Marine aquarium fish fishery vulnerability assessment

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Queensland Government

Marine Aquarium Fish Fishery
Species-Specific Vulnerability Assessment

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Cover photograph taken by J. Morton.

The Department of Agriculture and Fisheries proudly acknowledges all First Nations peoples (Aboriginal peoples and Torres Strait Islanders) and the Traditional Owners and Custodians of the country on which we live and work. We acknowledge their continuing connection to land, waters and culture and commit to ongoing reconciliation. We pay our respect to their Elders past and present.

Executive Summary

In April 2023, a whole-of-fishery (Level 1) Ecological Risk Assessment (ERA) was released for the Marine Aquarium Fish Fishery (MAFF; Morton & Jacobsen, 2023). The Level 1 ERA established a broad risk profile for the MAFF, identifying the key drivers of risk and the ecological components most likely to experience an undesirable event. The Level 1 ERA considered both the current fishing environment and the potential for fishing patterns and behaviours to shift within the broader management framework. The outputs of this assessment helped differentiate between low and high-risk elements and established a framework that could be built upon in subsequent assessments. The publication of the report also fulfilled a key condition of the Wildlife Trade Operation (WTO) export approval issued to this fishery under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act; Department of Climate Change Energy the Environment and Water, 2022).

On 18 April 2024, the MAFF was re-accredited as a WTO under Part 13A of the *EPBC Act* (Department of Climate Change Energy the Environment and Water, 2024). Condition 5(a) of this accreditation requires a Level 2 species-specific assessment to be completed for the fishery and for it to be published by 31 October 2024. In accordance with this condition, a species-specific vulnerability assessment has now been completed for the MAFF (herein referred to as the MAFF VA). This study focused specifically on the target species ecological component which was the only subgroup within the Level 1 ERA to be assigned a rating higher than ‘low/intermediate risk’ (Morton & Jacobsen, 2023). It provides an indicative assessment (low, medium or high) of each species’ vulnerability based on an evaluation of their resilience to disturbance and their susceptibility to the negative effects of fishing activities. The MAFF VA also identifies avenues where vulnerability can be further understood, managed or mitigated within this fishery.

The MAFF VA was compiled using a Productivity and Susceptibility Analysis (PSA) and takes into consideration a range of biological (age at maturity, maximum age, maximum size, reproductive strategy, and the von Bertalanffy growth coefficient [*k*]) and fisheries-specific attributes (geographic distribution, depth profile, ecological niche, management strategy, catchability, and market value). As the PSA can over-estimate vulnerability for some species (Zhou *et al.,* 2016), the study also included a Residual Vulnerability Analysis (RVA). The RVA gives further consideration to management and mitigation measures not explicitly included in the PSA and/or any additional information that may influence the overall vulnerability of a species (Australian Fisheries Management Authority, 2017). The primary purpose of the RVA is to minimise the number of false-positive results or instances where the level of vulnerability has been overestimated.

Operators in the MAFF target a diverse range of marine vertebrate and invertebrate species for sale on the domestic and international market. Assessing the vulnerability of all species (>1,500) that can be retained in the MAFF was deemed both unnecessary and unwarranted. Accordingly, it was determined that the MAFF VA would prioritise assessments for subgroups (key teleost species within families of concern) targeted within the MAFF. A review of the available data indicated that a high number of fish species are retained infrequently and have been harvested at comparatively low levels over the last 10 years (Department of Agriculture and Fisheries, 2023a). This includes elasmobranchs which are retained in very small quantities (<0.3 per cent of the total catch over the last 10 years; Department of Agriculture and Fisheries, 2022a; 2023a). Further, harvest data for invertebrates has poor species resolution and provides limited insight into the extent of any species-specific fishing

pressures. These reporting deficiencies are compounded by data limitations surrounding the biology and taxonomy of invertebrate species.

A review of historical catch data, industry wholesale lists and a previous sustainability assessment (Roelofs & Silcock, 2008) produced a preliminary list of over 700 teleosts that were considered for inclusion in the MAFF VA. This list was rationalised to 137 species of marine aquarium fishes with the assistance of industry, scientific experts and management agencies. The remaining species were viewed as secondary assessment priorities and were omitted from this iteration of the MAFF VA. If required, secondary teleost species and elasmobranchs will be considered for inclusion in future assessments. Vulnerability assessments for invertebrates are more challenging and are highly dependent on the quality and quantity of the available data.

The outputs of this vulnerability assessment support the broader hypothesis of the MAFF being a lower-risk fishery. Of the 137 species assessed, only the blueface angelfish (*Pomacanthus xanthometopon*) registered a vulnerability rating of high. All remaining species were assigned a MAFF vulnerability rating of low (n = 104) or medium (n = 32). The key drivers of vulnerability varied across individual species and complexes. However, data deficiencies were identified as a key factor of influence within the productivity component, particularly for assessments involving the age at maturity, maximum age and von Bertalanffy growth coefficient attributes. Within the susceptibility analysis, depth profile and catchability were scored consistently high across all teleost subgroups.

Species with medium or high-vulnerability ratings are viewed as higher priorities in terms of reviewing the suitability and adequacy of the current management arrangements. While not universal, the vulnerability rating of some species support the establishment of more prescriptive management arrangements to monitor and manage their long-term harvest e.g. reviewing/updating the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026*, reviewing decision rules used to manage the long-term harvest of key species and updating logbooks to increase the resolution of the harvest-rate data. Any management response, if deemed necessary, will be done in consultation with the Marine Aquarium Fish and Coral Fisheries Working Group and consider all aspects of the fishery. The outputs of the MAFF VA will assist in this process.

Of notable importance, a number of reforms have already been implemented in the MAFF to address key risk areas. This includes the development of the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* and the introduction of an expanded logbook on 1 July 2023 (Department of Agriculture and Fisheries, 2022a; Queensland Government, 2024). The updated logbook includes an expanded species list to increase the resolution of reported data. These reforms build on the well-established risk-management framework already employed in this fishery e.g. limited licensing, input controls, gear limitations, spatial closures and marine park zoning (the Great Barrier Reef Marine Park area and the Great Sandy Marine Park). Some commercial fishers also adhere to industry led initiatives including the Stewardship Action Plan which aims to mitigate ecological risk (Pro-vision Reef, 2013).

The following recommendations have been identified as areas where vulnerability profiles can be refined, and the level of vulnerability better understood, reduced or managed within the MAFF. A number of these recommendations are already being progressed as part of the *Queensland Sustainable Fisheries Strategy 2017–2027*.

Recommendations

1. Review and update the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026*.

2. Review the suitability of the harvest strategy decision rules, their ability to effectively monitor harvest rates, and minimise the potential long-term risks for Tier 1 and Tier 2 species e.g. catch and effort increases that are inconsistent with the objectives of the harvest strategy.

3. Continue implementing the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* and review the suitability/applicability of current reporting requirements.

4. Explore avenues to further understand the distribution and biology of harvested species through scientific research and engagement with relevant stakeholders.

5. Review the need to assess the vulnerability of invertebrates, sharks and batoids in the MAFF.

6. Continue to explore avenues to provide vulnerable species with additional protections to minimise the cumulative risks associated with harvesting during climatic events and disturbances.

Summary of the outputs from the *Marine Aquarium Fish Fishery Vulnerability Assessment*

Common name	Species name	Productivity	Susceptibility	Final vulnerability rating
Acanthuridae				
Greyhead surgeonfish	*Acanthurus nigros*	2.00	1.91	Medium
Orangeblotch surgeonfish	*Acanthurus olivaceus*	2.00	1.59	Low
Mimic surgeonfish	*Acanthurus pyroferus*	2.00	1.41	Low
Night surgeonfish	*Acanthurus thompsoni*	2.00	1.91	Medium
Twospot bristletooth	*Ctenochaetus binotatus*	1.80	1.41	Low
Clown unicornfish	*Naso lituratus*	2.00	1.78	Medium
Blue tang	*Paracanthurus hepatus*	2.00	1.82	Medium
Sailfin tang	*Zebrasoma veliferum*	2.20	1.59	Medium
Apogonidae				
Sydney cardinalfish	*Ostorhinchus limenus*	1.60	2.04	Low
Pajama cardinalfish	*Sphaeramia nematoptera*	1.20	1.70	Low
Lea's cardinalfish	*Taeniamia leai*	1.20	1.91	Low
Balistidae				
Clown triggerfish	*Balistoides conspicillum*	2.60	1.41	Medium
Blenniidae				
Redstreaked blenny	*Cirripectes stigmaticus*	1.60	1.70	Low
Australian combtooth blenny	*Ecsenius australianus*	1.20	1.91	Low
Tiger combtooth blenny	*Ecsenius tigris*	1.20	2.04	Low
Centriscidae				
Jointed razorfish	*Aeoliscus strigatus*	1.40	1.70	Low
Grooved razorfish	*Centriscus scutatus*	1.40	1.51	Low
Chaetodontidae				
Goldstripe butterflyfish	*Chaetodon aureofasciatus*	1.60	1.91	Low

Common name	Species name	Productivity	Susceptibility	Final vulnerability rating
Dusky butterflyfish	*Chaetodon flavirostris*	1.80	1.70	Low
Klein's butterflyfish	*Chaetodon kleinii*	1.60	1.51	Low
Blackback butterflyfish	*Chaetodon melannotus*	2.20	1.70	Medium
Mertens' butterflyfish	*Chaetodon mertensii*	1.60	1.41	Low
Meyer's butterflyfish	*Chaetodon meyeri*	1.60	1.70	Low
Ornate butterflyfish	*Chaetodon ornatissimus*	1.60	1.70	Low
Dot-and-dash butterflyfish	*Chaetodon pelewensis*	1.60	1.51	Low
Lattice butterflyfish	*Chaetodon rafflesii*	1.60	1.70	Low
Rainford's butterflyfish	*Chaetodon rainfordi*	1.60	2.14	Medium
Reticulate butterflyfish	*Chaetodon reticulatus*	1.60	1.70	Low
Chevron butterflyfish	*Chaetodon trifascialis*	1.60	1.51	Low
Doublesaddle butterflyfish	*Chaetodon ulietensis*	1.60	1.70	Low
Margined coralfish	*Chelmon marginalis*	1.60	1.70	Low
Muller's coralfish	*Chelmon muelleri*	1.60	2.04	Low
Beaked coralfish	*Chelmon rostratus*	1.60	1.70	Low
Forceps fish	*Forcipiger flavissimus*	2.00	1.59	Low
Longnose butterflyfish	*Forcipiger longirostris*	2.00	1.59	Low
Pyramid butterflyfish	*Hemitaurichthys polylepis*	1.60	1.91	Low
Schooling bannerfish	*Heniochus diphreutes*	1.80	1.51	Low
Gobiidae				
Whitebarred goby	*Amblygobius phalaena*	1.80	1.51	Low
Bridled goby	*Arenigobius bifrenatus*	1.60	2.04	Low
Mud-reef goby	*Exyrias belissimus*	1.80	1.35	Low
Old glory goby	*Koumansetta rainfordi*	1.40	1.70	Low
Ocellate glidergoby	*Valenciennea longipinnis*	1.40	1.51	Low
Blueband glidergoby	*Valenciennea strigata*	1.40	1.51	Low
Labridae				
Bluetail wrasse	*Anampses femininus*	2.00	2.04	Medium
Blue-and-yellow wrasse	*Anampses lennardi*	2.00	2.29	Medium
Speckled wrasse	*Anampses meleagrides*	2.00	1.91	Medium
Harlequin tuskfish	*Choerodon fasciatus*	2.00	1.91	Medium
Deepwater wrasse	*Cirrhilabrus bathyphilus*	1.00	2.00	Low
Conde's wrasse	*Cirrhilabrus condei*	1.00	1.78	Low
Blueside wrasse	*Cirrhilabrus cyanopleura*	1.20	1.82	Low
Exquisite wrasse	*Cirrhilabrus exquisitus*	1.20	1.82	Low
Laboute's wrasse	*Cirrhilabrus laboutei*	1.20	2.00	Low
Lavender wrasse	*Cirrhilabrus lineatus*	1.20	2.00	Low
Pink-banded fairy wrasse	*Cirrhilabrus roseafascia*	1.20	1.59	Low
Scott's wrasse	*Cirrhilabrus scottorum*	1.20	1.91	Low
Squire's fairy wrasse	*Cirrhilabrus squirei*	1.00	2.29	Low
Clown wrasse	*Coris gaimard*	2.20	1.41	Low

Common name	Species name	Productivity	Susceptibility	Final vulnerability rating
False-eyed wrasse	*Halichoeres biocellatus*	1.20	1.59	Low
Golden wrasse	*Halichoeres chrysus*	1.20	1.41	Low
Hoeven's wrasse	*Halichoeres melanurus*	1.20	1.51	Low
Pastel slender wrasse	*Hologymnosus doliatus*	2.40	1.59	Medium
Bicolor cleanerfish	*Labroides bicolor*	1.60	1.70	Low
Common cleanerfish	*Labroides dimidiatus*	1.60	1.70	Low
Breastspot cleanerfish	*Labroides pectoralis*	1.60	1.70	Low
Choat's wrasse	*Macropharyngodon choati*	1.20	1.91	Low
Kuiter's wrasse	*Macropharyngodon kuiteri*	1.20	1.78	Low
Leopard wrasse	*Macropharyngodon meleagris*	1.20	1.51	Low
Black leopard wrasse	*Macropharyngodon negrosensis*	1.20	1.70	Low
Filamentous flasher wrasse	*Paracheilinus filamentosus*	1.20	2.04	Low
Candy wrasse	*Pseudojuloides splendens*	1.20	1.59	Low
Green moon wrasse	*Thalassoma lutescens*	1.80	1.70	Low
Monacanthidae				
Harlequin filefish	*Oxymonacanthus longirostris*	1.60	1.70	Low
Monocentridae				
Australian pineapplefish	*Cleidopus gloriamaris*	2.60	1.70	Medium
Plesiopidae				
Yellow scissortail	*Assessor flavissimus*	1.20	1.91	Low
Blue scissortail	*Assessor macneilli*	1.20	2.04	Low
Pomacanthidae				
Threespot angelfish	*Apolemichthys trimaculatus*	2.40	1.78	Medium
Golden angelfish	*Centropyge aurantia*	1.60	1.78	Low
Bicolor angelfish	*Centropyge bicolor*	1.80	1.70	Low
Coral beauty	*Centropyge bispinosa*	1.80	1.78	Low
Whitetail angelfish	*Centropyge fisheri*	1.40	1.59	Low
Lemonpeel angelfish	*Centropyge flavissima*	1.60	1.91	Low
Yellow angelfish	*Centropyge heraldi*	1.60	1.78	Low
Flame angelfish	*Centropyge loriculus*	1.60	1.78	Low
Conspicuous angelfish	*Chaetodontoplus conspicillatus*	2.40	2.04	Medium
Scribbled angelfish	*Chaetodontoplus duboulayi*	2.40	1.51	Medium
Queensland yellowtail angelfish	*Chaetodontoplus meredithi*	2.40	1.70	Medium
Lamarck's angelfish	*Genicanthus lamarck*	2.40	1.78	Medium
Watanabe's angelfish	*Genicanthus watanabei*	1.80	1.78	Low
Multibar angelfish	*Paracentropyge multifasciatus*	1.80	1.78	Low
Emperor angelfish	*Pomacanthus imperator*	2.60	1.78	Medium
Bluegirdle angelfish	*Pomacanthus navarchus*	2.40	1.91	Medium
Blueface angelfish	*Pomacanthus xanthometopon*	2.60	1.91	High

Common name	Species name	Productivity	Susceptibility	Final vulnerability rating
Pomacentridae				
Barrier Reef anemonefish	*Amphiprion akindynos*	2.00	2.04	Medium
Orangefin anemonefish	*Amphiprion chrysopterus*	2.00	2.04	Medium
Clark's anemonefish	*Amphiprion clarkii*	2.00	1.91	Medium
Wideband anemonefish	*Amphiprion latezonatus*	2.00	2.18	Medium
Blackback anemonefish	*Amphiprion melanopus*	2.20	1.62	Medium
Western clown anemonefish	*Amphiprion ocellaris*	2.00	1.73	Medium
Eastern clown anemonefish	*Amphiprion percula*	2.00	2.04	Medium
Pink anemonefish	*Amphiprion perideraion*	2.00	1.82	Medium
Saddleback anemonefish	*Amphiprion polymnus*	2.00	1.82	Medium
Blackaxil puller	*Chromis atripectoralis*	1.80	1.82	Low
Half-and-half puller	*Chromis iomelas*	1.60	1.70	Low
Yellowback puller	*Chromis nitida*	1.60	1.94	Low
Vanderbilt's puller	*Chromis vanderbilti*	1.40	1.62	Low
Blue-green puller	*Chromis viridis*	1.80	1.82	Low
Blue demoiselle	*Chrysiptera cyanea*	1.40	1.70	Low
Starck's demoiselle	*Chrysiptera starcki*	1.60	1.78	Low
South Seas demoiselle	*Chrysiptera taupou*	1.40	1.51	Low
Banded humbug	*Dascyllus aruanus*	1.80	1.94	Medium
Threespot humbug	*Dascyllus trimaculatus*	1.80	1.82	Low
Fusilier damsel	*Lepidozygus tapeinosoma*	1.60	1.82	Low
Neon damsel	*Pomacentrus coelestis*	1.40	1.62	Low
Peacock damsel	*Pomacentrus pavo*	1.80	1.70	Low
Princess damsel	*Pomacentrus vaiuli*	1.60	1.51	Low
Spine-cheek clownfish	*Premnas biaculeatus*	2.20	1.82	Medium
Serranidae				
Pygmy basslet	*Luzonichthys waitei*	1.00	2.04	Low
Yellowback basslet	*Pseudanthias bicolor*	1.60	1.59	Low
Red basslet	*Pseudanthias cooperi*	1.60	1.51	Low
Fairy basslet	*Pseudanthias dispar*	1.40	1.82	Low
Pacific basslet	*Pseudanthias huchtii*	1.60	1.82	Low
Pink basslet	*Pseudanthias hypselosoma*	1.60	1.70	Low
Luzon basslet	*Pseudanthias luzonensis*	1.60	1.78	Low
Sailfin queen	*Pseudanthias pascalus*	1.60	1.70	Low
Painted basslet	*Pseudanthias pictilis*	1.60	1.91	Low
Mirror basslet	*Pseudanthias pleurotaenia*	1.60	1.51	Low
Lilac-tip basslet	*Pseudanthias rubrizonatus*	1.80	1.70	Low
Princess basslet	*Pseudanthias smithvanizi*	1.40	1.70	Low
Orange basslet	*Pseudanthias squamipinnis*	1.60	1.51	Low
Purple queen	*Pseudanthias tuka*	1.60	1.82	Low

Common name	Species name	Productivity	Susceptibility	Final vulnerability rating
Longfin basslet	*Pseudanthias ventralis*	1.40	1.78	Low
Golden anthias	*Pyronotanthias aurulentus*	1.40	1.91	Low
Lori's basslet	*Pyronotanthias lori*	1.60	1.59	Low
Swallowtail basslet	*Serranocirrhitus latus*	1.60	1.78	Low
Siganidae				
Coral rabbitfish	*Siganus corallinus*	1.80	1.70	Low
Masked rabbitfish	*Siganus puellus*	1.80	1.91	Low
Foxface	*Siganus vulpinus*	1.80	1.91	Low

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Definitions and Abbreviations

AFMA	–	Australian Fisheries Management Authority.
AIMS	–	Australian Institute of Marine Science.
CAAB	–	Codes for Australian Aquatic Biota.
CITES	–	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
CSIRO	–	Commonwealth Scientific and Industrial Research Organisation.
DAF/QDAF	–	Queensland Department of Agriculture and Fisheries.
EPBC Act	–	*Environment Protection and Biodiversity Conservation Act 1999.*
ERAEF	–	*Ecological Risk Assessment for the Effects of Fishing*. A risk assessment strategy established by Hobday *et al*. (2011) and employed by the AFMA.
False positive	–	The situation where a species at low vulnerability is incorrectly assigned a higher vulnerability rating due to the method being used, data limitation etc. In the context of an VA, false positives are preferred over false negatives.
False negative	–	The situation where a species at high vulnerability is assigned a lower vulnerability rating. When compared, false-negative results are considered to be of more concern as the impacts/consequences can be more significant.
GBRMP / GBRMPA	–	Great Barrier Reef Marine Park / Great Barrier Reef Marine Park Authority.
MAFF	–	Marine Aquarium Fish Fishery.
PSA	–	Productivity and Susceptibility Analysis. One of the two VA methodologies that can be used as part of the Level 2 assessments.
RVA	–	Residual Vulnerability Analysis.
SAFE	–	*Sustainability Assessment for Fishing Effects*. One of the two VA methodologies that can be used as part of the Level 2 assessments. This method can be separated into a base SAFE (bSAFE) and enhanced SAFE (eSAFE). The data requirements for eSAFE is higher than a bSAFE which aligns more closely to a PSA.
VA	–	Vulnerability Assessment.
WTO	–	Wildlife Trade Operation.

1 Introduction

The Marine Aquarium Fish Fishery (MAFF) is a hand-collection fishery that primarily operates within the confines of the Great Barrier Reef Marine Park (GBRMP; Department of Agriculture and Fisheries, 2023a). Operators collect a diverse range of marine fishes, invertebrates and elasmobranchs for the live marine aquarium trade. Most are collected in coral reef or inter-reef habitats and are sold on international and domestic markets for display in aquaria or as brood stock.

Condition 5 of the previous MAFF Wildlife Trade Operation (WTO) accreditation required an Ecological Risk Assessment (ERA) to be completed for the fishery (Department of Climate Change Energy the Environment and Water, 2022). Wildlife Trade Operation accreditations are issued under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and are required for all export fisheries (EPBC Act; Department of Climate Change Energy the Environment and Water, 2022). Condition 5 of this WTO was fulfilled with the publication of the MAFF whole-of-fishery ERA; otherwise known as a Level 1 ERA (Department of Agriculture and Fisheries, 2018b; 2023a; Morton & Jacobsen, 2023). The Level 1 ERA established a broad risk profile for the MAFF, identifying the key drivers of risk and the ecological components most likely to experience an undesirable event.

On 18 April 2024, the MAFF was re-accredited as a WTO under Part 13A of the *EPBC Act* (Department of Climate Change Energy the Environment and Water, 2024). Condition 5(a) of this accreditation requires a species-specific (Level 2) assessment to be completed for the fishery and for it to be published by 31 October 2024 (Department of Climate Change Energy the Environment and Water, 2024). In accordance with this condition, a species-specific Vulnerability Assessment (VA) has now been completed for the MAFF, herein referred to as the MAFF VA.

The following provides an in-depth account of the findings of the MAFF VA for a range of marine ornamental fishes. Species represented in this report were identified as key target species, contributors to the historical MAFF harvest and/or are targeted with more regularity within this fishery (Department of Agriculture and Fisheries, 2022d; 2023a). Expert advice was also utilised to prioritise species for assessment. The completion of this report fulfils Condition 5(a) of the MAFF WTO and fulfils a core recommendation of the Level 1 ERA (Morton & Jacobsen, 2023). The report establishes a new, more adaptive strategy for assessing vulnerability in the MAFF and updates the vulnerability profiles for a range of species (Roelofs & Silcock, 2008).

2 Scope

The MAFF VA considers all fishing activities permitted under the A1 or A2 fishery symbol (Business Queensland, 2024). The assessment takes into consideration fishing activities within the GBRMP, where the majority of effort is reported, as well as harvesting from smaller fishing grounds south of the marine park (Department of Agriculture and Fisheries, 2022d; 2023a).

While the scope of this assessment considers all A1 and A2 fishing activities, it does not include every species that can be retained for sale in this fishery. Under the Fisheries (Commercial Fisheries) Regulation 2019 (State of Queensland, 2019), operators with an A1 or A2 fishery symbol can take all fish[1] other than a) barramundi, b) sea cucumber[2], c) shell grit, d) star sand and e) any species of coral, oyster, pearl oyster or trochus. These provisions allow operators to retain a very high number of species across a wide range of vertebrate and invertebrate subgroups (Department of Agriculture and Fisheries, 2023a). Undertaking vulnerability assessments for all permitted MAFF species was deemed both unnecessary and unwarranted.

A review of the available data indicated that a high number of fish species are retained infrequently and have been harvested at comparatively low levels over the last 10 years (Department of Agriculture and Fisheries, 2023a). This includes elasmobranchs which are retained in very small quantities (<0.3 per cent of the total catch over the last 10 years; Department of Agriculture and Fisheries, 2022b; 2023a), require specialised husbandry and are often caught on consignment for display in public aquaria. For these reasons, elasmobranchs were viewed as lower assessment priorities and were omitted from the analysis.

Outside of fish species, invertebrates make up a notable portion of the reported MAFF catch (approximately 40% in recent years; Department of Agriculture and Fisheries, 2023a). However, harvest data for invertebrates has poor species resolution and provides limited insight into the extent of any species-specific fishing pressures. These reporting deficiencies are compounded by data limitations surrounding the biology and taxonomy of invertebrate species. From an assessment perspective, these (data) deficiencies make the assignment of vulnerability ratings more difficult and increase the probability of the PSA producing vulnerability over-estimates or false-positive results (Hobday *et al.*, 2011; Zhou *et al.*, 2016).

For the above reasons, it was determined that the MAFF VA would prioritise assessments for teleost families that are more frequently harvested in this fishery. This decision was taken in consultation with a range of stakeholders and the Marine Aquarium Fish and Coral Fisheries Working Group (Department of Agriculture and Fisheries, 2021d). When and where appropriate species excluded from the first iteration of the MAFF VA, including invertebrates and elasmobranchs, will be considered for inclusion in subsequent assessments involving this fishery.

The scope and extent of future MAFF assessments will depend on a range of factors, including but not limited to, the effectiveness of the harvest strategy program (Department of Agriculture and Fisheries, 2020; 2021c) and the outputs of initiatives instigated under the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a). When necessary, future MAFF assessments will incorporate vulnerability profile updates for species included in this assessment to account for new information and developments.

3 Methods

In Queensland, ERAs have previously been developed on an as-needs basis and have often employed alternate methodologies. This process has now been formalised as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* and risk assessments are being completed in accordance

[1] Excludes species protected under the *Fisheries Act 1994* and subordinate legislation and those classified as no-take.

[2] Under the Fisheries (Commercial Fisheries) Regulation 2019, 'sea cucumber' does not include fish of the following species—(a) *Bohadschia graeffei*; (b) *Calachrius crassus*; (c) *Cucmaria miniata*; (d) *Euapta godeffroyi*; (e) *Holothuria edulis*; (f) *Holothuria hilla*; (g) *Opheodesoma spp*.; (h) *Pentacta anceps*; (i) *Pentacta lutea*; (j) *Pseudocolchirus violaceus*; (k) *Stichopus noctivagus*; (l) *Synapta maculata.*

with the *Queensland Ecological Risk Assessment Guideline* (the Guideline; Department of Agriculture and Fisheries, 2017; Department of Agriculture and Fisheries, 2018b). The Guideline was released in March 2018 and includes a Scoping Study, a qualitative whole-of-fishery (Level 1) assessment, a semi-quantitative species-specific (Level 2) assessment and, where necessary, a fully quantitative (Level 3) ERA (Department of Agriculture and Fisheries, 2018b).

A Scoping Study and whole-of-fishery (Level 1) ERA was completed for the MAFF in April 2023 (Department of Agriculture and Fisheries, 2023b; Morton & Jacobsen, 2023). This assessment represents the next step in the assessment framework (Level 2) and examines how vulnerable a priority subset of species are to fishing activities within the MAFF.

3.1 Species Prioritisation Process

The following provides a brief overview of how the assessment list was compiled for the MAFF VA and the species prioritisation process. A comprehensive overview of the species prioritisation process and justifications for including or omitting a species from the vulnerability assessment has been provided in Appendix A and B.

A preliminary list of MAFF species was collated through a review of the fisheries logbook data, previous vulnerability assessments and industry resources (Department of Agriculture and Fisheries, 2023a; Roelofs & Silcock, 2008). While more diverse, this list consisted largely of damselfishes (Family Pomacentridae), wrasses (Family Labridae), angelfishes (Family Pomacanthidae), butterflyfishes (Family Chaetodontidae), anthias (Family Serranidae), surgeonfishes (Family Acanthuridae), assessors (Family Plesiopidae), gobies (Family Gobiidae), cardinalfishes (Family Apogonidae) and blennies (Family Blenniidae) (Appendix B). These families were all identified as key contributors to the historical MAFF teleost harvest and are targeted with more regularity within this fishery (Department of Agriculture and Fisheries, 2022d; 2023a).

Once compiled, the preliminary species list was subject to a final prioritisation process (Appendix A). While more advanced, some of the key considerations of the species prioritisation process included the contribution of each species to the total historical harvest, available information on each species distribution and their presence in fishery-dependent data supplied by industry. Further refinements to the list were determined with the assistance of industry stakeholders, scientific experts and management agencies including the Great Barrier Reef Marine Park Authority (GBRMPA) and the Australian Institute of Marine Science (AIMS). For completeness, the final species list was cross-referenced with previous vulnerability and sustainability analyses to ensure that all teleosts with higher ratings were included in the updated assessment (Roelofs & Silcock, 2008).

Each species included in the VA required a baseline of information on their distribution, habitat preferences and depth profiles. Where possible, this information was obtained from peer-reviewed articles and literature. However, the vulnerability profiles of most species also relied on a number of core references, including but not limited to: *Field Guide to Marine Fishes of Tropical Australia and South-East Asia* (Allen, 2018), *Guide to Sea Fishes of Australia* (Kuiter, 2023), *Fishes of the Great Barrier Reef and Coral Sea* (Randall *et al.*, 1990), and *Coastal Fishes of South-Eastern Australia* (Kuiter, 1993).

In the absence of peer-reviewed data, information was sourced from grey literature, suitable proxies and publicly accessible databases such as Fishes of Australia (www.fishesofaustralia.net.au), FishBase (www.fishbase.org), and the IUCN Red List of Threatened Species (www.iucnredlist.org).

Additional information including on the distribution of individual species were obtained through CSIRO National Collections and Marine Infrastructure (https://www.cmar.csiro.au/caab/) and resources associated with the management and regulation of marine national parks e.g. the Great Barrier Reef Marine Park, Moreton Bay Marine Park and Great Sandy Marine Park.

Fisheries data used in the MAFF VA were obtained through the fisheries logbook program, the *Queensland Fisheries Summary Report* (Department of Agriculture and Fisheries, 2022d) and information contained in third party approvals and assessments (Department of Climate Change Energy the Environment and Water, 2022).

3.2 Productivity and Susceptibility Analysis (PSA)

The MAFF Level 2 assessment applied a Productivity and Susceptibility Analysis (PSA) and the framework was largely aligned with that used in other commercial fisheries (Department of Agriculture and Fisheries, 2022b). Aspects of this framework though were amended to accommodate the comparatively small scale and specificity of the MAFF (Department of Agriculture and Fisheries, 2018b; 2022b).

One of the challenges of undertaking a PSA is that it has the potential to produce false positive results or risk overestimates (Department of Agriculture and Fisheries, 2018b; Zhou *et al.*, 2016). This is due, in part, to the conservative nature of the assessment protocols and the influence of confounding factors such as data deficiencies. The potential for false positives is considered higher in hand collection fisheries like the MAFF due to it having a smaller effort footprint and more targeted fishing impacts. This fishery also operates under a more extensive risk management framework that includes limited licencing, gear restrictions and a complex system of marine-park spatial closures. The direct implications being that the PSA may produce results that are more reflective of the potential risk *versus* an actual or real risk (Department of Agriculture and Fisheries, 2018b). In other words, the PSA will accurately identify the attributes that make a species more vulnerable to MAFF fishing activities but may be less reliable in terms of determining how this vulnerability translates to risk within the current fishing environment. Due to this potential, the PSA was defined as a 'vulnerability assessment' (*versus* a risk assessment) as it provides a more accurate reflection of what the method is assessing within the MAFF.

While the MAFF VA follows the broader framework established under the Guidelines (Department of Agriculture and Fisheries, 2018b), assessment criteria were amended to account for regional nuances and the nature of marine ornamental species. These amendments were informed by a review of analogous vulnerability assessments involving ornamental fisheries (Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Okemwa *et al.*, 2016; Roelofs & Silcock, 2008) and were undertaken in consultation with scientific experts and the Marine Aquarium Fish and Coral Fisheries Working Group (Department of Agriculture and Fisheries, 2021d).[3] The following provides an overview of the attributes and criteria used to assess the life-history constraints of individual species and their susceptibility to activities within the MAFF. Additional information on the attributes used to construct the MAFF PSA are provided in Appendix C. For a more detailed account of the broader PSA methodology, including key assumptions, refer to Hobday *et al.* (2007) and Patrick *et al.* (2009).

