

Ecological Risk Assessment of the Queensland Marine Aquarium Fish Fishery

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Anthony Roelofs
Department of Primary Industries and Fisheries

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Front cover: Yellowface Angelfish (*Pomacanthus xanthurus*)—photo courtesy of Helen Taylor

INTRODUCTION

The Queensland Marine Aquarium Fish Fishery (MAFF) is one of a range of harvest fisheries managed by the Department of Primary Industries and Fisheries (DPI&F). Aquarium fish species are marketed both domestically and internationally and are also collected recreationally. More information on the MAFF can be found in Ryan and Clarke (2005) and in the 2007 Annual Status Report (Department of Primary Industries and Fisheries 2008).

This risk assessment is designed to provide a more formal assessment of the impacts of the fishery on target species, CITES and EPBC Act listed species and to identify areas at risk from overfishing.

The MAFF was accredited as a three-year Wildlife Trade Operation, exempting the fishery from Part 13A export controls of the *Environment Protection and Biodiversity Conservation Act 1999*. The WTO expires on November 2008.

The Australia Government Department of the Environment, Water, Heritage and the Arts (DEWHA) made a number of recommendations that form conditions of the exemption. The recommendations are designed to address any risks or uncertainties that were identified during assessment of the fishery.

One of these recommendations was for:

'DPI&F to undertake an ecological risk assessment to identify key target species and CITES and EPBC Act listed species (other than finfish species managed under the Fisheries (Coral Reef Fin Fish) Management Plan 2003 most at risk from the MAFF and areas at risk from overfishing. DPI&F to develop and implement responses to mitigate identified high risks within 12 months of the completion of the ecological risk assessment process.'

The ecological risk assessment was based on a workshop held on 21 August 2007 with key stakeholders. These stakeholders included:

- Experienced commercial collectors
- Science representatives
- Representative from GBRMPA.
- Fishery managers
- DPI&F assessment and monitoring staff

The list of attendees can be found in Appendix 1.

The objectives of the workshop were to:

- Determine the level of risk to the ecological sustainability of key target species and CITES and EPBC Act listed species (other than finfish species managed under the Fisheries (Coral Reef Fin Fish) Management Plan 2003 most at risk from the MAFF and areas at risk from overfishing.
- Develop management responses to species identified as greater than low risk.

