INTERNATIONAL TRADE IN NON-CITES LISTED MARINE ORNAMENTAL FISH

International trade, conservation status, management and legislation for non-CITES marine ornamental fish in support of the implementation of Decision 18.296 *[Updated]*

UN environment programme
WCMC

International trade in non-CITES listed marine ornamental fish: International trade, conservation status, management and legislation for non-CITES marine ornamental fish in support of the implementation of Decision 18.296 *[Updated]*

Prepared by the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) in cooperation with the CITES Secretariat.

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Executive Summary

Marine ornamental fish[1] are a substantial component of the international wildlife trade market. If managed sustainably, their harvest can provide ongoing livelihood benefits to the indigenous peoples and local communities (IPLCs) involved, along with broader incentive to maintain coral reefs (Wabnitz *et al.*, 2003; Schwerdtner Máñez *et al.*, 2014; King, 2019). Despite known high volumes of international trade in marine ornamental fish, an overall picture of the number and diversity of the species found in trade is lacking at the global level, although there are national and regional datasets held by industry and others (Rhyne *et al.*, 2017; Biondo and Burki, 2020).

At its 18th meeting (CoP18, Geneva, 2019), the CITES Conference of the Parties adopted three Decisions relating to marine ornamental fish (Decisions 18.296 to 18.298), based on document CoP18 Doc. 94 on *Conservation management and trade in marine ornamental fishes.* To contribute towards the implementation of Decision 18.296 c), the CITES Secretariat engaged the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) to compile workshop documents on marine ornamental fishes' biology, conservation status, trade and management, and applicable trade regulations.

The draft of these compiled documents was published in 2022 as CoP19 Inf. 99; the version presented here was updated in April 2024 to incorporate several revised datasets ahead of the CITES marine ornamental fish workshop to be held in Brisbane, Australia 7-10 May 2024 (for further details on the updated datasets included, see p.6 of the Introduction).

Methods

To gather information on marine ornamental fish trade, conservation status, management and legislation, a survey was circulated via a Notification to the Parties on 30 March 2021 (Notif.2021/030; see Annex A). Sixty-one responses to the stakeholder survey were received from 65 Authorities/ organisations/ individuals, including from 11 CITES Authorities[2]. Almost half of the responses from CITES Authorities were from the European Region (five), with two from North America and one each from Africa, Asia, Central and South America and the Caribbean, and Oceania.

Further information on marine ornamental fish species was compiled from species databases (e.g. IUCN Red List, FishBase), trade databases (e.g. US imports in LEMIS, EU imports in TRACES, TRAFFIC Wildlife Trade Portal and GMAD), expert consultation, relevant management plans and legislation in key countries of export, and the wider published literature.

This report uses these data sources to address the objectives of the following Sections, which follow the four Thematic Studies as proposed by the Secretariat in paragraph 5 of AC31 Doc. 36:

Section 1 (Thematic Study 1): identify non-CITES marine ornamental fish **species in international trade** and, where data are available, explore patterns in this trade including evidence of captive breeding.

Section 2 (Thematic Study 2): explore the **conservation status and intrinsic vulnerability to extinction** for all non-CITES marine ornamental fish species identified in Section 1 as 'in international trade', and provisionally categorise these species according to their possible likelihood of being threatened by international trade. Species provisionally considered a 'higher risk' on the basis of their conservation status may warrant prioritisation for further research into the potential impact of international trade.

[1] Defined here as fish (including sharks and rays) living amongst, or in close relation, to coral reefs in the tropical/subtropical Western Atlantic and Indo-Pacific oceans (typically between 30°N and 30°S latitudes), which are caught for public or private aquariums (AC31 Doc. 36).

[2] Australia, Ecuador, Estonia, France and overseas territories (Mayotte, Guadeloupe, Martinique), Israel, Kenya, Mexico, New Caledonia, Singapore, Spain and the United States of America.

Section 3 (combines Thematic Studies 3 and 4): summarise **management measures and legislation relating to the harvest and export** of non-CITES marine ornamental fish in six key countries of export: Australia, Fiji, Indonesia, Kenya, the Philippines and Sri Lanka.

Section 1. International trade in non-CITES marine ornamental fish

- Of the 2191 marine ornamental fish species identified through this study, **81% (1764 species in 131 families) were categorised as being in international trade.** The main range States for these species were **Indonesia (1175 species), Australia (1085 species) and the Philippines (1061 species)**, aligning with key exporting countries identified in the literature (Wabnitz *et al.*, 2003; Biondo and Burki, 2019).

- A mean average of 3.8 million kg of non-freshwater ornamental fish (HS code 030119) were reportedly exported globally each year 2012-2021, however data were not available to estimate the *number* of marine ornamental fish in global trade each year. On the basis of recent official import data from two key marine ornamental fish importers (the EU and US), **combined imports into the EU and US may comprise of >9 million individual marine ornamental fish per year based on trade data and stakeholder survey responses**. Further industry data indicated that whilst over 1000 species were imported into the EU and UK, a quarter of imports were in just five species.

- In agreement with previous studies (Wabnitz *et al.*, 2003; Murray and Watson, 2014; Dey, 2016), this study found **limited evidence of captive-bred specimens in international trade for most marine ornamental fish species** based on the datasets available (although additional captive breeding for domestic trade may also be occurring). Successful captive breeding was reported for 311 (18%) of the species in trade, however only 110 of these species appeared to be 'commonly' or 'moderately' available for retail from captive-bred sources, with the remaining species in trade being sourced from the wild. Other species may be captive bred for domestic aquaria but not enter international trade.

- In order for trade to be effectively monitored globally, **global species-level data on the number of individuals in trade** are required. In particular, data and information (such as the quantity of individual species) are needed from key exporting countries as well as other key importing countries (e.g. China and Japan) to enable a balanced analysis of trade levels and trends, and will be critical in ultimately assessing overall sustainability of the international trade in marine ornamental fish species. However, they were not made available at any taxonomic level for this study.

Section 2. Conservation status of non-CITES marine ornamental fish in live international trade

- Of the 1764 non-CITES listed marine ornamental fish species identified in Section 1 as being in international trade, **90% have IUCN Red List assessments: 60 species are currently considered globally threatened or Near Threatened, while the majority are currently considered to be 'Least Concern' (1469)**. Although, over half of these Red List assessments were over ten years old including 22 Near Threatened or globally threatened species. The species with older assessments and higher **vulnerability** or which have not yet been assessed may be priorities for (re)assessment.

- **Seventy-seven (4%) of the marine ornamental fish species in international trade had high intrinsic vulnerability index scores** (Cheung *et al.*, 2005), indicating that their life history and ecological traits make them more vulnerable to extinction. This includes large bodied, slow to mature species with relatively low fecundity, such as moray eels (family Muraenidae; 18 species), sharks/rays (class Elasmobranchii; 18 species with a high vulnerability), and large groupers

(family Epinephelidae; 10 species). Due to their large adult size, many of these species are primarily traded for public aquaria.

- Species were provisionally grouped as having a 'lower', 'moderate' or 'higher' likelihood of being threatened by international trade based on their conservation status and intrinsic vulnerability to extinction, supplemented with expert input (See Figure ES1 for summary). The **majority of marine ornamental fish species found to be in international trade (~82%, 1447 species) were considered 'lower risk' (i.e. unlikely to be currently threatened by international trade)** based on their conservation status and intrinsic vulnerability.

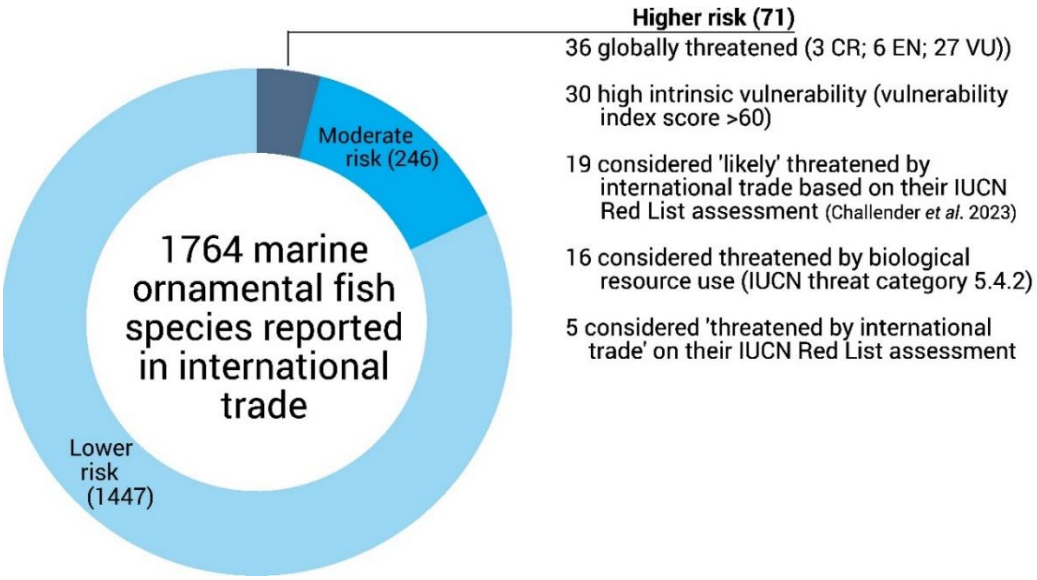


Figure ES1. Provisional groupings for the likelihood of marine ornamental fish species being threatened by international trade, based on their conservation status, intrinsic vulnerability and expert input.

- **Less than 5% (71 species) of marine ornamental fish species found to be in international trade were considered to have a higher potential likelihood of being threatened by international trade**. These species had high intrinsic vulnerability and/or risk of extinction according to IUCN Red List assessments and may therefore be priorities for more detailed assessment of the impact of international trade. Thirty-three of these species are imported into the EU and/or UK.

Section 3. Management and regulation of marine ornamental fisheries from harvest to export

- **The management measures and legislation were explored for six key countries of marine ornamental fish exports (Australia, Fiji, Indonesia, Kenya, the Philippines and Sri Lanka).** These were identified on the basis of their global exports of HS code 030119 (live non-freshwater ornamental fish) and the number of marine ornamental fish species native to their waters, as well as further information from the scientific literature and stakeholder survey responses. All six countries exported >100,000 kg/year of HS-030119 and had at least 10 native species provisionally classified as 'higher risk'.

- Based on available information, the harvest and export of marine ornamental fish in the focal countries appears to be **largely regulated and managed as part of general fisheries management**, rather than having management specific to live ornamental marine fish species. There are some exceptions, with specific subnational marine ornamental fish harvest management plans in Australia and Sri Lanka, and all focal countries have some regulations relating to the export of live animals. Marine ornamental fish are collected live, have different supply chains, are often smaller in size and have different ecologies than fish caught for food and transported dead or processed. As a result, the generalist management measures in place for the sustainable

harvesting or export of food fish (e.g. specific gear restrictions) may not be suitable for the management needs of marine ornamental fisheries.

- **All six focal countries of export specified harvest management or export measures for at least one marine ornamental fish species in legislation and/or management plans**. These measures included prohibition of take, prohibition or restriction of exports, requirements for a management plan and/or additional harvest monitoring. In total, 620 marine ornamental species were found to have additional harvest management or export measure requirements: 43 species had species-specific management measures, the remaining 577 species were included within family- or genus-level measures in one or more of their native range States.
- **Of the 71 species provisionally classified as 'higher risk' in Section 2, 37 were considered native to the waters of at least one of the focal countries.** Of the 37 native and provisionally 'higher risk' species, 17 were covered by harvest management or export measures in at least one of the focal countries that they were native to. The remaining 20 species provisionally classified as 'higher risk' and occurring in these focal countries did not appear to have any specific management measures in place based on available information.

- National legislation in all six focal countries of export includes some **harvest management measures** directly written into the legislation (i.e. are a legislated requirements) that covered marine ornamental fish, either specifically or as part of general fisheries management. For other measures, national legislation allows for them to be put in place (e.g. via management plans) but does not require them to be in place. This is particularly true for measures such as harvest quotas, which are more locally specific. Evidence of management plans incorporating these measures was often limited; however, this may be because they were published in local languages or were not readily available online. Furthermore, stakeholder survey responses were only received from government authorities for two of the focal countries (CITES Authorities responded from Australia and Kenya); responses for Fiji and the Philippines were provided by industry representatives and no information was received via stakeholder survey respondents for Indonesia or Sri Lanka. Further engagement from other focal countries may have provided additional resources published in local languages or maintained locally and would be beneficial going forwards to provide further insights and address knowledge gaps.
- Four of the six focal countries appear to have regulations that would enable live fish to be tracked through the domestic supply chain via harvest and export permits (Australia), live fish transport licences (the Philippines and Sri Lanka) or health certificates (Indonesia). The remaining countries (Fiji and Kenya) do not appear to have equivalent licensing systems, meaning it is likely difficult to effectively monitor domestic supply chains.

- In addition to domestic measures in place governing harvest and trade, countries of export must also **adhere to the specific requirements of the countries of import**. These requirements vary between importing countries, but may include evidence of legal harvest, export permits and health certificates. All countries of export include provisions in their legislation to ensure that exports have appropriate quarantine and/or health checks in line with importing country requirements; Indonesia, Kenya and the Philippines go beyond this and require quarantine of all exports of marine ornamental fish irrespective of importer requirements.
- Enforcement of the legislative measures is key to effective management but is a concern in many places. Overall, NGO and industry survey respondents identified three of the six focal countries (Indonesia, Kenya and the Philippines) as having no or insufficient management or enforcement in place and insufficient industry standards; Australia and Fiji were considered by respondents to have sufficient management and enforcement. Sri Lanka was not named by any survey respondent as having either no/insufficient or sufficient measures in place. One independent researcher commented in their stakeholder survey response that the enforcement of national

legislation was inadequate across most countries, despite national legislation being in place, but that at the local community level there were many examples of effective and sustainable management including in places like Les, Indonesia.

Abbreviations

EU	European Union
FMA	Fishery Management Area
GMAD	Global Marine Aquarium Database
HS	Harmonised system (internationally standardised system of classifying goods)
IPLC	Indigenous peoples and local communities
LEMIS	Law Enforcement Management and Information System (trade data management system from the United States of America)
LGU	Local Government Unit (Philippines)
MPA	Marine Protected Area
MSY	Maximum Sustainable Yield
TAC	Total Allowable Catch
TRACES	Trade Control and Expert System (trade data management system for the European Union)
UK	United Kingdom of Great Britain and Northern Ireland
US	United States of America

Introduction

Background

Marine ornamental fish[3] are a substantial component of the international wildlife trade market. If managed sustainably, their harvest can provide ongoing livelihood benefits to the indigenous peoples and local communities (IPLC) involved, along with broader incentive to maintain coral reefs (Wabnitz *et al.*, 2003; Schwerdtner Máñez *et al.*, 2014; King, 2019). Whilst some trade in marine ornamental fish has continued over decades without any apparent adverse impacts on wild populations (e.g. *Zebrasoma flavescens* (Yellow tang) in West Hawaii, Rossiter and Levine, 2014); overfishing for the aquarium trade can be a threat to some ornamental fish species (Rhyne *et al.*, 2012). In general, however, data remain largely insufficient for the impacts of harvesting and trade to be fully assessed.

In a study assessing global wildlife trade using the UN Comtrade database conducted by Andersson *et al.* (2021), 'ornamental fish' (HS codes 030110, 030111 and 030119, including both freshwater and marine species) were identified as the main commodity traded in the wildlife pets category, worth a total of USD 17 billion between 1997 and 2016 (averaging USD 850 million/year). This supported previous findings that the global live ornamental coral reef fish trade is a multi-billion-dollar industry (Bruckner, 2005; Dey, 2016; Biondo and Burki, 2020), although industry representatives report this to be a considerable over-estimate of the market's value (OATA & OFI, *pers. comm.*).

Marine species are estimated to comprise between 10% (Biondo and Burki, 2019) and 25% (extrapolated from UK imports; OATA & OFI, *pers. comm.*) of the ornamental fish trade industry, or 15% of the ornamental fish market by value (Dey, 2016). It is estimated in the literature that between 20 million (Domínguez and Botella, 2014) and 150 million marine ornamental fish are traded globally on an annual basis (Stevens *et al.*, 2017), although industry representatives estimate the number to be closer to 10 million (OATA & OFI, *pers. comm.*). The demand for marine species is mainly from hobbyists, with less than 1% of the global market for ornamental fish stemming from public aquaria (Dey, 2016). Public aquaria do, however, account for a significantly higher proportion of the total *value* of marine ornamental fish trade and are the sole market for a number of larger species, including many sharks that are not suitable for home aquaria (OATA & OFI, *pers. comm.*). Whilst the captive (or 'tank') breeding of marine ornamental fish for commercial trade is considered an expanding industry (Muyot *et al.*, 2018; Sweet and Pedersen, 2019), it is not economically viable for many species traded in relatively small quantities (King, 2019). There are also many technical obstacles to the successful captive breeding of marine ornamental fish (Moorhead and Zeng, 2010) and it has been estimated that 99% of the global marine ornamental fish trade is comprised of fish harvested from the wild (Pouil *et al.*, 2019). However, this is likely to be a substantial underestimate of the actual proportion of captive-bred individuals in retail, since it doesn't take into consideration the captive breeding of species for domestic aquaria (e.g. in the EU, UK and US), and much of the sourcing data are not publicly available for assessment. For example, it was estimated by industry representatives that *Amphiprion ocellaris* (Clown anemonefish) alone comprises up to 7% of the market, is almost exclusively from captive sources and often traded domestically (OATA & OFI, *pers. comm.*).

At present (up to and including CoP19), 35 species of marine ornamental fish are currently listed in the CITES Appendices[4]; two thirds of which are seahorses. One of these species, *Holacanthus clarionensis* (Clarion angelfish) was listed due to potential threat from live aquaria trade. The pet trade was also noted as a potential threat in the listing proposal for the genus *Hippocampus* (seahorses),

[3] Defined here as fish (including sharks and rays) living amongst, or in close relation, to coral reefs in the tropical/subtropical Western Atlantic and Indo-Pacific oceans (typically between 30°N and 30°S latitudes), which are caught for public or private aquariums (AC31 Doc. 36).

[4] According to the definition of 'marine ornamental fish' used here and detailed in the methods of Section 1 below, this included one genus (*Hippocampus* (seahorses) accounting for 24 marine ornamental species) and a further 11 species in other genera (*Cheilinus undulatus* (Humphead wrasse), *Holacanthus clarionensis* (Clarion angelfish) and nine shark species).

although the primary threat was from traditional medicine: six *Hippocampus* species were listed due to threat from trade [5], whilst the remaining *Hippocampus* species were listed under lookalike provisions. Other CITES-listed marine ornamental fish were proposed for inclusion in the Appendices due to other trade threats including for meat and fins (nine shark species) or trade for the live food market (*Cheilinus undulatus* (Humphead wrasse)). These 35 taxa are excluded from this report, which focuses only on non-CITES marine ornamental fish species in line with Decisions adopted at the 18th Conference of the Parties (see below).

Despite known high volumes of international trade in marine ornamental fish, an overall picture of the number and diversity of the species found in trade is lacking at the global level, although there are national and regional datasets held by industry and others (Rhyne *et al.*, 2017; Biondo and Burki, 2020). This has been attributed to a number of factors, including the absence of official global tracking and monitoring systems (Rhyne *et al.*, 2017; Biondo and Burki, 2020) or global regulatory bodies (Stevens *et al.*, 2017), although IATA (International Air Transport Association) provide regulations on shipping and OFI (Ornamental Fish International) has a global code of practice. A lack of globally accessible data on the species, quantities and source of the specimens in trade (e.g. wild versus captive-bred) has also been considered a hinderance (Wabnitz *et al.*, 2003; Rhyne *et al.*, 2012; Biondo, 2017, 2018; Biondo and Burki, 2019). According to Janssen and Shepherd (2018), these challenges can leave species vulnerable to undetected impacts of trade on populations.

CITES Decisions 18.296-18.298

At its 18th meeting (CoP18, Geneva, 2019), the CITES Conference of the Parties adopted three Decisions relating to marine ornamental fish (Decisions 18.296 to 18.298), based on document CoP18 Doc. 94 on *Conservation management and trade in marine ornamental fishes.*

In particular Decision 18.296, directed the Secretariat to:

a) *convene a technical workshop to consider the conservation priorities and management needs related to the trade in non-CITES listed marine ornamental fishes worldwide with a particular focus on data from importing and exporting countries;*

b) *invite the Animals Committee, representatives from range States, exporting, and importing countries, fishery stakeholder, industry representatives and relevant intergovernmental and non-governmental organizations to participate in this workshop;*

c) *contract appropriate technical experts to prepare workshop documents on marine ornamental fishes' biology; conservation status; trade and management; applicable trade regulations; and enforcement, and invite workshop participants to [submit the] contribute relevant information and expertise to the workshop; and*

d) *submit findings and recommendations of this workshop to the Animals Committee.*

To contribute towards the implementation of Decision 18.296 c), the CITES Secretariat engaged the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) to compile workshop documents on marine ornamental fishes' biology, conservation status, trade and management, and applicable trade regulations. This information is arranged and analysed based on the four thematic studies proposed by the Secretariat in Paragraph 5 of AC31 Doc. 36:

[5] *Hippocampus. barbourin, H. comes, H. erectus, H. ingens, H. reidi* and *H. spinosissimus*, which were proposed for listing primarily due to threat from overharvesting for traditional medicine. All of these species were categorised as Vulnerable on the IUCN Red List at the time of the proposal (https://speciesplus.net/api/v1/documents/52).

Thematic Study 1: International trade in non-CITES listed live coral reef fishes.
Thematic Study 2: Biology and conservation status of the main non-CITES listed coral reef fishes traded internationally as live specimens.
Thematic Study 3: Fisheries management of non-CITES listed live coral reef fishes in international trade.
Thematic Study 4: Relevant legislation and enforcement.

The four thematic studies synthesize results gathered from the literature, relevant trade databases[6] and through targeted expert consultation, as well as a stakeholder survey made available to all CITES Parties and other relevant stakeholders including traders/trade representatives, non-governmental organisations (NGOs) and independent researchers. Key findings are provided at the end of each Section for review by the Animals Committee.

Stakeholder survey

To gather information on marine ornamental fish trade, conservation status, management and legislation, a survey was circulated via a Notification to the Parties on 30 March 2021 (Notif. 2021/030; see Annex A)[7]. The survey was initially open for 5 weeks but was extended a further 6 weeks (11 weeks total) due to high levels of interest and requests for additional time to collate information from respondents. In addition, UNEP-WCMC engaged with representatives from Brazil, Indonesia, Singapore and South Africa at the 74th Meeting of the CITES Standing Committee (SC74, Lyon, March 2022) to encourage further responses[8].

Respondents

Sixty-two responses to the stakeholder survey were received from 66 Authorities, organisations and/or individuals[9], including four joint submissions (see Table i for details of respondents). The 62 responses were provided by 34 different countries/territories. The largest number of responses were received from the European Region (24 responses from 19 countries/territories), while ≤5 responses were received from Central and South America and the Caribbean (three), Africa (four) and Oceania (five).

Table i shows the country/territory of respondents and whether they identified their country as exporting, importing or re-exporting/transit countries for marine ornamental fish. A similar number of respondents identified their country as exporters (28 responses) and importers (34 responses); 10 respondents, including five from North America, identified their country as exporting, transit and importing countries for marine ornamental fishes.

Seventeen survey responses were provided by CITES Authorities (11 responses from 11 Authorities[10]) and other government agencies (six responses from five agencies). Almost half of the responses from CITES Authorities were from the European Region (five), with two from North America and one each from Africa, Asia, Central and South America and the Caribbean, and Oceania (see Table i for countries).

[6] UN Comtrade (global commodity trade), LEMIS (US imports), TRACES (EU imports) and GMAD; see Annex C for full details of datasets.
[7] UNEP-WCMC also provided the survey in Word in English, French and Spanish via email to over 100 stakeholders (including CITES Authorities for 13 priority countries that had not already responded to the survey) on 7 May 2021.
[8] These Parties were provided the survey in Word directly via email, and a response was subsequently received from Singapore.
[9] Not all surveys were completed to the same degree; the number of questions answered in these 62 responses ranged between 2-43. Further details provided in Annex A.
[10] Australia, Ecuador, Estonia, France and overseas territories (Mayotte, Guadeloupe, Martinique), Israel, Kenya, Mexico, New Caledonia, Singapore, Spain and the United States of America.

***Table i**. Reported country/territory of survey responses included in the report (n=62) and whether respondents identified their country as an exporting, importing or transit (re-exporting) country for the marine ornamental fish trade. The number of responses for each country/territory is provided in parentheses. Where exporting, importing and re-exporting/transit are all left blank, the respondent(s) did not provide an answer to the relevant question.*

Country/ territory (no. responses[11])	Exporting	Importing	Transit	Response received from CITES Authority
Africa (n= 4 responses)				
Kenya (2)				✓
South Africa (1)				
Uganda (1)				
Asia (n= 10 responses)				
India (1)				
Indonesia (1)				
Japan (1)				
Malaysia (2)				
Philippines (4)				
Singapore (2)				✓
Central and South America and the Caribbean (n= 3 responses)				
Cuba (2)				
Ecuador (1)				✓
Europe (n= 24 responses)				
Croatia (1)				
Denmark (1)				
Estonia (1)				✓
France (2)				
France and overseas territories: Mayotte, Guadeloupe, Martinique (1)				✓
French Polynesia (1)				
Germany (2)				
Hungary (1)				
Israel (1)				✓
Italy (1)				
Netherlands and United Kingdom (1)				
New Caledonia (3)				✓
Norway (1)				
Portugal (1)				
Spain (1)				✓
Switzerland (1)				
Switzerland and United Kingdom (1)				
United Kingdom (3)				
North America (n= 15 responses)				
Mexico (2)				✓
United States of America (13)				✓
Oceania (n= 5 responses)				
Australia (2)				✓
Fiji (1)				
Palau (1)				
Papua New Guinea (1)				

[11] In instances where there were multiple respondents from a country, not all respondents necessarily provided the same answers or completed the survey to the same degree.

The largest number of responses were received from trade and pet industry representatives (Figure i), with 19 responses submitted by 19 representatives from 12 countries.

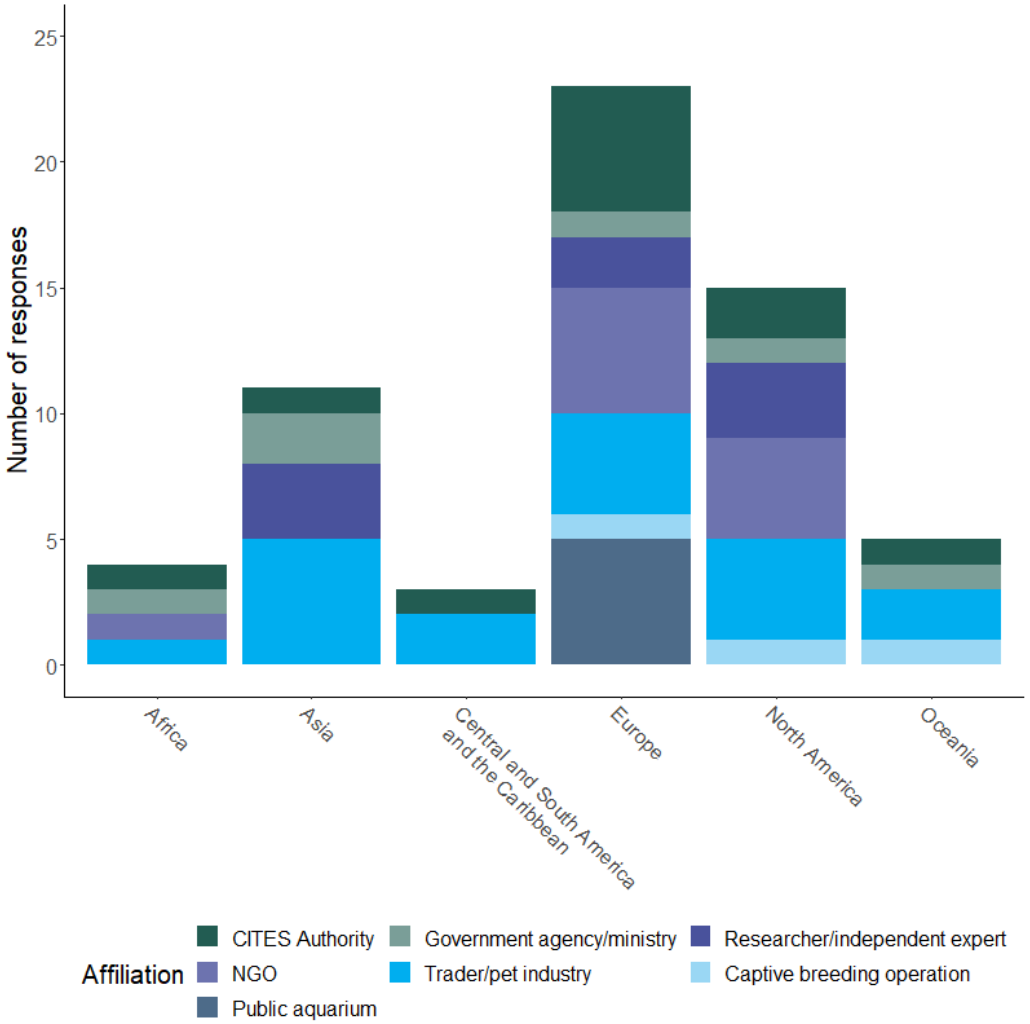


Figure i. Number of survey responses included in report (n=62) by CITES region of respondent's reported country/territory. Responses by region are further disaggregated by the reported affiliation of the respondent. ***Data source:*** *responses to survey shared via Notif. 2021/030.*

The survey asked stakeholders to identify marine ornamental fish species that are in international trade, identify species that are considered threatened by international trade, clarify which species are captive bred and provide levels of captive breeding, and to provide details on management and legislation related to the trade in their countries. In addition to the direct survey responses, respondents provided a further 49 resources in the form of published scientific papers and reports, management plans, legislation, species lists relating to conservation status and captive breeding, and trade datasets. Trade data included summaries of export or domestic trade data for five countries (excluding extracts from publicly available datasets such as UN Comtrade) and three lists of species that can be bred in captivity were also provided (see Annex A, Table A1). The responses and supplementary datasets/resources were compiled along with information from relevant trade and conservation databases, expert consultation and the wider literature to explore and compile information on the trade (Section 1), conservation status (Section 2), and management and legislation (Section 3) for marine ornamental fish.

Updates made to this report since publishing as CoP19 Inf. 99

This draft report was originally published as CoP19 Inf. 99 in 2022 in relation to CoP19 agenda item 80. Since then, several of the core datasets used in the report have been revised and updated. In order to make the most up to date information available to the CITES marine ornamental fish workshop (May 2024 in Brisbane, Australia), the following updates to the report have been made in line with updates to these datasets:

- The data derived from Fishbase have been updated from version 02/2022 to version 05/2023, including updating the core taxonomic backbone, vulnerability index scores and additional information relating to the ecology and distribution of the species;

- The IUCN Red List has been updated from version 2021-2 (with unpublished assessments provided by IUCN prior to publication in 2022-1) to version 2023-1;

- A more comprehensive dataset has been provided for *all* species imported into the EU under the Combined Nomenclature (CN) code 03011900 ('live ornamental fish - other than freshwater'), from the TRACES database 2018-2023 based on an updated TRACES dataset provided on 09/02/2024; and

- Any marine ornamental fish species listed at CoP19 in 2022 have been removed from this report.

The updates to the underlying datasets did not substantially impact the overall findings of the report originally presented in document CoP19 Inf. 99, but the updated datasets did affect aspects of the species-specific findings. Of particular note, while the overall number of marine ornamental fish species reported in international trade is slightly higher in this updated version (1764 compared to 1708), the total number of marine ornamental fish species that were provisionally grouped as 'higher risk' (i.e. having a higher likelihood of being threatened by international trade) is lower in this updated version (71 compared with 80 species originally presented in document CoP19 Inf. 99; see Figure 2.3 and Table 2.2. for the updated species list).

Section 1. International trade in non-CITES listed marine ornamental fish

Introduction

Robust, species-specific trade data are key to ensuring the sustainability of trade in marine ornamental fish (Rhyne *et al.*, 2017). Due to the lack of globally comparable or comprehensive datasets, most research into the marine ornamental fish trade has been at the country or regional level. While regional and national datasets can provide extremely valuable insights into trade quantities and trading partners for different taxonomic groups, these databases often lack specificity regarding the individual fish species traded. For example, import declarations frequently report trade at higher taxonomic levels or as commodity/tariff codes (e.g. as HS code 030119 – 'Ornamental Fish, Live, Other Than Freshwater'). This is the case for databases such as TRACES, which records imports into the European Union (EU)[12] (Biondo and Burki, 2019), LEMIS for imports into the United States of America (US)[13] (Rhyne *et al.*, 2012), and imports into Switzerland[14] (Biondo, 2017). Trade in marine fish may be further obscured by combining marine fish with freshwater fish and invertebrates (Olivier, 2001; Biondo, 2017; Biondo and Burki, 2020), misreporting food fish under the ornamental fish commodity code, or reporting all individuals in a mixed-species shipment under a single species name[15]. The overall result is that it is often difficult or not possible to determine how much trade in individual species is occurring (Rhyne *et al.*, 2017).

In this Section, ~30 different resources and datasets were brought together to identify the number, taxonomic diversity and geographic spread of marine ornamental fish in international trade. These resources included FishBase; the IUCN Red List of Threatened Species; trade databases such as LEMIS, TRACES and GMAD; the wider scientific and industry literature; and expert input via stakeholder survey and accompanying data submitted as part of the stakeholder survey. A high-level overview of marine ornamental fish trade quantities over time is provided, along with a more detailed analysis of trade trends where taxonomic data were available (EU and US imports only). Finally, the species within international trade most likely to be largely captive-bred[16] were also identified.

All species with evidence of international trade were considered in Section 2, which focuses on the assessment of conservation status of these species (page 23).