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[3] Membership for the Marine Aquarium Fish and Coral Fisheries Working Group includes industry representatives, scientific experts and management agencies like the Queensland Department of Agriculture and Fisheries and the Great Barrier Reef Marine Park Authority.

The PSA, in effect, estimates the relative vulnerability of key species based on their biological productivity and susceptibility to activities within a fishery (de Freitas *et al.*, 2023; Hobday *et al.*, 2011; Stobutzki *et al.*, 2002). The productivity component of the PSA examines the life-history constraints of a species and the potential for an attribute to contribute to the overall vulnerability. These attributes are based on the biology of the species and include age at maturity, maximum age, maximum size, reproductive strategy and the von Bertalanffy growth coefficient (Table 1). Where possible, productivity assessment attributes were aligned with previous ERAs developed under the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017; 2018b). However, several amendments were made to the productivity attributes to account for life-history and morphological variations, data limitations and the unique dynamics of a hand-collection fishery.

One of the more significant changes within the productivity component was the omission of trophic level as an assessment attribute (Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2011; Hobday *et al.*, 2007). Limited gut content analyses have been undertaken for species targeted in the MAFF and dietary information included in grey literature (e.g. Fishbase) are unreliable (pers. comm. D. Bellwood). Including this attribute in the assessment would increase uncertainty and provide limited assistance differentiating between vulnerability levels of individual species.

As an analogous dietary attribute could not be found for trophic level, the von Bertalanffy growth coefficient (k) was included as a substitute. The von Bertalanffy growth function is a model commonly used to describe the growth of teleosts and elasmobranchs through time (Goldman, 2004; Pardo *et al.*, 2013; von Bertalanffy, 1938). Within this model, the growth coefficient (k) describes how quickly a species reaches its maximum length. While k does not deal specifically with the feeding behaviours of ornamental species, it has been used as an indicator of biological vulnerability to assess marine ornamental species in jurisdictions beyond Australian waters (Dee *et al.*, 2019; Fujita *et al.*, 2014; Okemwa *et al.*, 2016).

Criteria used to assign each productivity attribute with a score of low (1), medium (2) or high (3) vulnerability are outlined in Table 1. Additional information on all the productivity attributes considered as part of the MAFF VA and their previous use in assessments has been provided in Appendix C.

Table 1. *Scoring criteria and cut-off scores for the productivity component of the Productivity and Susceptibility Analysis (PSA) utilised as part of the MAFF VA. Where possible, attributes and scores/criteria were aligned with the national (ERAEF) approach (Hobday et al., 2011).*

Productivity attributes	**High productivity (Low vulnerability, score = 1)**	**Medium productivity (Medium vulnerability, score = 2)**	**Low productivity (High vulnerability, score = 3)**
Age at maturity	<1 year	1–2 years	>2 years
Maximum age	<5 years	5–15 years	>15 years
Maximum size	<10 cm	10–20 cm	>20 cm
Reproductive strategy and fecundity	Broadcast spawner, >1000 eggs	Demersal egg layer or mouth brooder, <1000 eggs	Live bearer
von Bertalanffy growth coefficient (k)	>0.25	0.15–0.25	<0.15

The susceptibility component of the PSA, by necessity, diverged further away from attributes applied in previous assessments (Appendix C; Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2011). For example, post-capture mortality was not included in the MAFF VA despite it being widely used as a susceptibility indicator (Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2011). As the MAFF is a hand-collection fishery with limited bycatch issues (Morton & Jacobsen, 2023), assessing post-interaction mortality provides limited assistance when differentiating between species-specific vulnerabilities. Conversely, the inclusion of this attribute in the MAFF VA would contribute to the production of more conservative assessments and a higher number of false-positives.

In addition to the broader framework, finer-scale amendments to the susceptibility attribute definitions and criteria were required. For example, selectivity is often based on the size of the animal compared to a predefined measure of the apparatus e.g. fish size compared to mesh size. In the MAFF, selectivity will depend on a wider range of factors including, but not limited to, market demand, rarity, size, sex, distribution (i.e. endemic), colouration and aquaria suitability (i.e. reef safe / non-aggressive species). For these reasons, the MAFF VA considered two alternate criteria for selectivity, market value and catchability (Table 2). Similarly, depth profile and ecological niche replaced encounterability as indicative measures of vulnerability (Table 2; Appendix C).

While the above amendments produced a more bespoke susceptibility assessment, it allowed for a more detailed evaluation of fishing-related vulnerability within the MAFF. The amendments also align the assessment methodology more closely with those used in analogous assessments involving ornamental fisheries (Dee *et al.*, 2019; Fujita *et al.*, 2014; Okemwa *et al.*, 2016). The following provides an overview of all the susceptibility attributes used in the PSA with Table 2 outlining the criteria used to assign scores for this part of the analysis. Further information on all of the susceptibility attributes considered for inclusion in the MAFF VA has been provided in Appendix C.

- **Availability**—Availability examines the overlap between the MAFF effort footprint and the portion of the species distribution occurring within the broader geographical spread of the fishery. In the MAFF, an absence of reliable species distributions limited the extent of any direct comparisons between the fishing effort overlap and regional species distributions. For this reason, availability scores were based on the broader geographic distribution assessment described in Hobday *et al.* (2007) and outlined in Table 2. This assumes the vulnerability posed to widely distributed species would be lower as they have refuge outside the prescribed fishing area.

- **Depth profile**—This attribute assesses the relationship between the species core depth profile and fishing activities within the MAFF. This assumes that species with a shallow depth range will have increased exposure and vulnerability to collection due to a higher interaction potential (i.e. with diving collectors). In comparison, species found at greater depths will be afforded a degree of natural protection from MAFF activities as diving access is more limited.

- **Ecological niche**—Ecological niche was used to identify the relationship between marine species and their surroundings. This attribute assumes that species with specialised functional roles or ecological connections are more susceptible to localised depletion when compared to generalist species. When impacted by fishing effort, specialist species will have more limited areas of refuge as they require specific habitats to survive.[4]

- **Management strategy**—The inclusion of management strategy as a susceptibility attribute helps differentiate between species that are afforded a higher level of protection under the current management regime and the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* (Department of Agriculture and Fisheries, 2021c).

  This attribute has been used in previous assessments involving Queensland commercial fisheries and in analogues ornamental fishery vulnerability assessments (Appendix C; Dee *et al.*, 2019; Department of Agriculture and Fisheries, 2022b). This addition was warranted as the MAFF operates under a more complex management system when compared to other jurisdictions (Department of Agriculture and Fisheries, 2021c; 2023a). These arrangements include provisions governing the use of resources within marine parks along the Queensland east coast (Department of Environment and Science, 2020a; b; Great Barrier Reef Marine Park Authority, 2020).

- **Market value**—Market value and desirability are important factors driving collection effort in the aquarium trade. In the MAFF VA, the market value attribute definition was aligned with a previous sustainability assessment (Roelofs & Silcock, 2008). This study, in effect, assumed that low value species are less vulnerable to fishing activities in the MAFF as they are generally plentiful and/or less desirable. Conversely, species that are of higher value are considered more vulnerable as they are often less readily available and/or rare.

  Market value is one of the more difficult aspects to assess in ornamental fisheries as it often reflects a wider array of considerations. This attribute though is frequently used in PSAs involving ornamental fisheries as an indirect assessment of a factor that increases the likelihood of a species being collected. When used in a PSA, attributes relating to ‘market value’ or ‘marketability’ generally hold to the principle that higher value species have higher vulnerability. This includes in the 2008 MAFF sustainability assessment (Roelofs & Silcock, 2008).

  The market value attribute used in the MAFF VA represents a refined version of the previous assessment (Roelofs & Silcock, 2008). The use of market value as an assessment attribute also aligns with PSAs involving alternate ornamental fisheries (Appendix C).

- **Catchability**—Catchability refers to the behavioural characteristics of a species which influences its susceptibility and ease of capture. This attribute assumes solitary species are less vulnerable to being targeted or caught due to the high-effort, low-gain, requirements of collecting a single specimen.[5] Species that are found in pairs, small groups, aggregations, or schools provide collectors increased opportunities to catch multiple specimens and are therefore more susceptible to the negative effects of fishing activities. Catchability is a modification of two attributes used in analogous fishery vulnerability assessments: Schooling / aggregation (Dee *et al.*, 2019) and Schooling/aggregation and other behavioural responses (Patrick *et al.*, 2009) (Appendix C).

[4] Whether or not a species can survive in a variety of habitats or is dependent on another species (e.g. through symbiotic relationships) is an important factor to consider. It defines how restricted a species is within its surroundings and impacts its ability to recover from disturbances (e.g. overharvesting).

[5] For some species, a high amount of fishing effort is required to obtain a small number of specimens. This results in low gain for collectors as the effort isn’t offset by high specimen quantities and/or revenue.

Table 2. *Scoring criteria and cut-off scores for the susceptibility component of the Productivity and Susceptibility Analysis (PSA). Where appropriate, attributes and the corresponding scores/criteria were aligned with national (ERAEF) approach (Hobday et al., 2011).*

Susceptibility attributes	**Low susceptibility (Low vulnerability, score = 1)**	**Medium susceptibility (Medium vulnerability, score = 2)**	**High susceptibility (High vulnerability, score = 3)**
Availability	Global: Widespread in the Indo-Pacific.	Restricted ranges in the Indo-Pacific. Constraints on regional distribution.	Endemic to Australia.
Depth profile	Limited accessibility: >30 m	Accessible: 10–30 m	Readily accessible: <10 m
Ecological niche	Generalist. Broad range of functions and habitat (not limited to coral reefs) e.g. do not depend on the reef although use its resources.	Associated with a specific habitat and/or ecological function e.g. depend on the reef to survive.	Specific microhabitat or symbiotic relationship.
Management strategy	Targeted stocks have proactive accountability measures (e.g. Tier 1).	Targeted stocks have reactive accountability measures (e.g. Tier 2).	Targeted stocks do not have accountability measures and are not closely monitored.
Market value	This species is low value. ($0–99)	This species is moderately valuable. ($100–999)	This species is high value. (>$1,000)
Catchability	Solitary and/or cryptic. i.e. species behaviour decreases the ease of capture.	Aggregating on the reef or in pairs i.e. species behaviour does not substantially affect the ease of capture.	Aggregating above the reef in groups / schools i.e. species behaviour increases the ease of capture.

3.3 PSA Scoring

All PSA attributes were assigned a score of 1 (low vulnerability), 2 (medium vulnerability) or 3 (high vulnerability) based on criteria outlined in Table 1 and Table 2 (Dee *et al.*, 2019; Hobday *et al.*, 2011; Okemwa *et al.*, 2016; Patrick *et al.*, 2010). In instances where an attribute has no available data and in the absence of credible information to the contrary, a default rating of high vulnerability (3) was assigned (Hobday *et al.,* 2011). This approach introduces a precautionary element into the PSA and minimises the potential occurrence of false-negative results. The inherent trade off with this approach is that the outputs of the MAFF VA can be conservative and may include a number of false positives (Zhou *et al.,* 2016). Issues associated with false positives and the overestimation of vulnerability will be examined further as part of the Residual Vulnerability Analysis (RVA) described below.

Vulnerability ratings (V) were based on a two-dimensional graphical representation of the productivity (x-axis) and susceptibility (y-axis) scores (Fig. 1).[6] Cross-referencing of the productivity (additive) and susceptibility (geometric) scores provides each species with a graphical location that can be used to calculate the Euclidean distance or the distance between the species reference point and the origin (i.e. 0, 0 on Fig. 1). This distance is calculated using the formula $V = ((P - X_0)^2 + (S - Y_0)^2)^{1/2}$ where P represents the productivity score, S represents the susceptibility score and X_0 and Y_0 are the respective x and y origin coordinates (Brown *et al.,* 2013). The further a species is away from the origin the higher the vulnerability is considered to be. For the purpose of this VA, cut offs for each vulnerability category were aligned with previous PSAs with scores below 2.64 classified as low vulnerability, scores between 2.64 and 3.18 as medium vulnerability and scores >3.18 classified as high vulnerability (Brown *et al.*, 2013; Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2007; Zhou *et al.*, 2016).

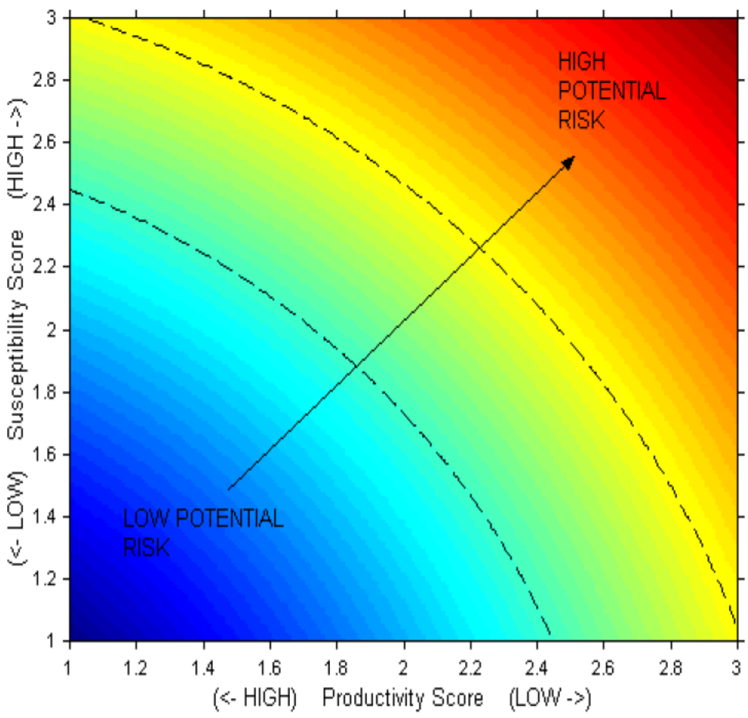

Figure 1. *Productivity and Susceptibility Analysis (PSA) plot demonstrating the two-dimensional space on which species units are plotted. PSA scores for species units represent the Euclidean distance or the distance between the origin and the productivity (x axis), susceptibility (y axis) intercept (excerpt from Hobday. et al., 2007).*

[6] The MAFF uses an adapted form of the methodology used to complete assessments for other commercial fisheries under the ERA Guidelines. While noting this variability, the principles behind the assessment and the risk rating thresholds remain the same.

The PSA ratings are considered an initial assessment of a species vulnerability and may be subject to change. These scores are based solely off the PSA criteria and will be refined as part of the RVA. These refined scores will be used to assign each species a final vulnerability rating

3.4 Uncertainty

A number of factors increase the level of uncertainty within a vulnerability assessment including the use of imprecise estimates, missing data, averages and proxies. The PSA methodology also includes precautionary elements that have the potential to increase uncertainty. For example, assigning a default high-vulnerability score for any attributes with missing data (Hobday *et al.,* 2011). In the MAFF VA, uncertainty was examined through a baseline assessment of each vulnerability profile to determine the proportion of attributes assigned precautionary vulnerability ratings. As species with greater data deficiencies will be assigned a higher number of default ratings, their profiles are more likely to fall on the conservative side of the spectrum. In these instances, it may be more appropriate to address these vulnerabilities through mechanisms like logbook reforms and the *Queensland Marine Aquarium Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2018a; 2022a; Queensland Government, 2024).

3.5 Residual Vulnerability Analysis (RVA)

Precautionary elements in the PSA combined with an undervaluation of some management arrangements can result in more conservative vulnerability assessments and a higher number of false positives. Similarly, the effectiveness of some attributes may be exaggerated, and subsequent vulnerability or risk scores could be underestimated (false negatives). To address these issues, PSA results were subjected to a Residual Vulnerability Analysis (RVA).[7] The RVA gives further consideration to mitigation/management measures that were not explicitly considered as part of the PSA and any additional information that may influence the vulnerability status of a species (Australian Fisheries Management Authority, 2017). In doing so, the RVA provides management with greater capacity to assess the vulnerability rating assigned to each species and how it applies to the current fishing environment (Department of Agriculture and Fisheries, 2018b).

The RVA framework was based on guidelines established by CSIRO and the Australian Fisheries Management Authority (AFMA; Australian Fisheries Management Authority, 2018). These guidelines identify six avenues where additional information may be given further consideration as part of a PSA. Given regional nuances and data variability, a degree of flexibility was required with respect to how these guidelines were applied to commercial fisheries in Queensland and the justifications used. The RVA was also expanded to include a seventh guideline titled *Additional Scientific Assessment and Consultation*. While a version of this guideline has been used in previous commonwealth fishery assessments, it was removed as part of a broader procedural review (Australian Fisheries Management Authority, 2018). In Queensland, this guideline was retained as the broader assessment framework includes a series of consultation steps that aid in the development and finalisation of fishery-specific assessments (Department of Agriculture and Fisheries, 2018b).

[7] Previous reports delivered under the Guidelines (Department of Agriculture and Fisheries, 2018b) have utilised a Residual Risk Analysis component. For the purpose of this report Residual Risk Analysis has been amended to 'Residual Vulnerability Analysis', in line with the adapted MAFF VA terminology.

In instances where the RVA resulted in an amendment to the preliminary score, full justifications were provided including the guidelines in which the amendments were considered (Appendix F). A summary of each guideline and the RVA considerations has been provided in Table 3.

Table 3. *Guidelines used to assess residual vulnerability including a brief overview of factors taken into consideration. Summary represents a modified excerpt from the revised AFMA ERA, Residual Risk Assessment Guidelines (Australian Fisheries Management Authority, 2018).*

Guidelines	Summary
Guideline 1*: Vulnerability rating due to missing, incorrect or out of date information.*	Considers if susceptibility and/or productivity attribute data for a species is missing or incorrect for the fishery assessment and is correct using data from a trusted source or another fishery.
Guideline 2*: Additional scientific assessment and consultation.*	Considers any additional scientific assessments on the biology or distribution of the species and the impact of the fishery. This may include verifiable accounts and data raised through key consultative processes including but not limited to targeted consultation with key experts and oversight committees established as part of the *Queensland Sustainable Fisheries Strategy 2017–2027* e.g. Fisheries Working Groups and the Sustainable Fisheries Expert Panel.
Guideline 3*: Vulnerable with spatial assumptions.*	Provides further consideration to the spatial distribution data, habitat data and any assumptions underpinning the assessment.
Guideline 4*: Vulnerable in regard to level of interaction / capture with a zero or negligible level of susceptibility.*	Considers observer or expert information to better calculate susceptibility for those species known to have a low likelihood or no record of interaction nor capture with the fishery.
Guideline 5*: Effort and catch management arrangements for target and byproduct species.*	Considers current management arrangements based on effort and catch limits set using a scientific assessment for key species.
Guideline 6*: Management arrangements to mitigate against the level of bycatch.*	Considers management arrangements in place that mitigate against bycatch by the use of gear modifications, mitigation devices and catch limits.
Guideline 7*: Management arrangements relating to seasonal, spatial and depth closures.*	Considers management arrangements based on seasonal, spatial and/or depth closures.

4 Results

4.1 Productivity and Susceptibility Analysis (PSA)

Cross-referencing fisheries dependent data, previous assessments, industry species lists, and desktop research produced a preliminary list of over 700 teleosts that were considered for inclusion in the MAFF VA. Subsequent consultation and further research rationalised this list to 311 species. Of these, 137 species were identified as assessment priorities with the remaining viewed as secondary species. Secondary species were classified as lower assessment priorities and will be considered for inclusion in subsequent vulnerability assessments (Appendix B).

Of the species identified for inclusion in this iteration of the MAFF VA, wrasses (Family Labridae) had the highest representation (*n* = 28), followed by damselfishes (Family Pomacentridae, *n* = 24), butterflyfishes (Family Chaetodontidae, *n* = 20), anthias/basslets (Family Serranidae, *n* = 18), angelfishes (Family Pomacanthidae, *n* = 17), surgeonfishes (Family Acanthuridae, *n* = 8), gobies (Family Gobiidae, *n* = 6), cardinalfishes (Family Apogonidae, *n* = 3), blennies (Family Blenniidae, *n* = 3), rabbitfishes (Family Siganidae, *n* = 3), razorfishes (Family Centriscidae, *n* = 2), assessors (Family Plesiopidae, *n* = 2), triggerfishes (Family Balistidae, *n* = 1), filefishes (Family Monacanthidae, *n* = 1), and pineapplefishes (Family Monocentridae, *n* = 1). Harvest rates for a number of these families are comparatively low but selected species were included in the assessment as a precautionary measure (Appendix B).

Based on the prescribed criteria (Table 1), all species registered productivity scores greater than, or equal to 1.60 (*average* = 2.40). At a family level, triggerfishes (Family Balistidae) had the highest average productivity score (2.80), followed by filefishes (Family Monacanthidae), pineapplefishes (Family Monocentridae) and rabbitfishes (Family Siganidae) (*average* = 2.60). The remaining families had an average productivity score of between 2.30 and 2.47 (Appendix D). At the species level, the candy wrasse (*Pseudojuloides splendens*), the pink-banded fairy wrasse (*Cirrhilabrus roseafascia*) and the clown triggerfish (*Balistoides conspicillum*) registered an assessment-high productivity score of 2.80 (Appendix D). The Hoeven's wrasse (*Halichoeres melanurus*) and the flame angelfish (*Centropyge loriculus*) had the lowest productivity score (1.60; Appendix D).

Of the five productivity attributes assessed, age at maturity (*average* = 2.96), maximum age (*average* = 2.88) and the von Bertalanffy growth coefficient (*k*, *average* = 2.74) had the highest average scores. Conversely, maximum size and reproductive strategy had the lowest average at 2.07 and 1.34 respectively (Appendix D).

Productivity assessments varied in terms of the available data and the need to assign precautionary vulnerability ratings. These deficiencies were most evident in attributes relating to the age and growth of ornamental species i.e. age at maturity, maximum age and the von Bertalanffy growth coefficient (Table 4). Acquiring age and growth data from standard age-based metrics (e.g. otolith studies[8]) is often lethal to the specimens sampled (Department of Agriculture and Fisheries, 2021b; Tobin, 2014). These methods do not align with the business model employed in the MAFF which prioritises the sale of species in the live ornamental trade. The remainder of the scores assigned to the productivity attributes were largely supported by scientific evidence (Appendix D).

In the susceptibility analysis, all teleosts registered scores of between 1.41 and 2.45 at an average of 1.86 (Appendix D). At a family level, blennies (Family Blenniidae) and cardinalfishes (Family Apogonidae) had the highest average susceptibility score at 2.19 and 2.06 respectively. The remaining family groups had an average susceptibility score of between 1.51 and 1.97 (Appendix D).

[8] Ageing fish species is most accurately estimated through an analysis of the rings present in otoliths (ear bones) (Choat & Robertson, 2002). Growth curves can then be developed to estimate k, L∞, and Tmax using size-at-age data from otolith sampling.

Table 4. *Summary of the number of attributes that were assigned a precautionary high (3) score as part of the Productivity and Susceptibility Analysis (PSA) due to data deficiencies.*

	Productivity					**Susceptibility**					
	Age at maturity	**Maximum age**	**Maximum size**	**Reproductive strategy**	**von Bertalanffy (*k*)**	**Availability**	**Depth profile**	**Ecological niche**	**Management strategy**	**Catchability**	**Market value**
Species with data	5	22	137	134	21	137	136	135	137	116	111
Species missing attribute data	132	115	0	3	116	0	1	2	0	21	26
% Unknown Information	96%	84%	0%	2.2%	85%	0%	0.7%	1.5%	0%	15%	19%

At a species level, the tiger combtooth blenny (*Ecsenius tigris*) and the Squire's fairy wrasse (*Cirrhilabrus squirei*) registered the highest susceptibility score of the assessment (2.45) due, in part, to them having a high level of availability and more limited datasets (Appendix D). At the other end of the spectrum, the Mertens' butterflyfish (*Chaetodon mertensii*) registered a susceptibility score of just 1.41 (Appendix D).

Across the study, the depth profile attribute was the greatest contributor of vulnerability within the susceptibility component (*average* = 2.88; *range* = 1.00 to 3.00), followed by catchability (*average* = 2.36), management strategy (*average* = 1.93), ecological niche (*average* = 1.82), market value (*average* = 1.74) and availability (*average* = 1.28) (Appendix D).

The majority of scores assigned to susceptibility attributes were supported by scientific evidence, the grey literature and/or were assigned with a high degree of confidence (e.g. availability; Table 4). Of the six susceptibility attributes assessed, data deficiencies / assessment uncertainty presented the biggest challenge for market value and catchability (Table 4). Scores assigned to these two attributes were more precautionary and contributed to the production of more conservative (preliminary) vulnerability assessments (Table 5; Appendix D).

When the productivity and susceptibility scores were taken into consideration, Family Blenniidae, (*average* = 3.31) had the highest average vulnerability score, followed by Family Apogonidae (*average* = 3.22), Family Balistidae (*average* = 3.18), Family Siganidae (*average* = 3.18), Family Monocentridae (*average* = 3.17), Family Monacanthidae (*average* = 3.11) and Family Plesiopidae (*average* = 3.11) (Table 5). Within these families, 31 species had preliminary PSA scores that fell within the high-vulnerability category, 103 species in the medium-vulnerability category and three in the low-vulnerability category. The dominance of the medium and high vulnerability classifications largely reflects the presence of data deficiencies and the need to assign precautionary ratings to key attributes e.g. age at maturity, maximum age, *k*, market value and catchability (Appendix D; Table 4).

Table 5. *Preliminary vulnerability ratings for each respective family compiled as part of the Productivity and Susceptibility Analysis (PSA), the number of species in each vulnerability category and the overall highest score and average score for each Family. Refer to Appendix D for a full account of the attribute scores assigned to individual species.*

Family	No. Species in Each PSA Classification			Vulnerability Score Summary	
	Low	Medium	High	Highest score	Average
Acanthuridae	0	6	2	3.30	2.96
Apogonidae	0	1	2	3.39	3.22
Balistidae	0	0	1	3.18	3.18
Blenniidae	0	1	2	3.43	3.31
Centriscidae	0	2	0	3.09	3.05
Chaetodontidae	0	19	1	3.30	3.02
Gobiidae	0	4	2	3.39	3.03
Labridae	1	19	8	3.57	3.08
Monacanthidae	0	1	0	3.11	3.11
Monocentridae	0	1	0	3.17	3.17
Plesiopidae	0	2	0	3.15	3.11
Pomacanthidae	2	11	4	3.22	3.01
Pomacentridae	0	17	7	3.49	3.05
Serranidae	0	18	0	3.10	2.95
Siganidae	0	1	2	3.22	3.18

4.2 Residual Vulnerability Analysis (RVA)

The RVA of the preliminary attribute scores refined the profiles of most species included in this assessment (Table 6; Appendix E). The magnitude of the RVA refinements was due, in part, to the paucity of information on the age and growth of ornamental species. In the PSA, these deficiencies resulted in a high number of species being assigned a default high (3) vulnerability score for age at maturity, maximum age and von Bertalanffy growth coefficient (Table 4; Appendix D). In the RVA, a notable portion of these default high scores were refined and reduced through additional consultation, consideration of alternate growth models and the use of proxies. Less extensive amendments were made to preliminary scores assigned to the reproductive strategy attribute (Appendix E and F).

When compared to the productivity component, the RVA of the susceptibility scores produced fewer amendments (Appendix E). The vast majority of these refinements involved the market value and catchability attribute (Appendix E). Preliminary depth profile attribute scores were also reduced for a number of species as part of the RVA process (Appendix E). These refinements were supported by information collated through additional consultation and in-depth reviews of regional distribution data, depth profiles and operational constraints (Appendix F).

Table 6. *Vulnerability ratings for each of the respective Families after the results of the Residual Vulnerability Analysis (RVA) were taken into consideration including the number of species in each vulnerability category, the highest vulnerability score and average vulnerability score for each Family. Refer to Appendix E and F for a full account of the RVA including key justifications. Families with '*' were only represented by one species.*

Family	RVA (No. Species)			Key drivers of vulnerability	Final Vulnerability Scores	
	Low	Medium	High		Highest score	Average score
Acanthuridae	3	5	0	Maximum age, maximum size, depth profile	2.76	2.61
Apogonidae	3	0	0	Depth profile	2.59	2.30
Balistidae*	0	1	0	Age at maturity, maximum age, maximum size	2.96	2.96
Blenniidae	3	0	0	Depth profile	2.37	2.32
Centriscidae	2	0	0	Catchability, depth profile	2.2	2.13
Chaetodontidae	18	2	0	Maximum age, maximum size, depth profile, catchability	2.78	2.40
Gobiidae	6	0	0	Depth profile	2.59	2.25
Labridae	23	5	0	Maximum size, depth profile, catchability	3.04	2.32
Monacanthidae*	1	0	0	Depth profile	2.33	2.33
Monocentridae*	0	1	0	Age at maturity, maximum age, *k*	3.11	3.11
Plesiopidae	2	0	0	Depth profile, catchability	2.37	2.31
Pomacanthidae	9	7	1	Age at maturity, maximum age, maximum size, depth profile	3.22	2.72
Pomacentridae	13	11	0	Maximum age, *k*, depth profile, ecological niche, catchability	2.96	2.55
Serranidae	18	0	0	Depth profile, catchability	2.49	2.32
Siganidae	3	0	0	Maximum size, depth profile	2.62	2.57

Across the study, score amendments implemented as part of the RVA reduced the vulnerability scores across a wide range of species. When the amendments were accounted for in the final analysis, all but three families registered average scores within the 'low' vulnerability range (Table 6). The average score for Family Balistidae (2.96), Family Monocentridae (3.11) and Family Pomacanthidae (2.72) indicate that species within these groups had a marginally higher (medium) vulnerability to fishing activities with the MAFF. While no teleost family registered an average 'high' vulnerability score (i.e. >3.18); the maximum score for Family Pomacanthidae did exceed this threshold (Table 6).

The extent of the changes were similarly significant at a species level, with amendments made as part of the RVA reducing the vulnerability rating of 18 species from high to low, 12 species from high to medium and 83 species from medium to low. Vulnerability profile amendments were completed for, but did not alter, the overall classification of 24 species (Appendix D and E). At the completion of the RVA, the assessed species were assigned a cumulative breakdown of 104 low-vulnerability ratings, 32 medium-vulnerability ratings and just one high-vulnerability rating (Table 6).

A full overview of the RVA outcomes has been provided in Appendix E with the justifications underpinning each amendment detailed in Appendix F.

5 Discussion

The *Marine Aquarium Fish Fishery Level 1 ERA – Whole-of-Fishery Assessment* provides a detailed overview of the broader risks posed by this fishery and the ecological components most likely to be impacted (Morton & Jacobsen, 2023).[9] The outputs of the Level 1 ERA demonstrated that the MAFF poses a low to negligible risk to most of the ecological components assessed. The notable exception being the target species ecological component (Morton & Jacobsen, 2023). This report builds on the outputs of the Level 1 ERA and provides further insight into the vulnerability of marine ornamental teleosts retained in this fishery. This report though is not a sustainability assessment and the outputs of the MAFF VA cannot be used to make broader inferences about the long-term sustainability of this fishery and/or the species being harvested.

While target species have been the subject of a previous sustainability assessment (Roelofs & Silcock, 2008), the management regime for this fishery has undergone considerable change. As a consequence, previous reports have limited relevance to the current fishing environment. This by extension, limits their value in terms of informing discussions surrounding the long-term management of species harvested within the MAFF. The changing MAFF landscape, combined with ongoing management reforms implemented under the *Queensland Sustainable Fisheries Strategy 2017–2027*, supported the development of an updated vulnerability assessment (Department of Agriculture and Fisheries, 2017; 2021c; 2022a).

While the scope of the MAFF VA is smaller than previous assessments (Roelofs & Silcock, 2008), it better reflects harvest patterns and assessment priorities within the MAFF. The primary and secondary species lists were compiled through an extensive consultation process and provides a comprehensive representation of the teleost families targeted in this fishery. The following provides an

[9] Completed 28 April 2023 in accordance with the MAFF Wildlife Trade Operation (WTO) accreditation.

overview of some of the general vulnerability considerations for this fishery (section 5.1) and a more specific assessment of the drivers of vulnerability for the main teleost families (section 5.2).

5.1 Whole-of-Fishery Considerations

The outputs of this assessment lend support to the broader hypothesis that the MAFF is a lower risk fishery. Of the 137 species included in this assessment, the vast majority fell within the low (*n* = 104, 76 per cent) or medium (*n* = 32, 23 per cent) vulnerability categories. At the end of the PSA/RVA only the blueface angelfish (*Pomacanthus xanthometopon*), was classified as having high vulnerability in the MAFF (Table 6: Appendix E). The biology and life-history constraints of this species contributed to this result with *P. xanthometopon* registering an assessment high productivity score of 2.60 (Appendix E). While noting these vulnerabilities, harvest levels for *P. xanthometapon* are expected to be low in the MAFF (Appendix B) and these vulnerabilities are arguably best addressed through improved monitoring.

