GBR there is a system-wide trend of declining coral cover[3] [4] [5](Bellwood *et al.* 2004; Hughes *et al.* 2011; Osborne *et al.* 2011). Formal monitoring of the GBR was initiated in 1986 following declines in coral cover after two crown of thorns starfish outbreaks (References to the AIMS LTMP). Since that time, coral cover has remained unchanged or declined in 28 of 29 sub-regions of the GBR. This trend indicates a gradual erosion of resilience that is impeding the capacity of this huge reef system to return towards its earlier condition, despite temporary increases in coral cover on a small number of reefs[4].

The Australian Institute of Marine Science (AIMS) conducts a Long Term Monitoring Program (LTMP), which has been surveying the health of 47 reefs in the GBR annually since 1993, and is to continue biannually for the foreseeable future. The data, collected by visual observation by divers, captures the natural variability of coral (and fish) populations and documents the effects of disturbances like crown of thorns starfish, cyclones and bleaching. This program represents the longest continuous temporal record of change in reef communities over such a large scale. While the AIMS LTMP data series is useful in tracking reef health on a broad scale, it does not include strong coverage of some of the habitat types utilised by coral species harvested in the QCF and it is not intended to examine the impact of harvesting on coral populations.

Cairns Area Coral Distribution and Status

The latest AIMS LTMP surveys of seven reefs in the Cairns area were conducted from 15 February to 4 March 2012. Reef-wide live coral cover was variable, but in the Cairns sector it was most often low, ranging between 5-10% and 20-30% on different reefs. Although coral cover was similar to that reported in 2010 and 2011, recent surveys reported lower values on some reefs. These lower values may be due to peripheral effects of Cyclone Yasi, which developed just prior to the surveys of these reefs in February 2011.

This study reported coral bleaching affected approximately 5% of reefs in the Cairns sector. The suite of species with bleaching was consistent among reefs and was most common among genera known to be sensitive to thermal stress such as Pocillopora, Seriatopora, Stylophora and Montipora. Some colonies of *Montastrea curta* and *Goniastrea pectinata* were also partially or completely bleached on most reefs, along with a small number of other Faviids and Porites *spp*.

[3] Bellwood DR, Hughes TP, Folke C, Nyström M (2004) Confronting the coral reef crisis. Nature 429: 827–833.
[4] Hughes, T.P., Bellwood, D.R., Barid, A.H., Brodie, J., Bruno, J.F, Pandolf, J.M., *Shifting baselines, declining coral cover, and the erosion of reef resilience: comment on Sweatman et al (2011),* Coral Reefs (2011), 30:653-660
[5] Osborne, K., Dolman, A., Burgess, S., Johns. K., Disturbance and the Dynamics of Coral Cover on the Great Barrier Reef (1995 – 2009) PLoS One. 2011; 6(3): e17516

Bleaching was severe at Green Island and Fitzroy Island where bleached Acropora *spp*. were also observed. Coral disease (discussed in the Disturbance section on page 25), in the Cairns sector is usually above the GBR-wide average and is considered a major threatening process for coral reefs worldwide. The incidence of coral disease in the latest survey was similar to previous surveys, except at Arlington Reef where the incidence of white syndrome, the most common of approximately 30 different recognised coral diseases, was well above the maximum value previously reported for this reef.

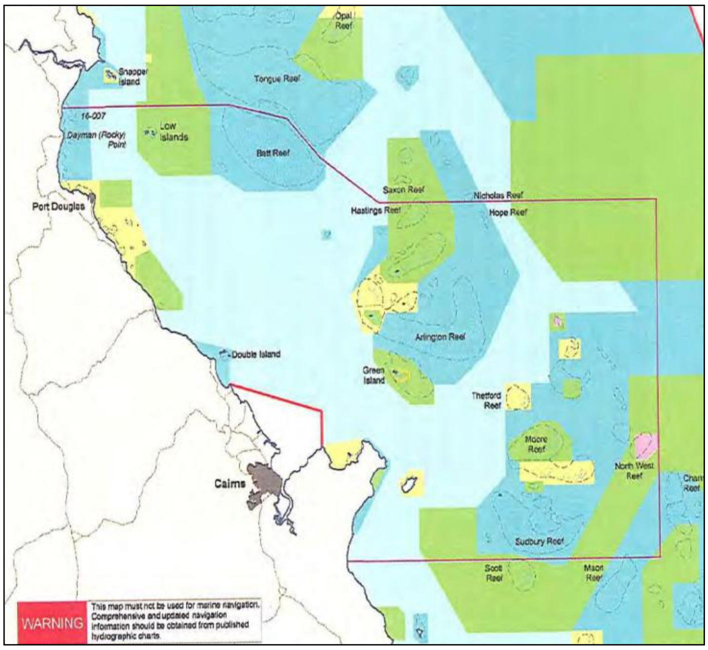

Figure 2 - Cairns Coral Collection Area Map

Keppel Islands Coral Distribution and Status

The Keppel Islands are a group of 16 continental islands lying 18 km off the coastal town of Yeppoon in the southern GBR. Many of the islands are surrounded by fringing reefs. In many areas the coral communities are abundant and coral cover is high (60-70%) relative to other parts of the GBR. The reef communities of the Keppel Islands are exposed to a range of environmental pressures. In the last decade alone, reefs have been affected by flood plumes from the Fitzroy River[6], thermal bleaching events in 2002 and early 2006, and a shallow-water mortality event when a heavy rainfall event coincided with an extreme low tide in late 2006[7].

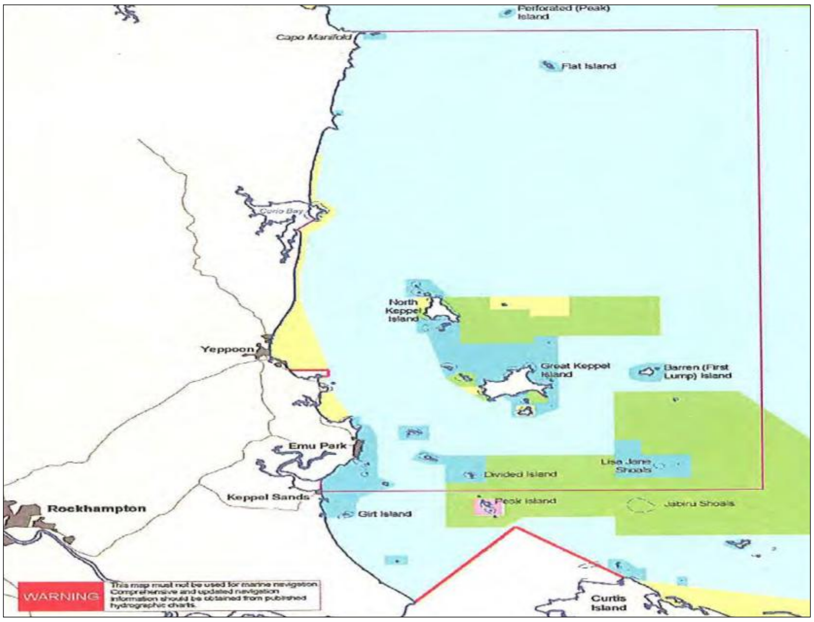

Figure 3 - Keppel Islands Coral Collection Area Map

Reefs within the Keppel Bay region have been affected by both flooding and bleaching events at regular intervals over the last 20 years. Most notably, a severe flood devastated reefs in the

6 Van Woesik, R., *Immediate impact of the January 1991 floods on the coral assemblages of the Keppel Islands,* Research Publication 23, Great Barrier Reef Marine Park Authority, 1991

7 Great Barrier Reef Marine Park Authority, *Great Barrier Reef coral bleaching surveys 2006,* Research Publication 87, 2007

area in 1991, the mass bleaching events of 1998 and 2002 impacted Keppel reefs, and in the summer of 2006 most sites experienced at least 40 per cent bleaching-induced mortality of corals due to a highly localised and severe warming event[8 9].

Most areas of the Keppel islands are dominated by fast growing Acropora species. Plate corals and small bommies are also present. Acropora species are the most susceptible types of corals to thermal stress[10]. Therefore, most of the reefs within the Keppel Islands are highly vulnerable to the increased frequency of warm temperature anomalies in the future[7], however due to their fast growing habit, are also capable of rapid recovery in the aftermath of these disturbances[11].

Vulnerability and Ecological Risk Assessments

In 2008, the Queensland Department of Primary Industries and Fisheries (QLD DPI) (now Queensland Department of Agriculture, Fisheries and Forestry (QLD DAFF) conducted a Vulnerability Assessment[12], which was then used to inform an Ecological Risk Assessment[13] of the QCF. These assessments were the first of their kind to be developed in Australia for coral reef ecosystems and provided a good basis in 2008 for progressive management arrangements to be implemented for the fishery based on the data available in 2006 and 2007. When combined with suitable ongoing data collection and adaptive management in relation to harvest, this system would be capable of providing leading edge management practices.

The Vulnerability Assessment and Ecological Risk Assessment were conducted with a stakeholder group comprising the commercial collectors, scientists from James Cook University (JCU), fisheries managers, government officials from the Great Barrier Reef Marine Park Authority (GBRMPA) and QLD DPI responsible for monitoring of the GBR and an independent scientist. This assessment was based on data collected in the fishery from 2006 and 2007 and was due to be reviewed including a repeat stakeholder workshop in early 2012, however, this review has been postponed and is unlikely to be conducted until late 2012. These original assessments were used as the basis for the management regime that has been in place since 2008. While these assessments provided a good basis for management based on the information available in 2006 and 2007, the changes that have occurred in the fishery since the initial assessment has meant that some of these arrangements may no longer be suitable for the current harvesting practices in the QCF.

The Vulnerability Assessment evaluated coral species harvested against five different criteria in order to determine their vulnerability to harvesting pressure. These criteria were:

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8 Berkelmans, R. & J. K. Oliver, *Large-scale bleaching of corals on the Great Barrier Reef*, Coral Reefs, 18, 55-60, 1999

9 Berkelmans, R., G. De'ath, S. Kininmonth & W. Skirving, *A comparison of the 1998 and 2002 coral bleaching events on the Great Barrier Reef: spatial correlation, patterns, and predictions*. Coral Reefs, 23, 74-83, 2004

10 Baird AH, Marshall PA and Wolstenholme J, *Latitudinal variation in the reproduction of Acropora in the Coral Sea.* Proceedings of the 9th International Coral Reef Symposium 1: 385-389, 2002.

11 Linares C, Pratchett MS, Coker MS, *Recolonisation and growth of Acropora hyacinthus following climate-induced coral bleaching on the Great Barrier Reef*, Marine Ecology Progress Series 438:97-104 (2011)

12 Roelofs, A & Silcock, R, *A vulnerability assessment of coral taxa collected in the Queensland Coral Fishery,* QLD Department of Primary Industries and Fisheries, October 2008

13 Roelofs, A & Silcock, R, *Ecological Risk Assessment of the Queensland Coral Fishery,* QLD Department of Primary Industries and Fisheries, October 2008

1. Accessibility: related to the depth range the species inhabits (0->60m)
2. Habitat/Ecological niche: related to types and range of habitats occur in
3. Distribution: ranging from very restricted to widespread
4. Susceptibility to bleaching
5. Abundance: ranging from rare to very common

There was no overt assessment of the likelihood of a particular species being targeted by commercial harvesters and therefore harvested at a faster rate than other species. This is an important factor in determining how vulnerable a species is to harvesting pressure, as it is well known that commercial harvesters prefer those species that are more colourful and vibrant. This makes it far more likely these species will be harvested in greater numbers, and even if they may be considered to be at "less than negligible risk"[13] due to their biological traits, if the numbers harvested exceeds the rate of replenishment of the species, then the harvest regime may be considered detrimental.

The Ecological Risk Assessment states that the retained species component tree was based on species that were assigned a "moderate" (or greater) level of risk through the QCF Vulnerability Assessment". "Moderate level of risk" is not defined in the Vulnerability Assessment and the levels of risk that were assigned to species in this document are:

- Very low (< 2)
- Low (2-2.99)
- Medium (3-3.99)
- High (4-5)

The hard coral species that are contained in the species component tree are as shown in Table 1 with their corresponding Vulnerability Risk (VAR):

Table 1 - ERA listed species included in the component tree

Species listed in ERA	VAR
Acropora spp	2.8
Catalaphyllia jarinei	2.6
Plerogyra spp	2.9
Euphyllia glabrascens	2.2
Caulastrea spp	2.9
Oulophyllia spp	2.5
Hydnophora spp	2.7
Montipora spp	3.2
Scolymia vitensis	2.8
Scolymia australis	2.8
Blastomussa wellsi	2.6
Blastomussa merletti	2.6
Acanthastrea lordhowensis	2.6
Acanthastrea bowerbanksii	2.6
Mycedium spp	2.2
Trachyphyllia geoffroyi	2.5
Other	N/A

Table 2 – Vulnerability Assessment - species with a score of 2.2 or greater that have been omitted from the ERA

Species listed in Vul. Ass.	VAR
Euphyllia	2.4
Physogyra	2.2
Dendrophyllia	**2.5**
Duncanopsammia axifuga	**2.7**
Turbinaria	2.2
Balanophyllia	**2.8**
Heteropsammia	2.4
Favia	2.2
Favites	2.4
Goniastrea	2.4
Leptastrea	**2.6**
Leptoria	2.3
Montastrea	2.4
Moseleya latistellata	**2.7**
Platygyra	**2.7**
Plesiastrea	**2.5**
Fungia	2.2
Cycloseris	**2.6**
Diaseris	**2.6**
Heliofungia	2.2
Cynarina	2.2
Micromussa	**2.8**
Mussa	2.4
Symphyllia	**2.9**
Pectinia	**2.6**
Echinophyllia	2.2
Pocillopora	**2.7**
Seriatopora	**2.8**
Stylophora	**2.6**
Alveopora	2.2
Pavona	**2.6**
Distichopora	2.4

Given the spread of VAR's in Table 1 ranges from 2.2 to 3.2, it has been assumed that "moderate risk" is considered to be anything greater than 2.2, however, there are a number of species in the Vulnerability Assessment document that have VARs in this range that are not contained in the Ecological Risk Assessment. The species with VARs >= 2.2 that have not been included in the Ecological Risk Assessment are shown in Table 2.

If the outliers in Table 1 are ignored (those with VAR of 2.2), it could be assumed that in general a "moderate risk" is considered any species with a VAR >2.5 which is the midpoint of the Vulnerability Risk ratings, and would seem logical.

If this was the case, an additional 16 species should be included in the hard coral species component tree for analysis in the Ecological Risk Assessment (shown in bold in Table 2). While *Duncanopsammia axifuga* is not contained on the Ecological Risk Assessment retained species component tree, it is assessed in the Ecological Risk Assessment, and assigned low risk. It is assumed that this has been left off the species component tree by mistake, however, this has created further confusion as to exactly how the assessment process has been applied.

While there may be a good rationale for the decisions to include or exclude certain species from further consideration, the process followed and reasoning applied are not clearly articulated in the Ecological Risk Assessment and Vulnerability Assessment reports. This has made it difficult for the Australian CITES Scientific Authority for Marine Species to assess the appropriateness of the assessment decisions.

Additionally, the Ecological Risk Assessment process conducted is based on the *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wild Capture Fisheries*[14], which states:

> "To be of value for the ESD reporting process, it is not sufficient to only quote the levels of consequence and likelihood levels chosen and the subsequent risk ratings generated. Instead, appropriately detailed justifications for why these levels were chosen and why any decisions were made are also needed. The key element is that other parties who were not part of the process to generate the report need to be able to see the logic and assumptions behind the decisions that were made."

Currently, this is not the case with the Ecological Risk Assessment and Vulnerability Assessments. The reporting process will need to be improved for future iterations of the vulnerability and ecological risk assessments to ensure the above objective is met.

Species of Hard Coral Harvested in the QCF

The CITES Scientific Authority for Marine Species has utilised a number of different data sets in order to determine whether there were any "species of potential concern" with regard to making a robust NDF. The data sets that were utilised were:

Data source 1 Aggregated export data for two periods: the first from 2008-2010; and the second from 2010-2012, supplied by Queensland DAFF from previous 'Permits and Administration Database' queries run by the department. These

[14] Fletcher, W, Chesson, J, Fisher, M, Sainsbury, K, Hundloe, T, Smith, A & Whitworth, B, 2002, *National ESD Reporting Framework for Australian Fisheries: The 'How To' Guide for Wild Capture Fisheries,* FRDC Project 2000/145, Canberra, Australia

data were supplied within Excel spreadsheets, and were broken down to species level, state from which the export occurred, and total numbers exported.

Data source 2	Export data from 2006 to March 2012 broken down to species level, state from which the export occurred, and either the total numbers of pieces of each species/genus or weight of each species/genus exported, broken down by financial year (i.e. FY11/12 is incomplete).
Data source 3	QLD QCF Annual Status Reports with harvest data from FY06/07 until FY10/11. These data contained within the Annual Status Reports are based on the outcomes of the Ecological Risk Assessment and therefore cover only those species included in the component tree (Table 1).
Data source 4	QLD QCF harvest data including spatial distribution to the resolution of 6X6nm blocks, for the years 2006 to 2011. Again, because these data are based on the outcomes of the Ecological Risk Assessment, they therefore cover only those species included in the component tree (Table 1).

The species included in logbooks for recording harvest information is limited in the QCF to those identified in the Ecological Risk Assessment as “moderate risk or greater”, which means that harvest levels for species not included in this subset are not covered Annual Status Reports nor the logbook based datasets recording spatially distributed harvest. Due to the limitations on species covered in the QCF Annual Status Reports and spatially distributed harvest data sets, it was necessary to analyse the export data records discussed at 1 and 2 above to gain an indication of which species could have changed in importance within the fishery subsequent to the Ecological Risk Assessment.

It is important to note however, that because these export data are based on the location of exporters, in some instances, while an exporter may reside in one state, they could be exporting product sourced from another state. Therefore, to ensure that this assessment has covered all species that may have been sourced from the QCF for export, this assessment has considered all CITES-listed coral species that have been exported from Australia between 2006 to March 2012, for which the species’ distribution extends into Queensland waters. A full list of the species considered in this assessment is presented in Table 3 at Annex A.

In further analysing this data to focus on the exports most likely to have originated from the QCF, the records were extracted for those exports that had originated from the state of Queensland. As explained above, because these export data are based on the location of exporters, in some instances, while an exporter may reside in Queensland, they could be exporting product sourced from a fishery other than the QCF. Conversely, product sourced from the QCF could be exported from another State, and would not show up in the Queensland export data set. As a consequence, there is an unquantified amount of error involved with attributing specific exports to a particular state/fishery. However, given the QCF only implements catch reporting for those species identified in the Ecological Risk Assessment as at “moderate risk or greater”, the export data represents the best information available on the species not covered in fishery harvest reporting.