Methods

Identification of marine ornamental fish species

Using FishBase (version 05/2023[17]) as the central taxonomic backbone, non-CITES listed[18] marine ornamental fish species were identified based on data from FishBase, the IUCN Red List assessments,

[12] Managed by DG SANTE (Health and Food Safety).
[13] Managed by the United States Fish and Wildlife Service.
[14] Database maintained by the Swiss Federal Food Safety and Veterinary Office.
[15] Some countries (e.g. the UK, Netherlands and Germany, Europe's largest importing countries) record all fish in a shipment as the most commonly occurring species to streamline trade and minimise holding time at customs (OATA & OFI, *pers. comm.*).
[16] Evidence of captive breeding from European traders (Tropical Marine Centre, *unpublished data*; OATA & OFI, *unpublished data),* marine ornamental fish breeders (Sweet and Pedersen, 2019), US imports (2010-2021), United Kingdom (UK) fish shop surveys (Pinnegar, 2021, *unpublished data*) and general availability of captive-bred species in the literature (Wabnitz *et al.*, 2003; Domínguez and Botella, 2014) (see methods in Annex B).
[17] Accessed via Boettiger *et al.* (2012). Rfishbase: exploring, manipulating and visualising FishBase data from R. Journal of Fish Biology, Available at https://github.com/ropensci/rfishbase. Data also available at https://www.fishbase.org/.
[18] As of CoP19, 35 marine ornamental fish species were listed in the CITES Appendices: one genus (*Hippocampus* (seahorses) accounting for 24 marine ornamental species) and a further 11 species in other genera.

literature review and expert consultation (including via stakeholder surveys). Species were classified as marine ornamental fish if they met the following two criteria:

1. They were native to tropical and/or subtropical marine coral reefs according to FishBase[19]

2. There was evidence of the species being used for aquaria and/or display purposes. Marine tropical/subtropical coral reef fish were considered to be 'ornamental fish' (i.e. collected live for both private/hobbyist and public aquaria trade) based on any of the following:

- FishBase listed either 'commercial' or 'public aquariums' as human uses;
- the IUCN Red List considered 'pet/display animal' to be an end use;
- trade was recorded in GMAD;
- the species was displayed as an ornamental fish by a Species360 member organisation (Species360, 2021);
- there was evidence from the literature or expert consultation of sale in aquarium shops, or captive breeding for the aquarium trade;
- the species was reported in the literature as an ornamental fish; and/or
- the species was included in stakeholder survey responses to questions asking for information on any live marine ornamental fish taxa in international trade.

Following consultation with industry stakeholders, this list was further expanded to include additional species traded internationally for marine reef tanks that may not fully meet the strict definition of 'marine ornamental fish' detailed in AC31 Doc. 36.

CITES-listed marine ornamental fish were excluded: full details of inclusion criteria, including references, are included in Annex B.

Identification of non-CITES marine ornamental fish species in international trade

In the absence of a centralised global database monitoring international trade in non-CITES listed marine ornamental fish species, evidence of international trade was gathered from:

- databases including GMAD (1988-2003), LEMIS (imports into the US 2010-2021), TRACES (imported into the EU 2018-2023), and the TRAFFIC Wildlife Trade Portal (2011-2022);
- the scientific literature;
- consultation with industry stakeholders (OATA & OFI*, unpublished data;* Tropical Marine Centre*, unpublished data*); and
- stakeholder survey responses.

Full details of data sources are provided in Annex C.

Classification of captive-bred species

Data on captive breeding were collated from multiple sources, so the term 'captive-bred' was used in this report to indicate that a species could be bred (i.e. reproduce with viable offspring) in captivity, irrespective of how many generations or whether wild supplementation to the breeding stock was involved.

Evidence of captive breeding was collated from data provided by European traders (OATA & OFI, *unpublished data;* Tropical Marine Centre, *unpublished data*), marine ornamental fish breeders/ hobbyists (Sweet and Pedersen, 2019), US imports (2010-2021), UK fish shop surveys (Pinnegar,

[19] Available at http://www.fishbase.org/ (version 05/2023).

unpublished data) and general availability of captive-bred species in the literature (Wabnitz *et al*. 2003; Domínguez and Botella, 2014).

Based on evidence from five of these datasets (Wabnitz et al. 2003; Sweet and Pedersen, 2019; OATA & OFI, *unpublished data*; Tropical Marine Centre, *unpublished data*; and US imports), species were grouped by the estimated scale of captive breeding. Where there was evidence of captive breeding at a commercial scale (i.e. 'bred for retail'), species were grouped as 'commonly', 'moderately' or 'rarely' available as captive-bred. A further group of species were identified as having been successfully bred in captivity (i.e. successful captive breeding by specialist breeders/hobbyists), but there was no evidence that this could be reproduced at a scale suitable for commercial trade; these species were considered 'not available for retail'. Full methods are detailed in Annex B.

Results

Number of marine ornamental fish species in international trade

This study identified 2191 marine ornamental fish species based on data from FishBase, the IUCN Red List, trade databases, the published literature and expert input (including from industry representatives and the stakeholder survey). The full list of species, along with additional metadata on distribution, extinction risk, vulnerability, and evidence of international trade, are provided in the accompanying Excel file (**Summary Table_Marine ornamental fish species in trade.xlsx).** Due to differences in taxonomy, data availability and definitions of 'marine ornamental fish', the figure of 2191 will likely differ from other estimates (e.g. Rhyne *et al.* (2017)).

Of the 2191 non-CITES listed species identified as marine ornamental fish, there was evidence for over three quarters being in international trade (1764, 81%) based on one or more of the sources summarised in Table 1.1. These species were spread across 40 orders and 118 families, and almost all species (1730, 98%) were ray-finned, bony fishes (Actinopteri [Teleosti in FishBase], Osteichthyes), with a small number (34) of cartilaginous fish species, such as sharks and rays (Elasmobranchii, Chondrichthyes). The full list of species found to be in international trade are indicated in the 'Evidence of species in international trade' column of the accompanying Excel file, a summary of the marine ornamental fish families can be found in a separate tab in the same Excel file.

Table 1.1*. Number of marine ornamental fish species with evidence of international trade according to different sources of trade data. Datasets are ordered by number of species included. Some species will appear in multiple datasets. Full details of all datasets included in Annex C.*

Dataset	Number of species with evidence of international trade
Published literature	1137
Expert input (e.g. unpublished datasets)[a]	1023
GMAD (Global Marine Aquarium Database, 1988-2003)	979
LEMIS (live imports into the US 2010-2021)	96
TRACES (live imports into the EU 2018-2023)	1168
TRAFFIC Wildlife Trade Portal	4

[a] Hill and Watson, 2021, *unpublished data*; Tropical Marine Centre, *unpublished data;* OATA & OFI, *unpublished data*; exports from New Caledonia and French Polynesia as provided in stakeholder survey responses.

The top families by **number of marine ornamental fish species in international trade** were also amongst those containing the highest number of marine ornamental species overall (Figure 1.1). Labridae (wrasses), Pomacentridae (damselfish/clownfish), Gobiidae (gobies), and Chaetodontidae (butterflyfish) all contained over one hundred marine ornamental species in international trade (~39% of all marine ornamental fish in international trade).

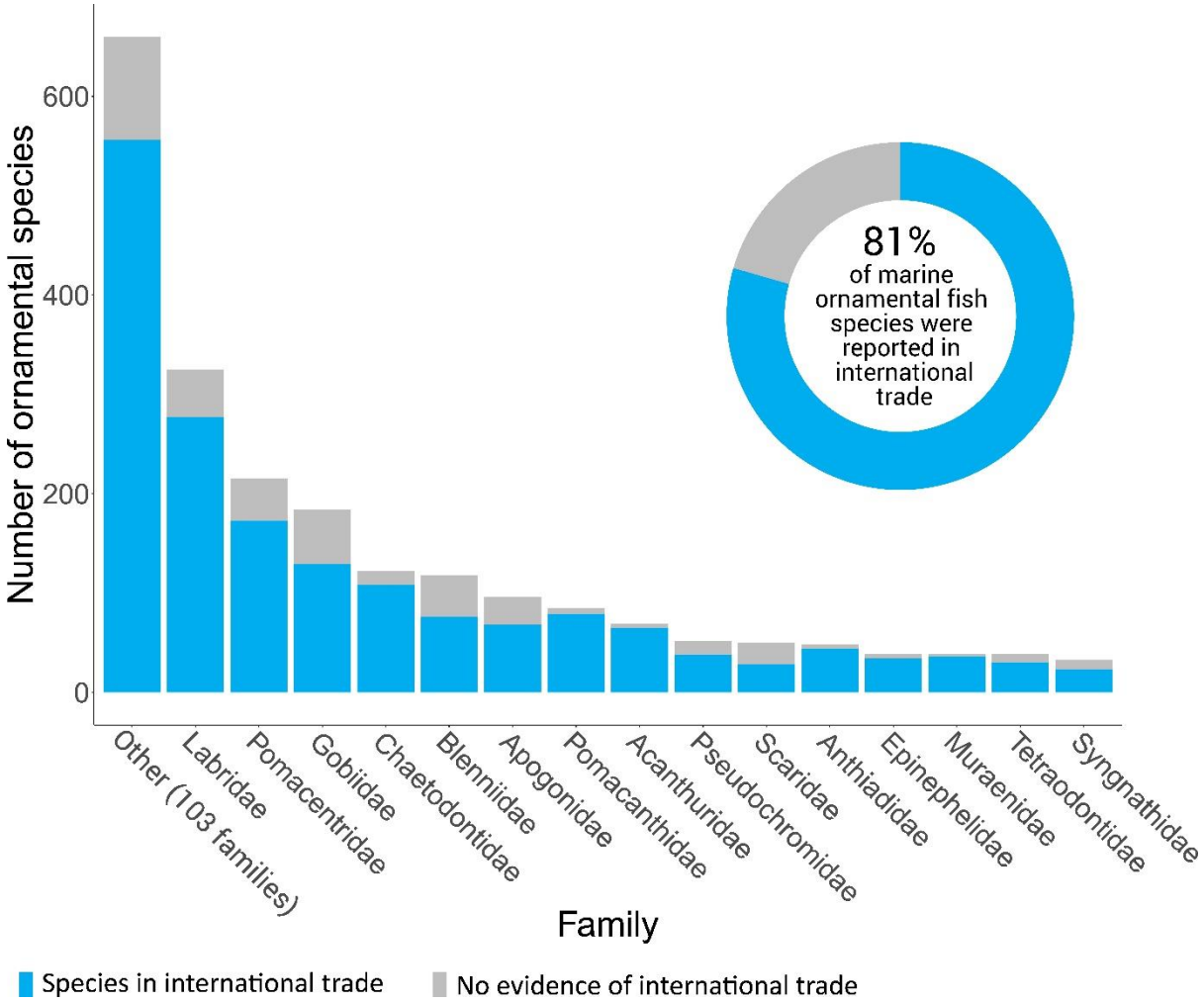


***Figure 1.1**. Proportion of total marine ornamental fish species (n=2191 species) that have been identified as present in international trade, showing the top 15 families by number of marine ornamental fish species. All other marine ornamental fish species (37% of total) are included in the 'other' category.*

Geographic distribution of marine ornamental fish species in trade

Based on range data in FishBase, 95% (1684) of the 1764 marine ornamental fish species in international trade were considered native to Asia (1482 species) and/or Oceania (1334 species). Marine ornamental fish species richness was particularly high around Indonesia (1175 species, 67%), Australia (1085 species, 62%) and the Philippines (1061 species, 60%) (Figure 1.2). As core parts of the Coral Triangle, Indonesia and the Philippines are considered the centre of marine fish biodiversity (Carpenter and Springer, 2005; Allen and Erdmann, 2009) and have also been identified by previous studies as the largest exporters of marine ornamental fish (Wabnitz *et al.*, 2003; Biondo and Burki, 2019). Of these three countries with highest marine ornamental fish species richness, a stakeholder survey response was received from the CITES Authority for Australia only. No responses from CITES Authorities or other in-country government agencies were received from either Indonesia or the Philippines, although responses were received from a trader, pet industry and an NGO in the Philippines, and a limited response was received from an NGO in Indonesia.

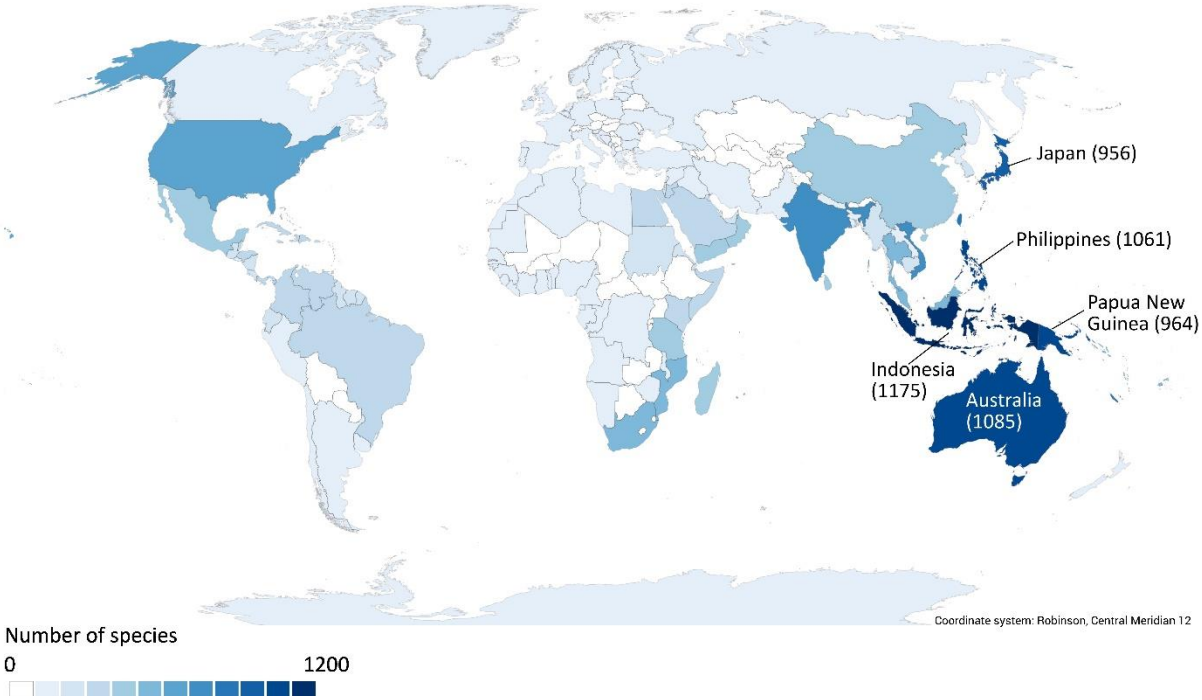


***Figure 1.2**. Range States/territories of marine ornamental fish that have been identified as present in international trade (n=1764 species). Countries/territories considered range States of at least 50% of the marine ornamental fish in international trade are labelled. The number of species identified in international trade that are native to each country is given in parentheses. This does not imply that range States are exporting all of their native marine ornamental fish species, since many species have wide distributions.* ***Data sources:** Base layers: United Nations Geospatial, 2020 [20] ; range States/territories: FishBase (https://www.fishbase.org version 05/2023); evidence of presence in international trade: multiple sources (see Annex C).*

Quantities and trends in marine ornamental fish trade

While there is no current centralised database of the global trade in non-CITES listed marine ornamental fish species[21], overall volume can be estimated from the official trade statistics in the UN Comtrade database. Official trade datasets were also obtained for two of the largest importing country/regions (Leal *et al.*, 2016; Rhyne *et al.*, 2017; Biondo and Burki, 2020): the EU (TRACES database) and US (LEMIS database). Further industry data was received for EU and UK imports (OATA & OFI, *unpublished data*). As also noted in CoP18 Doc. 94, there is a general lack of data from the major exporting regions in Africa, Asia, Central and South America and the Caribbean, or Oceania, although trade data for four exporting/transit countries were provided via stakeholder survey responses. See Annex B for further methods and details of these datasets.

[20] The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties ; Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined ; Final status of the Abyei area is not yet determined; A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

[21] Marine ornamental fish trade data were collated from wholesalers on a voluntary basis in GMAD (detailed in Annex C), but the data were collected for trade between 1988 and 2003, and may not represent current patterns of trade. The FAO database could not be used for this purpose because species-level data are not available.

Between 2012 and 2021[22] approximately 38 million kg of non-freshwater ornamental fish (HS code 030119)[23] worth an estimated USD 326 million[24] was reported in international trade globally (based on exporter-reported data in UN Comtrade[25]). Annual quantities ranged between 1.6 million kg (in 2014 and 2015) and 8.8 million kg (in 2017) (Figure 1.3). The mean annual export quantity reported for 2017 and 2018 (8.5 million kg) was over three times higher than the mean average for the other years (2.6 million kg). This was predominantly driven by exports reported by the Philippines, which reported a mean of 5.6 million kg/year in 2017-2018 compared to 0.2 million kg/year for the other years in the study period.

Whilst trade in HS code 030119 provides a high-level summary of trends over time and main trade routes, it cannot be used to estimate the species or number of individual marine ornamental fish in trade. The trade in live fish by weight also includes the weight of water and packaging, which can be many times larger than the weight of the fish themselves (OATA & OFI, *pers. comm.*). Furthermore, all marine ornamental fish are traded under the same HS code, including large species for display in public aquaria and small species for home aquaria; this means the number of individual fish in trade cannot be estimated without knowing the relative ratios of different species in trade.

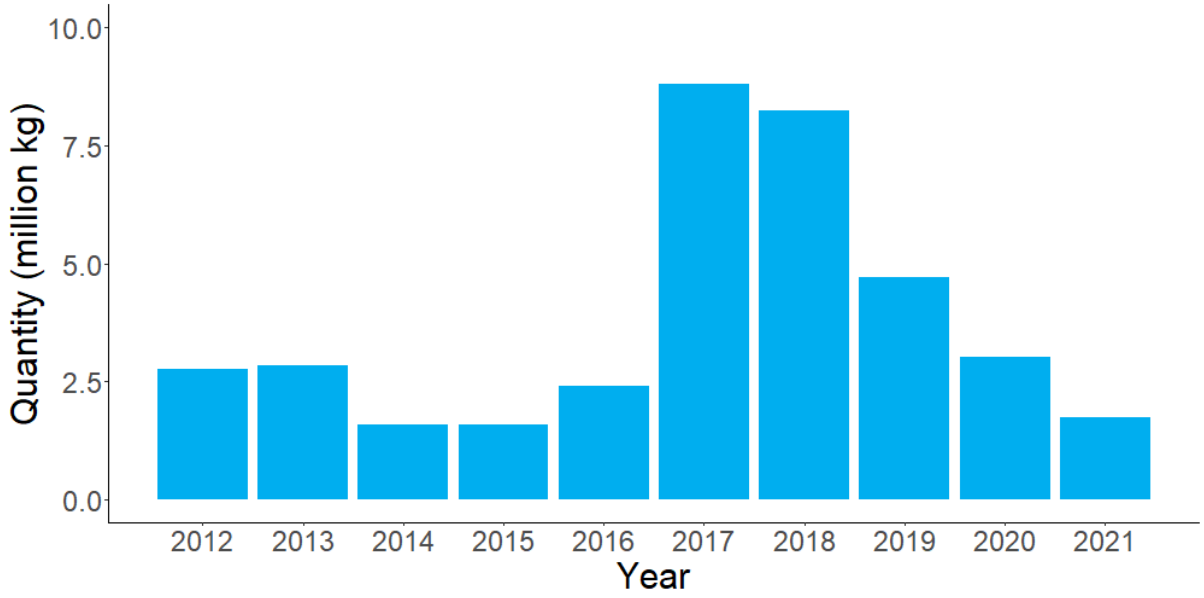


***Figure 1.3**. Annual weight of live non-freshwater ornamental fish (HS code 030119) reported in international trade by countries of export 2012-2021. **Data source**: UN Comtrade (extracted 22/04/22).*

In line with previous studies (Wabnitz *et al.*, 2003; Biondo and Burki, 2019), the UN Comtrade data showed the Philippines and Indonesia to be the two main exporting countries/regions of non-freshwater ornamental fish (HS-030119) 2012-2021 (12.9 million kg and 7 million kg reported as exported by the countries respectively). Together, these two exporting countries accounted for over half of all global exports in non-freshwater ornamental fish 2012-2021.

The three largest countries/regions of import 2012-2021 (based on exporter-reported data in UN Comtrade) were the US (11.7 million kg), the EU (3.8 million kg) and China (3.2 million kg).

[22] 2021 data may be incomplete due to reporting cycle. Prior to 2012 all live ornamental fish were traded as HS-030110 ('fish: live, ornamental') with no distinction made between freshwater and non-freshwater species.
[23] It is unclear how much of this weight is water, however one trade representative suggested in their stakeholder survey response that water may account for >90% of the reported weight of live marine ornamental fish trade.
[24] Corrected for 2022 inflation.
[25] Accessed via https://comtrade.un.org/data/. Trade between EU27 countries (i.e. 'intra-EU trade') and trade reported as 're-exports' was excluded.

Whilst the weight of live non-freshwater ornamental fish traded as HS-030119 provides a high-level overview of marine ornamental fish in international trade, the UN Comtrade dataset does not include any taxonomic information or indication of how many individual fish are being traded (i.e. trade by weight will also include the weight of the water and packaging). Trade in other fish commodities may also be incorrectly reported under HS code 030119, artificially inflating the quantities (see discussion in King (2019)). More specific data on recent imports were also obtained via data requests from the two largest importers of non-freshwater ornamental fish by weight: EU imports from the TRACES database (2018-2023) and US imports from the LEMIS database (2010-2021). Full methods for analyses are detailed in Annex B. Because the EU and US datasets cover different year ranges, and have different taxonomic resolution and data specificity (e.g. information on whether trade is captive or wild-sourced), they were considered and analysed separately in the sections below.

*Imports into the EU as reported by **industry***

Based on industry import data provided by the ornamental fish trade associations OFI and OATA (OATA & OFI, *unpublished data*)[26], 1007 species from 84 families were imported into the EU and UK in the most recent five years. This number is considerably lower than the 1764 marine ornamental fish species found to be in international trade in this report. This difference could be accounted for by several reasons: differences in taxonomy, additional species imported by other countries (e.g. China or Japan) that aren't imported by the EU or UK, and differences in temporal scope (this report considered a wider year range for evidence of international trade to increase data coverage).

Imports are dominated by a relatively small number of species: 25% of imports by quantity are in five species (Figure 1.4), with 88 species making up >75% of reported imports. The majority of species imported into the EU/UK were in relatively low quantities: 330 species collectively accounting for ~1% of all imports. Whilst the number of individuals imported into the EU/UK was not available for each species, ~2.5 million marine ornamental fish are estimated to be imported annually into the EU and UK for both public and private aquaria (Tropical Marine Centre, *pers. comms.*).

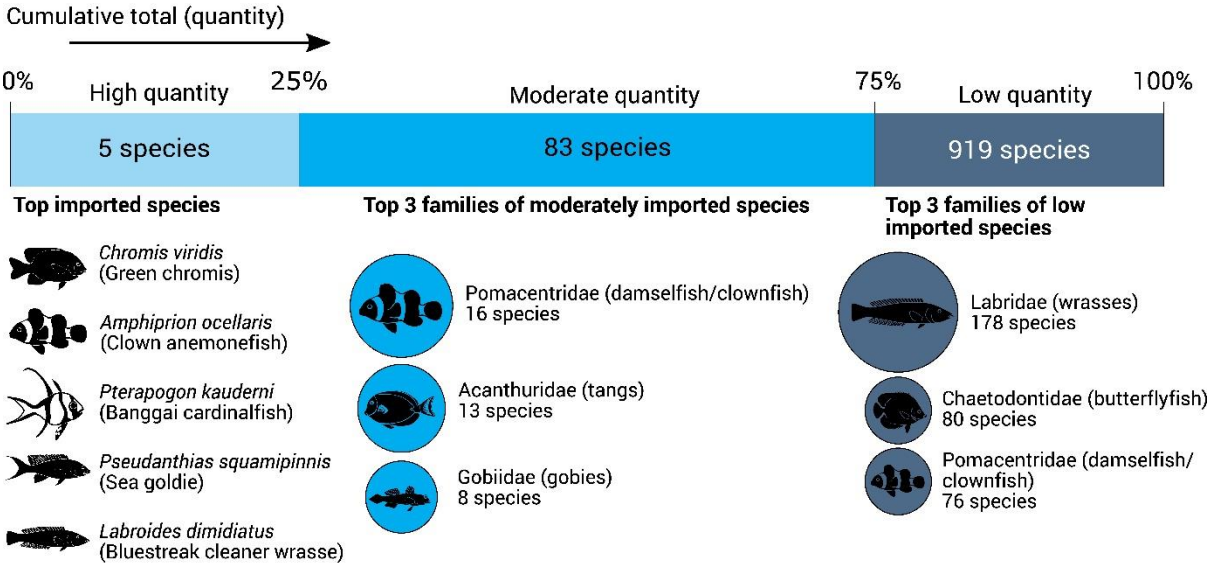


Figure 1.4. *Cumulative total of relative quantities of marine ornamental fish imported into the EU and UK according to data provided by industry. The top families shown for species imported in moderate and low quantities accounted for at least 45% of moderately and 34% of low imported species respectively. The circle size indicates the relative proportion of species imported in moderate or low quantities.* ***Data source:*** *OATA & OFI, unpublished data.*

[26] Nomenclature was aligned with the core Fishbase taxonomic backbone

Imports into the EU as reported in the official TRACES database

TRACES holds the official data for the EU's imports, exports and intra-EU movement of live animals and goods (see Annex B for methods). Data from TRACES 2018-2023 were provided to UNEP-WCMC via an information request. Whilst data from the entire time-period were used as evidence of marine ornamental fish in international trade (trade reported in 1166 species and 89 families), the number of individuals imported into the EU was analysed from the most recent three years of data (2021-2023) only, since a new TRACES platform was introduced in 2020 that may not be entirely comparable to the data reported under the previous platform (≤2020).

According to this database ~4.7 million live marine ornamental fish were validated for import into the EU 2021-2023 under the HS code 03011900 ('live ornamental fish - other than freshwater'). Imports of a further 9803 individuals were either rejected or partially rejected, and 364,067 individuals were reported as 'authorized for transit' via the EU to other destination countries; the rejected, partially rejected and transit shipments were excluded from the following summaries.

Approximately 48% of EU imports 2021-2023 were reported at the species level, with 741 species of marine ornamental fish reported. A further 22% of trade was reported at genus level (210 genera, notably *Centropyge* and *Acanthurus*) and 29% of trade was reported at the family level (74 families[27], primarily Pomacentridae and Pomacanthidae). Data on the source of imports (e.g. wild- or captive-sourced) were not available in the TRACES database.

Approximately 75% of all imports by quantity were in four families (Pomacentridae (damselfish/clownfish), Pomacanthidae (angelfish), Acanthuridae (tangs) and Labridae (wrasses); (Figure 1.5)). Since many of the marine ornamental fish families do not exclusively contain marine ornamental species, these quantities may be over-estimates; for example, family-level trade quantities may also include temperate or brackish species, species that are not associated with coral reefs, or those that may be traded in substantial quantities as live food fish (but are not captured under another HS code). Of the ornamental fish imported into the EU 2021-2023 under HS code 03011900, almost half (47%) originated in **Indonesia** (accounting for 2.2 million fish); this was the main country of origin for the top four imported ornamental fish families under this code (Figure 1.5). A further 21% of imports originated in **the Philippines,** 10% from **Kenya** and 9% from **Sri Lanka**.

The estimated 4.7 million individuals imported into the EU 2021-2023 equates to an average of around 1.6 million individuals per year, lower than industry estimates of ~2.5 million individuals entering the EU annually. There were also differences in the relative proportions of trade in families between the two datasets. Specifically, TRACES data reported 75% of EU imports to be in four families (Pomacentridae (damselfish/clownfish), Pomacanthidae (angelfish), Acanthuridae (tangs) and Labridae (wrasses)), whereas the same four families accounted for 55% of imports according to estimated industry data. Similarly, there were some differences in the relative proportions of specific families; for example, Pomacanthidae was second largest family imported into the EU by quantity according to TRACES, but was seventh largest according to industry data. Gobiidae was fifth largest in TRACES but third largest in industry reports. The differences in relative proportions of trade between families may reflect how data are reported; for example, industry representatives indicate that all fish in a mixed-species shipment may be reported under the name of the commonest species in that shipment, rather than being reported species-by-species (Tropical Marine Centre, *pers. comm*.) or at family level. This may also explain some of the differences in total volume reported between TRACES and industry if, for example, marine fish are entering the EU with freshwater species.

[27] Trade in the family Syngnathidae (pipefish, seahorses and sea dragons) was excluded since seahorses (*Hippocampus* spp.) are already CITES listed and not considered in this analysis.

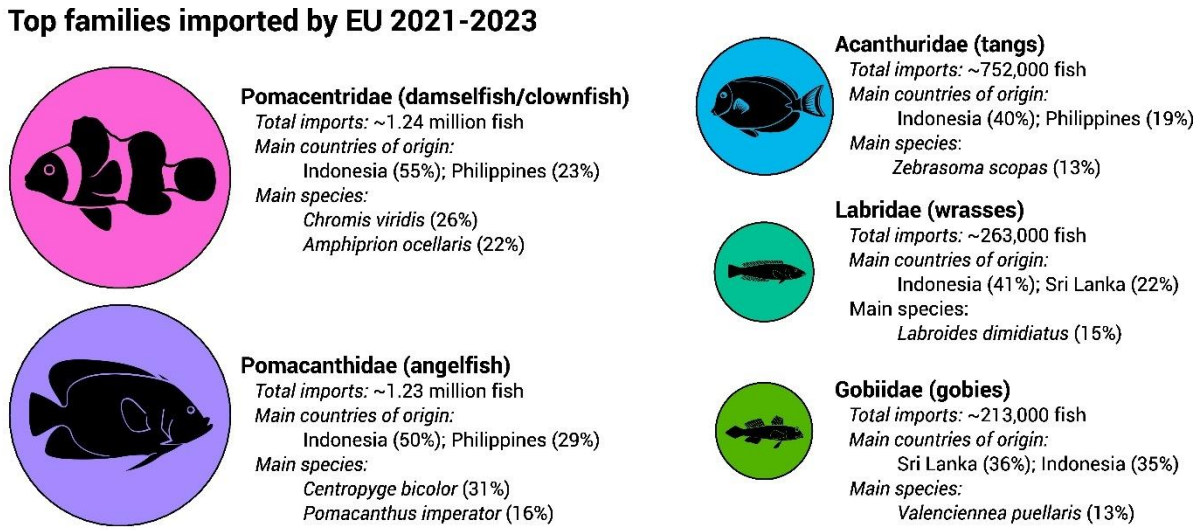


Figure 1.5. *Top marine ornamental fish families imported live into the EU 2021-2023 under HS code 03011900, including main reported countries of origin and main species reported in trade (trade reported at higher taxonomic levels were not included in the 'main species' lists). Circle size indicates total quantity imported. All families shown accounted for at least 5% of the total marine ornamental fish imported into the EU (80% of total).* ***Data source:*** *EU import data (TRACES 2021-2023, extracted 09/02/2024).*

US imports (LEMIS database)

According to estimates provided by the US CITES Management Authority via the stakeholder survey, the US imports ~5-9 million live marine ornamental fish annually and produces a further 1 million for domestic use. Most of this trade is reported as 'Tropical fish (marine sp.)' without further taxonomic refinement. In historic US import data collated by Eskew *et al.* (2020) for 2005-2014 an average of ~13 million individual fish were reportedly imported annually as either 'Tropical fish (marine sp.) or as a marine ornamental fish species or genus, of these <0.2% (22,000 individuals/year) were reported for marine ornamental fish at species or genus level[28].

More recent data on US imports 2010-2021 of marine ornamental fish were provided to UNEP-WCMC by the USFWS (US Fish and Wildlife Service) via a FOIA request[29]. These data only included trade reported at species or genus level, so do not give a comprehensive picture of US imports during this time period. Since taxa may not be reported at the genus or species level consistently between years, it is important not to conflate trends in recording taxonomic specificity with meaningful temporal patterns. Furthermore, trade in some taxonomic groups may not have been reported at genus or species level at all; these species would not appear in the genus/species level summary below, even if they are traded in high abundance.

Based on this dataset provided directly by the USFWS, the LEMIS dataset records ~75,000 individuals and a further 1300 kg of marine ornamental fish imported into the US per year (2010-2021) at the species or genus level. This comprised of 90 marine ornamental species and 106 genera that were likely to be marine ornamental species. Over 70% of the imports by number of individuals and all imports by weight were reported as wild-sourced. These wild-sourced imports primarily originated from Indonesia (30% of wild-sourced trade reported at species/genus level), the Philippines (29%) and Mexico (16%).

[28] The LEMIS data made publicly available by Eskew *et al.* (2020) are not comprehensive of all data in the LEMIS database and so may be an underestimate of the total trade reported.
[29] Data at the species/genus level were provided to UNEP-WCMC based on the FOIA request for US imports of live individuals for 49 marine ornamental fish families and a further 160 species.

Over 60% of the wild-sourced imports reported at species/genus level comprised two lionfish genera: *Pterois* (lionfish) or *Dendrochirus* (dwarf lionfish). The main reported lionfish species, *Pterois volitans* (Red lionfish), is also an invasive species with well-established populations around the US coast: imports were considered to pose an ongoing risk of further introductions or supplementary of established populations (Lyons *et al.*, 2019). This does not, however, reflect the taxonomic patterns in US imports found in other datasets (Rhyne *et al.*, 2017; Biondo and Burki, 2020)[30]. For example, an assessment of US imports in 2011 based on customs declarations (rather than official data recorded in LEMIS) found that, as with recent EU/UK imports (see industry data above), US imports were dominated by Pomacentridae (damselfish/clownfish) (Rhyne *et al.*, 2017). Most notable amongst these were *Chromis viridis* (Green chromis, 11.6% of live aquarium imports), *Chrysiptera parasema* (Goldtail demoiselle, 4.6%) and *Chrysiptera cyanea* (Sapphire devil, 4.4%).

Estimated scale of annual trade according to stakeholder survey responses

Within the stakeholder survey, respondents were asked to estimate the annual scale of marine ornamental fish exported, re-exported and/or imported by their stated country/territory; information was provided by respondents from 14 counties[31] (Table 1.2). (Re)export and/or import trade data were also provided for four of these countries[32] in survey responses (Table 1.3).

Annual exports/ imports of marine ornamental fish were estimated to be 'very large' (≥200 000 specimens annually and/or >USD 300 000) by respondents from three exporting countries (Kenya, the Philippines and the US) and four importing countries (France and its overseas territories[33], Japan, Singapore and the US). Re-exports were also considered 'very large' by respondents from Singapore and the US, suggesting they may be important transit countries. Respondents from a further seven countries of export and four countries of import reported their country as having 'small' (<50 000 specimens annually and/or <USD 100 000) exports/imports.

[30] Data can be explored via the dashboard at https://aquariumtradedata.org/, however data were not available for analysis.
[31] Australia, Cuba, France and overseas territories (Mayotte, Guadeloupe, Martinique), French Polynesia, Germany, Japan, Kenya, New Caledonia, Norway, Palau, Papua New Guinea, Philippines, Singapore, US.
[32] France and overseas territories (Mayotte, Guadeloupe, Martinique), French Polynesia, New Caledonia and Singapore.
[33] Mayotte, Guadeloupe, Martinique.