The management regime for the MAFF already incorporates a number of risk-mitigation strategies including the use of a limited licencing policy, gear restrictions and detailed reporting requirements (Department of Agriculture and Fisheries, 2023a). As the fishery operates within the confines of the GBRMP, operators are also subject to provisions governing the use of resources within the World Heritage Area. These provisions are particularly effective for managing the extent of any future increases in the MAFF effort footprint. For example, the Great Barrier Reef Representative Areas Program restricts or prohibits commercial fishing activities in around 38 per cent of the GBRMP i.e. the Buffer (Olive Green) Zones, Scientific Research (Orange) Zones, Marine National Park (Green) Zone and Preservation (Pink) Zones (Great Barrier Reef Marine Park Authority, Undated). While commercial harvesting can occur outside these zones, not all regions will be actively fished by MAFF operations. Commercial operators are also required to hold an approved GBRMPA permit if fishing within the marine park. The collection of aquarium fish for non-commercial purposes is not permitted within the GBRMP without a relevant permit.

In 2021, the MAFF management regime was strengthened through the establishment of a fishery-specific harvest strategy. The *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* came into effect on 1 September 2021 and aims to improve the capacity of the fishery to manage long-term sustainability risks (Department of Agriculture and Fisheries, 2021c). This harvest strategy includes, among other things, decision rules to identify the potential for localised depletion, reference points to guide the management of key species and safeguards to prevent harvest levels exceeding acceptable limits (Department of Agriculture and Fisheries, 2021c). These measures were supported through the establishment of a *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* and broader reforms of the logbook reporting system (Department of Agriculture and Fisheries, 2021a; d; 2022a).

The *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* is purposely designed to maintain harvest rates for marine aquarium species at levels which a) represent a low risk and b) are considered ecologically sustainable (Department of Agriculture and Fisheries, 2021c). To do this, the strategy separates MAFF species into one of two management tiers. Tier 1 species (*n* = 22) have more responsive decision rules which implement measures to restrict catch rates, if and when, the annual harvest exceeds 1.5 times that of the historical reference point average. These measures could include establishing a total allowable commercial catch limit, trip limits and additional spatial closures. All other species are classified as Tier 2 and have decision rules that trigger a review of the available data to determine the need for further management action (Department of Agriculture and Fisheries, 2021c).

The introduction of a fishery-specific harvest strategy is a significant step forward for the long-term management of resources within this fishery. However, the MAFF VA did identify several areas where the harvest strategy framework should be refined and improved. For example, only 13 of the 22 Tier 1 species can be legally retained under an A1 or A2 fishery symbol: wedgefish (Family Rhinidae), giant guitarfish (Family Glaucostegidae), mako sharks (*Isurus* spp.) and nine teleosts. As the short fin mako shark (*Isurus oxyrinchus*) and the longfin mako shark (*I. paucus*) are listed as migratory species under the EPBC Act, they are also classified as no-take species within the GBRMP (Great Barrier Reef Marine Park Authority, 2023).

Of the remaining Tier 1 species / species complexes, six are fully protected under the *Fisheries Act 1994* due to ongoing concerns surrounding their long-term sustainability and conservation. These being: sawfish (Family Pristidae), humphead Maori wrasse (*Cheilinus undulatus*), barramundi cod (*Chromileptes altivelis*), potato rockcod (*Epinephelus tukula*), Queensland groper (*E. lanceolatus*) and paddletail (*Lutjanus gibbus*) (Department of Employment Economic Development and Innovation, 2011). The scalloped hammerhead shark (*Sphyrna lewini*), great hammerhead shark (*S. mokarran*) and smooth hammerhead shark (*S. zygaena*) have also been reclassified as 'no-take species' within Queensland state waters (Department of Agriculture and Fisheries, 2024). Similarly, the short fin mako shark (*Isurus oxyrinchus*) and the longfin mako shark (*I. paucus*) are listed as migratory species under the *Environment Protection and Biodiversity Act 1999* and, therefore, are fully protected within the GBRMP. These species could potentially be removed from the harvest strategy without having a discernible impact on the overall MAFF monitoring mechanisms.

Of the Tier 1 species that can be retained for sale, several are harvested in smaller quantities or on consignment (Department of Agriculture and Fisheries, 2023a). These species tend to be larger and are more likely to be encountered, caught and retained in other fisheries. For example, higher numbers of wedgefish (Family Rhinidae) and giant guitarfish (Family Glaucostegidae) will be retained in inshore (gillnet) net operations or caught as bycatch in prawn trawl fisheries (Courtney *et al.*, 2007; Department of Agriculture and Fisheries, 2022c; Jacobsen *et al.*, 2021a; b; Kyne, 2008; Kyne *et al.*, 2021). When compared, MAFF operations are more likely to retain smaller, more fecund, benthic species such as the brownbanded bambooshark (*Chiloscyllium punctatum*), the epaulette shark (*Hemiscyllium ocellatum*) and the bluespotted fantail ray (*Taeniura lymma*). These species though require specialised husbandry and retention rates will be limited by market demand. Given the above considerations, there would be merit in reviewing the current harvest classifications applied to this group to determine their ongoing applicability and suitability.

The remaining Tier 1 species belong to families that are harvested in the MAFF with increased frequency, in particular the nine teleosts (Department of Agriculture and Fisheries, 2023a). The nine Tier 1 teleosts were included in the MAFF VA and all were assigned medium vulnerability classifications (Appendix E). The nine Tier 1 species being: the wideband anemonefish (*Amphiprion latezonatus*), blackback anemonefish (*Amphiprion melanopus*), ocellaris clownfish (*Amphiprion ocellaris*), orange clownfish (*Amphiprion percula*), harlequin tuskfish (*Choerodon fasciatus*), pineapplefish (*Cleidopus gloriamaris*), blue tang (*Paracanthurus hepatus*), scribbled angelfish

(*Chaetodontoplus duboulayi*), and Queensland yellowtail angelfish (*Chaetodontoplus meredithi*) (Department of Agriculture and Fisheries, 2021c).[10]

For the above species, retention of their Tier 1 status is warranted. However, it is also recommended that the Tier 1 list be extended to include *P. xanthometopon* as a minimum, if not all species with a rating of medium or high (Appendix E). While a change of this magnitude would increase the number of Tier 1 species, it could be offset through the removal of superfluous species; that is no-take and/or low-harvest species. Amending the Tier 1 list to accommodate species at medium and high vulnerability would also align with the *Marine Aquarium Fish Fishery Harvest strategy: 2021–2026* which states:

> … *if fishing impacts are considered to generate an undesirable level of risk* (*moderate or high risk*)*, then the marine aquarium fish species would be elevated to tier 1 and an appropriate management response developed to reduce the risk, where possible. In addition to the level of ecological risk, a species may also be considered a tier 1 species if it is classified as prohibited for recreational take.*

If adopted, the above amendments would ensure that the harvest strategy aligns more closely with the current fishing environment. This is of particular importance as the effectiveness of the harvest strategy has yet to be fully tested in an active fishing environment. This, in part, was because reporting systems previously used in the MAFF were not sufficient to monitor harvest rates against Tier 1 and Tier 2 decision rules. These deficiencies are now being addressed as part of a broader *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a). For example, a substantial review of the MAFF reporting requirements was completed in 2022/23 and resulted in a significant expansion of species-specific logbook reporting (Queensland Government, 2024). The revised logbook came into effect on 1 July 2023 and was directly informed by the MAFF VA species prioritisation process (Appendix A; B).

Data compiled through the revised logbook will better inform management on the suitability and applicability of decision rules / trigger limits applied through the harvest strategy program (Department of Agriculture and Fisheries, 2021c). Any review of the harvest strategy should consider the feasibility, suitability and appropriateness of introducing measures to limit harvest rates. It is recognised that introducing species-specific catch limits in the MAFF will be more difficult. Evidently, this was discussed at length in the whole-of-fishery (Level 1) ERA (Morton & Jacobsen, 2023). However, improving the capacity of the fishery to restrict harvest (if and when required) will help safeguard against longer-term and potentially unsustainable increases in effort. It will also allow the fishery to respond more adequately to a changing fishing environment e.g. the targeting of a small number of species to meet emerging markets.

Commercial fishers who have an A1 and D fishery symbol are permitted to access the MAFF and QCF simultaneously.[11] Effort data for both fisheries show frequent fluctuations with operators adjusting their fishing behaviours to reflect shifts in market demand. In more recent examples, effort levels for the QCF have well-exceeded that of the MAFF. However, the QCF has recently transitioned to more stringent harvest limits to manage the take of key species. These changes are likely to result

[10] The common names recorded in the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* may not align with those listed in this report.
[11] This can only occur if both the A1 and D fishery symbols are on the same primary commercial fishing licence they are fishing under.

in a reduction in effort and, at present, it is not clear if operators will transition effort to the MAFF i.e. if and when the coral allocation is exhausted. If this were to occur, then the catch and effort levels for some marine ornamental species may increase and expose regional populations to additional fishing pressures. The ability of these populations to absorb an increased rate of fishing mortality and/or to rebound after potential decline will depend on the vulnerability factors of each species (Table 6; Appendix E). It will also depend on the extent of any potential increase in effort.

For species with wide geographical distributions, stable populations and sufficient protection from commercial fishing, increasing seasonal catch and effort may not translate to an increased level of risk. For these species, arrangements applied at the whole-of-fishery level may be adequate in terms of managing the long-term sustainability risk. The key caveat being that any increase in risk will be dependent on the temporal and spatial scale of harvest. Increasing regional catch and effort may elicit a different response from endemic species and rarer species with smaller populations, abundances or regional distributions. These species are often more marketable, are of higher value and are more likely to be targeted/retained if observed in the immediately fished area. For these species, increasing catch and exploitation rates may have longer-term implications in terms of their ability to absorb fishing pressures, to rebound after potential declines and (potentially) lead to localised depletion.

When compared to teleosts, logbook reforms for invertebrates were more limited and harvest rates for these species continue to be reported at a higher taxonomic level (Queensland Government, 2024). This, in part, is due to invertebrates being retained in smaller quantities and having comparatively high levels of productivity. Of note, there has been a proportional shift in the total MAFF harvest with the invertebrate contribution increasing from approximately 30 per cent to 40 per cent over the last three years (Department of Agriculture and Fisheries, 2023a). Improving the level of information on invertebrate compositions is considered an area where vulnerability or risk can be better understood, mitigated or managed within this fishery.[12] This vulnerability is arguably best addressed through the relevant Fisheries Working Group and the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2021a; d; 2022a).

Outside of fishing activities and fishing related risks, a range of external (confounding) factors will contribute to the overall vulnerability of MAFF species. These external risks often lie outside the fisheries management framework and represent an accumulation of broader issues or activities. With that said, they have the potential to negatively impact the conservation status of these species and the ecosystems they rely on. Examples of external (non-fishing) disturbances include climate change, crown of thorns starfish outbreaks, coastal development, agricultural runoff, and severe weather events such as cyclones (Department of Environment Science and Innovation, 2019; Great Barrier Reef Marine Park Authority, 2019). Depending on the extent of the disturbance, these events may exert considerable influence on the long-term structure of the MAFF, market trends and catch/effort patterns.

External disturbances, including those listed above, may contribute to a reduction in the quality and extent of habitats used by coral reef fishes. Loss of ecological function provided by coral reef fishes is a potential threat if their diversity and abundance is impacted (Pratchett *et al.*, 2011). While the

[12] Invertebrates were not included in this iteration of the MAFF VA due to the low species resolution in fisheries dependent data, the rich diversity of invertebrates that are permitted to be collected in the MAFF and taxonomic and identification limitations for these species. The number of invertebrate species (e.g. crustaceans, echinoderms and molluscs etc.) that are permitted take would exceed 10,000. An understanding of what species are being collected will be essential to any future invertebrate-specific vulnerability assessment.

consequences will vary, the detrimental impacts of regional habitat degradation will be higher for fish species that depend on another organism to survive (e.g. corallivores that consume live coral and some species of anemonefish that have mutualistic partnerships with anemones). In sustained events, these disturbances can lead to phase shifts in regional species assemblages and habitat availability. This in turn may exacerbate or amplify the vulnerability of a species.

It is recognised that the management of external disturbance is challenging and difficult to adequately address through a fisheries-management framework. This fact was reflected in the current assessment which used PSA criteria that did not consider external impacts, pressures or disturbances (Table 1 and 2). However, gaining a better understanding of how this these types of disturbances impact regional populations will allow for greater consideration of the cumulative impacts and better inform the long-term management of this fishery.

Promisingly, there is evidence that aspects of the marine aquarium trade are adapting to accommodate technological advancements and reduce ecological impacts. For example, an increasing number of anemonefishes (*Amphiprion* spp.) are being bred in captivity for sale on domestic and international markets. Fishes produced from intensive aquaculture systems can be more sustainable in comparison to wild-caught specimens. There are however many challenges with this mode of production and many facets of this approach are still in the development/research phase, including spawning induction, larval rearing and nutrition. These challenges mean that most species cannot currently be reared in captivity with wild harvest continuing to meet market demand. This inference is supported by research which estimates that 90 to 95 per cent of marine ornamental species are still harvested from wild stocks (King, 2019).

Given the developmental nature of captive-breeding programs, they were not considered as part of the MAFF VA. However, the continued growth and expansion of this aspect of the ornamental trade has the potential to change the vulnerability profile of some MAFF species. The likely outcomes being a theoretical decline in fishing-related vulnerability for some species. The extent of these benefits will be highly dependent on the tracking of product through the supply chains and onto the international/domestic markets. Assessments such as this one could be used to identify species of priority for aquaculture research and development to reduce pressure on wild stocks.

5.2 Family and Species-Specific Considerations

Biological constraints were identified as a key factor of influence in terms of the ratings assigned to individual species (Appendix E). Many species at the lower end of the vulnerability scale have high productivity (mature quickly, short-lived, high turnover rates), are more fecund (pelagic spawners) and are globally widespread, e.g. the deepwater wrasse (*Cirrhilabrus cyanopleura*), false-eyed wrasse (*Halichores biocellatus*), and leopard wrasse (*Macropharyngodon meleagris*). Conversely, more vulnerable species were often longer-lived, had lower levels of fecundity (demersal spawners) and/or depend on other organisms to survive e.g. the symbiotic relationship between *Amphiprion* spp. and certain anemones, and the commensal relationship between *Dascyllus* spp. and corals (Appendix E).

The outputs of the VA indicate that species from the families Pomacanthidae, Balistidae and Monocentridae were more vulnerable to MAFF fishing activities (Table 6). Species from the Family Pomacanthidae were often assigned higher vulnerability ratings as they tend to grow larger, mature later and are longer lived e.g. species from the genera *Apolemichthys*, *Chaetodontoplus*, *Genicanthus* and *Pomacanthus* (pers. comm. D. Bellwood; Sapolu, 2005). Productivity levels for this group are lower than most other species included in the MAFF VA and regional populations may take longer to recover from overharvesting and disturbance events. Inferences surrounding the vulnerability of Balistidae and Monocentridae were more limited as most members of these families were omitted from the analysis as lower assessment priorities (Appendix B). However, the single representative from each family did register a higher vulnerability rating (Appendix E). Depending on future harvest rates and species compositions, these results may point towards a future assessment need; that is the inclusion of additional species from the families Balistidae and Monocentridae.

Vulnerability levels for a number of the family groups displayed higher levels of interspecific variability; most notably the families Acanthuridae, Chaetodontidae, Labridae and Pomacentridae (Appendix E). For example, all species within the Pomacentridae genus *Amphiprion* were assigned a medium vulnerability rating due (in part) to their increased longevity and symbiotic relationship with anemones. However, genera *Chromis* and *Pomacentrus* tended to have lower levels of vulnerability as they are more productive (e.g. shorter lived, early onset of sexual maturity) and are found across a broader range of habitats (Appendix E). These results provide insight into the type of variability that exists within the target species ecological component and highlights the importance of understanding regional catch compositions. With the continued improvement of MAFF catch monitoring systems (Department of Agriculture and Fisheries, 2021c; 2022a), future assessments will be better placed to consider this type of variability.

In the susceptibility component, depth profile and catchability were two of the key vulnerability attributes (Table 2; Appendix E). These results were to be expected as shallow-water reef systems are more accessible to MAFF operators than deeper reefs due to operational constraints (Roelofs & Silcock, 2008). This vulnerability is compounded by the fact that most species included in the MAFF VA are found in pairs, small groups, aggregations, or schools. These behaviours increased the selectivity potential of some species and it was something that was accounted for in the catchability attribute scores (Appendix E). It is important to note, that these vulnerabilities were not universal and the depth profiles of some species prove them with a degree of natural protection. For example, economics, fishing efficiency and safety considerations will confine most MAFF fishing activities to water depths of less than 30 m. While species whose depth profiles include mesophotic coral reefs (begins at 30–40 m; Hinderstein *et al.*, 2010) will still be targeted, effort levels in these regions will be lower.[13] Beyond 40 m, species will be afforded considerable refuge from MAFF activities and will only be collected by operators with certain deep dive qualifications e.g. *Cirrhilabrus roseafascia* found on deep reefs (Bray, 2017d) and the deepwater basslet, *Pyronotanthias aurulentus* (Bray, 2022c).

Outside of depth profile and catchability, the market value of some species may see them targeted with greater regularity, including as part of specialised dive operations (e.g. deeper water operations). Some examples of which include highly desirable, high-value species from the genera *Centropyge* spp., *Cirrhilabrus* spp. and *Pseudanthias* spp. Likewise, Australian endemics and species with restricted ranges are often desirable due to their limited availability in the trade. This can lead to

[13] The mesophotic zone of reefs or mesophotic coral ecosystems are characterised by the existence of light dependent corals in low-light environments and differ from shallow water, high-light reefs. The species compositions and reef environments at these depths are largely unknown and understudied (Eyal *et al.*, 2021). Depths below 30 m are rarely dived for aquarium species due to complicated logistics including the limits of SCUBA equipment, decreased dive times, increased effort for low gain and additional depth acclimation required to bring specimens to the surface (pers. comm. A. Roelofs). It is reasonable to assume that species that are found beyond 40 m can gain considerable refuge from fishing activity in the MAFF, although there may be specialised biodiversity at these depths that is separate to shallow reefs.

higher market demands and increase the value of rarer species, particularly on the international market as they can only be sourced from select collectors. Notable examples from the MAFF include the bluetail wrasse (*Anampses femininus*) and the Queensland yellowtail angelfish (*Chaetodontoplus meredithi*; Appendix E). Species with these profiles should be closely monitored to reduce the potential for localised depletion and longer-term impacts.

Across the study, data deficiencies and information gaps impacted almost all of the species-specific assessments (Table 4; Appendix E). Within the productivity component, these deficiencies were most evident in attributes examining the species age and growth development (Table 5; Appendix D). Where possible, these deficiencies were addressed in the RVA using information acquired through additional consultation, proxies and captive breeding programs (Appendix F).[14] In the absence of a suitable species-specific proxy, the MAFF VA relied on a weight-of-evidence approach and considered estimates contained in more generalised databases such as Fishbase (Froese & Pauly, 2023l). Database estimates are often based at a higher taxonomic level and provide limited insight into the age and growth of individual species. With improved biological information, the vulnerability profiles of a number of species could be further refined. It would also provide greater insight into the extent of the biological vulnerability for groups like *Pomacanthus* spp. where the productivity component exerted more influence on the final ratings (Table 6; Appendix E).

In the susceptibility component, availability was one of the more difficult attributes to assess. Distribution maps for most species lacked adequate resolution and/or varied between information sources. As a consequence, all species were assessed using the alternate (global distribution) criteria for availability (Table 2). Where possible, these scores were refined using a weight-of-evidence approach that considered the suitability/applicability of global distribution maps and feedback compiled through targeted consultation. These refinements though were still precautionary and may have contributed to the production of more conservative vulnerability assessments. With improved information on catch compositions and locations, it is hypothesised that the availability assessment could be further refined to account for regional nuances.

Of interest, a review of the distribution data identified a potential range extension for at least one species, the western clown anemonefish (*Amphiprion ocellaris*). Range descriptions for *A. ocellaris* indicates that this species is only found in northern Australia (Allen, 2018; Bray, 2021; Kuiter, 2023). However, further consultation with industry and scientific experts revealed that *A. ocellaris* is (likely) found on the north-east coast of Queensland (pers. comm. J. Johnson). While difficult to quantify, this is unlikely to be the only example of a species where the prescribed distribution does not reflect regional fishing knowledge. For example, there remains notable gaps surrounding the connectivity of species/populations found in the Coral Sea and the outer GBR reefs, particularly for *Cirrhilabrus* spp., *Pseudanthias* spp. and *Pyronotanthias* spp.

Improving distributional data for MAFF species would assist in terms of understanding their regional interaction potential and cumulative fishing pressures. However, these deficiencies are more difficult to address through a fisheries management framework and may require further research into the distribution and taxonomy of key species. As primary users of these marine resources, MAFF operators are well positioned to contribute to this process i.e. in collaboration with third parties like the Queensland Museum. The Marine Aquarium Fish and Coral Fisheries Working Group and the

[14] Consultation with scientific experts from James Cook University was fundamental in refining the RVA scores for the age at maturity and maximum age attributes (Appendix F).

Queensland Marine Aquarium Fish Fishery Data Improvement Plan are two avenues where this option could be further explored (Department of Agriculture and Fisheries, 2022a; Queensland Government, 2024).

In addition to the distribution data, future MAFF assessments would benefit from an improved understanding of how MAFF species utilise regional habitats (ecological niche, catchability). While the available data provided a more generalised overview of their habitat preferences / ecological niche, there is less information on how important coral reefs are in the life-history of these species. For example, does a species depend on coral reefs to survive or does it only use the reef for its resources? Similarly, how does the life-history / behavioural patterns of each species influence their catchability e.g. cryptic, found in low abundance? From a vulnerability assessment perspective, these factors are important as species that can survive in a range of habitats (i.e. generalists) are often afforded considerable refuge from fishing activities including in the MAFF. Over the longer term, this information will be of increasing importance to understanding the resilience of species to cumulative vulnerability factors such as phase shifts in species assemblages due to climate change.

6 Recommendations

The recommendations are non-binding and are intended to provide insight into where species-specific vulnerabilities can be better understood, managed or mitigated in this fishery. Suggested improvements align with the objectives of the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* and the current Queensland Aquarium Fish Fishery WTO accreditation. Any changes to the management regime should be determined with input from the Marine Aquarium Fish and Coral Fisheries Working Group.

1. **Update the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026*.**

   As Condition 6 in the current WTO reaccreditation requires QDAF to review the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* by 30 May 2026, it is recommended that the review reconsider the Tier 1 and Tier 2 classifications, remove no-take species and elevate the classifications of species identified as being at a medium or high vulnerability.

   WTO Condition 6 also requires the harvest strategy to consider the outcomes of this assessment to ensure that it effectively manages risks to individual species and ecosystem functions, including risks associated with environmental disturbance and localised depletion (Commonwealth of Australia, 2024).

2. **Review the suitability of the harvest strategy decision rules, their ability to effectively monitor harvest rates, and minimise the potential long-term risks for Tier 1 and Tier 2 species e.g. catch and effort increases that are inconsistent with the objectives of the harvest strategy.**

   Decision rules in the current harvest strategy aim to reduce the risk of localised depletion to species in the MAFF through assessment and spatial management of intensive fishing effort. However, these decision rules cannot currently operate as intended due to a lack of spatial and species-specific historical data. Therefore, it is not possible to determine increases in harvest, concentrated effort or potential risk of localised depletion.

Data complied through the updated AQ06 logbook (implemented 1 July 2023) will assist in this process and inform discussions surrounding the suitability and applicability of the current decision rules. Improved monitoring of harvested species will also assist in terms of a) improving the adaptability of the fishery and b) its ability to identify, manage and respond within a dynamic fishing environment e.g. effectively respond to changing harvest patterns, increasing catch and effort etc. This should be explored in collaboration with the Marine Aquarium Fish and Coral Fisheries Working Group and potentially linked with the harvest strategy review.

3. **Continue implementing the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* and review the suitability/applicability of current reporting requirements.**

   The *AQ06 Queensland Aquarium Fish Fisheries Logbook* and species list should be updated to include all priority species assessed in this report to ensure catch is reported to species level as per the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a). Any future review of the MAFF logbook should consider the outputs of this VA.

4. **Explore avenues to further understand the distribution and biology of harvested species through scientific research and engagement with relevant stakeholders.**

   A deeper understanding into the distribution of key species is essential to limit their vulnerability to fishing activities and concentrations of effort within the MAFF, particularly for those with restricted ranges. Logbook data prior to 1 July 2023 is not to species-level, therefore concentration of effort and fishing pressure for individual species cannot be accurately determined. Increasing the resolution of spatial data will identify where key species are being harvested. This would be beneficial to understand effort shifts and risks to localised areas. Collaborating with industry members to gain regional fishing knowledge would be valuable to further understand the distribution and biological characteristics of some marine ornamental species on the east coast of Queensland.

5. **Continue to review the need and capacity to assess the vulnerability of invertebrates, sharks and batoids in the MAFF.**

   Elasmobranchs (sharks and batoids) make up a small percentage of the total MAFF catch as they are primarily caught for public aquaria displays via special order. It is important to understand what species are being collected and to what extent they are being harvested. However, this is already being managed through the introduction of an updated MAFF logbook (AQ06).

   The fisheries dependent data for invertebrate species are based at a very-high taxonomic level. Approximately 30 per cent of the MAFF catch over the last decade consist of invertebrates from the Class Crustacea, Phylum Echinodermata and Phylum Mollusca. Catch data for the MAFF shows that the number of retained invertebrates has declined through time. There has, however, been a proportional shift with the invertebrate contribution increasing from approximately 30 per cent to 40 per cent over the last three years. This increase is linked to a disproportionate decline in teleost/invertebrate retention rates versus the increased targeting of invertebrates.

   An understanding of the invertebrate species being retained, and the quantity should be prioritised in future MAFF assessments. The deficiency in invertebrate species resolution in the harvest data reflects current reporting requirements though may reflect broader deficiencies in our understanding of invertebrate taxonomy, distributions and biology. These challenges inhibited their inclusion in this assessment, however, when and where appropriate they may be considered in future assessments.

6. **Continue to explore avenues to provide vulnerable species with additional protections to minimise the cumulative risks associated with harvesting during climatic events and disturbances.**

   Climate change and disturbances are external drivers that can negatively impact species collected in the MAFF, particularly those that rely on coral reefs to survive. Although these external threats were not addressed in this assessment, they should be considered in future refinements of the management regime. This would provide a more holistic approach to managing vulnerable species, reduce the likelihood of localised depletion, and help to address any climate driven changes to the fishery environment. This would also help the MAFF to adapt and remain active through time.

7 Conclusion

The MAFF VA provides additional depth to the vulnerability profiles of priority teleost species and builds on the previous whole-of-fishery assessment (Department of Agriculture and Fisheries, 2018b). Outputs from the MAFF VA will help inform initiatives instigated under the *Queensland Sustainable Fisheries Strategy 2017–2027* and strengthen linkages between the ERA process and the remaining areas of reform (Department of Agriculture and Fisheries, 2017).

Precautionary elements included in the methodology combined with data deficiencies contributed to the development of more conservative vulnerability profiles in the PSA. For most of the species, the final vulnerability ratings were low and are unlikely to result in significant species-specific reforms. There were, however, several species where the final vulnerability rating requires further attention, and the management of the vulnerability is viewed as a higher priority. The recommendations have been identified as areas where vulnerability profiles can be refined, and the level of vulnerability reduced within the MAFF.

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9 Appendices

Appendix A – Species Prioritisation Process Overview.

Appendix B – Species Prioritisation Process: Justifications and Considerations.

Appendix C – Productivity and Susceptibility Analysis: Criteria Definitions, Justifications and Considerations.

Appendix D – Results: Productivity and Susceptibility Analysis.

Appendix E – Results: Residual Vulnerability Analysis.

Appendix F – Residual Vulnerability Analysis: Justifications and Considerations.

Appendix A—Species Prioritisation Process Overview

Under the Fisheries (Commercial Fisheries) Regulation 2019, (State of Queensland, 2019) operators with an A1 or A2 fishery symbol can take all fish other than a) barramundi, b) sea cucumber[15], c) shell grit, d) star sand and e) any species of coral, oyster, pearl oyster or trochus.[16] These provisions allow operators to retain a very high number of species across a wide range of vertebrate and invertebrate subgroups (Department of Agriculture and Fisheries, 2023a).

Operators in the MAFF target a diverse range of marine vertebrate and invertebrate species for sale on the domestic and international market. Assessing the vulnerability of all species (>1,500) that can be retained in the MAFF was deemed both unnecessary and unwarranted. Accordingly, it was determined that the MAFF VA would prioritise assessments for subgroups (key teleost species within families of concern) targeted within the MAFF.

A review of the available data indicated that a high number of fish species are retained infrequently and have been harvested at comparatively low levels over the last 10 years (Department of Agriculture and Fisheries, 2023a). This includes elasmobranchs which are retained in very small quantities (<0.3 per cent of the total catch over the last 10 years; Department of Agriculture and Fisheries, 2022a; 2023a). Further, harvest data for invertebrates has poor species resolution and provides limited insight into the extent of any species-specific fishing pressures. These reporting deficiencies are compounded by data limitations surrounding the biology and taxonomy of invertebrate species.

Given the above, both elasmobranchs and invertebrates were not included in this iteration of the MAFF VA. When and where appropriate, these subgroups will be considered for inclusion in subsequent assessments involving this fishery. The scope of any subsequent vulnerability assessments will depend on a range of factors including information availability and the outputs of the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a).

In line with the above decision, the MAFF VA primarily focused on key teleost families harvested in this fishery. To refine the scope of the MAFF VA, a review of the fisheries dependent data was undertaken to determine what families should be prioritised for assessment. This review was supported by a closer examination of fisheries-independent data including range descriptions, third-party assessments / conservation classifications, market trends and the outputs of previous MAFF assessments (Roelofs & Silcock, 2008). This review identified:

- Seven teleost families that should be progressed as assessment priorities: damselfishes (Family Pomacentridae), wrasses (Family Labridae), angelfishes (Family Pomacanthidae), butterflyfishes (Family Chaetodontidae), anthias (Family Serranidae), surgeonfishes (Family Acanthuridae), assessors (Family Plesiopidae).

[15] Under the Fisheries (Commercial Fisheries) Regulation 2019, **sea cucumber** does not include fish of the following species—(a) *Bohadschia graeffei;* (b) *Calachrius crassus;* (c) *Cucmaria miniata;* (d) *Euapta godeffroyi;* (e) *Holothuria edulis;* (f) *Holothuria hilla;* (g) *Opheodesoma* spp.*;* (h) *Pentacta anceps;* (i) *Pentacta lutea;* (j) *Pseudocolchirus violaceus;* (k) *Stichopus noctivagus;* (l) *Synapta maculata.*

[16] Excludes species protected under the *Fisheries Act 1994* and subordinate legislation and those classified as no-take.

- Three additional families that are harvested with more frequency in the MAFF: gobies (Family Gobiidae), cardinalfishes (Family Apogonidae) and blennies (Family Blenniidae).

The review of the available data (e.g. catch), interaction potential (e.g. distributions) and market demand/desirability produced a preliminary list of 311 species that were considered for inclusion in the MAFF VA.[17] This list included:

- All teleosts classified as Tier 1 in the *Marine Aquarium Fish Fishery Harvest Strategy: 2021–2026* and permitted to be harvested.
- Species assigned a medium or high rating in the previous sustainability assessments (Roelofs & Silcock, 2008).
- Species that featured more prominently in fisheries-dependent data.
- Species identified as assessment priorities during DAF market research.

Once finalised, the draft species list was distributed to key stakeholders to review and provide feedback. This consultation phase included the Marine Aquarium Fish and Coral Fisheries Working Group, experts from the scientific community and government organisations.

Through stakeholder consultation 137 species were identified as assessment priorities and included in the MAFF VA. The remaining 174 species were considered secondary assessment priorities and were omitted from the analysis. When and where appropriate, species identified as secondary priorities will be considered for inclusion in subsequent VAs/ERAs involving this fishery. The scope and extent of any future assessments will depend on a range of factors including the outputs of reforms initiated as part of the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a).

Appendix B provides an overview of the species that were consulted on as part of the MAFF VA development phase, their assessment classification, and the lines of evidence for their inclusion/exclusion.

