



Fishing for facts

AN INTRODUCTION TO THE UK ORNAMENTAL FISH TRADE

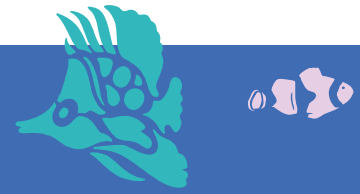


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Foreword

We estimate there could be more than 100 million fish sharing our homes and garden ponds, making them the UK's most populous pet species.



There is much debate about so-called 'exotic' pets, including ornamental fish, such as whether their trade is sustainable, the zoonotic and other biosecurity dangers they pose and how hard they are to look after. Also, the legal, sustainable trade is often incorrectly conflated with illegal trafficking without distinction. Much of this debate is based around misconceptions about the trade and keeping of ornamental fish and is often based on misleading or inaccurate information. As the UK trade association representing the businesses behind home aquariums and garden ponds we are keen that decisions affecting our sector are based on an accurate representation of the facts.

This report seeks to provide a factual overview of the UK trade in ornamental fishes. It provides information on the scale and structure of the trade and describes the comprehensive controls that already exist to govern it. Drawing on robust evidence, it explores the facts about the trade and keeping of live ornamental fishes in

terms of welfare standards, health and zoonotic risks, invasive and biosecurity risks, and sustainability. It will demonstrate that many of the risks highlighted are often over-exaggerated and misrepresent the facts.

Our industry deals with a wide range of live aquatic species, from fish and amphibians to invertebrates (such as shrimp and corals) to plants, and provides the necessary equipment and support to ensure successful keeping of those species in the home aquarium or garden pond. In this report we concentrate on the trade in live ornamental fish because this is a key driver for our industry.

We hope this report will help to better inform future decisions affecting the ornamental fish trade.

Dominic Whitmee

Chief Executive

Ornamental Aquatic Trade Association (OATA)



OATA was established in 1991 and represents more than 800 members from across the UK ornamental aquatic industry, from importers and wholesalers to manufacturers and retailers. Our objective is to support the activities of all those engaged in the ornamental aquatic trade. We aim to enhance the reputation of the trade by promoting the benefits derived from it, setting high standards, providing good education and training, and encouraging responsible ownership and enjoyment amongst fish keepers.

The ornamental aquatic trade is the catch-all term for our industry and covers a range of activities relating to aquariums in both homes and businesses and pond and water features in gardens, even if they do not contain fish. The word ornamental distinguishes our sector from the trade in food fish destined for our plates. We use the term home aquarium to distinguish from public aquariums to which some businesses in our sector supply fish and equipment.



The fish we keep

IN OUR HOMES AND GARDENS

Most home aquariums will hold a community of colourful tropical freshwater species. Marine (saltwater) and coral tanks tend to be kept by more experienced

aquarists and can be more expensive to run, requiring more specialist equipment and involvement. Garden ponds may be home to cold-water fish although many remain fishless

and are important wildlife havens for native invertebrates, amphibians such as newts and frogs, and an important water source for many terrestrial animals.

Ornamental fish – those we keep as pets – fall into two main categories: **FRESHWATER** and **MARINE** fish.

FRESHWATER FISH

Freshwater fish can be either cold-water or tropical. Cold-water fish live primarily in garden ponds and will survive in cooler unheated water.



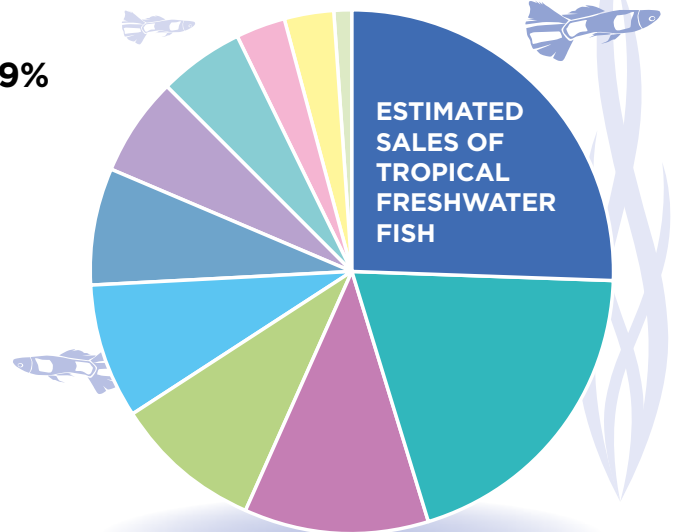
Tropical freshwater fish require warmer water that is maintained with a heater and few will survive without that constant higher temperature. There is a great variety of species available to choose from. By far the most popular choice of tropical aquarium is a “community tank” where multiple, often small-bodied, peaceful species co-exist in an aquarium. This set up is the one most commonly recommended for beginner fishkeepers.