Table 1.2. Estimated level of marine ornamental fish exported, re-exported and/or imported annually by stakeholder survey respondents (n=14 countries/territories), supplemented by estimates from industry (n=4 countries). ***Data sources:*** *Responses to survey shared via Notif. 2021/030; OATA & OFI, pers. comm.*

Scale of international trade in marine ornamental fish	Exports (n=14)	Re-exports (n=17)	Imports (n=17)
Small (<50,000 specimens, and /or value <USD 100,000)	**7 countries/territories:** Cuba France and overseas territories (Mayotte, Guadeloupe, Martinique) French Polynesia Japan New Caledonia Papua New Guinea Singapore	**3 countries:** Japan Kenya Norway	**4 countries/territories:** French Polynesia Kenya New Caledonia Norway
Medium (50,000-100,000 specimens, and/or value ~USD 150,000)		**2 countries:** Germany Sri Lanka*	**2 countries:** Germany Sri Lanka*
Large (100,000-200,000 specimens, and/or value ~USD 300,000)	**1 country:** Palau		
Very large (>200,000 specimens, and/or value >USD 300,000)	**6 countries:** Australia** Kenya Netherlands* Philippines Sri Lanka* United States of America	**4 countries:** Netherlands* Singapore United Kingdom United States of America	**7 countries:** Australia** France and overseas territories (Mayotte, Guadeloupe, Martinique) Japan Netherlands* Singapore United Kingdom United States of America
Unknown		**8 countries/territories:** Australia Cuba France and overseas territories (Mayotte, Guadeloupe, Martinique) French Polynesia New Caledonia Palau Papua New Guinea Philippines	**4 countries:** Cuba Palau Papua New Guinea Philippines

* Based on industry estimates (OATA & OFI, *pers. comm.*).
** Based on industry estimates (OATA & OFI, *pers. comm.*), survey response from Australia reported both import and export levels as 'unknown'.

Of the four stakeholder survey responses to provide national trade data for marine ornamental fish, three were from CITES Authorities (France and overseas territories (Mayotte, Guadeloupe, Martinique), New Caledonia and Singapore) and the response from French Polynesia was from another government agency. On average French Polynesia and Singapore annually (re)exported over 34,000 kg and 29,000 individuals respectively, New Caledonia exported ~10,000 individuals to the EU in 2020 and the French overseas territories Mayotte, Guadeloupe and Martinique together exported ~560 individuals annually (Table 1.3). This aligns with all four respondents reporting their exports to be 'small' overall (Table 1.2).

Table 1.3. Summary of the quantity and value** of marine ornamental fish (re)exported and/or imported by stakeholder survey respondents (based on data provided by n=4 countries/territories).* ***Data source:*** *Responses to survey shared via Notif. 2021/030.*

Country	Summary of exports ***	Summary of imports
France and overseas territories (Mayotte, Guadeloupe, Martinique)	Total live fish 2015-2021: 3936 No taxonomic information provided	Total live fish 2015-2021: 143 No taxonomic information provided
French Polynesia	Weight of live fish 2012-2021: >30,480 kg/year (worth >USD 0.23 million/year) Live fish to EU 2020: 1560 (8 species 72% of trade was in *Neocirrhites armatus* (Flame hawkfish)	Weight of live fish 2012: 287 kg from Singapore no imports were reported >2012
New Caledonia	Live fish to EU 2020: 9927 (84 species) 34% of trade was in Labridae (wrasses); 18% Serranidae (grammas); and 18% Pomacentridae (clownfish and damselfish)	*No data provided*
Singapore	Individuals 2018-2021: >29,400 individuals/year (worth ~ USD 0.24 million/year) 28% of trade was in Pomacentridae (clownfish and damselfish); and 25% Gobiidae (gobies)	Individuals 2018-2021: >123,875 individuals/year (worth > USD 0.41 million/year) 38% of trade was in Pomacentridae (clownfish and damselfish); and 11% Gobiidae (gobies; 11%)

* Trade levels reported at higher taxonomic levels may include species that do not meet the definition of marine ornamental fish used in this report and so be an overestimate.
** It is unclear whether value data corrected for inflation.
*** Export data may also include re-exports.

Captive-bred[34] marine ornamental fish

In concurrence with the literature (Pouil *et al.*, 2019), responses to the stakeholder survey indicated limited levels of captive breeding for marine ornamental fish. Respondents from 11/12 countries that answered at least one question on the source of marine ornamental fish in trade stated that the level of exports and/or imports of marine ornamental fish from captive sources was <25% of the overall trade in their country (Table 1.4). This included a response from the US CITES Management Authority estimating <3% exports and <9% imports of marine ornamental fish from captive sources.

Table 1.4. Summary of the percentage of marine ornamental fish (re)exported and/or imported from captive-bred sources as reported by stakeholder survey respondents (n= 13 countries). ***Data source:*** *Responses to survey shared via Notif. 2021/030.*

Country	Exports (n=10)	Re-exports (n=8)	Imports (n=8)
Cuba	<25%		
French Polynesia	0%		
Germany		<25%	<25%
Japan	<25%	<25%	<25%
Kenya	0%		
New Caledonia	<25%	<25%	<25%
Norway		<25%	<25%
Palau	75-100%	<25%	<25%
Papua New Guinea	<25%		
Philippines	<25%	<25%	<25%
Singapore	<25%		
UK		<25%	<25%
US	<25%	<25%	<25%

[34] In this report 'captive-bred' indicates that a species could be bred (i.e. reproduce with viable offspring) in captivity, irrespective of how many generations or whether wild supplementation to the breeding stock was involved.

Based on captive breeding reported by traders, breeders, the scientific literature, and from the wider trade data[35], there was evidence of captive breeding being achieved for 311 (18%) of the 1764 marine ornamental fishes found to be in international trade (Figure 1.6), with evidence of captive-bred specimens in retail for 183 species (10%). There was no evidence of captive breeding for 1453 species (82%): 486 species were only reported as being traded from wild sources and 967 species had no data (i.e. the species did not appear in any of the datasets used). Because these datasets are largely focused on European and American markets, there may be additional instances of successful captive breeding for species that are not captured here, although both Tropical Marine Centre (*unpublished data*) and Sweet and Pedersen (2019) consider their data to be globally representative.

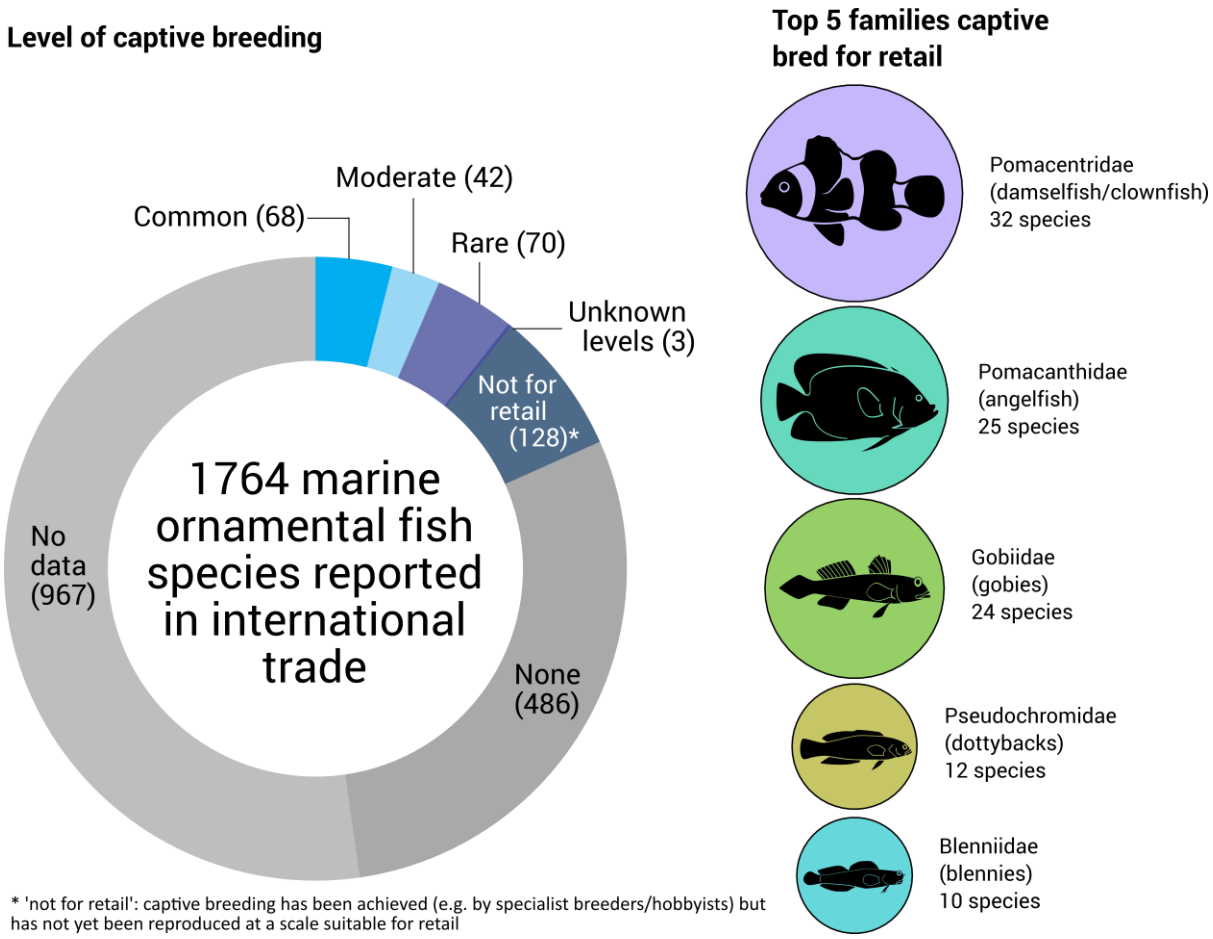


Figure 1.6. *Global availability of captive-bred individuals for marine ornamental fish species found in international trade and top five families with evidence of captive-bred specimens in retail (56% of species captive-bred for retail). Number of species and circle size for top five families refer to number of species with evidence of captive-bred specimens in retail.* ***Data sources:*** *Wabnitz et al. 2003; Domínguez and Botella (2014); Sweet and Pedersen, 2019; Pinnegar, unpublished data; OATA & OFI, unpublished data; Tropical Marine Centre, unpublished data; and US import data (LEMIS 2010-2021, extracted on 22/10/2021); see Annex B for full methods.*

The 183 species with evidence of captive-bred specimens in retail belonged to 39 families, although half were from Pomacentridae (damselfish/clownfish, 32 species), Pomacanthidae (angelfish, 25

[35] Evidence of captive breeding from European traders (Tropical Marine Centre, *unpublished data*; OATA & OFI, *unpublished data*), marine ornamental fish breeders (Sweet and Pedersen, 2019), US imports (2010-2021), United Kingdom (UK) fish shop surveys (Pinnegar, *unpublished data*) and general availability of captive-bred species in the literature (Wabnitz *et al.*, 2003; Domínguez and Botella, 2014) (see methods in Annex B).

species), Gobiidae (gobies, 24 species) or Pseudochromidae (dottybacks, 12 species). Despite having amongst the highest number of marine ornamental fish species in trade, no species in the families Labridae (wrasses) or Chaetodontidae (butterflyfish) were 'commonly' or 'moderately' captive-bred. This is considered likely due to difficulties in replicating the environmental conditions required for breeding and/or larval rearing (OATA & OFI, *pers. comm.*).

Several high-demand groups such as Acanthuridae (tangs), Labridae (wrasses) and Serranidae (grammas) have historically been considered to have low potential for aquaculture (Murray and Watson, 2014). However, recent advancements in captive breeding mean that Serranidae (grammas) from captive-bred sources are becoming more common in general trade (OATA & OFI, *pers. comm.*) and high-demand species such as *Labroides dimidiatus* (Bluestreak cleaner wrasse) and *Pseudocheilinus hexataenia* (Six-line wrasse) are starting to become available from captive sources. One stakeholder survey respondent also noted that 'damselfish and chromis' (in family Pomacentridae) in trade were almost always from wild sources.

Summary of main marine ornamental fish families in trade

Section 1 identified 118 fish families that included at least one marine ornamental fish species in trade, with a range of 1-277 marine ornamental species per family (Figure 1.1). Ten of these families each contained >50 marine ornamental species (Table 1.5) and together accounted for 60% (1057 species) of all marine ornamental fish identified in this study. For eight of these families, the **proportion of marine ornamental fish species traded internationally** within each family exceeded two thirds of the total ornamental species in the family (Table 1.5). This included Acanthuridae (tangs) and Pomacanthidae (angelfish) with ≥90% of their marine ornamental species in international trade. Almost a quarter of Pseudochromidae (dottybacks) in trade were also considered to be commonly or moderately captive-bred based on methods detailed above and in Annex B.

Table 1.5. *Summary of evidence of families in international trade and captive breeding for the largest ornamental fish families (families with >50 ornamental fish species each), ranked by percentage of marine ornamental fish species in international trade.* ***Data Sources***: *[a]Official EU import data (TRACES 2021-2023, extracted on 09/02/2024);[b]EU/UK import data from industry (OATA & OFI, unpublished data).*

Family	No. of marine ornamental species	% ornamental species in international trade	No. of marine ornamental species frequently traded as captive-bred * (% total marine ornamental species in family)	Quantities recorded imported into the EU and UK based on official[a] and industry-reported data[b]
 Acanthuridae (tangs)	69	94.2%	1 (1.4%)	***TRACES (2021-2023):*** third largest family by quantity (16%, ~750,000 individuals) ***Industry:*** fourth largest family by quantity (9% of total)
 Pomacanthidae (angelfish)	85	92.9%	10 (11.8%)	***TRACES (2021-2023)****:* second largest family by quantity (26%,~1.23 million individuals) ***Industry****:* 5% of total
 Chaetodontidae (butterflyfish)	122	88.5%	0	***TRACES (2021-2023)****: 2.5*% of total (~117,000 individuals) ***Industry****:* 3% of total
 Labridae (wrasses)	325	85.2%	0	***TRACES (2021-2023)****:* fourth largest family by quantity (6%, ~263,000 individuals) ***Industry****:* third largest family by quantity (11% of total)
 Pomacentridae (damselfish/ clownfish)	215	80.5%	23 (10.6%)	***TRACES (2021-2023)****:* largest family by quantity (27%, ~1.25 million individuals) ***Industry****:* largest family by quantity (30% of total)
 Pseudochromidae (dottybacks)	52	73.1%	12 (23%)	***TRACES (2021-2023):*** 1% of total (~32,000 individuals) ***Industry:*** 5% of total

Family	No. of marine ornamental species	% ornamental species in international trade	No. of marine ornamental species frequently traded as captive-bred * (% total marine ornamental species in family)	Quantities recorded imported into the EU and UK based on official[a] and industry-reported data[b]
 Apogonidae (cardinalfish)	96	70.8%	6 (6.2%)	***TRACES (2021-2023)****: s*eventh largest family by quantity *3%* (~119,000 individuals) ***Industry****:* fifth largest family by quantity (6% of total)
 Gobiidae (gobies)	184	70.1%	17 (9.2%)	***TRACES (2021-2023)****:* fifth largest family by quantity (5%, ~213,000 individuals) ***Industry****:* second largest family by quantity (12% of total)
 Blenniidae (blennies)	118	64.4%	7 (5.9%)	***TRACES (2021-2023)****:* sixth largest family by quantity, 3% (~122,000 individuals) ***Industry****:* 4% of total
 Scaridae (parrotfish)	50	56%	0	***TRACES (2021-2023):*** 0.04%% of total (~1,600 individuals) ***Industry****:* <0.1% of total

* Species were considered frequently captive-bred if they were classified as either 'commonly' or 'moderately' available from captive-bred sources. Methods for categorising level of captive breeding detailed in Annex B and based on evidence reported by a European wholesaler, retailers, breeders/hobbyists, and the US trade data.

Key findings of Section 1

- **Of the 2191 marine ornamental fish species identified through this study, 81% (1764 species in 118 families) were categorised as being in international trade.** For eight of the ten largest ornamental fish families (containing >50 marine ornamental species each), the proportion of marine ornamental fish species traded internationally within each family also exceeded two thirds of the total species in those families.

- **The main range States for the species in international trade were Indonesia (1175 species), Australia (1085 species) and the Philippines (1061 species)**, aligning with key exporting countries identified in the literature (Wabnitz *et al.*, 2003; Biondo and Burki, 2019).
- A mean average of 3.8 million kg of non-freshwater ornamental fish (HS code 030119) were reportedly exported globally each year 2012-2021, however data were not available to estimate the *number* of marine ornamental fish in global trade each year. On the basis of recent official import data from two key marine ornamental fish importers (the EU and US), **combined imports into the EU and US may comprise of >9 million individual marine ornamental fish per year based on trade data and stakeholder survey responses**. Further industry data indicated that whilst over 1000 species were imported into the EU and UK, a quarter of imports were in just five species. In order to achieve a global picture of trade, data for other key importing countries (e.g. China and Japan) are also needed since they may comprise of different species to those seen in western imports. However, they were not made available at any taxonomic level for this study. Data on exports from all key countries of export (in particular Australia, Indonesia, and the Philippines, but also including Fiji, Kenya and Sri Lanka) was also lacking, but are vital in understanding where different species are being sourced.

- In agreement with previous studies (Wabnitz *et al.*, 2003; Murray and Watson, 2014; Dey, 2016), this study found **limited evidence of captive-bred specimens in international trade for most marine ornamental fish species** based on the datasets available (although additional captive breeding for domestic trade may also be occurring). Successful captive breeding was reported for 311 (18%) of the species in trade, however only 110 of these species appeared to be 'commonly' or 'moderately' available for retail from captive-bred sources, with the remaining species in trade being sourced from the wild. Other species may be captive bred for domestic aquaria but not enter international trade.

- In order for trade to be effectively monitored globally, **global species-level data on the number of individuals in trade** are required. In particular, data and information (such as the quantity of individual species) are needed from key exporting countries to enable a balanced analysis of trade levels and trends, and will be critical in ultimately assessing overall sustainability of the international trade in marine ornamental fish species.

Section 2. Conservation status of non-CITES listed marine ornamental fish in live international trade

Introduction

Despite the presence of multiple potential threats, very little information is available on the conservation status of most marine ornamental fishes in trade, and the effects of collection are mostly unknown (Dee *et al.*, 2019). This lack of information can be a barrier to sustainable management. Section 2 presents an overview of available information on the conservation status and provides a provisional categorisation of the potential risk posed to non-CITES listed marine ornamental fish found in international trade using a risk classification methodology. This methodology is based on information held within FishBase and relevant IUCN Red List assessments, and information gained from expert consultation and wider literature.

Background

While some species appear to be managed sustainably (e.g. *Zebrasoma flavescens* (Yellow tang) in West Hawaii; (Rossiter and Levine, 2014), others are considered to be more at risk. For example, collection for the aquarium trade is listed as one of the key threats to the Endangered *Pterapogon kauderni* (Banggai cardinalfish) (Allen and Donaldson, 2007) which has been previously subject to substantial wild harvest. In other species, such as *Amphiprion ocellaris* (Clown anemonefish) and *Amphiprion clarkii* (Yellowtail clownfish), collection has reportedly reduced genetic diversity of target populations, which can lead to population collapse (Madduppa *et al.*, 2018).

Captive breeding[36] may alleviate some wild collection pressure on a few specific ornamental fish species, including some high demand species that are regularly bred in captivity (such as *Amphiprion*; Dee *et al.* (2019)), however most species continue to be wild-sourced. CoP18 Doc.94 states that 25 marine ornamental species are captive-bred at a commercial scale, while Section 1 classified 110 species as commonly or moderately captive-bred (Figure 1.6) including the globally threatened *Megalops atlanticus* (tarpon)[37] and *Pterapogon kauderni* (Banggai cardinalfish)[38]. However, species which can be captive-bred may still be threatened by wild harvest (Dee *et al.*, 2019). For example, demand may exceed captive supply (Murray and Watson, 2014; Pinnegar and Murray, 2019), or wild-sourced specimens may remain more desirable or economical under certain circumstances (Tlusty, 2002; Moorhead and Zeng, 2010; Akmal *et al.*, 2020). In other cases, wild-sourced specimens may be misreported as captive-bred (Rhyne *et al.*, 2017). Some species are also intrinsically more vulnerable to overharvesting than others due to life history characteristics such as habitat specificity, low fecundity, limited dispersal or slow growth rates (Dee *et al.*, 2019).

Sustainability is also influenced by mortality along all stages of the supply chain; mortality may be apparent at the point of harvest, holding and/or transport due to methods used, or have a delayed impact once fish have reached retailers. Recent estimates place the proportion of exported marine ornamental fish reported as 'dead on arrival' at 1-2% (UK imports, King 2019; Tropical Marine Centre, *pers. comm.*; OATA & OFI, *pers. comm.*). This is considerably lower than estimated from older studies where 11-40% of tropical fish from Indonesia were reported 'dead on arrival' (Schmidt and Kunzmann, 2005) and 33-50% of fish imported into the US from Southeast Asia were reported as dying shortly after arrival (Wabnitz *et al.*, 2003).

[36] In this report, for simplicity, 'captive-bred' indicates that a species could be bred (i.e. reproduce with viable offspring) in captivity, irrespective of how many generations or whether wild supplementation to the breeding stock was involved.
[37] Traded for public aquaria.
[38] Previously proposed for CITES listing at CoP17 (CoP17 Prop. 46) and CoP14 (CoP14 Prop. 19), but withdrawn both times.

In addition to the threat posed by direct overexploitation, marine ornamental fishes face other threats, which can act on their own or synergistically to threaten both the species themselves and the livelihoods of communities that are reliant on coral reef fisheries. For example, marine ornamental fish are also threatened by the loss of coral reef habitat due to climate change, coral bleaching, development, pollution and coral collection for the aquarium trade (Ferse *et al.*, 2012; Teh *et al.*, 2013; Hughes *et al.*, 2018). It has been estimated that about 50% of coral reefs have been lost since the 1980s through environmental stress and escalating demands on reefs (Hoegh-Guldberg *et al.*, 2019). Coral loss results in a loss of resources available to associated fishes (Pratchett *et al.*, 2008), with population declines following coral loss observed in a number of coral-associated reef fishes (Jones *et al.*, 2004).

Methods

For Section 2, available information was compiled on the conservation status and intrinsic vulnerability to extinction for all 1764 non-CITES listed marine ornamental fish species that were identified as in international trade in Section 1; these data were used to provisionally categorise the species according to their possible likelihood of being threatened by international trade. This made use of species' IUCN Red List assessments (including Red List status and threat information), as well as an index of species' intrinsic vulnerability to extinction extracted from FishBase. The intrinsic vulnerability index provides a score of how vulnerable to extinction a species is likely to be along an arbitrary scale of 1 (low vulnerability) to 100 (very high vulnerability) based on biological, life history and ecological traits[39] following methods developed by Cheung *et al.* (2005)[40]. A species' intrinsic vulnerability index was categorised as low (<30), moderate (30-60) or high/very high (>60) according to the categories defined by Cheung *et al.* (2005).

Likelihood of being threatened by international trade

The 1764 marine ornamental fish species were provisionally grouped according to the likelihood that international trade may pose a threat to the species as means of identifying species that could be prioritised for future research. Since no globally comprehensive, species-level datasets exist for the international trade in non-CITES listed marine ornamental fish, species were grouped based on their conservation status and intrinsic vulnerability, supplemented with additional information on threats from the IUCN Red List and from expert consultation (see Table 2.1). Whilst it is important not to conflate conservation status with threat from trade, species with a higher extinction risk were considered to have a higher *likelihood* of being threatened by over-harvesting for international trade due to, for example, their intrinsic biology or small population size. These species could be considered priorities for further assessment into whether international trade does pose a substantial threat to the species. To fully assess the threat to these species from international trade, more comprehensive, species-level trade datasets and expert input are required.

[39]Maximum length, age at first maturity, longevity, von Bertalanffy growth parameter *K*, natural mortality rate, fecundity, strength of spatial behaviour, and geographic range.

[40] Scores obtained via Boettiger *et al.* (2012). Rfishbase: exploring, manipulating and visualising FishBase data from R. Journal of Fish Biology, Available at https://github.com/ropensci/rfishbase. Data also available at https://www.fishbase.org/.

Table 2.1. Selection methods for provisionally grouping marine ornamental fish species according to their potential likelihood of being threatened by international trade. These were based on species conservation status, extinction risk and expert input.

Likelihood of threat from international trade	Selection methods
Higher	Species were grouped as having a higher likelihood of being threatened by international trade if they met one or more of the following: • Classified as globally threatened ('Critically Endangered', 'Endangered' or 'Vulnerable') on the IUCN Red List; • Classified as 'Near Threatened', 'Data Deficient' or not yet assessed on the IUCN Red List *and* had a 'high' or 'very high' intrinsic vulnerability index score (>60) according to Cheung *et al.* (2005); • Classified as 'Near Threatened' or 'Data Deficient' *and* were considered to be threatened by biological resource use (threat category 5.4.2) or threatened by international trade[41] on the IUCN Red List; • Identified in expert consultation (via stakeholder survey response) as being at risk from international trade; and/or • Identified as 'likely' threatened by international trade in (Challender *et al.*, 2023)
Moderate	Species that did not meet the inclusion criteria for 'higher' likelihood of threat from international trade were grouped as having a moderate likelihood if they were: • Classified as 'Near Threatened' *and* had a 'moderate' or 'low' intrinsic vulnerability index score (≤60) according to Cheung *et al.* (2005); or • Classified as 'Data Deficient', 'Least Concern' (over 10 years ago ≤2013)*, or not yet assessed on the IUCN Red List *and* had a 'moderate' intrinsic vulnerability index score (30-60).
Lower	Species were considered to have a lower likelihood of being threatened by international trade if they met one or more of the following: • Classified as 'Least Concern' on the IUCN Red List within the last 10 years (>2013)*; or • Classified as Least Concern' over 10 years ago (≤2013), 'Data Deficient' or not yet assessed on the IUCN Red List *and* had a 'low' intrinsic vulnerability index score (<30) according to Cheung *et al.* (2005).

* Red List assessments over 10 years old may no longer reflect the current conservation status of the species.

To aid interpretation, further metadata were provided for all marine ornamental fish species, where available, in Table 2.2. (for higher risk species) and in the accompanying excel document for all species. This additional metadata includes:

- Demand for use in aquaria: whether species were considered to be in demand for hobbyist aquaria (i.e. globally available in aquarium shops), public aquaria, or had the potential to be in high demand due to their intrinsic biology/ecology according to FishBase[42]; and
- The relative cumulative percentage of EU and UK imports by total quantity based on industry data (OATA & OFI, *pers. comm.*). The level of species imports into the EU/UK were classified as 'high' (quantity within top 25% of imports); 'moderate' (quantity within 25% - 75% of imports), 'low' (quantity within 75.1% - 99% of imports) and 'very low' (quantity within the lowest 1%).

[41] The 'threat from international trade' field is inconsistently used across taxa, and may not have been completed for some species.

[42] Categories were defined by FishBase as: 'commercial' trade (fish found in aquarium shops globally, and considered to be in high demand); 'public aquaria' (fish shown in public aquaria that are considered usually too large or difficult to keep in private/home aquaria); or in 'potential' demand (fish that are considered small, attractive and easy to keep, but which do not yet appear to be in commercial levels of trade).

Results

Overview of conservation status

Of the 1764 marine ornamental fish species found to be to be in international trade in Section 1, 90% (1595 species) had an existing global IUCN Red List assessment, although over half (907 species) were assessed over 10 years ago (≤2013) and so their categorisation may no longer reflect the current conservation status of the species. Of those assessed, the majority of species were classified by IUCN as Least Concern (92%, 1469 species), with 4% (60) classified as Near Threatened or globally threatened[43] (Figure 2.1).

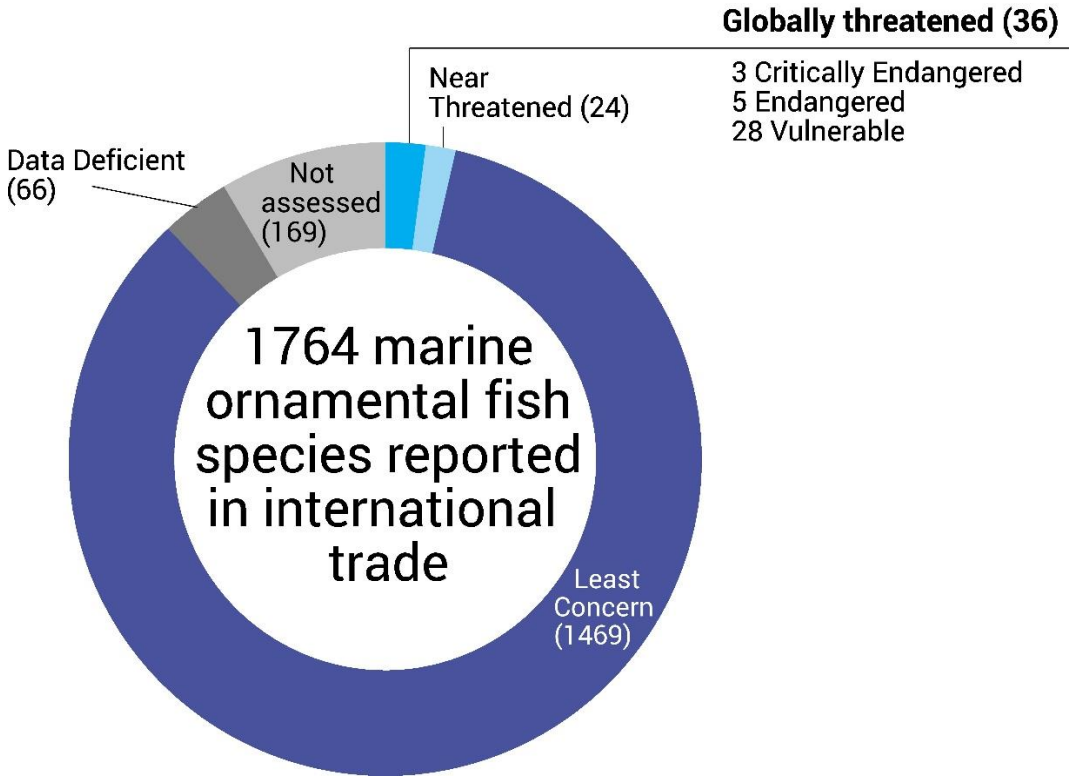


Figure 2.1. *IUCN Red List status of the 1764 marine ornamental species found in international trade. 'Globally threatened' includes the Red List categories 'Vulnerable,' 'Endangered,' and 'Critically Endangered.'*
Data source: *IUCN Red List (https://www.iucnredlist.org, version 2023-1.*

Of the species with Red List assessments, 76 were considered to be threatened by intentional biological resource use (threat classification 5.4.2). Five of these species were near or globally threatened: *Balistes punctatus* (Bluespotted triggerfish), *Balistes vetula* (Queen triggerfish), *Lachnolaimus maximus* (Hogfish), *Oxymonacanthus longirostris* (Harlequin filefish) and *Carcharias taurus* (Sand tigershark)[44], eight were Data Deficient, and the majority (60 species) were categorised as 'Least Concern'.

Overview of intrinsic vulnerability

The marine ornamental fish species found in international trade had intrinsic vulnerability index scores ranging between 10 (very low) and 90 (very high) (Figure 2.2), with a mean score of 20.26. Over

[43] Classified as Vulnerable, Endangered or Critically Endangered on the IUCN Red List.
[44] These five species are reportedly traded in relatively small quantities and primarily for public aquaria (OATA & OFI, *pers. comm.*).

two thirds (1381) of species had low intrinsic vulnerability index scores (<30), indicating that they had life history and ecological traits associated with low vulnerability to extinction (e.g. species with high fecundity and wide ranges). Approximately 17% (304) of species had moderate vulnerability to extinction, and around 4%% (77) of species were considered to have high vulnerability to extinction based on their life history and ecological traits: these highly vulnerable species tend to be larger-bodied, and are slower to mature and reproduce. High vulnerability species include a number of sharks and rays (class: Elasmobranchii), which are largely traded for public aquaria.

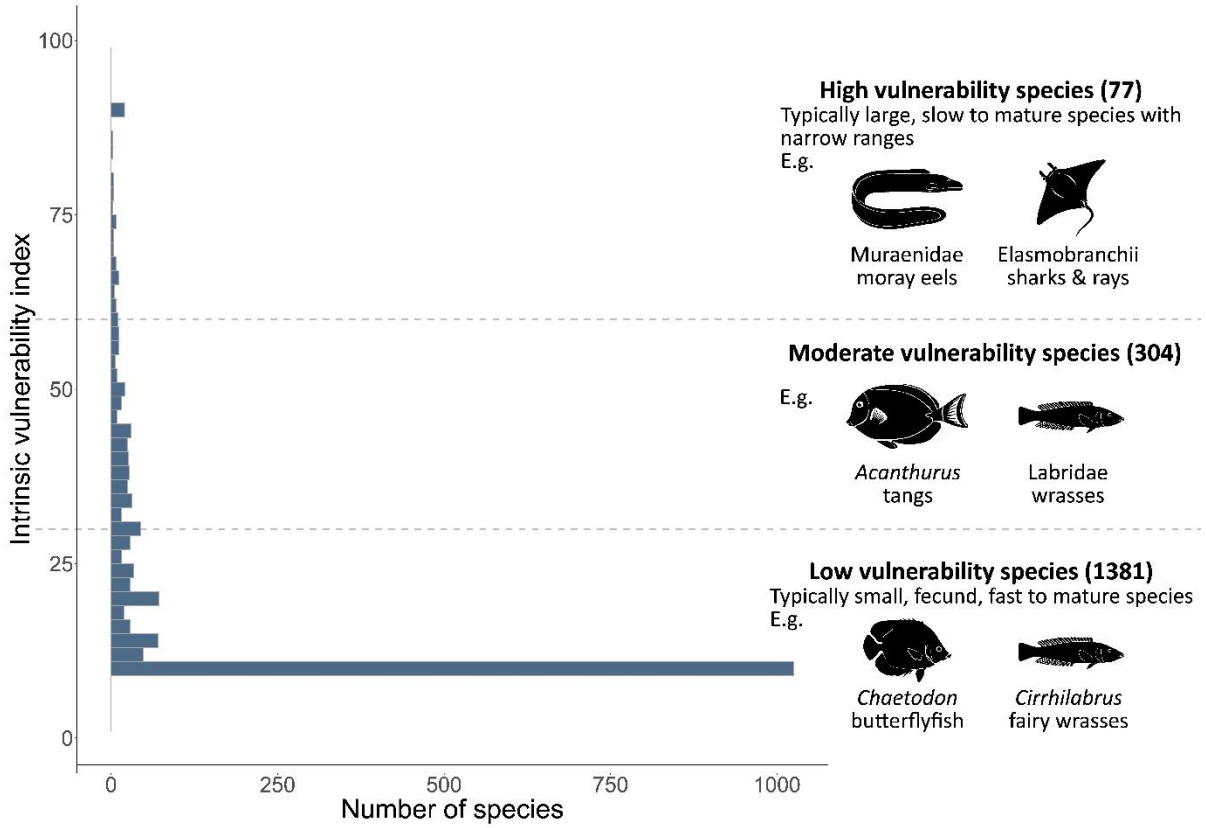


Figure 2.2. *Histogram for the number of marine ornamental fish species found in international trade by intrinsic vulnerability index score (n=1762, two species did not have scores). Number of species in each vulnerability category (low, moderate and high) provided in parentheses; whilst example taxonomic groups are indicative of the vulnerability category, not all species within these taxa necessarily fall within that vulnerability category.* ***Data source:*** *FishBase (https://www.fishbase.org, version 05/2023).*

Likelihood of being threatened by international trade

Over three quarters (1467 species) of the marine ornamental fish species identified in international trade were provisionally assigned to the 'lower likelihood of risk from international trade' category (Figure 2.3); this was on the basis of their Red List status and/or a low overall vulnerability to extinction (low intrinsic vulnerability index score). The remaining quarter of species were classified as being at 'moderate' (226) or 'higher' (71) likelihood of risk from international trade.