[17] The preliminary species list for the MAFF VA included over **700** teleost species. The preliminary list was rationalised through a review of the available data, distribution information and an assessment of their interaction potential. Species that were not progressed to the consultation phase interact infrequently with the MAFF and/or have very low to negligible rates of harvest.

Appendix B—Species Prioritisation Process: Justifications and Considerations

The following provides a detailed overview of the 311 species that were included in the consultation phase of the MAFF VA species prioritisation process. Species were ranked as primary or secondary assessment priorities based on stakeholder feedback. All species with marked as 'Primary' with green boxes were included in this iteration of the MAFF VA. Pink boxes marked as 'Secondary' were moved to the secondary species list and not assessed in this iteration of the MAFF VA. In a small number of instances, the feedback determined that a species did not require assessment in this fishery (orange 'Omitted' boxes). When and where appropriate, species classified as secondary priorities will be considered for inclusion in subsequent assessments.

The list of species considered for inclusion in the MAFF VA was compiled from a range of sources and refined through consultation with the Marine Aquarium Fish and Coral Fisheries Working Group, industry, experts from the scientific community and government organisations. The scope and extent of any future vulnerability assessment for the MAFF will depend on a range of factors including the available information, catch trends and fishing priorities and developments / initiatives instigated as part of the *Queensland Marine Aquarium Fish Fishery Data Improvement Plan* (Department of Agriculture and Fisheries, 2022a).

***Key instruments**: FWG / IND (fisheries working group / industry), EXP (expert advice), PF (priority family), TS (target species), DAF / FDD (Department of Agriculture and Fisheries / fisheries dependent data), PA (medium vulnerability risk in previous assessment), HS T1 (harvest strategy Tier 1 species).*

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Starry triggerfish	*Abalistes stellatus*	37 465011	FWG / IND, EXP	Secondary	Family Balistidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Scissortail sergeant	*Abudefduf sexfasciatus*	37 372011	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Spiny puller	*Acanthochromis polyacanthus*	37 372015	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pencil surgeonfish	*Acanthurus dussumieri*	37 437008	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Bluelined surgeonfish	*Acanthurus lineatus*	37 437010	PF, FWG / IND,	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Velvet surgeonfish	*Acanthurus nigricans*	37 437012	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Dusky surgeonfish	*Acanthurus nigrofuscus*	37 437014	DAF / FDD, PF, FWD / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Greyhead surgeonfish	*Acanthurus nigros*	37 437015	PF, FWG / IND, EXP	Primary	Included.
Orangeblotch surgeonfish	*Acanthurus olivaceus*	37 437016	PF, FWG / IND, TS, EXP	Primary	Included.
Mimic surgeonfish	*Acanthurus pyroferus*	37 437017	PF, FWG / IND, TS, EXP	Primary	Included.
Night surgeonfish	*Acanthurus thompsoni*	37 437018	PF, FWG / IND, EXP	Primary	Included.
Convict surgeonfish	*Acanthurus triostegus*	37 437019	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Jointed razorfish	*Aeoliscus strigatus*	37 280003	PA, FWG / IND, EXP	Primary	Included.
Crosshatch goby	*Amblygobius decussatus*	37 428046	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Whitebarred goby	*Amblygobius phalaena*	37 428048	FWG / IND, TS, EXP	Primary	Included (precautionary).
Barrier Reef anemonefish	*Amphiprion akindynos*	37 372020	PF, PA, FWG / IND, TS, EXP	Primary	Included.
Orange-fin anemonefish	*Amphiprion chrysopterus*	37 372021	DAF / FDD, PF, PA, FWG / IND, EXP	Primary	Included.
Clark's anemonefish	*Amphiprion clarkii*	37 372007	DAF / FDD, PF, FWD / IND, EXP	Primary	Included.
Wideband anemonefish	*Amphiprion latezonatus*	37 372022	HS T1, DAF / FDD, PF, EXP	Primary	Included.
Blackback anemonefish	*Amphiprion melanopus*	37 372024	HS T1, DAF / FDD, PF, PA, FWG / IND, TS, EXP	Primary	Included.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Western clown anemonefish	*Amphiprion ocellaris*	37 372025	HS T1, DAF / FDD, PF, PA, FWG / IND, TS, EXP	Primary	Included.
Eastern clown anemonefish	*Amphiprion percula*	37 372026	HS T1, DAF / FDD, PF, PA, FWG / IND, TS, EXP	Primary	Included.
Skunk anemonefish	*Amphiprion perideraion*	37 372027	DAF / FDD, PF, PA, FWG / IND, EXP	Primary	Included.
Saddleback anemonefish	*Amphiprion polymnus*	37 372138	DAF / FDD, PF, EXP	Primary	Included.
Bluetail wrasse	*Anampses femininus*	37 384047	DAF / FDD, PF, EXP	Primary	Included.
Scribbled wrasse	*Anampses geographicus*	37 384048	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Blue-and-yellow wrasse	*Anampses lennardi*	37 384016	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Speckled wrasse	*Anampses meleagrides*	37 384049	PF, FWG / IND, EXP	Primary	Included.
Blackback wrasse	*Anampses neoguinaicus*	37 384050	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Threespot angelfish	*Apolemichthys trimaculatus*	37 365016	PF, FWG / IND, EXP	Primary	Included.
Bifrenatus goby	*Arenigobius bifrenatus*	37 428008	PA	Primary	Included.
Stars-and-stripes puffer	*Arothron hispidus*	37 467033	FWG / IND, EXP	Secondary	Family Tetraodontidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Blackspotted puffer	*Arothron nigropunctatus*	37 467027	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
False cleanerfish	*Aspidontus taeniatus*	37 408008	DAF / FDD	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Yellow scissortail	*Assessor flavissimus*	37 316003	DAF / FDD, FWG / IND, TS	Primary	Included.
Blue scissortail	*Assessor macneilli*	37 316004	DAF / FDD, FWG / IND, TS	Primary	Included.
Orangestripe triggerfish	*Balistapus undulatus*	37 465047	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Clown triggerfish	*Balistoides conspicillum*	37 465031	FWG / IND, EXP	Primary	Included.
Redspotted rockskipper	*Blenniella chrysospilos*	37 408042	FWG / IND, TS, EXP	Secondary	Family Blenniidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Coral pigfish	*Bodianus axillaris*	37 384053	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pacific diana's pigfish	*Bodianus dictynna*	37 384199	DAF / FDD, PF, EXP	Secondary	Not present in commercial collector stock lists or fisheries dependent data. This species will be considered for inclusion in subsequent assessments.
Eclipse pigfish	*Bodianus mesothorax*	37 384060	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Yellowtail fusilier	*Caesio cuning*	37 34601	DAF / FDD, FWG / IND, TS	Secondary	Family Caesionidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Blackspot toby	*Canthigaster bennetti*	37 467037	FWG / IND, TS, EXP	Secondary	Family Tetraodontidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Netted toby	*Canthigaster papua*	37 467042	FWG / IND, EXP	Secondary	Family Tetraodontidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Solander's toby	*Canthigaster solandri*	37 467073	DAF / FDD	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Blacksaddle toby	*Canthigaster valentini*	37 467043	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Grooved razorfish	*Centriscus scutatus*	37 280001	TS, EXP	Primary	Included.
Golden angelfish	*Centropyge aurantia*	37 365021	DAF / FDD, PF, EXP	Primary	Included (precautionary).
Bicolor angelfish	*Centropyge bicolor*	37 365022	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Coral beauty	*Centropyge bispinosa*	37 365023	DAF / FDD, PF, FWG / IND, TS	Primary	Included.
Cocos-Keeling angelfish	*Centropyge colini*	37 365088	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Whitetail angelfish	*Centropyge fisheri / flavicauda*	37 365025	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Lemonpeel angelfish	*Centropyge flavissima*	37 365026	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Yellow angelfish	*Centropyge heraldi*	37 365027	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Flame angelfish	*Centropyge loriculus*	37 365028	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Multicolor angelfish	*Centropyge multicolor*	N/A	PF, FWG / IND	Omitted	Highly unlikely to overlap with MAFF footprint.
Keyhole angelfish	*Centropyge tibicen*	37 365031	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority.
Pearlscale angelfish	*Centropyge vrolikii*	37 365032	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Bicolour parrotfish	*Cetoscarus ocellatus*	37 386007	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Goldstripe butterflyfish	*Chaetodon aureofasciatus*	37 365013	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Threadfin butterflyfish	*Chaetodon auriga*	37 365019	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Citron butterflyfish	*Chaetodon citrinellus*	37 365036	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority.
Saddle butterflyfish	*Chaetodon ephippium*	37 365037	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority.
Dusky butterflyfish	*Chaetodon flavirostris*	37 365038	DAF / FDD, PF, FWG / IND	Primary	Included (precautionary). Advice/feedback from scientific expert/s suggested this species is a secondary priority. However, DAF identified that it is valuable.
Klein's butterflyfish	*Chaetodon kleinii*	37 365040	PF, FWG / IND, TS, EXP	Primary	Included.
Racoon butterflyfish	*Chaetodon lunula*	37 365042	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pinstripe butterflyfish	*Chaetodon lunulatus*	37 365059	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority.
Blackback butterflyfish	*Chaetodon melannotus*	37 365043	PF, PA, FWG / IND, EXP	Primary	Included.
Mertens' butterflyfish	*Chaetodon mertensii*	37 365044	PF, FWG / IND, TS, EXP	Primary	Included.
Meyer's butterflyfish	*Chaetodon meyeri*	37 365045	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Ornate butterflyfish	*Chaetodon ornatissimus*	37 365047	PF, PA, FWG / IND, EXP	Primary	Included.
Dot-and-dash butterflyfish	*Chaetodon pelewensis*	37 365049	PF, FWG / IND, TS, EXP	Primary	Included.
Bluespot butterflyfish	*Chaetodon plebeius*	37 365050	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Lattice butterflyfish	*Chaetodon rafflesii*	37 365052	PF, FWG / IND, EXP	Primary	Included.
Rainford's butterflyfish	*Chaetodon rainfordi*	37 365053	DAF / FDD, PF, PA, FWG / IND, TS, EXP	Primary	Included.
Reticulate butterflyfish	*Chaetodon reticulatus*	37 365054	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Chevron butterflyfish	*Chaetodon trifascialis*	37 365058	PF, FWG / IND, EXP	Primary	Included.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Doublesaddle butterflyfish	*Chaetodon ulietensis*	37 365060	PF, PA, FWG / IND, EXP	Primary	Included.
Teardrop butterflyfish	*Chaetodon unimaculatus*	37 365061	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Vagabond butterflyfish	*Chaetodon vagabundus*	37 365062	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Conspicuous angelfish	*Chaetodontoplus conspicillatus*	37 365064	DAF / FDD, PF, EXP	Primary	Included.
Scribbled angelfish	*Chaetodontoplus duboulayi*	37 365009	HS T1, DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Queensland yellowtail angelfish	*Chaetodontoplus meredithi*	37 365065	HS T1, DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Redbreast Maori wrasse	*Cheilinus fasciatus*	37 384066	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Red Maori wrasse	*Cheilinus oxycephalus*	37 384067	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Fiveline cardinalfish	*Cheilodipterus quinquelineatus*	37 327090	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Margined coralfish	*Chelmon marginalis*	37 365007	PF, FWG / IND, EXP	Primary	Included.
Muller's coralfish	*Chelmon muelleri*	37 365015	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Beaked coralfish	*Chelmon rostratus*	37 365017	PF, FWG / IND, TS, EXP	Primary	Included.
Milkspot toadfish	*Chelonodon patoca*	37 467015	FWG / IND, EXP	Secondary	Family Tetraodontidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Bullethead parrotfish	*Chlorurus sordidus*	37 386030	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Harlequin tuskfish	*Choerodon fasciatus*	37 384073	HS T1, DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Blackspot tuskfish	*Choerodon schoenleinii*	37 384010	PF, FWG / IND, EXP	Secondary	Primarily a commercial and recreational food fish.
Black axil puller	*Chromis atripectoralis*	37 372036	PF, FWG / IND, EXP	Primary	Included.
Half-and-half puller	*Chromis iomelas*	37 372043	PF, FWG / IND, TS	Primary	Included.
Lined puller	*Chromis lineata*	37 372046	DAF / FDD, PF, EXP	Secondary	Not present in commercial collector stock lists or fisheries dependent data. This species will be considered for inclusion in subsequent assessments.
Yellowback puller	*Chromis nitida*	37 372049	DAF / FDD, PF, FWG / IND, TS	Primary	Included.
Vanderbilt's puller	*Chromis vanderbilti*	37 372052	PF, FWG / IND, TS	Primary	Included.
Blue-green puller	*Chromis viridis*	37 372053	PF, FWG / IND, TS, EXP	Primary	Included.
Blue demoiselle	*Chrysiptera cyanea*	37 372060	PF, FWG / IND, TS	Primary	Included.
Bluehead demoiselle	*Chrysiptera rollandi*	37 372067	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Starck's demoiselle	*Chrysiptera starcki*	37 372068	PF, FWG / IND, TS, EXP	Primary	Included.
Talbot's demoiselle	*Chrysiptera talboti*	37 372069	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
South Seas demoiselle	*Chrysiptera taupou*	37 372070	PF, FWG / IND, TS	Primary	Included.
Deepwater wrasse	*Cirrhilabrus bathyphilus*	37 384193	PF, FWG / IND, TS, EXP	Primary	Included.
Conde's wrasse	*Cirrhilabrus condei*	37 384190	DAF / FDD, PF, EXP	Primary	Included.
Blueside wrasse	*Cirrhilabrus cyanopleura*	37 384079	DAF / FDD, PF, EXP	Primary	Included.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Exquisite wrasse	*Cirrhilabrus exquisitus*	37 384080	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Laboute's wrasse	*Cirrhilabrus laboutei*	37 384081	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Lavender wrasse	*Cirrhilabrus lineatus*	37 384082	PF, FWG / IND, TS, EXP	Primary	Included.
Finespot wrasse	*Cirrhilabrus punctatus*	37 384083	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pink-banded fairy wrasse	*Cirrhilabrus roseafascia*	37 384218	PF, FWG / IND, EXP	Primary	Included.
Scott's wrasse	*Cirrhilabrus scottorum*	37 384084	PF, FWG / IND, TS, EXP	Primary	Included.
Squire's fairy wrasse	*Cirrhilabrus squirei*	37 384216	PF, FWG / IND, EXP	Primary	Included.
Blotched hawkfish	*Cirrhitichthys aprinus*	37 374001	DAF / FDD, EXP	Secondary	Family Cirrhitidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Dwarf hawkfish	*Cirrhitichthys falco*	37 374003	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Spotted hawkfish	*Cirrhitichthys oxycephalus*	37 374004	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Chestnut blenny	*Cirripectes castaneus*	37 408011	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Redstreaked blenny	*Cirripectes stigmaticus*	37 408017	PA, FWG / IND	Primary	Included.
Australian pineapplefish	*Cleidopus gloriamaris*	37 259001	HS T1, DAF / FDD	Primary	Included.
Clown wrasse	*Coris gaimard*	37 384094	PF, FWG / IND, TS	Primary	Included.
Triplespot blenny	*Crossosalarias macrospilus*	37 408018	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Yellow shrimpgoby	*Cryptocentrus cinctus*	37 428098	FWG / IND, EXP	Secondary	Family Gobiidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Twospot bristletooth	*Ctenochaetus binotatus*	37 437021	PF, FWG / IND, TS	Primary	Included.
Lined bristletooth	*Ctenochaetus striatus*	37 437022	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Orange-tip bristletooth	*Ctenochaetus tominiensis*	37 437042	DAF / FDD, PF, EXP	Secondary	Not present in commercial collector stock lists or fisheries dependent data. This species will be prioritised for inclusion in subsequent assessments.
Lavender dottyback	*Cypho purpurascens*	37 313013	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Banded humbug	*Dascyllus aruanus*	37 372073	PF, FWG / IND, TS	Primary	Included.
Headband humbug	*Dascyllus reticulatus*	37 372074	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Threespot humbug	*Dascyllus trimaculatus*	37 372075	PF, FWG / IND, TS	Primary	Included.
Zebra lionfish	*Dendrochirus zebra*	37 287026	DAF / FDD, FWG / IND, EXP	Secondary	Family Scorpaenidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Australian combtooth blenny	*Ecsenius australianus*	37 408021	PA	Primary	Included.
Bicolor combtooth blenny	*Ecsenius bicolor*	37 408022	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Midas combtooth blenny	*Ecsenius midas*	37 408028	DAF / FDD, FWG / IND, EXP	Secondary	Family Blenniidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Smallspotted combtooth blenny	*Ecsenius stictus*	37 408031	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Tiger combtooth blenny	*Ecsenius tigris*	37 408032	PA, FWG / IND, TS, EXP	Primary	Included.
Slingjaw wrasse	*Epibulus insidiator*	37 384104	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Beautiful goby	*Exyrias bellissimus*	37 428139	PA, FWG / IND	Primary	Included.
Forceps fish	*Forcipiger flavissimus*	37 365068	PF, FWG / IND, TS, EXP	Primary	Included.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Longnose butterflyfish	*Forcipiger longirostris*	37 365069	DAF / FDD, PF, FWG / IND	Primary	Included.
Lamarck's angelfish	*Genicanthus lamarck*	37 365070	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Watanabe's angelfish	*Genicanthus watanabei*	37 365073	PF, FWG / IND, TS	Primary	Included.
Golden trevally	*Gnathanodon speciosus*	37 337012	FWG / IND	Secondary	Family Carangidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Lemon coralgoby	*Gobiodon citrinus*	37 428158	DAF / FDD, FWG / IND, EXP	Secondary	Family Gobiidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Maori coralgoby	*Gobiodon histrio*	37 428160	DAF / FDD, FWG / IND, EXP	Secondary	Family Gobiidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Birdnose wrasse	*Gomphosus varius*	37 384106	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
False-eyed wrasse	*Halichoeres biocellatus*	37 384107	PF, FWG / IND, TS	Primary	Included.
Pastel-green wrasse	*Halichoeres chloropterus*	37 384109	PF, FWG / IND,	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Golden wrasse	*Halichoeres chrysus*	37 384110	PF, FWG / IND, TS	Primary	Included.
Checkerboard wrasse	*Halichoeres hortulanus*	37 384112	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Dusky wrasse	*Halichoeres marginatus*	37 384114	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Hoeven's wrasse	*Halichoeres melanurus*	37 384032	PF, FWG / IND, TS	Primary	Included.
Cloud wrasse	*Halichoeres nebulosus*	37 384118	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Twotone wrasse	*Halichoeres prosopeion*	37 384120	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Thicklip wrasse	*Hemigymnus melapterus*	37 384125	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Pyramid butterflyfish	*Hemitaurichthys polylepis*	37 365074	PF, FWG / IND, TS, EXP	Primary	Included.
Longfin bannerfish	*Heniochus acuminatus*	37 365011	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Schooling bannerfish	*Heniochus diphreutes*	37 365005	PF, FWG / IND, EXP	Primary	Included.
Masked bannerfish	*Heniochus monoceros*	37 365076	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pastel slender wrasse	*Hologymnosus doliatus*	37 384127	PF, FWG / IND, EXP	Primary	Included.
Old glory goby	*Koumansetta rainfordi*	37 428049	FWG / IND, TS, EXP	Primary	Included.
Bicolor cleanerfish	*Labroides bicolor*	37 384130	PF, FWG / IND, EXP	Primary	Included.
Common cleanerfish	*Labroides dimidiatus*	37 384028	PF, FWG / IND, TS, EXP	Primary	Included.
Gold cleaner wrasse	*Labroides pectoralis*	37 384131	PF, PA, FWG / IND, EXP	Primary	Included.
Longhorn cowfish	*Lactoria cornuta*	37 466004	FWG / IND, EXP	Secondary	Family Ostraciidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Thornback cowfish	*Lactoria fornasini*	37 466018	DAF / FDD, EXP	Secondary	Family Ostraciidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Fusilier damsel	*Lepidozygus tapeinosoma*	37 372082	PF, FWG / IND, TS, EXP	Primary	Included.
Bluestriped snapper	*Lutjanus kasmira*	37 346044	FWG / IND, TS	Secondary	Family Lutjanidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Fiveline snapper	*Lutjanus quinquelineatus*	37 346006	FWG / IND, TS	Secondary	Family Lutjanidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Brownstripe snapper	*Lutjanus vitta*	37 346003	FWG / IND	Secondary	Family Lutjanidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Seaver splitfin	*Luzonichthys seaver*	N/A	PF, FWG / IND, TS, EXP	Secondary	*L. seaver* not considered a primary assessment priority due to inhabiting mesophotic reefs in the Coral Sea and has a depth profile of 90−100 m (beyond most SCUBA limits). This species will be considered for inclusion in subsequent assessments.
Pygmy basslet	*Luzonichthys waitei*	37 311104	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Black-and-white snapper	*Macolor niger*	37 346048	FWG / IND	Secondary	Family Lutjanidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Choat's wrasse	*Macropharyngodon choati*	37 384134	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Kuiter's wrasse	*Macropharyngodon kuiteri*	37 384135	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Leopard wrasse	*Macropharyngodon meleagris*	37 384136	PF, FWG / IND, TS, EXP	Primary	Included.
Black leopard wrasse	*Macropharyngodon negrosensis*	37 384137	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Ornate leopard wrasse	*Macropharyngodon ornatus*	37 384138	DAF / FDD, PF, FWG / IND, EXP	Omitted	Not present in Queensland waters based on the advice/feedback from scientific expert/s.
Eyelash fangblenny	*Meiacanthus atrodorsalis*	37 408051	FWG / IND, TS	Secondary	Family Blenniidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Linespot fangblenny	*Meiacanthus grammistes*	37 408005	FWG / IND	Secondary	Family Blenniidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Pinktail triggerfish	*Melichthys vidua*	37 465058	DAF / FDD, FWG / IND	Secondary	Family Balistidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Stripey	*Microcanthus strigatus*	37 361028	DAF / FDD, EXP	Secondary	Family Microcanthidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Blonde naso tang	*Naso elegans*	37 437052	DAF / FDD, PF	Omitted	Not present in Queensland waters based on the advice/feedback from scientific expert/s.
Sleek unicornfish	*Naso hexacanthus*	37 437028	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Clown unicornfish	*Naso lituratus*	37 437029	PF, FWG / IND, TS	Primary	Included.
Bluespine unicornfish	*Naso unicornis*	37 437031	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Bignose unicornfish	*Naso vlamingii*	37 437032	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Bracelet cardinalfish	*Nectamia viria*	37 327164	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Purple firegoby	*Nemateleotris decora*	37 435007	DAF / FDD, FWG / IND, EXP	Secondary	Family Microdesmidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Helfrich's dartfish	*Nemateleotris helfrichi*	37 435029	DAF / FDD, EXP	Secondary	Family Microdesmidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Red firegoby	*Nemateleotris magnifica*	37 435008	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Flame hawkfish	*Neocirrhites armatus*	37 374007	FWG / IND, TS, EXP	Secondary	Family Cirrhitidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Black damsel	*Neoglyphidodon melas*	37 372084	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Yellowtail demoiselle	*Neopomacentrus azysron*	37 372087	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Regal demoiselle	*Neopomacentrus cyanomos*	37 372089	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Marble dragonet	*Neosynchiropus ocellatus*	37 427032	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Carpet wrasse	*Novaculichthys taeniourus*	37 384140	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Redtooth triggerfish	*Odonus niger*	37 465061	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Multicolour dottyback	*Ogilbyina novaehollandiae*	37 313009	DAF / FDD, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Plain cardinalfish	*Ostorhinchus apogonoides*	37 327043	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Orangelined cardinalfish	*Ostorhinchus cyanosoma*	37 327052	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Fourline cardinalfish	*Ostorhinchus doederleini*	37 327053	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Sydney cardinalfish	*Ostorhinchus limenus*	37 327066	PA	Primary	Included.
Coral cardinalfish	*Ostorhinchus properuptus*	37 327072	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pearly-line cardinalfish	*Ostorhinchus taeniophorus*	37 327075	FWG / IND, EXP	Secondary	Family Apogonidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Yellow boxfish	*Ostracion cubicus*	37 466013	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Longtail dottyback	*Oxycercichthys veliferus*	37 313017	FWG / IND, EXP	Secondary	Family Pseudochromidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent ERAs.
Violetline Maori wrasse	*Oxycheilinus digramma*	37 384065	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Longnose hawkfish	*Oxycirrhites typus*	37 374008	DAF / FDD, FWG / IND, EXP	Secondary	Family Cirrhitidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Harlequin filefish	*Oxymonacanthus longirostris*	37 465062	FWG / IND, EXP	Primary	Included.
Blue tang	*Paracanthurus hepatus*	37 437033	HS T1, DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Multibar angelfish	*Paracentropyge multifasciatus*	37 365029	DAF / FDD, PF, EXP	Primary	Included.
Filamentous flasher wrasse	*Paracheilinus filamentosus*	37 384192	DAF / FDD, PF, EXP	Primary	Included.
Ringeye hawkfish	*Paracirrhites arcatus*	37 374009	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Freckled hawkfish	*Paracirrhites forsteri*	37 374010	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Blacksaddle filefish	*Paraluteres prionurus*	37 465063	FWG / IND	Secondary	Family Monacanthidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Bicolour goatfish	*Parupeneus barberinoides*	37 355021	FWG / IND, TS	Secondary	Family Mullidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Goldsaddle goatfish	*Parupeneus cyclostomus*	37 355025	FWG / IND, TS	Secondary	Family Mullidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Banded goatfish	*Parupeneus multifasciatus*	37 355026	FWG / IND	Secondary	Family Mullidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Royal dottyback	*Pictichromis paccagnellae*	37 313010	FWG / IND, TS, EXP	Secondary	Family Pseudochromidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Bicolor fangblenny	*Plagiotremus laudandus*	37 408075	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Spotted sweetlips	*Plectorhinchus chaetodonoides*	37 350014	FWG / IND	Secondary	Family Haemulidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Striped sweetlips	*Plectorhinchus lessonii*	37 350020	FWG / IND	Secondary	Family Haemulidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Oblique-banded aweetlips	*Plectorhinchus lineatus*	37 350022	FWG / IND	Secondary	Family Haemulidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Coral devil	*Plesiops coeruleolineatus*	37 316013	FWG / IND	Secondary	Family Plesiopidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Striped catfish	*Plotosus lineatus*	37 192002	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Emperor angelfish	*Pomacanthus imperator*	37 365014	PF, FWG / IND, EXP	Primary	Included.
Bluegirdle angelfish	*Pomacanthus navarchus*	37 365079	DAF / FDD, PF, EXP	Primary	Included.
Blue angelfish	*Pomacanthus semicirculatus*	37 365080	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Sixband angelfish	*Pomacanthus sexstriatus*	37 365010	DAF / FDD, PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Blueface angelfish	*Pomacanthus xanthometopon*	37 365081	DAF / FDD, PF, FWG / IND, EXP	Primary	Included as a precautionary measure in response to expert advice that indicated the species has a conservative life history, is found in naturally low abundance, and may be more susceptible to fishing activities if market demand increases.
Ambon damsel	*Pomacentrus amboinensis*	37 372106	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Neon damsel	*Pomacentrus coelestis*	37 372111	PF, FWG / IND, TS	Primary	Included.
Lemon damsel	*Pomacentrus moluccensis*	37 372118	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Peacock damsel	*Pomacentrus pavo*	37 372122	PF, FWG / IND, EXP	Primary	Included.
Princess damsel	*Pomacentrus vaiuli*	37 372126	PF, FWG / IND, EXP	Primary	Included.
Spine-cheek clownfish	*Premnas biaculeatus*	37 372129	PF, PA, FWG / IND, TS, EXP	Primary	Included.
Sleepy goby	*Psammogobius biocellatus*	37 428025	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Yellowback basslet	*Pseudanthias bicolor*	37 311112	PF, FWG / IND, TS, EXP	Primary	Included.
Red basslet	*Pseudanthias cooperi*	37 311113	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Fairy basslet	*Pseudanthias dispar*	37 311114	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Barrier Reef basslet	*Pseudanthias engelhardi*	37 311115	PF	Secondary	*P. engelhardi* not considered a primary assessment priority due to depth profile of 40−200 m (beyond most SCUBA limits) and only known from a few specimens. This species will be considered for inclusion in subsequent assessments.
Pacific basslet	*Pseudanthias huchtii*	37 311117	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Pink basslet	*Pseudanthias hypselosoma*	37 311094	FWG / IND, TS, EXP	Primary	Included.
Luzon basslet	*Pseudanthias luzonensis*	37 311120	DAF / FDD, PF, FWG / IND, EXP	Primary	Included.
Purple-tip anthias	*Pseudanthias paralourgus*	37 311242	PF	Secondary	*P. paralourgus* not considered a primary assessment priority as only known from a few specimens. This species will be considered for inclusion in subsequent assessments.
Sailfin queen	*Pseudanthias pascalus* (*Mirolabrichthys pascalus*)	37 311121	PF, TS, EXP	Primary	Included.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Painted basslet	*Pseudanthias pictilis*	37 311122	DAF / FDD, PF, FWG / IND, TS, EXP	Primary	Included.
Mirror basslet	*Pseudanthias pleurotaenia*	37 311123	PF, FWG / IND, TS, EXP	Primary	Included.
Lilac-tip basslet	*Pseudanthias rubrizonatus*	37 311124	DAF / FDD, PF, EXP	Primary	Included (precautionary).
Princess basslet	*Pseudanthias smithvanizi*	37 311125	DAF / FDD, PF, EXP	Primary	Included (precautionary).
Orange basslet	*Pseudanthias squamipinnis*	37 311126	PF, FWG / IND, TS, EXP	Primary	Included.
Purple queen	*Pseudanthias tuka*	37 311127	DAF / FDD, TS, EXP	Primary	Included.
Longfin basslet	*Pseudanthias ventralis* (*cf. australis*)	37 311128	PF, FWG / IND, TS, EXP	Primary	Included.
Pinstripe wrasse	*Pseudocheilinus evanidus*	37 384142	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Sixline wrasse	*Pseudocheilinus hexataenia*	37 384143	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Whitebarred pink wrasse	*Pseudocheilinus ocellatus*	37 384184	PF, FWG / IND	Secondary	Classified as a secondary vulnerability priority based on advice from scientific expert/s on other species in the genus.
Yellowhead dottyback	*Pseudochromis cyanotaenia*	37 313016	FWG / IND, EXP	Secondary	Family Pseudochromidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Dusky dottyback	*Pseudochromis fuscus*	37 313006	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Candy wrasse	*Pseudojuloides splendens*	37 384147	PF, FWG / IND, EXP	Primary	Included.
Arrow dartgoby	*Ptereleotris evides*	37 435015	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Zebra dartgoby	*Ptereleotris zebra*	37 435022	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Doubleline fusilier	*Pterocaesio digramma*	37 346050	FWG / IND	Secondary	Family Caesionidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Bigtail fusilier	*Pterocaesio marri*	37 346068	FWG / IND, TS	Secondary	Family Caesionidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Spotfin lionfish	*Pterois antennata*	37 287064	FWG / IND, EXP	Secondary	Family Scorpaenidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Common lionfish	*Pterois volitans*	37 287040	FWG / IND, EXP	Secondary	Family Scorpaenidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Mandarinfish	*Pterosynchiropus splendidus*	37 427034	DAF / FDD, EXP	Secondary	Family Callionymidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Regal angelfish	*Pygoplites diacanthus*	37 365082	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Golden anthias	*Pyronotanthias aurulentus*	37 311196	PF, FWG / IND, TS, EXP	Primary	Included (precautionary).
Lori's basslet	*Pyronotanthias lori*	37 311119	PF, FWG / IND, TS, EXP	Primary	Included.
Southern sailfin anthias	*Rabaulichthys squirei*	37 311194	DAF / FDD, PF, FWG / IND, TS, EXP	Omitted	Highly unlikely to overlap with MAFF footprint.
Hawaiian triggerfish	*Rhinecanthus aculeatus*	37 465028	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Wedgetail triggerfish	*Rhinecanthus rectangulus*	37 465073	DAF / FDD, FWG / IND, EXP	Secondary	Family Balistidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Blackpatch triggerfish	*Rhinecanthus verrucosus*	37 465074	FWG / IND, EXP	Secondary	Family Balistidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Weedy scorpionfish	*Rhinopias aphanes*	37 287065	FWG / IND, EXP	Secondary	Family Scorpaenidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Banded blenny	*Salarias fasciatus*	37 408079	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Two-line monocle bream	*Scolopsis bilineata*	37 347031	DAF / FDD, FWG / IND, TS	Secondary	Family Nemipteridae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Swallowtail basslet	*Serranocirrhitus latus*	37 311130	PF, FWG / IND, TS, EXP	Primary	Included.
Coral rabbitfish	*Siganus corallinus*	37 438008	PA, FWG / IND, TS	Primary	Included.
Bluelined rabbitfish	*Siganus doliatus*	37 438009	FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Bluelined rabbitfish	*Siganus puellus*	37 438011	PA, FWG / IND	Primary	Included.
Spotted rabbitfish	*Siganus punctatus*	37 438003	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Scribbled rabbitfish	*Siganus spinus*	37 438013	DAF / FDD, FWG / IND, EXP	Secondary	Family Siganidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Doublebar rabbitfish	*Siganus virgatus*	37 438016	DAF / FDD, FWG / IND, EXP	Secondary	Family Siganidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Foxface	*Siganus vulpinus*	37 438017	PA, FWG / IND	Primary	Included.
Crab-eye goby	*Signigobius biocellatus*	37 428249	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pajama cardinalfish	*Sphaeramia nematoptera*	37 327119	PA, FWG / IND, TS	Primary	Included.
Redspot wrasse	*Stethojulis bandanensis*	37 384154	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Pallid triggerfish	*Sufflamen bursa*	37 465078	DAF / FDD, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Eye-stripe triggerfish	*Sufflamen chrysopterum*	37 465079	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Chinamanfish	*Symphorus nematophorus*	37 346017	FWG / IND	Secondary	Family Lutjanidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Lea's cardinalfish	*Taeniamia leai*	37 327083	PA	Primary	Included.
Leaf scorpionfish	*Taenianotus triacanthus*	37 287090	DAF / FDD, EXP	Secondary	Family Scorpaenidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Bluehead wrasse	*Thalassoma amblycephalum*	37 384164	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Sixbar wrasse	*Thalassoma hardwicke*	37 384165	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Jansen's wrasse	*Thalassoma jansenii*	37 384166	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Moon wrasse	*Thalassoma lunare*	37 384167	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Green moon wrasse	*Thalassoma lutescens*	37 384168	PF, FWG / IND, TS, EXP	Primary	Included.
Red-ribbon wrasse	*Thalassoma quinquevittatum*	37 384170	PF, FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Rusty-spotted toadfish	*Torquigener pallimaculatus*	37 467009	DAF / FDD, EXP	Secondary	Family Tetraodontidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Longfin threadtail anthias	*Tosana longipinnis*	37 311229	PF	Secondary	*T. longipinnis* not considered a primary assessment priority as only known from a few (44) specimens. This species will be considered for inclusion in subsequent assessments.
Decorated glidergoby	*Valenciennea decora*	37 428326	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Ocellate glidergoby	*Valenciennea longipinnis*	37 428282	FWG / IND, TS	Primary	Included (precautionary).
Orangespotted glidergoby	*Valenciennea puellaris*	37 428284	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Blueband glidergoby	*Valenciennea strigata*	37 428286	FWG / IND, TS	Primary	Included (precautionary).