Additionally, over recent years, coral specimens have only been permitted to be harvested for export within two other Australian fisheries – the Western Australian Marine Aquarium Fish

Managed Fishery (WA MAFMF) and the Northern Territory Marine Aquarium Fishery (NT MAF). The NT MAF, has comparatively low levels of harvest compared to the QCF, and the Scientific Authority for Marine Species has recently conducted an analysis of the harvesting of all CITES-listed species within the WA MAFMF, which included logbook reporting of all species harvested. On the basis of a comparison of what is known about these two fisheries and Australian export figures, the trends in number of species and volumes of those species exported from the state of Queensland is thought to be reasonably representative of the harvesting trends within the QCF. The Australian Scientific Authority for Marine Species has therefore conducted the following analysis on that basis.

Analysis of the export records from the department's Permits and Administration Database provides an indication of likely trends in relation to the harvest of species within the QCF. These data suggest that the number of species exported overseas from the state of Queensland has increased from roughly 95 species/genus in FY06/07 to a maximum of 218 in FY09/10. During the current financial year (FY11/12) roughly 150 species have been exported from Queensland (data up until March 2012). These data indicate that both the number and volume of hard coral species harvested in the QCF is likely to have expanded dramatically since 2006.

As a consequence of the expansion of the fishery, a large number of species of potential concern for NDFs in the fishery that were not identified in the Ecological Risk Assessment as "moderate risk or greater", and consequentially are not included in harvest logbooks. This represents a significant monitoring and management gap in the QCF which requires attention.

This detailed analysis to determine a list of species of potential concern, and the various export and likely harvesting trends within the fishery is described at Annex B to this report. This includes a diagrammatic depiction of the increasing trends in harvest of particular species in Figures 4 to 6, and Tables 4 to 8 of Annex B. The implications of these trends are central to the ongoing sustainable management of the QCF, and the species identified as 'of potential concern' for a NDF are considered particularly important in implementing the recommendations within the conclusions to this NDF.

QCF Performance Measurement System

Following the Ecological Risk Assessment process, the then QLD DPI developed and implemented a Performance Measurement System which sets specific trigger reference points for those species that were considered as at "moderate risk or greater" (i.e. those species contained in Table 1 plus *Duncanopsammia axifuga*).

When a trigger level is reached, the QLD DAFF instigates a management response, which is to determine the source and reason for the increase. The Performance Measurement System states "*Within three months of becoming aware of a review event being triggered, QPIF will undertake a review of likely causes, and implications for sustainable management of the fishery. Pending the outcome of that review QPIF will finalise a timetable for the implementation of appropriate management responses.*"

The Performance Measurement System includes a trigger limit so that if 80% of the harvest of a species identified as "more than negligible risk" in the Ecological Risk Assessment occurs within a single 6x6nm block, a review into the reason for this harvest should take place. Given the comparatively high level of harvest of some species currently, compared to when this management review trigger was designed, it is considered that this high percentage would no-longer be appropriate for many species, and would fail to pick up all but the most extreme concentration of harvest. Consequentially, this management review trigger is no longer considered an appropriate control measure to constrain harvest to within sustainable limits.

Another trigger reference point is applied to each of the individual species identified as “more than negligible risk” in the Ecological Risk Assessment, under which a management response is initiated upon an increase or decrease in harvest of 30% from the previous two-year average. It should be noted that the fishery includes three management units (‘Cairns’, ‘Keppel’ and ‘Other’) and the trigger applies when harvest changes by 30% or more for the total harvest from the entire fishery. QLD DAFF has advised that from the 2010-2011 financial year, the trigger limit has been applied on the basis of the number of pieces harvested instead of weight, while in previous years, the trigger limit has been applied to total weight harvested. QLD DAFF note that this is due to the fact that under the previous system, the weight was estimated using a series of broad categories, which were chosen on the basis of the size of the containers used to transport the coral, and therefore contained a large possibility for error. The new method of measurement (measurement of pieces rather than weight) is considered to be more accurate.

In undertaking this assessment, to further examine trends in harvesting, Australia’s Scientific Authority for Marine Species has further analysed the data in the Annual Status Reports, on a regional scale. Figure 7 to this report, provided at Annex C, depict this analysis, showing the 30% trigger limit compared to the previous two-year average, were it to be applied to each region individually.

Additionally, the paired graphs in Figure 7 (provided at Annex C), depict the harvest of each species measured in pieces and also weight, both of which are recorded in the fishery. The reason for examining both is, as explained above, weight had previously been used as the unit of measurement to determine whether the 30% trigger had been reached, however since 2010-2011 this was changed to pieces of coral. Assessment and comparison of both methods allows examination of how the trigger system has been applied using these two forms of measurement, and how it might be applied most effectively in the future.

Increasing trends in harvest of individual species and application of trigger reference points

Analysis of Figure 7 (provided at Annex C) indicates that, had the 30% trigger been applied on a regional basis, a large proportion of the species identified in the QCF Ecological Risk Assessment would have triggered every year.

The Annual Status Reports list the only species to have triggered as *Scolymia vitensis*. (in the 2008-09 Report). *S. vitensis* exports are a fraction of *S. australis*, therefore, it actually seems more likely that this was the species that was triggering. Despite *S. vitensis* being identified as requiring monitoring, it was still being reported as “donut coral”, which did not allow it to be separated from *S. australis,* as can be seen from the last two graphs in Figure 7 (Annex C)

Additionally, in the 2008-09 and 2009-10 Annual Status Report *S. vitensis* is said to have triggered as the harvest increased by 80% and 96% respectively. However on both occasions it is stated that the increase did not require investigation because the increase was attributed to “most likely [being] an artefact of how this species is labelled and reported for import country requirements”. This explanation has been interpreted to mean that importers were requiring species-level identification where previously they had accepted genus-level identification, which may have resulted in an increase in reported harvest of this individual species. However, comparing the export data for this species for 2008-09 indicates that the export of this species actually decreased by approximately 20% over the previous 2 year average. The CITES Scientific Authority for Marine Species recommends that further investigation is required to fully understand the driver/s for what appears to be a significant increase (almost 180%) reported harvest of this species (or possibly *S. australis*) over a two year period while exports of this species from the fishery in the same time period, according to CITES export data, decreased by approximately 80%.

Figure 7 (at Annex C) indicates further patterns of potential concern of harvest of the species identified as being at “moderate risk or greater” in Ecological Risk Assessment process. It is possible that using the total harvest across the entire fishery as the basis for the 30% trigger reference point may be masking localised depletions occurring in specific regions, as the harvest within individual regions often varies considerably year to year.

This fishery has grown substantially over the past six year, which may be in part due to coral trade bans introduced for product sourced from some neighbouring countries (see ‘International Context’ section on page 28). The large number of species that were previously rarely targeted but have undergone substantial increases in harvest levels represents an area for further investigation and management focus to ensure harvest is sustainable. Additionally, despite the Performance Measurement System, the trend of increasing harvest has not resulted in the gathering of additional information on the status of species in the areas of collection (nor within non-collection sites for comparative purposes) to inform ongoing harvest levels and methods.

Comparison of applying trigger reference points on the basis of pieces harvested and on estimated weight harvested

Figure 7 (at Annex C) indicates that had the 30% trigger been applied to number of coral pieces rather than weight prior to 2010/11, a number of the species under consideration would have triggered in previous years. Conversely, many of these species would also have triggered in 2010-2011 had the trigger been applied by harvest weight as in previous years.

Another significant potential concern regarding the new triggering methodology appears when the harvest of number of pieces is compared to the export data. Figure 8 (a-h) which is provided at Annex D indicates that the pieces reported as exported from this fishery has recently begun to exceed the harvest being reported. It appears clear from the intersection point of the graphs in Figure 8 (at Annex D) the point where export numbers begins to exceed harvest numbers tend to correlates with the transition from a trigger limit based on weight to a trigger limit based on number of pieces. Analysis of the last two years status reports also indicates that there has been increasing harvest of coral pieces in larger size categories for many species, with LC6 sized pieces beginning to be targeted in the 2010 status report for the first time.

It is possible that fishers have begun harvesting larger pieces, which are subsequently subdivided into smaller pieces for export (sometimes referred to as ‘fragging’), which would explain the pattern repeated for many species where harvest numbers are now lower than export numbers (noting that some exports from the state of Queensland may have originated from a fishery other than the QCF). LC6 size equates to any coral piece that is greater than 1kg, given that the normal export size is approximately 130g, there could be in excess of 10 pieces exported for each one piece harvested at this size. However, this single fragging explanation is unlikely to entirely account for the repeated pattern of reported exports trending towards exceeding reported harvest, as expert opinion suggest that based on the preferred harvest and export techniques, Acropora species would result in the greatest discrepancies between harvest and export figures. Additionally, this explanation would not account for the discrepancies for single polyp corals, such as *Scolymia* (Pratchett., Pers comm., 2012). As explained previously, there is also some degree of error in attributing exports from the state of Queensland to the QCF, so this may account for a proportion of the discrepancy.

Spatial Distribution of Harvest for Heavily Traded Species

Figures 9 through to Figure 22, provided at Annex E to this assessment, depict spatial distribution of harvest within the QCF. Figure 9 is based on the QCF logbook data and depicts the number of species recorded as collected in each 6X6mn block across the fishery. Figure 10 shows the number of individual pieces (not species-specific) collected in each 6x6nm block. Figures 11 through to 22 show the spatial distribution for the most heavily traded coral species and/or families. These maps were created by the GIS team within the department using the data supplied by the QLD DAFF, discussed at 'Data source 4' above. Graphs depicting the spatial distribution and concentration of harvest were developed for the most heavily traded species for which those data were available. Unfortunately because the data supplied were based on log book reports, which are in turn based on the outcomes of the 2008 Ecological Risk Assessment process, not all heavily traded species were captured individually. It would advantageous to be able to present graphs of this type for all species of potential concern, (i.e. all those species and genus listed in Table 7 and others identified as requiring management focus).

The graphs at Annex E were developed to better understand the distribution of harvest of the heavily traded species within the QCF, and therefore get an indication of what the likely harvest may be for the other species of concern in Table 7. For the most part, the harvest of individual species is relatively well dispersed, with only a few areas of concentrated harvest. These areas of concentrated harvest are quite consistent for most of the species and most years and would therefore be particularly important for focussing future species surveys to ensure ongoing harvest is sustainable. It is worth noting that it appears the levels of harvest from these areas have been fairly consistent over the years, even with higher levels of take more recently, which suggests current levels of harvest have not had a negative impact on populations at these sites. Without survey data however, it is difficult to assess long-term sustainability.

Given there are relatively few areas of concentrated harvest and the large numbers of species being harvested in those locations, a survey concentrated on these areas could provide valuable information to determine conclusively what level of harvest could be supported by these sites in the future. Additionally, according to expert advice, the nearshore habitats that show a focus of harvest are among the least studied areas of the GBR. The AIMS LTMP for example, does not encompass many areas where collections are concentrated, so this may represent a need for longer-term study of the effects of harvesting compared to relatively un-harvested representative sites (Pratchett., Pers comm, 2012).

Overall, for most sites and species, a temporal comparison of the spatial concentration of harvest provides improved confidence that historical harvest levels are unlikely to have been causing detriment to the reefs. If localised depletion had occurred, one might expect to observe a shift in the area of concentrated harvest away from previously harvested sites, and this does not seem to have occurred for those species for which spatial harvest data exist. Further, any such depletion would likely have been observed by the operators, and in accordance with the Stewardship Action Plan, harvest moratoriums would have been implemented.

Biological Characteristics

Hard corals belong to the Scleractinia Order, part of the Phylum Coelenterata, which also includes soft corals, jelly fish and anemones. Corals are either Zooxanthellate or Azooxanthellate. Zooxanthellate corals share a symbiotic relationship with microalgae that live in the gastrodermis of the coral. This relationship allows the corals to live in environments that are fairly nutrient poor, as the zooxanthallae can produce the required nutrients for the coral host though photosynthesis. This relationship however, makes these corals extremely dependent on sunlight; consequently they are usually found in relatively shallow waters. Azooxanthellate corals are reliant on catching their own food, through absorption of nutrients or catching plankton.

Corals are radially symmetrical with a sac-like body called the coelenterons, which has one opening that acts as a mouth and anus. Tentacles extend from around this opening; however, for a large proportion of species, this is only observable at night. The skeletal structure of a polyp is referred to as a corallite, which is effectively a tube with radial vertical plates. Individual polyps are connected by tubes from their coelenterons that carry water and nutrients. The body wall of the coelenterons is comprised of an inner cell layer called the gastrodermis and an outer wall cell layer called the ectodermis. Radially inside the coelenterons are vertical partitions called mesenteries which contain the coral's reproductive organs. The reproductive organs develop on an annual cycle just before breeding season and then disappear. The majority of corals are hermaphroditic, however, a few species, namely Fungia, have male and female specimens in different colonies (called gonochoric).

Corals reproduce either by broadcast spawning or by brooding larvae internally. Broadcast spawners release eggs and sperm into the water and are responsible for "mass spawning" events that occur worldwide. On the GBR, mass spawning events occur during spring, in the week following a full moon in October or November. This coincides with mass spawning events in the Solomon Islands and New Caledonia[15]. Baird (2011) has indicated that there is also a smaller scale (fewer species) mass spawning event that occurs from October-December, mainly at sites where *Porites* and *Acropora* species dominate.

Species Specific Biological Traits and Status

Species specific biological traits have been included for the 14 most heavily traded species that have been identified in this assessment as of potential concern. This information is presented in Annex G to this report, and has been obtained from Veron (2000)[16] and the QCF Ecological Risk Assessment[13]. To inform a revised Ecological Risk Assessment and recommended harvest methods, it would be valuable to analysis this sort of information for all of the species and families of potential concern as identified in this assessment. Such a desktop review would

[15] Baird, A.H., Blakeway D. R., Hurley, T. J., Stoddart, J. A., Seasonality of coral reproduction in the Dampier Archipelago, northern Western Australia, Marine Biology, 158: 275-285, 2011

[16] Veron (2000) - Veron, J.A., *Corals of the World,*, Australian Institute of Marine Science and CRR QLD Pty Ltd, 2000

strengthen a future NDF, particularly if it summarised what is known about species reproduction methods, recovery rates from harvest (dependent on method), and any other considerations of importance to particular species, such as whether various colour-morphs are genetically identical or distinct, and therefore whether unharvested colonies are suitable to replace the particular colour-morphs targeted for harvest.

Species Specific Harvest Methods in the QCF

The Stewardship Action Plan has particular methods it emphasises to ensure that harvest practices are “best practice” and continually improving. These species specific biological traits are an important consideration in designing appropriate practices to minimise the impact of harvest, particularly in relation to the large variety of species that have become a focus of the fishery subsequent to the development of the Ecological Risk Assessment. The harvest practice information presented in Table 3 has been taken from the 2008 Ecological Risk Assessment. A repetition of form of evaluation would be of value for the species that were previously not considered, with explicit documentation of species reproductive strategies and the implications of harvest on population recovery.

Table 3. - Harvest strategy for individual coral species from the 2008 ERA

Coral	Harvest Strategy
Acropora spp	No removal of whole large colonies (base plate is left to regrow)
Catalaphyllia jardinei	Large pieces can be segmented so only part of colony removed. Whole small colonies also taken.
Scolymia australis	Chiseled or levered from substrate but substrate left intact (this is the case with all corals growing on solid structure).
Duncanopsammia axifuga	Size and colour selected. Max about lawn bowl sized, average baseball-sized. Approx 5-10% of cover of this species will be colourful enough for collection.

Threats to Hard Corals in QCF

Disturbances

A disturbance is defined as “a discrete, punctuated killing, displacement or damaging of one or more individuals (or colonies)”[17]. Coral reefs are susceptible to numerous disturbances, both natural and anthropogenic, including: coral bleaching (caused by climate change); cyclones and severe storms; Crown of Thorns outbreaks (*Acanthaster planci*); water quality; coral disease; and ocean acidification.

Disturbances vary in intensity, time scale and distribution and the long lasting effects are dependent on all three factors. An acute disturbance occurs over a relatively short period of time, however, a chronic disturbance is defined as “a series of acute disturbances that occur so frequently that there is little time between them for recovery”[17]. Disturbances have several effects on the ecology of coral reef systems. They may alter the physical structure of reefs by

[17] Connell, J.H., Hughes, T.P., Wallace, C.C., *A 30-Year Study of Coral Abundance, Recruitment and Disturbance at Several Scales in Space and Time*, Ecological Monographs, 67(4), p461-488, 1997

damaging substrate, increasing sedimentation or changing the local topography. They may also alter the biology of the ecosystems by changing the abundance and distributions of species, through disease, invasive species invasions and by killing off susceptible species allowing more resilient species to dominate the reef. The flow-on effects from these changes are numerous and include reduced physical refuges for marine species and reduced food sources. Halford (2009)[18] found that these second order effects were delayed up to 18 months after the initial disturbance and could often be missed by short term studies of the effects of a particular disturbance.

Several disturbances (e.g., cyclones, disease, and coral bleaching) are linked to warmer temperatures and primarily occur during the hotter summer season. At this time, the risk of bleaching is greatest and corals on cyclone damaged reefs are likely to be more susceptible to bleaching and disease. The GBRMPA has developed a Reef Health Incident Response System, which includes three plans, the Cyclone, Coral Disease and Coral Bleaching Risk and Impact Assessment Plans and enables managers to evaluate and effectively respond to simultaneous and cumulative impacts.

Coral Bleaching

Coral bleaching occurs when water temperatures exceed the average annual maximum temperature by more than 2 degrees for an extended period of time[19] and/or when corals become stressed. This causes the coral to expunge their symbiotic zooxanthellae causing the coral to lose colour and eventually die of starvation if the situation persists for several months. For at least some regions of the GBR, coral bleaching thresholds are water temperatures of around 30.8°C, with mortality thresholds often only 0.2 to 2°C greater than the bleaching threshold[9].

The most significant recent coral bleaching event occurred in 1998, where coral reefs around the world were bleached en masse due to excessively high water temperatures. The effect of this single outbreak on coral coverage and resulting reductions in biodiversity has been studied extensively. In addition to this 1998 bleaching event, in 2002 the GBR underwent its most severe reef-wide coral bleaching event on record and in 2006 localised but intense coral bleaching affected the southern GBR, particularly inshore reefs in the Keppel Island Group[9, 19]. Bleaching events of varying intensity occurred on the GBR in early 1980, 1982, 1987, 1992 and 1994[8]. In 1998, approximately 42% of reefs bleached to some extent, with 18% strongly bleached, while in 2002, 54% of reefs bleached to some extent, with 18% strongly bleached. In 2006 in the Keppel Island Group, approximately 87% of the reef flat and 98% of the reef slope coral bleached in this area, with 61% and 78% of these habitats, respectively, bleached white[19].

Coral bleaching and mortality thresholds are variable among regions. In addition, it has been hypothesised that bleaching thresholds have increased at a number of locations on the GBR (e.g. Magnetic Island, Daydream Island, Myrmidon reef and Chicken reef) since the major 2002 bleaching event, potentially as a result of acclimatization, possibly through shuffling

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[18] Halford, A.R., *Towards an understanding of resilience in isolated coral reefs*, Global Climate Change, 15, 3031-3045, 2009

[19] Berkelmans, R., *Bleaching and mortality thresholds: How much is too much? In: van Oppen, M.J.H., Lough, J.M. (Eds.), Coral Bleaching: Patterns and Processes, Causes and Consequences,* Ecological Studies, vol. 205. Springer, New York, pp. 103–120. 2009

zooxanthellae types within the coral tissue or in part through selection of more thermally resistant coral and symbiont genotypes among surviving populations[19].