ESTIMATED SALES OF COLDWATER FISH

89% Goldfish
7% Koi
2% Orfe
2% Tench

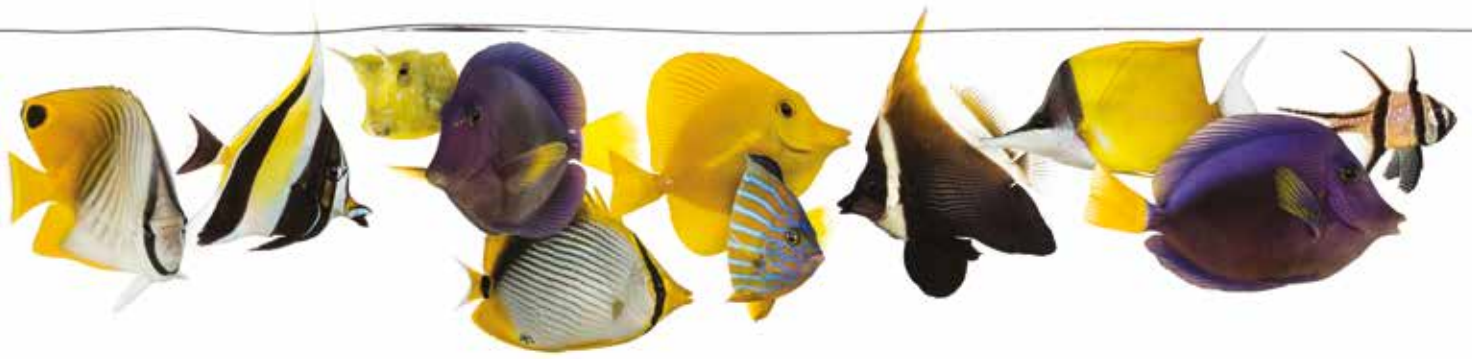
- Tetras **25%**
- Poeciliid livebearers **19%**
- Catfish **11%**
- Gourami **9%**
- Barb **8%**
- Cichlid **7%**
- Cyprinid - other **6%**
- Loaches **5%**
- Danios **3%**
- Rasbora **3%**
- Rainbowfish **1%**



The vast majority (95%) of freshwater fish are captive bred and supplied mainly from Asia (Singapore, Thailand and Sri Lanka)¹.