Common name	Species	CAAB	Key Instruments	Assessment Priority	Comments
Gilded triggerfish	*Xanthichthys auromarginatus*	37 465080	DAF / FDD, EXP	Secondary	Family Balistidae not considered a primary assessment priority due to comparatively low catch rates. This species will be considered for inclusion in subsequent assessments.
Moorish idol	*Zanclus cornutus*	37 437001	DAF / FDD, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Brown tang	*Zebrasoma scopas*	37 437036	PF, FWG / IND, TS	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.
Sailfin tang	*Zebrasoma veliferum*	37 437037	PF, FWG / IND	Primary	Included.
Fragile Cardinalfish	*Zoramia viridiventer*	37 327058	FWG / IND	Secondary	Classified as a secondary vulnerability assessment priority based on advice/feedback from scientific expert/s.

Appendix C—Productivity and Susceptibility Analysis: Criteria Definitions, Justifications and Considerations

The framework of the MAFF VA was based on a Productivity and Susceptibility Analysis (PSA) frequently used to assess vulnerability or risk for retained (target and byproduct), bycatch, and Threatened, Endangered and Protected (TEP) species. (Hobday *et al.*, 2011; Hobday *et al.*, 2007). As the business model differs for this fishery (i.e. live ornamental trade), this framework needed to be modified to ensure that a) it accurately reflects the MAFF operating environment and b) provides adequate assessment of the vulnerability posed to ornamental fish species on the Queensland east coast by commercial operations.

The following provides an overview of the attributes that were considered for inclusion in the MAFF VA, the reference source/s, and the key justifications. The adoption of attributes used in the MAFF VA was done in consultation with scientific experts, government agencies, industry and the Marine Aquarium Fish and Coral Fisheries Working Group.

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
Age at maturity	Productivity	The age that a fish of a certain population reaches maturity for the first time. Where protogynous/protandrous species were assessed, the last sex to mature was used to remain conservative.	For teleosts, age at maturity is most often positively correlated with age. Species that take longer to mature and reproduce are more vulnerable to depletion than those that have high turnover rates as they may be harvested before contributing to the stock. This attribute is an adaptation of average age at maturity (Baillargeon *et al.*, 2020; Hobday *et al.*, 2011; Hobday *et al.*, 2007), and age at maturity (Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009).	Included	(Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Patrick *et al.*, 2009)
Maximum age	Productivity	The maximum recorded or estimated age of a species. Otolith or scale analyses in literature were used in the PSA. When and where appropriate, information from alternate fisheries models, data from captive	The maximum age of a fish provides a direct indication of its natural mortality rate whereby the proportion of fishes dying from natural causes is negatively correlated with high maximum ages. Therefore, longer lived fish have a low natural mortality.	Included	(Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*,

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
		specimens and/or advice from scientific experts were used to refine scores as part of the RVA.	Maximum age differentiates between low productivity / high longevity and high productivity / low longevity stocks. This attribute is an adaptation of average maximum age (Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016) and maximum age (Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009).		2016; Patrick *et al.*, 2009)
Maximum size	Productivity	Defined as the maximum length in centimetres (cm) attained by a species. Where total length (TL) was not available, standard length (SL) was used.	This attribute is correlated with productivity. For example, the larger the fish, the longer it takes to mature and contribute to spawning biomass, and therefore, the higher the vulnerability to overharvesting or localised depletion. This attribute is an adaptation of average maximum size (Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016) and maximum size (Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009).	Included	(Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016; Patrick *et al.*, 2009)
Reproductive strategy	Productivity	The method used by a species to reproduce (i.e. pelagic spawner, demersal spawner or live bearer).	This attribute was used in the MAFF VA as it provides an indication of the level of mortality that may be expected for offspring and the amount of parental investment required for reproductive success. Species that produce less offspring and require investment are more vulnerable as more energy to raise young is required and fewer individuals reach adulthood. This attribute also accounted for fecundity. Species that are broadcast spawners are more	Included with amendments	(Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016; Patrick *et al.*, 2009)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			fecund (in terms of number of eggs produced) than demersal spawners and live bearers. This attribute is an adaptation of reproductive strategy (Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016) and breeding strategy (Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009).		
von Bertalanffy growth coefficient (*k*)	Productivity	The von Bertalanffy growth coefficient (*k*) measures the rate per year at which a fish approaches its asymptotic (maximum) length.	This attribute was used as *k* differentiates between high turnover and low turnover species in reference to their growth through time. This attribute aligns with von Bertalanffy growth coefficient including in assessments examining vulnerability in ornamental fisheries (Dee *et al.*, 2019; Fujita *et al.*, 2014; Okemwa *et al.*, 2016; Patrick *et al.*, 2009).	Included	(Dee *et al.*, 2019; Fujita *et al.*, 2014; Okemwa *et al.*, 2016; Patrick *et al.*, 2009)
Fecundity	Productivity	Fecundity is defined here as the number of eggs per spawning event.	This attribute is frequently used in PSA's involving species that are caught/retained for human consumption (Pidd *et al.*, 2021; Walton & Jacobsen, 2021; Walton *et al.*, 2021). This attribute assumes that the more eggs that are produced, the higher the chance of recovery success. However, this has only been quantified for few wild populations of coral reef fish. Consideration was given to using fecundity values from aquaculture and histological studies. However, consultation indicated that this information would not easily translate to eggs per spawn for wild populations. This is partly because there is limited information	Excluded, considered as part of alternate attribute.	(Baillargeon *et al.*, 2020; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			available on the percentage of reef fish that recruit back to the reef (pers. comm. D. Bellwood). It is possible for some species, that although the number of eggs per spawn in demersal spawners is lower than broadcast spawners, the recovery success may be higher. This is due to the higher level of parental care and investment of demersal spawning species. This is yet to be quantified. While fecundity was excluded as an attribute, it was still considered and integrated into the reproductive strategy attribute.		
Minimum population doubling time	Productivity	The time required to double a population size is used as a proxy for recruitment rate.	This attribute has been used in previous assessments examining vulnerability in ornamental fisheries (Okemwa *et al.*, 2016). Minimum population doubling time was excluded as an attribute due to the lack of accurate and reliable data for coral reef fishes. While minimum population doubling time estimates are available through broader databases like Fishbase, expert consultation recommended that they should not be used as a proxy for recruitment rate. It was further advised that there are no scientific studies on this topic for reef fish and therefore should not be used as an attribute in this assessment (pers. comm. D. Bellwood).	Excluded	(Okemwa *et al.*, 2016)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
Trophic level / Mean trophic level	Productivity	Trophic level refers to where an organism sits on a scale/level (represented as a value between 1 and 5) of an ecosystem food chain based on its diet.	Trophic level has been included as a Productivity attribute in a range of risk assessments involving species that are retained for human consumption (Pidd *et al.*, 2021; Walton & Jacobsen, 2021; Walton *et al.*, 2021). Lower-trophic level stocks are usually more productive and have higher growth rates than those higher in the food chain. This attribute can differentiate between primary consumers and higher level secondary and tertiary consumers. Trophic level ranks/values do not add value without adequate diet studies (pers. comm. D. Bellwood). There are limited studies available on coral reef fish gut content analyses. What a fish feeds on and gains its nutrition from is difficult to determine without this information. Therefore, trophic level approximations taken from the grey literature such as Fishbase are inaccurate for species in this assessment, as what a fish appears to feed on is not always what it actually feeds on. For example, *Paracanthurus hepatus* is supposedly a planktivore, however, adults also graze on algae and copepods. Therefore, *P. hepatus* is an omnivore.	Excluded	(Baillargeon *et al.*, 2020; Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Okemwa *et al.*, 2016; Patrick *et al.*, 2009)
Availability (geographic distribution)	Susceptibility	The area that a species is located spatially on a global scale.	Availability is a common component of the susceptibility analysis and, in the MAFF VA considers the geographic distribution of the species. Geographic distribution helps differentiate between species that are at higher	Included	(Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011;

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			vulnerability to the negative effects of fishing activities due to (e.g.) limits on their distribution (endemics/species with restricted ranges). This attribute assumes that species that are widely distributed or have global distributions are less vulnerable to experiencing an overfishing event as they have refuge from the fishery area. This attribute is an adaptation of Availability 2. Global distribution (Hobday *et al*., 2011), geographic concentration (Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009) and Availability: global distribution (Okemwa *et al.*, 2016).		Okemwa *et al.*, 2016; Patrick *et al.*, 2009)
Availability (overlap of species range with fishery)	Susceptibility	This attribute compares the overlap of fishing effort with the distribution of a given species.	This attribute is frequently used as an alternate for availability (geographic distribution). A review of the available data determined that this attribute is less suited to the MAFF as the reliability of species-specific distribution maps within Queensland is currently unknown.	Excluded	(Dee *et al.*, 2019; Hobday *et al.*, 2011; Hobday *et al.*, 2007; Patrick *et al.*, 2009)
Depth profile	Susceptibility	The vertical bounds / depth range of a species in metres (m) in comparison to the operational constraints of the MAFF.	This attribute measured the relationship between a species core depth profile and their accessibility to fishers. This assumes that the higher the encounterability (the shallower the depth profile) the higher the chance of interaction. Species restricted to shallow reefs are more vulnerable to fishing activities compared to species with refuge beyond or with reduced	Included	(Dee *et al.*, 2019; Fujita *et al.*, 2014; Hobday *et al.*, 2011; Okemwa *et al.*, 2016; Patrick *et al.*, 2009)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			fishing pressure (e.g. species with broader depth ranges and/or inhabiting deeper reefs). Species found within 0–10 m are considered to have a high encounterability (i.e. a high vulnerability to collection) as divers at this depth can collect fish for extended periods of time.. Between 10–30 m is somewhat restricted due to time limits on SCUBA equipment. Beyond 30 m is rarely dived for aquarium species due to the limits of SCUBA equipment. This attribute is an adaptation of encounterability 2 – depth check (Hobday *et al.*, 2011), and vertical overlap (Dee *et al.*, 2019; Fujita *et al.*, 2014; Patrick *et al.*, 2009) although aligns with encounterability: depth (Okemwa *et al.*, 2016).		
Ecological niche	Susceptibility	The functional role of an organism within its environment and/or the way an organism interacts with its surroundings.	This attribute was used to identify species that are more vulnerable to the impacts of fishing due to their reliance on a specific habitat or another organism. The more specific the ecological connection, the more restricted the species is, and the more damaging the impacts of fishing activities. This attribute is an adaptation of encounterability 1 – habitat (Hobday *et al.*, 2011), encounterability: ecological niche (Okemwa *et al.*, 2016) and ecological niche (Baillargeon *et al.*, 2020).	Included	(Baillargeon *et al.*, 2020; Hobday *et al.*, 2011; Okemwa *et al.*, 2016)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
Management strategy	Susceptibility	The strategy employed by government to protect aquarium fish stocks (specifically within the MAFF fishing environment).	Management strategy accounts for species that are afforded some level of protection due to management practices and those that are not protected and therefore more vulnerable. Management strategy has been suggested as a useful attribute in other PSA framework studies (Patrick *et al.*, 2009) and has been applied in ERAs involving other Queensland fisheries (Department of Agriculture and Fisheries, 2022b). The susceptibility of a species/stock to overfishing can be influenced by the fisheries management practices in place to control harvesting (e.g. catch limits). This attribute was adapted accordingly to be representative of the Queensland Marine Aquarium Fish Fishery. Of note, the inclusion of this attribute has been applied effectively in other risk assessments developed under the *Queensland Sustainable Fisheries Strategy 2017–2027* (Department of Agriculture and Fisheries, 2017; 2022b).	Included	(Dee *et al.*, 2019; Department of Agriculture and Fisheries, 2022b; Patrick *et al.*, 2009)
Catchability	Susceptibility	The behavioural characteristics of a species that influences its susceptibility and ease of capture with fishing gear.	This attribute was used to differentiate between species that are found solitarily and are high effort / difficult to catch, versus those that are found aggregating or schooling and can be caught with less effort. This attribute assumes solitary species are less like to be targeted or caught due to the high-effort low-gain involved in collecting a single	Included	(Dee *et al.*, 2019; Patrick *et al.*, 2009)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			specimen. In comparison, low-effort high-gain species are found in pairs/small groups on the reef or aggregations/schools above the reef whereby multiple specimens can be caught at once. It is recognised that catchability will depend on a wider range of factors. The intent of this attribute though is to provide an indicative assessment of an element that will contribute to a species being selected. Catchability will be used as an alternative to 'Selectivity' that focuses solely on gear. This attribute is a modification of schooling/aggregation (Dee *et al.*, 2019) and schooling/aggregation and other behavioural responses (Patrick *et al.*, 2009).		
Market value	Susceptibility	The market value of a species in the aquarium trade.	This attribute assumes that low value species are less vulnerable to collection activities, overharvesting or localised depletion as they are generally less desirable and/or plentiful. On the other hand, higher value species that may be rare or found within a limited range, may experience increased vulnerability to harvesting as they are more desirable. High value can also be a result of collection, husbandry and/or transport/shipping costs. The market value attribute was adapted from market value (Roelofs & Silcock, 2008), desirability/value of the fishery (Patrick *et al.*,	Included with amendments.	(Dee *et al.*, 2019; Okemwa *et al.*, 2016; Patrick *et al.*, 2009; Roelofs & Silcock, 2008)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			2009), selectivity: desirability/market value (Okemwa *et al.*, 2016), and value of the fishery (Dee *et al.*, 2019).		
Aquarium suitability	Susceptibility	The suitability/appropriateness of a fish species to living within captive conditions (e.g. aquaria). Based on the Aquarium Suitability Index described by Michael (2005).	This attribute was considered in a previous MAFF assessment and assumes that species that do not acclimate well and/or do not feed in captivity are less likely to be collected (Roelofs & Silcock, 2008). However, this assumption does not hold true across species (e.g. species that are difficult to maintain / have higher mortality rates may also be collected in higher numbers to meet demand). In the context of this assessment, there is no measurable connection between vulnerability and aquarium suitability, therefore it was not included.	Excluded	(Roelofs & Silcock, 2008)
Appropriateness		The susceptibility to capture of a species based on their appropriateness to captive conditions and supply chain mortality. Based on the aquarium suitability Index described by Michael (2005).	This attribute has been applied in analogous vulnerability assessments involving ornamental fisheries (Dee *et al.*, 2019). It assumes that species that do not acclimatise to captive conditions and/or feed well in aquariums are more susceptible to collection than those that are hardy and durable. Appropriateness is analogous to aquarium suitability and the same caveats will apply to this attribute.	Excluded	(Dee *et al.*, 2019)
Selectivity (in reference to gear)	Susceptibility	Considers the potential of the gear to capture or retain species.	In previous ERAs involving Queensland fisheries, criteria used to assess selectivity was based on the gear/apparatus used (Department of Agriculture and Fisheries, 2022b).	Excluded	(Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2007)

Attribute	PSA Component	Definition	Justifications and Considerations	Included/ Excluded	References
			A gear-based selectivity attribute is less suited to the MAFF as it is a hand-collection fishery with negligible bycatch. This fishery primarily uses small nets to collect aquarium species and is highly selective to the target specimen. Gear selectivity is not a useful tool to differentiate between vulnerability among teleosts in this assessment.		
Post-capture mortality	Susceptibility	Handling practices that may affect the survival of species after capture and release.	Post-capture mortality is frequently used as a risk indicator in PSAs of commercial food fish fishing activities. Aquarium species are collected with the intention of keeping them alive for the live aquarium trade. Furthermore, most species that are targeted are caught, limiting the specimens that are/would be released. For these reasons, this attribute was not used in this assessment.	Excluded	(Department of Agriculture and Fisheries, 2022b; Hobday *et al.*, 2007; Okemwa *et al.*, 2016)
Seasonal migrations	Susceptibility	Seasonal migrations either to or from the fishery area (i.e. spawning or feeding migrations) which could affect the overlap between the stock and the fishery.	The vast majority of aquarium fish species are non-migratory, therefore this attribute was not a beneficial metric for the assessment of vulnerability in the MAFF.	Excluded	(Patrick *et al.*, 2009)

Appendix D—Results: Productivity and Susceptibility Analysis

Preliminary vulnerability ratings compiled as part of the Productivity and Susceptibility Analysis (PSA) and the scores assigned to each based on criteria outlined in Table 1 and Table 2. Final PSA values are calculated using the scores assigned to each attribute and where possible, align with the methods outlined in Hobday et al. (2007). The criteria and scoring used in this method were modified to be representative of the MAFF which, when compared to other jurisdictions, operates under a more complex management system. Pink boxes with '*' represent attributes that were assigned precautionary score due to an absence of species-specific data.

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	PSA score
Family Acanthuridae															
Greyhead Surgeonfish	*Acanthurus nigros*	3*	3*	3	1	3*	2.60	1	3	2	2	2	3*	2.04	**3.30**
Orangeblotch Surgeonfish	*Acanthurus olivaceus*	3*	3	3	1	1	2.20	1	3	1	2	2	2	1.70	**2.78**
Mimic Surgeonfish	*Acanthurus pyroferus*	3*	3	3	1	1	2.20	1	3	1	2	1	2	1.51	**2.67**
Night Surgeonfish	*Acanthurus thompsoni*	3*	3*	3	1	3*	2.60	1	3	2	2	3	2	2.04	**3.30**
Twospot Bristletooth	*Ctenochaetus binotatus*	3*	2	3	1	3*	2.40	1	3	1	2	3*	2	1.82	**3.01**
Clown Unicornfish	*Naso lituratus*	3*	3	3	1	1	2.20	1	3	2	2	3*	2	2.04	**3.00**
Blue Tang	*Paracanthurus hepatus*	3*	3*	3	1	1	2.20	1	3	2	1	3	2	1.82	**2.85**
Sailfin Tang	*Zebrasoma veliferum*	3*	3	3	1	1	2.20	1	3	1	2	2	2	1.70	**2.78**
Family Apogonidae															
Sydney Cardinalfish	*Ostorhinchus limenus*	3*	3*	2	2	3*	2.60	3	3	1	2	2	3*	2.18	**3.39**
Pajama cardinalfish	*Sphaeramia nematoptera*	3*	3*	1	2	3*	2.40	1	3	2	2	2	1	1.70	**2.94**
Lea's Cardinalfish	*Taeniamia leai*	3*	3*	1	2	3*	2.40	2	3	2	2	2	3*	2.29	**3.32**
Family Balistidae															
Clown Triggerfish	*Balistoides conspicillum*	3*	3*	3	2	3*	2.80	1	3	1	2	1	2	1.51	**3.18**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	PSA score
Family Blenniidae															
Redstreaked Blenny	*Cirripectes stigmaticus*	3*	3*	2	2	3*	2.60	1	3	2	2	3*	1	1.82	**3.17**
Australian Combtooth Blenny	*Ecsenius australianus*	3*	3*	1	2	3*	2.40	2	3	2	2	3*	2	2.29	**3.32**
Tiger Combtooth Blenny	*Ecsenius tigris*	3*	3*	1	2	3*	2.40	3	3	2	2	3*	2	2.45	**3.43**
Family Centriscidae															
Jointed Razorfish	*Aeoliscus strigatus*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Grooved Razorfish	*Centriscus scutatus*	3*	3*	2	1	3*	2.40	1	3	1	2	3	3*	1.94	**3.09**
Family Chaetodontidae															
Goldstripe Butterflyfish	*Chaetodon aureofasciatus*	3*	3*	2	1	3*	2.40	2	3	2	2	2	1	1.91	**3.07**
Dusky Butterflyfish	*Chaetodon flavirostris*	3*	3*	3	1	3*	2.60	1	3	1	2	2	3*	1.82	**3.17**
Klein's Butterflyfish	*Chaetodon kleinii*	3*	3*	2	1	3*	2.40	1	3	1	2	3	1	1.62	**2.89**
Blackback Butterflyfish	*Chaetodon melannotus*	3*	3*	2	1	3*	2.40	1	3	2	2	2	3*	2.04	**3.15**
Mertens' Butterflyfish	*Chaetodon mertensii*	3*	3*	2	1	3*	2.40	1	2	1	2	2	1	1.41	**2.79**
Meyer's Butterflyfish	*Chaetodon meyeri*	3*	3*	2	1	3*	2.40	1	3	2	2	2	1	1.70	**2.94**
Ornate Butterflyfish	*Chaetodon ornatissimus*	3*	2	2	1	1	1.80	1	3	2	2	2	3*	2.04	**2.72**
Dot-and-dash Butterflyfish	*Chaetodon pelewensis*	3*	3*	2	1	3*	2.40	1	3	1	2	2	1	1.51	**2.84**
Lattice Butterflyfish	*Chaetodon rafflesii*	3*	3*	2	1	3*	2.40	1	3	2	2	2	3*	2.04	**3.15**
Rainford's Butterflyfish	*Chaetodon rainfordi*	2	3*	2	1	3*	2.20	2	3	2	2	2	3*	2.29	**3.18**
Reticulate Butterflyfish	*Chaetodon reticulatus*	3*	3*	2	1	3*	2.40	1	3	2	2	2	3*	2.04	**3.15**
Chevron Butterflyfish	*Chaetodon trifascialis*	3*	3*	2	1	3*	2.40	1	3	2	2	1	1	1.51	**2.84**
Doublesaddle Butterflyfish	*Chaetodon ulietensis*	3*	3*	2	1	3*	2.40	1	3	2	2	2	3*	2.04	**3.15**
Margined Coralfish	*Chelmon marginalis*	3*	3*	2	1	3*	2.40	2	3	1	2	2	1	1.70	**2.94**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (k)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	PSA score
Muller's Coralfish	*Chelmon muelleri*	3*	3*	2	1	1	2.00	3	3	1	2	2	3*	2.18	**2.96**
Beaked Coralfish	*Chelmon rostratus*	3*	3*	2	1	3*	2.40	1	3	1	2	2	2	1.70	**2.94**
Forceps Fish	*Forcipiger flavissimus*	3*	3*	3	1	3*	2.60	1	3	1	2	2	2	1.70	**3.11**
Longnose Butterflyfish	*Forcipiger longirostris*	3*	3*	3	1	3*	2.60	1	3	2	2	2	3*	2.04	**3.30**
Pyramid Butterflyfish	*Hemitaurichthys polylepis*	3*	3*	2	1	3*	2.40	1	3	2	2	3	2	2.04	**3.15**
Schooling Bannerfish	*Heniochus diphreutes*	3*	3*	3	1	3*	2.60	1	3	1	2	3	1	1.62	**3.06**
Family Gobiidae															
Whitebarred Goby	*Amblygobius phalaena*	3*	1	2	2	3	2.20	1	3	1	2	2	1	1.51	**2.67**
Bridled Goby	*Arenigobius bifrenatus*	3*	3*	2	2	3*	2.60	3	3	1	2	2	3*	2.18	**3.39**
Mud-reef Goby	*Exyrias belissimus*	3*	3*	2	2	3*	2.60	1	3	1	2	3*	3*	1.94	**3.25**
Old Glory Goby	*Koumansetta rainfordi*	3*	3*	1	2	3*	2.40	1	3*	2	2	3*	1	1.82	**3.01**
Ocellate Glidergoby	*Valenciennea longipinnis*	3*	3*	2	2	3*	2.60	1	3	1	2	2	3*	1.82	**3.17**
Blueband Glidergoby	*Valenciennea strigata*	3*	1	2	2	3*	2.20	1	3	1	2	2	1	1.51	**2.67**
Family Labridae															
Bluetail Wrasse	*Anampses femininus*	3*	3*	3	1	3*	2.60	2	3	1	2	2	3	2.04	**3.30**
Blue-and-yellow Wrasse	*Anampses lennardi*	3*	3*	3	1	3*	2.60	3	3	2	2	2	2	2.29	**3.46**
Speckled Wrasse	*Anampses meleagrides*	3*	3*	3	1	3*	2.60	1	3	2	2	2	2	1.91	**3.22**
Harlequin Tuskfish	*Choerodon fasciatus*	3*	2	3	1	1	2.00	2	3	2	1	2	2	1.91	**2.76**
Deepwater Wrasse	*Cirrhilabrus bathyphilus*	3*	3*	1	1	3*	2.20	2	3	2	2	3*	2	2.29	**3.18**
Conde's Wrasse	*Cirrhilabrus condei*	3*	3*	1	1	3*	2.20	1	3	2	2	3*	3*	2.18	**3.10**
Blueside Wrasse	*Cirrhilabrus cyanopleura*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Exquisite Wrasse	*Cirrhilabrus exquisitus*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**

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Laboute's Wrasse	*Cirrhilabrus laboutei*	3*	3*	2	1	3*	2.40	2	3	2	2	3*	2	2.29	**3.32**
Lavender Wrasse	*Cirrhilabrus lineatus*	3*	3*	2	1	3*	2.40	2	2	2	2	3*	2	2.14	**3.22**
Pink-banded Fairy Wrasse	*Cirrhilabrus roseafascia*	3*	3*	2	3*	3*	2.80	1	2	2	2	3*	2	1.91	**3.39**
Scott's Wrasse	*Cirrhilabrus scottorum*	3*	3*	2	1	3*	2.40	1	3	2	2	2	2	1.91	**3.07**
Squire's Fairy Wrasse	*Cirrhilabrus squirei*	3*	3*	1	3*	3*	2.60	3	2	2	2	3*	3*	2.45	**3.57**
Clown Wrasse	*Coris gaimard*	3*	3*	3	1	3*	2.60	1	3	1	2	2	1	1.51	**3.01**
False-eyed Wrasse	*Halichoeres biocellatus*	3*	3*	2	1	3*	2.40	1	3	2	2	3*	1	1.82	**3.01**
Golden Wrasse	*Halichoeres chrysus*	3*	3*	2	1	3*	2.40	1	3	1	2	2	1	1.51	**2.84**
Hoeven's Wrasse	*Halichoeres melanurus*	3*	1	2	1	1	1.60	1	3	1	2	2	1	1.51	**2.20**
Pastel Slender Wrasse	*Hologymnosus doliatus*	3*	3*	3	1	3*	2.60	1	3	2	2	2	1	1.70	**3.11**
Bicolor Cleanerfish	*Labroides bicolor*	3*	3*	2	1	3*	2.40	1	3	2	2	3*	1	1.82	**3.01**
Common Cleanerfish	*Labroides dimidiatus*	3*	3*	2	1	3*	2.40	1	3	2	2	2	1	1.70	**2.94**
Breastspot Cleanerfish	*Labroides pectoralis*	3*	3*	2	1	3*	2.40	1	3	2	2	2	1	1.70	**2.94**
Choat's Wrasse	*Macropharyngodon choati*	3*	3*	2	1	3*	2.40	2	3	1	2	2	2	1.91	**3.07**
Kuiter's Wrasse	*Macropharyngodon kuiteri*	3*	3*	2	1	3*	2.40	2	3	1	2	3*	2	2.04	**3.15**
Leopard Wrasse	*Macropharyngodon meleagris*	3*	3*	2	1	3*	2.40	1	3	1	2	2	1	1.51	**2.84**
Black Leopard Wrasse	*Macropharyngodon negrosensis*	3*	3*	2	1	3*	2.40	1	3	2	2	3*	1	1.82	**3.01**
Filamentous Flasher Wrasse	*Paracheilinus filamentosus*	3*	3*	2	1	3*	2.40	2	3	2	2	3	1	2.04	**3.15**
Candy Wrasse	*Pseudojuloides splendens*	3*	3*	2	3*	3*	2.80	1	3	2	2	2	1	1.70	**3.27**
Green Moon Wrasse	*Thalassoma lutescens*	3*	3*	3	1	3*	2.60	1	3	2	2	3*	1	1.82	**3.17**
Family Monacanthidae															
Harlequin Filefish	*Oxymonacanthus longirostris*	3*	3*	2	2	3*	2.60	1	3	2	2	2	1	1.70	**3.11**

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Family Monocentridae															
Australian Pineapplefish	*Cleidopus gloriamaris*	3*	3*	3	1	3*	2.60	3	3	1	1	2	2	1.82	**3.17**
Family Plesiopidae															
Yellow Scissortail	*Assessor flavissimus*	3*	3*	1	2	3*	2.40	2	3	2	2	2	1	1.91	**3.07**
Blue Scissortail	*Assessor macneilli*	3*	3*	1	2	3*	2.40	2	3	2	2	3	1	2.04	**3.15**
Family Pomacanthidae															
Threespot Angelfish	*Apolemichthys trimaculatus*	3*	3*	3	1	3*	2.60	1	2	2	2	2	2	1.78	**3.15**
Golden Angelfish	*Centropyge aurantia*	3*	3*	2	1	3*	2.40	1	3	2	2	3	2	2.04	**3.15**
Bicolor Angelfish	*Centropyge bicolor*	2	3	2	1	1	1.80	1	3	2	2	2	1	1.70	**2.47**
Coral Beauty	*Centropyge bispinosa*	3*	3	2	1	1	2.00	1	3	2	2	2	2	1.91	**2.76**
Whitetail Angelfish	*Centropyge fisheri*	3*	3*	1	1	3*	2.20	1	3	1	2	2	1	1.51	**2.67**
Lemonpeel Angelfish	*Centropyge flavissima*	3*	3*	2	1	3*	2.40	1	3	2	2	2	2	1.91	**3.07**
Yellow Angelfish	*Centropyge heraldi*	3*	3*	2	1	3*	2.40	1	3	2	2	2	2	1.91	**3.07**
Flame Angelfish	*Centropyge loriculus*	2	2	2	1	1	1.60	1	3	2	2	3*	2	2.04	**2.59**
Conspicuous Angelfish	*Chaetodontoplus conspicillatus*	3*	3*	3	1	3*	2.60	2	3	1	2	2	3	2.04	**3.30**
Scribbled angelfish	*Chaetodontoplus duboulayi*	3*	3*	3	1	3*	2.60	1	3	1	1	2	2	1.51	**3.01**
Queensland Yellowtail Angelfish	*Chaetodontoplus meredithi*	3*	3*	3	1	3*	2.60	3	2	1	1	2	2	1.70	**3.11**
Lamarck's Angelfish	*Genicanthus lamarck*	3*	3*	3	1	3*	2.60	1	2	2	2	2	2	1.78	**3.15**
Watanabe's Angelfish	*Genicanthus watanabei*	3*	3*	2	1	3*	2.40	1	2	2	2	2	2	1.78	**2.99**
Multibar Angelfish	*Paracentropyge multifasciatus*	3*	3*	2	1	3*	2.40	1	3	2	2	2	2	1.91	**3.07**
Emperor Angelfish	*Pomacanthus imperator*	3*	3	3	1	3	2.60	1	3	2	2	2	2	1.91	**3.22**
Bluegirdle Angelfish	*Pomacanthus navarchus*	3*	3*	3	1	3*	2.60	1	3	2	2	2	2	1.91	**3.22**