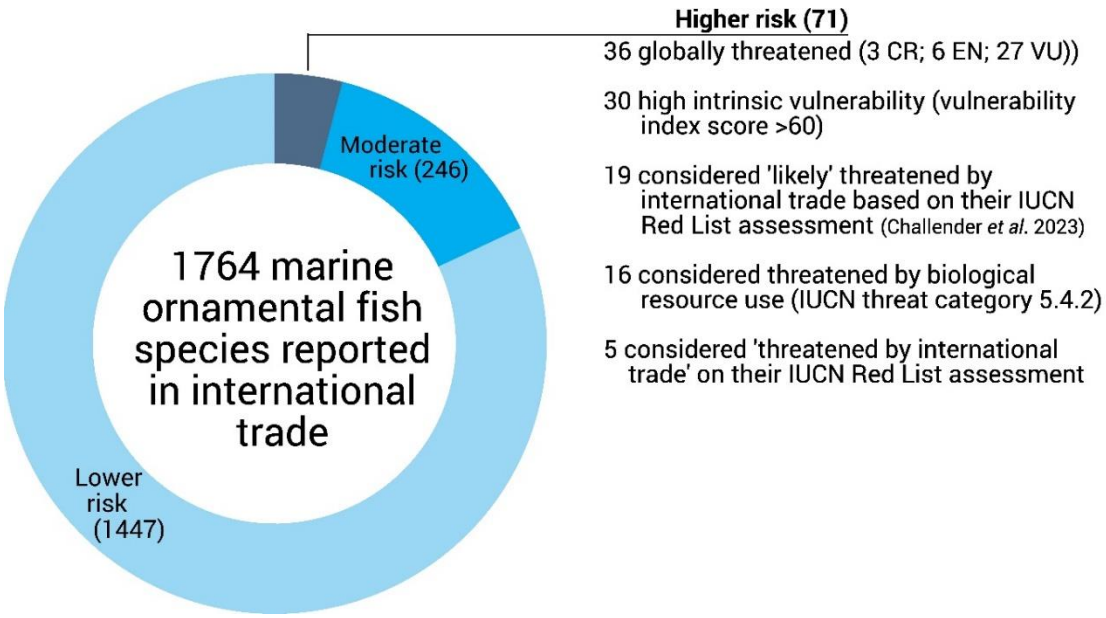


Figure 2.3. Provisional groupings for the likelihood of marine ornamental fish species being threatened by international trade, based on their conservation status, intrinsic vulnerability and expert input.

Species provisionally categorised as 'higher risk'

Details of the 71 marine ornamental fish species provisionally grouped as 'higher risk' (i.e. having a **higher likelihood of being threatened by international trade**), along with further information on their conservation status, vulnerability, level of captive breeding and demand for aquaria are provided in Table 2.2. The majority (63) of these 'higher risk' species were identified based on their extinction risk (including the 36 species assessed as globally threatened[45] on the IUCN Red List) and intrinsic vulnerability. A further 5 Near Threatened species were identified as 'likely' threatened by international trade based on information in their Red List assessments (Challender *et al.*, 2023) and 3 species were identified via expert consultation as being threatened by the ornamental fish trade.

The IUCN Red List considered 16 of these 'higher risk' species to be threatened by large scale biological resource use (threat classification 5.4.2) and 5 to be threatened by international trade, although the threat classification does not specify whether this can be specifically attributed to the international ornamental trade and are not always applied, particularly in older assessments. Twenty-eight of the species at higher likelihood of risk were last assessed for the IUCN Red List over ten years ago, and 7 of these species do not yet have an IUCN Red List assessment.

[45] Classified as Vulnerable, Endangered or Critically Endangered on the IUCN Red List.

Table 2.2. *Marine ornamental fish species identified as* ***potentially having a higher likelihood of being at risk from international trade*** *on the basis of their high extinction risk and intrinsic vulnerability (**n=71 species**). Metadata are also provided on levels of captive breeding, relative level of EU and UK imports and demand for use in aquaria.* ***Data Sources***: [a,h] *IUCN Red List (https://www.iucnredlist.org, version 2023-1); Cheung* et al. *(2005) via FishBase (https://www.fishbase.org, version 05/2023);* [c] *Level of captive breeding as determined in Section 1 (methods in Annex B);* [d] *EU/UK import data from industry (OATA & OFI, unpublished data);* [e] *EU import data 2021-2023 (TRACES);* [f] *FishBase (https://www.fishbase.org, version 05/2023);* [g] *likelihood of threat from international trade based on (i) expert consultation, (ii) literature review, (iii) IUCN Red List assessment field 'threatened by international trade' and/or (iv) results from Challender* et al. *(2023).*

Family	Species	Red List category (population trend)[a]*	Intrinsic vulnerability Index[b]	Level of captive breeding[c]	Relative level of EU/UK imports[d]**	No. of individuals imported into the EU 2021-2023[e]	Demand for use in aquaria[f]	Threat from international trade[g]	Threatened by biological resource use (5.4.2)[h]
				Actinopteri					
Acanthuridae	*Acanthurus chronixis* (Chronixis surgeonfish)	VU (?)†	Low 18)	No data	Low	0	Commercial		
Apogonidae	*Pterapogon kauderni* (Banggai cardinal fish)	EN (↓)†	Low (19.08)	Common	High	62,741	Commercial	✓ ii, iv	
Balistidae	*Balistes capriscus* (Grey triggerfish)	VU (↓)†	Moderate (46.03)	None	Very low	1	Public		
	Balistes punctatus (Bluespotted triggerfish)	VU (↓)†	Moderate (37.52)	None	Very low	1	Unspecified	✓ iv	✓
	Balistes vetula (Queen triggerfish)	NT (↓)†	Moderate (53.73)	Not for retail	Very low	17	Commercial	✓ ii	✓
Blenniidae	*Ecsenius tigris* (Tiger combtooth blenny)	VU (?)†	Low (10)	No data	0	6	Commercial		
Chaetodontidae	*Chaetodon trifascialis* (Chevron butterflyfish)	NT (↓)†	Low (10.89)	No data	Very low	30	Commercial	✓ iv	
Epinephelidae	*Epinephelus fuscoguttatus* (Brown-marbled grouper)	VU (↓)	Moderate (57.09)	Moderate	0	0	Commercial	✓ iv	
	Epinephelus lanceolatus (Giant grouper)	DD (↓)	(High) 90	Not for retail	0	2200	Commercial	✓ ii, iii	
	Epinephelus morio (Red grouper)	VU (↓)	High (63.98)	No data	0	0	Public	✓ iii, iv	
	Epinephelus striatus (Nassau grouper)	CR (↓)	High(63.42)	No data	0	0	Public	✓ ii, iv	
	Mycteroperca bonaci (Black grouper)	NT (↓)	High (62.99)	No data	0	0	Public	✓ iv	
	Mycteroperca interstitialis (Yellowmouth grouper)	VU (↓)	High (67.35)	No data	0	0	Public	✓ ii, iv	
	Mycteroperca venenosa (Yellowfin grouper)	NT (↓)	High (62.16)	No data	0	0	Public	✓ iv	
Gobiidae	*Callogobius amikami* (Amikami nano goby)	EN (?)	Low (10)	No data	Very low	1	Rarely		
	Coryphopterus lipernes (Peppermint goby)	VU (?)†	Low (10)	No data	0	0	Commercial		
	Coryphopterus personatus (Masked goby)	VU (?)†	Low (10)	Moderate	0	29	Commercial		
	Elacatinus figaro (Barber goby)	VU (?)	Low (10)	Common	Low	0	Commercial		?††
	Elacatinus prochilos (Broadstripe goby)	VU (?)†	Low (10)	Not for retail	0	0	Rarely		

Family	Species	Red List category (population trend)[a]*	Intrinsic vulnerability Index[b]	Level of captive breeding[c]	Relative level of EU/UK imports[d]**	No. of individuals imported into the EU 2021-2023[e]	Demand for use in aquaria[f]	Threat from international trade[g]	Threatened by biological resource use (5.4.2)[h]
Haemulidae	*Plectorhinchus albovittatus* (Two-striped sweetlips)	-	High (73.2)	No data	Very low	0	Commercial		
Kyphosidae	*Kyphosus incisor* (Yellow sea chub)	-	High (65.88)	No data	0	0	Rarely		
Labridae	*Bodianus frenchii* (Foxfish)	NT (↓)†	High (65.84)	No data	0	0	Rarely		
	Cirrhilabrus balteatus (Girdled wrasse)	DD (?)†	Low (10)	No data	Very low	0	Rarely		✓
	Cirrhilabrus filamentosus (Whip-fin wrasse)	DD (?)†	Low (10)	None	Low	52	Unspecified		✓
	Cirrhilabrus rubrisquamis (Red velvet fairy wrasse)	DD (?)†	Low (10)	None	Low	246	Rarely		✓
	Cirrhilabrus solorensis (Red-eye wrasse)	DD (?)†	Low (10)	None	Low	270	Rarely		✓
	Cirrhilabrus tonozukai (Tono's wrasse)	DD (?)†	Low (10)	None	Low	4	Rarely		✓
	Halichoeres adustus (Black wrasse)	VU (?)†	Low (10)	No data	Low	0	Rarely		
	Lachnolaimus maximus (Hogfish)	VU (↓)†	Moderate (58.79)	Not for retail	Very low	0	Commercial	✓ ii, iv	✓
	Larabicus quadrilineatus (Fourline wrasse)	DD (?)†	Low (10)	None	Low	350	Rarely		✓
	Semicossyphus pulcher (California sheephead)	VU (↓)†	Moderate (54.9)	None	0	0	Commercial		
	Tautoga onitis (Tautog)	VU (↓)†	High (69.1)	No data	0	0	Public		
Lutjanidae	*Lutjanus analis* (Mutton snapper)	NT (↓)	Moderate (55.45)	No data	0	0	Commercial	✓ iv	
	Lutjanus jocu (Dog snapper)	DD (↓)	High (66.26)	No data	0	0	Public		
	Lutjanus synagris (Lane snapper)	NT (↓)	Moderate (37.06)	No data	0	0	Public	✓ iv	
Megalopidae	*Megalops atlanticus* (Tarpon)	VU (↓)	High (75.86)	Common	0	0	Public	✓ iv	
Monacanthidae	*Oxymonacanthus longirostris* (Harlequin filefish)	VU (↓)	Low (10)	Not for retail	Low	461	Commercial	✓ iv	✓
Pegasidae	*Pegasus volitans* (Longtail seamouth)	DD (?)	Low (10)	No data	Low	0	Rarely		✓
Pomacanthidae	*Apolemichthys kingi* (Tiger angelfish)	LC (?)†	Low (11)	No data	Very low	6	Rarely	✓ i	
	Chaetodontoplus duboulayi (Scribbled angelfish)	LC (→)†	Low (18)	Rare	Low	23	Commercial	✓ i	
	Chaetodontoplus meredithi (Queensland yellowtail angelfish)	LC (→)†	Low (15)	Rare	Very low	7	Unspecified	✓ i	
	Holacanthus limbaughi (Clipperton angelfish)	NT (→)†	Low (15)	Moderate	0	0	Rarely	✓ iv	
Pomacentridae	*Amblyglyphidodon ternatensis* (Ternate damsel)	VU (↓)†	Low (10)	Not for retail	Low	0	Unspecified		

Family	Species	Red List category (population trend)[a]*	Intrinsic vulnerability Index[b]	Level of captive breeding[c]	Relative level of EU/UK imports[d]**	No. of individuals imported into the EU 2021-2023[e]	Demand for use in aquaria[f]	Threat from international trade[g]	Threatened by biological resource use (5.4.2)[h]
	Amphiprion mccullochi (Whitesnout anemonefish)	VU (?)	Low (10)	Rare	0	0	Commercial		? ++
	Chrysiptera arnazae (Arnaz's damselfish)	VU (?)	Low (10)	No data	Low	0	Rarely		? ++
	Chrysiptera hemicyanea (Azure demoiselle)	VU (?)	Low (10)	Moderate	Moderate	35,976	Commercial		? ++
	Plectroglyphidodon dickii (Blackbar devil)	NT (↓)	Low (25.23)	No data	0	0	Commercial		✓
Scaridae	*Bolbometopon muricatum* (Green humphead parrotfish)	VU (↓)†	High (67.49)	No data	0	0	Commercial	✓ ii	
Sebastidae	*Sebastes constellatus* (Starry rockfish)	-	High (66.62)	No data	0	0	Rarely		
	Sebastes melanops (Black rockfish)	-	High (63.5)	No data	0	0	Public		
	Sebastes nigrocinctus (Tiger rockfish)	-	High (70.52)	None	0	0	Public		
	Sebastes paucispinis (Bocaccio rockfish)	EN (?)†	High (62.81)	No data	0	0	Public		
	Sebastes ruberrimus (Yelloweye rockfish)	-	High (73.46)	None	0	0	Public		
Siganidae	*Siganus unimaculatus* (Blotched foxface)	DD (?)	Low (14.4)	None	Low	510	Commercial		✓
	Siganus uspi (Bicolored foxface)	NT (?)	Low (14)	None	Low	171	Commercial	✓ iv	
Sphyraenidae	*Sphyraena jello* (Pickhandle barracuda)	-	High (75.07)	No data	0	0	Rarely		
Syngnathidae	*Dunckerocampus dactyliophorus* (Ringed pipefish)	DD (?)	Low (10)	Moderate	Low	0	Public	✓ iii	
				Elasmobranchii					
Aetobatidae	*Aetobatus narinari* (Whitespotted eagle ray)	EN (↓)	High (74.63)	None	0	7	Rarely		
Carchariidae	*Carcharias taurus* (Sand tiger shark)	CR (↓)	Moderate (58.1)	None	0	2	Rarely	✓ iv	✓
Dasyatidae	*Himantura uarnak* (Honeycomb stingray)	EN (↓)	High (90)	No data	0	13	Commercial	✓ ii	
	Pastinachus sephen (Cowtail stingray)	NT (↓)	High (90)	None	0	0	Commercial	✓ iv	
Ginglymostomatidae	*Ginglymostoma cirratum* (Nurse shark)	VU (↓)	High (90)	None	Very low	0	Public		
	Nebrius ferrugineus (Tawny nurse shark)	VU (↓)	High (90)	No data	0	0	Unspecified	✓ ii	
Hemiscylliidae	*Chiloscyllium punctatum* (Brownbanded bambooshark)	NT (↓)	High (79.2)	Common	Low	236	Commercial		
	Hemiscyllium hallstromi (Papuan epaulette shark)	VU (?)	Moderate (50.8)	No data	0	0	Rarely		
Rhinopteridae	*Rhinoptera neglecta* (Australian cownose ray)	DD (?)	High (86.35)	No data	0	0	Rarely		
Scyliorhinidae	*Scyliorhinus stellaris* (Nursehound)	VU (↓)	High (67.18)	None	0	0	Public		
Stegostomatidae	*Stegostoma tigrinumm* (Zebra shark)	-	High (90)	Rare	0	4	Rarely	✓ ii	

Family	Species	Red List category (population trend)[a]*	Intrinsic vulnerability Index[b]	Level of captive breeding[c]	Relative level of EU/UK imports[d]**	No. of individuals imported into the EU 2021-2023[e]	Demand for use in aquaria[f]	Threat from international trade[g]	Threatened by biological resource use (5.4.2)[h]
Torpedinidae	*Torpedo marmorata* (Marbled electric ray)	VU (↓)	High (60)	None	Very low	0	Public		
	Torpedo sinuspersici (Variable torpedo ray)	DD (?)	High (78)	No data	0	0	Rarely		
Triakidae	*Triakis scyllium* (Banded houndshark)	EN (↓)	High (64.32)	No data	Very low	0	Rarely		

* IUCN Red List category: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; - = not assessed.
Red List population trend: ↑ = increasing ↓ = decreasing; → = stable; ? = unknown.
** Relative cumulative % of EU/UK imports by total quantity: High = quantity within top 25%; Moderate = quantity within 25% - 75%; Low = quantity within 75.1% - 99%; Very Low = quantity within the lowest 1% (species accounted for <0.01% of the total quantity of imports of marine ornamental fish).
[†]IUCN Red List assessment over 10 years old (≤2013).

Since there are no globally comparable data currently available on the quantities of each species in trade, **provisionally 'higher risk' species were identified as potential priorities for further research based on their conservation status and vulnerability** without accounting for levels of trade. As a result, some of these 'higher risk' species may be traded in small quantities that, upon further research, have negligible impact on the survival of the species. Conversely, even a small offtake could have significant conservation implications for other threatened species in the list.

Species-level trade data were made available by industry representatives for EU and UK imports, providing an indication of demand and relative trade in each species (OATA & OFI, *pers. comm.*). However, it is important to note that these data are indicative only and should not be considered globally representative, since other major importing countries (e.g. the US, China and Japan) will have their own national market patterns and trading partnerships with source countries.

Twenty of the 'higher risk' species each accounted for >0.01% of EU/UK imports; highest amongst these were *Pterapogon kauderni* (Banggai cardinalfish), one of the top five species imported into the EU by quantity and *Chrysiptera hemicyanea* (Azure demoiselle), both of which are frequently captive bred. A further 12 species were imported in 'very low' levels, with each accounting for <0.01% of the EU/UK's total imports; based on an estimated 2.5 million individual marine ornamental fish imported into the EU/UK annually (Tropical Marine Centre, *pers. comm.*) this could be approximated to <250 individuals annually imported for each of these species. The species imported in very low quantities were mainly larger species that are predominantly imported for public aquaria (Tropical Marine Centre, *pers. comm.*). Over half of the 'higher risk' species (39 species) were not recorded as imported into the EU or UK by industry at all in the past few years for ornamental purposes, although seven of these were reported as imported into the EU 2021-2023 in the official EU database TRACES.

Species provisionally classified as being at 'higher risk' include those such as groupers (family: Serranidae) and sharks/rays (class: Elasmobranchii), which are generally considered too large for standard hobbyist tanks but are in demand for public aquaria where facilities are generally larger. For example, *Megalops atlanticus* (Tarpon) and *Epinephelus morio* (Red grouper) are larger species that frequently appear in public aquaria (Species360, 2021). All of these species were reported in EU/UK imports in 'very low' quantities or were not reported in EU/UK imports at all (Table 2.2; OATA & OFI, *unpublished data*). Some larger species may also be bought as juveniles for home aquaria but outgrow their tanks as they mature.

As well as being traded for aquaria/display purposes, some marine ornamental fish are also in demand for live food fish. For example, three groupers with a higher risk of being threatened by international trade are also commonly traded live as food fish *Epinephelus fuscoguttatus* (Brown-marbled grouper) and *E. lanceolatus* (Giant grouper)); however, the Red List status and trade data often do not distinguish between these two purposes of live trade.

Species provisionally categorised as 'moderate risk'

Of the marine ornamental fish species in international trade, approximately 14% (246) were classified as having a **moderate likelihood of being threatened by international trade** on the basis of their extinction risk and intrinsic vulnerability. Of these, 12 were considered Near Threatened on the IUCN Red List, with low-moderate intrinsic vulnerability index scores (<60). The remaining species were either Least Concern (183), Data Deficient (7) or had not yet been assessed for the IUCN Red List (44). Nearly half of these 'moderate' species belong to three families: Labridae (wrasses, 43 species), Muraenidae (moray eels, 33 species) and Acanthuridae (tangs, 29 species).

Species provisionally categorised as 'lower risk'

The remaining 1447 species of marine ornamental fish were considered to be at **lowest threat from international trade** based on the current information available, and were largely classified as being of

Least Concern on the IUCN Red List (1283 species). The remaining species were either Data Deficient (46) or had not yet been assessed on the IUCN Red List (118) but had low intrinsic vulnerability to extinction. Of the 'lower risk' species that had Red List assessments, around 48% (689 species) were over ten years old (assessed ≤2013).

Five families accounted for almost half of the species considered to be at a lower likelihood of being threatened by international trade: Labridae (wrasses, 223 species), Pomacentridae (damselfish/clownfish, 163 species), Gobiidae (gobies, 122 species), Chaetodontidae (butterflyfish, 104 species) and Blenniidae (blennies,75 species).

A full list of marine ornamental fish species, along with accompanying metadata on conservation status, vulnerability and distribution and their estimated likelihood of threat from trade are provided in the accompanying excel document.

Key findings of Section 2

- Of the 1764 non-CITES listed marine ornamental fish species identified in Section 1 as being in international trade, 90% have IUCN Red List assessments: 60 species are currently considered globally threatened or Near Threatened, while the majority are currently considered to be 'Least Concern' (1469).
- Over half of the non-CITES listed marine ornamental fish species identified in Section 1 as being in international trade either have Red List assessments over ten years old (907 species, including 22 Near Threatened or globally threatened species) or have not yet been assessed (165 species). **Those with higher vulnerability or which have not yet been assessed may be priorities for (re)assessment.**
- Seventy-seven (4%) of the marine ornamental fish species in international trade had high intrinsic vulnerability index scores (Cheung *et al.*, 2005), indicating that their life history and ecological traits make them more vulnerable to extinction. This includes large bodied, slow to mature species with relatively low fecundity, such as moray eels (family Muraenidae; 18 species), sharks/rays (class Elasmobranchii; 18 species with a high vulnerability), and large groupers (family Epinephelidae; 10 species). Due to their large adult size, many of these species are primarily traded for public aquaria.
- Species were provisionally grouped as having a 'lower', 'moderate' or 'higher' likelihood of being threatened by international trade based on their conservation status and intrinsic vulnerability to extinction, supplemented with expert input. The **majority of marine ornamental fish species found to be in international trade (~82%, 1447 species) were considered 'lower risk' (i.e. unlikely to be currently threatened by international trade)** based on their conservation status and intrinsic vulnerability.
- **Less than 5% (71 species) of marine ornamental fish species found to be in international trade were considered to have a higher potential likelihood of being threatened by international trade**. These species had high intrinsic vulnerability and/or risk of extinction according to IUCN Red List assessments and may therefore be priorities for more detailed assessment of the impact of international trade. Thirty-three of these species are imported into the EU and/or UK.

Section 3. Management and regulation of marine ornamental fisheries from harvest to export

Introduction

Section 3 combines Thematic Studies 3 (fisheries management) and 4 (legislation) as proposed by the Secretariat in paragraph 5 of AC31 Doc. 36. Since management measures are often implemented through legislation, there is not always a clear distinction between the two. To streamline the information and provide CITES Parties with a clear, overarching summary of relevant measures in place for each of the main exporting countries, information on management and legislation was combined.

This section compiles and summarises available information on the management of marine ornamental fisheries and the regulation of the international export of marine ornamental fish in six of the main countries of export (**Australia, Fiji, Indonesia, Kenya, the Philippines and Sri Lanka**). It includes an assessment of whether fisheries management and/or export legislation is specific to marine ornamental fish in each of the six countries and identifies potential gaps in management and legislation. Further information on import regulations are also summarised where provided in stakeholder survey responses.

Background

Whilst oversight of marine ornamental fisheries is required to ensure that they are biologically sustainable and equitable to those involved in the trade, targeted, evidence-based management is often lacking (Wabnitz *et al.*, 2003; Gillett *et al.*, 2020). Conventional fish stock management relies on extensive data about stock status, population dynamics, trends and collection effort. However, this information is often limited in ornamental fisheries due to a high diversity of poorly studied species and low institutional and management capacity in many source countries (Fujita *et al.*, 2014; Dee *et al.*, 2014). As a result, where management plans do exist for marine ornamental fisheries, they are often not taxon-specific, and are frequently designed without an assessment of fish stocks to support them (Wabnitz *et al.*, 2003; Gillett *et al.*, 2020).

Many of the approaches used to manage food fisheries can also be applied to the management of marine ornamental fisheries, including the use of harvest quotas or equipment restrictions to limit total catch, implementing no-take zones or closed seasons to allow for fish stock recovery, and banning the harvest of particular species entirely (Wood, 2001b; Dee *et al.*, 2014). Marine Protected Areas (MPAs) are one of the most common management tools in coral reef conservation (Burke *et al.*, 2011; Beltrán *et al.*, 2017). Whilst some are effective, over 60% of MPAs in southeast Asia and the Atlantic have been rated in the past as ineffective for reducing overfishing (Burke *et al.*, 2011). Dee *et al.* (2014) reviewed a variety of approaches for managing marine ornamental fisheries and identified the most successful methods to include species harvest moratoriums, no-take zones, tiered quota systems and import/export restrictions. Given the richness of marine ornamental fish species, and the difficulty in managing each individually, it has been suggested that an ecosystem (i.e. coral reef-level) approach to management of these fisheries may be more realistic (Fujita *et al.*, 2014). Management may also target the underlying drivers of unsustainable or destructive fishing practices by addressing socio-economic issues or resolving conflicts between resource users.

The effectiveness of management strategies not only relies on a strong evidence-base, but also on effective enforcement and local community buy-in (Burke *et al.*, 2011). For example, in the Pacific Ocean, Wood (2001a) noted that empowering local communities with legal rights over their reef fisheries had been an effective strategy in ensuring that the local marine ornamental fisheries were

managed sustainably. Where enforcement or community knowledge of national legislation is lacking, management measures in legislation or management plans are likely to remain ineffective and at greater risk of being unsustainable.

Methods

Information on the management and legislation relating to marine ornamental fish harvest and export was compiled for six key countries of export. Where species-specific management or export measures were available, these were cross checked against species provisionally identified as 'higher risk' from Section 2 to see if protection is already in place.

Further to this, responses to the stakeholder survey on national legislation and enforcement relating to the export and import of ornamental fish was also collated. In total, respondents from 11 countries of export[1] (19 respondents) and 19 countries of import[1] (30 respondents) provided answers to the relevant survey questions.

Identification of main exporting countries of marine ornamental fish

Section 3 identified six countries for in-depth assessment: Australia, Fiji, Indonesia, Kenya, the Philippines, and Sri Lanka (Table 3.1). These countries were selected as they are all considered important range States and exporters of marine ornamental fish based on:

- the number of marine ornamental fish identified as present in international trade that are considered native to the country according to FishBase;
- the number of native marine ornamental fish identified as 'higher risk' (i.e. having a higher likelihood of being threatened by international trade) in Section 2;
- the quantity of marine ornamental fish exported by the country according to Section 1 analyses of UN Comtrade data (HS code 030119) 2012-2021 and the wider literature; and/or
- responses to stakeholder survey shared through Notif. 2021/030.

All six countries exported over 1million kg of live non-freshwater ornamental fish 2012-2021 and were native range States for at least nine of the 'higher risk' species identified in Section 2. Collectively the focal countries accounted for approximately two thirds of global exports of live non-freshwater ornamental fish traded under HS code 030119 2012-2021 (see Figure 3.1).

Table 3.1**. Focal exporting countries ordered alphabetically. Additional information is included on the number of native marine ornamental fish with evidence of international trade and the total weight of non-freshwater ornamental fish (HS code 030119) reported as exported by each country 2012-2021.* ***Data sources: *FishBase (https://www.fishbase.org version 05/2023); [b]UN Comtrade (extracted 22/04/22); [c] Responses to survey shared via Notif. 2021/030.*

Exporting country	Number of native marine ornamental fish with evidence of international trade[a] (number of 'higher risk' species in parentheses)	Quantity of live non-freshwater ornamental fish (HS code 030119) exported 2012-2021 (million kg)[b] (% of global exports in parentheses)
Australia	908 (23)	1.62 (4.3%)
Fiji	459 (9)	1.13 (2.9%)
Indonesia	1011 (24)	7.00 (18.6%)
Kenya	249 (9)	1.06 (2.8%)
Philippines	913 (17)	12.90 (34.2%)
Sri Lanka	317 (11)	1.01 (2.7%)

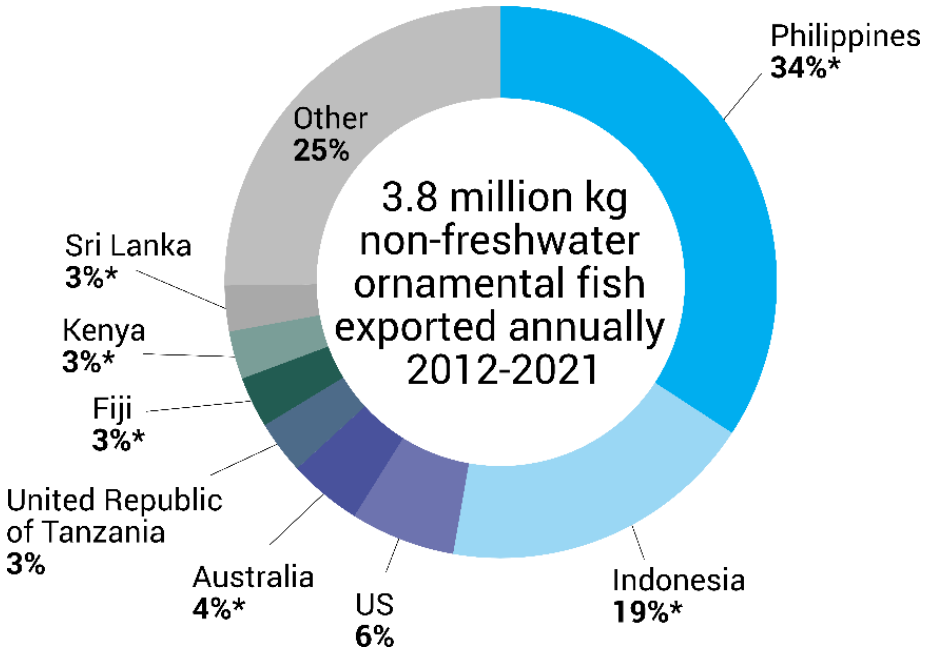


***Figure 3.1**. Top eight countries of export as a percentage of global exports of live non-freshwater ornamental fish (HS code 030119) reported by countries of export 2012-2021. Focal countries are indicated with an asterisk (*). **Data source:** UN Comtrade (extracted 22/04/22).*

Stakeholder survey respondents from four of the six focal countries of export (the CITES Authorities of Australia and Kenya, and industry representatives in Fiji[46] and the Philippines) provided information on the management and regulation of marine ornamental fish harvesting and/or export. This information is summarised below and supplemented with additional documents and literature.

No relevant information was received via the stakeholder survey from any respondent in Indonesia or Sri Lanka (including from government, NGO or industry representatives), so the information below is based only on available literature. As a result, measures managed via industry standards, legislation published in local languages and/or stored in local systems may not be comprehensive. Information on harvest and export management measures was also provided by survey respondents from a further eight non-focal countries[47]. Responses for these countries are summarised in Annex D.

Identification of national or subnational regulations relating to the management and/or export of marine ornamental fish in six focal countries of export

Information on the national and subnational[48] management and export of marine ornamental fish was gathered from stakeholder survey responses and the wider literature for the six focal exporting countries, with particular emphasis on harvest methods, restrictions and requirements for export. A summary of the management and export information compiled is provided for each of the six countries below.

Internet searches were largely conducted using publicly accessible legislation databases (e.g. the Environmental Law Information Service [ECOLEX] [49], UN Environment Programme Law and

[46] The respondent from Fiji provided information on fisheries management only.
[47] Cuba, France and overseas territories (Mayotte, Guadeloupe, Martinique), French Polynesia, Israel, Japan, New Caledonia, Singapore, and the US.
[48] In this report, 'subnational' primarily refers to provinces or regions within a country. Where possible, information on smaller scale/local management was collected for individual marine reserves, but this is not comprehensive.
[49] Accessed via https://www.ecolex.org/.

Environment Assistance Platform [UNEP-LEAP][50] and the Pacific Community [SPC][51]) and a broader literature search to supplement information provided via stakeholder survey responses. Consequently, legislation or management plans published in other languages, and documents stored in less accessible systems (including subnational documents that may be stored locally) are unlikely to be comprehensively represented.

Documents collated for the focal countries features in Section 3 comprised of:

- national and/or subnational initiatives, frameworks or regulations that cover the **management** of all or selected marine ornamental fish species; and
- national and/or subnational regulations relating to the **export** of marine ornamental fish.

Further information was also summarised on any relevant transportation and quarantine measures to provide an overview of all steps in the domestic trade flow from point of harvest to point of export (see Figure 3.2).