Industry data



TROPICAL MARINE FISH

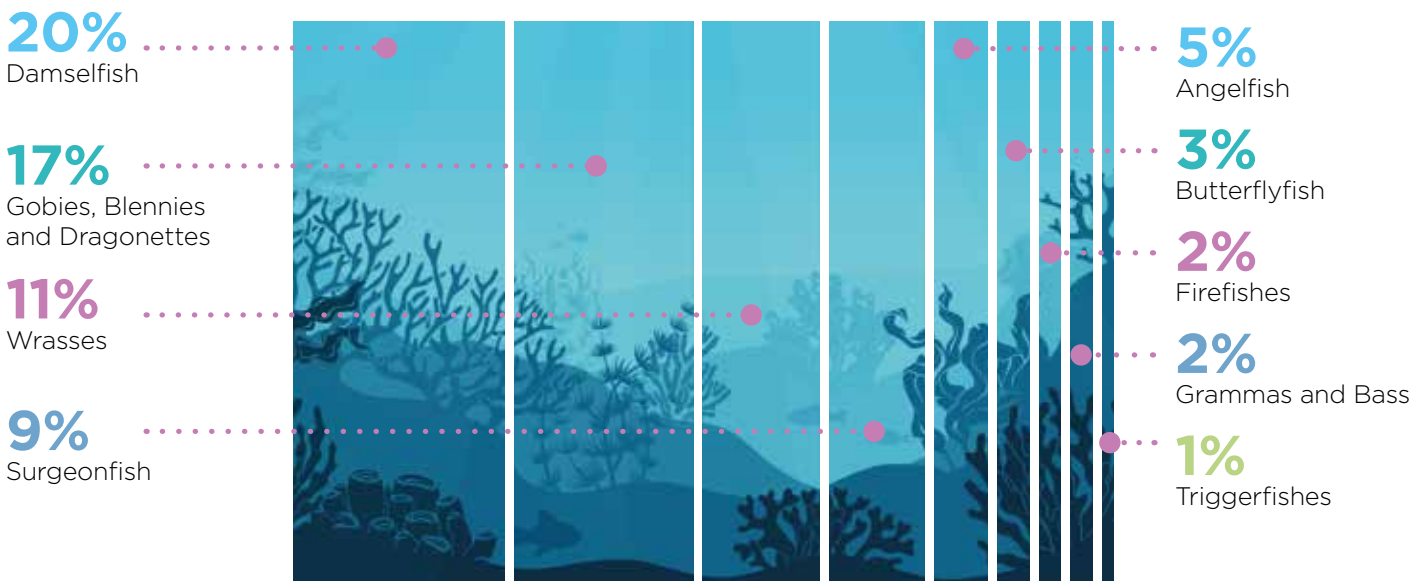
Tropical marine (saltwater) fish are mostly native to coral reefs and need heated water with salt added to the required salinity. In addition, there are typically different requirements for water quality as keepers must replicate an environment as dilute as the ocean. Saltwater fish are usually kept by more experienced aquarists because there is a requirement for more

detailed technical knowledge to meet the fishes' physiological needs.

Although there is a growing sector of successful captive rearing programmes for certain species of marine fish in trade (such as Clownfish) many species will be collected in the wild by artisanal local fisheries using low impact techniques¹⁻³.

There are estimated to be fewer than 700 marine ornamental fish species in trade in the UK and the majority of these are sold in small quantities. Fewer than an estimated 120 species make up 80% of the UK marine ornamental fish trade. Total numbers of individuals sold in trade are typically much lower than tropical freshwater species.

ESTIMATED SALES OF TROPICAL MARINE FISH



Industry data

Planted underwater gardens within tanks that are scaped with rockwork, wood and aquatic plants are increasing in popularity. These often have no fish at all or small species to emphasise the impact of the aquascape. There are even international competitions for the best scapes and aquascapers in the hobby.



Some fishkeepers become passionate about keeping and breeding particular species and will often join hobby groups to learn more and share their knowledge. These groups often contribute to conservation efforts of wild species whose natural ranges may be under threat from habitat loss or degradation^{4,5}. See pages 16 to 17 for other benefits of keeping fish. These can range from educational benefits in raising awareness about conservation to learning about water chemistry, biology and geography, and the calming health benefits of keeping fish.

For what it's worth

A SNAPSHOT OF THE UK ORNAMENTAL FISH INDUSTRY IN 2020



4 million

households own pet fish

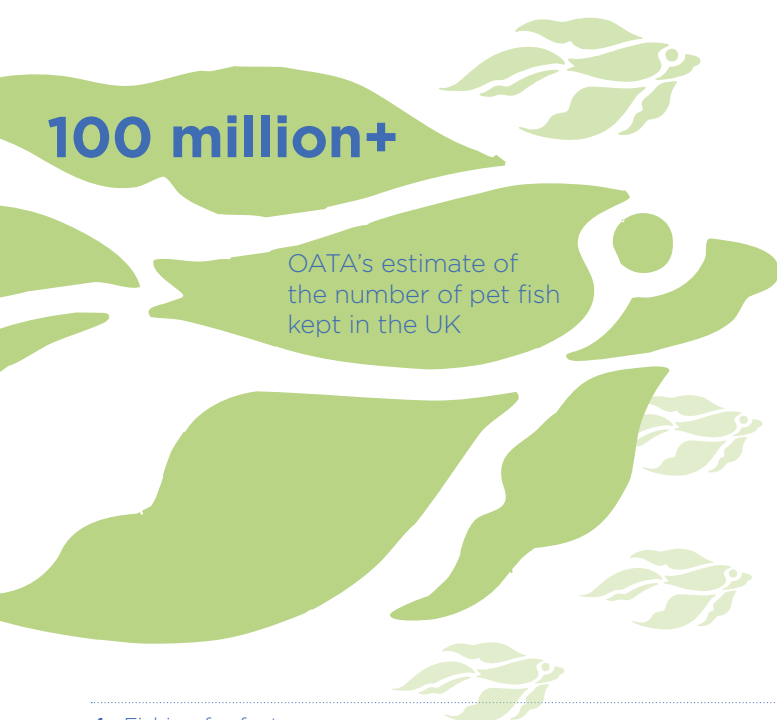


14%

 of the population

£400 million

the estimated amount spent by pet fish owners annually on their hobby



c.8.5 million

customers a year visit aquatic retailers.