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Blueface Angelfish	*Pomacanthus xanthometopon*	3*	3*	3	1	3*	2.60	1	3	2	2	2	2	1.91	**3.22**
Family Pomacentridae															
Barrier Reef Anemonefish	*Amphiprion akindynos*	3*	3	2	2	1	2.20	2	3	3	2	2	1	2.04	**3.00**
Orangefin Anemonefish	*Amphiprion chrysopterus*	3*	3*	2	2	3*	2.60	1	3	3	2	2	3*	2.18	**3.39**
Clark's Anemonefish	*Amphiprion clarkii*	3*	3*	2	2	3*	2.60	1	3	3	2	2	1	1.82	**3.17**
Wideband Anemonefish	*Amphiprion latezonatus*	3*	3*	2	2	3*	2.60	3	3	3	1	2	3*	2.33	**3.49**
Blackback Anemonefish	*Amphiprion melanopus*	3*	3	2	2	2	2.40	1	3	3	1	2	1	1.62	**2.89**
Western Clown Anemonefish	*Amphiprion ocellaris*	2	3*	2	2	3*	2.40	1	3	3	1	3	1	1.73	**2.96**
Eastern Clown Anemonefish	*Amphiprion percula*	3*	3*	2	2	3*	2.60	2	3	3	1	2	2	2.04	**3.30**
Pink Anemonefish	*Amphiprion perideraion*	3*	3*	2	2	3*	2.60	1	3	3	2	2	1	1.82	**3.17**
Saddleback Anemonefish	*Amphiprion polymnus*	2	3*	2	2	3*	2.40	1	3	3	2	2	1	1.82	**3.01**
Blackaxil Puller	*Chromis atripectoralis*	3*	3*	2	2	3*	2.60	1	3	2	2	3	3*	2.18	**3.39**
Half-and-half Puller	*Chromis iomelas*	3*	2	1	2	3*	2.20	1	3	2	2	2	1	1.70	**2.78**
Yellowback Puller	*Chromis nitida*	3*	3*	1	2	3*	2.40	3	3	1	2	3	1	1.94	**3.09**
Vanderbilt's Puller	*Chromis vanderbilti*	3*	3*	1	2	3*	2.40	1	3	1	2	3	1	1.62	**2.89**
Blue-green Puller	*Chromis viridis*	3*	2	2	2	1	2.00	1	3	2	2	3	1	1.82	**2.70**
Blue Demoiselle	*Chrysiptera cyanea*	3*	3*	1	2	3*	2.40	1	3	2	2	2	1	1.70	**2.94**
Starck's Demoiselle	*Chrysiptera starcki*	3*	3*	2	2	3*	2.60	1	2	2	2	2	1	1.59	**3.05**
South Seas Demoiselle	*Chrysiptera taupou*	3*	3*	1	2	3*	2.40	1	3	2	2	3*	1	1.82	**3.01**
Banded Humbug	*Dascyllus aruanus*	3*	2	2	2	1	2.00	1	3	3	2	3	1	1.94	**2.79**
Threespot Humbug	*Dascyllus trimaculatus*	3*	3*	2	2	3*	2.60	1	3	3	2	3	1	1.94	**3.25**
Fusilier Damsel	*Lepidozygus tapeinosoma*	3*	3*	2	2	3*	2.60	1	3	3*	2	3	1	1.94	**3.25**

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Neon damsel	*Pomacentrus coelestis*	3*	1	2	2	3*	2.20	1	3	1	2	3	1	1.62	**2.73**
Peacock Damsel	*Pomacentrus pavo*	3*	3*	2	2	3*	2.60	1	3	2	2	2	3*	2.04	**3.30**
Princess Damsel	*Pomacentrus vaiuli*	3*	3*	1	2	3*	2.40	1	3	2	2	1	1	1.51	**2.84**
Spine-cheek Clownfish	*Premnas biaculeatus*	3*	3	2	2	1	2.20	1	3	3	2	2	1	1.82	**2.85**
Family Serranidae															
Pygmy Basslet	*Luzonichthys waitei*	3*	3*	1	1	3*	2.20	1	3	2	2	3	3*	2.18	**3.10**
Yellowback basslet	*Pseudanthias bicolor*	3*	3*	2	1	3*	2.40	1	2	2	2	2	1	1.59	**2.88**
Red Basslet	*Pseudanthias cooperi*	3*	3*	2	1	3*	2.40	1	3	1	2	3	1	1.62	**2.89**
Fairy Basslet	*Pseudanthias dispar*	3*	3*	1	1	3*	2.20	1	3	2	2	3	1	1.82	**2.85**
Pacific Basslet	*Pseudanthias huchtii*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Pink Basslet	*Pseudanthias hypselosoma*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Luzon Basslet	*Pseudanthias luzonensis*	3*	3*	2	1	3*	2.40	1	2	2	2	2	3*	1.91	**3.07**
Sailfin Queen	*Pseudanthias pascalus*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Painted Basslet	*Pseudanthias pictilis*	3*	3*	2	1	3*	2.40	1	2	2	2	3	2	1.91	**3.07**
Mirror Basslet	*Pseudanthias pleurotaenia*	3*	3*	2	1	3*	2.40	1	2	2	2	3	1	1.70	**2.94**
Lilac-tip Basslet	*Pseudanthias rubrizonatus*	3*	2	2	1	2	2.00	1	3	1	2	3	3*	1.94	**2.79**
Princess Basslet	*Pseudanthias smithvanizi*	3*	3*	1	1	3*	2.20	1	3	2	2	3	3*	2.18	**3.10**
Orange basslet	*Pseudanthias squamipinnis*	3*	3*	2	1	3*	2.40	1	3	1	2	3	1	1.62	**2.89**
Purple Queen	*Pseudanthias tuka*	3*	3*	2	1	3*	2.40	1	3	2	2	3	1	1.82	**3.01**
Longfin Basslet	*Pseudanthias ventralis*	3*	3*	1	1	3*	2.20	1	2	2	2	2	2	1.78	**2.83**
	Pyronotanthias aurulentus	3*	3*	1	1	3*	2.20	2	1	3*	2	3*	2	2.04	**3.00**
Lori's Basslet	*Pyronotanthias lori*	3*	3*	2	1	3*	2.40	1	3	2	2	2	1	1.70	**2.94**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	PSA score
Swallowtail Basslet	*Serranocirrhitus latus*	3*	3*	2	1	1	2.00	1	3	2	2	2	2	1.91	**2.76**
Family Siganidae															
Coral Rabbitfish	*Siganus corallinus*	3*	3*	3	1	3*	2.60	1	3	2	2	2	1	1.70	**3.11**
Masked Rabbitfish	*Siganus puellus*	3*	3*	3	1	3*	2.60	1	3	2	2	2	2	1.91	**3.22**
Foxface	*Siganus vulpinus*	3*	3*	3	1	3*	2.60	1	3	2	2	2	2	1.91	**3.22**

Appendix E—Results: Residual Vulnerability Analysis

Residual Vulnerability Assessment (RVA) of the preliminary scores assigned as part of the Productivity and Susceptibility Analysis (PSA). The RVA takes into consideration any additional information that was not explicitly considered as part of the PSA criteria (Table 1 and Table 2). The purpose of the RVA is to refine the preliminary (PSA) risk scores and reduce the number of false-positive results or vulnerability overestimates. Pink shaded squares represent attribute scores that were amended as part of the RVA. Refer to Appendix F for a full account of the RVA including key justifications.

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Family Acanthuridae															
Greyhead surgeonfish	*Acanthurus nigros*	2	3	3	1	1	2.00	1	3	2	2	2	2	1.91	**2.76**
Orangeblotch surgeonfish	*Acanthurus olivaceus*	2	3	3	1	1	2.00	1	2	1	2	2	2	1.59	**2.55**
Mimic surgeonfish	*Acanthurus pyroferus*	2	3	3	1	1	2.00	1	2	1	2	1	2	1.41	**2.45**
Night surgeonfish	*Acanthurus thompsoni*	2	3	3	1	1	2.00	1	2	2	2	3	2	1.91	**2.76**
Twospot bristletooth	*Ctenochaetus binotatus*	2	2	3	1	1	1.80	1	2	1	2	1	2	1.41	**2.29**
Clown unicornfish	*Naso lituratus*	2	3	3	1	1	2.00	1	2	2	2	2	2	1.78	**2.68**
Blue tang	*Paracanthurus hepatus*	2	3	3	1	1	2.00	1	3	2	1	3	2	1.82	**2.70**
Sailfin tang	*Zebrasoma veliferum*	3	3	3	1	1	2.20	1	2	1	2	2	2	1.59	**2.71**
Family Apogonidae															
Sydney cardinalfish	*Ostorhinchus limenus*	2	1	2	2	1	1.60	3	3	1	2	2	2	2.04	**2.59**
Pajama cardinalfish	*Sphaeramia nematoptera*	1	1	1	2	1	1.20	1	3	2	2	2	1	1.70	**2.08**
Lea's cardinalfish	*Taeniamia leai*	1	1	1	2	1	1.20	2	3	2	2	2	1	1.91	**2.25**
Family Balistidae															
Clown triggerfish	*Balistoides conspicillum*	3	3	3	2	2	2.60	1	2	1	2	1	2	1.41	**2.96**
Family Blenniidae															

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Redstreaked blenny	*Cirripectes stigmaticus*	2	1	2	2	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Australian combtooth blenny	*Ecsenius australianus*	1	1	1	2	1	1.20	2	3	2	2	1	2	1.91	**2.25**
Tiger combtooth blenny	*Ecsenius tigris*	1	1	1	2	1	1.20	3	3	2	2	1	2	2.04	**2.37**
Family Centriscidae															
Jointed razorfish	*Aeoliscus strigatus*	2	1	2	1	1	1.40	1	2	2	2	3	1	1.70	**2.20**
Grooved razorfish	*Centriscus scutatus*	2	1	2	1	1	1.40	1	2	1	2	3	1	1.51	**2.06**
Family Chaetodontidae															
Goldstripe butterflyfish	*Chaetodon aureofasciatus*	2	2	2	1	1	1.60	2	3	2	2	2	1	1.91	**2.49**
Dusky butterflyfish	*Chaetodon flavirostris*	2	2	3	1	1	1.80	1	3	1	2	2	2	1.70	**2.47**
Klein's butterflyfish	*Chaetodon kleinii*	2	2	2	1	1	1.60	1	2	1	2	3	1	1.51	**2.20**
Blackback butterflyfish	*Chaetodon melannotus*	2	3	2	1	3	2.20	1	3	2	2	2	1	1.70	**2.78**
Mertens' butterflyfish	*Chaetodon mertensii*	2	2	2	1	1	1.60	1	2	1	2	2	1	1.41	**2.14**
Meyer's butterflyfish	*Chaetodon meyeri*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Ornate butterflyfish	*Chaetodon ornatissimus*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Dot-and-dash butterflyfish	*Chaetodon pelewensis*	2	2	2	1	1	1.60	1	3	1	2	2	1	1.51	**2.20**
Lattice butterflyfish	*Chaetodon rafflesii*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Rainford's butterflyfish	*Chaetodon rainfordi*	2	2	2	1	1	1.60	2	3	2	2	2	2	2.14	**2.67**
Reticulate butterflyfish	*Chaetodon reticulatus*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Chevron butterflyfish	*Chaetodon trifascialis*	2	2	2	1	1	1.60	1	3	2	2	1	1	1.51	**2.20**
Doublesaddle butterflyfish	*Chaetodon ulietensis*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Margined coralfish	*Chelmon marginalis*	2	2	2	1	1	1.60	2	3	1	2	2	1	1.70	**2.33**
Muller's coralfish	*Chelmon muelleri*	2	2	2	1	1	1.60	3	3	1	2	2	2	2.04	**2.59**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Beaked coralfish	*Chelmon rostratus*	2	2	2	1	1	1.60	1	3	1	2	2	2	1.70	**2.33**
Forceps fish	*Forcipiger flavissimus*	2	3	3	1	1	2.00	1	2	1	2	2	2	1.59	**2.55**
Longnose butterflyfish	*Forcipiger longirostris*	2	3	3	1	1	2.00	1	2	2	2	2	1	1.59	**2.55**
Pyramid butterflyfish	*Hemitaurichthys polylepis*	2	2	2	1	1	1.60	1	2	2	2	3	2	1.91	**2.49**
Schooling bannerfish	*Heniochus diphreutes*	2	2	3	1	1	1.80	1	2	1	2	3	1	1.51	**2.35**
Family Gobiidae															
Whitebarred goby	*Amblygobius phalaena*	1	1	2	2	3	1.80	1	3	1	2	2	1	1.51	**2.35**
Bridled goby	*Arenigobius bifrenatus*	2	1	2	2	1	1.60	3	3	1	2	2	2	2.04	**2.59**
Mud-reef goby	*Exyrias belissimus*	2	2	2	2	1	1.80	1	3	1	2	1	1	1.35	**2.25**
Old Glory goby	*Koumansetta rainfordi*	2	1	1	2	1	1.40	1	3	2	2	2	1	1.70	**2.20**
Ocellate glidergoby	*Valenciennea longipinnis*	1	1	2	2	1	1.40	1	3	1	2	2	1	1.51	**2.06**
Blueband glidergoby	*Valenciennea strigata*	1	1	2	2	1	1.40	1	3	1	2	2	1	1.51	**2.06**
Family Labridae															
Bluetail wrasse	*Anampses femininus*	3	2	3	1	1	2.00	2	3	1	2	2	3	2.04	**2.86**
Blue-and-yellow wrasse	*Anampses lennardi*	3	2	3	1	1	2.00	3	3	2	2	2	2	2.29	**3.04**
Speckled wrasse	*Anampses meleagrides*	3	2	3	1	1	2.00	1	3	2	2	2	2	1.91	**2.76**
Harlequin tuskfish	*Choerodon fasciatus*	3	2	3	1	1	2.00	2	3	2	1	2	2	1.91	**2.76**
Deepwater wrasse	*Cirrhilabrus bathyphilus*	1	1	1	1	1	1.00	2	2	2	2	2	2	2.00	**2.24**
Conde's wrasse	*Cirrhilabrus condei*	1	1	1	1	1	1.00	1	2	2	2	2	2	1.78	**2.04**
Blueside wrasse	*Cirrhilabrus cyanopleura*	1	1	2	1	1	1.20	1	3	2	2	3	1	1.82	**2.18**
Exquisite wrasse	*Cirrhilabrus exquisitus*	1	1	2	1	1	1.20	1	3	2	2	3	1	1.82	**2.18**
Laboute's wrasse	*Cirrhilabrus laboutei*	1	1	2	1	1	1.20	2	2	2	2	2	2	2.00	**2.33**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Lavender wrasse	*Cirrhilabrus lineatus*	1	1	2	1	1	1.20	2	2	2	2	2	2	2.00	**2.33**
Pink-banded fairy wrasse	*Cirrhilabrus roseafascia*	1	1	2	1	1	1.20	1	1	2	2	2	2	1.59	**1.99**
Scott's wrasse	*Cirrhilabrus scottorum*	1	1	2	1	1	1.20	1	3	2	2	2	2	1.91	**2.25**
Squire's fairy wrasse	*Cirrhilabrus squirei*	1	1	1	1	1	1.00	3	2	2	2	2	3	2.29	**2.50**
Clown wrasse	*Coris gaimard*	3	2	3	1	2	2.20	1	2	1	2	2	1	1.41	**2.62**
False-eyed wrasse	*Halichoeres biocellatus*	1	1	2	1	1	1.20	1	2	2	2	2	1	1.59	**1.99**
Golden wrasse	*Halichoeres chrysus*	1	1	2	1	1	1.20	1	2	1	2	2	1	1.41	**1.85**
Hoeven's wrasse	*Halichoeres melanurus*	1	1	2	1	1	1.20	1	3	1	2	2	1	1.51	**1.93**
Pastel slender wrasse	*Hologymnosus doliatus*	3	3	3	1	2	2.40	1	2	2	2	2	1	1.59	**2.88**
Bicolor cleanerfish	*Labroides bicolor*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Common cleanerfish	*Labroides dimidiatus*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Breastspot cleanerfish	*Labroides pectoralis*	2	2	2	1	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Choat's wrasse	*Macropharyngodon choati*	1	1	2	1	1	1.20	2	3	1	2	2	2	1.91	**2.25**
Kuiter's wrasse	*Macropharyngodon kuiteri*	1	1	2	1	1	1.20	2	2	1	2	2	2	1.78	**2.15**
Leopard wrasse	*Macropharyngodon meleagris*	1	1	2	1	1	1.20	1	3	1	2	2	1	1.51	**1.93**
Black leopard wrasse	*Macropharyngodon negrosensis*	1	1	2	1	1	1.20	1	3	2	2	2	1	1.70	**2.08**
Filamentous flasher wrasse	*Paracheilinus filamentosus*	1	1	2	1	1	1.20	2	3	2	2	3	1	2.04	**2.37**
Candy wrasse	*Pseudojuloides splendens*	1	1	2	1	1	1.20	1	2	2	2	2	1	1.59	**1.99**
Green moon wrasse	*Thalassoma lutescens*	2	2	3	1	1	1.80	1	3	2	2	2	1	1.70	**2.47**
Family Monacanthidae															
Harlequin filefish	*Oxymonacanthus longirostris*	2	1	2	2	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Family Monocentridae															

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Australian pineapplefish	*Cleidopus gloriamaris*	3	3	3	1	3	2.60	3	2	1	1	2	2	1.70	**3.11**
Family Plesiopidae															
Yellow scissortail	*Assessor flavissimus*	1	1	1	2	1	1.20	2	3	2	2	2	1	1.91	**2.25**
Blue scissortail	*Assessor macneilli*	1	1	1	2	1	1.20	2	3	2	2	3	1	2.04	**2.37**
Family Pomacanthidae															
Threespot angelfish	*Apolemichthys trimaculatus*	3	3	3	1	2	2.40	1	2	2	2	2	2	1.78	**2.99**
Golden angelfish	*Centropyge aurantia*	2	2	2	1	1	1.60	1	2	2	2	2	2	1.78	**2.39**
Bicolor angelfish	*Centropyge bicolor*	2	3	2	1	1	1.80	1	3	2	2	2	1	1.70	**2.47**
Coral beauty	*Centropyge bispinosa*	2	3	2	1	1	1.80	1	2	2	2	2	2	1.78	**2.53**
Whitetail angelfish	*Centropyge fisheri*	2	2	1	1	1	1.40	1	2	1	2	2	2	1.59	**2.12**
Lemonpeel angelfish	*Centropyge flavissima*	2	2	2	1	1	1.60	1	3	2	2	2	2	1.91	**2.49**
Yellow angelfish	*Centropyge heraldi*	2	2	2	1	1	1.60	1	2	2	2	2	2	1.78	**2.39**
Flame angelfish	*Centropyge loriculus*	2	2	2	1	1	1.60	1	2	2	2	2	2	1.78	**2.39**
Conspicuous angelfish	*Chaetodontoplus conspicillatus*	3	3	3	1	2	2.40	2	3	1	2	2	3	2.04	**3.15**
Scribbled angelfish	*Chaetodontoplus duboulayi*	3	3	3	1	2	2.40	1	3	1	1	2	2	1.51	**2.84**
Queensland yellowtail angelfish	*Chaetodontoplus meredithi*	3	3	3	1	2	2.40	3	2	1	1	2	2	1.70	**2.94**
Lamarck's angelfish	*Genicanthus lamarck*	3	3	3	1	2	2.40	1	2	2	2	2	2	1.78	**2.99**
Watanabe's angelfish	*Genicanthus watanabei*	3	2	2	1	1	1.80	1	2	2	2	2	2	1.78	**2.53**
Multibar angelfish	*Paracentropyge multifasciatus*	3	2	2	1	1	1.80	1	2	2	2	2	2	1.78	**2.53**
Emperor angelfish	*Pomacanthus imperator*	3	3	3	1	3	2.60	1	2	2	2	2	2	1.78	**3.15**
Bluegirdle angelfish	*Pomacanthus navarchus*	3	3	3	1	2	2.40	1	3	2	2	2	2	1.91	**3.07**
Blueface angelfish	*Pomacanthus xanthometopon*	3	3	3	1	3	2.60	1	3	2	2	2	2	1.91	**3.22**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Family Pomacentridae															
Barrier Reef anemonefish	*Amphiprion akindynos*	2	3	2	2	1	2.00	2	3	3	2	2	1	2.04	**2.86**
Orangefin anemonefish	*Amphiprion chrysopterus*	2	3	2	2	1	2.00	1	3	3	2	2	2	2.04	**2.86**
Clark's anemonefish	*Amphiprion clarkii*	2	3	2	2	1	2.00	1	2	3	2	2	2	1.91	**2.76**
Wideband anemonefish	*Amphiprion latezonatus*	2	3	2	2	1	2.00	3	2	3	1	2	3	2.18	**2.96**
Blackback anemonefish	*Amphiprion melanopus*	2	3	2	2	2	2.20	1	3	3	1	2	1	1.62	**2.73**
Western clown anemonefish	*Amphiprion ocellaris*	2	3	2	2	1	2.00	1	3	3	1	3	1	1.73	**2.65**
Eastern clown anemonefish	*Amphiprion percula*	2	3	2	2	1	2.00	2	3	3	1	2	2	2.04	**2.86**
Pink anemonefish	*Amphiprion perideraion*	2	3	2	2	1	2.00	1	3	3	2	2	1	1.82	**2.70**
Saddleback anemonefish	*Amphiprion polymnus*	2	3	2	2	1	2.00	1	3	3	2	2	1	1.82	**2.70**
Blackaxil puller	*Chromis atripectoralis*	2	2	2	2	1	1.80	1	3	2	2	3	1	1.82	**2.56**
Half-and-half puller	*Chromis iomelas*	2	2	1	2	1	1.60	1	3	2	2	2	1	1.70	**2.33**
Yellowback puller	*Chromis nitida*	2	2	1	2	1	1.60	3	3	1	2	3	1	1.94	**2.52**
Vanderbilt's puller	*Chromis vanderbilti*	1	2	1	2	1	1.40	1	3	1	2	3	1	1.62	**2.14**
Blue-green puller	*Chromis viridis*	2	2	2	2	1	1.80	1	3	2	2	3	1	1.82	**2.56**
Blue demoiselle	*Chrysiptera cyanea*	2	1	1	2	1	1.40	1	3	2	2	2	1	1.70	**2.20**
Starck's demoiselle	*Chrysiptera starcki*	2	1	2	2	1	1.60	1	2	2	2	2	2	1.78	**2.39**
South Seas demoiselle	*Chrysiptera taupou*	2	1	1	2	1	1.40	1	3	2	2	1	1	1.51	**2.06**
Banded humbug	*Dascyllus aruanus*	2	2	2	2	1	1.80	1	3	3	2	3	1	1.94	**2.65**
Threespot humbug	*Dascyllus trimaculatus*	2	2	2	2	1	1.80	1	2	3	2	3	1	1.82	**2.56**
Fusilier damsel	*Lepidozygus tapeinosoma*	2	1	2	2	1	1.60	1	3	2	2	3	1	1.82	**2.42**
Neon damsel	*Pomacentrus coelestis*	1	1	2	2	1	1.40	1	3	1	2	3	1	1.62	**2.14**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Peacock damsel	*Pomacentrus pavo*	2	2	2	2	1	1.80	1	3	2	2	2	1	1.70	**2.47**
Princess damsel	*Pomacentrus vaiuli*	2	2	1	2	1	1.60	1	3	2	2	1	1	1.51	**2.20**
Spine-cheek clownfish	*Premnas biaculeatus*	3	3	2	2	1	2.20	1	3	3	2	2	1	1.82	**2.85**
Family Serranidae															
Pygmy basslet	*Luzonichthys waitei*	1	1	1	1	1	1.00	1	3	2	2	3	2	2.04	**2.27**
Yellowback basslet	*Pseudanthias bicolor*	2	2	2	1	1	1.60	1	2	2	2	2	1	1.59	**2.25**
Red basslet	*Pseudanthias cooperi*	2	2	2	1	1	1.60	1	2	1	2	3	1	1.51	**2.20**
Fairy basslet	*Pseudanthias dispar*	2	2	1	1	1	1.40	1	3	2	2	3	1	1.82	**2.29**
Pacific basslet	*Pseudanthias huchtii*	2	2	2	1	1	1.60	1	3	2	2	3	1	1.82	**2.42**
Pink basslet	*Pseudanthias hypselosoma*	2	2	2	1	1	1.60	1	2	2	2	3	1	1.70	**2.33**
Luzon basslet	*Pseudanthias luzonensis*	2	2	2	1	1	1.60	1	2	2	2	2	2	1.78	**2.39**
Sailfin queen	*Pseudanthias pascalus*	2	2	2	1	1	1.60	1	2	2	2	3	1	1.70	**2.33**
Painted basslet	*Pseudanthias pictilis*	2	2	2	1	1	1.60	1	2	2	2	3	2	1.91	**2.49**
Mirror basslet	*Pseudanthias pleurotaenia*	2	2	2	1	1	1.60	1	1	2	2	3	1	1.51	**2.20**
Lilac-tip basslet	*Pseudanthias rubrizonatus*	2	2	2	1	2	1.80	1	2	1	2	3	2	1.70	**2.47**
Princess basslet	*Pseudanthias smithvanizi*	2	2	1	1	1	1.40	1	2	2	2	3	1	1.70	**2.20**
Orange basslet	*Pseudanthias squamipinnis*	2	2	2	1	1	1.60	1	2	1	2	3	1	1.51	**2.20**
Purple queen	*Pseudanthias tuka*	2	2	2	1	1	1.60	1	3	2	2	3	1	1.82	**2.42**
Longfin basslet	*Pseudanthias ventralis*	2	2	1	1	1	1.40	1	2	2	2	2	2	1.78	**2.27**
Golden anthias	*Pyronotanthias aurulentus*	2	2	1	1	1	1.40	2	1	2	2	3	2	1.91	**2.37**
Lori's basslet	*Pyronotanthias lori*	2	2	2	1	1	1.60	1	2	2	2	2	1	1.59	**2.25**
Swallowtail basslet	*Serranocirrhitus latus*	2	2	2	1	1	1.60	1	2	2	2	2	2	1.78	**2.39**

Common name	Species Name	Age at maturity	Maximum age	Maximum size	Reproductive strategy	Von Bertalanffy growth coefficient (*k*)	Productivity (additive)	Availability	Depth profile	Ecological niche	Management strategy	Catchability	Market value	Susceptibility (multiplicative)	RVA score
Family Siganidae															
Coral rabbitfish	*Siganus corallinus*	2	2	3	1	1	1.80	1	3	2	2	2	1	1.70	**2.47**
Masked rabbitfish	*Siganus puellus*	2	2	3	1	1	1.80	1	3	2	2	2	2	1.91	**2.62**
Foxface	*Siganus vulpinus*	2	2	3	1	1	1.80	1	3	2	2	2	2	1.91	**2.62**

Appendix F—Residual Vulnerability Analysis: Justifications and Considerations

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Age at maturity				
Family Gobiidae Whitebarred goby (*A. phalaena*)	Age at maturity (Productivity)	3	1	Age at maturity for *A. phalaena* is not known and the species was assigned a precautionary high (3) score for this attribute in the PSA. In the absence of additional data, the Fishbase age at maturity estimate was used as a baseline assessment and the accuracy of this estimate tested through a review of the available data. For reference, Fishbase estimated the age at maturity to be 0.3 years for *A. phalaena* (Froese & Pauly, 2023j) with the maximum age of this species estimated to be 14 months (Hernaman & Munday, 2005). Given the above, it is reasonable to assume that this species matures in less than one year. **Key changes to the PSA scores** While lacking species-specific age at maturity data, informed estimates and additional information on life history of *A. phalaena* are available. Based on this information, the age at maturity attribute score was reduced from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information*.
Family Apogonidae Pajama cardinalfish (*S. nematoptera*) Lea's cardinalfish (*T. leai*) **Family Blenniidae** Australian combtooth blenny (*E. australianus*)	Age at maturity (Productivity)	3	1	Age at maturity for the listed species is not known, therefore they were assigned a precautionary high (3) score for this attribute. In the absence of species-specific data and/or suitable proxies, Fishbase age at maturity estimates were used as a baseline assessment for the listed species. The accuracy of these estimates were then tested through additional consultation undertaken as part of the RVA. Fishbase estimated the age at maturity to be less than one year for all of the listed species (Froese & Pauly, 2023l). Further consultation on the biology of these species determined that

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Tiger combtooth blenny (*E. tigris*) **Family Plesiopidae** Yellow scissortail (*A. flavissimus*) Blue scissortail (*A. macneilli*) **Family Serranidae** Pygmy basslet (*L. waitei*)				the Fishbase values for age at maturity are reasonable estimates, particularly as these species are likely to be short-lived (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided and available estimates, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae Neon damsel (*P. coelestis*)	Age at maturity (Productivity)	3	1	As age at maturity is not known, *P. coelestis* was assigned a precautionary high (3) score for this attribute in the PSA. However, otolith analyses determined that *P. coelestis* has a short lifespan on the Great Barrier Reef (127 to 160 days; Kingsford *et al.*, 2017). Considering this, it is reasonable to assume that *P. coelestis* matures in <6 months. Further consultation on the biology of this species supported this inference (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and advice provided, the preliminary score assigned to this attribute was decreased from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Gobiidae Blueband glidergoby (*V. strigata*)	Age at maturity (Productivity)	3	1	Age at maturity for the listed *Valenciennea* spp. is not known and they were assigned a precautionary high (3) score for this attribute. In the RVA, further consideration was given to the available data, including information on closely related species. Field studies conducted on Moorea Island determined that *V. strigata* is generally short-lived (less than one year) with the vast majority of tagged individuals

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Ocellate glidergoby (*V. longipinnis*)				disappearing from the study within the same season (Reavis, 1997). The implication being that *V. strigata* has a short lifespan with the onset of sexual maturity occurring in less than 12 months. Less information is available on the age and growth of *V. longipinnis*. However, it is reasonable to assume the growth dynamics of this species would be similar to *V. strigata*. Further consultation on the biology of these species determined that this is a fair assumption (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Labridae All *Cirrhilabrus* spp., *Halichores* spp., and *Macropharyngodon* spp. assessed. Filamentous flasher wrasse (*P. filamentosus*) Candy wrasse (*P. splendens*)	Age at maturity (Productivity)	3	1	Significant information gaps exist in the age and growth data of the listed species and genera. In the PSA, this resulted in a wide range of species being assigned a precautionary high (3) score for this attribute. In the RVA, the suitability of these scores were given further consideration. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. Fishbase contains life-history estimates or defaults for fish species based on the family or genus level. Fishbase may also use the maximum size of a species to predict other life-history traits including age at maturity. Fishbase provides an age at maturity estimate of between one and two years for *C. exquisitus*, *C. laboutei, C. lineatus*, *C. scottorum, C. bathyphilus, C. roseafascia*, *C. condei*, *C. cyanopleura*, *H. biocellatus, H. chrysus, H. melanurus, M. choati, M. kuiteri*, *M. meleagris*, *M. negrosensis, P. filamentosus, P. splendens* and less than one year for *C. squirei* (Froese & Pauly, 2023l).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Further consultation on the biology of *Cirrhilabrus* spp., *Halichores* spp., *Macropharyngodon* spp., *Paracheilinus* spp. and *Pseudojuloides* spp. determined that the Fishbase values for age at maturity are likely overestimates. It was also confirmed that these species are more likely to mature in less than one year (i.e. are short-lived), have high turnover rates and growth rates that are tightly connected with age (pers. comm. H. Choat). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae All *Chromis* spp., *Chrysiptera* spp., and *Dascyllus* spp. assessed. Fusilier damsel (*L. tapeinosoma*) Peacock damsel (*P. pavo*) Princess damsel (*P. vaiuli*)	Age at maturity (Productivity)	3	1–2	Age at maturity assessments for *Chromis* spp. and *Chrysiptera* spp. were limited by the available data. These deficiencies resulted in the species being assigned precautionary high (3) scores in the PSA. As suitable proxies could not be found, the RVA considered alternate measure to refine the vulnerability profiles of these species. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. Fishbase contains life-history estimates or defaults for fish species based on the family level. Fishbase may also use the maximum size of a species to predict other life-history traits including age at maturity. This database provided an age at maturity estimated of less than one year for *C. vanderbilti* and between one and two years for the remaining damselfish species/genera (Froese & Pauly, 2023l). Further consultation on the biology of these damselfishes determined that Fishbase age at maturity values were reasonable (pers. comm. D. Bellwood) and their use (as a proxy) would not contribute to a false-negative result. **Key changes to the PSA scores**