The rate and prospects for recovery of the coral from bleaching is highly variable, and may be dependent on ongoing reproduction and recruitment potential[20] (Pratchett Pers comm., 2012). In some cases the polyps are able to recover their symbiotic algae[21]. However, severe or repeated bleaching can result in the death of polyps, which leaves the reef vulnerable to colonization by algae and structural collapse[22]. For example, at Orpheus Island and Pandora Reef, respectively two and a half years after the bleaching event in 1998, only 20 to 30% and 1 to 15% of the severely bleached coral areas (*Porites* spp.) remained alive.

Cyclones and Severe Storms

On the GBR, cyclone season begins in November and continues until April, with a peak in January and February. Extreme intensity cyclones (i.e. categories 4 and 5) have the potential to cause severe damage to benthic reef communities and the underlying reef structure over hundreds of kilometres[23] and are therefore important in shaping coral reef communities. Damage caused by cyclones is primarily mechanical, caused by large powerful waves buffeting the coral reefs and causing coral to break off. Following cyclonic events, increased sedimentation causing smothering and light deprivation and osmotic stress caused by a reduction in salinity as a result of an influx of freshwater, can also cause significant loss of coral cover.[24]

On average, five tropical cyclones affect the Queensland coast each year. On the GBR, storms have been attributed with causing 34% of the coral mortality recorded between 1995 and 2009[5]. In addition, the GBR has experienced four extreme intensity cyclones this century[23]. The three most recent high intensity cyclones were tropical cyclone Larry in 2006, tropical cyclone Hamish in 2009 and tropical cyclone Yasi in 2011. Reef damage from these cyclones was so severe that the time needed for full recovery may well exceed the return times of subsequent storms, leading to lower resilience and increased vulnerability.

Tropical cyclone Hamish caused extensive reef damage when it traversed along the outer edge of the southern GBR for around 500 km. Tropical cyclone Yasi is considered to be the most destructive cyclone to affect the GBR since records began and it affected large areas of the reef. In total, 775 of the 2900 reefs within the GBRMPA boundary were within areas exposed to gale force, destructive or very destructive winds[23]. Just over 15% (3,834 km^2) of the 24,839 km^2 reef area within the marine park is estimated to have sustained some level of coral damage,

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[20] Pratchett, M.S., Munday, P.L., Wilson, S.K., Graham, N.A., Cinner, J.E., Bellwood, D.R., Jones, G.P., Polunin, N.V.C., McClanahan, T.R., *Effects of climate-induced coral bleaching on coral-reef fishes — ecological and economic consequences*. Oceanogr. Mar. Biol. 46, 251–296, 2008

[21] Hoegh-Guldberg, O. *Climate change, coral bleaching and the future of the world's coral reefs*, Marine and Freshwater Research, 50, 839-866, 1999

[22] Diaz-Pulido, G. & L. J. McCook, *The fate of bleached corals: patterns and dynamics of algal recruitment*. Marine Ecology Progress Series, 232, 115-128, 2002

[23] Great Barrier Reef Marine Park Authority, *Impacts of tropical cyclone Yasi on the Great Barrier Reef – A report on the findings of a rapid ecological impact assessment,* July 2011

[24] Blakeway, D.R., *Patterns of mortality from natural and anthropogenic influences in Dampier corals: 2004 cyclone and dredging impacts*, Corals of the Dampier Harbour: Their Survival and Reproduction during the Dredging Programs of 2004, MScience Pty Ltd, 2005

with six per cent (1513 km^2) sustaining severe coral damage and some degree of structural damage as a result of tropical cyclone Yasi.

The reef damage caused by tropical cyclone Yasi was severe, extensive and patchy. There tended to be large differences in the amount of damage observed at survey sites within any single reef, with this intra-reef patchiness being greater at reefs farthest from the path of the cyclone eye[23]. Reef structural damage was primarily confined to reefs within the areas of destructive and very destructive winds that occurred between Cairns and Townsville. The severity of damage was substantially lower at reefs more than 250 km from the cyclone eye, with no structural damage recorded in surveys of reefs south of Townsville.

The large scale of damage from this cyclone may have implications for the rate of recovery through larval recruitment. At sites free from additional stresses, signs of recovery through larval recruitment can be expected within three to five years. Return to substantial coral cover at severely damaged sites is likely to take 10 years or more. It can be expected to take even longer for recovery to pre-cyclone species diversity[23].

The GBRMPA developed the Cyclone Risk and Impact Assessment Plan (http://www.gbrmpa.gov.au/__data/assets/pdf_file/0003/12954/Tropical-Cyclone-RIAP.pdf) in April 2011 following tropical cyclone Yasi. A part of the GBRMPA reef health incident management system the plan provides a structured framework for the management of impacts on the health of the GBR and is implemented by the GBRMPA each cyclone season.

Crown-of-Thorns Starfish Outbreaks

Crown of Thorns Starfish (*Acanthaster planci)* outbreaks have been occurring in Australian waters, especially the GBR since the early 1960s. Fossilised remains indicate that this species has occurred in Australian waters since up to 7000 years ago[25], however it is unknown if outbreaks are a new phenomena.

Each *A. planci* female can produce up to 60 million eggs in a single spawning season, which once fertilised become planktonic larvae for 4-6 weeks. *A. planci* reach sexual maturity between 2 and 3 years of age and are able to breed for 5-7 years. *A. planci* form aggregations during the breeding season which commences around December to January on the GBR[26]. The fertilisation rate for *A. planci* is the highest for any invertebrate measured in the field[25]. Once the planktonic larvae reach between 1-2 mm in width they begin to settle to the sea floor, where they remain largely invisible eating encrusting algae until they reach 6 months of age and they begin to eat coral. The commencement of eating coral corresponds to a period of rapid growth, where the starfish will grow from 1 cm up to 25 cm in the space of 2 years. A full sized adult starfish can reach up to 1 m in diameter and when moving at full pace can cover a distance of 20 metres per hour. Harriott *et al.* (2003) stated *"scientists estimate that a healthy coral reef with about 40-50% coral cover can support about 20-30 crowns-of-thorns starfish per hectare*" There have been three reported *A. planci* outbreaks on the GBR, and each time coral cover has declined by up to 90% on worst affected reefs (Pratchett., Pers comm, 2012).

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[25] Harriott, V., Goggin, L., Sweatman, H., *Crown of Thorns Starfish on the Great Barrier Reef – Current State of Knowledge,* Cooperative Research Centre – Reef Research Centre, November 2003
[26] Babcock, R.C., Mundy, C.N., *Reproductive Biology, spawning and field fertilization rates of Acanthaster planci,* Aust. J. Mar. Freshwater Res, 43, 525-34, 1992

Predation of coral by *A. planci* accounts for a large proportion of the observed decline in coral cover on the GBR. There have been three protracted large-scale population outbreaks of *A. planci* on the GBR, which began in 1962 (originating at Green Island), 1979 (originating at Green Island) and 1993 (originating at Lizard Island, followed by 7 other reefs in the Cairns and Lizard Island region)[27]. Between 1985 and 1997, 32% of monitored reefs on the GBR experienced *A. planci* outbreaks. The coral cover on these reefs averaged 9% one year after the outbreak, while reefs that had not experienced an outbreak in the same period had a mean coral cover of 28%. These figures suggest a GBR –wide reduction in coral cover of 0.5% per year due to *A. planci* alone in this 12 year period. Fabricius *et al*. (2010) suggest that primary outbreaks of *A. planci* occur when food limitation is removed due to floods, which increase the amount of phytoplankton available.

Management measures to minimise *A. planci* outbreaks include, incentives and legislation to reduce river discharges of nutrients, sediments and pesticides from agricultural areas (Fabricius *et al.* 2010). Low *A. planci* densities might also be achieved through long-term no-take fishing zones in high risk areas to increase the carrying capacity of fish populations and targeted efforts by divers, particularly following floods, to remove *A. planci*[27].

Water quality

Coastal coral reefs are exposed to increasing amounts of nutrients, sediments, and pollutants washing off cleared, fertilized, and urbanized catchments[28]. Sediment, nutrients, chemical contaminants, and other pollutants are introduced into the ocean by various mechanisms, including river discharge, surface runoff, groundwater seeps, and atmospheric deposition. Humans introduce sewage into coastal waters through direct discharge, treatment plants, and septic leakage, each bringing nutrients and microbial contamination. Agricultural runoff brings additional nutrients from fertilizers, as well as harmful chemicals such as pesticides. Elevated sediment levels are generated by poor land-use practices. Industry is a major source of chemical contaminants, especially heavy metals and hydrocarbons[29].

While there are some coral species harvested within the QCF that actually prefer turbid conditions (Pratchett., Pers comm., 2012), generally high levels of turbidity, nutrients, and sedimentation lead to the deterioration of coral reefs at local scales[30] and large scales[28]. The type and severity of response to terrestrial runoff will depend on which of these factors caused the changes and also on the physical, hydrodynamic, spatial and biological properties of the location[30]. Water clarity affects species richness[28]. Mechanisms responsible for low coral diversity in areas of high turbidity and nutrients include energy limitation from light-limited rates of photosynthesis and growth, reduced coral recruitment, increased juvenile mortality as the smaller corals are being smothered by macroalgae and a shallower depth limit for reef development[28]. In severe conditions, the overall outcome is reduced reef calcification,

[27] Fabricius, K.E., Okaji, K., De'ath, G., *Three lines of evidence to link outbreaks of crown of thorns sea star, Acanthaster planci, to the release of larval food limitation*, Coral Reefs, 29: 593-605, 2010
[28] De'Ath, G., Fabricius, K., *Water quality as a regional driver of coral biodiversity and macro algae on the Great Barrier Reef,* Ecological Applications, 20(3), p 840-850, 2010
[29] Brainard, R.E., C. Birkeland, C.M. Eakin, P. McElhany, M.W. Miller, M. Patterson, and G.A Piniak. 2011. Status Review Report of 82 Species of Corals under the US Endangered Species Act. Pacific Island Fisheries Science Centre. NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-27, 530 p. + 1 appendix.
[30] Fabricius, K.E., *Effects of terrestrial runoff on the ecology of corals and coral reefs: review and synthesis,* Marine Pollution Bulletin, 50, pg 125-146, 2005

shallower photosynthetic compensation points, changed coral community structure, and greatly reduced species richness. Hence reef ecosystems increasingly simplify with increasing exposure to terrestrial runoff, compromising their ability to maintain essential ecosystem functions at the presently increasing frequencies of human-induced disturbances[30].

The reef water quality protection plan (http://www.reefplan.qld.gov.au/index.aspx) is a joint initiative of the Queensland and Australian governments, which is designed to improve the quality of water in the GBR through improved land management in reef catchments. The plan is a series of collaborative and coordinated projects and partnerships. The goals are to halt and reverse the decline in water quality entering the reef by 2013 and to ensure that by 2020 the quality of water entering the reef from adjacent catchments has no detrimental impact on the health and resilience of the GBR. The plan includes reef-wide water quality targets to quantify the amount of improvement to be achieved in water quality parameters including nutrient, pesticide and sediment loads.

Coral Disease

There are approximately 30 recognised coral diseases worldwide. The following diseases have been recorded in the GBR: Black Band Disease; White Syndrome; Skeletal Eroding Band; Brown Band; Black Spot Necrosing Syndrome; Pink Spot; and other growth anomalies.

The GBR has had a long term monitoring program for over 20 years, which has found an increase in the percentage of coral diseases over the last 5 years. Three of the infectious diseases mentioned above – White Syndrome, Black Band and Brown Band disease – have been identified as being of particular concern[31]. The drivers for coral disease are largely unknown however there has been some research to suggest that coral susceptibility to particular diseases is increased with rising sea temperatures[32].

Ocean Acidification

Ocean acidification (i.e. reduced pH) and reduced availability of carbon ions in the ocean has resulted from the increased CO_2 concentration in the atmosphere changing the partial pressures of CO_2 in the surface ocean. Decreasing carbonate-ion concentrations reduce the rate of calcification of marine organisms such as reef-building corals, ultimately favouring erosion[33]. Such changes in carbon chemistry can substantially reduce coral calcification and reef cementation and may affect many stages of the coral life cycle[29].

Reef-building corals may exhibit several responses to reduced calcification, all of which have deleterious consequences for reef ecosystems. The most direct response is a decreased linear

[31] Maynard, J., K. Anthony, C. Harvell, M. Burgman, R. Beeden, H. Sweatman, S. Heron, J. Lamb & B. Willis (2011) Predicting outbreaks of a climate-driven coral disease in the Great Barrier Reef. Coral Reefs, 30, 485-495.

[32] Bruno, J.F., Selig, E.R, Casey, K.S., Page, C.A., Willis, B.L., Harvell, D., Sweatman, H., Melendy, A.M., *Thermal Stress and Coral Cover as Drivers of Coral Disease Outbreaks,* PLoS Biology Vol 5, Iss 6, 2007

[33] O. Hoegh-Guldberg, P. J. Mumby, A. J. Hooten, R. S. Steneck, P. Greenfield, E. Gomez,C. D. Harvell, P. F. Sale, A. J. Edwards, K. Caldeira, N. Knowlton, C. M. Eakin, R. Iglesias-Prieto, N. Muthiga, R. H. Bradbury, A. Dubi, M. E. Hatziolos, *Coral Reefs under rapid climate change and ocean acidification,* Science, Vol 318, 2007

extension rate and skeletal density of coral colonies [34 29]. For example, the massive coral *Porites* on the GBR has shown reductions in linear extension rate of 1.02% per year and in skeletal density of 0.36% per year during the past 16 years[34]. This is equivalent to a reduction of 21% in growth rate (the product of linear extension rate and skeletal density) over the 16 year period between 1988 and 2003[33 34]. Alternatively, corals may maintain their physical extension or growth rates by reducing skeletal density [33 29]. Increasingly brittle coral skeletons are at greater risk of storm damage. The loss of structural complexity will affect the ability of reefs to absorb wave energy and thereby impair coastal protection[33]. Corals may also invest greater energy in calcification in order to maintain both skeletal growth and density under reduced carbonate saturation, which may result in the diversion of resources from other essential processes, such as reproduction, which could ultimately reduce the larval output from reefs and impair the potential for recolonisation following disturbance [33 29].

Harvest by indigenous communities/recreational fishers/illegal hunters

In the area of the QCF, recreational fishers can collect corals for personal home aquaria. Recreational capacity is limited by apparatus restrictions (i.e. coral may only be taken by hand or by using hand-held non-mechanical implements, such as a hammer and chisel) for the QCF as well as limits to the fishable area for recreational fishers to waters outside of declared Marine Parks through regulations imposed under Marine Parks' legislation. Nevertheless, there are currently no data available on the level of recreational harvest of coral species. Indigenous harvest of corals in the area of the QCF has not been documented, but is believed to be minimal.

Collection for export

CITES NDFs should consider the national context, however this is of varying importance depending on the contiguousness of populations. Within Australia, there have historically been three export coral fisheries, in Queensland, Western Australia and the Northern Territory. Given the large distances separating these areas, for management purposes they can be considered distinct. However it is worthy of note that virtually all species harvested in each of these fisheries are found in at least one or often both of the other regions.

Management considerations

The adequacy of the management arrangements and harvest levels have been taken into consideration in this assessment and in determining the conditions under which an NDF may be made for the export of coral from the QCF.

In consideration of the potential impact of this fishery it needs to be taken into account that:

- Greater than 30% spatial protection is afforded by zoning in the GBRMPA plus there is a further natural protection because many sites can only rarely be dived (also, less than 1% of the GBR area is visited per year by licensed collectors);

[34] Cooper, T.F., De'ath, G., Fabricius, K.E., Lough, J.M., *Declining coral calcification in massive Porites in two nearshore regions of the northern Great Barrier Reef,* Global Change Biology, 14, 529-538, 2008

- The scale of the fishery is small in comparison to the scale of the GBR and, with the possible exception of some localised depletion, effort is well spread. The inter-reefal area is also much larger than the reefal area on the GBR and there is comparatively little competition for habitat space in the inter-reefal areas.

The QCF is also unique in that a Coral Stress Response Plan and the associated Stewardship Action Plan are in place. The effect of these management plans is that if severe environmental perturbation occurs, such as bleaching, then scaled management responses, up to and including a total moratorium on collecting, can be put in place quickly in the affected area. Following the floods and extreme weather events experienced in Queensland in 2011 a collection moratorium was put in place, voluntarily by industry under the terms of the Stewardship Action Plan, in a designated area of the Keppel Islands in 2011. This moratorium was still in place at the time of this assessment. The Stewardship Action Plan allows for moratoriums to remain in place until reef health impact surveys indicate that it is prudent to lift them.

Areas Closed to Harvest

There are large areas along the Queensland coastline that are closed to coral harvest (refer Figure 23, which is provided at Annex G) through general fisheries closures or marine parks zoning under the Commonwealth *Great Barrier Reef Marine Park Act 1975* and the Queensland *Marine Parks Act 1982*. These areas would provide significant sources for coral recruitment along the Queensland coast following fishing activity or a disturbance at a particular location. It should be noted that large scale disturbances such as coral bleaching and cyclonic activity would be likely to have the same depletion impact on these protected areas as on fished areas. Protected areas do however build ecosystem resilience and reduce the risk of over-fishing. There has been research that has indicated that coral bleaching has more effect in Marine Protected Areas due to there being a higher proportion of susceptible species in those areas, but that recovery is also much quicker[35] compared to non-protected areas.

International Context

Despite being the centre of marine biodiversity, coral reefs in the Indo-Pacific region are in decline[32]. The high demand for corals internationally means that in order for countries to continue trading in them, there is a need to undertake surveys of their distribution and abundance and the amount of trade to ensure they are not being over-exploited.

Some Indo-Pacific countries have implemented surveys and/or export quotas to ensure their harvest of corals for international trade is sustainable. For example, Fiji introduced export quotas in 2005 after two separate export suspensions were imposed by the CITES authorities. Fiji also undertook a review of their export quotas in 2009 to inform a NDF assessment. This NDF assessment involved comparing coral densities obtained through surveys to the number of corals exported in 2007. The NDF showed that Fiji's coral collectors were removing from <1% to 5% of the population of each taxon on an annual basis. Although the study concluded that the export was non-detrimental because the export numbers were low compared to natural

[35] Ateweberhan, M., McClanahan, T.R., Graham, N.A.J., Sheppard, C.R.C., *Episodic heterogeneous decline and recovery of coral cover in the Indian Ocean,* Coral Reefs, 30:739-752, 2011

abundance of the hard coral resource, it was also acknowledged that further studies were needed to confirm this finding.

Indonesia undertook similar surveys to establish a conservative calculation of the percentage of the population that could be removed, considering the life-history of each taxon and the actual size distribution. Results ranged from 1% to 10 % of the population, with higher numbers for the faster growing corals that were very common and were known to recruit well. These numbers were compared to the existing harvest quota to determine whether the quota was sustainable or had the potential to result in overexploitation. It was determined that Indonesia's coral collectors were removing from <1% to 96 % of the population of each taxon on an annual basis and that the export quotas for some taxa needed to be revised. Indonesia has had export quotas since as early as 2000.