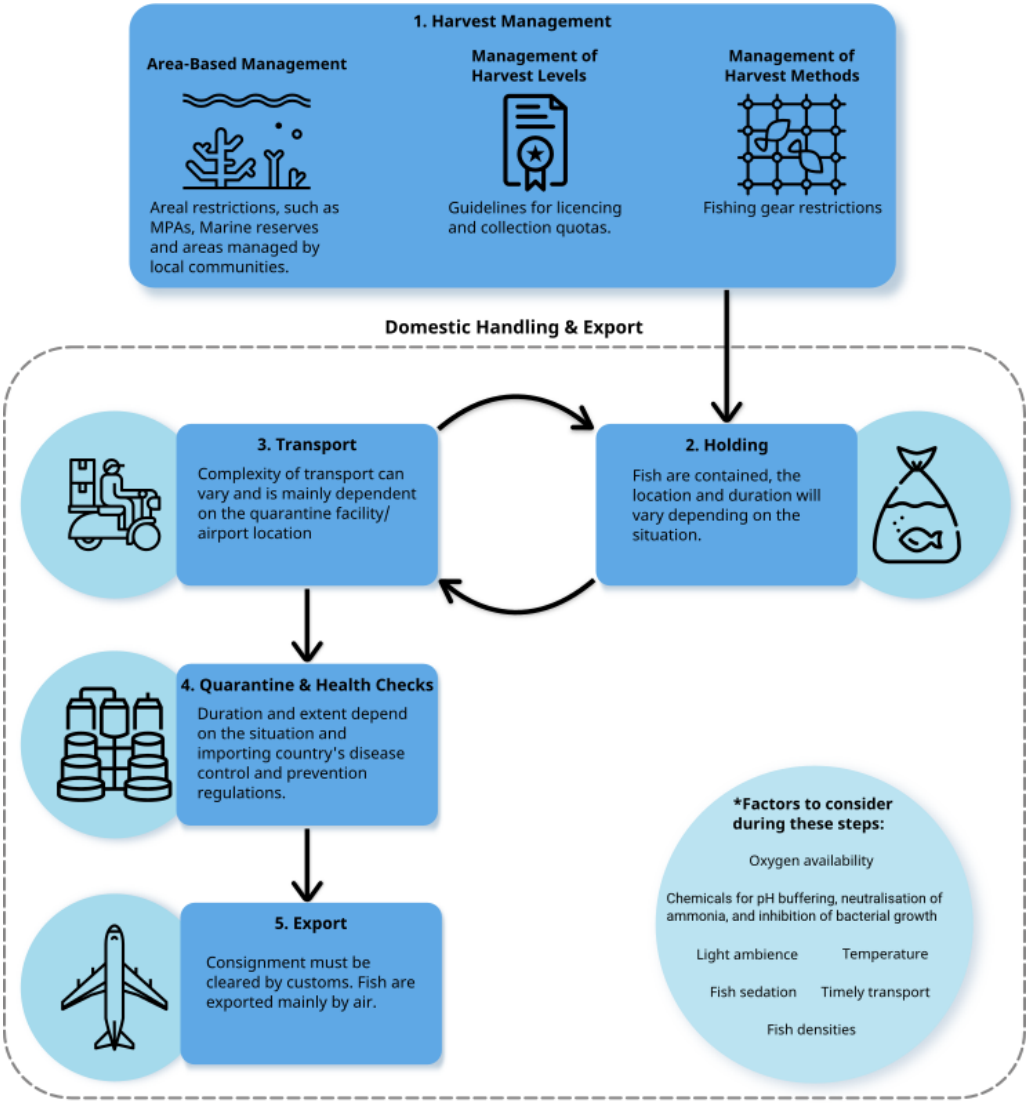


Figure 3.2. Steps in the domestic trade flow of marine ornamental fish. Key considerations for each step are outlined. ***Data sources:*** *Wabnitz et al., (2003); Livengood and Chapman (2007); Reksodihardjo-Lilley and Lilley (2007); Townsend (2011).*

[50] Accessed via https://leap.unep.org.
[51] Accessed via https://www.spc.int/CoastalFisheries/Legislation.

Information on the specific types of management measure (e.g. setting harvest quotas, establishing no take zones, restricting take to certain species), and whether these measures applied to all marine ornamental fish in the country, were also collated. Management measures were considered to be present if they were either evident in specific management plans (e.g. at the country level, or for specific reserves) and/or there were provisions in national/subnational legislation for the measures to be implemented (but there was no evidence of them in the management plans examined). As far as possible, this distinction is indicated in the results. A list of documents considered as part of this review is provided in Annex E.

Finally, the degree to which those species provisionally categorised as 'higher risk' in Section 2 were covered by management measures in focal country range States was also explored, where possible, including whether there were any specific management measures in place for these species (e.g. species action plans).

Results

Marine ornamental fish-specific harvest management and export measures

Based on available information, the harvest and export of marine ornamental fish in the focal countries appears to be largely regulated and managed as part of general fisheries management, rather than having management specific to live ornamental marine fish species. The exceptions are the Australian territories of Queensland and Western Australia, which have harvest management plans in place for specific marine ornamental fisheries, and the South Coast of Sri Lanka, which has specific live ornamental fish regulations (Table 3.2). Whilst there is no legislation specific to the export of marine ornamental fish, additional regulations around the export of live animals were identified for all focal countries.

All six focal countries of export specified harvest management or export measures for at least one marine ornamental fish species in legislation and/or management plans (Table 3.2). These measures included: inclusion in a national protected species list, prohibition of take, prohibition or restriction of exports, requirement for a species management or action plan, and/or additional harvest monitoring requirements within broader fisheries management plans. In total, 620 marine ornamental fish species were found to have additional harvest management or export measure requirements: 43 species had species-specific management measures[52], the remaining 577 species were included within family- or genus-level measures in one or more of their native range States.

Of the 71 species provisionally classified as 'higher risk' in Section 2, 37 were considered native to the waters of at least one of the focal countries (see Annex F for full list of provisional 'higher risk' species

[52] *Amphiprion latezonatus* (Wide-band anemonefish), *Amphiprion melanopus* (Fire clownfish), *Amphiprion ocellaris* (Clown anemonefish), *Amphiprion percula* (Orange clownfish), *Anampses elegans* (Elegant wrasse), *Balistoides conspicillum* (Clown triggerfish), *Carcharias taurus* (Sand tigershark), *Centropyge bispinosa* (Twospined angelfish), *Centropyge flavipectoralis* (Yellowfin angelfish), *Chaetodon bennetti* (Bluelashed butterflyfish), *Chaetodon ephippium* (Saddle butterflyfish), *Chaetodon falcula* (Blackwedged butterflyfish), *Chaetodon madagaskariensis* (Seychelles butterflyfish), *Chaetodon meyeri* (Scrawled butterflyfish), *Chaetodon octofasciatus* (Eightband butterflyfish), *Chaetodon ornatissimus* (Ornate butterflyfish), *Chaetodon semeion* (Dotted butterflyfish), *Chaetodon triangulum* (Triangle butterflyfish), *Chaetodon unimaculatus* (Teardrop butterflyfish), *Chaetodon xanthocephalus* (Yellowhead butterflyfish), *Chaetodontoplus ballinae* (Ballina angelfish), *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chaetodontoplus meredithi* (Queensland yellowtail angelfish), *Choerodon fasciatus* (Harlequin tuskfish), *Cirrhilabrus hygroxerus* (Monsoon fairy wrasse), *Cleidopus gloriamaris* (Australian pineapplefish), *Coris aygula* (Clown coris), *Epinephelus lanceolatus* (Giant grouper), *Heniochus monoceros* (Masked bannerfish), *Heniochus pleurotaenia* (Phantom bannerfish), *Labroides bicolor* (Bicolor cleaner wrasse), *Lutjanus gibbus* (Humpback red snapper), *Paracanthurus hepatus* (Blue tang), *Platax pinnatus* (Dusky batfish), *Meiacanthus bundoon* (Bundoon blenny), *Paraplesiops bleekeri* (Eastern blue devil), *Plectorhinchus albovittatus* (Two-striped sweetlips), *Pseudobalistes fuscus* (Yellow-spotted triggerfish), *Pterapogon kauderni (*Banggai cardinalfish), *Pterois radiata* (Radial firefish), *Pygoplites diacanthus* (Regal angelfish), *Siganus uspi* (Bicolored foxface) and *Variola louti* (Yellow-edged lyretail).

and whether they are native to any of the focal exporting countries). Seventeen 'higher risk' species were covered by harvest management or export measures in at least one of the focal countries: six of these had species specific measures (*Carcharias taurus* (Sand tigershark), *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chaetodontoplus meredithi* (Queensland yellowtail angelfish), *Epinephelus lanceolatus* (Giant grouper), *Pterapogon kauderni* (Banggai cardinalfish) and *Siganus uspi* (Bicolored foxface)) and the remaining 11 were included within family- or genus-level measures in one or more of their range States. All provisionally classified 'higher risk' species are included in Table 3.2. Twenty of species provisionally categorised as 'higher risk' and native to the focal countries were not found to be specifically included within national protected species lists amongst these countries.

Table 3.2*. National/subnational management measures specific to marine ornamental fish in the six focal countries of export. The number of marine ornamental fish identified with harvest management or export measures in place* are also detailed (see country summaries from page 46 onwards for further details). Marine ornamental fish-specific management documents and species lists are included in Annex E.*

Exporting country	Marine ornamental **fisheries managed** as part of general fisheries (✓) or specific to marine ornamental fish (✓✓)	Marine ornamental fish **exports** covered by regulations for general fisheries (✓) or specific to live animals (✓✓)	Marine ornamental fish with harvest management or export measures in place	Marine ornamental fish **provisionally classified as 'higher risk' in Section 2** with harvest management or export measures in place
Australia	✓✓ (subnational)	✓✓	✓ **462 species** subject to prohibition of take, management plan requirements or additional monitoring in one or more territories *Including 444 native species only covered by family-level measures for 6 families*[a]	✓ **8 species** (*Amphiprion mccullochi* (Whitesnout anemonefish), *Bodianus frenchii* (Foxfish), *Carcharias taurus* (Sand tiger shark), *Chaetodon trifascialis* (Chevron butterflyfish), *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chaetodontoplus meredithi* (Queensland yellowtail angelfish), *Chrysiptera hemicyanea* (Azure demoiselle), *Dunckerocampus dactyliophorus* (Ringed pipefish) and *Epinephelus lanceolatus* (Giant grouper))
Fiji	✓	✓✓	✓ **115 species** subject to harvest restrictions *Including 112 species only covered by family-level measures for 11 families*[b]	✓ 4 **species** (*Epinephelus fuscoguttatus* (Brown-marbled grouper), *Epinephelus lanceolatus* (Giant grouper), *Siganus uspi* (Bicolored foxface) and *Sphyraena jello* (Pickhandle barracuda))
Indonesia	✓	✓	✓ **1 species** subject to action plan	✓ **1 species** (*Pterapogon kauderni (*Banggai cardinalfish))
Kenya	✓	✓✓	✓ **2 species** require harvest licences	✓ **2 species** (*Carcharias taurus* (Sand tiger shark) and *Epinephelus lanceolatus* (Giant grouper))
The Philippines	✓	✓✓	✓ **65 species** require specific harvest permits *All are included in family- or genus-level measures*[c]	✓ **5 species** (*Bolbometopon muricatum* (Green humphead parrotfish), *Epinephelus fuscoguttatus* (Brown-marbled grouper), *E. lanceolatus* (Giant grouper), *Signus unimaculatus* (Blotched foxface) and *Sphyraena jello* (Pickhandle barracuda).)
Sri Lanka	✓✓ (subnational)	✓✓	✓ **25 species** subject to prohibition of take and/or export or restricted export	✓ **2 species** (*Epinephelus lanceolatus* (Giant grouper) and *Plectorhinchus albovittatus* (Two-striped sweetlips))

***** Measures include: prohibition of take or export, management plans, additional monitoring and harvest or export restrictions.

[a] Prohibition of take for Syngnathidae (seadragons, seahorses, pipefish) across Australia and additional monitoring of Chaetodontidae (butterflyfish), Gobiidae (gobies), Labridae (wrasses), Pomacanthidae (angelfish), Pomacentridae (damselfish and clownfish) in Queensland.

[b] Belonidae (needlefishes), Callyodontidae ([Scaridae] parrotfishes), Carangidae (jacks and pompanos), Hepatidae ([Acanthuridae] tangs), Lethrinidae (emperors and scavengers), Lutjanidae (snappers), Mugilidae (mullets), Mullidae (goatfishes), Serranidae (groupers), Siganidae (rabbitfishes), Sphyraenidae (barracudas).

[c] Dasyatidae (stingrays), *Epinephelus* (groupers), *Lutjanus* (snappers), Mugilidae (mullet), Scaridae (parrotfish), *Scolopsis* (monocle bream), Siganidae (rabbitfishes), Sphyraenidae (barracudas) and *Upeneus* (goatfish).

Overview of marine ornamental fish management and export measures in the focal exporting countries

All focal countries manage their fisheries (including their marine ornamental fisheries) via a combination of management measures. At a high level, these measures were categorised into area-based measures (e.g. protected areas); licensing and harvest level measures (e.g. quotas); and harvest method measures (e.g. gear restrictions, seasonal closures and prohibiting damaging fishing methods). Some measures are directly outlined in national/subnational legislation, whilst others are provisioned for in legislation but with actual measures established within more specific documents such as management plans (Table 3.3).

Based on available information, there were fewer measures regulating the export of marine ornamental fish in legislation than regulating the harvest of these species. In particular, none of the focal countries were found to regulate the quantities of marine ornamental fish exported, and only the Philippines reportedly regulated the size/development stage of one or more species of marine ornamental fish at export (as reported by a trader in their stakeholder survey). All countries, however, make provisions to ensure export measures and documentation meet the requirements of the countries of import. This means that specific export measures implemented are likely to vary depending on the country of import.

Stakeholder survey respondents from three of the focal countries provided specific information on legislation and enforcement related to the export of marine ornamental fish. of these, respondents from Australia (CITES Authority) and the Philippines (traders) considered the relevant legislation and enforcement, and the management measures in place to be sufficient for ensuring trade levels were sustainable (Table 3.4). The respondent from Kenya (CITES Authority) considered legislation and enforcement to be 'partially' sufficient, and management measures to be insufficient. No responses were received from any respondent affiliation or organisation in Fiji, Indonesia or Sri Lanka.

***Table 3.3**. Types of harvest and export management measures covering marine ornamental fish in the six focal countries of export. Colours indicate the following: dark blue = measures written into legislation; light blue = legislation allows for measures to be put in place (e.g. via management plans), or a response was provided via the stakeholder survey, but without wider context.*

Key: ✓ = evidence of measure in available documents or stakeholder survey response; X = measure not identified as present in stakeholder survey response and not found in available documents; ? = no stakeholder survey response received and no evidence in available documents.

	Measure	Australia*			Fiji	Indonesia	Kenya	Philippines	Sri Lanka
		Northern Territory	*Queensland*	*Western Australia*					
Harvest management measures	Prohibition/ regulation of take in protected areas	✓	✓	✓	✓ No take in subnational marine reserve regulations	✓ No take in conservation area core zones	✓ No take of protected species in MPAs	✓ No-take fish sanctuaries required for ≥15% coastal areas in each municipality	✓ No take in Marine Protected Areas or Sanctuaries
	Licensing system for fishing	✓ Specific licensing for harvest of commercial aquarium fish; no licence required for recreational fishing.	✓ Specific licensing for harvest of commercial aquarium fish	✓ Public permitted to collect for their own aquaria without licence.	✓	✓ Exemption for 'small fishers'	✓ A specific aquarium fish harvesting licence is required	✓ Collection permit required; priority given to local harvesters	✓ specific licensing for marine ornamental fish
	Harvest quotas by taxon per year	✓	✓ Stricter monitoring for priority taxa; harvest quotas are set in management plans.	✓	X *based on survey response*	✓	X *based on survey response*	✓	?
	Restrictions on size/ development stage	✓	✓	✓	✓ Size restrictions for taxa Sphyraenidae, Siganidae, and Lutjanidae	✓	✓	✓	✓
	Seasonal restrictions	✓	✓ Two five-day closures around the new moon in October and November	✓ No take in popular areas during tourist season.	✓ Taxon-specific seasonal harvest bans for groupers and coral trout	✓	✓	✓	✓ Informally established due to monsoon cycles
	Gear/ equipment restrictions	✓ Gear restricted to low-impact, hand-held equipment under aquarium fishery licence.	✓ Commercial gear restrictions; recreational collection restricted to free diving.	✓ Gear restricted to hand-held equipment.	✓ In subnational marine reserve regulations	✓	✓	✓ Gear restrictions; minimum mesh size	✓

	Measure	Australia*			Fiji	Indonesia	Kenya	Philippines	Sri Lanka
		Northern Territory	*Queensland*	*Western Australia*					
	Prohibition of fishing with explosives or poisons	✓ Prohibited, but may be permitted under specific agreed licences	✓	✓	✓	✓	✓	✓	✓
Export management measures	Prohibition of export of marine ornamental fish	✓ Only fish harvested from an approved Wildlife Trade Operation (WTO) can be exported			?	?	X *based on survey response*	✓ Export of globally threatened species prohibited	✓ Prohibited or restricted export for some species
	Controls on export quantities	X *based on survey response*			?	?	X *based on survey response*	X *based on survey response*	?
	Controls on sizes/ developmental stages that can be exported	X *based on survey response*			?	?	X *based on survey response*	✓ *based on survey response*	?
	Controls on source (e.g. wild, captive)	✓			NA (No evidence of captive breeding)	?	NA (No evidence of captive breeding)	NA (No evidence of captive breeding)	NA (No evidence of captive breeding)
	Monitoring of trade levels	✓ Domestic monitoring via annual reports for fisheries			?	✓ Domestic monitoring via health certificates	X *based on survey response*	✓	?
	Animal health provisions that cover live fish trade	*If required by importing country*			*If required by importing country*	✓	✓ Quarantine checks required	✓ Quarantine checks required	*If required by importing country*
	Industry standards regulating the live marine ornamental fishery	✓			✓	?	✓	✓	✓
	Additional measures	Management plans can only be made after an environmental impact assessment			Ecological/ species assessment required before fisheries harvesting granted	Further species-level protection for *Pterapogon kauderni*	An aquarium fisheries management plan is currently being developed **		Ecological/species assessment required before fisheries harvesting granted

* Australia is largely managed at subnational level; the key territories with relevant marine ornamental fisheries are shown disaggregated.
** Based on survey response from CITES Authority.

Table 3.4. *National legislation and enforcement relating to the export of marine ornamental fish species for the six focal countries of export based on stakeholder survey responses and supplemented with additional information on export legislation and enforcement bodies for the three focal export countries that did not provide survey responses (Fiji, Indonesia and Sri Lanka) was collected from the wider literature.* ***Data sources:*** *Responses to survey shared via Notif. 2021/030.*

Country/territory (no. survey responses)	National legislation relating to the export of marine ornamental fish	Body/bodies responsible for enforcement	Measures in place to ensure effective enforcement	Respondent considers national legislation enforcement to be sufficient	Respondent considers export measures to be sufficient	Respondent comments on whether enforcement and/or export measures are sufficient
Australia (1) *	✓ (at both national and state levels)	Managed by state-level government agencies and enforced by compliance officers and/or police (including water police).	Commercial catch logbooks, data monitoring, port inspections and often vessel trackers; land and sea patrols by police; surveillances, investigations and inspections of fishing boats, ports and wholesale/retail outlets.	✓	✓	-
Fiji (0)	✓ (Endangered and Protected Species Act 2002)	Ministry of Waterways and Environment	An authority officer conducts searches of premises and vehicles. Export permit must accompany consignments. Fines or imprisonment can be prescribed in the breach of regulations	-	-	-
Indonesia (0)	X	X	There is not a system for export licensing, instead traceability via quarantine regulations and health certificates is used to monitor the movement and export of marine ornamental fish.	-	-	-
Kenya (1) *	✓ (Fisheries Management and Development Act 2016)	The Kenya Fisheries Service	An aquarium fisheries management plan is being developed	Partial	X	Consignment value rarely fully disclosed and frequently under-reported.
Philippines (4)	✓ (Republic Act No. 10654) †	Bureau of Fisheries Department of Agriculture Local Government Units Coast Guard and maritime police	Multiple and unannounced facility inspections throughout the year; inspection required for granting export permits; inspection of shipments at the airport.	✓	✓	-
Sri Lanka (0)	✓ (Fishing (Import and Export) Regulations 2010)	Department of Fisheries and Aquatic Resources	Export licence, additional regulations and punishments for protected species	-	-	-

'- ' no response provided by survey respondent.
Survey response provided by CITES Authority (*) or another government agency (**).
† 3/4 survey respondents reported no or unknown relevant legislation in place.

Focal countries of export management summaries

Information on the management and relevant legislation relating to the harvest and export of marine ornamental fish was collated for six of the main marine ornamental fish exporting countries: Australia, Fiji, Indonesia, Kenya, the Philippines and Sri Lanka.

These country summaries identify where legislation or management plans specifically cover marine ornamental fisheries and, where possible, where subnational management is in place. Further details on harvest management measures in place via area-based management, the management of harvest levels (including via licensing) and of harvest methods, as well as information on holding, quarantine and health checks are also detailed for each country in turn, where relevant. Core legislations are named in the summaries, with further amendments and related legislation accessible via Annex E.

To contextualise the information on harvest management, the following information is also included for each country:

- the number of native marine ornamental fish in international trade, and the number of these that were provisionally classified as 'higher risk' in Section 2 (see Table 3.1);
- the percentage of global exports of live non-freshwater ornamental fish (HS code 030119) accounted for by the country according to exporter-reported data in UN Comtrade 2012-2021 (see Table 3.1);
- MPA coverage (Protected Planet[53]); and
- the percentage of MPAs with Protected Area Management Effectiveness (PAME) evaluations (Protected Planet[53]).

[53] UNEP-WCMC and IUCN (2022), Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM) [Online], October 2022, Cambridge, UK: UNEP-WCMC and IUCN. Accessed via: www.protectedplanet.net (extracted on 21/10/2022).

Australia

Number of native marine ornamental fish in international trade: 908 species[a]
Number of 'higher risk' marine ornamental fish: 23 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 4.3%[a]
MPA coverage: 44.34%[c]
MPAs with PAME evaluations: 5.1%[c]

Key harvest management measures

- Designated no take zones
- Commercial fishing licences required (restricted number of licences available)
- Gear and net restrictions
  Some subnational temporal closures
- Specific measures for protected species
- Prohibition of explosives and poisons

Key export management measures

- Industry standards for holding and transport
- Sanitary certificates can be issued if required by importing country
- Export permits required
- Export is only permitted from an approved program (e.g. Wildlife Trade Operation)

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

The marine ornamental fish industry in Australia is considered well-established, with licensed collectors and breeders supplying a network of exporters, domestic retailers, and hobbyists (O'sullivan *et al.*, 2008). Many collection businesses in Australia are family owned and have been running for at least 10 years (O'sullivan *et al.*, 2008), with limited new businesses entering the sector due to the restricted number of harvest licences permitted within each state (O'sullivan *et al.*, 2008). Most wild marine ornamental fish harvest occurs in the tropical reefs off the coasts of Western Australia, Northern Territory and Queensland (Morrisey *et al.*, 2011), supporting both domestic and international aquarium markets. A small number of Syngnathidae (seadragons, seahorses, pipefish) are also annually collected in Victoria to supplement breeding stock in the local aquaculture industry (≤4 individuals from each of the three permitted species), however no wild-caught specimens are permitted for export according to the relevant Declarations of an approved Wildlife Trade Operation (see environmental assessments for Victoria in Annex E).

According to the CITES Authority's stakeholder survey response, '*marine ornamental fisheries in Australia are managed on an ecological risk basis, with sustainable catch limits and reporting requirements set by the relevant State or Territory*'. Subnational fisheries regulations and management must also comply with the national Environment Protection and Biodiversity Conservation Act 1999 and associated 2000 Regulation, with further national industry standards for harvest and trade established in 2013 (Donnelly, 2013). Each of the main Territories with marine ornamental fisheries (Northern Territory, Queensland and Western Australia) have separate management plans and legislation that are developed and made available by state governments. This includes two management plans that apply specifically to marine ornamental fisheries: the Queensland Performance Measurement System (soon to be replaced by a Harvest Strategy) and the Western Australian Marine Aquarium Fish Managed Fishery Management Plan 2018 (with supporting Marine Aquarium Fish Resource of Western Australia Harvest Strategy 2018 – 2022). Specific management and related legislation in the Northern Territory, Queensland and Western Australia are discussed separately below, and all management plans and legislation are listed in Annex E.

Northern Territory: The harvest of aquatic resources in the Northern Territory is managed through the Northern Territory Aquarium Fishery via state legislation (see Annex E). The Aquarium Fishery is an approved national Wildlife Trade Operation under the Australian Environmental Protection and

Biodiversity Act 1999. Whilst this fishery appears to largely focus on coral harvesting, the harvest of marine ornamental fish also occurs. In the 2020-2021 fishing season, 2285 individuals from 33 marine finfish were reported as collected under Aquarium Fishery licenses, although it was noted that this may not be representative of other years due to limited air traffic in response to Covid-19 during this period (DITT, 2022).

***Queensland*:** Marine ornamental fish harvest in Queensland is managed via state legislation through two fisheries: the Marine Aquarium Fish and Coral Sea Fisheries (legislation and harvest strategies listed in Annex E). Both fisheries predominantly operate around the Great Barrier Reef and have an established working group under Fisheries Queensland to support the operational management of the two fisheries. The Queensland Aquarium Fish Fishery is an approved national Wildlife Trade Operation under the Australian Environmental Protection and Biodiversity Act 1999. In 2012-2020, an annual commercial live harvest of ~113,000 individual aquarium fish was reported for the Marine Aquarium Fish Fishery, although total numbers have been declining since 2016. Total catch by IPLCs and for recreational purposes are not reported, however numbers are believed to be very small.

Western Australia: The commercial harvest of marine ornamental fish in Western Australia is primarily managed by the Western Australia Marine Aquarium Fish Managed Fishery via state legislation (legislation listed in Annex E). This fishery has been active since the 1960s and is an approved Wildlife Trade Operation under the Australian Environmental Protection and Biodiversity Act 1999. In 2016-2020, an annual live harvest of ~21,500 individual aquarium fish (excluding Sygnathiformes) and <100 non-CITES listed Sygnathiformes was reported by the Marine Aquarium Fish Managed (Smith *et al.*, 2022). Four marine ornamental fish were harvested at levels >1000 individuals/year[54] including *Chaetodontoplus duboulayi* (Scribbled angelfish), which was provisionally identified as 'higher risk' in Section 2. Remaining species were all reported at <500 individuals harvested/year. No marine ornamental fish species was reported as harvested above its sustainable harvest threshold, and the Marine Aquarium Fish Resource risk assessment 2022 concluded the risk to all species from overharvesting at these levels to be negligible (Smith *et al.*, 2022).

[54] *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chelmon marginalis* (Margined coralfish), *Chromis atripectoralis* (Black-axil chromis) and *Anampses lennardi* (Blue-and-yellow wrasse)

Marine ornamental fishery harvest management: Northern Territory

Management measures in place		*Relevant regulations*
Area-based management	Harvest is permitted in all inland, estuarine, and marine waters up to the border of the Australian Fishery Zone, except protected areas (e.g., East Point Aquatic Reserve and Darwin Harbour), sanctuary zones and Aboriginal sacred sites. Details of area restrictions are outlined in Northern Territory aquarium fishery assessment reports (DPIR, 2019; DITT, 2022).	Regulation No. 20/1992
Licencing and harvest level management	Up to 12 **Aquarium Fishing/Display licences may be issued** for the commercial harvest of live fish for sale and display in aquariums. Individual licences may have different agreed fishing restrictions, including harvest levels and permissible species to harvest, trade and/or display. In the 2020/2021 season 11 licences had been issued, although five of the seven active licences were for corals (DITT, 2022). Whilst IPLCs are entitled to harvest fish using traditional methods for local use, they are not permitted to fish commercially without a licence. It was recognised in the Northern Territory Aquarium Fisheries assessment reports 2016 and 2019 that coastal IPLCs had expressed interest in entering the commercial aquarium trade, and that additional mechanisms for inclusion within the industry needed to be explored (Anon, 2016; DITT, 2019). However, this did not appear in the fishery's 2022 Wildlife Trade Operations Export Approval Submission (DITT, 2022).	Regulation No. 20/1992
	Licences are not required for recreational fishing, however there are total catch and size restrictions in place and fish caught recreationally cannot be sold onwards (NT Recreational Fishing Controls, 2020). Marine ornamental fish harvest must also be recorded in a commercial logbook by the number of individuals harvested and reported monthly (DITT, 2022).	
	Catch of **species protected in national or state legislation** is not permitted; this includes all Syngnathidae (seadragons, seahorses, pipefish) found in Northern Territory waters[55](DPIR, 2020). Further populations of *Cirrhilabrus hygroxerus* (Monsoon fairy wrasse) and a localised black colour morph of *Amphiprion ocellaris* (Clown anemonefish) were found to be at 'highest risk' in an ecological risk assessment in 2019 (DITT, 2019). The population of *A. ocellaris* (endemic to the greater Darwin region) had the highest risk rating of all species assessed, and a two-year moratorium on commercial take was established until 2022 (DITT, 2022).	
Harvest method management	**Low-impact, hand-held collection methods** for marine ornamental fish are permitted under Aquarium Fishing/Display Fishery licensing including cast and scoop nets.	Regulation No. 20/1992[56]
	Specific **restrictions on explosives or dangerous substances were not identified** for marine ornamental fish, however these methods may be permitted under general fishing licences.	Act No. 58/1988; Regulation No. 20/1992

[55]Although there is no state list of native Syngnathids, FishBase lists 19 as native to Australia including *Dunckerocampus dactyliophorus* (Ringed pipefish), which was provisionally classified as a 'higher risk' species in Section 2.

[56] Potential Aquarium Fishery management measures are detailed in the 2022 Northern Territory Aquarium Fishery Wildlife Trade Operations Export Approval Submission. Accessed via: https://www.dcceew.gov.au/sites/default/files/documents/nt-aquarium-reassessment-aug-2022.pdf.

Marine ornamental fishery harvest management: Queensland

Management measures in place		*Relevant regulations*
Area-based management	**Fishing is prohibited** in the areas of the Coral Sea Fishery designated IUCN II (National Park) (Director of National Parks, 2018), while the remaining area of the fishery is managed under the Australian Fisheries Management Authority's harvest strategies.	Regulation No. 83/2008
Licencing and harvest level management	In both Queensland fisheries a **licence is required** to collect marine ornamental fish; individual licences may have specific restrictions (e.g. on fishing area, species permitted for harvest and catch limits). The Marine Aquarium Fish Fishery permits up to 49 licences, and the Coral Sea Fishery allows up to 12 permits including two specifically for the aquarium sector (including corals) (AFMA, 2021).	
	All commercial state-managed fisheries are required to complete a **logbook with daily catch and effort** (by species), and details of collection time, location and the type of fishing gear/method used. Any catch that is then released or discarded must also be recorded.	Legislation No. 178/2019
	Neither Queensland fishery sets quotas, but offtake of certain species is prohibited in all state waters, including all Syngnathidae (seadragons, seahorses, pipefish) and the 'higher risk' *Epinephelus lanceolatus* (Giant grouper) (DEEDI, 2011). Total catch levels (or 'triggers') are also in place for relevant species within the main commercially harvested marine ornamental fish taxa in Queensland[57], which trigger a review and potential catch level adjustment if exceeded (DAF, 2021). The **Marine Aquarium Fish Fishery harvest strategy** also classifies species into tiers based on their ecological risk: species classified in 'tier 1' are considered to have a moderate or high risk from harvesting and require a management plan to be put in place to manage the risk. Tier 1 species include 11 non-CITES listed marine ornamental fish[58], including *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chaetodontoplus meredithi* (Queensland yellowtail angelfish) and *Epinephelus lanceolatus* (Giant grouper), which were identified as 'higher risk' species in Section 2.	
Harvest method management	**Commercial apparatus is restricted** to the use of small seine nets, lines with single barbless hooks and scoop nets with self-contained underwater breathing apparatus (scuba) or hookah, and recreational harvesters are restricted to free diving only (CITES Management Authority for Australia stakeholder survey response).	Regulation No. 83/2008
	Specific **seasonal closures** are also in place, including for two annual 5-day periods around the new moon in October and November. Size limits also exist for many finfish groups (maintained on the Queensland Parliamentary Council website; DEEDI, 2009).	Regulation No. 83/2008
	Explosives and noxious substances are also strictly prohibited.	Regulation No. 83/2008

[57] Pomacentridae (damselfish and clownfish), Chaetodontidae (butterflyfish), Pomacanthidae (angelfish), Labridae (wrasses) and Gobiidae (gobies).

[58] *Amphiprion latezonatus* (Wide-band anemonefish), *Amphiprion melanopus* (Fire clownfish), *Amphiprion ocellaris* (Clown anemonefish), *Amphiprion percula* (Orange clownfish), *Chaetodontoplus duboulayi* (Scribbled angelfish), *Chaetodontoplus meredithi* (Queensland yellowtail angelfish), *Choerodon fasciatus* (Harlequin tuskfish), *Cleidopus gloriamaris* (Australian pineapplefish), *Epinephelus lanceolatus* (Giant grouper), *Lutjanus gibbus* (Humpback red snapper), *Paracanthurus hepatus* (Blue tang).

Marine ornamental fishery harvest management: Western Australia

Management measures in place		*Relevant regulations*
Area-based management	**Harvest is not permitted in protected areas**, including reef observation areas and sanctuaries, as well as marine nature reserves where both commercial and recreational fishing are not permitted. Commercial fishing may also be restricted in marine parks and marine management areas subject to site-specific management plans	Act No. 126/1984
Licencing and harvest level management	Within the Marine Aquarium Fish Managed Fishery, a **licence is required** to collect marine ornamental fish for commercial purposes. Whilst licensing is not required for recreational fishing, the number of recreational collectors is considered negligible (DPIRD, 2018). Twelve Managed Fishery Licences were in place at time of the 2018-2022 fishery management plan publication, each of which had specific restrictions on harvest size, species and equipment.	
	There are established quotas for a limited number of species, which are managed under the Individual Transferrable Quota system and include Syngnathiformes (seadragons, seahorses, pipefish) (FRMA, 2018). For other species, annual catch level is considered low compared with stock levels, so is primarily managed by limiting the number of commercial licences (DPIRD, 2018). Threshold levels exist for all marine ornamental fish targeted by the fishery, which if exceeded, triggers a review of management arrangements (DPIRD, 2018). All catch must be recorded in the logbook by the number of individuals/total weight, effort, and collection location. Ecological risk assessments are reviewed approximately every 3-5 years to ensure sufficient sustainable management of the fishery.	
Harvest method management	Apparatus is restricted to hand-held tools, nets and line fishing (FRMA, 2018), and the use of **noxious substances and explosives is prohibited.**	Biodiversity Conservation Regulations 2018

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	**No legislation pertaining specifically to the holding and transport** of marine ornamental fish were identified, however the condition of the vessel or aircraft on which the live animals, including fish, are being transported should not deteriorate the health and welfare of the animals.	Export control (Fish and Fish Products) Rules 2021; Export Control (Animals) Rules 2021
	Pre-export quarantine or isolation of live animals must be carried out at approved premises (decided by the Secretary) **only if required by the importing country.** Conditions to ensure that the health and welfare of the live animals during export, including the condition of the vessel or aircraft, the nature of their accommodation, and feed and water, are to be considered but not specified. Accredited veterinary health checks for live animals prior to export are only required for livestock.	Act No. 12/2020; Export Control (Animals) Rules 2021
Export	The export of regulated native specimens is prohibited unless (1) an export permit is obtained, (2) the export is from an approved program such as a Wildlife Trade Operation or management plan, or (3) if the export is for the exchange of scientific specimens. This effectively limits the export of marine ornamental fish to those harvested from marine ornamental fisheries such as the Queensland Aquarium Fish Fishery and the Western Australia Marine Aquarium Fish Managed Fishery, which are approved Wildlife Trade Operations. An **export permit for 'prescribed live animals', including fish**, is required and involves the approval of a notice of intention, and, if required, a government certificate and health and welfare checks to meet importing country regulations and authorisation under Commonwealth law.	Act No. 91/1999; Act No. 12/2020; Export Control (Animals) Rules 2021
	Licences and permits for the take, trade and export of live fish are managed at state or territory level, for example in Australian Capital Territory (ACT), New South Wales (NSW), Northern Territory (NT), Victoria, Queensland, and Western Australia (WA). Additional requirements include a permit for keeping fish in a confined area for commercial purposes in New South Wales, and the specifications for aquarium trade licences in the aquarium fishing/display fishery industry in the Northern Territory.	Act No. 58/1988 (NT); Act No. 1/1994 (NSW); Fish Resources Management Regulations 1995 (WA); Act No. 92/1995 (VI); Act No. 21/2000 (ACT); Regulation No. 178/2019 (QL)
Enforcement	All fisheries from which export is granted are required to produce annual reports to the Department of the Environment and Water Resources including information about catch data and status of target stock, quantities and numbers of specimens sold for each species, and status of export approval/accreditation. A civil penalty may be liable to individuals who have exported live animals in contravention of the prescribed export conditions.	Act No. 91/1999; Guidelines for the Ecologically Sustainable Management of Fisheries 2007; Export Control (Animals) Rules 2021

Fiji

Number of native marine ornamental fish in international trade: 459 species[a]
Number of 'higher risk' marine ornamental fish: 9 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 2.9%[a]
MPA coverage: 0.92%[c]
MPAs with PAME evaluations: 0.01%[c]

Key harvest management measures

- Designated no take zones through both MPAs and community marine reserves
- Commercial fishing licences required but no quotas
- Gear and fish size restrictions
- Breathing apparatus not permitted for collection
- Prohibition of explosives and poisons

Key export management measures

- Industry standards for holding and transport
- Sanitary certificates can be issued if required by importing country
- Export permits required
  Specific export permits for protected species

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

Fiji has been actively exporting marine ornamental fish since 1984 and is considered the largest Pacific Island exporter of fish for the aquarium trade (Manoa, 2008). Harvesting of marine fish is regulated via national legislation, subnational secondary legislation and community-based management of traditional fishing grounds (known locally as 'qoliqoli'[59]) (legislation and management plans in Annex E).