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Based on the available data and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1) for *C. vanderbilti* and to medium (2) for the remaining species. This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Serranidae All *Pseudanthias* spp. and *Pyronotanthias* spp. assessed.	Age at maturity (Productivity)	3	2	Age at maturity assessments for *Pseudanthias* spp. and *Pyronotanthias* spp. were limited by the available data. These deficiencies resulted in the species being assigned precautionary high (3) scores for this attribute in the PSA. As suitable proxies could not be found, the RVA considered alternate measures to refine the vulnerability profiles of these species. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. Fishbase contains life-history estimates or defaults for fish species based on the family or genus level. Fishbase may also use the maximum size of a species to predict other life-history traits including age at maturity. This database provided age at maturity estimates of between one and two years for *Pseudanthias dispar, P. bicolor, P. cooperi, P. hutchii, P. hypselosoma, P. luzonensis, P. pascalus, P. pictilis, P. pleurotaenia, P. rubrizonatus, P. squamipinnis, P. tuka, Pyronotanthias lori* and less than one year for *Pseudanthias smithvanizi, P. ventralis,* and *Pyronotanthias aurulentus.* Further consultation on the biology of this species determined that all *Pseudanthias* spp. and *Pyronotanthias* spp. would mature at approximately one year of age. **Key changes to the PSA scores** Based on the available data and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				For *P. ventralis,* and *P. aurulentus* a medium score for age at maturity may still represent an over-estimate of vulnerability. The decision to assign these species with a more conservative vulnerability score was precautionary and remains consistent with the broader VA approach.
Family Acanthuridae Greyhead surgeonfish (*A. nigros*) Orangeblotch surgeonfish (*A. olivaceus*) Mimic surgeonfish (*A. pyroferus*) Night surgeonfish (*A. thompsoni*)	Age at maturity (Productivity)	3	2	Age at maturity for *A. olivaceus* has not been determined using gonadal analyses or captive studies and the species was assigned a precautionary high (3) score for this attribute. A review of the available data did not identify a suitable species-based proxy. However, higher-level age at maturity estimates (e.g. genus-level) have been determined through growth curve modelling. For example, a study by Choat & Robertson (2002) estimated the age of sexual maturity for genera *Acanthurus* and *Naso* to be at 6% and 15% of the maximum total length (T_{max}) respectively. Based on this account, *A. olivaceous* is expected to reach sexual maturity at or around two years of age (Choat & Robertson, 2002). This inference was supported by additional scientific consultation undertaken as part of the RVA (pers. comm. D. Bellwood). Age at maturity estimates were not available for *A. pyroferus*, *A. thompsoni* and *A. nigros* and these three were also assigned a precautionary high (3) score. While more nuanced, a review of the available data for *A. pyroferus, A. thompsoni* and *A. nigros* indicated that a similar approach could be applied for these species. Further consultation on the biology of *Acanthurus* spp. also supported the hypothesis that age at maturity for these species would be approximately two years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available information and the advice provided, the preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Acanthuridae	Age at maturity (Productivity)	3	2	Age at maturity has not been determined for *P. hepatus* and the species was assigned a precautionary high (3) score for this attribute in the PSA.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Blue tang (*P. hepatus*)				Age and growth information for *P. hepatus* is limited, however, Fishbase contains life-history estimates or defaults for these species based on the family level (Acanthuridae). Fishbase may also use maximum size as a predictive mechanism for other life-history traits including age at maturity. Fishbase provided an age at maturity estimate of 1.6 years for *P. hepatus* (Froese & Pauly, 2023k). A second estimate contained within the Atlas of Living Australia, indicates that *P. hepatus* matures between nine and 12 months of age (Atlas of Living Australia, Undated). While the accuracy of database estimates can vary, consultation undertaken as part of the RVA indicated that age at maturity for *P. hepatus* would be at or around two years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the information available and the advice provided, the preliminary score assigned to this attribute was decreased from high (3) to medium (2). The available evidence, at present, did not support a further reduction of the score assigned to this attribute. Changes made as part of the RVA were done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae Orangefin anemonefish (*A. chrysopterus*) Clark's anemonefish (*A. clarkii*) Wideband anemonefish (*A. latezonatus*) Eastern clown anemonefish (*A. percula*)	Age at maturity (Productivity)	3	2	As age at maturity data were not available for the listed species, they were all assigned a precautionary high (3) score for this attribute. While noting these deficiencies, some information on the age and growth of *Amphiprion* spp is available. For example, *A. ocellaris* specimens from the Andaman and Nicobar islands produced progeny that attained reproductive maturity at 18 months of age in a captive life-history analysis (Madhu *et al.*, 2012). Further, histological analyses of gonadal tissue of the progeny of *A. polymnus* specimens collected from the Gulf of Thailand determined age at maturity to be 14 months (Rattanayuvakorn *et al.*, 2006). As these two species belong to the same genus, a reasonable hypothesis would be the listed species mature between one and two years. Further consultation on the biology of *Amphiprion* spp.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Pink anemonefish (*A. perideraion*)				confirmed that one to two years would be an appropriate estimate for the listed species (pers. comm. D. Bellwood). **Key changes to the PSA scores** Despite the lack of species-specific data, proxies for other species in the genus *Amphiprion* are available and informative. Based on the available data and advice provided, the preliminary scores assigned were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae Barrier Reer anemonefish (*A. akindynos*) Blackback anemonefish (*A. melanopus*)	Age at maturity (Productivity)	3	2	Age at maturity was estimated for the listed species at the point at which 50% of non-female individuals are mature (Buechler, 2005). The age at maturation for *A. akindynos* was determined to be 2–3, 4–5 and 6–7 years consecutively for specimens collected from Kimbe Bay, Lizard Island and One Tree Island (Buechler, 2005). Age at maturity for *A. melanopus* was 2–3 years for specimens from Lizard Island and One Tree Island (Buechler, 2005). The highest value from the study by Buechler, 2005 was used in the PSA to remain precautionary. Further consultation on the biology of the listed species determined that an age at maturity estimate of >2 years may be conservative, and that 2 years would be an appropriate estimate (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and advice provided, the preliminary scores assigned were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information* and *Guideline 2: additional scientific assessment and consultation.*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Family Pomacanthidae Golden angelfish (*C. aurantia*) Coral beauty (*C. bispinosa*) Lemonpeel angelfish (*C. flavissima*) Yellow angelfish (*C. heraldi*) Whitetail angelfish (*C. fisheri*)	Age at maturity (*Productivity*)	3	2	Age at maturity for the listed pygmy angelfishes is not known and they were assigned a precautionary high (3) score for this attribute. In the RVA, this rating was refined using proxies from morphologically and taxonomically similar species. A study by Sapolu (2005) which used histological analyses of gonadal tissue determined that *C. bicolor* specimens from the Great Barrier Reef matured at 0.56 years and two years of age for males and females respectively. Using the same methodology, *C. loriculus* was determined to be mature at 0.44 years (females) and two years (males) (Sapolu, 2005). Further consultation on the biology of *Centropyge* spp. determined that the listed pygmy angelfish would likely mature within two years (pers. comm. D. Bellwood). Based on this recommendation and the available data, an age of maturity estimate of one to two years was applied to all five pygmy angelfish species. **Key changes to the PSA scores** Based on the data available and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* Note – As pygmy angelfish are sequential hermaphrodites (i.e. change sex with age/growth), the RVA considered their ability to contribute to the biomass of populations as mature males and later as females. It was concluded that the age at maturity as both males and females is equally important to maintain sex ratios and the highest available estimate should be used.
Family Siganidae Coral rabbitfish (*S. corallinus*) Masked rabbitfish (*S. puellus*) Foxface (*S. vulpinus*)	Age at maturity (Productivity)	3	2	Age at maturity data were not available for *S. corallinus*. *S. puellus* or *S. vulpinus* and all three species were assigned precautionary high (3) scores for age at maturity. In the RVA, further consideration was given to age and growth data collated for morphologically and taxonomically similar species. Age and growth analyses for *S. argenteus* sampled from the Mariana Islands indicate that this species matures at ~1.3 years, with *S. punctatus* from the

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Indo-Pacific reporting similar results (i.e. one year) (Rhodes *et al.*, 2017; Taylor *et al.*, 2016). The *Lizard Island Field Guide* by the Australian Museum (in conjunction with the Lizard Island Research station) provides a tertiary source of information that states that the listed rabbitfish mature at two years of age (Australian Museum, Undated-a; b; c). Fishbase contains estimates or defaults for these species based on the family level. While considered less-reliable, age at maturity estimates contained in Fishbase indicate that *S. corallinus, S. puellus and S. vulpinus* mature between one and two years of age (Froese & Pauly, 2023l). Further consultation on the biology of *Siganus* spp. determined that the listed rabbitfishes would likely mature within two years (pers. comm. D. Bellwood). **Key changes to the PSA scores** A weight-of-evidence approach suggests that the age at maturity of the listed species is likely to be between one and two years. Based on the available information, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Family Chaetodontidae Muller's coralfish (*C. muelleri*) Beaked coralfish (*C. rostratus*) Margined coralfish (*C. marginalis*) Forceps fish (*F. flavissimus*) Longnose butterflyfish (*F. longirostris*)	Age at maturity (Productivity)	3	2	Age at maturity for the listed Coralfishes is not known and they were all assigned a precautionary high (3) score for this attribute. In the absence of additional data, Fishbase age at maturity estimates were used as a baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase estimated the age at maturity for the listed species to be between one and two years (Froese & Pauly, 2023l). Further consultation on the biology of *Chelmon* spp., *Forcipiger* spp., *Hemitaurichthys* spp. and *Heniochus* spp. determined that these species would likely mature within two years (pers. comm. D. Bellwood). **Key changes to the PSA scores**

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Pyramid butterflyfish (*H. polylepis*) Schooling bannerfish (*H. diphreutes*)				Based on the available estimates and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Acanthuridae Twospot bristletooth (*C. binotatus*) Clown unicornfish (*N. lituratus*) **Family Apogonidae** Sydney cardinalfish (*O. limenus*) **Family Blenniidae** Redstreaked blenny (*C. stigmaticus*) **Family Centriscidae** Jointed razorfish (*A. strigatus*) Grooved razorfish (*C. scutatus*) **Family Gobiidae** Old glory goby (*K. rainfordi*) Bridled goby (*A. bifrenatus*)	Age at maturity (Productivity)	3	2	Age at maturity data were not available for the listed species and all were assigned a precautionary high (3) score for this attribute. In the absence of additional data, Fishbase age at maturity estimates were used as a baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase estimated the age at maturity for the listed species to be between one and two years (Froese & Pauly, 2023l). These assessments were calculated from the length at first maturity using the inverse of the von Bertalanffy growth function: $T_{mat} = t0 - \ln(1 - Lm/Linf)/k$ (Froese & Pauly, 2023l). They assume that the age at first maturity (T_{mat}) is equal to the age at which 50% of individuals in the population attain maturity. Further consultation on the biology of these species confirmed that one to two years was a reasonable estimate of age at maturity (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available information and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Mud-reef goby (*E. belissimus*) **Family Labridae** Bicolor cleanerfish (*L. bicolor*) Common cleanerfish (*L. dimidiatus*) Breastspot Cleanerfish (*L. pectoralis*) **Family Monacanthidae** Harlequin filefish (*O. longirostris*) **Family Pomacentridae** Banded humbug (*D. aruanus*) Threespot humbug (*D. trimaculatus*) **Family Serranidae** Swallowtail basslet (*S. latus*)				
Family Labridae Green moon wrasse (*T. lutescens*)	Age at maturity (Productivity)	3	2	Age at maturity for *T. lutescens* is not known and the species was assigned a precautionary high (3) score for this attribute. While species-specific data were not available, gonad analysis provided an age at maturity estimate for *T. lunare* (females) of one to two years on the Great Barrier Reef (Ackerman, 2004). As this species belongs to the same genus, it was used as a proxy for *T. lutescens*. Additional consultation undertaken as part of the RVA supported the approach taken (pers. comm. D. Bellwood).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Key changes to the PSA scores Based on the evidence and advice provided, the preliminary high (3) score is appropriate for this species. This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Family Acanthuridae Sailfin tang (*Z. veliferum*)	Age at maturity (Productivity)	3	3	Age at maturity for *Z. veliferum* has not been determined and the species was assigned a precautionary high (3) score for this attribute. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase estimated the *Z. veliferum* age at maturity to be 2.8 years (Froese & Pauly, 2023m). Further consultation on the biology of *Z. veliferum.* supported the inference that age at maturity for this species would be greater than two years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, the preliminary score assigned to this attribute will be maintained at high (3). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* While the RVA did not alter the score assigned to this attribute, it is an area within the *Z. veliferum* vulnerability profile that could be improved with additional information.
Family Pomacentridae Spine-cheek clownfish (*P. biaculeatus*)	Age at maturity (Productivity)	3	3	Age at maturity estimates were not available for the listed species and was assigned a precautionary high (3) score in the PSA. A study by Buechler, 2005 estimated the age at maturation for *P. biaculeatus* specimens from Kimbe Bay and Lizard Island to be between 2–3 years. This was based on the age at which >50% of non-female individuals are mature. Further consultation on the biology of this species confirmed that two to three years was a reasonable estimate of age at maturity (pers. comm. D. Bellwood).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Key changes to the PSA scores Based on the advice provided, the preliminary score assigned to this attribute will be maintained at high (3). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* While the RVA did not alter the score assigned to this attribute, it is an area within the *P. biaculeatus* vulnerability profile that could be improved with additional information.
Family Balistidae Clown triggerfish (*B. conspicillum*) **Family Labridae** Bluetail wrasse (*A. femininus*) Blue-and-yellow wrasse (*A. lennardi*) Speckled wrasse (*A. meleagrides*) Harlequin tuskfish (*C. fasciatus*) Clown wrasse (*C. gaimard*) Pastel slender wrasse (*H. doliatus*) **Family Monocentridae**	Age at maturity (Productivity)	3	3	Age at maturity estimates were not available for the listed species and all were assigned a precautionary high (3) score in the PSA. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. Fishbase contains life-history estimates or defaults for these species based on the family level. Fishbase may also use maximum size as a predictive mechanism for other life-history traits including age at maturity. Information contained within this database indicated that these species reach sexual maturity after two years (Froese & Pauly, 2023l). Further consultation on the biology of the listed species indicated that '>2 years' was a reasonable estimate for age at maturity (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, the preliminary score assigned to the listed species for this attribute will be maintained at high (3). However, the vulnerability profiles of all listed species were refined as part of the RVA. The RVA for this attribute considered *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Australian pineapplefish (*C. gloriamaris*) **Family Pomacanthidae** Watanabe's angelfish (*G. watanabei*) Lamarck's angelfish (*G. lamarck*) Multibar angelfish (*P. multifasciatus*) Emperor angelfish (*P. imperator*) Bluegirdle angelfish (*P. navarchus*) Blueface angelfish (*P. xanthometopon*) Threespot angelfish (*A. trimaculatus*)				
Family Chaetodontidae All assessed *Chaetodon* spp. [excluding Rainford's butterflyfish (*C. rainfordi*)]	Age at maturity (Productivity)	3	2	Twelve of the 13 *Chaetodon* species were assigned a precautionary high (3) score age at maturity due to data deficiencies. The age at maturity for the remaining species, *C. rainfordi*, was confirmed as two years through analysis of gonads and population structures (Fowler, 1991).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Further consultation on the biology of *Chaetodon* spp. indicated that all 13 species would likely mature within two years. Accordingly, it was recommended that the age at maturity for *C. rainfordi* be used as a proxy for the 12 remaining species (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacanthidae Conspicuous angelfish (*C. conspicillatus*) Scribbled angelfish (*C. duboulayi*) Queensland yellowtail angelfish (*C. meredithi*)	Age at maturity (Productivity)	3	3	Age at maturity for *C. conspicillatus*¸ *C. duboulayi* and *C. meredithi* is not known and all three species were assigned a precautionary high (3) score for this attribute. As a suitable proxy based on research or experimental studies, the RVA considered alternate measures to refine the vulnerability profiles of these species. In the absence of additional data, age at maturity estimates provided by Fishbase were used as a baseline assessment. Fishbase contains life-history estimates or defaults for fish species based on the family where they are derived. Fishbase may also use the maximum size of a species to predict other life-history traits including age at maturity. Fishbase estimated the age at maturity to be greater than two years for *C. conspicillatus, C. duboulayi* and *C. meredithi* (Froese & Pauly, 2023l). Further consultation on the biology of *Chaetodontoplus* spp. supported this inference and indicated that these species would likely mature within four years (pers. comm. D. Bellwood). For this reason, *C. conspicillatus* was amended to four years. **Key changes to the PSA scores**

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Based on the advice provided, the preliminary score assigned to these species for this attribute will be maintained at high (3). However, the vulnerability profiles of all listed species were refined as part of the RVA.
Maximum age				
Family Gobiidae Ocellate glidergoby (*V. longipinnis*)	Maximum age (Productivity)	3	1	Maximum age for the listed species has not been determined with otolith or scale analyses, therefore they were assigned a precautionary high (3) score for this attribute. In the RVA, further consideration was given to data compiled for taxonomically/morphologically similar species and studies undertaken outside of Australia. Field studies conducted on Moorea Island determined that *V. strigata* is generally short-lived (less than one year) with the vast majority of tagged individuals disappearing from the study within the same season (Reavis, 1997). The implication being that *V. strigata* has a fairly short lifespan with the onset of sexual maturity occurring in less than 12 months. As *V. longipinnis* is in the same genus as *V. strigata,* it is appropriate to use this data as a proxy. **Key changes to the PSA scores** Based on the available information, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Family Labridae All *Cirrhilabrus* spp., *Macropharyngodon* spp., *Paracheilinus* spp. and *Pseudojuloides* spp. assessed.	Maximum age (Productivity)	3	1	There is limited information on the age and growth development of *Cirrhilabrus* spp., *Macropharyngodon* spp., *Paracheilinus* spp. and *Pseudojuloides* spp. In the PSA, this resulted in species within this complex being assigned a precautionary high (3) vulnerability score for maximum age. For other species with significant data deficiencies, values contained in Fishbase were used as a baseline assessment. Further consultation on the biology of the listed genera/species determined that Fishbase age estimates greater than five years are likely overestimates (pers.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				comm. H. Choat). This consultation also confirmed that species within these genera will (likely) live for less than five years as they mature quickly (less than one year) and have high turnover rates (pers. comm. H. Choat). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* While this amendment was applied at a genus level, expert consultation indicates that there is a low probability that this amendment will contribute to a false-negative result i.e. a vulnerability underestimate.
Family Apogonidae Sydney cardinalfish (*O. limenus*) Pajama cardinalfish (*S. nematoptera*) Lea's cardinalfish (*T. leai*) **Family Blenniidae** Redstreaked blenny (*C. stigmaticus*) Australian combtooth blenny (*E. australianus*)	Maximum age (Productivity)	3	1	A range of species included in the analysis have limited age and growth data and could not be assigned an adequate score for maximum age in the PSA. In accordance with the VA methodology, these species were assigned a precautionary high (3) score for this attribute. A review of the available data failed to produce a suitable proxy for the listed species. In the absence of any additional data, age and growth data included in Fishbase were used as the baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase provided a maximum age estimate of less than five years for the listed species (Froese & Pauly, 2023l). Further consultation on the biology of these species determined that the Fishbase values provide a reasonable estimate for use in the MAFF VA (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Tiger combtooth blenny (*E. tigris*) **Family Centriscidae** Jointed razorfish (*A. strigatus*) Grooved razorfish (*C. scutatus*) **Family Gobiidae** Old glory goby (*K. rainfordi*) Bridled goby (*A. bifrenatus*) **Family Labridae** False-eyed wrasse (*H. biocellatus*) Golden wrasse (*H. chrysus*) **Family Monacanthidae** Harlequin filefish (*O. longirostris*) **Family Plesiopidae** Yellow scissortail (*A. flavissimus*) Blue scissortail (*A. macneilli*) **Family Pomacentridae**				*missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* While noting the above, future assessments would benefit from additional information on the age and growth of these species. This information could be used to further refine the vulnerability profiles and confirm the suitability of the score assigned to this attribute.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Blue demoiselle (*C. cyanea*) Starck's demoiselle (*C. starcki*) South Seas demoiselle (*C. taupou*) Fusilier damsel (*L. tapeinosoma*) **Family Serranidae** Pygmy basslet (*L. waitei*)				
Family *Chaetodontidae* All *Chaetodon* spp., *Chelmon* spp. and *Hemitaurichthys* spp. assessed (excluding *C. ornatissimus* and *C. melannotus*)	Maximum age (Productivity)	3	2	There is limited information on the age and growth development of the *Chaetodon* spp., *Chelmon* spp. and *Hemitaurichthys* spp. within Australian waters. In the RVA further consideration was given to assessments conducted in other jurisdictions and information that may provide further insight into the age and growth of these species. While not conducted in Australian waters, otolith analyses provided a maximum age estimate of approximately 10 years for *C. ornatissimus* in French Polynesia (Morat *et al.*, 2020). Further consultation undertaken as part of the RVA indicated that the maximum age for the listed species would also be around 10 years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				The above amendments were supported by additional consultation on the biology of *Chaetodon* spp. For reference, *C. ornatissimus* was the designated proxy for this subgroup of species.
Family Pomacentridae Blackaxil puller (*C. atripectoralis*) Yellowback puller (*C. nitida*) Vanderbilt's puller (*C. vanderbilti*) Threespot humbug (*D. trimaculatus*)	Maximum age (Productivity)	3	2	As maximum age has not been determined through otolith or scale analyses, the listed species were assigned a precautionary high (3) score for this attribute. In the RVA, further consideration was given to data compiled for taxonomically/morphologically similar species and studies undertaken outside of Australia. Otolith analyses of *C. iomelas*, *C. viridis* and *D. aruanus* from French Polynesia determined they have maximum ages of approximately five, nine and seven years, respectively (Morat *et al.*, 2020). Further consultation on the biology of *Chromis* spp. and *Dascyllus* spp. confirmed that the maximum age for the listed species would most likely be between five and 10 years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the available data and the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* For reference, maximum age estimates for *C. iomelas*, *C. viridis* and *D. aruanus* were used as proxies for species listed in the corresponding genus.
Family Pomacentridae Peacock damsel (*P. pavo*) Princess damsel (*P. vaiuli*)	Maximum age (Productivity)	3	2	Maximum age for the listed species has not been determined with otolith or scale analyses, therefore both were assigned a precautionary high (3) score for this attribute. However, otolith analyses have been used to determine the age of various other species of *Pomacentrus* spp. including on the Great Barrier Reef. For example, both *P. moluccensis* and *P. wardi* have maximum age estimates of at least 10 years (Fowler & Doherty, 1992), with *P. amboinensis* living to at least 6.5 years (McCormick, 2016). For the purpose of this VA, a reasonable

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				hypothesis is that the maximum age of *P. pavo* and *P. vaiuli* falls within the 5–15-year age bracket. **Key changes to the PSA scores** Based on the available data, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.*
Family Labridae Bicolor cleanerfish (*L. bicolor*) Common cleanerfish (*L. dimidiatus*) Breastspot cleanerfish (*L. pectoralis*)	Maximum age (Productivity)	3	2	Maximum age has not been determined for *L. bicolor*, *L. dimidiatus* or *L. pectoralis* through otolith or scale analysis; therefore, all three were assigned a precautionary high (3) score for this attribute. A review of the available data failed to produce a suitable proxy for the listed species. In the absence of any additional data, age estimates provided in Fishbase were used as the baseline assessments. The accuracy of these estimates were then tested through additional consultation. Fishbase provided a maximum age estimate of five and 15 years for *L. bicolor* and *L. dimidiatus* and less than five years for *L. pectoralis* (Froese & Pauly, 2023l). However, further consultation on the biology of these species indicated that they would live for at least five years and likely longer (though less than 15) (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* For some of these species a medium score for maximum age may overestimate the attribute vulnerability. The decision to assign each score was precautionary and aligns with the conservative nature of the MAFF VA methodology.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Family Serranidae All *Pseudanthias* spp. (excluding *P. rubrizonatus*), *Pyronotanthias* spp. and *Serranocirrhitus* spp.	Maximum age (Productivity)	3	2	There is limited information on the age and growth of species from the genera *Pseudanthias, Pyronotanthias* and *Serranocirrhitus.* Due to this deficiency, a high proportion of the species from *Pseudanthias*. *Pyronotanthias* and *Serranocirrhitus* were assigned a precautionary high (3) score for this attribute accordingly. In the absence of any additional data, age estimates provided in Fishbase were used as the baseline assessments. The accuracy of these estimates were then tested through additional consultation. Fishbase provided maximum age estimates of between 1.9 and 6.3 years for species within the listed families/genera (Froese & Pauly, 2023l). Of the species with available information, otolith analyses involving *P. rubrizonatus* at an artificial reef in north-western Australia registered age estimates from zero to five years (Fowler & Booth, 2012). Hobbyists have also reported *P. squamipinnis* having a lifespan of five to seven years (Bay Bridge Aquarium, Undated) and five to six years in captivity (Miller, 2022). While age estimates vary, the VA methodology needs to consider a) the suitability of the estimate/proxy and b) the potential for a false-negative result. In line with this approach, the RVA applied maximum age estimates in captivity were used as a proxy for the remaining *Pseudanthias* spp. While Fishbase estimated the maximum age of *Pyronotanthias* spp. and *Serranocirrhitus* spp. to be less than five years, it was determined that the same score should be applied to these species (Froese & Pauly, 2023l). **Key changes to the PSA scores** Based on the available information, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.* It is recognised that a rating of medium may overestimate the attribute vulnerability for some species. Though after a review of the available information and ongoing uncertainty surrounding Fishbase estimates, it was determined that this score should be applied across all *Pseudanthias*

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				spp. (excluding *P. rubrizonatus*)*, Pyronotanthias* spp. and *Serranocirrhitus* spp. Future VAs would benefit from additional information on the age and growth of these species. This information could be used to further refine the vulnerability profiles and confirm the suitability of the score assigned to this attribute
Family Gobiidae Mud-reef goby (*E. belissimus*) **Family Labridae** Bluetail wrasse (*A. femininus*) Blue-and-yellow wrasse (*A. lennardi*) Speckled wrasse (*A. meleagrides*) Clown wrasse (*C. gaimard*) **Family Pomacanthidae** Golden angelfish (*C. aurantia*) Lemonpeel angelfish (*C. flavissima*) Yellow angelfish (*C. heraldi*) Whitetail angelfish (*C. fisheri*) Watanabe's angelfish (*G. watanabei*)	Maximum age (Productivity)	3	2	A range of species included in the analysis have limited age and growth data and could not be assigned an adequate score for maximum age in the PSA. In accordance with the VA methodology, these species were assigned a precautionary high (3) score for this attribute. A review of the available data failed to produce a suitable proxy for the listed species. In the absence of any additional data, age and growth data included in Fishbase was used as the baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase provided a maximum age estimates of between 5 and 15 years (Froese & Pauly, 2023l). Further consultation on the biology of these species determined that the Fishbase values provided a reasonable estimate for use in the MAFF VA (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* While noting the above, future VAs would benefit from additional information on the age and growth of these species. This information could be used to further refine the vulnerability profiles and confirm the suitability of the score assigned to this attribute.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Multibar angelfish (*P. multifasciatus*)				
Family Chaetodontidae Schooling bannerfish (*H. diphreutes*)	Maximum age (Productivity)	3	2	The maximum age for *H. diphreutes* has not been confirmed through otolith or scale analysis and the species was assigned a precautionary high (3) score for this attribute. For other species with significant data deficiencies, values contained in Fishbase were used as a baseline assessment. Fishbase provided a maximum age estimate of less than five years for *H. diphreutes* (Froese & Pauly, 2023n). However, further consultation on the biology of this species indicated that a maximum age estimate of between five and fifteen years would be more realistic (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, the preliminary score assigned to this attribute was decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* Going forward, future assessments would benefit from additional information on the age and growth of this species. This information, at the very least, will provide further insight on the suitability of the proxy estimate and/or the potential for a vulnerability overestimate.
Family Siganidae Coral rabbitfish (*S. corallinus*) Masked rabbitfish (*S. puellus*) Foxface (*S. vulpinus*)	Maximum age (Productivity)	3	2	*Siganus corallinus*, *S. puellus* and *S. vulpinus* were all assigned a precautionary high (3) score for maximum age due to an absence of data. A review of the available data failed to produce a suitable proxy for the listed species. In the absence of any additional data, age and growth data included in Fishbase were used as the baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase provided maximum age estimates of between 4.2 and 5.8 years (Froese & Pauly, 2023l). Further consultation on the biology of *Siganus* spp. indicated that Fishbase

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				estimates for these species may be less reliable. As an alternative, it was recommended that a maximum age of 10 years be used as the proxy (pers. comm. D. Bellwood). **Key changes to the PSA scores** In line with this recommendation, 10 years was used as a proxy maximum age for *S. corallinus*, *S. puellus* and *S. vulpinus*. This resulted in a downgrading of the attribute scores from high (3) to medium (2) for these species. This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Labridae Green moon wrasse (*T. lutescens*)	Maximum age (Productivity)	3	2	A maximum age has not been determined for *T. lutescens* and the species was assigned a precautionary high (3) score for this attribute. A review of the available data provided age and growth data for at least one closely aligned species, *T. lunare.* This study used otolith analysis and provided a maximum age estimate of seven years for *T. lunare* (Ackerman, 2004). For reference, Fishbase provided a maximum age estimate for *T. lutescens* of 10.5 years (Froese & Pauly, 2023o). **Key changes to the PSA scores** As *T. lunare* is from the same genus and has a similar total length, age estimates for this species were used as a proxy for *T. lutescens*. In-line with this decision, the score assigned to this attribute were decreased from high (3) to medium (2). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information.* While this proxy value (seven years) is less than the Fishbase estimate, adopting this higher value would still result in a downgrading of the score from high to medium.
Family Acanthuridae Blue tang (*P. hepatus*)	Maximum age (Productivity)	3	3	As maximum age for the *P. hepatus* has not been determined with otolith or scale analyses, the species was assigned a precautionary high (3) score for this attribute. In the RVA, further

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				consideration was given to the available information including maximum age (T_{max}) estimates derived from alternate methods. The maximum age for *P. hepatus* has been calculated using growth data with estimates representing the age at which the species would theoretically reach its total length. Using this method, Rumagia *et al.* (2021) estimated the maximum age (T_{max}) of *P. hepatus* to be 4.54 years. Fishbase estimates the T_{max} of *P. hepatus* to be 6.3 years using the same method. Further consultation on the biology of this species indicates that the maximum age for this species would be greater than 15 years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, the preliminary score assigned to this attribute was maintained as high (3). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Chaetodontidae Forceps fish (*Forcipiger flavissimus*) Longnose butterflyfish (*F. longirostris*)	Maximum age (Productivity)	3	3	Maximum age estimates for *F. flavissimus* have not been published in primary literature and, as a consequence, the species was assigned a precautionary high (3) score in the PSA. However, a tertiary source 'AnAge: The Animal Ageing and Longevity Database' states that *F. flavissimus* lives for 18 years in the wild (Human Ageing Genomic Resources, 2017). The information was derived from a text on Longevity Records by Carey & Judge (2000). As estimates provided in broader databases are (potentially) less-robust, the suitability and applicability of this estimate was reviewed in consultation with scientific experts familiar with the biology of these species. This consultation indicated that the maximum age for *F. flavissimus* would likely exceed 15 years. It was further advised that maximum age estimates for *F. flavissimus* presents as a suitable proxy for *F. longirostris* (pers. comm. D. Bellwood). **Key changes to the PSA scores**