The UK aquatics industry is made up of retailers, importers, wholesalers, manufacturers, aquatic plant growers and sellers, fish breeders and pond and aquarium consultants.



£15.7 million

UK import value of ornamental fish in 2020^{6*}

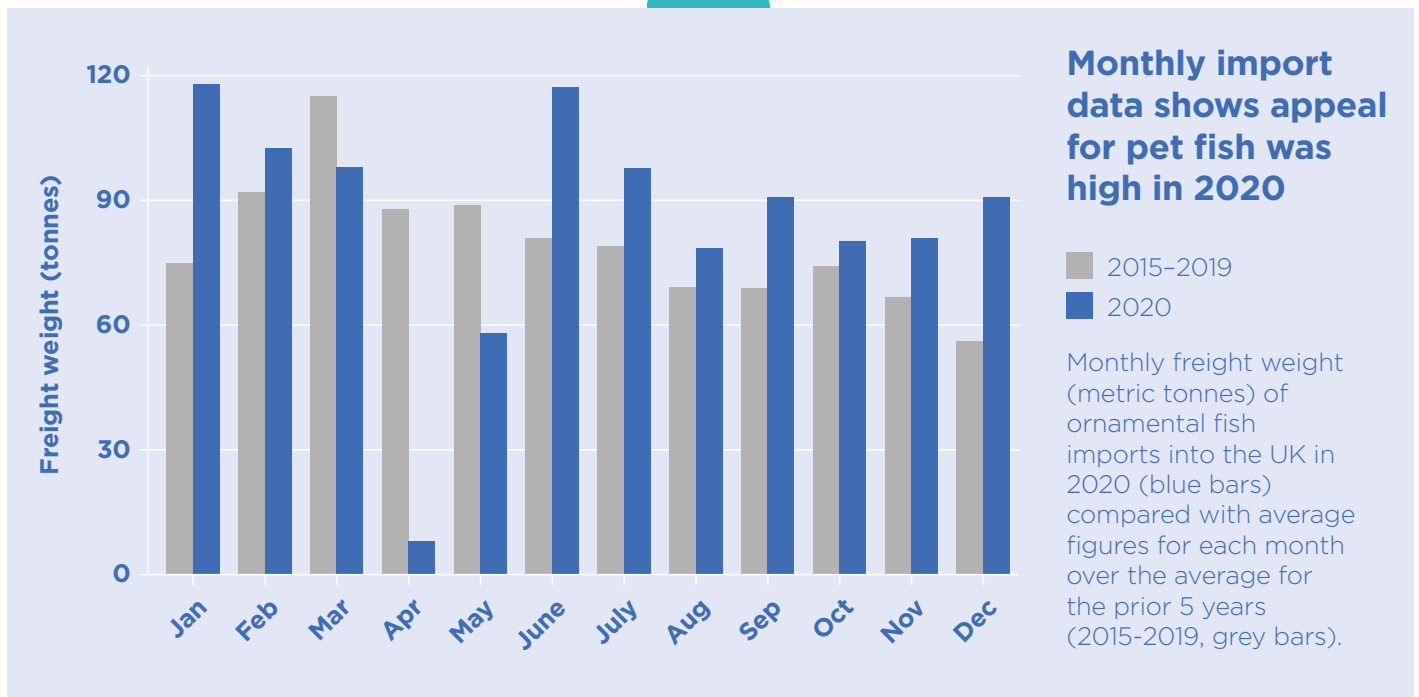
*Despite the twin effects of Covid-19 and the UK's exit from the EU, the value remained remarkably stable in 2020, believed to be due to heightened interest in indoor and home-based hobbies such as fishkeeping.