A baseline assessment of the species richness of coral reefs in the Solomon Islands was undertaken in 2004 and showed that these reefs are highly diverse[36]. Nevertheless, some of the species most highly traded from Australia are not found in the Solomon Islands (e.g. species in the genera *Catalaphyllia*, *Moseleya,* and *Duncanopsammia*). In 2005, coral exports from the Solomon Islands accounted for approximately 4% of global coral exports[37].

The Fiji export quota includes twelve taxa that have zero quotas and thirty-six genera containing 81 species that are not included in the quota and therefore may not be exported. Three of Australia's most highly exported species (*Catalaphyllia jardinei*, *Cynarina lacrymalis*,and *Blasstomussa wellsi*) have a quota of zero in Fiji and 6 of Australia's most highly exported species (*Scolymia australis*, *Ducanopsammia axifuga*, *Acanthastrea lordhowensis*, *Euphyllia divisia*, *Heliofungia actiniformis*, and *Moseleya latistellata*) may not be exported from Fiji. Of the thirteen most exported species from Australia, 9 are subject to export quotas in Indonesia.

Given the limited sources available to meet the high international demand for these species, Australian fisheries will have to closely monitor harvest and the status of populations to ensure the high demand does not lead to unsustainable harvest levels.

Conclusions

The Vulnerability Assessment, Environmental Risk Assessment, Performance Measurement System, Coral Stress Response Plan and an associated Stewardship action Plan, as well as the large areas closed to harvest in the Great Barrier Reef provide the basis for an adaptive management framework that can be adjusted to provide confidence that harvest of coral species in the QCF is maintained at levels that will not be detrimental to the survival of CITES-listed species. The development of the Vulnerability Assessment, Ecological Risk Assessment and Performance Measurement System represents a positive initiative towards meeting CITES NDF requirements. However given the considerable growth and change that has occurred in the fishery since the Ecological Risk Assessment and Performance Measurement System were

[36] Green, A., P. Lokani, W. Atu, P. Ramohia, P. Thomas and J. Almany (eds) *Solomon Islands Marine Assessment: Technical report of survey conducted May 13 to June 17, 2004*. TNC Pacific Island Countries Report No. 1/06, 2006
[37] Lal, P., Kinch, J., *Financial assessment of the marine trade of corals in Solomon Islands*, May 2005

developed there is a relatively urgent need to review the Ecological Risk Assessment and revise the Performance Measurement System to ensure that ongoing harvest is non-detrimental. Additionally, the design and application of the QCF trigger reference points are not ideally suited to the scale and harvest patterns of the fishery. These would benefit from a number of revisions to ensure sensitive adaptive management processes are initiated to address changes in harvest and NDF data needs for individual species.

The specific aspects of the Vulnerability Assessment, Ecological Risk Assessment and Performance Measurement System that need to be revised to ensure that CITES requirements are met are detailed below. On the understanding that each of these matters are addressed in the review of the Ecological Risk Assessment and Performance Measurement System and within the timeframe specified in the WTO declaration, harvest may be considered non-detrimental to CITES species harvest in the fishery over the course of a three year WTO.

Review of the ecological risk assessment

Five areas have been identified for the review and revision of the QCF Ecological Risk Assessment. These areas should be addressed in consultation with the Australian CITES Scientific Authority for Marine Species (situated in the Marine Division of DSEWPaC) in the time frames specified in the conditions on the WTO.

1. There is an urgent need to update the Vulnerability Assessment and Ecological Risk Assessment (and then subsequently the Performance Measurement System) because of the large scale increase in the number and volumes of species collected.

2. The Vulnerability Assessment should explicitly consider the desirability of individual species and the consequential likelihood that desired species may be heavily targeted. Given the highly selective and targeted nature of this fishery, this is a relevant factor that needs to be articulated.

3. There is a need to clearly explain the methodology for selecting species from the Vulnerability Assessment for further consideration in the subsequent Ecological Risk Assessment. Currently it is not clear why some species with higher vulnerability scores were excluded from further consideration / and Performance Measurement System focus, when species with lower vulnerability scores remained a focus.

4. The Vulnerability Assessment and Ecological Risk Assessment should consider the harvest method with regard to the likely impact on species. For example, only small sections are removed from some species, allowing the colony to continue growing, whilst for other species the entire coral is removed, which may have a greater impact, depending on the reproductive attributes of the species in question. This consideration within the Vulnerability Assessment and Ecological Risk Assessment would allow more appropriate precaution to be applied to the management of harvest of those species subjected to high impact harvesting practices.

5. Currently, there is very little management focus on species for which harvest has historically been low, but has increased subsequent to the Ecological Risk Assessment being conducted. Should the fishery continue to change in terms of the species taken and the volume of harvest, there is a need to ensure that the Ecological Risk

Assessment and resulting Performance Measurement System can be updated within reasonable a timeframe to adequately manage harvest of all species.

This means that there needs to be a review system to examine the harvest/export of species so that any experiencing significant increases in take can be incorporated in the Ecological Risk Assessment and Performance Measurement System (including catch reporting in logbooks and applicability of trigger reference points).

Review of the Performance Measurement System

Five areas for focus within the review of the performance management system to better meet the requirements of a CITES NDF for coral species harvested within the QCF are outlined below. These areas should be addressed in consultation with the Australian CITES Scientific Authority for Marine Species (situated in the Marine Division of DSEWPaC) in the time frames specified in the conditions on the WTO.

6. The triggered management responses need to be revised for the improvement of the data and information that underpins CITES NDFs. Australia's CITES Scientific Authority for Marine Species is taking a risk-based approach to the information requirements for making NDFs. Under this approach, the level of information required to inform a NDF will vary depending on the biological vulnerability of the species, its global and national status, the risks posed to the species (including level of harvest), and the degree of certainty associated with these factors. Should harvest increase or decrease to such a degree that a management response is triggered, it is expected that information will be gathered to improve the certainty associated with the above factors to inform management decisions.

   For example, in a situation with staged management responses for progressive triggers:

   - on reaching the first trigger, in addition to the assessment of the probable reason for the increase or decrease in harvesting, fishery managers may gather information to fill some of the information fields above to assess the likely impact of harvest on the population (i.e. for the species in question, managers may look into and document: the harvesting techniques employed by operators, giving consideration to the species biology including reproductive mechanisms (sexual/asexual) to examine the likely impact; the loss/ recovery rate for the reproductive unit (how fast the number of removed "polyps" are thought to take to replace); and what is known about the spatial distribution of the harvest compared to what is known about the species' local distribution?). Should an assessment of this information be concerning or uncertain, managers may restrict harvest at that point and move to the second trigger, however if on assessment it is thought continued harvest is likely to be non-detrimental, it may continue.

   - Should a second trigger be reached, managers should require a survey of areas of concentrated harvest to assess the species' population status, with continued harvest only possible if the survey returns favourable results as to the status/biomass of the species. A long-term aim of such survey work would be to develop an understanding of the relative biomass for species in any given area to compare to the percentage harvested. This can then be repeated to detect significant changes in individual species biomass, or species composition or relative cover at collection sites.

In any survey work undertaken, it is also recommended that other species that are taken in substantial quantities in the fishery, as well as those identified in the Ecological Risk Assessment, should be surveyed at the same time, even if those species were not responsible for triggering the survey. In most cases, additional local information on population status is the single most useful factor in building confidence in future NDFs, and if surveys are already being undertaken, this may be achieved for species of importance to the fishery with minimal additional cost.

7. The harvest triggers should be applied to both pieces collected and by weight, to account for the variable collecting practices used for different species, and to prevent the incentive for fishers to collect fewer, but larger pieces which may misrepresent actual harvest volumes. In this way, if either the harvest weight or the number of pieces collected for a particular species alters significantly, this will be detected and can be investigated. Using only one of these measures leaves the possibility that changes may be masked resulting in concerning trends in harvest remaining unmanaged.

8. Currently, a trigger is in place for when total harvest of a particular species or species group identified in the fishery Ecological Risk Assessment increases or decreases by 30% compared to the previous two-year average. In order to better account for the possibility of concentrated harvest resulting in localised depletion, in addition to this ‘whole of fishery trigger’, it is also necessary to apply a similar trigger for each of the three management regions identified in the fishery’s performance management system. For example, a management response should be triggered if the harvest of a species or species group within any individual region increases by 30% in one year compared to the previous two-year average.

9. A trigger currently exists so that should 80% of the total harvest of a species identified in the Ecological Risk Assessment as at “more than negligible risk” occur within a single 6x6nm block, a review into the harvest should take place. While this arrangement may have been appropriate when this fishery was small and exploratory, considering the current scale of harvest for many species, it is no longer likely to trigger and is not suited to effectively manage localised concentration of effort and potential overharvest.

   A more appropriate trigger would be if X% of the total harvest of any individual species or species group were to occur within a single 6x6nm block, a review into the harvest should take place. The percentage figure (X) to trigger a management response could be set using a sliding scale, depending on the level of harvest. This would avoid unnecessary triggering should only a few pieces of a species be collected, but all from a single block. It would also account for species that are collected in large numbers, and for which it may be concerning if a relatively small percentage of the harvest were to occur within a single 6X6nm block.

   For example: it is probably not necessary to set any trigger for species with low annual harvest (e.g. below 100 pieces annually); for species with moderate harvest (e.g. 101 – 500 pieces annually), a trigger of 100% of harvest occurring within a single 6X6nm block may be appropriate; for species collected in quantities of 501 – 2000 pieces, a trigger of 80% may be appropriate, and for species collected in quantities between 2001 – 5000, a trigger of 60% may be appropriate. For those species collected in quantities of > 5000 pieces annually, a trigger of 40% may apply. (N.B. these figures are provided as an example for illustration purposes only).

10. Provisions need to be introduced to ensure that in situations where harvest of a species or species group is consistently increasing (or decreasing) over time, but not reaching the trigger for any one particular year, that an assessment is undertaken to gather information on the status of the species to ensure harvest is sustainable.

    This is required to account for a large subsection of species where harvest is steadily, but continually increasing over the long-term, but that do not become a focus of management due to the gradual nature of the increase.

11. When a trigger is reached, the management response needs to consider the requirements for making NDFs and ensuring the fishery is sustainable. For example, rather than just requiring a ‘management review’ when a trigger is reached, specific requirements should be included within the review to ensure the harvest has been closely examined.

Species Specific Concerns

For most species raised as “of potential concern” in this NDF due either to their rapid increase in level of harvest or substantial trade volume, most are unlikely to be experiencing detrimental impacts thus far due to the relatively well dispersed and consistent harvest patterns, and it is expected that the revision of the Vulnerability Assessment, Ecological Risk Assessment, and Performance Measurement System should address longer-term NDF requirements if they adequately consider the conclusions of this NDF.

However, one species is still of particular potential concern – *Catalaphyllia jardinei*. While it has been noted that industry listed this species as being locally abundant during the 2008 Ecological Risk Assessment process, it was also noted that there was evidence of localised depletion back in 2006 and 2007. The harvest and export numbers of this species since that assessment have increased dramatically, especially in the 2010 -11 time period. It is therefore considered likely that the areas in the Cairns region of highly concentrated effort (as evidenced by the maroon and red squares on the spatial distribution map Figure 11, Annex E) may be displaying more signs of depletion similar to that reported during the 2006-07 time period.

It is recommended that the abundance of this species be investigated as soon as possible and that specific management arrangements for the sustainable harvest of this species be implemented if concerning depletion is identified.

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Annexes A to G - Analyses Conducted in Undertaking QCF NDF Assessment

Annex A – Table 3 - Species Considered in the NDF Assessment for the Queensland Coral Fishery

Acanthastrea amakusensis	Acropora lutkeni	Astreopora gracilis	Echinopora lamellosa
Acanthastrea bowerbanki	Acropora microclados	Astreopora incrustans	Echinopora mammiformis
Acanthastrea brevis	Acropora microphthalma	Astreopora listeri	Echinopora pacificus
Acanthastrea echinata	Acropora millepora	Astreopora macrostoma	Eguchipsammia fistula
Acanthastrea hillae	Acropora monticulosa	Astreopora moretonensis	Euphyllia ancora
Acanthastrea lordhowensis	Acropora multiacuta	Astreopora myriophthalma	Euphyllia cristata
Acanthastrea regularis	Acropora nana	Astreopora ocellata	Euphyllia divisa
Acrhelia horrescens	Acropora nasuta	Astreopora scabra	Euphyllia fimbriata
Acropora abrolhosensis	Acropora nobilis	Australogyra zelli	Euphyllia glabrescens
Acropora abrotanoides	Acropora palifera	Balanophyllia bairdiana	Euphyllia paraancora
Acropora aculeus	Acropora palmerae	Balanophyllia dentata	Favia danae
Acropora acuminata	Acropora paniculata	Balanophyllia desmophyllioides	Favia danai
Acropora anthocercis	Acropora polystoma	Balanophyllia elliptica	Favia favus
Acropora aspera	Acropora prostrata	Balanophyllia stimpsonii	Favia helianthoides
Acropora austera	Acropora pulchra	Balanophyllia yongei	Favia laxa
Acropora azurea	Acropora robusta	Barabattoia amicorum	Favia lizardensis
Acropora brueggemanni	Acropora rosaria	Blastomussa merleti	Favia maritima
Acropora bushyensis	Acropora samoensis	Blastomussa wellsi	Favia matthaii
Acropora cardenae	Acropora sarmentosa	Catalaphyllia jardinei	Favia maxima
Acropora carduus	Acropora secale	Caulastraea curvata	Favia pallida
Acropora caroliniana	Acropora selago	Caulastraea echinulata	Favia rotumana
Acropora cerealis	Acropora solitaryensis	Caulastraea furcata	Favia rotundata
Acropora chesterfieldensis	Acropora spathulata	Caulastraea tumida	Favia speciosa
Acropora clathrata	Acropora speciosa	Coeloseris mayeri	Favia stelligera
Acropora crateriformis	Acropora squarrosa	Coscinaraea columna	Favia truncatus
Acropora cuneata	Acropora striata	Coscinaraea crassa	Favia veroni
Acropora cytherea	Acropora subglabra	Coscinaraea exesa	Favia vietnamensis
Acropora danai	Acropora subulata	Coscinaraea wellsi	Favites abdita
Acropora dendrum	Acropora tenuis	Ctenactis albitentaculata	Favites chinensis
Acropora digitifera	Acropora torihalimeda	Ctenactis crassa	Favites complanata
Acropora divaricata	Acropora torresiana	Ctenactis echinata	Favites flexuosa
Acropora donei	Acropora tortuosa	Cynarina lacrymalis	Favites halicora
Acropora echinata	Acropora valenciennesi	Cyphastrea agassizi	Favites pentagona
Acropora elizabethensis	Acropora valida	Cyphastrea chalcidicum	Favites russelli
Acropora elseyi	Acropora vaughani	Cyphastrea decadia	Fungia concinna
Acropora florida	Acropora verweyi	Cyphastrea japonica	Fungia costulata
Acropora formosa	Acropora wallaceae	Cyphastrea microphthalma	Fungia curvata
Acropora gemmifera	Acropora willisae	Cyphastrea ocellina	Fungia cyclolites

Acropora glauca	Acropora yongei	Cyphastrea serailia	Fungia danae
Acropora globiceps	Alveopora allingi	Dendrophyllia alcocki	Fungia distorta
Acropora grandis	Alveopora catalai	Dendrophyllia incisa	Fungia fragilis
Acropora granulosa	Alveopora fenestrata	Dendrophyllia velata	Fungia fralinae
Acropora horrida	Alveopora gigas	Diploastrea heliopora	Fungia fungites
Acropora humilis	Alveopora marionensis	Duncanopsammia axifuga	Fungia granulosa
Acropora hyacinthus	Alveopora spongiosa	Echinophyllia aspera	Fungia gravis
Acropora insignis	Alveopora tizardi	Echinophyllia echinata	Fungia horrida
Acropora intermedia	Alveopora verrilliana	Echinophyllia echinoporoides	Fungia klunzingeri
Acropora kirstyae	Anacropora forbesi	Echinophyllia nishihirai	Fungia moluccensis
Acropora latistella	Anacropora matthai	Echinophyllia orpheensis	Fungia patelliformis
Acropora listeri	Anacropora puertogalerae	Echinophyllia tosaensis	Fungia paumotensis
Acropora longicyathus	Anacropora reticulata	Echinopora gemmacea	Fungia repanda
Acropora loripes	Astreopora cucullata	Echinopora hirsutissima	Fungia scabra
Acropora lovelli	Astreopora explanata	Echinopora horrida	Fungia scruposa
Fungia scutaria	Leptoseris papyracea	Montipora venosa	Porites lichen
Fungia sinensis	Leptoseris scabra	Montipora verrucosa	Porites lobata
Fungia somervillei	Leptoseris solida	Montipora verruculosus	Porites lutea
Fungia tenuis	Leptoseris yabei	Moseleya latistellata	Porites mayeri
Galaxea acrhelia	Lithophyllon mokai	Mycedium elephantotus	Porites monticulosa
Galaxea astreata	Lobophyllia corymbosa	Mycedium robokaki	Porites murrayensis
Galaxea fascicularis	Lobophyllia diminuta	Oulastrea crispata	Porites myrmidonensis
Galaxea longisepta	Lobophyllia hataii	Oulophyllia bennettae	Porites nigrescens
Goniastrea aspera	Lobophyllia hemprichii	Oulophyllia crispa	Porites rus
Goniastrea australensis	Lobophyllia pachysepta	Oxypora glabra	Porites solida
Goniastrea edwardsi	Lobophyllia robusta	Oxypora lacera	Porites stephensoni
Goniastrea favulus	Madracis kirbyi	Pachyseris rugosa	Porites vaughani
Goniastrea minuta	Merulina ampliata	Pachyseris speciosa	Psammocora contigua
Goniastrea palauensis	Merulina scabricula	Pavona bipartita	Psammocora digitata
Goniastrea pectinata	Micromussa diminuta	Pavona cactus	Psammocora explanulata
Goniastrea retiformis	Montastrea annuligera	Pavona clavus	Psammocora haimiana
Goniopora columna	Montastrea curta	Pavona danai	Psammocora nierstraszi
Goniopora djiboutiensis	Montastrea magnistellata	Pavona decussata	Psammocora profundacella
Goniopora eclipsensis	Montastrea valenciennesi	Pavona duerdeni	Psammocora superficialis
Goniopora fruticosa	Montipora aequituberculata	Pavona explanulata	Psammocora vaughani
Goniopora lobata	Montipora angulata	Pavona maldivensis	Sandalolitha robusta
Goniopora minor	Montipora australiensis	Pavona minuta	Scolymia australis
Goniopora norfolkensis	Montipora caliculata	Pavona varians	Scolymia vitiensis
Goniopora palmensis	Montipora capricornis	Pavona venosa	Seriatopora aculeata
Goniopora pandoraensis	Montipora corbettensis	Pectinia alcicornis	Seriatopora caliendrum
Goniopora pendulus	Montipora crassituberculata	Pectinia lactuca	Seriatopora hystrix
Goniopora somaliensis	Montipora danae	Pectinia paeonia	Stylophora pistillata
Goniopora stokesi	Montipora digitata	Petrophyllia rediviva	Symphyllia agaricia
Goniopora stutchburyi	Montipora efflorescens	Physogyra lichtensteini	Symphyllia radians
Goniopora tenuidens	Montipora effusa	Platygyra contorta	Symphyllia recta
Heliofungia actiniformis	Montipora floweri	Platygyra daedalea	Symphyllia valenciennesii