The marine ornamental fish supply chain in Fiji is relatively short (Gillett *et al.*, 2020), largely comprising of IPLC collectors employed or informally contracted to directly collect marine ornamental fish by exporting companies (Lal and Cerelala, 2005). In 2008, there were three aquarium companies based in Fiji and operating in the traditional fishing grounds (Manoa, 2008), with compensation paid to the qoliqoli owners for access to the fishing area (Teh *et al.*, 2009). One of these companies is still active, however no evidence of current activity were found for the remaining two.

Marine ornamental fisheries are managed via general food fisheries or marine reserve management plans and legislation, rather than any specific to the harvest of live ornamental species (see Annex E for full list of legislation and subnational reserve-specific management plans). Where non-CITES marine ornamental fish species are afforded more specific protection, this is targeted at taxa such as groupers and coral trout[60], in the form of seasonal harvest bans. These are both, however, ornamental and food fish, rather than species that are harvested exclusively for ornamental purposes.

[59] Qoliqolis are fishing grounds owned by IPLCs including family units and socio-political associations of indigenous Fijian communities (Lal and Cerelala, 2005) who have the right to manage and utilise these areas for subsistence under the Qoliqoli Bill 2006.
[60] Subject to ongoing seasonal harvest restrictions under the Ban on fishing, collection, sales and export of all species of Grouper (Kawakawa) and Coral trout (Donu) (Annex E).

Marine ornamental fishery harvest management

Management measures in place		*Relevant regulations*
Area-based management	Harvest **restrictions vary between marine reserves**, with specific provisions detailed in the reserve-specific regulations. However, several reserves[61] all follow the same management structure, with the collection of all species prohibited within the reserve and a buffer zone in which only targeted, low impact fishing practices are permitted.	Act No. 4/1941
	Fisheries management measures are also established via **community-declared (i.e. non-gazetted) marine reserves** in line with national regulations. For example, 12 of the community marine reserves detailed in the Kubulau District Management Plan prohibit take of 'any aquatic animal, including fish' in their waters (management plan in Annex E).	Act No. 4/1941
Licencing and harvest level management	**Licensing is required** for all commercial fishing in Fiji's waters, including for IPLCs (Tokabwebwe, 2015). However, according to the stakeholder survey response from a Fiji-based aquarium company, there are no restrictions on the number of fish that can be harvested annually once a licence has been acquired. It was noted that aquarium companies have utilised the same collection sites for many years without negatively impacting fish abundance (stakeholder survey respondents, Manoa, 2008), however no information on oversight or long-term monitoring was identified.	Act No. 4/1941
Harvest method management	Fishing net, mesh and taxon-specific fish size regulations are directly outlined in legislation. Size restrictions are specified for 11 families of fish that include marine ornamental species native to Fiji[62]; this includes *Siganus uspi* (Bicolored foxface) and *Sphyraena jello* (Pickhandle barracuda) from the families Siganidae (rabbitfishes) and Sphyraenidae (barracudas) respectively, which were provisionally classified as 'higher risk' in Section 2. The use of **breathing apparatus is also not permitted** during the collection of fish (including ornamental fish); however, the ongoing use of scuba gear was reported in 2020 (Vacala, 2020).	Regulation No. 17/1965; Legal Notice No. 17/1997
	Whilst no seasonal harvest restrictions were identified specifically for marine ornamental fisheries in Fiji, seasonal bans have been put in place for grouper and coral trout species, which are traded for both aquaria and as highly valued food fish. The fishing, collection and sale of these species has been prohibited during peak spawning season (June-September) since 2018.	Announced via public notice[63]
	Explosives and the use of chemicals aimed at 'taking, stupefying, or killing' fish are prohibited, including the use of any substance containing derris vine, (a plant highly toxic to fish with paralysis effects).	Act No. 4/1941; Decree No. 78/2012

[61] Shark Reef Marine Reserve (2014), Wakaya Marine Reserve (2015), Kiuva Marine Reserve (2018) and Naigoro Passage Spawning Aggregation Marine Reserve (2018) (Annex E).

[62] Belonidae (needlefishes), Callyodontidae ([Scaridae] parrotfishes), Carangidae (jacks and pompanos), Hepatidae ([Acanthuridae] tangs), Lethrinidae (emperors and scavengers), Lutjanidae (snappers), Mugilidae (mullets), Mullidae (goatfishes), Serranidae (groupers), Siganidae (rabbitfishes), Sphyraenidae (barracudas).

[63] First announced via Public Notice 2018 on the Seasonal Ban of Grouper and Coral Trout (issued under Regulation 4 of the Offshore Fisheries Management Regulations 2014), and later via publicly announced extensions to this ban. The ban was temporarily lifted in 2020 and 2021 to reduce the negative economic impact of Covid-19 on harvesters.

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	Existing legislation for the movement of fish from collection site to export in Fiji appears to primarily apply to food fish, rather than ornamental species caught for the live aquarium trade. However, specific regulations are in place for **the holding and transport of endangered species** (including live specimens), which include 3 non-CITES marine ornamental fish species[64], of which two species (*Epinephelus lanceolatus* (Giant grouper) and *Siganus uspi* (Bicolored foxface)) were provisionally classified as 'higher risk' in Section 2.	Act No. 29/2002
	Biosecurity inspections and sanitary certificates can be issued in accordance with the **requirements of the importing country** at the port of export. Biosecurity measures can also be requested by a Biosecurity Authority in addition to those required by the importing country prior to granting export clearance, however biosecurity or health checks do not appear to be required for every shipment.	Promulgation No. 28/2008
Export	The Fisheries Department issues **permits for the export of live fish**, export without a permit is prohibited.	Regulation No. 17/1965
	Specific export permits are required for species listed as protected, 3 of which are non-CITES marine ornamental fish species[65], including two provisionally identified as 'higher risk' in Section 2: *Epinephalus lanceolatus* (Giant grouper) and *Siganus uspi* (Bicolored foxface).	Act No. 29/2002
Enforcement	Fines and/or imprisonment can be applied for the attempted export of species listed in the Endangered and Protected Species Act 2002 without a permit.	Act No. 29/2002

[64] *Epinephelus lanceolatus* (Giant grouper), *Meiacanthus bundoon* (Bundoon blenny) and *Siganus uspi* (Bicolored foxface).

Indonesia

Number of native marine ornamental fish in international trade: 1011 species[a]
Number of 'higher risk' marine ornamental fish: 24 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 18.6%[a]
MPA coverage: 3.06%[c]
MPAs with PAME evaluations: 0.08%[c]

Key harvest management measures

- Designated no take zones
- Commercial fishing licences required
- Temporal, species and gear restrictions can be implemented via management plans
- Net restrictions (*but more relevant to food fisheries*)
- Prohibition of explosives and poisons

Key export management measures

- Traceability from harvest to export via health certificates (required for export and domestic movement)
- Quarantine before export
- Further certification for export of protected species

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

Indonesia is one of the two main exporters of marine ornamental fish (see Section 1), which are primarily harvested from Jakarta and Bali, and in smaller quantities from Makassar (South Sulawesi), Solo (Java) and Medan (North Sumatra) (Sinansari and Priono, 2019). Most harvesting is carried out by small-scale collectors who trade with local intermediaries (Ferse *et al.*, 2012; Glaser *et al.*, 2015). Local marine ornamental fisheries also play an important role in the economic stability of many coastal IPLCs (Reksodihardjo-Lilley and Lilley, 2007).

According to Muawanah *et al.* (2018), Indonesia committed to move towards an ecosystem approach to fisheries management, with the aim of securing long-term sustainability of both fisheries and the ecosystem services they provide to society. With decision making in Indonesia dispersed across national, provincial and district levels of government, effective fisheries management and enforcement requires cooperation and coordination across many agencies (Sari *et al.*, 2022).

At the national level, marine ornamental fisheries are largely managed by general fisheries legislation, rather than anything specific to the harvest of live ornamental species (see Annex E for full list of legislation). In addition, fisheries management is decentralised to provincial governments, allowing for more nuanced community-based management systems. Except for the *Pterapogon kauderni* (Banggai cardinalfish) National Plan of Action (Case Study 1), no evidence of subnational marine ornamental fisheries management was identified. However, this is likely to reflect the limited number of subnational legislation and documents available in English online. Furthermore, no survey response was received from an Indonesian government authority and the one respondent from Indonesia (a national NGO) did not provide information on marine ornamental fish management or legislation.

Expert stakeholder survey responses [65] named Indonesia as a country with no/insufficient management measures, insufficient enforcement of management measures and insufficient industry standards to ensure the sustainable harvest of marine ornamental fish. However, a trader indicated that they believed Indonesia's industry standard were sufficient. One respondent noted that while the harvest of marine ornamental fish does fall within existing legislation in Indonesia, enforcement is often considered to be inadequate (particularly in remote areas) due to resource limitation and low capacity for monitoring.

[65] From an importing country CITES Authority, an international NGO and an independent researcher.

Marine ornamental fishery harvest management

Management measures in place		*Relevant regulations*
Area-based management	A zoning system of management is implemented for coastal areas up to 12 nautical miles from shore. **Licences cannot be issued for activities (including fish harvest) within designated core zones**, while other areas designated as sustainable fisheries zones and utilisation zones are subject to a fisheries management action plan. No activity is permitted that changes the 'natural integrity' in areas designated as Sanctuary Reserves or Nature Conservation Areas, although it is unclear whether this includes fish collection.	Act No. 5/1990; Law No. 1/2014; Act No. 23/2014
Licencing and harvest level management	**Licensing is required** for all commercial fishing in Indonesian waters, excepting individuals classed as 'small fishers'[66] who are exempt from licensing. Permits are either location or resource specific and are issued by the relevant minister via management plans. There is no limit on the number of permits that can be issued.	Law No. 45/2009
	Collection quotas can be set in local fisheries management plans, but no relevant quotas were published within national legislation. Whilst there are also regulations specifically restricting the collection of threatened species[67], no non-CITES marine ornamental fish species were included in the resulting protected species list. According to Akmal *et al.* (2020), government authorities **do not collect data on either the species or number of individuals of marine ornamental fish harvested**, rather, harvest is recorded in national statistics as 'ornamental fish' by weight, and therefore species-specific sustainable harvest levels cannot be set or monitored.	Regulation No. 60/2007
Harvest method management	Minister can introduce restrictions (via fisheries management plans) to dictate closed seasons, the size of fish that can be taken, equipment that can be used and monitoring requirements (e.g., the use of a logbook to record catch). No management plans implementing such restrictions were identified, but this may be because they were published in local languages or were not readily available online, and no stakeholder survey response was provided by Indonesia.	Regulation No. 60/2007
	The use of seine and trawl nets is prohibited, however there are reports of ongoing illegal net use due to limited enforcement (Sahputra, 2022).	Decree No. 18/2021
	Destructive fishing methods are strictly prohibited, including explosives, poison and other materials that destroy reefs. However, possessing specimens obtained using destructive methods is not prohibited. Furthermore, according to Glaser *et al.* (2015) there is evidence of ongoing use of these fishing methods due to minimal punishment, poor enforcement and a lack of support for small-scale harvesters to purchase alternative equipment.	Law No. 45/2009

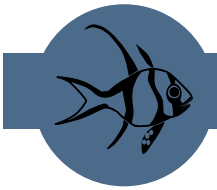
[66] Defined in Fisheries Law No.45/2009 as '*any person whose livelihood is fishing in order to fulfil his/her daily needs by using fishery vessel with maximum capacity of 5 (five) gross ton (GT)*'.
[67] Act No. 5/1990 on the Conservation of Biological Resources and their Ecosystems.

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	Whilst holding and transporting marine ornamental fish does not appear to require a licence, **health certificates are required** for export, import, and domestic movement between different areas [68] of Indonesia. This creates a **traceable record of the movement from harvest site to point of export**, although does not provide verification of the sustainability or legality of animal sourcing. To effectively manage the movement of marine ornamental fish domestically, web-based e-permitting systems have also reportedly been developed to allow for more thorough trade monitoring and streamlined trade process (CITES AC31 Doc. 31). For example, a quarantine certification platform was reportedly launched via the Fish Quarantine and Inspection Agency in 2021 to facilitate the domestic trade in certified fish between areas (Akmal *et al.*, 2021).	Law No. 21/2019
	All animals must be **quarantined** prior to export. Provisions for quarantine facilities at the points of entry and exit between areas and into/out of the country are also outlined.	Law No. 21/2019
Export	All animals and/or animal products require an '**export approval**' to be submitted as a goods export notification and approved prior to export. A **health certificate** must also be issued by a certified veterinarian prior to export.	Law No. 21/2019; Regulation No. 29/2019
	Traders of *Pterapogon kauderni* **require further registration to export** this species.	Banggai Cardinal Fish National Plan of Action
Enforcement	The Animal, Fish and Plant Quarantine Law No. 21/2019 has facilitated closer surveillance of the movement of animals and plants, as well as providing stronger provisions for punishing illegal activity under the Law with fines and imprisonment. In a 2020 report, TRAFFIC highlighted several instances of this Law being used to facilitate wildlife seizures for other taxa and to provide evidence during the prosecution of alleged wildlife traffickers (Anatory and Jumadh M, 2020).	Law No. 21/2019

It was also noted by Akmal *et al.* (2020) that there is a mismatch between the number of species reported as exported by Indonesia and those reported as imported by trading partners, with almost twice as many species reported as imported into the US as were exported by Indonesia around the same time. This may indicate issues with identification, mismatches in nomenclature or differences in the level of reporting between the two trading Parties. Clarification and resolution of such mismatches would be an important step in ensuring trade is monitored more robustly.

[68] In the context of this Act, 'area' refers to '*an administrative area of government, part of an island, and island, or group of islands within a sovereign territory of the Republic of Indonesia*'.

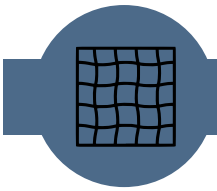


Case Study 1| Banggai cardinalfish Management Plan

The Banggai Cardinal Fish National Plan of Action was put in place for 2017-2021 to cover several aspects of management for *Pterapogon kauderni* (Banggai cardinalfish) (Direktorat konservasi dan kaenekaragantan hayati laut, 2016) (Direktorat konservasi dan kaenekaragantan hayati laut, 2016). This includes the ongoing designation of a MPA that restricted entry into and activity within the endemic range of the species; in line with the zoning system used for MPA's across Indonesia, this MPA prohibited take of the species in core zones. However, surveys between 2017 and 2019 have not yet reported any difference in *P. kauderni* population patterns between sites within the MPA and controls (CITES AC31 Doc. 31), and the Marine Protection Atlas currently classifies it as a 'less protected/unknown' MPA[69]. The take of sea urchins and anemones was also restricted to preserve key habitat.

Harvest of *P. kauderni* is prohibited during the species peak reproduction periods (Feb-March and Oct-Nov). Harvest quotas outside of these times are set based on TAC (total allowable catch), as determined by data collected from ongoing population and habitat monitoring. There is a commitment to prioritise local fishers/traders when allocating the harvest quotas, and a restocking effort is reportedly underway across the species original distribution. Further details are summarised in CITES AC31 Doc. 31, although the translated text of the National Plan of Action could not be accessed.

A new five-year (2022-2026) national strategy for this species is reportedly being prepared (Gokkon, 2022).



Case Study 2| Community-based management in Les, Bali

Marine ornamental fishing and the use of cyanide was first adopted in Les, in the Buleleng district, Bali, Indonesia in the 1980s and became widespread by 1990. The adoption of cyanide fishing was estimated to have caused the loss of over 90% of live coral cover in the area (Frey, 2012; Frey and Berkes, 2017), and the decline in ornamental fish diversity (Muswar *et al.*, 2019). In response, the Indonesian NGO, Yayasan Bahtera Nusantara (YBN) worked with >100 local marine ornamental fish collectors to implement sustainable alternatives to cyanide such as the use of barrier nets and hand nets to catch the fish (Yahya *et al.*, 2008; Frey, 2012). This led to the creation of a self-organised ornamental fishers' association and the founding of the Ministry of Marine Affairs and Fisheries in 2001 (Frey and Berkes, 2017). All marine ornamental fish collectors at Les abandoned the use of cyanide for new techniques by 2003 and created a community-based export business (Frey and Berkes, 2017; Muswar *et al.*, 2019).

Further collaboration between the Marine Aquarium Council (MAC), local NGOs and marine ornamental fish collectors in Les established artificial reefs and an eco-labelling scheme to promote cyanide-free fishing through a sustainable-sourcing price premium (Frey, 2012; Muswar *et al.*, 2019). The eco-labelling period continued for a few years before the MAC in Indonesia was dissolved (Frey and Berkes, 2017), but cyanide-free fishing in Les is said to have continued (Muswar *et al.*, 2019). Data from the Indonesian Nature Institute found that live coral cover in Les rose to approximately 45% in 2011, primarily attributed to reef restoration efforts (Frey, 2012; Frey and Berkes, 2017).

[69] Accessed via: https://mpatlas.org/zones/68808721.

Kenya

Number of native marine ornamental fish in international trade: 249 species[a]
Number of 'higher risk' marine ornamental fish: 9 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 2.8%[a]
MPA coverage: 0.73%[c]
MPAs with PAME evaluations: 0.07%[c]

Key harvest management measures

- Designated no take zones
- Commercial fishing licences required but not quotas
- Gear and net restrictions
- Prohibition of explosives and poisons

Key export management measures

- Industry standards for holding and transport
- Quarantine before export
- Export permits and health certificates required

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

The marine ornamental fish industry was established in Kenya in the 1970s (Okemwa *et al.*, 2006) and is considered the largest exporter in the Western Indian Ocean (Opiyo *et al.*, 2016). All marine ornamental fish are mainly harvested from the wild along the Southcoast, Mombasa and Kilifi areas, with Shimoni and Nyali being the most popular fishing sites (Okemwa *et al.*, 2006). Marine ornamental fish are primarily harvested using carious dip and scoop hand nets along with snorkels in shallow water and scuba gear in deeper waters (Okemwa *et al.*, 2006).

Kenya has a short supply chain, where collectors are hired directly by the exporting companies according to international market demand (Okemwa *et al.*, 2016). All gear used by collectors is provided by the exporters, including motorised boats and vehicles for the transport of fish to holding tanks (Okemwa *et al.*, 2006). It was estimated that there were approximately 200 full-time licensed collectors working in 2014 (Bodi, 2016). Eight exporting companies were reportedly active in 2016, with one company accounting for 70% of consignments (Okemwa *et al.*, 2016). Three of these companies, including the dominant company, are still active (Abuyeka, 2022).

At the national level, marine ornamental fisheries are largely managed by general fisheries legislation, rather than anything specific to the harvest of live ornamental species (see Annex E for full list of legislation). According to Opiyo *et al.* (2016), these regulations are not well enforced for marine ornamental fish harvesting due to limited data on harvest levels and the lack of specific management measures for ornamental fisheries. However, in their stakeholder survey response, the CITES Authority respondent from Kenya noted that a specific aquarium fisheries management plan is currently under development to address this issue.

Marine ornamental fishery harvest management

Management measures in place		*Relevant regulations*
Area-based management	Fishing is prohibited within MPAs designated as **Marine Parks** (unless with written permission of the Director-General) or **Marine Reserves** (except for subsistence fishing, which is unlikely to include the harvest of marine ornamental fish). MPAs designated as Marine Conservation Areas include a zoning system of management, which may also include areas where the harvest of marine resources is prohibited.	Act No. 47/2013; Act No. 35/2016
	Informal seasonal area-based fishing restrictions are also effectively established due to seasonal monsoon activity. For example, in the southeast of the country, fishing during monsoon season is restricted to snorkelling in the shallow waters close to shore (Okemwa *et al.*, 2006).	
Licencing and harvest level management	**Licenses are required** to harvest fish live for aquarium purposes. Any activity relating to listed endangered and threatened species requires a permit. Furthermore, the Cabinet Secretary may prohibit any activity compromising the survival of a listed species. The list of endangered and threatened species includes 2 non-CITES marine ornamental fish species which were also provisionally classified as 'higher risk' in Section 2: *Epinephelus lanceolatus* (Giant grouper) and *Carcharias taurus* (Sand tigershark). Recovery plans can also be created for listed species.	Regulation No. 34/1991; Act No. 47/2013
	The Director-General can set limitations on the amounts and species fished in Kenyan waters; however, no quotas were identified for marine ornamental fish.	Act No. 35/2016
Harvest method management	Certain net types are prohibited including monofilament netting, which may have otherwise been used in marine ornamental fish harvesting.	Act No. 35/2016
	Power is given to the Director-General to establish seasonal and additional gear restrictions.	Act No. 35/2016
	Explosives and poisons are prohibited for the collection of any fish.	Regulation No. 34/1991; Act No. 47/2013; Act No. 35/2016

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	A **permit is required** to move live fish between Kenya's four domestic water catchment areas.	Regulation No. 34/1991
	Whilst no legislation pertaining specifically to the transportation of marine ornamental fish was identified, there are broad regulations regarding the maintenance of good welfare standards during the holding of live fish. For example, the water provided must not contain harmful organisms or substances that may cause harm to the ornamental fish.	Regulation No. 170/2007
	The Minister is responsible for prescribing conditions under which animals may be exported for the purpose of disease control, this may include quarantine. The Department of Veterinary Services is responsible for monitoring compliance with animal health and welfare measures, as well as international health certification. However, it has been noted by Opiyo *et al.* (2016) that due to a lack of experts on fish health, there are currently only limited biosecurity measures in place.	Act No. 4/1965
Export	**Permits and health certificates are required** for the export of live fish. Permits must specify the number and number of individuals to be traded.	Regulation No. 34/1991; Regulation No. 170/2007; Act No. 47/2013
Enforcement	Fish Inspectors are responsible for the assessment of holding facilities, focusing on hazards, hygiene practices, water quality, and hygiene and work procedures.	Regulation No. 170/2007
	Trade in species without a permit issued can be subject to fines and/or imprisonment.	Act No. 47/2013

Philippines

Number of native marine ornamental fish in international trade: 913 species[a]
Number of 'higher risk' marine ornamental fish: 17 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 34.2%[a]
MPA coverage: 1.74%[c]
MPAs with PAME evaluations: 0.09%[c]

Key harvest management measures

- 15% of coastal areas in each municipality should be designated commercial no take fish sanctuaries
- Commercial fishing permit required - priority given to IPLCs
- Net size restrictions
- Prohibition of explosives and poisons

Key export management measures

- Local transport permit and auxiliary invoice for transport required
- Quarantine before export
- Export permits required
- Export of globally threatened species prohibited

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

The Philippines is one of the two main global exporters of marine ornamental fish (see Section 1). As with many other focal countries, marine ornamental fish are largely harvested by small-scale collectors fishing close to their villages (Muyot *et al.*, 2018). Fish are sold to intermediaries, many of whom are also locally based and secure exclusive trade deals with the collectors; they are then either directly sold onto exporters or to exporters via a second intermediary if collection occurs far from a point of export (Muyot *et al.*, 2018). The main areas of export reported to be Metro Manila and Cebu City due to the presence of international airports (Muyot *et al.*, 2019). Exporters tend to be either major commercial exporters that ship fish over great distances (e.g. to Europe or the US) or more small-scale, local exporters that have less capacity to support long distance travel and so primarily export to other countries in Asia due to the lower mortality risk (Muyot *et al.*, 2018).

In 2001, it was estimated that over 2000 collectors and 40 exporting companies were working across different regions of the country (Wood, 2001b). Marine ornamental fish are primarily harvested from three of the 12 fisheries management areas (FMAs) established under the Fisheries Administrative Order No. 263 of 2019[42]: Region 3 (Central Luzon), Region 4A (Calabarzon) and Region 7 (Cebu) (Muyot *et al.*, 2019). These cover the southwest (Regions 3 and 4) and central (Region 7) areas of the Philippines where the main coral reefs are located.

Marine ornamental fishery management in the Philippines falls within broader fishery legislation (i.e. for food fish), rather than legislation specific to the harvest of live ornamental species. (see Annex E for a full list and further detail below). More broadly, the Wildlife Resources Conservation and Protection Act 2001 stipulates that activities, including harvest, must *'not* [be] *detrimental to the survival of the species'* involved based on best available data; further provisions are made for threatened species (detailed below). Under the Local Government Code 1991[70], local government units (LGUs) are also authorised to generate regulations for the local implementation of certain national legislation related to the environment.

Ornamental fisheries (both marine and freshwater) were identified as a target area for growth by the Philippines' National Fisheries Industry Development Plan 2016, and one stakeholder survey

[70] Accessed via: https://www.ecolex.org/details/legislation/local-government-code-of-1991-republic-act-no-7160-lex-faoc093246.

respondent from the Philippines noted that there were 10 national and 1200 local marine ornamental fish management plans in place. However, there appeared to be limited national and no LGU legislation specific to marine ornamental fish, and no specific marine ornamental fishery management plans were provided by survey respondents or identified through additional literature searches. According to Muyot *et al.* (2019), the development of sustainable management practices and legislation for ornamental fisheries have not been prioritised within the Philippines due to the small size of the industry[71]. Stakeholder survey respondents also reported that enforcement of harvesting measures and regulations was considered to be inadequate (particularly in remote areas) due to resource limitation and low capacity for monitoring.

[71] Since this study is based on legislation and documents provided via expert consultation, stakeholder survey responses and online English language searches, additional documents published exclusively in local languages or not made available online also may not have been identified.

Marine ornamental fishery harvest management

Management measures in place		*Relevant regulations*
Area-based management	15% of coastal areas[72] in each municipality should be **designated as fish sanctuaries** in which no fish can be commercially harvested. However, no information could be found on the implementation of this goal.	Republic Act No. 7586/1992; Republic Act No. 8550/1998
	A **country-wide network of protected areas** was also established for the preservation of biodiversity and ecosystems, within which hunting or possessing animals without a permit is prohibited. Each protected area requires a management plan to outline permitted activities, however, in 2010 only 12% of 251 MPAs had a management plan with functioning enforcement and monitoring (Weeks *et al.*, 2010). Further ongoing fishing within no-take protected areas has been recorded (Marriott *et al.*, 2021).	Republic Act No. 7586/1992
Licencing and harvest level management	A **permit is required** for all fishing activities, with preference given to IPLCs adjacent to municipal waters. The number of permits issued should be determined by the area's MSY, although there is no indication of how frequently this is reviewed, and methods and equipment restrictions are not specified. This method also appears to target mainly fish intended for consumption, and it is not species-specific. For 'non-threatened' and economically important species, an **Aquatic Wildlife Special Use Permit** (AWSUP) must be secured. These permits are renewed every three years and specify the methods, species and quantities that can be harvested; they also require prior clearance from relevant IPLCs and the submission of annual harvest reports. The preliminary list of economically important species covered by AWSUPs includes 61 of the 1025 marine ornamental fish species native to the Philippines[73], including five species provisionally identified as 'higher risk' in Section 2[74]. Whilst there are also regulations specifically restricting the collection of threatened species[75], no non-CITES marine ornamental fish species were included in the resulting protected species list[76].	Republic Act No. 8550/1998; Administrative Order No. 233/2010
	LGUs are also required to monitor commercial fishing effort (days/hours fishing, gear used, and number of collectors) and fishing yield/catch to ensure that total catch remains within the MSY or TAC.	Republic Act No. 8550/1998; Administrative Order No. 3/1998

[72] Seaward waters within 200 meters isobath, including coral reefs.

[73] The Fisheries Administrative Order No. 233 of 2010 includes the following genera and families that contain at least one marine ornamental fish species native to the Philippines: Dasyatidae (stingrays), *Epinephelus* (groupers), *Lutjanus* (snappers), Mugilidae (mullet), Scaridae (parrotfish), *Scolopsis* (monocle bream), Siganidae (rabbitfishes), Sphyraenidae (barracudas) and *Upeneus* (goatfish).

[74] *Bolbometopon muricatum* (Green humphead parrotfish), *Epinephelus fuscoguttatus* (Brown-marbled grouper), *E. lanceolatus* (Giant grouper), *Signus unimaculatus* (Blotched foxface) and *Sphyraena jello (Pickhandle barracuda*).

[75] Wildlife Resources Conservation and Protection Act 2001, which defines threatened species as '*species or subspecies considered as critically endangered, endangered, vulnerable or other accepted categories of wildlife whose population is at risk of extinction*'.

[76] Fisheries Administrative Order No. 208 in 2001 and Implementing Rules and Regulations of the Philippine Fisheries Code of a1998 (Administrative Order No. 10/2015).

Management measures in place		*Relevant regulations*
Harvest method management	Harvesters are **permitted to use 'passive' fishing equipment** (e.g., hook and line, gill nets). Small and medium commercial fishing vessels are also **permitted to use 'active' equipment**, such as purse seine and ring nets, providing they do not touch the sea floor and they meet minimum net requirements.	Administrative Order No. 10/2015
	Power is given to LGUs to declare **closed seasons** for fishing within their fisheries management plans; however, no measures are directly specified in national legislation.	Administrative Order No. 10/2015
	The use or possession of **explosives, noxious or poisonous substances**, or any other fishing method (e.g. muro-ami[77])that may damage reefs, is prohibited. Furthermore, 'causing' the harvest of fish using one of these methods is also prohibited.	Republic Act No. 8550/1998; Administrative Order No. 10/2015

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	A **local transport permit** is required for the domestic movement of aquatic wildlife from point of origin to export. The permit is noted as valid for a single batch or shipment up to three months after issuance and **must be accompanied by additional documentation** verifying inspection at the place of collection, legal possession or acquisition and a health certificate issued by the Fish Health Section. An **auxiliary invoice for transport** (issued by the municipal government at the point of collection) is also required to accompany fish during all domestic transport. Monthly summaries of issued auxiliary invoices much be provided to the Provincial Fisheries Office to facilitate ongoing monitoring.	Republic Act No. 8550/1998; Administrative Order No. 233/2010
	All exported fish should undergo **quarantine inspections** by the Fisheries Inspection and Quarantine Service. Regional laboratories are responsible for national ongoing disease surveillance. Fish suspected to carry fish pests or diseases should be quarantined until they are found to be free of pests/disease and authorised for ongoing transportation or export.	Republic Act No. 8550/1998; Administrative Order No. 10/2015
Export	**Export permits are required** for each shipment of marine ornamental fish entering international trade. These permits are valid for three months after issuance and must be accompanied by the required **transportation documents**, as well as an **inspection by the Bureau of Fisheries and Aquatic Resources**. Fish exports must also meet **quality and labelling standards** determined by the Department of Agriculture.	Memorandum Order No. 2/2009; Administrative Order No. 227/2008; Administrative Order No. 233/2010; Administrative Order No. 10/2015
	The transport and **export of fish categorised as globally threatened** by the IUCN and of fish found to have been caught using **explosives** or **noxious/poisonous** substances is **prohibited**.	Administrative Order No. 10/2015
Enforcement	The Bureau of Fisheries and Aquatic Resources are responsible for inspecting facilities, shipments and documents at export (e.g. airport). The illegal possession, trade and/or transport of marine ornamental fish may result in fines and/or imprisonment.	Administrative Order No. 233/2010

[77] A destructive method for harvesting elusive fish from coral reefs; it involves encircling an area of reef with nets and 'pounding' the reef to draw the fish out.

Sri Lanka

Number of native marine ornamental fish in international trade: 317 species[a]
Number of 'higher risk' marine ornamental fish: 11 species[b]
Percentage of global exports of live non-freshwater ornamental fish (HS-030119) 2012-2021: 2.7%[a]
MPA coverage: 0.07%[c]
MPAs with PAME evaluations: 0%[c]

Key harvest management measures

- Designated no take zones
- Commercial fishing licence required
  Additional aquarium fishery licence required in Matara and Galle Districts
- Net size restrictions
- Prohibition of explosives and poisons

Key export management measures

- Licence for possessing, transporting or selling fish required
- Quarantine or heath certificates can be issued if required by the importing country
- Operation Licence for harvest and export licence required for export
- Export of certain marine ornamental fish species prohibited or restricted

Sources: [a]See Section 1; [b]See Section 2; [c] www.protectedplanet.net. (extracted on 21/10/2022)

Sri Lanka is widely considered to be the first country to export marine ornamental fish, which started in the 1930s (Jonklass, 1989; Wijesekara and Yakupitiyage, 2001). The primary areas of harvest are along the west and south coast of the country (Wilhelmsson *et al.*, 2002). Due to its age, the aquarium trade is a well-established industry in Sri Lanka. Over 1000 full and part-time collectors were believed to be operating in 2009, with around half located in the Galle and Matara Districts on the southern coast (Rajasuriya, 2009). Marine ornamental harvest is considered economically important to the country, with collectors estimated to earn seven times Sri Lanka's minimum monthly wage according to a survey of collectors in the Trincomalee District along the east coast (Priyashadi *et al.*, 2022).