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				While the primary source was a tertiary reference (i.e. AnAge: The Animal Ageing and Longevity Database), a weight-of-evidence approach supports retaining the preliminary scores for this attribute. While the RVA did not alter the rating for this attribute, it did refine the vulnerability profiles of both species. These considerations and updates were consistent with *Guideline 1: rating due to missing, incorrect, or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Chaetodontidae Blackback butterflyfish (*C. melannotus*)	Maximum age (Productivity)	3	3	Maximum age estimates were not available for *C. melannotus* and the species was assigned a precautionary high (3) score for this attribute in the PSA. In the RVA, further consideration was given to the available data and potential proxies. This review confirmed an absence of direct age and growth data for this species. However, unpublished data (M. Berumen) referenced in a secondary study suggests that *C. melannotus* can live for up to 20 years (Pratchett *et al.*, 2006). **Key changes to the PSA scores** No change. While the use of secondary references is not ideal, the use of this data in the RVA will not alter the final vulnerability rating for *C. melannotus*. Referencing this material will also assist future assessments. The RVA of maximum age considered *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Acanthuridae Night surgeonfish (*A. thompsoni*) Greyhead surgeonfish (*A. nigros*)	Maximum age (Productivity)	3	3	Maximum age estimates were not available for *A. thompsoni* and *A. nigros*; therefore, both were assigned a precautionary high (3) score for this attribute. In the RVA, a wider range of reference materials were considered including estimates outlined in broader databases. Fishbase contains life-history estimates or defaults for fish species based on the family where they are derived. Fishbase may also use the maximum size of the fish to predict other life-history traits including age at maturity. In using these methods, Fishbase provided a maximum age estimate of around five years for *A thompsoni* and *A. nigros* (Froese & Pauly, 2023l). While noting these estimates, other source material suggests species within this genus live for longer

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				periods. For example, longevity estimates for *A. olivaceous* range from 14 years to 33 years (Choat & Robertson, 2002; Pardee *et al.*, 2022). Similarly *A. pyroferus* has longevity estimates of 28 years (Choat & Robertson, 2002) and 19 years (Morat *et al.*, 2020). Longevity estimate variations a) make it more difficult to assess the attribute vulnerability and b) supports the adoption of a more precautionary approach. Although it may be conservative, a reasonable hypothesis is that Acanthurids live for greater than 15 years. Subsequent consultation on the biology of these species supported this inference with 15 to >20 years identified as an appropriate, nominal estimate of maximum age (pers. comm. D. Bellwood). **Key changes to the PSA scores** No change. Based on the advice provided, the preliminary score assigned to the listed species for this attribute will be maintained at high (3). However, the vulnerability profiles of *A. thompsoni* and *A. nigros* were refined as part of the RVA. This decision considered *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae Orangefin anemonefish (*A. chrysopterus*) Wideband anemonefish (*A. latezonatus*) Pink anemonefish (*A. perideraion*) Saddleback anemonefish (*A. polymnus*)	Maximum age (Productivity)	3	3	There is limited information on the age and growth of *A. chrysopterus*, *A. latezonatus, A. perideraion* and *A. polymnus*. This was reflected in the PSA where all four species were assigned a precautionary high (3) score for maximum age. In the RVA, further consideration was given to age and growth data for taxonomically/morphologically similar species. A study using otolith analyses estimated the maximum age of female *A. melanopus*, *A. akindynos* and *P. biaculeatus* on the Great Barrier Reef to be 38 years, 28 years, and 17 years respectively (Buechler, 2005). The listed species are in the same genus as the species studied by Buechler (2005). Further consultation on the biology of these species indicates that the maximum age for the listed species would be greater than 15 years and upwards of 20 years (pers. comm. D.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Bellwood). This consultation also supported the use of *A. melanopus*, *A. akindynos* and *P. biaculeatus* as age and growth proxies for the listed species. **Key changes to the PSA scores** The data did not support altering the assigned score. However, the vulnerability profiles of all listed species were refined as part of the RVA. Future assessments would benefit from additional information on the age and growth of these species in Australian waters. This information could be used to further refine the vulnerability profiles and confirm the suitability of a high vulnerability score for this attribute. The above decision considered *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Pomacentridae Clark's anemonefish (*A. clarkii*) Western clown anemonefish (*A. ocellaris*) Eastern clown anemonefish (*A. percula*)	Maximum age (Productivity)	3	3	Maximum age for the listed species has not been confirmed in Australian waters and all were assigned a precautionary high (3) score for this attribute. In the RVA, further consideration was given to the available data including from studies conducted outside of Australian waters, in captivity and on taxonomically/morphologically similar species. In one example, an *A. clarkii* specimen was observed at a study site in Miyake-jima (Japan) over an 11 year period, with estimates placing the age of the fish at or around 13 years (Moyer, 1986). A report on captive *A. ocellaris* specimens also confirmed they can continue to spawn beyond 20 years of age (Sahm *et al.*, 2019). The life expectancy of the oldest *A. percula* individual was estimated to be 30 years using a stage-structured matrix model (Burston & Garcia, 2007). From a VA perspective, it is reasonable to hypothesise that the maximum age for species within this genus exceeds 15 years. This inference was supported by further consultation undertaken as part of the RVA which determined that the maximum age for the listed species would be greater than 15 years and upwards of 20 years (pers. comm. D. Bellwood).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Key changes to the PSA scores No change. Based on the advice provided, the preliminary score assigned to the listed species for this attribute will be maintained at high (3). However, the vulnerability profiles of all listed species were refined as part of the RVA. Future VAs would benefit from additional information on the age and growth of these species in Australian waters. This information could be used to further refine the vulnerability profiles and confirm the suitability of a high vulnerability score for this attribute.
Family Balistidae Clown triggerfish (*B. conspicillum*) **Family Labridae** Pastel slender wrasse (*H. doliatus*) **Family Monocentridae** Australian pineapplefish (*C. gloriamaris*) **Family Pomacanthidae** Conspicuous angelfish (*C. conspicillatus*) Scribbled angelfish (*C. duboulayi*)	Maximum age (Productivity)	3	3	A range of species included in the analysis have limited age and growth data and could not be assigned an adequate score for maximum age in the PSA. In accordance with the VA methodology, these species were assigned a precautionary high (3) score for this attribute. A review of the available data failed to produce a suitable proxy for the listed species. In the absence of any additional data, age and growth data included in Fishbase was used as the baseline assessment. The accuracy of these estimates were then tested through additional consultation. Fishbase provided a maximum age of six years for *C. conspicillatus* and greater than 15 years for the remaining species (Froese & Pauly, 2023l). Further consultation on the biology of these species indicates that the maximum age for all of the listed species would most likely be greater than 15 years (pers. comm. D. Bellwood). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were maintained as high (3). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.* For at least one of the species, *C. conspicillatus*, retaining a high (3) vulnerability rating for maximum age may represent a vulnerability over-estimate. After a review of the available information, it was determined that the preliminary score should be retained for *C. conspicillatus* as a precautionary measure. Future VAs would benefit from additional information on the age

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Queensland yellowtail angelfish (*C. meredithi*) Lamarck's angelfish (*G. lamarck*) Bluegirdle angelfish (*P. navarchus*) Blueface angelfish (*P. xanthometapon*) Threespot angelfish (*A. trimaculatus*)				and growth of these species. This information could be used to further refine the vulnerability profiles and confirm the suitability of the score assigned to this attribute.
Von Bertalanffy growth coefficient (*k*)				
Family; Acanthuridae, Apogonidae, Balistidae, Blenniidae, Centriscidae, Chaetodontidae, Gobiidae, Labridae, Monacanthidae, Monocentridae, Plesiopidae, Pomacanthidae, Pomacentridae, Serranidae and **Siganidae** Multiple species [excluding (*A. olivaceous, A. pyroferus, A. phalaena, A. akindynos, A. melanopus, C. bicolor, C.*	Von Bertalanffy (*k*) (Productivity)	3	1 - 3	When compared to species retained for human consumption, few age and growth studies have been undertaken for ornamental species. This can be attributed to the fact that a) the value of these species is based on their sale in the live aquarium trade and b) traditional ageing methods are lethal for the animal being assessed (e.g. age and growth analyses based on otoliths). These deficiencies were reflected in the PSA where a high percentage of the species were assigned a precautionary high (3) score for the von Bertalanffy growth coefficient (*k*). In the absence of data and without a suitable proxy, Fishbase estimates were used as baseline assessments. Fishbase contains life-history estimates or defaults for fish species based on the family level. Fishbase may also use the maximum size of the fish to predict other life-history traits including the von Bertalanffy growth coefficient (*k*). A review of the Fishbase data provided *k*-estimates for *C. melannotus, C. gloriamaris,* and *P. xanthometapon* of <0.15. Growth coefficient estimates for *C. duboulayi, C. meredithi, C. gaimard, B. conspicillum, H. doliatus, G. lamarck, P. navarchus,* and *A. trimaculatus* ranged

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
bispinosa, C. loriculus, C. ornatissimus, C. muelleri, C. fasciatus, C. viridis, D. aruanus, H. melanurus, N. lituratus, P. hepatus, P. biaculeatus, P. rubrizonatus, S. latus, Z. veliferum, P. imperator)]				from 0.15 to 0.25. with the remaining species registering *k*-values >0.25 (Froese & Pauly, 2023l). *Chaetodontoplus conspicillatus* was aligned with the other two species in the genus *Chaetodontoplus.* Further consultation on the biology of these species confirmed that there was limited information on the growth of the species and determining *k* for most coral reef species is difficult. For this reason, Fishbase likely represents the best source of information for the VA at the time (pers. comm. D. Bellwood). **Key changes to the PSA scores** Despite the lack of data, informed estimates are available and amendments were made as part of the RVA. Attribute score amendments and reductions varied between species and were based on estimates contained in Fishbase. Changes made as part of the RVA were done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information* and *Guideline 2: additional scientific assessment and consultation.* It is recognised that estimates contained in larger biological databases may have a higher degree of uncertainty. The use of this data though was considered appropriate given the external advice provided and the lack of information on the age and growth of ornamental species.
Reproductive strategy				
Family Labridae Pink-banded fairy wrasse (*C. roseafascia*) Squire's fairy wrasse (*C. squirei*)	Reproductive Strategy (Productivity)	3	1	The reproductive strategy of the listed species has not been published in primary literature, therefore they were assigned a precautionary high (3) score for this attribute. The available information indicates that wrasses in the genus *Cirrhilabrus* are broadcast spawners (Allen & Hammer, 2016). As *C. roseafascia* and *C. squirei* are from the genus *Cirrhilabrus* spp., it is reasonable to assume that they employ the same reproductive strategy.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Candy wrasse (*P. splendens*)				Further review of the available information provided limited insight into the reproductive strategy employed by *P. splendens*. However, Fishbase states that all Indo-Pacific wrasses are pelagic spawners and form harems (Froese & Pauly, 2023p). This information was used as a proxy for *P. splendens.* **Key changes to the PSA scores** Based on the available information, the preliminary scores assigned were reduced from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Depth profile				
Family; Acanthuridae, Balistidae, Centriscidae, Chaetodontidae, Labridae, Monocentridae, Pomacanthidae, Pomacentridae, and **Serranidae** Multiple species	Depth Profile (Susceptibility)	3	2	Multiple species were assigned a high (3) score in the PSA for depth profile as they are found in shallow water (<10 m) and can be readily accessible by divers collecting aquarium fish. However, many of these species are found across a broader range of depths. The mesophotic zone of reefs, or mesophotic coral ecosystems (MCEs) begin at depths of 30–40 m (Hinderstein *et al.*, 2010). These reefs are characterised by the existence of light-dependent corals in low-light environments and differ from shallow water, high-light reefs. Depths below 30 m are rarely dived for aquarium species due to the limits of SCUBA equipment (pers. comm. A. Roelofs). It is reasonable to assume that species that are found beyond 40 m can gain considerable refuge from fishing activity in the MAFF. On review of the available information and operational constraints of the VA, it is reasonable to assume that species that are restricted to shallow depths (0−10 m) will be at greater vulnerability of localised depletion when compared to species found (e.g.) from 0−50 m. The working hypothesis being that species found at greater depths will be afforded a degree of natural protection. **Key changes to the PSA scores**

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				For the reasons listed, any species with a depth profile that extends beyond 40 m will be reduced from a high-vulnerability score (3) to a medium-vulnerability score (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*. While this change altered the depth profile score for a number of species, amendments made as part of the RVA were conservative and provide a better reflection of the attribute's vulnerability. Amendments made as part of the RVA are not expected to contribute to a false-negative result or a vulnerability underestimate.
Family Gobiidae Old glory goby (*K. rainfordi*)	Depth Profile (Susceptibility)	3	3	*Koumansetta rainfordi* was assigned a preliminary high (3) score in the PSA for depth profile attribute. The suitability of this score was reviewed as part of the RVA and the extent of the available information, including within more generalised databases. Information on the depth profile of *K. rainfordi* is limited and there is a lack of published data. However, Fishbase states that *K. rainfordi* are found from 2–30 m (Froese & Pauly, 2023q). While information contained in broader databases can be less robust, this estimate represents the best available information for *K. rainfordi*. **Key changes to the PSA scores** No change. However, the vulnerability profile of *K. rainfordi* was refined as part of the RVA. The RVA for this attribute considered *Guideline 1: rating due to missing, incorrect, or out of date information*.
Family Serranidae Mirror basslet (*P. pleurotaenia*) **Family Labridae** Pink-banded fairy wrasse (*C. roseafascia*)	Depth Profile (Susceptibility)	2	1	*Pseudanthias pleurotaenia* and *Cirrhilabrus roseafascia* were assigned a medium vulnerability score (2) for this attribute based on a more generalised depth profile. In the RVA, the suitability and applicability of this score was reviewed. The text *Guide to Sea* Fishes of Australia states that *P. pleutrotaenia* is most often found from depths >30 m (Kuiter, 2023) with Fishes of Australia confirming that *C. roseafascia* is found from 30–155 m (Bray, 2017b). As these species are found in deepwater reefs and beyond the

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				collection activities of most divers, they are provided with a high degree of natural protection. Used in a weight-of-evidence approach, this information suggests that the preliminary score assigned to this attribute was too conservative. **Key changes to the PSA scores** Based on the available information, the preliminary score was reduced from medium (2) to low (1). This was done in accordance with *Guideline 3: Vulnerable with spatial assumptions* and, to a lesser extent, *Guideline 4: Vulnerable in regards to level of interaction / capture with a zero or negligible level of susceptibility.*
Ecological niche				
Family Serranidae *P. aurulentus* (*Pyronotanthias cf aurulentus*)	Ecological niche (Susceptibility)	3	2	Information on the habitat preferences of *P. aurulentus* is limited and there is lack of published data. As a consequence, the species was assigned a precautionary high (3) score in the PSA for this attribute. IUCN provides a tertiary source of information for the ecological niche of *P. aurulentus,* stating that it aggregates on deep coral reefs (Williams *et al.*, 2016). While there is no evidence to suggest this species is found in a symbiotic relationship, it does depend on coral reefs at some stage in its life history and/or uses resources provided by coral reef ecosystems. A review of this information and its applicability to the MAFF suggests that a preliminary high (3) vulnerability score is too conservative for this species. **Key changes to the PSA scores** Based on the available information it is reasonable to reduce the vulnerability rating from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Family Pomacentridae Fusilier damsel (*L. tapeinosoma*)	Ecological niche (Susceptibility)	3	2	Information on the habitat preferences of *L. tapeinosoma* is limited and there is lack of published data. As a consequence, the species was assigned a precautionary high (3) score in the PSA for this attribute. Fishbase provides a tertiary source of information for the ecological niche of *L. tapeinosoma,* stating that this species is found in seaward reefs and sometimes lagoon patch reefs. While there is no evidence to suggest this species is found in a symbiotic relationship, it does depend on coral reefs at some stage in its life history and/or uses resources provided by coral reef ecosystems. A review of this information and its applicability to the MAFF suggests that a preliminary high (3) vulnerability score is too conservative for this species. **Key changes to the PSA scores** Based on the available information it is reasonable to reduce the vulnerability rating from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Catchability				
Family Acanthuridae Twospot bristletooth (*C. binotatus*) Clown unicornfish (*N. lituratus*) **Family Blenniidae** Redstreaked blenny (*C. stigmaticus*) **Family Gobiidae**	Catchability (Susceptibility)	3	2	Information on the behaviour of the listed species is limited and there is lack of (published) species-specific data. Due to these deficiencies, all species were assigned a precautionary high (3) score in the PSA for catchability. In the RVA, further consideration was given to the available data, including estimates contained in more generalised databases. Fishbase provides a tertiary source of information for the listed species. Fishbase states that *K. rainfordi* is either solitary or found in small groups within coral reef structures (Froese & Pauly, 2023r) and *C. stigmaticus* exists solitarily or in small groups (Froese & Pauly, 2023a). There is no evidence to suggest these species are schooling, which is to be expected given that the vast majority of Gobiidae and Blenniidae are benthic fishes. Of the remaining species, Fishbase states that *C. binotatus* is usually solitary (Froese & Pauly, 2023b), *T. lutescens* occurs in

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Old glory goby (*K. rainfordi*) **Family Labridae** Green moon wrasse (*T. lutescens*) False-eyed wrasse (*H. biocellatus*)				groups (Froese & Pauly, 2023i), and *N. lituratus,* and *H. biocellatus* are found in small groups (Froese & Pauly, 2023c; d; Froese & Pauly, 2023e). **Key changes to the PSA scores** Based on the available information, preliminary vulnerability ratings for the listed species (except for *C. binotatus*) were reduced from high (3) to medium (2). The preliminary vulnerability rating for *C. binotatus* was reduced from high (3) to low (1). These changes were done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*. The reliance on more general biological databases like Fishbase is not ideal as estimates can be less robust. In the RVA, these estimates were considered in conjunction with information on the known behaviours and depth profiles of the broader families. This increased the level of confidence in the assessment and facilitated some minor amendments to the catchability score. While the amended score may still represent an overestimate for some species, the available information did not warrant further amendment.
Family Pomacanthidae Golden angelfish (*C. aurantia*) Flame angelfish (*C. loriculus*)	Catchability (Susceptibility)	3	2	Information on the social behaviour *of C.* aurantia *and C. loriculus* has not been published and both were assigned a precautionary high (3) score in the PSA for catchability*.* *Centropyge* spp. have varying social complexes and can be found singly, in pairs or in small aggregations in harems. The *Guide to Sea* Fishes of Australia states that *C. bicolor,* and *C. heraldi* are found in small groups (Kuiter, 2023). Grey literature, such as Fishes of Australia states that *C. bispinosa* and *C. flavissima* are found in small harems (Bray, 2022b; Undated). While more difficult to quantify, Fishbase indicates that *C. loriculus* exists in harems of three to seven individuals (Froese & Pauly, 2023f). While information if limited for both *C. aurantia* and *C. loriculus*, a weight-of-evidence approach indicated that the social behaviours of these species will be similar to that reported for other

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				members of the genus. Accordingly, information from closely aligned species were used as a proxies. **Key changes to the PSA scores** Based on the available information preliminary vulnerability ratings were reduced from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Family Pomacentridae South seas demoiselle (*Chrysiptera taupou*)	Catchability (Susceptibility)	3	1	There is limited information on the social behaviour of *C. taupou* and the species was assigned a precautionary high (3) score in the PSA for catchability. Tertiary information from Fishbase (Froese & Pauly, 2023g) and the aquarium guide, *Reef Aquarium Fishes* (Michael, 2005), suggests that *C. taupou* pairs during breeding and/or forms mated pairs. However, anecdotal evidence also suggests that the species is aggressive, territorial (Michael, 2005) and likely to be solitary for most of its life. **Key changes to the PSA scores** Based on the available information the vulnerability rating was reduced from high (3) to low (1). While this RVA amendment is considerable, the revised score better reflects the available information. This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information.*
Family Labridae Laboute's wrasse (*C. laboutei*) Lavender wrasse (*C. lineatus*) Deepwater wrasse (*C. bathyphilus*)	Catchability (Susceptibility)	3	2	Further information is required on social behaviours displayed by the Family Labridae. These deficiencies were reflected in the PSA where a number of the species were assigned a precautionary high (3) score for catchability. In the RVA, further consideration was given to the suitability of these scores and any data contained in more generalised databases. A review of the grey literature indicated members of the genus *Cirrhilabrus* spp. form small harems/groups i.e. one male and a small group of females (Bray, 2022a). This information was used as a proxy for species listed within the *Cirrhilabrus* genus.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Conde's wrasse (*C. condei*) Pink-banded fairy wrasse (*C. roseafascia*) Squire's fairy wrasse (*C. squirei*) Bicolor cleanerfish (*L. bicolor*)				*Reef Aquarium Fishes* states most cleaner wrasses (*Labroides* spp.) form small harems with one male and three to six females (Michael, 2005). This inference was supported by Fishes of Australia which states that cleaner wrasses form harems with one male and up to five females (Bray, 2017a). This information, while not species specific, is relevant to the *Labroides* genus and was used as a proxy for the catchability attribute. **Key changes to the PSA scores** Based on the available information it is reasonable to reduce the vulnerability rating from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Family Blenniidae Australian combtooth blenny (*E. australianus*) Tiger combtooth blenny (*E. tigris*)	Catchability (Susceptibility)	3	1	There is limited information on the social behaviour of *E. australianus* and *E. tigris* and both were assigned a precautionary high (3) score in the PSA for catchability. In the absence of a suitable proxy, additional information was sourced from scientific experts with a greater understanding of the behaviours of both species. Further consultation on the behaviour of *Ecsenius* spp. indicated that *E. australianus* and *E. tigris* are solitary and are occasionally found in pairs during spawning events (pers. comm. D. Ceccarelli). **Key changes to the PSA scores** Based on the advice provided, preliminary scores assigned to this attribute were decreased from high (3) to low (1). This was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Gobiidae Mud-reef goby (*E. belissimus*)	Catchability (Susceptibility)	3	1	Information on the social behaviour of *E. belissimus* is limited and the species was assigned a precautionary high (3) score in the PSA for catchability. A review of the primary information sources provided limited insight into the behaviours of this species and/or an indication of the catchability vulnerability. However, data from transect

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				surveys in the citizen science program 'Reef Life Survey' recorded this species as solitary on the Great Barrier Reef (Reef Life Survey, 2019). **Key changes to the PSA scores** Based on the available information it is reasonable to reduce the vulnerability rating from high (3) to low (1). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Family Labridae Kuiter's wrasse (*M. kuiteri*) Black leopard wrasse (*M. negrosensis*)	Catchability (Susceptibility)	3	2	There is limited information on the social behaviour of *M. kuiteri* or *M. negrosensis* and both species were assigned a precautionary high (3) score for catchability. Detailed information on the genus *Macropharygdon* is available on Live Aquaria, an online aquarium retailer. Live Aquaria states that *Macropharygdon* spp. form harems: one male and a few females (Live Aquaria, 2023). Fishbase also provides a tertiary source of information for *M. negrosensis* stating that it is found in pairs or small groups (Froese & Pauly, 2023h). **Key changes to the PSA scores** The available information supported a reduction in the catchability vulnerability scores from high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*.
Family Serranidae *P. aurulentus* (*Pyronotanthias cf aurulentus*)	Catchability (Susceptibility)	3	3	*Pyronotanthias aurulentus.* was assigned a precautionary high (3) score in the PSA for catchability due to data deficiencies. While species-specific data were not available, the IUCN Red List provides a tertiary source of information for *P.* cf. *aurulentus*. The background information for this assessment indicates that *P.* cf. *aurulentus* shoal together above reefs (Williams *et al.*, 2016). Further consultation on the behaviour of this species supported this inference; noting that most other anthias form small aggregations (pers. comm. J. Johnson).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				Key changes to the PSA scores There is some uncertainty surrounding the size of this species' aggregations. Given this uncertainty, the preliminary scores assigned to this attribute were maintained. While a high (3) score may overestimate the attribute vulnerability, the available information did not support a lowering of the score. The decision to retain this score was done in accordance with *Guideline 1: rating due to missing, incorrect or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Market value				
Family Acanthuridae Greyhead surgeonfish (*A. nigros*) **Family Apogonidae** Lea's cardinalfish (*T. leai*) **Family Centriscidae** Grooved razorfish (*C. scutatus*) **Family Chaetodontidae** Dusky butterflyfish (*C. flavirostris*)	Market value (Susceptibility)	3	1–3	Market value was one of the more complicated attributes to assess and displayed regional variability. Sale prices for the listed species were based on Australian markets and as a result of this information, all species were assigned a precautionary high (3) vulnerability score in the PSA. In the RVA, further consideration was given to their value on international markets, wholesale lists and US retail aquarium markets. In determining an appropriate market value, the RVA applied a precautionary approach to ensure that the score refinements did not contribute to a false-positive result. The following provides an overview of the information considered for each species and the amended score. - *A. chrysopterus* is low value on Australian wholesale lists and with a 200%[18] retail markup. Specimens from Fiji and the Marshall Islands varied between low and moderate value on the US retail market. Further consultation on the abundance of this species indicates that it is rare in Australian waters (pers. comm. D. Ceccarelli). This could make this species more valuable and/or desirable. Score: medium (2). - *A. clarkii, C. starcki,* and *C. fisheri* are low value on the Australian retail market. However, further consultation on the abundance of this species indicates that they are rare in

[18] Industry advised that in Australia, the markup value of a marine fish is typically 150 to 200 per cent of the wholesale price depending on the value of the specimen. To remain conservative, a 200 per cent markup was applied to the wholesale cost of species in the RVA where necessary. This reflects its selling price on the Australian retail market.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Blackback butterflyfish (*C. melannotus*) Ornate butterflyfish (*C. ornatissimus*) Rainford's butterflyfish (*C. rainfordi*) Doublesaddle butterflyfish (*C. ulietensis*) Lattice butterflyfish (*C. rafflesii*) Reticulate butterflyfish (*C. reticulatus*) Muller's coralfish (*C. muelleri*) Longnose butterflyfish (*F. longirostris*) **Family Gobiidae** Mud-reef goby (*E. belissimus*) Ocellate Glidergoby (*V. longipinnis*) **Family Labridae** Conde's wrasse (*C. condei*) Squire's fairy wrasse (*C. squirei*)				Australian waters (pers. comm. D. Ceccarelli). This could make these species more valuable and/or desirable. Score: medium (2). - *A. latezonatus* captive bred specimens were <$100 on Australian wholesale lists although moderately valuable once the 200% retail markup was applied. It is expected that wild caught individuals would gain a much higher price as they are endemic to Australia and are only found in a restricted geographical range. Australian specimens are high value on US retail markets (>$1,000). Score: high (3). - *C. atripectoralis* is low value on Australian wholesale lists and with a 200% retail markup. This species is low value on the US retail market, however there was no indication as to whether they were Australian specimens. Score: low (1). - *C. flavirostris* is low value on Australian wholesale lists and with a 200% retail markup. Australian specimens are moderately valuable on US retail markets. Score: medium (2). - *C. melannotus* is low value on Australian wholesale lists and with a 200% retail markup. Indonesian specimens are low value on US retail markets. Score: low (1). - *C. ornatissimus* is low value on Australian wholesale lists and with a 200% retail markup. This species is moderately valuable on US retail markets, however there was no indication as to whether they were Australian specimens. Score low: (1). - *C. rainfordi* is low value on Australian wholesale lists and with a 200% retail markup. Australian specimens are moderately valuable on the US retail market. Score: medium (2). - *C. ulietensis* is low value on Australian wholesale lists and with a 200% retail markup. Fijian specimens are moderately valuable on the US retail market. Score: low (1). - *C. rafflesii* is low value on Australian wholesale lists and with a 200% retail markup. Fijian specimens are moderately valuable on the US retail market. Score: low (1).

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
Family Pomacentridae Orangefin anemonefish (*A. chrystopterus*) Clark's anemonefish (*A. clarkii*) Wideband anemonefish (*A. latezonatus*) Blackaxil puller (*C. atripectoralis*) Starck's demoiselle (*C. starcki*) Peacock damsel (*P. pavo*) **Family Pomacanthidae** Whitetail angelfish (*C. fisheri*) **Family Serranidae** Pygmy basslet (*L. waitei*) Luzon basslet (*P. luzonensis*) Lilac-tip basslet (*P. rubrizonatus*) Princess basslet (*P. smithvanizi*)				- *C. reticulatus* is low value on Australian wholesale lists and with a 200% retail markup. Specimens from the Western Pacific are moderately valuable on the US retail market. Score: low (1). - *C. muelleri* is low value on Australian wholesale lists and with a 200% retail markup. Australian specimens are moderately valuable on the US retail market. Further consultation on the abundance of this species indicates that it is rare in Australian waters (pers. comm. D. Ceccarelli). This could make this species more valuable and/or desirable. Score: medium (2). - *F. longirostris* is low value on Australian wholesale lists and with a 200% retail markup. Indonesian specimens are moderately valuable on the US retail market. Score: low (1). - *E. belissimus* is low value on Australian wholesale lists and with a 200% retail markup. Score: low (1). - *V. longipinnis* is low value on Australian wholesale lists and with a 200% retail markup. Specimens from the Indo-Pacific and Fiji are low value on the US retail market. Score: low (1). - *C. condei* is low value on Australian wholesale lists and moderately valuable with a 200% markup. Specimens from the Solomon Islands are moderately valuable on the US retail market. Score: medium (2). - *C. squirei* is high value on Australian wholesale lists and with a 200% markup. Specimens from Australia are also high value on the US retail market. Score: high (3). - *L. waitei* is low value on Australian wholesale lists and with a 200% retail markup. Specimens from Fiji and the Marshall Islands are low value on the US retail market. Further consultation on the abundance of this species indicates that it is rare in Australian

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				waters (pers. comm. D. Ceccarelli). This could make this species more valuable and/or desirable. Score: medium (2). - *P. luzonensis* is low value on Australian wholesale lists and moderately valuable with a 200% markup. Specimens from the Indo-Pacific are moderately valuable on the US retail market. Score: medium (2). - *P. rubrizonatus* is low value on Australian wholesale lists and moderately valuable with a 200% markup. Australian specimens are moderately valuable on the US retail market. Score: medium (2). - *P. smithvanizi* is low value on Australian wholesale lists and with a 200% retail markup. Specimens from Fiji and the Philippines are moderately valuable on the US market. Score: low (1). - *T. leai* is low value (<$100) on Australian wholesale lists and with a 200% retail markup. Score: low (1). - *A. nigros* is low value on Australian wholesale lists and moderately valuable with a 200% retail markup. Further consultation on the abundance of this species indicates that it is rare in Australian waters (pers. comm. D. Ceccarelli). This could make this species more valuable and/or desirable. Score: medium (2). - *C. scutatus* is low value on Australian wholesale lists and with a 200% retail markup. Score: low (1). - *P. pavo* is low value on Australian wholesale lists and with a 200% retail markup. Score: low (1). **Key changes to the PSA scores** The RVA of the preliminary market value attribute resulted in score amendments for a number of species. When scores were amended, they were typically reduced. The extent of the

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				vulnerability score reductions were not uniform. Amendments made as part of the RVA were done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information* and *Guideline 2: additional scientific assessment and consultation.*
Family Apogonidae Sydney cardinalfish (*O.limenus*) **Family Gobiidae** Bridled goby (*A. bifrenatus*)	Market value (Susceptibility)	3	2	These species were included in the current assessment as they were given medium or high-vulnerability scores in the 2008 report "*Sustainability Assessment of Marine Fish Species Collected in the Queensland Marine Aquarium Trade"* (Roelofs & Silcock, 2008). However, it is unlikely that *A. bifrenatus* and *O. limenus* are collected in the MAFF and there is limited information on their sale in the retail aquarium market. For reference: - *O. limenus* is endemic to Australia and is distributed from K'gari (formerly Fraser Island) to eastern Victoria (Bray, 2019; Water., 2015). It is unlikely that this species is being heavily collected due to the small overlap between its distribution and the MAFF fishery area. - *A. bifrenatus* is endemic to Australia and is distributed in southern Australia from Moreton Bay through to Western Australia (Bray, 2017c; Commonwealth Scientific and Industrial Research Organisation, Undated). Within the aquarium trade, traits that influence the market value of marine fishes include rarity, endemicity, colouration and behaviour. While *A. bifrenatus* and *O. limenus* are endemic, they are not brightly coloured or rare, and there are no places to purchase them online. Further, there is little to no information that suggests they are targeted in the MAFF. **Key changes to the PSA scores** Both *A. bifrenatus* and *O. limenus* were included in the assessment as a precautionary measure. However, evidence suggests that these species are either not targeted in the MAFF and/or are harvested in very low quantities. In the VA, this absence of data was reflected in the paucity of information on market trends and values.

Species	Attribute	PSA Score	RVA Score	Justifications and Considerations
				In the RVA, further consideration was given to the suitability of the preliminary score and confounding factors. This review determined that there was sufficient evidence to warrant a decrease in vulnerability from a score of high (3) to medium (2). This change was done in accordance with *Guideline 1: rating due to missing, incorrect, or out of date information*. A market value score of medium (2) for *A. bifrenatus* and *O. limenus* may still represent an overestimate. The information though did not support a further reduction of this score.