1,023 metric tonnes

Volumes of live ornamental fish coming into the UK in 2020^{6*}

↓ 54% from 2005

*Exchange rate fluctuations makes freight weight a better indicator of fish imports. Since 2005 freight weight has steadily decreased which is probably a combination of improved ways to transport fish (most of the freight weight comprises the water rather than the fish) as well as falling market demand (and therefore fewer fish).



Monthly import data shows appeal for pet fish was high in 2020

■ 2015-2019
■ 2020

Monthly freight weight (metric tonnes) of ornamental fish imports into the UK in 2020 (blue bars) compared with average figures for each month over the average for the prior 5 years (2015-2019, grey bars).

This graph shows that fish imports in 2020 (blue) remained strong compared with average figures for the prior 5 years (2015-2019 grey), despite severe disruption due to reduced flight availability. Demand for pet fish echoed the general picture of increased pet ownership of other species during the Covid-19 pandemic in 2020, possibly as a result of increased home working and an uptake of indoor hobbies like fishkeeping⁶.

Split between freshwater and marine fish imports by freight weight⁶

Freshwater fish
2020
77%



Marine fish
2020
23%



Where in the world

DO OUR PET FISH COME FROM?

In 2020, the UK imported ornamental fish from 40 countries (compared with 47 countries in 2019). The reduction in exporting countries is thought to be a result of Covid-19 impacts on flight availability^{6,7}.