Due to monsoon patterns, marine ornamental fish harvesting moves cyclically around different regions of Sri Lanka throughout the year. Full-time collectors of marine ornamental fish follow these cyclical patterns to continue harvesting from suitable fishing sites, whereas part-time collectors only collect fish during suitable seasons close to their villages. Collectors predominantly operate independently in small groups and harvest fish in response to demand. This relationship is usually managed by an intermediary who communicates export orders to collectors and arranges the transport of fish from collectors to exporters (Wilhelmsson *et al.*, 2002). In 2014, there were 30 active companies exporting aquarium fish, both marine and freshwater species, for the international market (Herath and Wijewardene, 2014).

At the national level, marine ornamental fishery management in Sri Lanka is regulated through broader fishery legislation (i.e. for food fish); however, there are some subnational measures specific to the harvest of live ornamental fish. For example, the Fishing Operations Regulations of Catching Live Ornamental Fish or Lobster in the South Coast (Matara and Galle District) Fisheries Management Area 2012 specifically outlines licensing and catchment regulations for the harvest of live ornamental fish in two of the main collection districts. Marine ornamental fisheries must also comply with the more general legislation, most importantly the Fauna and Flora Protection Ordinance and the Fisheries and Aquatic Resources Act 1996 (see Annex E for list of key regulations).

Expert stakeholder survey responses from industry indicated that while many regulations are in place across Sri Lanka to manage the harvest of marine ornamental fish, enforcement is often considered to be inadequate (particularly in remote areas) due to limited resources or capacity for monitoring.

Marine ornamental fishery harvest management

Management measures in place		*Relevant regulations*
Area-based management	The killing or collection of any wild animal is prohibited within marine protected areas designated as **Sanctuaries, Striction Natural Reserves or National Parks**. This includes areas such as the Hikkaduwa National Park and Bar Reef Sanctuary. Other areas designated as fisheries reserves prohibit the fishing or collection of any aquatic resource without a specific permit. Further reserve-specific management provisions may also be established via secondary, subnational legislation.	Ordinance No. 2/1937
	Informal seasonal MPAs are also effectively established due to seasonal monsoon activity making specific fishing grounds inaccessible for up to seven months of the year (Wood, 2001a; stakeholder survey response).	
Licencing and harvest level management	A **licence is required** for all fishing activities, with specific restrictions on the species of fish and types of permitted fishing operations varying between individual licences. Six marine ornamental fish species[78] are also included in the list of protected species (see Table 3.2), which are not permitted to be collected, killed or offered for sale from any area of Sri Lanka. At the **subnational licensing level**, the harvest of live ornamental fish from the south coast marine aquarium fishery in the Matara and Galle Districts also requires a separate licence to be issued. Whilst these are two of the most active Districts for marine ornamental fishing, there appears to be no fixed limit to the number of licences that can be issued. Furthermore, although collectors must report their monthly catch via log-sheets, it is unclear how frequently licence restrictions are reviewed, and a 2009 assessment of this fishery reported local mistrust in providing accurate catch data out of fear of harvest level restrictions being put in pace (Rajasuriya, 2009).	Ordinance No. 2/1937; Act No. 2/1996
	There appears to be **no quota system in place** for managing the level of marine ornamental fish harvest. A survey of collectors in the Matara and Galle Districts Fishery in 2009 (Rajasuriya, 2009) identified low local abundance for some of the species in highest demand from exports, including *Acanthurus leucosternon* (Powderblue surgeonfish) and *Naso lituratu* (Orangespine unicornfish), suggesting a need for further harvest level management.	
Harvest method management	**Net size and type restrictions** for the harvest of fish, although some of these (e.g. Moxi nets) were reportedly still in use in 2015 (Sosai, 2015). It is also unclear how directly relevant these restrictions are to marine ornamental fish species, since most are harvested in Sri Lanka using hand nets (Bunting *et al.*, 2003; Wabnitz *et al.*, 2003).	Act No. 2/1996
	Explosives and toxic substances are prohibited for the capturing of marine ornamental fish. However, poor enforcement means many of these prohibited methods, including explosive fishing and the use of banned nets continued to be reported (Sosai, 2015).	Ordinance No. 2/1937; Act No. 2/1996

[78] *Centropyge bispinosa* (Twospined angelfish), *Coris aygula* (Clown coris), *Labroides bicolor* (Bicolor cleaner wrasse), *Platax pinnatus* (Dusky batfish), *Pterois radiata* (Radial firefish), *Pygoplites diacanthus* (Regal angelfish).

Export regulations relating to marine ornamental fish

Management measures in place		*Relevant regulations*
Domestic handling	A **licence for possession, exhibiting for sale, selling or transporting fish** or aquatic resources is required. There are six marine ornamental fish species listed as protected species (Table 3.2); possessing, transporting, or offering for sale any of these species is prohibited and may be punished with a fine and/or imprisonment.	Ordinance No. 2/1937; Regulation No. 1665/16 - 2010
	Whilst health certificates are required for fish *products*, there **does not appear to be national legislation relating to health or biosecurity of *live* fish prior to export**. There is evidence of training and good practice guidelines for the holding and **quarantining** of ornamental fish prior to export[79], and, whilst much of this appears directed towards freshwater aquacultured fish, some generalisations for marine species can be drawn.	Fish Products (Export) Regulations 1998
Export	All harvest of fish or aquatic resources for export requires both a valid **Operation Licence** for harvest and an **export licence**. It is unclear whether licence data are collected and monitored in a systematic way to ensure exports of individual species are sustainable.	Regulation No. 1665/16 - 2010
	Furthermore, there was no evidence of size or quantity restrictions in place, with the exception of species for which export is either prohibited or significantly restricted under national legislation. The list of **prohibited species** includes nine marine ornamental fish[80], and a further 16[81] species have restricted export (export licence must be granted by the Director of Fisheries and Aquatic Resources).	Regulation No. 1036/13 - 1998

[79] E.g. from the National Aquaculture Training Institute (Accessed via: https://www.srilankabusiness.com/pdf/8-quarantine-and-holding-for-export.pdf).

[80] *Centropyge bispinosa* (Twospined angelfish), *Chaetodon semeion* (Dotted butterflyfish), *Coris aygula* (Clown coris), *Epinephelus lanceolatus* (Giant grouper), *Labroides bicolor* (Bicolor cleaner wrasse), *Platax pinnatus* (Dusky batfish), *Plectorhinchus albovittatus* (Two-striped sweetlips), *Pterois radiata* (Radial firefish), *Pygoplites diacanthus* (Regal angelfish).

[81] *Balistoides conspicillum* (Clown triggerfish), *Centropyge flavipectoralis* (Yellowfin angelfish), *Chaetodon bennetti* (Bluelashed butterflyfish), *Chaetodon ephippium* (Saddle butterflyfish), *Chaetodon falcula* (Blackwedged butterflyfish), *Chaetodon madagaskariensis* (Seychelles butterflyfish), *Chaetodon meyeri* (Scrawled butterflyfish), *Chaetodon octofasciatus* (Eightband butterflyfish), *Chaetodon rnatissimus* (Ornate butterflyfish), *Chaetodon triangulum* (Triangle butterflyfish), *Chaetodon unimaculatus* (Teardrop butterflyfish), *Chaetodon xanthocephalus* (Yellowhead butterflyfish), *Heniochus monoceros* (Masked bannerfish), *Heniochus pleurotaenia* (Phantom bannerfish), *Pseudobalistes fuscus* (Yellow-spotted triggerfish), *Variola louti* (Yellow-edged lyretail).

Overview of marine ornamental fish import measures based on stakeholder survey responses

The international trade in marine ornamental fish is not only determined by measures and regulations put in place by the countries of export, but also by those in place in the countries of import. For example, many of the main marine ornamental fish countries of import (e.g. the EU, UK and US) all require specific licences and documentation from the exporter prior to permitting the import. This documentation typically includes health certificates verifying that species are free from key diseases, evidence of legal acquisition by registered/licenced exporters, and a record of the quantities of each species included in the shipment. Some countries, such as Australia, also maintain lists of species (including fish) that are permitted for import to minimise the risk of importing potentially invasive non-native species.

Thirty-one respondents from 20 countries provided information on national legislation relating to the import of marine ornamental fish and the enforcement of this legislation. Of these, nine responses where from either CITES Authorities (seven countries) or other government agencies (two countries) (Table 3.5).

Respondents from 16 countries reported national legislation in place to regulate the imports of marine ornamental fish. However only six of these (Australia, Germany, New Caledonia, the Philippines, Singapore and the UK) considered the enforcement of the relevant import legislation and/or the overall import management measures in place to be sufficient in ensuring the trade in marine ornamental fish species is sustainable. Responses from Australia and Singapore were provided by the country's CITES Authority; responses from Germany, the Philippines and the UK were provided by industry traders and the response from New Caledonia was provided by an international NGO.

Responses were received from four of the main importers of marine ornamental fish: the EU (France, Germany, Portugal and Spain), Japan, the UK and the US[82]. Of these, the UK, US and three of the four EU-based respondents (France, Germany and Portugal) reported relevant national import legislation to be in place. However, only the respondents from Germany and the UK considered the legislation and import management measures to be sufficient. The respondent from Japan (trader) reported there to be no national legislation regulating the import of marine ornamental fish; no response was received from Japan's CITES Authority or any other government agency.

The most reported measure in place for ensuring the effective enforcement of import legislation was the requirement of import licences (5/9 country respondents). Respondents from four countries reported enforcement was carried out through random port inspections, the UK noted additional veterinary checks and local pet shop inspections, and Israel reported requiring an NDF (Non-Detriment Finding) from the country of export for all wild-sourced specimens, as well as prohibiting the import of all Critically Endangered, Endangered or Vulnerable species.

[82] Based on UN Comtrade exporter-reported trade in HS code 030119 (live ornamental fish - other than freshwater) 2012-2021: the US accounted for 31% of all imports, the EU (excluding historic UK data) 10% and Japan 5%. See Annex B for details of UN Comtrade methods.

Table 3.5. *National legislation and enforcement relating to the* ***import*** *of marine ornamental fish species, as reported by stakeholder survey respondents (n= 31 respondents from 20 countries). Additional information on whether the respondent considered enforcement of national legislation and export measures to be sufficient to ensure trade in marine ornamental fish is sustainable.* ***Data sources:*** *Responses to survey shared via Notif. 2021/030.*

Country/territory (no. survey responses)	National legislation relating to the import of marine ornamental fish	Body/bodies responsible for enforcement	Measures in place to ensure effective enforcement	Respondent considers national legislation enforcement to be sufficient	Respondent considers import measures to be sufficient	Respondent comments on whether enforcement and/or import measures are sufficient
Australia (1) *	✓ (List of Specimens Taken to be Suitable for Live Import)	Australian Customs Department of Agriculture, Water and the Environment	Import permits required for many species.	✓	✓	
France (1)	✓	-	-	-	-	
France and overseas territories: Mayotte, Guadeloupe, Martinique (1) *	?	-	-	-	?	
French Polynesia (1) **	✓ (Le code de l'environnement de la Polynésie francaise [The environmental code of French Polynesia])	National and local government	-	X	X	
Germany (2)	✓ (registration of imports)	German Federal Agency for Nature Conservation (Bundesamt für Naturschutz)	Customs import control.	✓	✓	
India (1)	✓	-	-	-	-	
Israel (1) *	✓	Israel Nature and Parks Authority	All imported ornamental fish require an import permit, and wild harvested specimens require an NDF. The import of globally threatened species is prohibited.	Partial	X	Wild-sourced imports require an NDF, however it is difficult to assess whether the harvest and trade is at sustainable levels.
Japan (1)	X	-	-	-	-	
Kenya (1) *	✓	Kenya Fisheries Service	Licenses and permits are required to deal and trade in the ornamental fishes.	Partial	Partial	Collection of ornamental fish in the country of origin is not well monitored.
Malaysia (2) **	✓	Marine Fisheries Department Malaysia	-	X / partial	X	
New Caledonia (1)	✓	-	-	✓	✓	
Norway (1)	✓	-	-	-	-	

Country/territory (no. survey responses)	National legislation relating to the import of marine ornamental fish	Body/bodies responsible for enforcement	Measures in place to ensure effective enforcement	Respondent considers national legislation enforcement to be sufficient	Respondent considers import measures to be sufficient	Respondent comments on whether enforcement and/or import measures are sufficient
Philippines (4)	✓ (Republic Act No. 10654) †	Fisheries and Custom	Random inspection.	✓	✓	
Portugal (1)	✓	National authorities	-	Partial	X	No reliable data is available on what is collected, where and in what numbers
Singapore (2) *	✓ (Animals and Birds (Live Fish) Rules 2011)	The National Parks Board regulates the licence to import/export ornamental fish	All imports require a valid import permit to be verified by authorities at the borders before import is permitted.	✓	Partial	
South Africa (1)	✓ (Marine Living Resources Act 1998)	Department of Environment Forestry and Fisheries, South African Revenue Service	Irregular checks at ports of entry and exit.	X	X	There is a lack of capacity for sufficient enforcement, and very few measures are in place part from national legislation (e.g. no active permit/compliance checks or beach patrols)
Spain (1) *	X	-	-	-	-	
Switzerland (1)	X	CITES Authorities Swiss Federal office for Food Safety and Veterinary	-	X	X	
United Kingdom of Great Britain and Northern Ireland (1)	✓	Border Force Centre for Environment, Fisheries and Aquaculture Science Department for Environment, Food & Rural Affairs Joint Nature Conservation Committee	Border checks, veterinary checks, and site inspections. Regular pet shop inspections and audits.	✓	✓	
United States of America (6) *	✓ (but only species and activities covered by the Endangered Species Act 1973 or the Lacey Act)	Animal and Plant Health Inspection Service US Department of Agriculture US Fish and Wildlife Service Various Departments of Fish and Game	Import licence and declarations are required. Routine inspections are performed at different stages of the supply chain, specifically at ports of import, and in importing facilities.	X	✓ (sharks) X (other marine ornamental fish species)	There is little to no disease testing, insufficient regulation of online trade, an insufficient number of inspectors, and insufficient resources. Import licences are often not reported at the species level.

'- ' no response provided by survey respondent. † 3/4 survey respondents reported no relevant legislation in place.
Survey response provided by CITES Authority (*) or another government agency within the country (**).

Key findings from Section 3

- Based on available information, the harvest and export of marine ornamental fish in the focal countries appears to be **largely regulated and managed as part of general fisheries management**, rather than having management specific to live ornamental marine fish species. There are some exceptions, with specific subnational marine ornamental fish harvest management plans in Australia and Sri Lanka, and additional regulations for the export of live animals in all focal countries. Marine ornamental fish are collected live, have different supply chains, are often smaller in size and have different ecologies than fish caught for food and transported dead or processed. As a result, the generalist management measures in place for the sustainable harvesting or export of food fish (e.g. specific gear restrictions) may not be suitable for the management needs of marine ornamental fisheries.

- **All six focal countries of export specified harvest management or export measures for at least one marine ornamental fish species in legislation and/or management plans**. These measures included prohibition of take, prohibition or restriction of exports, requirements for a management plan and/or additional harvest monitoring. In total, 620 marine ornamental species were found to have additional harvest management or export measure requirements: 43 species had species-specific management measures, the remaining 577 species were included within family- or genus-level measures in one or more of their native range States.

- **Of the 80 species provisionally classified as 'higher risk' in Section 2, 37 were considered native to the waters of at least one of the focal countries.** Seventeen species provisionally identified as 'higher risk' were covered by harvest management or export measures in at least one of the focal countries. The remaining 20 species provisionally classified as 'higher risk' and occurring in these focal countries did not appear to have any specific management measures in place (see Annex F for list of 'higher risk' species and the focal countries they are considered native to), based on available information.

- National legislation in all six focal countries of export includes some **harvest management measures** directly written into the legislation (i.e. are a legislated requirements). For other measures, national legislation allows for them to be put in place (e.g. via management plans) but does not require them to be in place. This is particularly true for measures such as harvest quotas, which are more locally specific. Evidence of management plans incorporating these measures was often limited; however, this may be because they were published in local languages or were not readily available online. Furthermore, stakeholder survey responses were only received from government authorities for two of the focal countries (CITES Authorities responded from Australia and Kenya); responses for Fiji and the Philippines were provided by industry representatives and no information was received via stakeholder survey respondents for Indonesia or Sri Lanka. **Engagement from other focal countries is key in providing further insights and addressing these knowledge gaps**, and may have provided additional resources published in local languages or maintained locally.

- Four of the six focal countries appear to have regulations that would enable live fish to be tracked through the domestic supply chain via harvest and export permits (Australia), live fish transport licences (the Philippines and Sri Lanka) or health certificates (Indonesia). The remaining countries (Fiji and Kenya) do not appear to have equivalent licensing systems, meaning it is likely difficult to effectively monitor domestic supply chains.

- In addition to domestic measures in place governing harvest and trade national regulations, countries of export must also **adhere to the specific requirements of the countries of import**. These requirements vary between importing countries, but may include evidence of legal harvest, export permits and health certificates. All countries of export include provisions in their legislation to ensure that exports have appropriate quarantine and/or health checks in line with importing

country requirements; Indonesia, Kenya and the Philippines go beyond this and require quarantine of all exports of marine ornamental fish irrespective of importer requirements.

- Enforcement of the legislative measures is key to effective management but is a concern in many places. Overall, NGO and industry survey respondents identified three of the six focal countries (Indonesia, Kenya and the Philippines) as having no or insufficient management or enforcement in place and insufficient industry standards; Australia and Fiji were considered by respondents to have sufficient management and enforcement. Kenya was not included in either list by any survey respondent. One independent researcher commented in their stakeholder survey response that the enforcement of national legislation was inadequate across most countries, despite national legislation being in place, but that at the local community level there were many examples of effective and sustainable management including in places like Les, Indonesia.

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ANNEX A: Summary of stakeholder survey responses

To gather information from CITES Parties, traders/trade representatives and other stakeholders on the perceived conservation status, management and legislation of the trade in marine ornamental fishes, a survey was circulated via a CITES Notification to the Parties (Notif. 2021/030). The survey was available for 11 weeks total (30 March 2021 – 15 June 2021).

The stakeholder survey comprised 47 questions pertaining to the four Section topics (international trade, conservation status, management and legislation), including separate questions for exporting and importing or re-exporting/transit countries.

In total 100 survey responses were received. Of these, 35 were excluded because they only contained information on the respondent and/or whether they held or had access to any trade data[83], without answering any questions relating to the thematic studies. To avoid duplicating results from respondents who may have started new surveys several times, when multiple incomplete survey responses were received from the same respondent they were combined if there were no conflicting results (n=3 instances).

The number of questions answered in the remaining 62 surveys varied from 2 to 43, with a median of 10.5 questions answered. Due to this, the total number of data points will vary from question to question.

In addition to answers to the survey questions respondents also provided additional resources in the form of trade datasets, protected species lists, captive breeding information, management plans, legislation, scientific publications and reports (see Table A1 for a subset of national resources summarised by country of respondent).

[83] Stakeholder survey question: Do you/your organisation hold or have access to data on the international trade in wild-sourced and/or captive-produced live marine ornamental fish (e.g. levels of export from, transit through (import and re-export) or import into your country or region)?

Table A1. *Summary of national resources provided by respondents to the stakeholder survey (n= 20 resources from 13 respondents). Scientific publications, public reports and data extracts from public datasets (e.g. UN Comtrade) are not included in the table.* ***Source:*** *Responses to survey shared via Notif. 2021/030.*

Resource type (number of resources provided)	Summary of data provided by respondent-reported country Respondents from CITES Authorities (*), other governmental agency (**), independent researchers/NGO (†) and traders (††) are indicated
Captive breeding (3)	*France*†: List of species that can be captive-bred *UK*†: Aquaculture potential of marine ornamental fish *UK*††: List of species that can be captive-bred and % of specimens in trade that were captive-bred
Legislation (3)	*Israel** *Kenya** *South Africa*
Management plans (2)	*France and overseas territories (Mayotte, Guadeloupe, Martinique)** *French Polynesia***
Conservation status of species (3)	*Australia** *French Polynesia***: 'black list' of species *USA**: list of species considered to be at risk from trade
Trade data (8)	Import and/or export data provided by respondents from the following countries: *France and overseas territories (Mayotte, Guadeloupe, Martinique)**: National customs data for annual number of specimens imported and exported (2015-2021) *French Polynesia***: Total number of 'aquarium fish' exported annually (1998-2020) and disaggregated by trading partner for 2020; number of specimens exported to the EU per species (year not specified) *New Caledonia**: number of specimens exported to the EU per species (year not specified) *Singapore**: National import and export data in HS code 030119 disaggregated by family (2018-2021) *UK*†: Number of specimens sold domestically (by month and retailer) in the UK *UK*††: List of fish species traded and whether the species was in the top 50% or 80% of species traded by quantity
Other (1)	*International NGO*: list of species in aquaria (including number of specimens and institutions)

ANNEX B: Methods for identifying marine ornamental fish in international trade (Section 1)

Identification of marine ornamental fish species

Using FishBase as the central taxonomic backbone, marine ornamental fish species were identified based on data from FishBase, the IUCN Red List assessments literature review and expert consultation. Species were classified as marine ornamental fishes if they met the following two criteria:

1. They were native to tropical and/or subtropical marine coral reefs:

Species were identified as marine coral reef fish if they were classified in FishBase[84] as (a) 'saltwater' (i.e. marine) species, (b) 'native' or 'endemic' to 'tropical' or 'subtropical' climates, and (c) 'reef-adjacent' and/or had the habitat classification types 'coral reef', 'soft coral' or 'hard coral'.

2. There was evidence of the species being used for aquaria and/or display purposes:

Not all tropical/subtropical coral reef fish species are in demand for use in the live aquaria trade (e.g. *Lates calcarifer* (Barramundi) lives in marine tropical coral reefs but is harvested as a food fish). We considered marine tropical/subtropical coral reef fish to be 'ornamental fishes' (i.e. collected for the live aquaria trade) based on any of the following:

- FishBase listed either 'commercial' or 'public aquariums' as human uses;
- the IUCN Red List considered 'pet/display animal' to be an end use;
- trade was recorded in GMAD (Global Marine Aquarium Database);
- trade was recorded in TRACES (imports into the EU) 2018-2023 under the HS code 030119 ('live ornamental fish - other than freshwater');
- the species was displayed as an ornamental fish by a Species360 member organisation (Species360, 2021);
- there was evidence from the literature or expert consultation of sale in aquarium shops (Pinnegar and Murray, 2019; Hill and Watson, 2021, *unpublished data*; Tropical Marine Centre, *unpublished data*), or captive breeding (Sweet and Pedersen, 2019; Pinnegar, 2021, *unpublished data*) for the aquarium trade;
- the species was reported in the literature as an ornamental fish (Wood, 2001; Wabnitz *et al.*, 2003; Bruckner, 2005; LeGore *et al.*, 2005; Craig *et al.*, 2012; Rhyne *et al.*, 2012; Domínguez and Botella, 2014; Rhyne *et al.*, 2017; Biondo, 2018; Muyot *et al.*, 2018; Biondo and Burki, 2019; Muyot *et al.*, 2019; Pinnegar and Murray, 2019; Nuryanto *et al.*, 2020a, 2020b; Borges *et al.*, 2021; Cardoso *et al.*, 2021; Nuryanto *et al.*, 2021); and/or
- the species was included in stakeholder survey responses to questions asking for information on any live marine ornamental fish taxa in international trade.

Identification of non-CITES marine ornamental fish species in international trade

In the absence of a centralised global database monitoring international trade in non-CITES listed[85] marine ornamental fish species, we gathered evidence of international trade from a number of databases and published literature, supplemented by information received in the stakeholder survey responses.

We considered species to be in international trade if they were:

[84] Available at http://www.fishbase.org/. Version 05/2023.
[85] As of December 2021, 35 marine ornamental fish species were listed in the CITES Appendices: one genus (*Hippocampus* [seahorses] accounting for 24 marine ornamental species) and a further 11 species in other genera.

- reported as live imports from either captive or wild sources by the United States of America (US, 2010-2021) or the European Union (EU, 2018-2023) according to the LEMIS (US) or TRACES (EU) databases respectively, unless there was evidence of the species in live trade largely as live food fish;
- recorded in GMAD (1988-2003);
- included in the TRAFFIC wildlife trade portal as either a 'seizure' or as 'smuggling/illegal trade' (2011-2022);
- found in the literature to be in international trade (Wood, 2001; Wabnitz *et al.*, 2003; Bruckner, 2005; LeGore *et al.*, 2005; Craig *et al.*, 2012; Rhyne *et al.*, 2012; Domínguez and Botella, 2014; Rhyne *et al.*, 2017; Biondo, 2018; Muyot *et al.*, 2018; Biondo and Burki, 2019; Muyot *et al.*, 2019; Pinnegar and Murray, 2019; Nuryanto *et al.*, 2020a, 2020b; Cardoso *et al.*, 2021; Nuryanto *et al.*, 2021), or sold at aquarium shops outside their native range (Pinnegar and Murray, 2019; Hill and Watson, 2021, *unpublished data*);
- imported or re-exported as an ornamental fish by the Tropical Marine Centre (*unpublished data*); and/or
- listed in stakeholder survey responses as being in international trade (data were provided by two countries of export: New Caledonia and French Polynesia).

Further details of all databases, papers, reports and other references used to identify the species in international trade are provided in Annex C.

Trade in live reef food fish

Some large marine ornamental fish are traded extensively as live food fish, with lower demand for (largely public) aquaria: 31 marine ornamental fish species in international trade (listed below) were also identified as being important live food fish (Cesar, 2000; Department of Agriculture-Bureau of Fisheries and Aquatic Resources, 2004; Hau *et al.*, 2019; Johannes and Lam, 1999; McGilvray and Chan, 2001; Radjawali, 2011; Sadovy, 1998; Sadovy *et al.*, 2003; Sadovy de Mitcheson, 2019; Scales *et al.*, 2007; Thyresson *et al.*, 2013). To prevent conflating the ornamental fish trade with the live food fish trade, these species were excluded from analyses of international trade where they appeared in either LEMIS or TRACES databases because these data sources do not differentiate between the different purposes of live trade. Species were retained if there was evidence of them in trade for ornamental purposes from other sources. This removed one species (*Choerodon azurio*) from further analysis because the only evidence of it in international trade was imports in the US (based on LEMIS data) that could not be attributed to demand for aquaria. It is important to note that the remaining species are likely to be in international trade for both ornamental and food purposes, however it is rarely possible ascertain the purpose of trade from the available data.

- *Anyperodon leucogrammicus* (Slender grouper)
- *Cephalopholis argus* (Peacock hind)
- *Cephalopholis boenak* (Chocolate hind)
- *Cephalopholis miniata* (Coral hind)
- *Choerodon anchorago* (Orange-dotted tuskfish)
- *Choerodon azurio* (Azurio tuskfish)
- *Cromileptes altivelis* (Humpback grouper)
- *Epinephelus coioides* (Orange-spotted grouper)
- *Epinephelus cyanopodus* (Speckled blue grouper)
- *Epinephelus fasciatus* (Blacktip grouper)
- *Epinephelus fuscoguttatus* (Brown-marbled grouper)
- *Epinephelus howlandi* (Blacksaddle grouper)
- *Epinephelus lanceolatus* (Giant grouper)
- *Epinephelus maculatus* (Highfin grouper)
- *Epinephelus merra* (Honeycomb grouper)
- *Lutjanus malabaricus* (Malabar blood snapper)
- *Lutjanus sebae* (Emperor red snapper)
- *Monacanthus chinensis* (Fan-bellied leatherjacket)
- *Plectropomus laevis* (Black-saddled coral grouper)
- *Plectropomus leopardus* (Leopard coral grouper)
- *Pomadasys kaakan* (Javelin grunter)
- *Rachycentron canadum* (Cobia)
- *Scarus forsteni* (Forsten's parrotfish)
- *Scarus ghobban* (Blue-barred parrotfish)
- *Scatophagus argus* (Spotted scat)
- *Seriola dumerili* (Greater amberjack)
- *Siganus guttatus* (Orange-spotted spinefoot)
- *Synanceia verrucosa* (Stonefish)
- *Trachinotus blochii* (Snubnose pompano)
- *Variola louti* (Yellow-edged lyretail)

- *Girella punctata* (Largescale blackfish)

After excluding, where relevant, evidence on international trade likely to be from food fish (1 species), 1764 fish species were considered to be either in, or likely to be in, international live trade for aquaria/ornamental purposes.

Analysis of international trade patterns in marine ornamental fish

To provide a global estimate of marine ornamental fish in international trade, exports of the HS code 030119 ('live ornamental fish - other than freshwater') were extracted from UN Comtrade (https://comtrade.un.org/) for the years 2012-2021[86] disaggregated by year, reporting exporter and trading partner (i.e. importing country/territory) on 22/04/2022. No taxonomic data were available. Trade quantities were reported by weight (kg) and the value of trade was reported in US dollars (USD). Value data were corrected for 2022 USD inflation using https://www.usinflationcalculator.com/ (27/04/2022). It is important to note that trade in HS code 030119 does not provide any taxonomic resolution, indication of the number of *individuals* in trade and may include trade in species that do not meet the definition of 'marine ornamental fish' used in this report[87]. HS code 030119 may also be incorrected applied to other commodities, in particular food fish which are often traded in much larger quantities than small, live marine ornamental species.

Further to the overall quantities of trade reported as HS code 030119, more specific trade data from two of the key marine ornamental fish importers were also obtained to explore quantities and trends in trade: imports into the EU 2018-2023 (TRACES database) and into the US 2010-2021 (LEMIS database). Whilst these datasets contain imports from two of the key importers of marine ornamental fish (Rhyne *et al.*, 2017; Wabnitz *et al.*, 2003; Burke *et al.*, 2011; Biondo and Burki, 2020), they should not be considered a complete picture of global trade volumes.

Since the two datasets covered different time periods and levels of data specificity, they were analysed separately.

*Imports into the EU as reported by **industry***

Data on imports into the EU were provided by two Europe-based trade associations - OATA (Ornamental Aquatic Trade Association) and OFI (Ornamental Fish International) - from a number of verified sources including directly from businesses and relevant literature. These data were primarily provided at the species level as a percentage of overall imports by number of individuals; a few taxa are largely imported at a higher taxonomic level (e.g. *Wetmorella* (Sharpnose wrasses)), these were provided at the genus level. Species traded for public aquaria only were not included in this dataset.

Imports into the EU as reported in the official TRACES database

Data on imports into the EU were available from TRACES (managed by DG SANTE (Health and Food Safety)) for the years 2018-2023 (extracted on 09/02/2024) for the HS code 03011900 ('live ornamental fish - other than freshwater'). Imports into the United Kingdom of Great Britain and Northern Ireland (UK) were included for the years 2018-2020. Whilst data from the entire time-period were used as evidence of marine ornamental fish in international trade (trade reported in 1166 species and 89 families), the number of individuals imported into the EU was analysed from the most recent three years of data (2021-2023) only, since a new TRACES platform was introduced in 2020 that may not be entirely comparable to the data reported under the previous platform (≤2020). No information was available on the source (e.g. wild vs captive) of the trade.

The family Syngnathidae was excluded from the analysis to avoid inflating trade quantities since it includes seahorse species (*Hippocampus* spp.), which are already CITES-listed and not considered as part of this report. Any species considered to be largely traded as live food fish were also excluded.

US imports

[86] 2021 data may be incomplete due to reporting cycle. Prior to 2012 all live ornamental fish were traded as HS-030110 ('fish: live, ornamental') with no distinction made between freshwater and non-freshwater species.

[87] Fish (including sharks and rays) living amongst, or in close relation, to coral reefs in the tropical/subtropical Western Atlantic and Indo-Pacific oceans (typically between 30ºN and 30ºS latitudes; NOAA, 2017), which are caught for public or private aquariums (AC31 Doc. 36).

Imports of live marine ornamental fish into the US (reported at genus or species level) were obtained from LEMIS (managed by US Fish and Wildlife Service) for the years 2010-2021[88] (extracted on 22/10/2021). US imports reported at the family level were not reported, but if imports into the US show similar patterns to that reported in EU imports (i.e. most trade reported at family level), then the quantities imported into the US presented in this report are a significant underestimate. Any species considered to be largely traded as live food fish were also excluded.

Imports were aggregated across all years by reported taxa, source and unit. Trade reported with the source codes 'W' (wild), 'R' (ranched) and 'U' (unknown) were classified as 'wild-sourced trade'; 'captive-sourced trade' was considered to include trade reported as 'C' (captive-bred) and 'F' (captive-sourced, F1 generation).

Classification of captive-bred species

The degree to which a species can be bred in captivity was assessed based on the following data:

- Proportion of individuals obtained from captive-bred sources by a European wholesaler (Tropical Marine Centre, *unpublished data*);
- Level of captive breeding reported by breeders and aquaria hobbyists in a survey carried out by CORAL magazine (Sweet and Pedersen, 2019);
- Proportion of individuals reportedly imported into the United States of America as 'captive-bred' 2010-2021 (excluding trade reported by weight or at higher taxonomic levels);
- Main species reported in the literature as bred and farmed for the marine aquarium trade, some species that can be captive-bred but for which production and marketing are considered difficult, and some species subject to captive breeding research, but which have not yet been successfully bred and reared in captivity (Wabnitz *et al*. 2003);
- Species reported as 'captive-bred' by UK aquarium shops (Pinnegar, *unpublished data*); and
- Species found in retail and considered 'bred in captivity' (Domínguez and Botella, 2014).

The relative *scale* of captive breeding could be estimated for five of these datasets (Wabnitz et al. 2003; Sweet and Pedersen, 2019; OATA & OFI, *unpublished data*; Tropical Marine Centre, *unpublished data*; and US imports), enabling the level of captive breeding to be categorised into 'common', 'moderate', 'rare', 'not available for retail' or 'no evidence of captive breeding' (see Table B1 for thresholds applied to each dataset). Data from Pinnegar (*unpublished data*) and Domínguez and Botella (2014) provided further evidence of captive breeding, but did not provide data on the scale.

Table B1. *The relative scale of captive breeding estimated from four captive breeding data sources.*

Relative scale of captive breeding based on each dataset	European wholesale[a] % individuals obtained from captive-bred sources	Captive breeding success reported by breeders/ hobbyists[b]	Imports into the US[c] % individuals reportedly imported as 'captive bred'	Main species bred for marine aquarium trade in the literature[d]
Common	>66%	'commonly available'	>66%	'commercially available'
Moderate	33% – 36%	'moderate to low'	33% – 36%	-
Rare	<33%	'scarce'	<33%	-
Not available for retail	-	Successful captive breeding had been reported, but not at a level suitable for retail	-	'production and marketing difficult'
No evidence of captive breeding	0	-	0	'subject of research'

[a] Tropical Marine Centre, *unpublished data*; [b] Sweet and Pedersen, 2019; [c] LEMIS 2010-2021; [d] Wabnitz *et al*. 2003

[88] Since data were extracted in October 2021, data for 2021 will be incomplete.