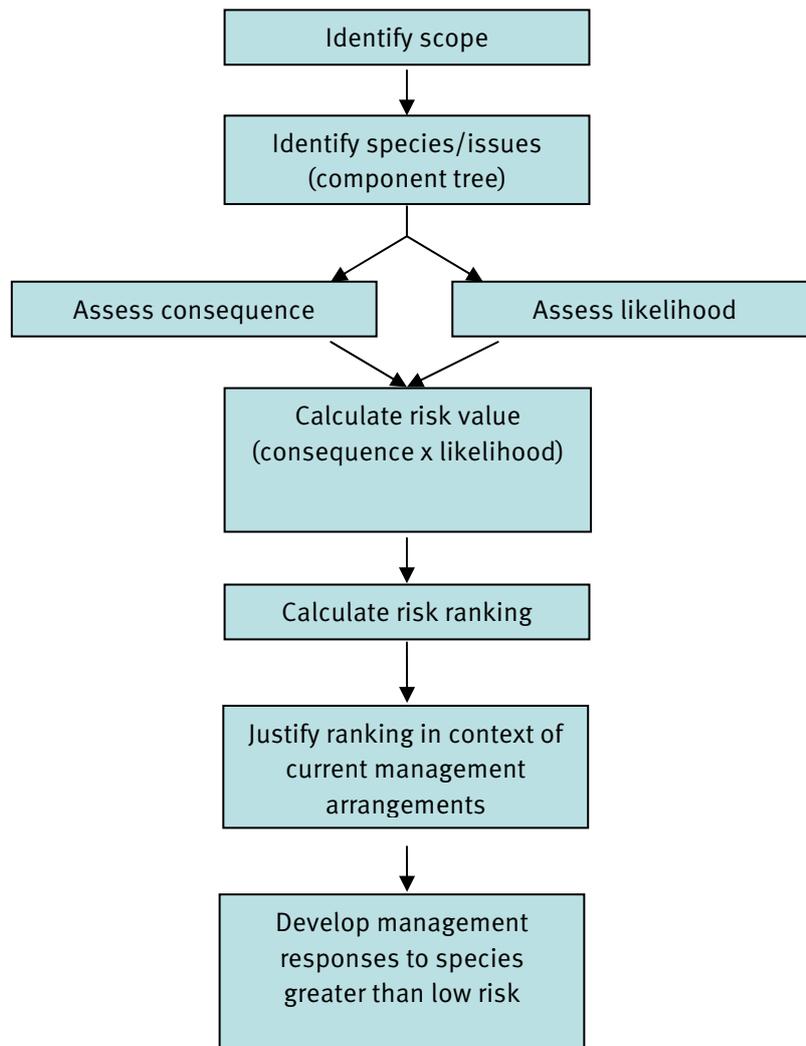


Figure 1. Risk assessment and performance measure development process

Process

Figure 1 provides an overview of the process that was followed in the workshop, highlighting the importance of justifying risks and developing management responses.

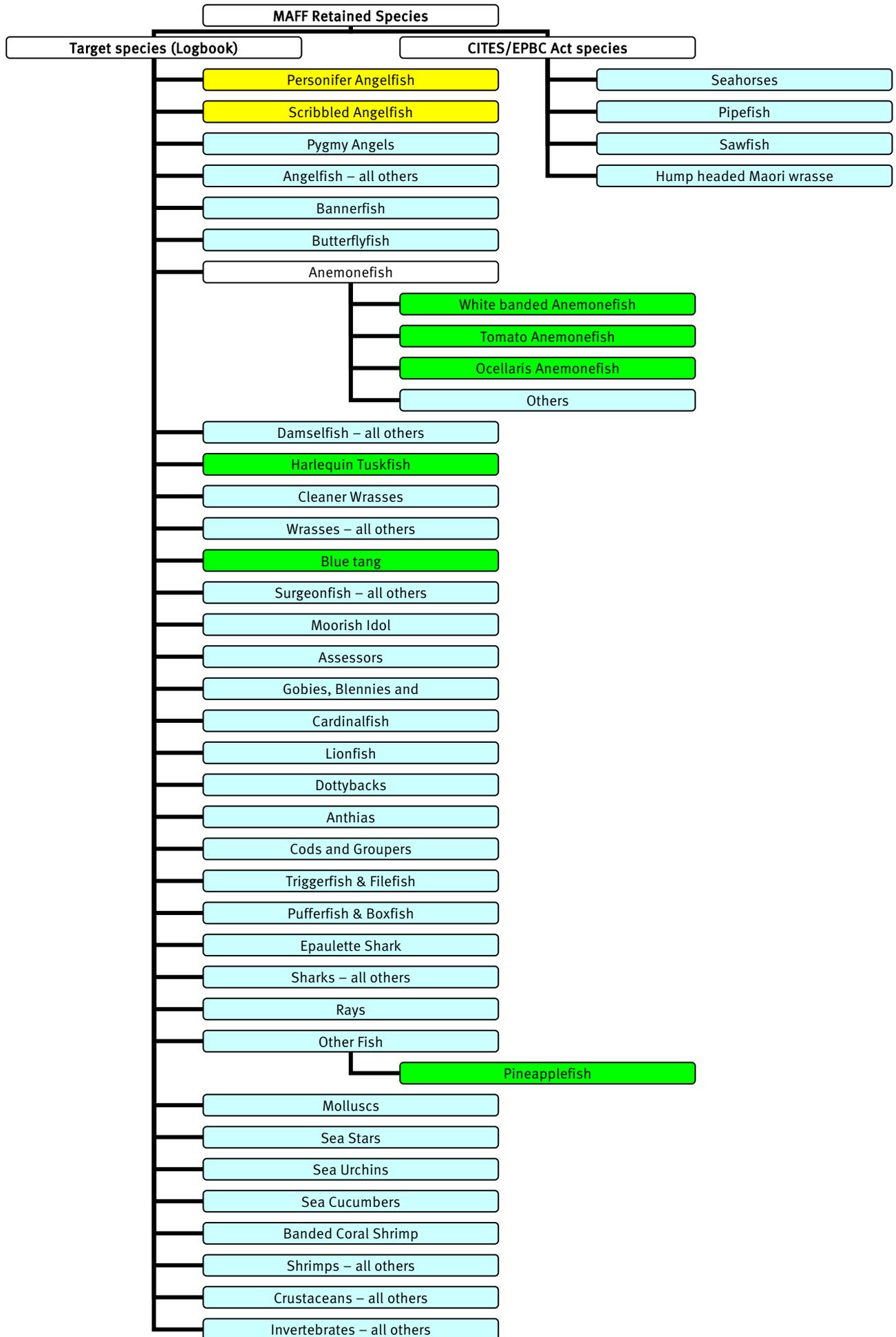
Much of the information necessary to make informed decisions in this risk assessment was already available or had been compiled in the document ‘A sustainability assessment of marine fish species collected in the Queensland marine aquarium trade’ (Roelofs & Silcock 2008)(supplied). This information assisted in developing the Scope, Issues and to calculate Risk Values at the workshop. The final values were validated and agreed to by all members of the workshop.