31 countries

(33 in 2019) exported freshwater fish

22 countries

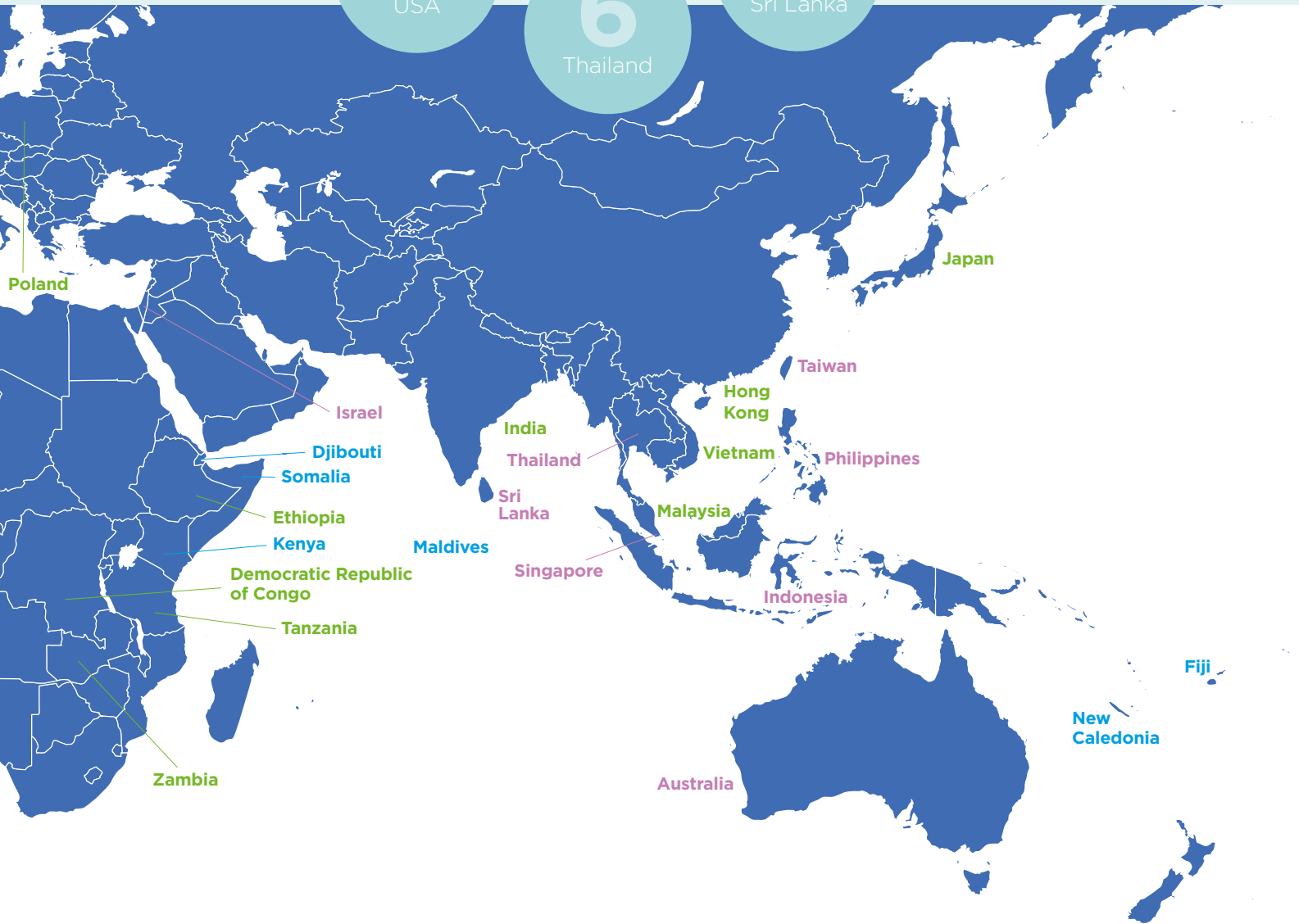
(28 in 2019) exported marine fish

(some countries export both marine and freshwater fish)

By far the largest proportion of fish kept as pets in the UK are tropical freshwater fish, the majority of which are captive reared and not taken from the wild. They pose low zoonotic and biosecurity risks because they are kept in home aquariums which are closed systems, they are handled rarely, and would very rarely survive in UK waters if released.



Top 10 countries exporting ornamental fish to the UK in 2020



A fish's journey

FROM COUNTRY TO KEEPER

There is little commercial rearing of ornamental fish in the UK. Most come from across the world, with 40 countries providing all types of fish to the UK in 2020. Approximately 75% of these overall are captive bred fish. For freshwater fish only 5% are sourced from the wild compared to about 90% of marine fish. It is important to note that captive-breeding of marine fish is a growing sector and these numbers are likely to change over the coming years.

The industry depends wholly on the provision of live and healthy aquatic animals so there are strong incentives to keep fish healthy throughout the entire supply chain and to ensure they are sustainably sourced. These incentives are supported by regulation along every step of the supply chain from breeding or collection in the country of origin to the home aquarium.

An overview of existing regulatory controls* governing the ornamental fish trade from source to the home.



COUNTRY OF ORIGIN

Generally, regulation falls into four broad categories:

- Local fisheries management measures such as fishery management plans and quotas governing allowable take.
- Customs controls which track traded species, quantities, price and destination to ensure the right taxes etc are paid.
- Species protection controls to ensure the sustainability of species in trade and/or their conservation status.
- Animal health controls to ensure exported species are not carrying infectious diseases.

IN THE AIR

- International Air Transportation Association (IATA) rules apply and state: *“Shippers must pack fish to survive unattended for at least 48 hours from time of acceptance by the airline”* and sets out packaging and labelling requirements¹⁰.
- Fish travel in a sealed environment, packed in bags with water and oxygen and are fasted prior to travel to prevent the build-up of waste products which would compromise their welfare.
- If a badly packed consignment reaches the UK it may result in a prosecution for animal cruelty.

ON ARRIVAL IN THE UK

- All live fish enter the UK through Border Control Posts. Animal and Plant Health Agency (APHA) vets, CEFAS's Fish Health Inspectorate (FHI), UK Border Force (UKBF) and HMRC examine accompanying health certificates, customs declarations and any CITES documentation as well as undertake visual checks to assess the health and welfare of transported fish.
- Fish importers must register as an Aquaculture Production Business and are regularly inspected for biosecurity purposes by FHI.
- The Import of Live Fish Act governs the freshwater fish species that are allowed into the country.

*A summary of the key regulatory controls is at Annex 1.



TRANSPORT IN THE UK

- Welfare of Animals in Transport Orders overseen by APHA set out the rules governing the welfare of animals in transport and apply to all commercial live animal journeys across the UK.
- Fish transported from airports remain in packaging complying to IATA standards¹⁰.



IN THE PET SHOP

- Animal Welfare Regulations in England outline the welfare standards that English pet shops selling animals must meet¹³. There are detailed standards which cover the five welfare needs of animals (for a suitable environment, diet and housing, to be able to behave normally and to be protected from pain, suffering, injury and disease). These include water quality standards, the need for staff training and good knowledge about the species sold and the provision of care information for all animals sold¹⁴. At the time of going to print, Wales and Scotland are developing similar regulations.