Species were assigned a ‘captive breeding score’ for each of these six data sources, which were used to determine a single, overall, classification of the level of captive breeding. Where species appeared in multiple datasets with different captive breeding scores, information from the four sources in Table B1 took precedence because they provide an indication of the *level* of captive breeding. Remaining discrepancies between datasets were resolved by classifying the level of species captive breeding first based on whether there was a majority captive breeding score (e.g. 2/3 data sources considered the species to be ‘commonly’ captive-bred) and, if there was no majority, classifying the species as ‘moderately’ captive-bred.

ANNEX C: Assessment of trade and conservation status datasets

In the absence of a centralised, global database of trade in marine ornamental fish species, evidence of international trade was gathered from a number of sources. Table C1 summarises all sources of quantitative trade data obtained from databases, the scientific literature, industry reports, stakeholder survey responses and expert consultation.

***Table C1**. Assessment and parameters of trade datasets used in Thematic Studies 1 and 2 to identify marine ornamental fish species in international trade and assess their conservation status respectively. The number of marine ornamental fish species in the dataset follows FishBase accepted taxonomy and the core list of non-CITES listed marine ornamental fish species identified in Section 1.*

Dataset name	Dataset description	Data Considerations
	Database	
FishBase	Global fish database[89] containing species-level information on, amongst other fields, biometrics, conservation status, distribution, ecology/life history, taxonomy and use for ~34,000 species of fish. FishBase uses the Catalog of Fishes[90] for its baseline taxonomy and provides the central dataset for this report. *Accessible via https://www.fishbase.org* (version 05/2023).	Coverage: central dataset, contains all species
GMAD (Global Marine Aquarium Database)	Database of marine ornamental species in international trade (including fish and invertebrates) collated from reported imports and/or exports by wholesalers 1988-2003.	Coverage: 1006 species Historic data collated from ~20% of wholesalers active during 2000-2003 (UNEP-WCMC, 2008). Includes quantity, countries/regions of origin and destination in many cases.
LEMIS	Official US Fish and Wildlife Service (USFWS) database on wildlife and wildlife products (primarily animals) imported into the US. *2010-2021 data on marine ornamental fish reported at genus and species level provided via FOIA request. Data extracted on 22/10/2021.*	Coverage: 90 species and 106 genera Trade largely reported at higher taxonomic levels and cannot be considered globally representative.
Species360 ZIMS (2021)	ZIMS (Zoological Information Management System) is a database curated by Species360 members and containing information on >22 000 species held within public collections (e.g. zoos and aquaria). Data are collated from >191 Species360 member institutions within a network of >1200 aquarium, zoo, university, research and governmental members. *Further information available at https://www.species360.org/.*	Coverage: 1074 species Data only cover species held by reporting institutions.

[89] Overseen by a consortium of 12 organisations (including FAO, universities, natural history museums and other NGOs), with contributions from almost 2500 collaborators.
[90] Accessible via https://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp and considered the standard core taxonomy for fish.

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Dataset name	Dataset description	Data Considerations
The IUCN Red List of Threatened Species	Global assessments of extinction risk, ecology, threats and use of >140 000 species *Accessible via https://www.iucnredlist.org* (version 2023-1)	Coverage: 1995 species published Not all species included in these analyses have been assessed by IUCN, and older assessments (e.g. >10 years old) may no longer represent the current conservation status of the species.
TRACES	Official database of the European Commission for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into and within the EU. (https://ec.europa.eu/food/animals/traces_en). *2018-2023 data provided via FOIA request. Data extracted on 09/02/2024.*	Coverage: 1168 species and 74 families Trade largely reported at the family level within the Harmonised System (HS) code 030119.
TRAFFIC Wildlife Trade Portal	Database on illegal wildlife trade incidents (including seizures) collated from publicly accessible sources. *Accessible via https://www.wildlifetradeportal.org/*	Coverage: 4 species Contains only publicly reported incidents of illegal wildlife trade, which may not be representative of the overall illegal trade in wildlife. Data may also be reported at higher taxonomic levels or non-specific common names.
Report		
Sweet and Pedersen (2019)	Marine ornamental fish species reported to have been bred successfully in captivity at any time up to 2019, labelled according to their perceived availability in the US (whether captive-bred specimens are commonly, moderately or rarely available in retail, or whether captive breeding has technically been achieved, but not yet at a scale suitable for retail). Data were gathered from a CORAL magazine survey of marine ornamental fish specialists and breeders.	Coverage: 277 species List curated by experts in the field, gathering data from small-scale breeders as well as commercial companies.
Scientific Literature		
Biondo (2018)	Top 10 families and top 20 marine ornamental fish species most commonly imported into Switzerland by volume between 2014 and 2017 based on the European database Trade Control and Expert System (TRACES) data.	Coverage: 10 families and 20 species Trade reported at higher taxonomic levels may also include non-ornamental species. Some species may only be reported at higher taxonomic levels (e.g. family) and so were not included in this dataset.
Biondo and Burki (2019)	Top 10 families and top 20 marine ornamental fish species most commonly imported into the EU by volume between 2014 and 2017, based on the European database Trade Control and Expert System (TRACES) data.	Coverage: 10 families and 20 species Trade reported at higher taxonomic levels may also include non-ornamental species. Some species may only be reported at higher taxonomic levels (e.g. family) and so were not included in this dataset.
Borges *et al.* (2021)	Marine ornamental fish species gathered from sale advert in 83 closed group forums on Facebook in Brazil between July and December 2018.	Coverage: 181 species Fish identity verified by experts where needed, but unclear if all sales indicated trade was occurring at an international scale.

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Dataset name	Dataset description	Data Considerations
Bruckner (2005)	Main marine ornamental species harvested from Brazil, Florida and Puerto Rico (the three largest source countries/states in the western Atlantic), and main marine fish species targeted for the global aquarium trade. Based on data from the U.S. Fish and Wildlife Service and U.S. Customs, the World Resources Institute, UNEP-WCMC, TRAFFIC USA, and other published reports.	Coverage: 15 species
Cardoso *et al.* (2021)	Marine ornamental fish imported and sold by an aquarium retailer in Sao Paulo, Southeastern Brazil, based on purchases made for the purpose of the study on marine ornamental fish parasites.	Coverage: 19 species No evidence of sale of international trade, so this dataset was only used as evidence of demand as ornamental species (i.e. for aquaria/display purposes). No date of fish purchase provided.
Dominguez and Botella (2014)	Marine ornamental fish species bred in captivity and other popular traded species worldwide.	Coverage: 22 species Source(s) of data were not specified.
Legore (2005)	Marine ornamental fish exported from Puerto Rico between 1998 and 2000 based on meetings, interviews and invoice documents prepared for shipments.	Coverage: 13 species
Muyot *et al.* (2018)	Marine ornamental fish species collected from the Philippines for export, based on interviews with diver-gatherers, middleman-traders and exporters conducted from 2016 to 2017.	Coverage: 3 species
Muyot *et al.* (2019)	Top 10 marine ornamental fish species collected from the Philippines in 2016 by value and by quantity based on survey data from exporters.	Coverage: 10 species
Nuryanto *et al.* (2020)a	Marine ornamental fish species collected and sold for the international aquarium trade at Cilacap, central Java, Indonesia based on data from purchases made from middlemen in 2019.	Coverage: 26 species
Nuryanto *et al.* (2020)b	Marine ornamental fish species collected and sold for the international aquarium trade at Pangandaran, west Java, Indonesia based on data from purchases made from middlemen in 2019.	Coverage: 90 species
Nuryanto *et al.* (2021)	Marine ornamental fish species sold for the international aquarium trade, live at 3 markets in West Java, Indonesia, based on data from purchases from fish collectors at market spots in 2018.	Coverage: 72 species
Pinnegar and Murray (2019)	Marine ornamental species identified from a survey of 50 aquarium shops in eastern England, carried out between April and August 2011. *Further unpublished data on species labelled as 'tank reared' provided by author (Pinnegar, unpublished data)*	Coverage: 280 species Fish identity confirmed using identification guides.
Rhyne *et al.* (2012)	Top 20 marine ornamental fish species imported into the US in a 1 year period between May 2004 and May 2005 based on shipment declarations maintained in the LEMIS database.	Coverage: 20 species
Rhyne *et al.* (2017)	Top 20 live marine aquarium fish imported into the US in 2008, 2009 and 2011 based on data in the LEMIS database.	Coverage: 20 species

Dataset name	Dataset description	Data Considerations
Wabnitz *et al.* (2003)	Highly traded marine ornamental fish species and their quantities in international trade based on data from GMAD for the years 1997 to 2002. A list of species most unsuitable for keeping in aquaria was also provided.	Coverage: 31 species *NB data from GMAD used directly*
Wood (2001)	List of highly exported fish species from Brazil, Eritrea, Costa Rica, Maldives, Saudi Arabia, Hawaii and Sri Lanka based on government export and/or import statistics, scientific literature and 'unpublished reports and knowledgeable contacts in the countries of origin'.	Coverage: 38 species
	Unpublished data	
French Polynesia national exports	Export data from French Polynesia to EU in 2020. Lists species/genera and the number of individuals exported. Obtained from national Authority via stakeholder survey.	Coverage: 6 species and 2 genera
M. Hill and G. Watson (2021)	Data from an online survey of species sold in 15 UK aquarium shops, 2015-2021.	Coverage: 252 species Small sample size and based on self-reported data.
New Caledonia national exports	List of marine ornamental fish species exported by New Caledonia, and the approximate number of individuals exported. Obtained from national Authority via stakeholder survey.	Coverage: 56 species Year of export unknown.
OATA & OFI *unpublished data*	List of species imported into Europe, including the proportion of trade (by number of individuals) comprised of each species and whether species are frequently traded from captive-bred sources.	Coverage: 1009 species Representative of European imports. Quantities not included.
Pinnegar *Unpublished data*	Marine ornamental species labelled as 'tank reared' from a survey of 50 aquarium shops in eastern England, carried out between April and August 2011.	Coverage: 280 species including 11 'tank reared' Fish identity confirmed using identification guides. Tank reared fish may be under-reported.
Tropical Marine Centre *unpublished data*	List of species traded by Tropical Marine Centre between 2017 and 2019, a large European marine fish wholesaler. Where available, addition information was provided for each species on the proportion of captive-bred individuals, and whether species were in the top 80% or top 50% of trade in quantity.	Coverage: 762 species Wide representation of species. Quantities not included.

ANNEX D: Summary of non-focal countries/ territories of export to provide responses to the stakeholder survey on marine ornamental fisheries management

Further to the information gathered for the six focal countries of export in Section 3, information on marine ornamental fisheries harvest and export management measures were reported in the stakeholder survey for a further eight countries/territories: Cuba, France and overseas territories (Mayotte, Guadeloupe and Martinique), French Polynesia, Israel, Japan, new Caledonia, Singapore and the US. These non-focal countries/territories of export are listed in Table D1 along with information on the number of native marine ornamental fish in international trade, and the quantity of live non-freshwater ornamental fish (HS code 030119) reported as exported by each country 2012-2021. Information on national export-related legislation was also provided by a further country (South Africa), although they provided no information on harvest or export management measures.

Table D2 summarises the management measures reported to be in place by stakeholder survey respondents from the country/territory and Table D3 details the national legislation and enforcement relating to the export of marine ornamental fish as reported by stakeholder survey respondents.

Table D1. *Summary of native species and overall quantity of marine ornamental fish species in international trade for countries where at least one stakeholder survey response included information on management other than the six focal exporting countries summarised in Section 3.* ***Data sources****: [a]FishBase (https://www.fishbase.org version 05/2023); [b]UN Comtrade (extracted 22/04/22); [c]Responses to survey shared via Notif. 2021/030.*

Range State	Number of native marine ornamental fish with evidence of international trade[a] (number of 'higher risk' species in parentheses)	Quantity of live non-freshwater ornamental fish (HS 030119) exported 2012-2021 (million kg)[b] (% of global exports in parentheses)
Cuba	22 (18)	No data reported
France and overseas territories: Mayotte, Guadeloupe, Martinique	Mayotte: 126 (8) Guadeloupe: 164 (16) Martinique: 174 (16)	No data reported at territory level
French Polynesia	389 (7)	0.3 (0.8%)
Israel	112 (10)	0.1 (0.2%)
Japan	798 (18)	<0.01 (0.1%)
New Caledonia	734 (14)	<0.01 (0.1%)
Singapore	122 (8)	0.8 (2.2%)
US	253 (26)	2.3 (6.1%)

***Table D2**. Types of harvest and export management measures covering marine ornamental fish for countries where at least one stakeholder survey response included information on management other than the six focal exporting countries summarised in Section 3. **Data sources**: Responses to survey shared via Notif. 2021/030.*

	Measure	Cuba (1)	France and overseas territories: Mayotte, Guadeloupe, Martinique (1) *	French Polynesia (1) **	Israel (1) *	Japan (1)	New Caledonia (2) **	Singapore (1) *	United States of America (4) *†
Harvest management measures	Prohibition/ regulation of take in protected areas	✓	✓		✓	✓	✓	✓	✓
	Licensing system for fishing	✓	✓		✓	✓	✓	✓	✓
	Harvest quotas by taxon per year	✓							✓-All commercial wild-take prohibited in Hawaii
	Restrictions on size/ development stage	✓							✓
	Seasonal restrictions		✓			✓			✓
	Gear/ equipment restrictions			✓ Prohibition of scuba-diving fishing		✓ Prohibition of scuba fishing; net size regulation			✓ Certain localities limit gear types, net sizes, construction
	Prohibition of fishing with explosives or poisons	✓	✓	✓	✓	✓	✓		✓ Use of quinaldine permitted in Florida
Export management measures	Prohibition of export of marine ornamental fish		-		✓				
	Controls on export quantities		-				✓		✓
	Controls on sizes/ developmental stages that can be exported	✓	-						✓
	Controls on source (e.g. wild, captive)		-		✓				✓

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Measure	Cuba (1)	France and overseas territories: Mayotte, Guadeloupe, Martinique (1) *	French Polynesia (1) **	Israel (1) *	Japan (1)	New Caledonia (2) **	Singapore (1) *	United States of America (4) *†
Monitoring of trade levels		-				✓	✓	✓
Animal health provisions that cover live fish trade		-				✓	✓	✓ Animal health in facilities governed by USDA (US Department of Agriculture)
Industry standards regulating the live marine ornamental fishery		-						✓ Air transport of live animals governed by the International Air Transport Association (IATA)
Additional measures		-	Currently exploring export restrictions (e.g. through establishing a Sanitary White List for export)	Wild take prohibited. Only captive-bred fish can be exported	No trade/export measures		Licence required to operate. Wild take prohibited under the Wildlife Act.	Stricter regulations are in place for species covered by the Lacey Act or the Endangered Species Act.

Survey response provided by CITES Authority (*) or another government agency (**).

'- ' no response provided by survey respondent.

† US CITES Authority response indicated that they considered no trade/export measure to be in place at the national level, however other respondents reported subnational provisions, voluntary measures and industry standards regulating aspects of trade.

Table D3. *National legislation and enforcement relating to the* ***export*** *of marine ornamental fish species, as reported by stakeholder survey respondents for countries where at least one stakeholder survey response included information on national legislation relating to export other than the six focal exporting countries summarised in Section 3. Information on whether the respondent considered enforcement of national legislation and export measures to be sufficient to ensure trade in marine ornamental fish is sustainable was also included.* ***Data sources:*** *Responses to survey shared via Notif. 2021/030.*

Country/territory (no. survey responses)	National legislation relating to the export of marine ornamental fish	Body/bodies responsible for enforcement	Measures in place to ensure effective enforcement	Respondent considers national legislation enforcement to be sufficient	Respondent considers export measures to be sufficient	Respondent comments on whether enforcement and/or export measures are sufficient
Cuba (1)	✓	Ministerio de Ciencia, Tecnologia y Medio Ambiente Ministerio de la Industria Alimentaria y Pesca		✓	✓	
France and overseas territories: Mayotte, Guadeloupe, Martinique (1) *	X	Mayotte: Direction des Peches Maritimes et de l'Aquaculture Guadeloupe and Martinique: Direction de la Mer Direction de l'Environnement, de l'Aménagement et du Logement Direction de l'Alimentation, de l'Agriculture et de la Foret	Local enforcement	?	?	
French Polynesia (1) **	X	Customs, Fisheries department Maritime affairs department	Local government	X	X	
Israel (1) *	✓	Israel Nature and Parks Authority Department of Fisheries of the Ministry of Agriculture	Marine rangers ensure no ornamental marine fish are taken and border controls ensure no international trade occurs	✓	✓	All ornamental fish are protected and take is not permitted
New Caledonia (2) *	✓ / X	Officers from Provincial Department of Environment and Sustainable development Official veterinarians of SIVAP for export certification	Physical inspections of each export needing veterinary certification; validation of species and quantities on invoice; removing any individuals from shipment that appear non-compliant	✓ / partial	✓ / partial	CITES Authority indicated no legislation and partially sufficient legislation enforcement and export measures.
Singapore (2) *	✓ (Wildlife Act 1965, Endangered Species (Import and Export) Act 2006, Animals and Birds (Live Fish) Rules 2011)	-	-	-	-	

Annexes

Country/territory (no. survey responses)	National legislation relating to the export of marine ornamental fish	Body/bodies responsible for enforcement	Measures in place to ensure effective enforcement	Respondent considers national legislation enforcement to be sufficient	Respondent considers export measures to be sufficient	Respondent comments on whether enforcement and/or export measures are sufficient
South Africa (1)	✓	The National Department of Environment, Forestry and Fisheries South African Revenue Service	No control or compliance measures	X	X	The sustainability of trade is unknown due to limited research, and enforcement effort on the ground is low
United States of America (4) *	✓ (but only species and activities covered by the Endangered Species Act 1973 or the Lacey Act)	US National Marine Fisheries Service Office of Law Enforcement US Fish and Wildlife Service Office of Law Enforcement State and Territorial Fisheries and Wildlife Enforcement agencies	Prosecutions for violations, both locally, and nationally.	✓ (sharks) X (other marine ornamental fish species)	Partial	There are insufficient resources to adequately enforce the Lacey Act and marking/ labelling requirements. The Endangered Species Act includes few marine ornamental fish species

'- ' no response provided by survey respondent.
Survey response provided by CITES Authority (*) or another government agency (**).
† 3/4 survey respondents reported no or unknown relevant legislation in place.

ANNEX E: National/subnational management and trade-related legislation for the six focal countries of export

Table E1. *Published management plans and legislation relating to management practices and/or the export of marine ornamental fish for the six focal countries of export. Documents specific to fishery management/trade, in particular those targeted towards marine ornamental fish are also indicated. Where available, hyperlinks to core documents, amendments and associated regulations are provided.*

Published document	Specific to fisheries (✓ = yes ✓✓ = yes, marine ornamental fish)	Type of document (L = legislation; MP = management plan; SL = protected species list)	Management	Trade/ export
Australia*				
National				
Act No. 91/1999 (Environment Protection and Biodiversity Conservation Act 1999)		L	✓	✓
Environment Protection and Biodiversity Conservation Regulations 2000		L	✓	✓
Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection) Act 2001		L		✓
Guidelines for the Ecologically Sustainable Management of Fisheries 2007	✓		✓	
Act No. 12/2020 (Export Control Act 2020)		L		✓
Export Control (Animals) Rules 2021		L		✓
Export Control (Fish and Fish Products) Rules 2021	✓	L		✓
Subnational: Australian Capital Territory				
Act No. 21/2000 (Fisheries Act 2000)	✓	L		✓
Subnational: New South Wales				
Act No. 1/1994 (Fisheries Management Act 1994)	✓	L		✓
Listed Protected Fish Species	✓	SL	✓	
Subnational: Northern Territory				
Act No. 58/1988 (Fisheries Act 1988)	✓	L	✓	✓
Regulation No. 20/1992 (Fisheries Regulations 1992)	✓	L	✓	✓
Territory Parks and Wildlife Conservation Regulations		L	✓	
Marine protected species in the Northern Territory: Identification guide		SL	✓	
Northern Territories Aquarium Fishery Management Plan	✓✓	MP	✓	✓
Subnational: Queensland				
Coral Sea Fishery Management Arrangement	✓	MP	✓	

Annexes

Published document	Specific to fisheries (✓ = yes ✓✓ = yes, marine ornamental fish)	Type of document (L = legislation; MP = management plan; SL = protected species list)	Management	Trade/ export
Coral Sea Fishery Harvest Strategy Framework	✓	MP	✓	
Fisheries Act 1994	✓	L	✓	✓
Fisheries (Coral Reef Fin Fish) Management Plan 2003	✓✓	L	✓	✓
Regulation No. 83/2008 (Fisheries Regulation 2008)	✓	L	✓	
Nature Conservation (Wildlife) Regulations 2016		L	✓	
Coral Sea Marine Park management plan 2018		MP	✓	
Fisheries (General) Regulations 2019	✓	L	✓	✓
Regulation No. 178/2019 (Fisheries (Commercial Fisheries) Regulations 2019)	✓	L	✓	✓
Queensland Harvest Strategy Policy 2021	✓	MP	✓	
Guide to the Queensland Marine Aquarium Fish Fishery and the Queensland Coral Fishery	✓✓		✓	
Looking after protected species in Queensland		SL	✓	
Marine Aquarium Fish Harvest Strategy	✓✓	MP	✓	
Subnational: Southern Australia				
Recreational fishing rules		SL	✓	
Subnational: Western Australia				
Marine Aquarium Fish Managed Fishery	✓✓		✓	
Aquatic Resources Management Act 2016		L	✓	✓
Biodiversity Conservation Act 2016		L	✓	✓
Biodiversity Conservation Regulations 2018		L	✓	✓
Fish Resources Management Regulations 1995		L		✓
Act No. 126/1984 (Conservation and Land Management Act 1984)	✓	L	✓	
Marine Aquarium Fish Managed Fishery Management Plan 2018	✓✓	MP		
Marine Aquarium Fish Resource of Western Australia Harvest Strategy 2018-2022	✓✓	MP	✓	
Ecological Risk Assessment for the Marine Aquarium Fish Resource 2022	✓✓	MP	✓	
Cocos (Keeling) Islands Marine Aquarium Fishery	✓✓	MP	✓	
Marine protected species identification guide		SL	✓	
Subnational: Victoria				
Flora and Fauna Guarantee Act 1988		L		✓
Act No. 92/1995 (Fisheries Act 1995)	✓	L		
Fisheries Regulations 2009	✓	L		

Published document	Specific to fisheries (✓ = yes ✓✓ = yes, marine ornamental fish)	Type of document (L = legislation; MP = management plan; SL = protected species list)	Management	Trade/ export
Oceanreef Aquaculture environmental assessment (*under the Environmental Protection and Biodiversity Conservation Act 1999*)	✓✓		✓	
PQ Aquatics environmental assessment (*under the Environmental Protection and Biodiversity Conservation Act 1999*)	✓✓	MP	✓	✓
Fiji				
National				
Act No.4/1941 (Fisheries Act 1941)	✓	L	✓	
Regulation No. 17/1965 (Fisheries Regulation 1965)	✓	L	✓	
Legal Notice No. 17/1997 (Fisheries (Restrictions on Use of Breathing Apparatus) Regulations 1997)	✓	L	✓	
Act No. 29/2002 (Endangered and Protected Species Act 2002)		L		✓
Environment Management Act 2005		L	✓	
Promulgation No.28/2008 (Biosecurity Promulgation 20008)		L		✓
Decree No. 78/2012 (Offshore Fisheries Management Act 2012)	✓	L	✓	
Offshore Fisheries Management Regulation 2014	✓	L	✓	
5-Year & 20-Year National Development Plan 2017		MP	✓	
Public Notice - Ban on fishing, collection, sales and export of all species of Grouper (Kawakawa) and Coral Trout (Donu) 2018 (*ongoing*)	✓		✓	
Subnational				
Kubulau District Ecosystem-Based Management Plan 2009		MP	✓	
Fisheries (Shark Reef Marine Reserve) (Serua) Regulations 2014	✓	L	✓	
Fisheries (Wakaya Marine Reserve) Regulations 2015	✓	L	✓	
Fisheries (Kiuva Marine Reserve) Regulations 2018	✓	L	✓	
Fisheries (Naiqoro Passage Spawning Aggregation Marine Reserve) Regulations 2018	✓	L	✓	
Indonesia				
National				
Act No. 5/1990 (Conservation of Biological Resources and their Ecosystems)		L	✓	
Law No. 45/2009 (amending Law No. 31/2004 concerning Fishery)	✓	L	✓	
Regulation No. 60/2007 (Conservation of Fishery Resources)	✓	L	✓	
Law No. 1/2014 (amending Law No. 27/2007 on the Management of Coastal Area and Isles)		L	✓	
Act No. 23/2014 (Local Government)		L	✓	

Annexes

Published document	Specific to fisheries (✓ = yes ✓✓ = yes, marine ornamental fish)	Type of document (L = legislation; MP = management plan; SL = protected species list)	Management	Trade/ export
Decree of Environmental and Forestry Ministry No. P.20/MENLHK/SETJEN/KUM.1/6/2018 regarding the Protected Flora and Fauna Species		SL	✓	
Law No. 21/2019 (Animal, Fish and Plant Quarantine)		L		✓
Decree No. 18/2021 (Fishing Equipment)	✓	L	✓	
Regulation No. 29/2019 (Exports and Imports of Animals and Animal Products)		L		✓
Banggai Cardinal Fish National Plan of Action	✓	MP	✓	
Kenya				
National				
Act No. 4/1965 (Animal Disease Act (Cap. 364) 1965)		L		✓
Regulation No. 34/1991 (Fisheries (General) Regulations (Cap. 378) 1991)	✓	L	✓	✓
Regulation No. 170/2007 (Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007)	✓	L		✓
Act No. 47/2013 (Wildlife Conservation and Management Act 2013)	✓	L	✓	
Act No. 35/2016 (Fisheries Management and Development Act 2016)	✓	L	✓	
Kenya Wildlife Service: Priority ecosystems and species		SL		
The Philippines				
National				
Republic Act No. 7586/1992 (National Integrated Protected Areas System (NIPAS) Act of 1992)		L	✓	
Republic Act No. 8550/1998 (Philippine Fisheries Code 1998)	✓	L	✓	✓
Administrative Order No. 3/1998 (Implementing Rules and Regulations of the Philippine Fisheries Code of 1998)	✓	L	✓	✓
Administrative order No. 10/2015 (Implementing Rules and Regulations of the Philippine Fisheries Code of 1998)	✓	L	✓	✓
Wildlife Resources Conservation and Protection Act (Republic Act No 9147)		L	✓	✓
Administrative Order No. 227/2008 (Rules and Regulations governing the Export of Fish and Live Aquatic Animals Products to European Member Countries).	✓	L		✓
Memorandum Order No. 2/2009 (Requirements for the Export of Live Aquatic Animals: Crustaceans, Fish and Invertebrates)		L		✓
Administrative Order No. 233/2010 (Aquatic Wildlife Conservation)	✓	L	✓	✓

Annexes

Published document	Specific to fisheries (✓ = yes ✓✓ = yes, marine ornamental fish)	Type of document (L = legislation; MP = management plan; SL = protected species list)	Management	Trade/ export
Administrative Order No. 10/2015 (implementing Rules and Regulations of the Philippine Fisheries Code of 1998 (R.A. No. 8550) as amended by R.A. No. 10654).	✓	L		✓
National list of threatened fauna		SL	✓	
Sri Lanka				
National				
Ordinance No. 2/1937 (Fauna and Flora Protection Ordinance 1937)		L; SL	✓	✓
Fisheries Regulations, 1941	✓	L		✓
National Environmental Act 1980		L	✓	
Act No. 2/1996 (Fisheries and Aquatic Resources Act 1996)	✓	L	✓	
Fishing Operations Regulations of 1996	✓	L	✓	
Fish Products (Export) Regulations 1998	✓	L		✓
Regulation No. 1036/13 - 1998 (Export and Import of Live Fish Regulations, 1998)	✓	L		✓
Regulation No. 1665/16 - 2010 (Fishing (Import and Export) Regulations 2010)	✓	L		✓
Conservation of Fish and Aquatic Resources within Sri Lanka Waters Regulations 2016	✓	L	✓	
Subnational				
Fisheries and Aquatic Resources Statute of Western Province	✓	L	✓	
Fishing Operations Regulations of Catching Live Ornamental Fish or Lobster in the South Coast (Matara and Galle District) Fisheries Management Area, 2012	✓✓	L	✓	

* Australia is largely managed subnationally; territories with relevant marine ornamental fisheries are shown disaggregated

ANNEX F: Native range States for 'higher risk' species in six focal countries of export

Table F1. *Distribution of marine ornamental fish species identified as 'higher risk' in Section 2, in particular whether they are native to the six focal countries of export.*

			Focal country range States					
Family	Species	Total native range States	Australia (n= 23)	Fiji (n= 9)	Indonesia (n= 24)	Kenya (n= 9)	Philippines (n= 17)	Sri Lanka (n= 11)
		Actinopteri						
Acanthuridae	*Acanthurus chronixis* (Chronixis surgeonfish)	1						
Apogonidae	*Pterapogon kauderni* (Banggai cardinal fish)	1			✓			
Balistidae	*Balistes punctatus* (Bluespotted triggerfish)	66						
	Balistes capriscus (Grey triggerfish)	65						
	Balistes vetula (Queen triggerfish)	54						
Blenniidae	*Ecsenius tigris* (Tiger combtooth blenny)	1	✓					
Chaetodontidae	*Chaetodon trifascialis* (Chevron butterflyfish)	56	✓	✓	✓	✓	✓	✓
Epinephelidae	*Epinephelus fuscoguttatus* (Brown-marbled grouper)	58	✓	✓	✓		✓	✓
	Epinephelus lanceolatus (Giant grouper)	58	✓	✓	✓	✓	✓	✓
	Epinephelus morio (Red grouper)	40						
	Epinephelus striatus (Nassau grouper)	40						
	Mycteroperca bonaci (Black grouper)	40						
	Mycteroperca interstitialis (Yellowmouth grouper)	33						
	Mycteroperca venenosa (Yellowfin grouper)	41						
Gobiidae	*Callogobius amikami* (Amikami nano goby)	4						
	Coryphopterus lipernes (Peppermint goby)	27						
	Coryphopterus personatus (Masked goby)	30						
	Elacatinus figaro (Barber goby)	1						
	Elacatinus prochilos (Broadstripe goby)	18						
Haemulidae	*Plectorhinchus albovittatus* (Two-striped sweetlips)	23		✓	✓		✓	✓
Kyphosidae	*Kyphosus incisor* (Yellow sea chub)	37						
Labridae	*Bodianus frenchii* (Foxfish)	1	✓					
	Cirrhilabrus balteatus (Girdled wrasse)	1						
	Cirrhilabrus filamentosus (Whip-fin wrasse)	2			✓			

Family	Species	Total native range States	Focal country range States					
			Australia (n= 23)	Fiji (n= 9)	Indonesia (n= 24)	Kenya (n= 9)	Philippines (n= 17)	Sri Lanka (n= 11)
	Cirrhilabrus rubrisquamis (Red velvet fairy wrasse)	2						
	Cirrhilabrus solorensis (Red-eye wrasse)	5			✓			
	Cirrhilabrus tonozukai (Tono's wrasse)	2			✓			
	Halichoeres adustus (Black wrasse)	2						
	Lachnolaimus maximus (Hogfish)	39						
	Larabicus quadrilineatus (Fourline wrasse)	5						
	Semicossyphus pulcher (California sheephead)	2						
	Tautoga onitis (Tautog)	2						
Lutjanidae	*Lutjanus analis* (Mutton snapper)	36						
	Lutjanus jocu (Dog snapper)	42						
	Lutjanus synagris (Lane snapper)	41						
Megalopidae	*Megalops atlanticus* (Tarpon)	67						
Monacanthidae	*Oxymonacanthus longirostris* (Harlequin filefish)	34	✓		✓		✓	✓
Pegasidae	*Pegasus volitans* (Longtail seamouth)	25	✓		✓		✓	✓
Pomacanthidae	*Apolemichthys kingi* (Tiger angelfish)	2						
	Chaetodontoplus duboulayi (Scribbled angelfish)	4	✓		✓			
	Chaetodontoplus meredithi (Queensland yellowtail angelfish)	2	✓					
	Holacanthus limbaughi (Clipperton angelfish)	1						
Pomacentridae	*Amblyglyphidodon ternatensis* (Ternate damsel)	12			✓		✓	
	Amphiprion mccullochi (Whitesnout anemonefish)	1	✓					
	Chrysiptera arnazae (Arnaz's damselfish)	2			✓			
	Chrysiptera hemicyanea (Azure demoiselle)	6	✓		✓			
	Plectroglyphidodon dickii (Blackbar devil)	45	✓		✓		✓	
Scaridae	*Bolbometopon muricatum* (Green humphead parrotfish)	43	✓		✓	✓	✓	
Sebastidae	*Sebastes constellatus* (Starry rockfish)	2						
	Sebastes melanops (Black rockfish)	4						
	Sebastes nigrocinctus (Tiger rockfish)	3						
	Sebastes paucispinis (Bocaccio rockfish)	4						
	Sebastes ruberrimus (Yelloweye rockfish)	4						
Siganidae	*Siganus unimaculatus* (Blotched foxface)	5	✓				✓	

Family	Species	Total native range States	Focal country range States					
			Australia (n= 23)	Fiji (n= 9)	Indonesia (n= 24)	Kenya (n= 9)	Philippines (n= 17)	Sri Lanka (n= 11)
	Siganus uspi (Bicolored foxface)	2		✓				
Sphyraenidae	*Sphyraena jello* (Pickhandle barracuda)	50	✓	✓	✓	✓	✓	✓
Syngnathidae	*Dunckerocampus dactyliophorus* (Ringed pipefish)	23	✓		✓		✓	
Elasmobranchii								
Aetobatidae	*Aetobatus narinari* (Whitespotted eagle ray)	89						
Carchariidae	*Carcharias taurus* (Sand tiger shark)	77	✓	✓	✓	✓	✓	
Dasyatidae	*Himantura uarnak* (Honeycomb stingray)	47	✓		✓	✓	✓	✓
	Pastinachus sephen (Cowtail stingray)	29	✓		✓			
Ginglymostomatidae	*Ginglymostoma cirratum* (Nurse shark)	60						
	Nebrius ferrugineus (Tawny nurse shark)	67	✓	✓	✓	✓	✓	✓
Hemiscylliidae	*Chiloscyllium punctatum* (Brownbanded bambooshark)	17	✓		✓		✓	
	Hemiscyllium hallstromi (Papuan epaulette shark)	1						
Rhinopteridae	*Rhinoptera neglecta* (Australian cownose ray)	1	✓					
Scyliorhinidae	*Scyliorhinus stellaris* (Nursehound)	37						
Stegostomatidae	*Stegostoma tigrinum* (Zebra shark)	57	✓	✓	✓	✓	✓	✓
Torpedinidae	*Torpedo marmorata* (Marbled electric ray)	54						
	Torpedo sinuspersici (Variable torpedo ray)	18				✓		✓
Triakidae	*Triakis scyllium* (Banded houndshark)	6						