Heliopora coerulea	Montipora foliosa	Platygyra lamellina	Trachyphyllia geoffroyi
Herpolitha limax	Montipora foveolata	Platygyra pini	Tubastraea coccinea
Heteropsammia cochlea	Montipora gaimardi	Platygyra ryukyuensis	Tubastraea diaphana
Heteropsammia moretonensis	Montipora granulosa	Platygyra sinensis	Tubastraea faulkneri
Hydnophora exesa	Montipora grisea	Platygyra verweyi	Tubastraea micranthus
Hydnophora microconos	Montipora hispida	Plerogyra sinuosa	Turbinaria bifrons
Hydnophora pilosa	Montipora hoffmeisteri	Plesiastrea versipora	Turbinaria conspicua
Hydnophora rigida	Montipora incrassata	Pocillopora damicornis	Turbinaria frondens
Leptastrea aequalis	Montipora informis	Pocillopora eydouxi	Turbinaria heronensis
Leptastrea bewickensis	Montipora millepora	Pocillopora kelleheri	Turbinaria mesenterina
Leptastrea inaequalis	Montipora mollis	Pocillopora ligulata	Turbinaria patula
Leptastrea pruinosa	Montipora monasteriata	Pocillopora meandrina	Turbinaria peltata
Leptastrea purpurea	Montipora nodosa	Pocillopora verrucosa	Turbinaria radicalis
Leptastrea transversa	Montipora peltiformis	Pocillopora woodjonesi	Turbinaria reniformis
Leptoria irregularis	Montipora spongodes	Podabacia crustacea	Turbinaria stellulata
Leptoria phrygia	Montipora spumosa	Polyphyllia talpina	Tubipora musica
Leptoseris explanata	Montipora stellata	Porites annae	Distichopora coccinea
Leptoseris foliosa	Montipora striata	Porites australiensis	Distichopora livida
Leptoseris gardineri	Montipora tuberculosa	Porites cylindrica	Distichopora nitida
Leptoseris hawaiiensis	Montipora turgescens	Porites densa	Distichopora violacea
Leptoseris incrustans	Montipora turtlensis	Porites evermanni	Corallium (Genus)
Leptoseris mycetoseroides	Montipora undata	Porites heronensis	Cirrhipathes (Genus)

Annex B - Assessment of Species of Hard Coral Exported From Queensland to Identify Those of Potential Concern in the QCF (Includes Tables 4-8 and Figures 4 – 6)

As described within the body of the NDF assessment, the CITES Scientific Authority for Marine Species had access to a number of different data sets which were analysed in order to determine whether there were any "species of potential concern" with regard to making a robust NDFs. The data sets that were utilised were:

Data source 1 Aggregated export data for two periods: the first from 2008-2010; and the second from 2010-2012, supplied by Queensland DAFF from previous 'Permits and Administration Database' (PAD) queries run by the department. These data were supplied within Excel spreadsheets, and were broken down to species level, state from which the export occurred, and total numbers exported.

Data source 2 Export data from 2006 to March 2012 broken down to species level, state from which the export occurred, and either the total numbers of pieces of each species/genus or weight of each species/genus exported, broken down by financial year (i.e. FY11/12 is incomplete).

Data source 3 QLD QCF Annual Status Reports with harvest data from FY06/07 until FY10/11. These data contained within the Annual Status Reports are based on the outcomes of the Ecological Risk Assessment and therefore cover only those species included in the component tree (Table 1).

Data source 4 QLD QCF harvest data including spatial distribution to the resolution of 6X6nm blocks, for the years 2006 to 2011. Again, because these data are based on the outcomes of the Ecological Risk Assessment, they therefore cover only those species included in the component tree (Table 1).

A preliminary list of species of potential concern was established through analysis of the aggregated export data (described under 'Data set 1). This was conducted as follows:

a) The International Union for Conservation of Nature (IUCN) Red List categorisation as Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern or Data Deficient was attributed to each species recorded as being exported from Queensland.

b) All species listed in the IUCN Red List as Vulnerable or Near Threatened were separated out and the numbers pieces and estimated weight of exports for the aggregated years were analysed. Note: none of the species are classed as higher than Vulnerable. Species that were ranked as Vulnerable or Near Threatened and also had a large level of take were considered to be "species of potential concern".

c) Other species that had comparably large levels of take but that were classed as Least Concern or Data deficient were also added to the preliminary list of species of potential concern for further investigation.

This list was then compared to previous coral assessments conducted, including the 2008 QLD QCF Vulnerability and Ecological Risk Assessments, the WA MAFMF NDF Assessment, CITES

Significant Trade Reviews[38] and other CITES related reviews of species. Most of the species on this preliminary list were previously identified as “of concern” or similar risk by other domestic or international risk assessments. Table 4 provides the preliminary list of coral species of potential concern with their IUCN status and whether they were identified as ‘of concern’ or equivalent (i.e. requiring similar focus in relevant risk assessment processes). This list was used to develop a finalised list of species for particular focus within this assessment

Table 4 - Preliminary list of coral species of potential concern, with their IUCN status and whether or not they were identified as ‘of concern’ or similar in other relevant risk assessment processes.

#	Species	IUCN Status	WA	QLD ERA	QLD VAR [39]	CITES
1	*Acanthastrea lordhowensis*	Near Threatened - uncommon		✓	✓	
2	*Blastomussa merletti*	Least Concern - moderately common		✓	✓	
3	*Blastomussa wellsi*	Near Threatened - relatively uncommon.		✓	✓	
4	*Catalaphyllia jardinei*	Vulnerable – rare, but conspicuous and easy to identify.	✓	✓	✓	✓
5	*Cynarina lacrymalis*[40]	Near Threatened - widespread and uncommon, can be locally common, and is conspicuous				
6	*Duncanopsammia axifuga*	Near Threatened – rare, but conspicuous	✓	✓	✓	✓
7	*Euphyllia spp*			✓	✓	
8	*Euphyllia ancora*	Vulnerable – This species is common, and where it occurs can form carpets	✓			
9	*Euphyllia cristata*	Vulnerable - widespread and moderately common				✓
10	*Euphyllia divisa*	Near Threatened - moderately common and widespread within the central Pacific				
11	*Euphyllia glabrescens*	Near Threatened – generally found to be common throughout most of its range	✓	✓	X	
12	*Heliofungia actiniformis*	Vulnerable – widespread and locally common. Heavily harvested for aquarium trade (in top 10 species traded)				
13	*Moseleya latistellata*	Vulnerable – uncommon	✓	X	✓	✓
14	*Plerogyra sinuosa*	Near Threatened – common and very widely distributed				✓
15	*Plerogyra spp*			✓	✓	
16	*Scolymia australis*	Least Concern - relatively common in		✓	✓	

[38] CITES Reviews of Significant Trade are initiated when the Secretariat is concerned about the level of International Trade for particular species. For a species to be included in a Review of Significant Trade, they are usually heavily traded, and considered vulnerable.
[39] Vulnerability Risk Rating greater than 2.5, assumed to be greater than moderate risk
[40] Synonym *Acanthophyllia deshayesiana* was also reported. The numbers for these two reported species were combined because they are the same species.

		subtropical localities, uncommon elsewhere				
17	*Scolymia vitiensis*	Near Threatened - usually uncommon, and it is rare in the south-west Indian Ocean		✓	✓	
18	*Trachyphyllia geoffroyi*	Near Threatened – widespread and uncommon	✓	✓	✓	✓

Once the time series export data described in 'Data set 2' was received, individual species or genus export trends per financial year from 2006 to March 2012 were analysed to confirm the above list, and determine whether there were any other concerning temporal trends in exports of particular species or genus (noting that for some species harvest and or export is only recorded at the genus level). The number of species or genus reported as exported in each financial year are shown in Table 5.

Table 5 - Number of Species Exported

Financial Year	Number of Species/Genus Exported
06/07	96
07/08	95
08/09	173
09/10	218
10/11	168
11/12	148

Temporal patterns of species targeted and levels of export (which infers harvest) have changed dramatically over the past six years since the collection of the data that informed the Ecological Risk Assessment and Performance Measurement System. With this in mind, the export records were analysed to determine any species that were being exported at greatly increased levels subsequent to 2006-07. There were a large number of species for which the export from Queensland had increased by over several hundred percent since 2006, generally most rapidly increasing over the 2010-11 period. This analysis revealed an additional 12 species (shown in **bold** in Table 6) that were rarely targeted previously, however showed spikes in export of over 1000 specimens in particular years. Generally, following these spikes, export levels have again decreased significantly in the year following however to levels still significantly greater than during the years that informed the Ecological Risk Assessment and Performance Measurement System (2006-07).

Table 6 – Export data from the State of Queensland - (numbers of pieces) for species of potential concern

Export Data	06/07	07/08	08/09	09/10	10/11	11/12
Acanthastrea lordhowensis	165	1700	6421	10235	9464	7547
Australomussa rowleyensis	**0**	**0**	**0**	**35**	**1170**	**400**
Blastomussa merletti	21	116	135	313	3419	1368

Export Data	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**
Blastomussa wellsi	234	1266	2408	4146	7985	3654
Catalaphyllia jardinei	1544	1156	1267	10596	27531	12165
Caulastrea furcata	**13**	**35**	**18**	**259**	**1486**	**131**
Cynarina lacrymalis	61	991	912	2460	9283	3096
Duncanopsammia axifuga	590	2172	3259	6071	11041	7833
Euphyllia ancora	38	858	1646	3137	7690	3337
Euphyllia cristata	175	58	30	50	288	290
Euphyllia divisa	188	467	957	2275	6789	2792
Euphyllia glabrescens	102	328	1067	2004	6393	2438
Galaxea fascicularis	**24**	**0**	**1**	**4**	**1257**	**405**
Goniopora stokesi	**0**	**0**	**0**	**38**	**1487**	**412**
Heliofungia actiniformis	10	17	324	1000	4103	2063
Heteropsammia cochlea	**0**	**0**	**0**	**1107**	**898**	**70**
Merulina ampliata	**10**	**0**	**21**	**7**	**1182**	**404**
Micromussa amakusensis	**55**	**524**	**169**	**4**	**1057**	**0**
Moseleya latistellata	23	138	635	794	1922	520
Physogyra lichtensteini	**0**	**1**	**9**	**4**	**1817**	**411**
Plerogyra sinuosa	168	966	1136	2704	7809	3143
Scolymia australis	318	1846	4276	9094	12144	7052
Scolymia vitiensis	22	851	346	228	509	324
Seriatopora hystrix	**253**	**290**	**144**	**116**	**1658**	**384**
Trachyphyllia geoffroyi	912	2423	1496	5390	10219	6335
Tubipora musica	**21**	**1**	**16**	**206**	**1337**	**406**
Turbinaria reniformis	**15**	**0**	**20**	**76**	**1337**	**407**

These data are shown graphically in Figure 4, and demonstrate the large increase in export numbers for a variety of species that are considered as "of potential concern". For ease of viewing, some species from the above table have been omitted.

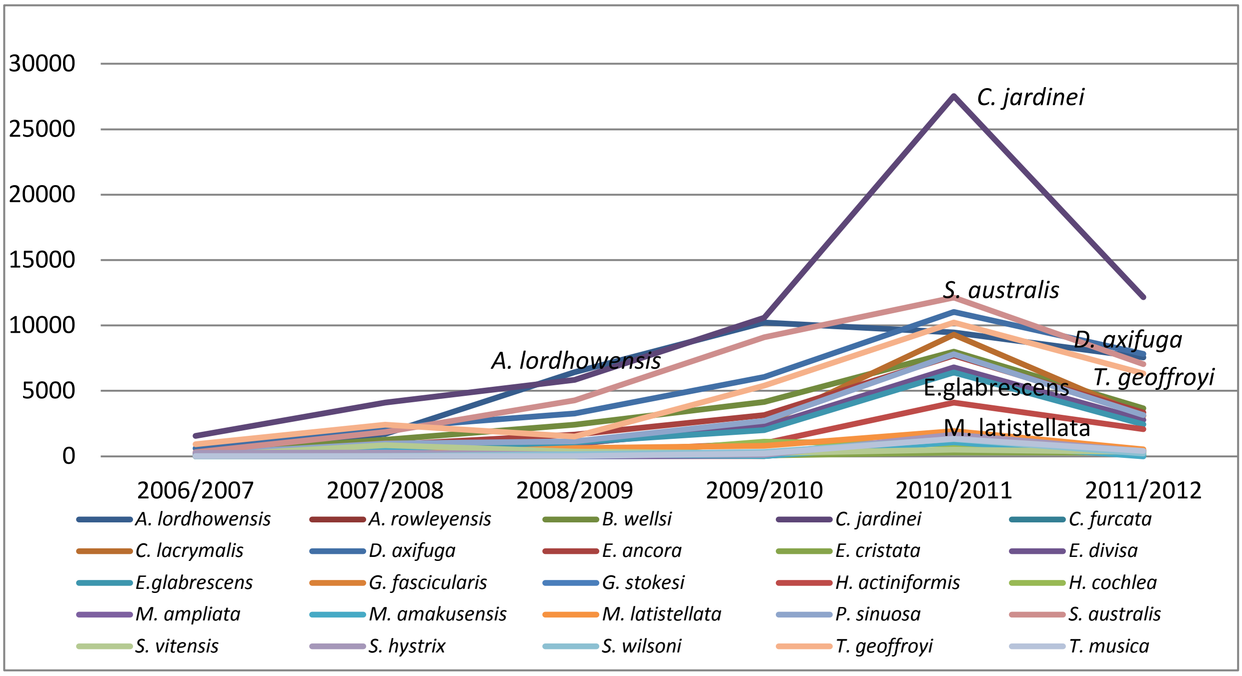


Figure 4 - Exports of species of potential concern from QCF

As can be seen in Figure 4, the top 10 most heavily exported corals (reported to individual species level) from the QCF over the past six years are:

1. *Catalaphyllia jardinei*
2. *Acanthastrea lordhowensis*
3. *Scolymia australis*
4. *Ducanopsammia axifuga*
5. *Trachyphyllia geoffroyi*
6. *Blasstomussa wellsi*
7. *Cynarina lacrymalis*
8. *Euphyllia ancora*
9. *Plerogyra sinuosa*
10. *Euphyllia divisia*

As the scale of export of *Catalaphyllia jardinei* is large compared to other species, it can be difficult to view all species in Figure 4, so *C. jardinei* has been omitted in Figure 5 to better depict the increasing trend of the other highly targeted species that are reported at species level.

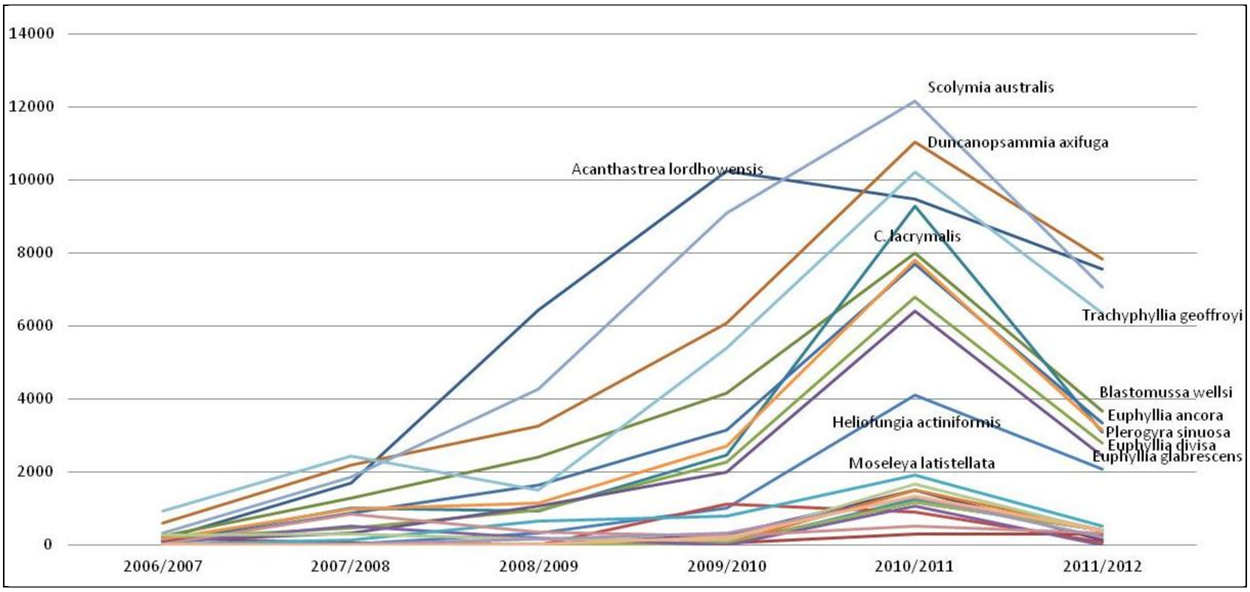


Figure 5 - Increases in exports of the top 10 most heavily traded corals reported to species-level from the QCF over the past 6 years, omitting *C. Jardinei*

Of those species that are reported to species level, after the top 10 species, *Euphyllia glabrescens, Heliofungia actiniformis, Blastomussa merletti* and *Moseleya latistellata* are the next most traded species. However, there are also a large number of exports that are not reported to species level and are instead reported to genus level. To account for this, the next step in the NDF assessment process was to determine what corals reported to genus level could be highly targeted. Figure 6 shows how genus level exports compare to those exports of the top five most heavily traded species from the QCF.