Scope

Issue identification (component trees)

Issue identification is an important step in any risk assessment process. The purpose of developing component trees was to assist the process of issue identification by moving through each of the ecological components of ESD in a comprehensive and structured manner, maximising consistency and minimising the chances of missing issues.

Issues and species were discussed by the Working Group and subsequently added/deleted to the generic component tree.



Risk assessment

The risk analysis is based upon the AS/NZ Standard, but adapted for use within the fisheries context (Fletcher et al. 2002). It works by assigning a level of consequence (from negligible to catastrophic) and the likelihood of this consequence occurring (from remote to likely) for each issue/species. The overall level of risk assigned to each species is based on the group's assessment of the perceived consequence multiplied by the perceived likelihood. Further information on the process can be found in Fletcher et al, 2002.

A realistic estimate was made by the group, based upon the combined judgment of the participants, who have significant expertise or experience in the fishery.

When considering the level of consequence or likelihood, participants made an assessment in context of the existing control measures and management arrangements already in place. When assessing consequence, participants noted the consequence on a population or region, not an individual animal. The consequence and likelihood tables can be found in Appendix 2.

A risk ranking was given, based on the risk value (see Table 3 and 4 in Appendix 2). The risk ranking dictates the amount of justification required and also the extent of management likely to be needed to address the risk.

Justification of the risk values and ratings are to be provided below.

Research and monitoring needs

It was agreed that the harvest of eight species identified as greater than negligible risk will be monitored through the collection of logbook information. A Performance Measurement System (PMS) for the fishery is to be developed in 2008. Limit reference points for the harvest of these eight species will be included in the MAFF PMS.

No research needs were identified at the workshop

APPENDIX 1 – LIST OF WORKSHOP ATTENDEES

Lyle Squire Jnr	Commercial aquarium fish collector
Don Gilson	Commercial aquarium fish collector
Fenton Walsh	Commercial aquarium fish collector
Rob Lowe	Commercial aquarium fish collector
Dave Bellwood	James Cook University
Morgan Pratchett	James Cook University
Margie Atkinson	Great Barrier Reef Marine Park Authority
Brigid Kerrigan	Fisheries resource management, Department of Primary Industries and Fisheries
Jesse Lowe	Queensland Parks and Wildlife Service
Tara Smith	Fisheries resource management, Department of Primary Industries and Fisheries
Michelle Winning	Assessment and Monitoring Unit, Department of Primary Industries and Fisheries
Anthony Roelofs	Assessment and Monitoring Unit, Department of Primary Industries and Fisheries
Rebecca Silcock	Assessment and Monitoring Unit, Department of Primary Industries and Fisheries

Apologies¹: Morgan Pratchett

¹ Note that those people who were unable to attend were still provided with the opportunity to comment on the justifications for risk rankings.

APPENDIX 2 – CONSEQUENCE AND LIKELIHOOD TABLES

Table 1 Detail of consequence table for target species or species groups

Level	Ecological sustainability of target species
Negligible (0)	Insignificant impacts to populations, (dynamics/structure/size)
Minor (1)	Detectable, but minimal localised impact on populations
Moderate (2)	Noticeable local impact, likely minimal impact on regional populations
Severe (3)	Significant impacts on populations
Major (4)	Will cause local depletion if continued
Catastrophic (5)	Regional depletions are imminent that may result in extinctions

Table 2 Detail of likelihood table for target species or species groups

Level	Descriptor
Likely (5)	Is expected to occur often
Occasional (4)	Is expected to occur moderately
Unlikely (3)	Is expected to occur only infrequently
Possible (2)	Unlikely, but has been known to occur elsewhere
Rare (1)	Happens only very rarely
Remote (0)	Never heard of, but not impossible

Table 3. Risk matrix – numbers in cells indicate risk value, the colours/shades indicate risk rankings (see Table 4 for details). Adapted from Fletcher *et al.* 2002.