IN THE HOME

- Fishkeepers, like any pet owner, are responsible for the five welfare needs of their animals as outlined in the Animal Welfare Act 2006¹⁵.
- The Wildlife and Countryside Act makes the release of pets such as fish into the wild a criminal offence¹⁶.
- Invasive alien species legislation identifies species that are illegal to keep in the UK.

Animal Welfare

PET FISH ARE WELL CARED FOR

The ornamental fish trade is built on the supply of live healthy fish so maintains high standards of animal welfare throughout the supply chain.



The ornamental fish trade relies on the provision of live, healthy, unstressed fish so welfare throughout the supply chain is of paramount importance¹⁻³. The people who work in this sector are often passionate fishkeepers themselves and care about the welfare of the fish they sell.

Good importers regularly audit their supply chains to ensure a regular stream of healthy fish and the industry is also governed by a host of national and international regulations throughout the supply chain covering welfare, health and biosecurity (see pages 8 to 9 and Annex 1).

UK businesses and consumers have no appetite for fish that are collected or bred in a way that compromises their welfare¹⁷. As such, the UK trade seeks to avoid engaging with those who use illegal damaging practices such as cyanide fishing^{3,18}. Indeed, UK businesses are known to support training workshops for local fishermen in the use of low impact collection techniques¹⁹.

Fish mortalities in transport are lower than generally thought

Fish mortalities are often seen as a barometer of bad practice and there is a much-cited statistic of 73% mortalities in the global ornamental fish trade²⁰. This figure is erroneous at best as it refers to a study published more than two decades ago¹⁷. It has been disputed by recent research, particularly given that it refers to sparse, anecdotal evidence from a specific group of importers rather than from verified data^{3,21}. Neither does the figure withstand economic scrutiny as no industry could sustain itself over the long term if such losses really existed. The Heathrow Animal Reception Centre, where 80% of ornamental fish pass through its inspection processes, have noted less than 1% of mortalities on arrival^{3,11,12}. It has also been acknowledged by the CITES Animals Committee that high mortality amongst shipments of live animals is mostly an issue associated with illegal trafficking. If animals are transported according to IATA rules there are rarely issues with mortality.

Industry bodies such as OATA in the UK and Ornamental Fish International (which represents the rest of the world) have done much to drive up standards, including through the introduction of Codes of Conduct that member businesses must adhere to^{22,23}.

The ornamental trade plays a key role in educating consumers about fish care

Pet retailers are proactive in educating customers to improve public understanding of good husbandry techniques which is also a requirement of pet shop licensing. Businesses have created their own systems to check their customers' knowledge and provide care advice, online materials and videos to educate new and existing keepers. Often fishkeepers themselves, good retailers will get behind initiatives that promote good welfare, such as the Big Fish Campaign, which sought to raise awareness about large-growing fish.

A fuller examination of animal welfare in the UK ornamental fish trade is at Annex 2.



London Heathrow's Animal Reception Centre receives 80% of all live ornamental fish imported into the UK. They report less than 1% mortalities on arrival, a statistic supported by the Fish Health Inspectorate^{3,11,12}.

HOW THE INDUSTRY HELPS

SETTING STANDARDS

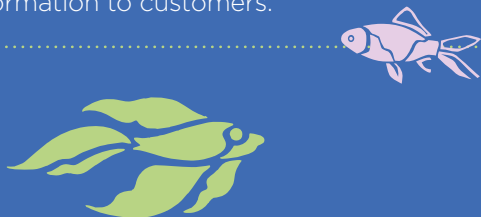
To be a member of the UK's representative body for the ornamental aquatic trade, OATA, all member businesses must adhere to its **Code of Conduct**²² which sets out requirements on animal welfare and other standards. Members must also adhere to specified, minimum **water quality**²⁴ standards, the number one factor in fish welfare.

GOOD PET SHOPS ARE GOOD PLACES TO BUY FISH

Good pet shops inspire fishkeepers through the enthusiasm and knowledge of their staff. Pet shop licensing requires staff to be trained in the species they sell so they can check their customers' knowledge and set-up before they sell any animal. Contrary to popular opinion good pet shops can play a role in stopping impulse buying. They are subject to public scrutiny every day they open, not just through formal local authority inspections, but also by the estimated 8.5 million customers annually who visit aquatic pet shops and will report animal welfare problems very quickly if they see them.