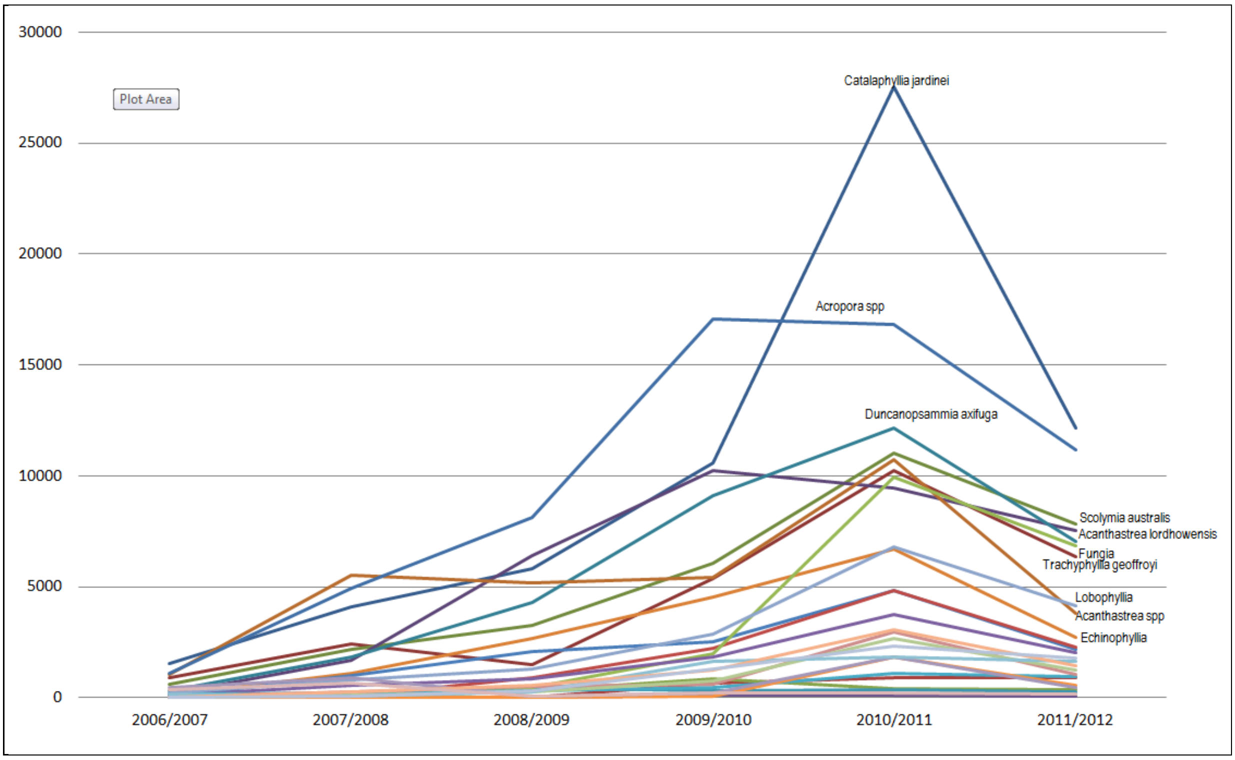


Figure 6 – The top 5 most commonly exported coral species from the QCF reported to species-level, compared to the most common coral exports reported to genus level.

Figure 6 indicates that, after *C. jardinei, Acropora* species are the most heavily traded corals.

Combining the species of potential concern in Table 6 with the export data for the most exported corals reported to genus level shows the large number of species of coral that are being exported in much higher volumes than during the 2006-07 period, at the time when the current Ecological Risk Assessment and Performance Management System were developed. Table 7 shows those species and genus of coral that have shown significantly increasing levels of harvest over the past six years. Based on total export figures from 2006 until March 2012, the species are listed from highest exports to lowest exports.

Table 7 - Export data for species of potential concern combined with the 20 most common exports reported to genus level

	Export Data	06/07	07/08	08/09	09/10	10/11	11/12	Total	VAR	IUCN
1	*Acropora spp*	1080	4912	8129	17046	16824	11168	59159	2.8	
2	*Catalaphyllia jardinei*	1544	1156	1267	10596	27531	12165	54259	2.6	Vul
3	*Acanthastrea lordhowensis*	165	1700	6421	10235	9464	7547	35532	2.6	NT
4	*Scolymia australis*	318	1846	4276	9094	12144	7052	34730	2.8	LC
5	*Acanthastrea spp*	1035	5528	5155	5416	10736	3811	31681	2.6	
6	*Duncanopsammia axifuga*	590	2172	3259	6071	11041	7833	30966	2.7	NT

	Export Data	06/07	07/08	08/09	09/10	10/11	11/12	Total	VAR	IUCN
7	*Trachyphyllia geoffroyi*	912	2423	1496	5390	10219	6335	26775	2.5	NT
8	*Blastomussa wellsi*	234	1266	2408	4146	7985	3654	19693	2.6	NT
9	*Fungia*	10	68	441	1998	9962	6859	19338	2.2	
10	*Echinophyllia*	88	1086	2647	4539	6688	2723	17771	2.2	
11	*Cynarina lacrymalis*	61	991	912	2460	9283	3096	16803	2.2	NT
12	*Euphyllia ancora*	38	858	1646	3137	7690	3337	16706	2.4	Vul
13	*Lobophyllia*	221	800	1303	2856	6784	4157	16121		
14	*Plerogyra sinuosa*	168	966	1136	2704	7809	3143	15926	2.9	NT
15	*Euphyllia divisa*	188	467	957	2275	6789	2792	13468	2.4	NT
16	*Favia*	82	1010	2100	2522	4826	2183	12723	2.2	
17	*Euphyllia glabrescens*	102	328	1067	2004	6393	2438	12332	2.2	NT
18	*Favites*	0	62	918	2220	4844	2266	10310	2.4	
19	*Goniastrea*	88	544	854	1820	3757	2049	9112	2.4	
20	*Heliofungia actiniformis*	10	17	324	1000	4103	2063	7517	2.2	Vul
21	*Symphyllia*	37	265	573	1223	3083	1422	6603	2.9	
22	*Tubastrea*	9	80	285	1314	2313	1780	5781	2	
23	*Scolymia spp*	150	43	248	1653	1843	1615	5552	2.8	
24	*Montipora*	46	248	502	626	2955	1050	5427	3.2	
25	*Blastomussa merletti*	21	116	135	313	3419	1368	5372	2.6	LC
26	*Platygyra*	21	90	265	769	2673	1242	5060	2.7	
27	*Moseleya latistellata*	23	138	635	794	1922	520	4032	2.7	Vul
28	*Pocillopora*	480	888	52	210	1823	434	3887	2.7	
29	*Goniopora*	184	233	331	478	1093	965	3284	2	
30	*Seriatopora hystrix*	253	290	144	116	1658	384	2845	2.8	LC

	Export Data	06/07	07/08	08/09	09/10	10/11	11/12	Total	VAR	IUCN
31	*Alvepora spp*	0	0	23	672	883	907	2485	2.2	
32	*Leptastrea*	0	0	28	69	1808	568	2473	2.6	
33	*Scolymia vitiensis*	22	851	346	228	509	324	2280	2.8	NT
34	*Physogyra lichtensteini*	0	1	9	4	1817	411	2242	2.2	Vul
35	*Heteropsammia cochlea*	0	0	0	1107	898	70	2075	2.4	LC
36	*Tubipora musica*	21	1	16	206	1337	406	1987		NT
37	*Caulastrea furcata*	13	35	18	259	1486	131	1942	2.9	LC
38	*Balanophyllia spp*	0	3	305	854	408	370	1940	2.8	
39	*Goniopora stokesi*	0	0	0	38	1487	412	1937	2	NT
40	*Turbinaria reniformis*	15	0	20	76	1337	407	1855	2.2	Vul
41	*Micromussa amakusensis*	55	524	169	4	1057	0	1809	2.8	NT
42	*Galaxea fascicularis*	24	0	1	4	1257	405	1691	2	NT
43	*Merulina ampliata*	10	0	21	7	1182	404	1624	2.1	LC
44	*Turbinaria spp*	337	633	78	188	211	166	1613	2.2	
45	*Australomussa rowleyensis*	0	0	0	35	1170	400	1605		NT
46	*Dendrophyllia spp*	7	0	449	290	362	249	1357	2.5	
47	*Euphyllia cristata*	175	58	30	50	288	290	891	2.4	Vul
48	*Caulastrea spp*	0	0	18	107	136	39	300	2.9	

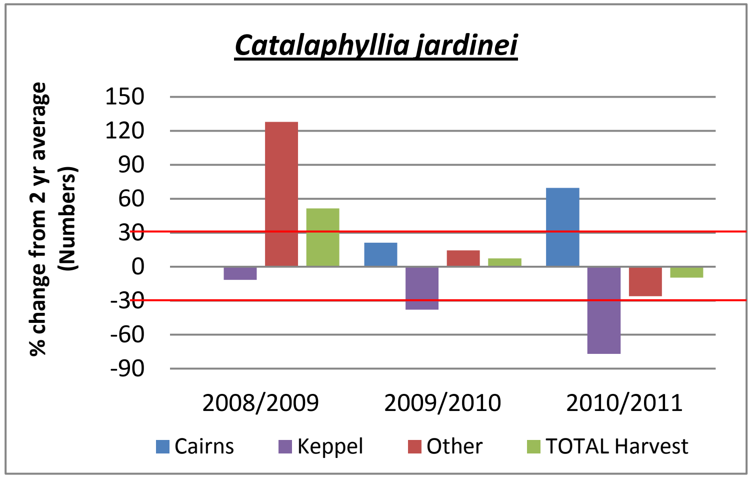
The next step was to analyse the information contained in the Annual Status Reports. The species reported within the Annual Status Reports reflect those species considered at “moderate risk or greater” in the Ecological Risk Assessment. Those species are reiterated in Table 8, along with their export ranking based on total values of export data (from Table 7 above).

Table 8 - ERA species with corresponding VAR and export figure ranking, based on the total for all exports of each species/genus from 2006-07 to 2011/12

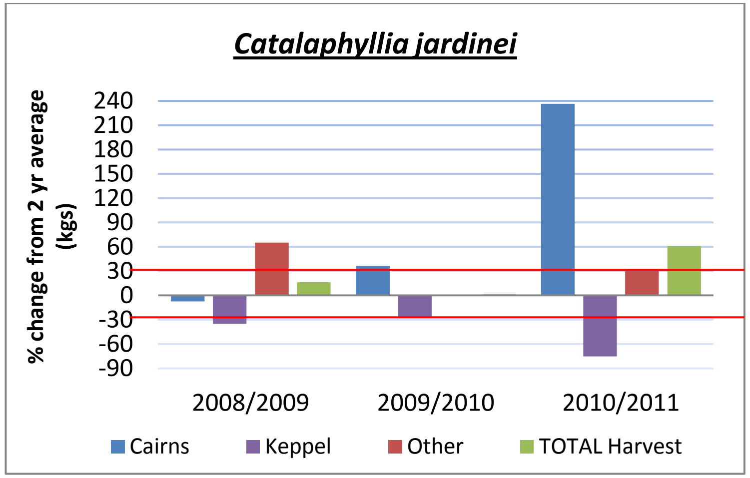
ERA Species	**VAR**	**Ranking**
Acropora spp	2.8	1st
Catalaphyllia jardinei	2.6	2nd
Plerogyra spp	2.9	14th *(P. sinuosa)*
Euphyllia glabrascens	2.2	17th
Caulastrea spp	2.9	49th (*C. furcata – 37th*)
Oulophyllia spp	2.5	Not in top 48
Hydnophora spp	2.7	Not in top 48
Montipora spp	3.2	Not in top 48
Scolymia vitensis	2.8	43rd
Scolymia australis	2.8	4th
Blastomussa wellsi	2.6	8th
Blastomussa merleti	2.6	25th
Acanthastrea lordhowensis	2.6	3rd
Acanthastrea bowerbanksii	2.6	Not in top 48
Mycedium spp	2.2	Not in top 48
Trachyphyllia geoffroyi	2.5	7th
Ducanopsammia axifuga	2.7	6th

A large number of the above species considered to be at more than negligible risk from the QCF do not figure in the most highly exported species (and therefore presumably the most highly harvested) species. Conversely, there are a significant number of highly targeted species, that were also considered to be moderately vulnerable i.e. *Moseleya latistellata*, that do not figure in the above table.

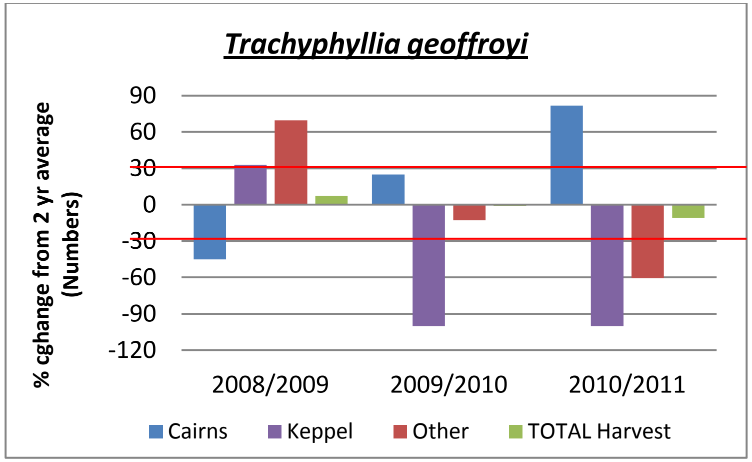
Annex C – Figure 7 (a – m) - Application of 30 % trigger Reference point applied to harvest of species over the whole fishery or regionally on the basis of both pieces and weight.



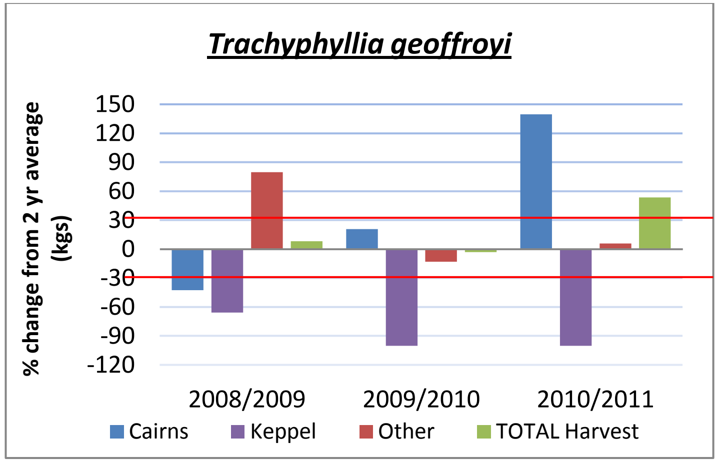
a.



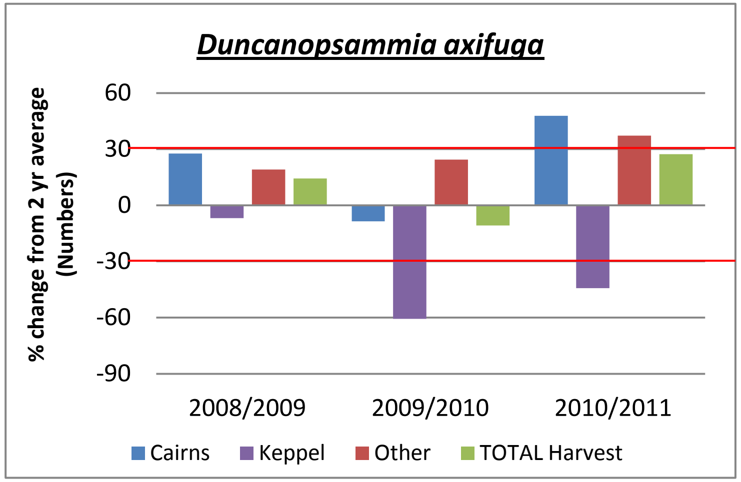
b.

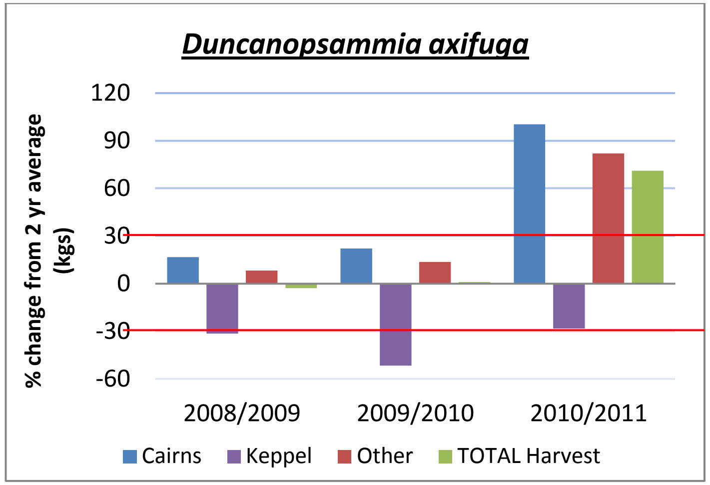


c.



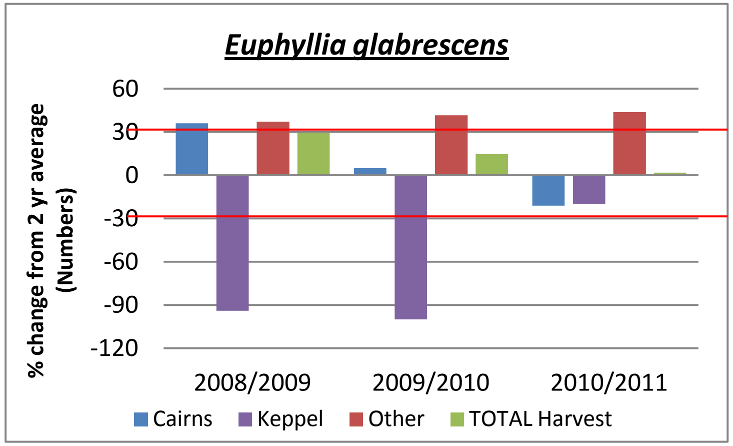
d.

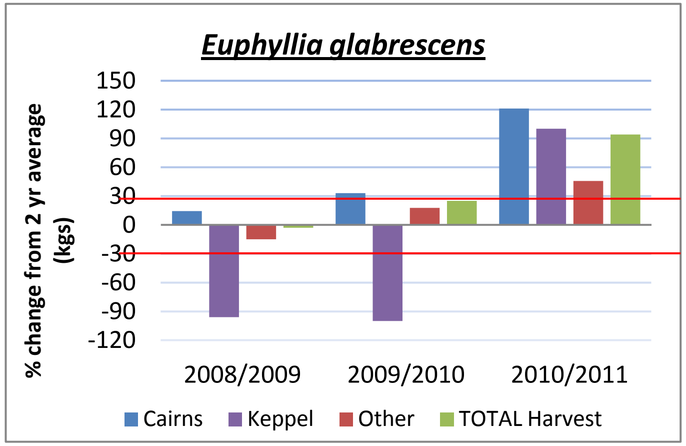

Duncanopsammia axifuga
% change from 2 yr average (Numbers)
60
30
0
-30
-60
-90
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest


Duncanopsammia axifuga
% change from 2 yr average (kgs)
120
90
60
30
0
-30
-60
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest

d.

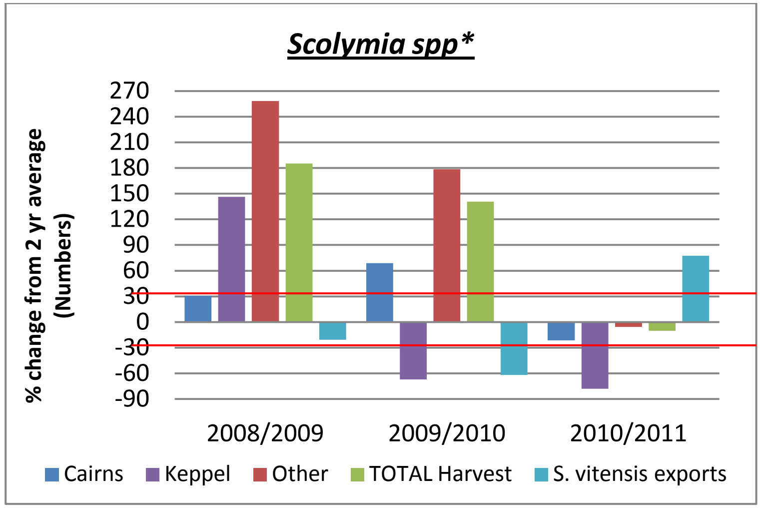
e.