Likelihood		Consequence					
		Negligible	Minor	Moderate	Severe	Major	Catastrophic
		0	1	2	3	4	5
Remote	1	0	1	2	3	4	5
Rare	2	0	2	4	6	8	10
Unlikely	3	0	3	6	9	12	15
Possible	4	0	4	8	12	16	20
Occasional	5	0	5	10	15	20	25
Likely	6	0	6	12	18	24	30

Table 4 Risk ranking definitions

RISK		Reporting	Management Response
Negligible	0	Short Justification Only	Nil
Low	1-6	Full Justification needed	None Specific
Moderate	7-12	Full Performance Report	Continue Current Management Arrangements
High	13-18	Full Performance Report	Changes to management required
Extreme	19-30	Full Performance Report	Substantial additional management needed urgently

Output from the Risk Assessment

The actual risk assessment is not just the scores generated during the assessment process but needs to include the appropriate level of documentation/justification for the categories selected.

SPECIES LIST FOR AQUARIUM FISH LISTED IN AQO4 (VERSION 04) LOGBOOK

Personifer Angelfish	<i>Chaetodontoplus meredithi</i>
Scribbled Angelfish	<i>Chaetodontoplus duboulayi</i>
Pygmy Angels	Pomacanthidae family – <i>Centropyge</i> spp.
Angelfish – all others	Pomacanthidae family – excluding <i>Chaetodontoplus meredithi</i> , <i>Chaetodontoplus duboulayi</i> and <i>Centropyge</i> spp.
Bannerfish	Chaetodontidae family – <i>Heniochus</i> spp.
Butterflyfish	Chaetodontidae family – excluding <i>Heniochus</i> spp.
Anemonefish	Pomacentridae family – <i>Amphiprion</i> spp. and <i>Premnas biaculeatus</i>
Damselfish – all others	Pomacentridae family – excluding <i>Amphiprion</i> spp. and <i>Premnas biaculeatus</i>
Harlequin Tuskfish	<i>Choerodon fasciatus</i>
Cleaner Wrasses	<i>Labroides</i> spp.
Wrasses – all others	Labridae family – excluding <i>Choerodon fasciatus</i> and <i>Labroides</i> spp.
Blue tang	<i>Paracanthurus hepatus</i>
Surgeonfish – all others	Acanthuridae family – excluding <i>Paracanthurus hepatus</i>
Moorish Idol	<i>Zanclus canescens/cornutus</i>
Assessors	Plesiopidae family – <i>Assessor</i> spp.
Gobies, Blennies and Dartfishes	Gobiidae family, Blenniidae family, Tripterygiidae family and Ptereleotridae family
Cardinalfish	Apogonidae family – <i>Apogon</i> spp., <i>Vincentia</i> spp., <i>Cheilodipterus</i> spp., <i>Archamia</i> spp.
Lionfish	Pteroidae family
Dottybacks	Pseudochromidae family (includes dottybacks and eelblennies)
Anthias	Serranidae family – <i>Pseudanthias</i> spp.
Cods and Groupers	Serranidae family – excluding <i>Pseudanthias</i> spp.
Triggerfish & Filefish	Balistidae family (triggerfish)
Pufferfish & Boxfish	Tetraodontidae family, Ostraciidae family and Diodontidae family
Epulette Shark	<i>Hemiscyllium ocellatum</i>
Sharks – all others	Order Squatiniformes, Pristiophoriformes, Echinorhiniformes, Squaliformes, Hexanchiformes, Carcharhiniformes, Lamniformes, Orectolobiformes, Heterodontiformes – excluding <i>Hemiscyllium</i>
Rays	Orders Pristiformes, Rhinobatiformes, Torpediniformes, Rajiformes, Myliobatiformes
Other Fish	Superclass Pisces – excluding taxonomic groups listed above
Molluscs	Phylum Mollusca
Sea Stars	Class Asteroidea, Crinoidea, Ophiuroidea
Sea Urchins	Class Echinoidea
Sea Cucumbers	Class Holothuridea
Banded Coral Shrimp	<i>Stenopus hispidus</i>
Shrimps – all others	Infraorders Penaeoidea & Caridea – excluding <i>Stenopus hispidus</i>
Crustaceans – all others	Subphylum Crustacea – excluding Infraorders Penaeoidea & Caridea
Invertebrates – all others	All invertebrate animals not listed above

Note: the abbreviation “spp.” refers to all species within the indicated genus.