Euphyllia glabrescens
% change from 2 yr average (Numbers)
60
30
0
-30
-60
-90
-120
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest

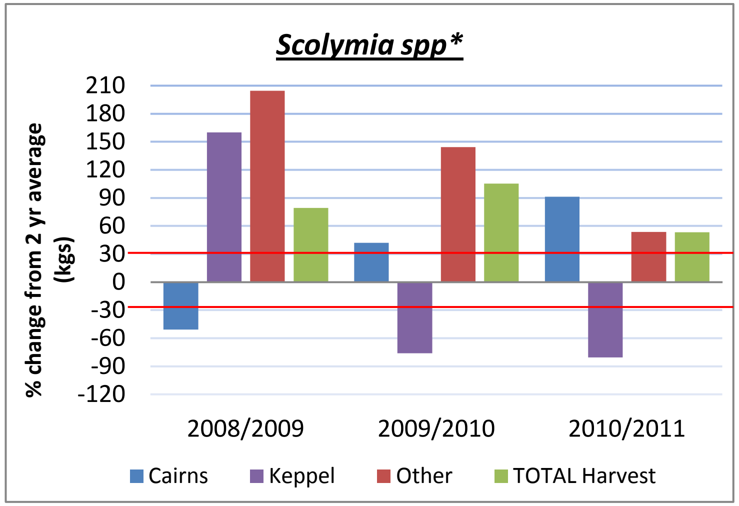

Euphyllia glabrescens
% change from 2 yr average (kgs)
150
120
90
60
30
0
-30
-60
-90
-120
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest

f.

g.



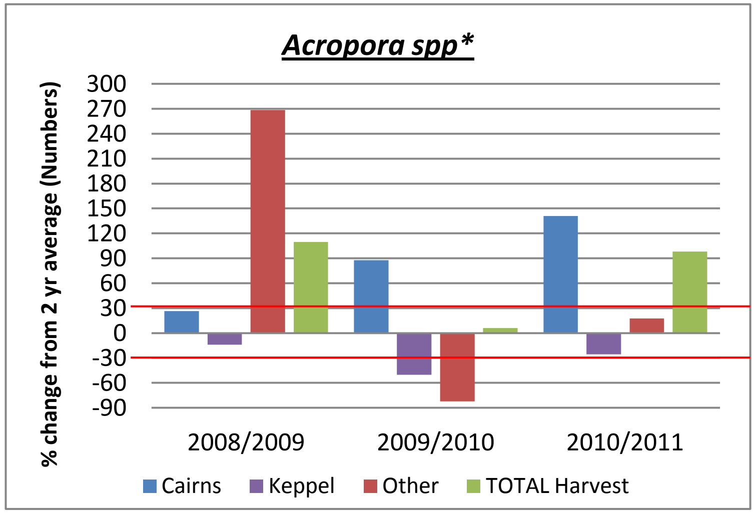
Scolymia spp*
% change from 2 yr average (Numbers)
270
240
210
180
150
120
90
60
30
0
-30
-60
-90
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest
S. vitensis exports



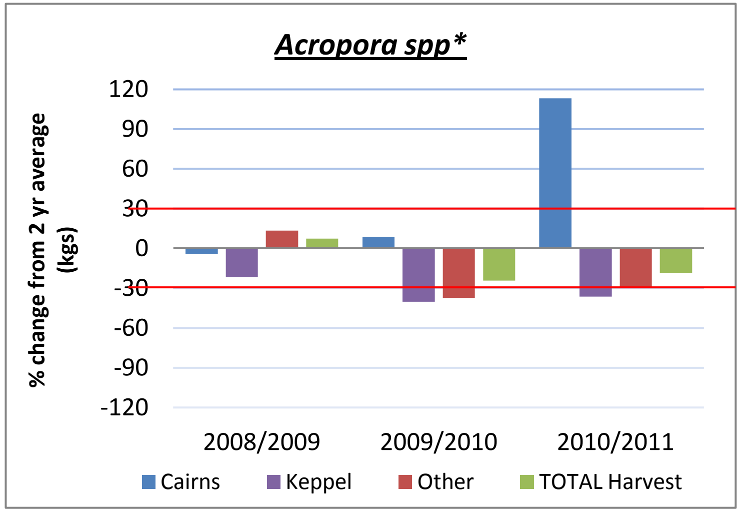
Scolymia spp*
% change from 2 yr average (kgs)
210
180
150
120
90
60
30
0
-30
-60
-90
-120
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest

h.

i.



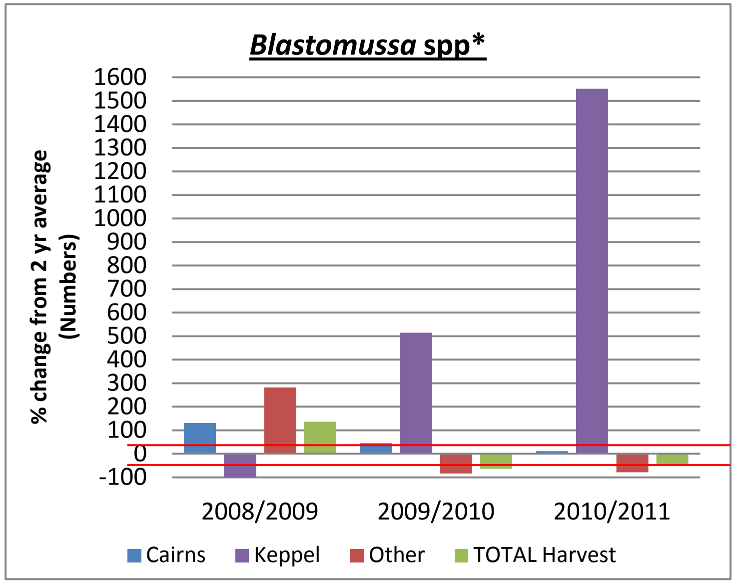
Acropora spp*
% change from 2 yr average (Numbers)
300
270
240
210
180
150
120
90
60
30
0
-30
-60
-90
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest



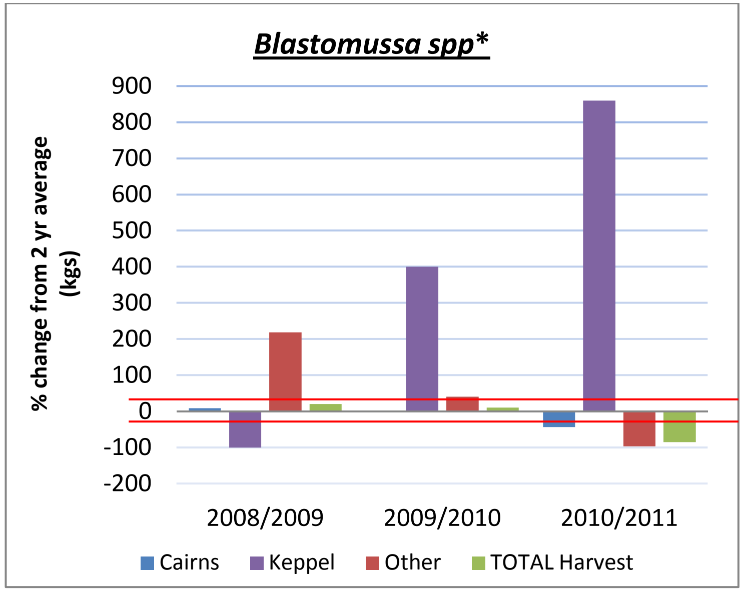
Acropora spp*
% change from 2 yr average (kgs)
120
90
60
30
0
-30
-60
-90
-120
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
TOTAL Harvest

j.

k.



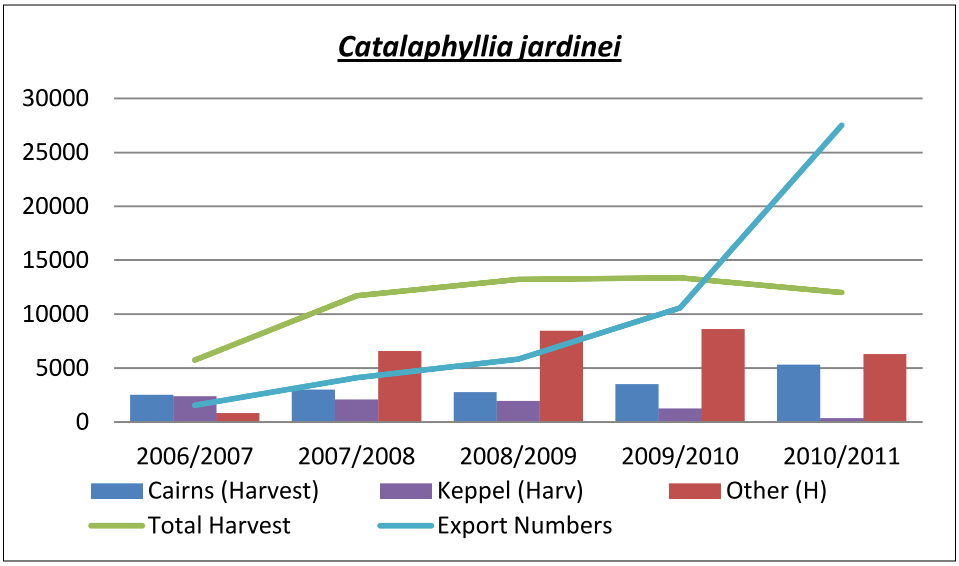
l.



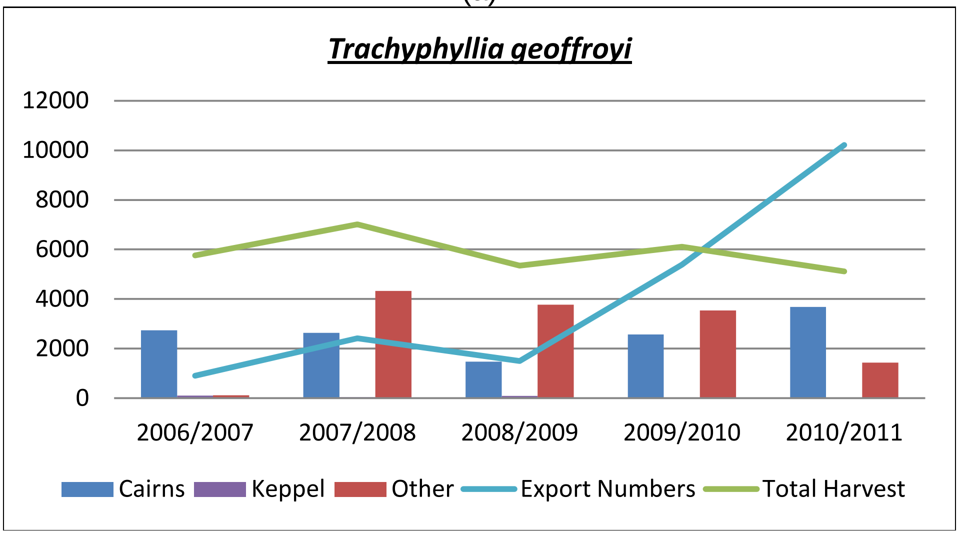
m.

Figure 7 -Diagrams showing the percentage change from the average harvest over the previous two years (2008/09 and 2009/10) for individual coral species, or genus. The diagrams depict the application of the +/-30% trigger limit if it were applied on a regional basis or on the basis of total harvest, and the paired diagrams show the different results realised if the trigger limit is applied on the basis of the number of pieces harvested versus the and kilograms harvested.

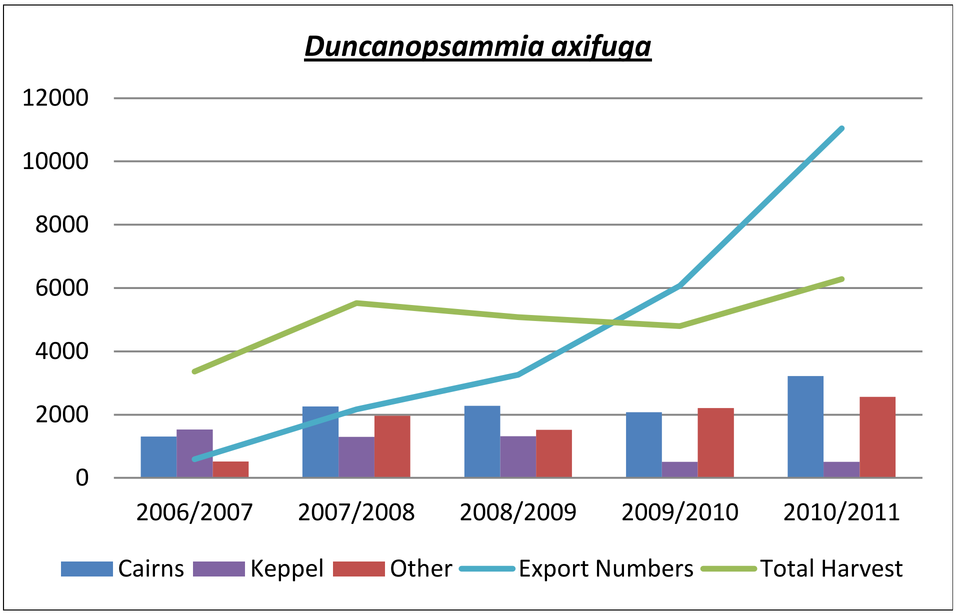
Annex D – Figure 8 (a – h) - Export (pieces) vs Harvest (pieces) Diagrams



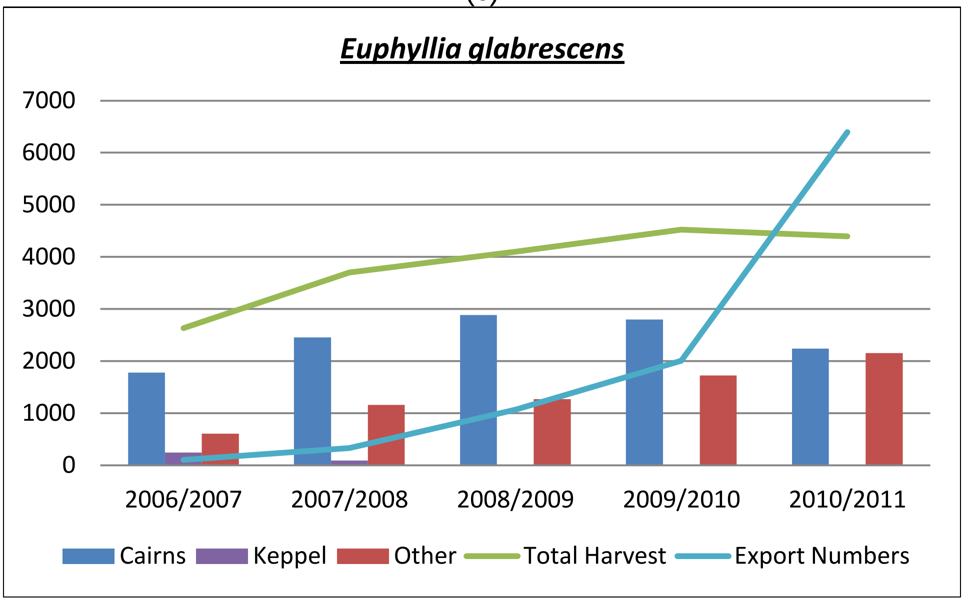
(a)



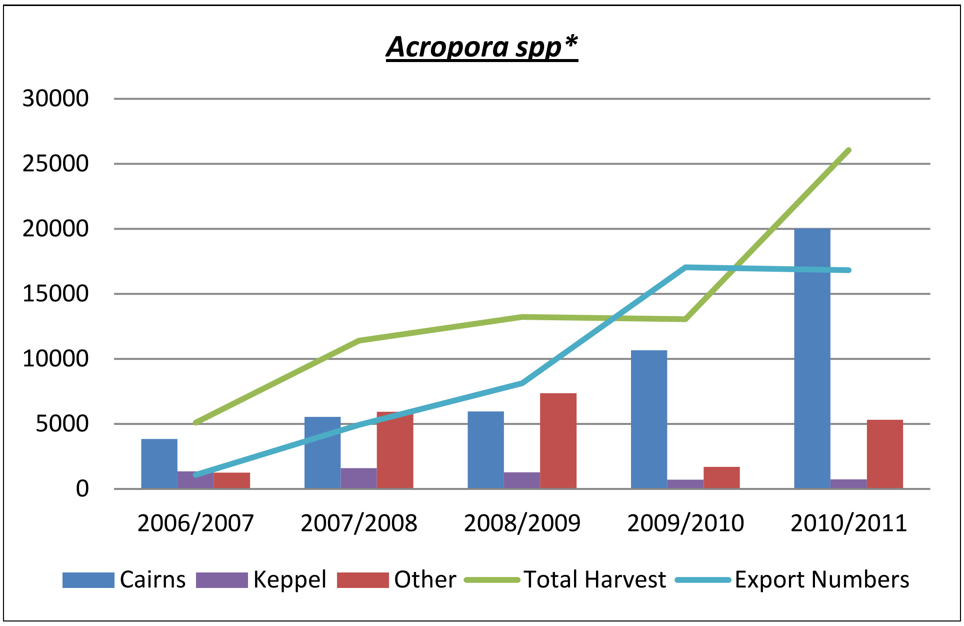
(b)


Duncanopsammia axifuga
12000
10000
8000
6000
4000
2000
0
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
Export Numbers
Total Harvest

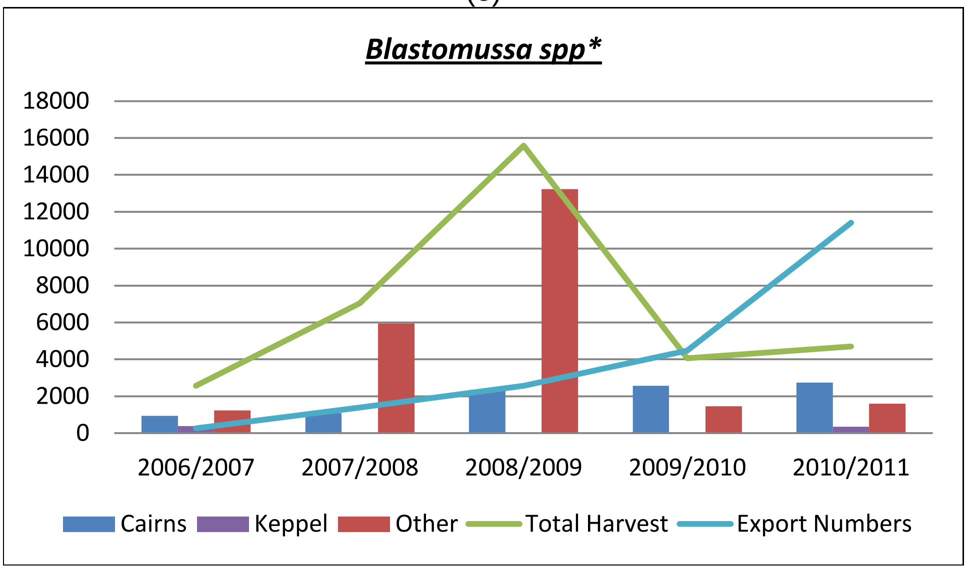
(c)