APPENDIX 3 - RISK RATINGS

VAR = Vulnerability ranking, RAR = Recovery ranking; from Roelofs, A & Silcock, R 2008, *A sustainability assessment of marine fish species collected in the Queensland marine aquarium trade*, Department of Primary Industries & Fisheries, Brisbane. (Shaded boxes indicate risk levels greater than negligible risk—see Table 4).

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Personifer Angelfish	Low		2	4	8	exported	Approximately 5000 fish collected in 2006. The market tends to target small fish (juvenile to sub-adult) as they are easier to keep and in higher demand, with the exception of larger adult males. Local impact at one specific area (sunshine coast area). Likelihood - location specific,	Possible trawl impacts
Scribbled Angelfish	Low	Low	2	4	8	exported	7400 in 2006, (MacKay Keppels Gladstone, Harvey bay) market target small fish (juveniles to sub-adult) male adults larger. 4-6 year cycle and recruitment, natural growth cycles rather than fishing impacts. Local depletions. Likelihood - location specific,	
Pygmy Angelfish	Low		0		0		Cryptic species, regions targeting different species. 80% of the species collected in the north <i>Bispinosus</i> and <i>bicolor</i> , south is <i>tibicen</i> .	
Angelfish all others	Low		0		0		No species is considered to warrant separation	
Bannerfish	Low		0		0	limited	<i>Monoceros</i> limited export species, cryptic species difficult to catch	
Butterflyfish			0		0		Common on reefs, take no impact on population, Species indicated as vulnerable were not considered to be at risk from the fishery and have been combined under the single species group heading.	
Rainford Butterflyfish	Moderate	Low	0		0			
Bluespot Butterflyfish	Moderate	Low	0		0			
Ornate Butterflyfish	Moderate	Low	0		0			
Blackback Butterflyfish	Moderate	Low	0		0			

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
White Banded Anemonefish	Moderate		1	1	1		Very common in NSW, no fishery in NSW, northern distribution sunshine coast. Deep water species found from +12m , difficult to access, population is self protecting, juveniles found in shallow to deep water, adults found in deeper water perhaps due to interspecific competition (brown clowns). Likelihood - yearly recruitment, data lacking, potential recreational species	
Tomato Anemonefish	Moderate	Moderate	1	2	2		Aquacultured species, however not in significant numbers, can be aggressive in tanks. Shallow water, can be difficult to catch due to depth (southern areas, 1-2m, northern areas, species caught on air +5). Sought after recreational species. Anemones retreat back in to coral cover, clumping, forming anemone beds, up to 50 individuals in an colony, it is unlikely that collectors would be able to remove all individuals off an anemone bed. Not key species targeted by the trade, not key export species. Colour variations imported. Likelihood - site specific circumstances.	Anemone can be harvested, generally found on smaller anemones, more suited to collection. Potential for Coral bleaching to impact on host with flow on effects to impact anemonefish, maybe relevant at a site specific scale
Orange-fin Anemonefish	Moderate	Moderate	0		0		Far northern GBR, limited distribution, Coral Sea. Can be seen to pair with <i>Amphiprion akindynos</i> . Unknown if aquacultured species, can be imported.	Anemone can be harvested; however tend to be larger anemones, generally only the smaller anemones are targeted.
Skunk Anemonefish	Moderate	Low	0		0		Aquacultured species, not highly sought after, not a popular species, small family units, 4-5 fish per anemone, collectors harvest larger pairs, rather than small individuals. Not targeted by recreational divers, 1 known host anemone. Common between 8-12m,	Anemone can be harvested; however tend to be larger anemones, generally only the smaller anemones are targeted.
Brown Anemonefish	Moderate	Moderate	0		0	limited	Limited export fish, imports, aquacultured. Can live in a range of anemone species, often in small family units, very widespread distribution, found in a range of depths. Average market, smaller individuals are targeted rather than the larger ones.	

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Maroon Anemonefish	Moderate	Low	0		0		Often found in pairs, often found in quadricolor anemones. Most cryptic of the clowns, adults often look dark in colour, not noticed by divers due to colouration. Research report indicates divers only accessing .3 of local population. Easy to breed in captivity, can be aggressive in tank. Not high export, not highly sought after	
Ocellaris/Percula Anemonefish	Moderate	Low	1	1	1		Often found in pairs, aquacultured species, most popular clownfish, northern distribution, occur in family units, typically take the larger pairs (may have neg effects on the population dynamics if they rely on local replenishment) anemones often found below 10m in areas of flow. Study on recruitment in low flow areas conducted in PNG, found high self seeding). Gene mixing, 50% of recruits come from unknown sources (Jeff Jones - Paper). There is some suggestion that if you remove the clownfish the anemone, the anemone may be at risk of predation. Not noted from collectors however. Likelihood - less accessibility than other clown fish. high demand but largely sourced by aqua	Bleaching, target recreational fishing
Damselfish all others	Low		0		0		Blue green chromis dominant species collected on the reef. Very common, very wide distribution, make up a large % of total damsel catch. No separation of damselfish species group considered necessary	
Harlequin Tuskfish	Low	Moderate	1	4	4	exported	Important export species, found on most inshore reefs north of the Cap bunker. Abundant in Swains and some reefs of the Cap bunker. Difficult to catch for novice. Juveniles cryptic, live in caves, different method to catching juveniles and adult fish. Bait is often used in catching individuals. Larger individuals are often territorial leading to juv/smaller fish displacement. 'Farming' of tuskfish influencing size distribution in populations. Likelihood - harvest selected size classes from selected area. Collection may impact on size distribution but not quantity. Population could in fact increase.	

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Cleaner Wrasse	Low		0		0		Literature suggests that the removal of cleaner wrasse may alter populations of surrounding fish species. Collectors do not see this happening. No real targeting of cleaners - often caught as a by-product of collecting. Juv's are generally not collected as they are too small and go through nets.	
Gold Cleaner Wrasse	Moderate	Low	0		0	no	Outer barrier reef fish, not as common as <i>Labroides dimidiatus</i> and not as easy to catch, as a result not a lot are collected. Not specifically targeted by the fishery. Not an export fish species, common in other areas of the world e.g. Fiji.	
Blue Cleaner Wrasse	Low		0		0		Industry is generally targeting the mid size range. Large adults tend to be cleaning. Less disruptive to the cleaning station if the mid size fish are removed.	
Wrasse all others	Low		0		0	Some species	In certain species the larger males are often targeted. Over harvesting of large fish from the reef may have severe ecosystem impacts? However, the fishery concentrates on generally smaller species and is unlikely to have ecosystem impact. Both males and females are targeted. Some species targeted for export, endemics such as <i>Macropharyngodon choati</i> , considered by the group to be of no concern because of limited harvest.	
Blue Tang	Low		2	3	6		Can recruit quickly, local depletions have been noted in the south. Difficult habitat to access, high current, shoals. Outer barrier and Coral Sea, so limited days that you can fish them. Sub-adults collected. Subject to juveniles settling on <i>Acropora</i> . Juveniles are hard to get out of coral heads. Anecdotal evidence of poor collection tech of recreational collectors causing damage to coral heads. Consequence score of 2 is because of southern impacts only (limited habitat, and southern end of distribution) In the northern end a score of 1 would be appropriate. Likelihood - has been known to occur some where else	At risk of climate change, as they need <i>Acropora</i>