Euphyllia glabrescens
7000
6000
5000
4000
3000
2000
1000
0
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
Total Harvest
Export Numbers

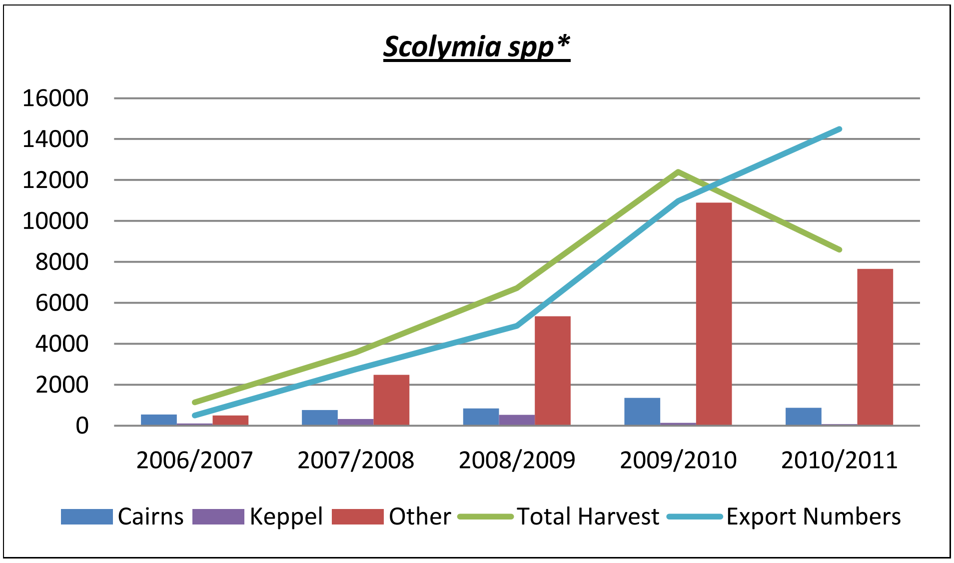
(d)


Acropora spp*
30000
25000
20000
15000
10000
5000
0
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
Total Harvest
Export Numbers

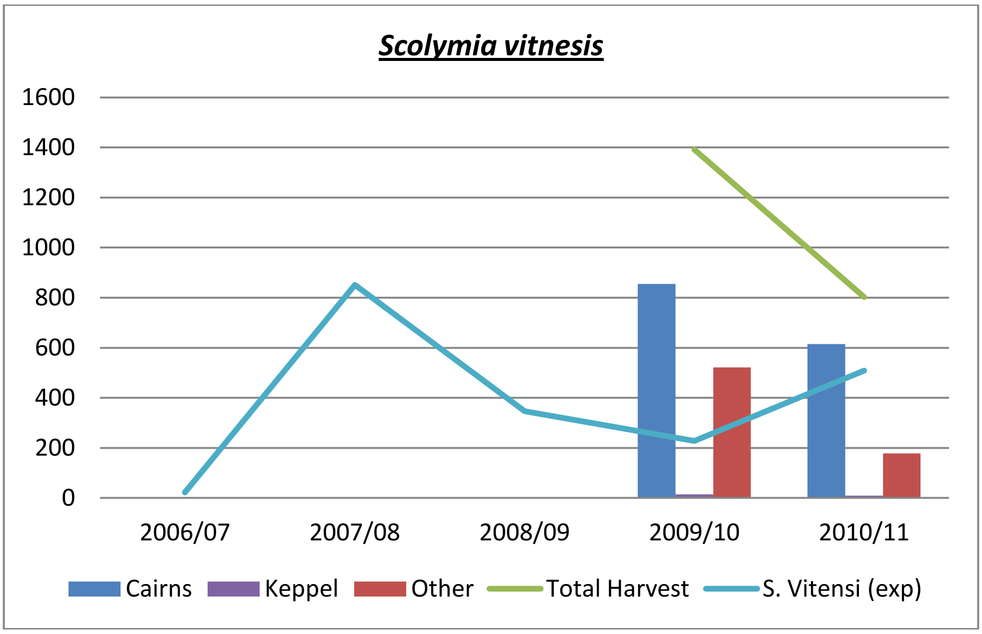
(e)


Blastomussa spp*
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
Total Harvest
Export Numbers

(f)


Scolymia spp*
16000
14000
12000
10000
8000
6000
4000
2000
0
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
Cairns
Keppel
Other
Total Harvest
Export Numbers

(g)



(h) (Harvest data for this species is only available for 2009/10 and 2010/11)

Figure 8 (a – h) – depicts the recorded levels of export being reported from the state of Queensland in pieces vs the level of QCF harvest as reported in pieces. It can be seen in these graphs that there is a pattern of the number of pieces being exported starting to exceed the number of pieces reported as harvested. Note, the final graph, (h), presents only two years harvest data as no more were available

.

Annex F. - Species Specific Biological Traits and Status

Species specific biological traits have been included for the 14 most heavily traded species identified in this assessment as of potential concern. The information on these species was obtained from Veron (2000) and the QCF Ecological Risk Assessment (2008).

***Catalaphyllia jardinei* –** Form flabello-meandroid colonies with large tubular tentacles as polyps. It is a distinctive green colour, with pink tips of the tentacles and striped oval disk. This species usually occurs in protected but turbid waters. According to Veron (2000), this species is “seldom common”, which correlates to the IUCN Red list (Vulnerable).

From 2008 Ecological Risk Assessment - Quite widely distributed through Indo-Pacific. Can be found in high current waters but generally in turbid waters so is not particularly specialised in niche requirements. Found in areas of large tidal movement in WA and Mackay. Collected to 15—20m but extends below 30m. Locally abundant. Large pieces can be segmented so only part of colony removed. Whole small colonies also taken. Rarer in southern waters. In north, some evidence of decline in heavily fished areas. Other areas have exhibited no noticeable decline over many years of collection.

***Acanthastrea lordhowensis* –** Found in shallow reef environments especially of subtropical localities. Colonies are massive and cerioid, with laterally compressed corallites of uneven height. Walls are acute: septa are thick, with large teeth. Columellae are barely developed. Colonies have a thick fleshy mantle which is covered by fine papillae. This species is very colourful: red, purple and green are the most common colours, with corallites and walls almost always of contrasting colours. According to Veron (2000) this species is sometimes common.

2008 Ecological Risk Assessment - Market demand for multi-coloured specimens so plain varieties not collected. Quite common.

Scolymia australis – Found in reef environments or on rocky headlands in high latitudes. Usually solitary but sometimes two to four centres occur in one corallite, or occasionally in separate corallites. Corallites are saucer-shaped and less than 60 millimetres diameter. Septa are sturdy with blunt saw-like teeth. This species is colourful, usually mixtures of cream, red, blue and green. Veron (2000) considers this species to be relatively common in subtropical localities, uncommon elsewhere.

2008 Ecological Risk Assessment - Occurs on solid substrate (reefal walls and solid inter-reefal shoal). Can occur in shallow waters where overhangs are present (i.e. shade). Mostly 12-20m. Moderately common. Solitary disc-shaped colonies. Selected for colour. Collected pieces are mostly red and green, striped varieties in southern waters however majority of corals are brown and are not collected. Chiseled or levered from substrate but substrate left intact (this is the case with all corals growing on solid structure).

***Duncanopsammia axifuga* –** is a green to blue grey colour, which forms colonies that have long tubular corallites which face upwards and attached to a solid substrate. Corallites are 10-14mm in diameter. This species has tentacles that extend during the day and at night. This species usually occurs in water depths greater than 20m, in areas where soft sand dominates. According to Veron (2000), this species is considered rare and conspicuous, which correlates to the IUCN Red List (Vulnerable).

From 2008 Ecological Risk Assessment - Industry suggests more abundant than described in the Vulnerability assessment. Occurs in inter-reefal habitat to 30m (majority of collection) and as shallow as 2m in coastal waters. Eco-niche more generalist than specialist. Important to industry and on international radar.

Trachyphyllia geoffroyi – forms flabello-meandroid free-living colonies, however large fully developed colonies of this nature are uncommon. Polyps of this species are fleshy and have a large mantle that extends from the skeleton during the day which retracts when disturbed. Tentacles are only extended at night. The most common habitat for this species is inter-reef environments and soft substrates. They are considered rare on reefs but common on continental islands and inter-reef habitats by Veron (2000). IUCN rates these as Near Threatened and uncommon but widespread.

2008 Ecological Risk Assessment - Found in narrow inlets, off Arlington lagoon bommies (15—30m depth, common in 18m+). Similar habit to Catalaphyllia but possibly more generalist/widespread. Not observed in southern waters. Locally prolific. Size and colour selected. Max about lawn bowl sized, average baseball-sized. Approx 5-10% of cover of this species will be colourful enough for collection. No observed decline in abundance in regularly dived sites over long time period (e.g. 10yrs). Inter-reefal habitats have ephemeral algal growth that can camouflage coral.

Blasstomussa wellsi – Found in lower reef slopes protected from wave action, and turbid environments. Colonies are phaceloid, rarely subplocoid. Corallites are 9-14 millimetres diameter. Septa are not arranged in cycles and are numerous. They have small blunt teeth. Mantles, but not tentacles, are extended during the day and may form a continuous surface obscuring the underlying growth-form. Considered rare (Veron, 2000).

2008 Ecological Risk Assessment - Generally found in turbid, deeper water habit (>12m, typically 16—35m+). More common on reef but extends to inter-reefal shoals. Requires consolidated substrate. Not common in large colonies. Moderately common in deep waters. EU concern and problems in Indonesia.

Cynarina lacrymalis – Found in protected reef environments and deep sandy substrates. Corals are monocentric, oval or circular, and are cylindrical with a base for attachment, or have a pointed base when free-living. Primary septa are thick and have extremely large, rounded or lobed teeth. Paliform lobes are usually well developed. Columellae are broad and compact. Tentacles are extended only at night. During the day the mantle is inflated with water and is translucent so that the toothed primary septo-costae are clearly seen. In conditions of low light the mantle may be over twice the diameter of the skeleton. Colours are usually mixtures of green or brown, but they may be pink and sometimes other colours. Considered by Veron (2000) to be seldom common but always conspicuous.

Euphyllia ancora – forms colonies that can carpet large areas of substrate. The polyps of this species can vary in shape, from either anchor to hammer or T-shaped; and also colour; ranging from blue-grey to orange but usually have either cream or green walls. This species is most commonly found in shallow water with moderate wave action. According to Veron (2000), this species is considered to be seldom common, which may not correlate to the IUCN Red List which rates this as common (Near Threatened).

Plerogyra sinuosa – Found in protected reef environments, especially, but not necessarily, in turbid water. Colonies are flabello-meandroid with valleys more or less connected by a light blistery coenosteum. Sometimes living parts of colonies are separated by dead basal parts. Vesicles are the size of grapes and usually have the shape of grapes but may be tubular, bifurcated or irregular, depending primarily on the state of inflation. Cream or bluish-grey in colour. According to Veron (2000) this species is usually uncommon.

2008 Ecological Risk Assessment, only Plerogyra species were assessed as "Not very popular in aquarium trade. Industry suggests locally abundant"

***Euphyllia divisia* –** Large colonies are usually found in shallow, turbid environments and are commonly attached to vertical surfaces. Colonies may be over one metre across. They are flabello-meandroid with exsert septa which plunge near the valley centre. Valley walls form sharp edges. There are no columellae. Polyps have large tubular tentacles with smaller tubular branches. All branches have knob-like tips. This species has translucent cream or green tentacles with pale tips. Considered to be seldom common, but conspicuous

Euphyllia glabrescens – Forms phaceloid colonies of corallites that are 20-30mm in diameter, separated by 15-30mm. The polyps are large and tubular with knob-like tips that are cream, green, pink or white. The rest of the tentacle colour ranges from grey-blue to grey green but generally has little variation. This species is found in a wide variety of habitats and is considered to be uncommon but conspicuous by Veron (2000). This does not correlate with the IUCN which states that this species is generally common throughout its range.

2008 Ecological Risk Assessment - Industry suggests very common in certain areas, particularly inter-reefal areas. Important species to QLD fishery and subject to some global concerns.

Heliofungia actiniformis – Usually found on flat soft or rubble substrates especially in reef lagoons or shallow turbid environments. Polyps are solitary, free-living (except for juveniles) and flat, with a central mouth. Septa have large lobed teeth. Polyps are among the largest of all corals. Tentacles are extended day and night and are long, similar to those of giant anemones. There is one mouth up to 30 millimetres wide. Colour is pale or dark blue-green or grey tentacles with white or pink tips. The oral disc is striped. Veron (2000) considers this species to be common.

***Blastomussa merletti* –** Found in reef environments, especially where the water is turbid. Colonies are phaceloid to plocoid, and consist of a few to large numbers of corallites. Corallites are less than 7 millimetres diameter. Septa are mostly in two cycles of which only the first reaches the columella. Septa have slightly serrated margins. Primary septa may be exsert. Columellae are poorly developed. Mantles, but not tentacles, are extended during the day and may form a continuous surface obscuring the underlying growth-form. This species is commonly dark red with conspicuous green oral discs. May also be pink, orange, brown or uniform dark grey with white margins to primary septa. Veron (2000) considers this species to be uncommon.

2008 Ecological Risk Assessment - Found in large colonies. Moderately common. Commonly in 15—20m reef edge but also inter-reefal hard substrate. Mostly on hard substrate but forms bommies on soft sediment.

Moseleya latistella – Forms "flat, submassive usually disc-like and sometimes free living"7 colonies. The tentacles of this species are only extended on dark nights. Colour varies from pale green to deep green or brown. They are usually found on muddy substrates in turbid water sometimes also on exposed reefs. According to Veron (2000), this species is considered to be uncommon, which correlates with the IUCN Red List (Vulnerable).

Although not in the top 14 traded species, Scolymia vitensis was assessed in the 2008 Ecological Risk Assessment, therefore, the observations from that workshop have been included here for completeness.

***Scolymia vitensis* –** This species habitat is most reef environments. There is wide latitudinal variation in this species. In subtropical localities it is usually solitary, flat and less than 60 millimetres diameter. In the tropics it is larger and sometimes colonial. Septa slope up from the columella to an indistinct wall then costae slope down to the periphery. This gives the fleshy mantle of the polyps a distinctive concentric texture. Secondary centres occur near the colony centre and also around the periphery. Septo-costae are sturdy, with large blunt teeth. Usually dark green or tan in colour. Considered to be usually uncommon, rare in the south-west Indian Ocean (Veron, 2000).

2008 Ecological Risk Assessment - Name often interchangeable with Cynarina deshayesiana. Inter-reefal soft bottom, 15—30m. Small monocentric (solitary) colonies (lawn bowl sized - smaller ones not valuable). Moderately common in ideal habitat (around 20m depth) - abundant where Catalaphyllia not so abundant. Selected for colour, not size. Variety of colours occur together. Typically byproduct. No observed detriment from collection over 10+yrs.

Annex G – Figure 23 - Great Barrier Reef Region

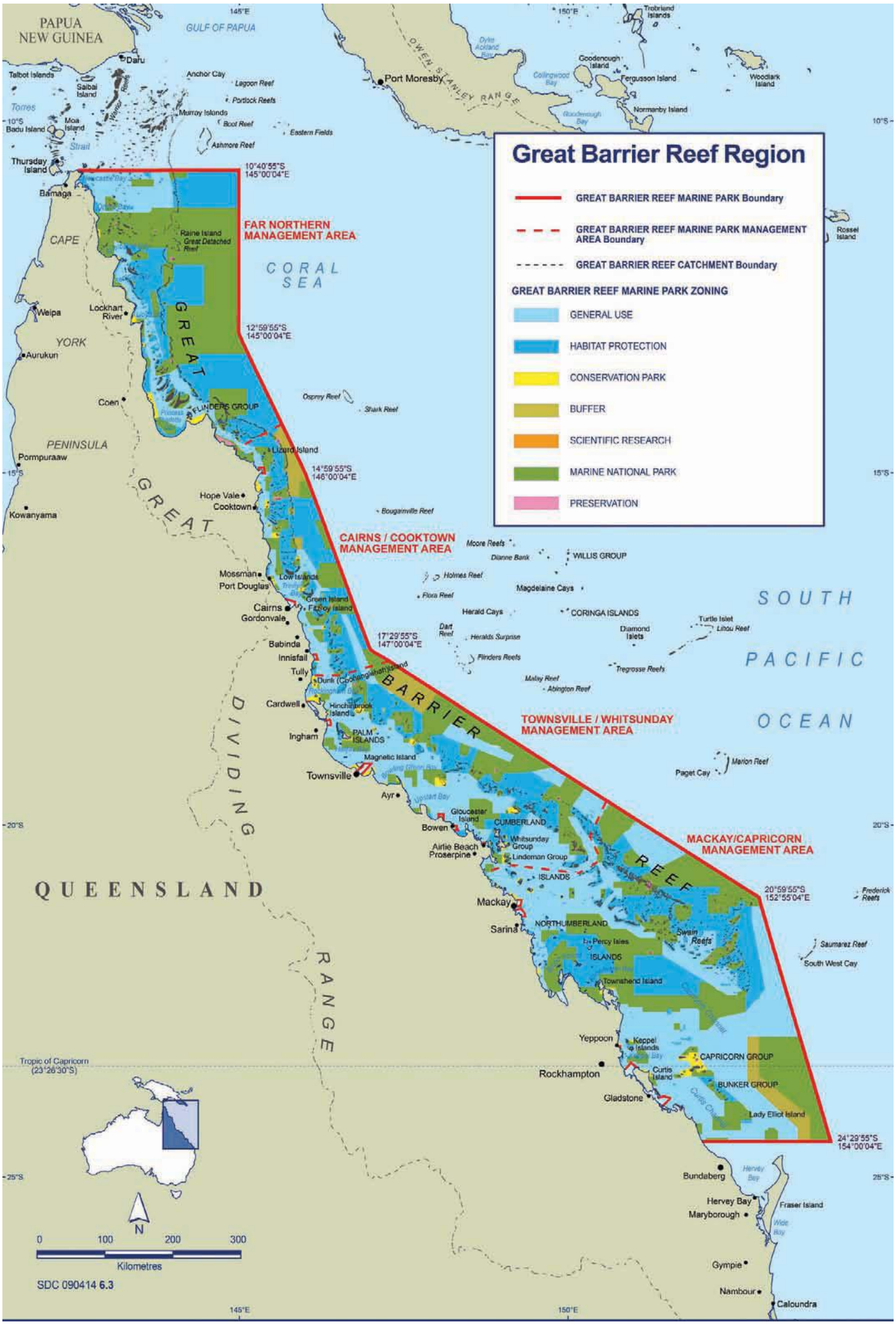


Figure 23 - Since 1 July 2004, more than 33 per cent of the Great Barrier Reef Marine Park has been designated as highly protected zones (Marine National Park, Preservation). Each of the Marine Park zones has a specific objective.