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Surgeonfish all others	Low		o		o		Tend to collect small numbers of small individuals. Collection practise unlikely to cause impacts through removal of herbivores. The majority of surgeonfish are mainly planktonic feeders as well as herbivores.	
Moorish Idol	Low		o		o		Smaller sizes targeted, regardless of collection area. Smaller sizes survive better in tanks. There is suggestion that the southern Moorish idols are hardier.	
Assessors	Low		o		o	exported	Export species. Hard to collect as they hide in caves. Accessibility issues reinforce sustainability.	
Reticulated Blenny	Moderate		o		o		Common on rubble areas, often difficult to collect. Popular species in the domestic market.	
Australian Blenny	Moderate		o		o		Common on rubble areas, often difficult to collect. Popular species in the domestic market.	
Tiger Blenny	Moderate		o		o		Found in the Coral Sea, not considered further by ERA	
Bifrenatus Goby	Moderate	Low	o		o		Southern species, however not common, not targeted by collectors	
Beautiful Goby	Moderate	Low	o		o		Not targeted	
Gobies, Blennies & Dartfish	Low		o		o		Nothing significant in this group. Most abundant species groups on the reef. No species needs to be considered separately by the ERA	
Cardinalfish					o		Nothing significant in this group. Most abundant species groups on the reef. No species other than those listed with high VAR need to be considered separately by the ERA	
Sydney Cardinalfish	Moderate	High	o		o		Southern species, collected at northern most limit of distribution, not very popular, not targeted often caught as a by-product.	
Lea's Cardinalfish	Moderate	High	o		o		Not targeted at all	
Pyjama Cardinalfish	Moderate	Low	o		o		Popular species, also an import species, aquacultured. Abundant within their habitat. Widespread. Generally associated with live coral. Northern species.	

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Lionfish	Low		o		o		Domestic species, also imported. Limited market for larger individuals. Easy to collect, recreational fishing in southern waters. Recruit well. In northern waters, easy to catch at night. Restricted to predator tanks, limited demand. Nocturnal. Dive operators have noted local depletion at a reef on the Gold Coast, on this occasion it would score a 1.	
Dottybacks	Low		o		o	Some species	Hard to collect, close to cover, found in rubble areas. Some species are targeted. Common. <i>Ogilbyina novaehollandiae</i> & <i>Cypho purpurascens</i> are export species	
Anthias	Low		o		o	exported	Abundant group. Export species. No sustainability concerns	
Cods & Groupers	Low		o		o		Predator tanks, regulated by size for many species. Min size limits the take. Can not import	
Triggerfish & Filefish	Low		o		o		Limited demand, often aggressive, some species are coralivores e.g. <i>Oxymonacanthus longirostris</i> . and difficult to feed. Suggestions that the removal of larger species of triggerfish in Africa, led to a rise in sea urchin abundance. Not the same for QLD, fishery targets smaller individuals.	
Pufferfish & Boxfish	Low		o		o		Smaller individuals are targeted, a lot of the boxfish are toxic thus not desirable in tanks.	
Epaulette Shark	Low		o		o		Export and domestic species. Small numbers collected in the fishery each year. Juveniles collected from reef tops, with limited demand for larger individuals of the species. Nocturnal. Aquacultured.	
Sharks all others	Low		o		o		Limited number of species targeted for general trade, limited take for public aquariums. Public aquariums have permits for some species for display. Given management control and limited demand this high profile group has been scored o.	
Marbled Catshark	Moderate	High	o		o		Not in fishery, not considered further in ERA	
Rays	Low		o		o		Limited southern take. Blue spot lagoon ray is the most commonly collected stingray in the north. Juv's are generally targeted. Larger species are collected for public display tanks.	

Species	VAR	RAR	Consequence	Likelihood	Risk level	Export	Justification	Other impacts
Other fish	Low		0		0		Tend to collect small numbers of small individuals. Minimal ecosystem impacts through removal of herbivores (parrots & rabbitfish).	
Razor Fish	Moderate		0		0		Not very popular, widespread.	By-catch by trawlers
Bluelined Rabbitfish	Moderate	Low	0		0		Smaller individuals are targeted, only a handful collected. Minimal ecosystem impacts through removal of herbivores (parrots & rabbitfish).	
Foxface	Moderate	Low	0		0		mix of sizes collected for the trade, limited demand, imported, not exported, cheap and common overseas. Minimal ecosystem impacts through removal of herbivores (parrots & rabbitfish).	
Pineapplefish	Low		1	3	3		collected recreationally (potential to be high), southern species, endemic	By-catch by trawlers
Humpheaded Maori Wrasse	Low		0		0		No take species for any fisheries, reflects CITES obligations, grows fast, habitat generalist, geographically widespread. Very limited numbers taken for public education only.	
Seahorse/Pipefish			0		0		Has been take in the GBR. Imported species, except for Hippocampus spp. Can be aquacultured. Low numbers, limited activity in accessible habitats.	
Sawfish			0		0		Very limited numbers taken for public education in Australia. Requires permits from DEW for export, strict controls, Pristis microdon, other sawfish no overseas trade, and very limited local demand for public display.	

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