TRAINING

In conjunction with industry experts, OATA has developed **City & Guilds accredited training programmes**³³ specific to the industry and covering water quality, filtration, fish biology and fish health to help staff provide informed and accurate information to customers.



ADVICE AND GUIDANCE

Care information for fishkeepers is key to ensuring that fish are well looked after in the home aquarium or garden pond. OATA has produced 45 different **care leaflets**²⁵, including the widest available range of species-specific care information, and a series of YouTube videos²⁶ on how to successfully set up and maintain different types of aquariums. All are available free of charge.

Many retailers develop their own care information for customers and will often have their own systems to guide customers in making good buying choices when it comes to setting up a new aquarium or adding fish to an existing one. These range from in-store and online information to videos for new fishkeepers. Many retailers offer **water testing facilities** enabling customers to bring in a sample of tank water giving shop staff an excellent opportunity to educate customers on improving water quality and how to pick the right species for their tank.

Pet care information is also freely available on the **Pet Portal**²⁷, an initiative of The Pet Charity supported by OATA, which provides a single source of pet care advice and information for pet owners or people interested in getting one, all validated by experts.

Based on information available in the Pet Portal, The Pet Charity, British Veterinary Zoological Society (BVZS), British Small Animal Veterinary Association (BSAVA), and the Companion Animal Sector Council (CASC) are developing **Pet Know How**²⁸ where prospective pet owners can take an online test to check they understand their future pet's care needs. On successful completion they will receive a certificate they can present to pet retailers to demonstrate they have researched and understand the care needs of the animal they wish to purchase.

OATA has produced a range of additional guidance to help businesses ensure the welfare needs of the fish they trade are met, such as on the selling of fish online²⁹ and transporting and acclimatising fish²². Advice has also been issued on giving fish as prizes³⁰, the trade in dyed fish³¹ and the use of fish as decorations³².

WORKING WITH OTHERS

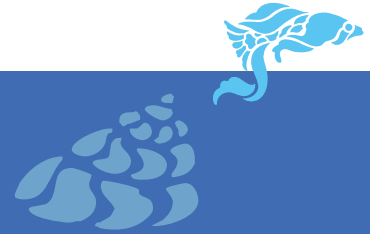
Through its trade association OATA, the industry works with organisations such as the All Party Parliamentary Group for Animal Welfare (APGAW)³⁴, the Companion Animal Sector Council (CASC)³⁵, The Pet Charity (TPC)²⁷, the Pet Advertising Advisory Group (PAAG)³⁶ and the Animal Welfare Network Wales (AWNW)³⁷, as well as directly with Government, to promote improved welfare standards for ornamental fish.



Health risks and biosecurity

PET FISH ARE SAFE TO KEEP

Ornamental fish pose low zoonotic and biosecurity risks because they are kept in home aquariums, handled rarely, and are highly unlikely to survive in UK waters if released.



The COVID-19 pandemic has brought the issue of zoonotic diseases (the ability for pathogens to jump species from animal to human) to world attention.

There are risks of both zoonotic and vector borne (when another organism passes on a disease) transmission with all animals³⁸. Historically there are few recorded cases of zoonotic disease leaps between fish and humans despite routine exposure to fish pathogens for hundreds of years³⁹. Any pathogen that infects fish is by definition adapted to infecting hosts in water so we know that good barriers (such as gloves and covering cuts) and hygiene (such as washing hands and equipment) are effective controls and are in place for those that work with live fish.

The ornamental fish trade presents a low biosecurity risk

Importing non-native fish comes with biosecurity risks but the UK adopts high standards at the border to protect our indigenous species. Fish health checks are carried out throughout the supply chain by trained officials from Fish Health Inspectorate (FHI)⁴⁰ and Animal and Plant Health Agency (APHA)⁴¹. These concentrate largely on cold-water pond fish such as Koi which pose the greatest risk to UK fish populations in terms of invasion risk and disease transmission. Imports of cold-water species are subject to 100% checks by FHI which also registers and regularly inspects the Aquaculture Production Businesses which import them. The Import of Live Fish Act⁴² dictates

which freshwater fish species are allowed for trade in England and Wales (with similar legislation for Scotland).

Some diseases are heavily monitored and legally notifiable, such as Koi Herpes Virus (KHV) and Spring Viraemia of Carp (SVC). These diseases are kept at bay through high cooperation from the industry which works actively with FHI to report potential outbreaks.

Tropical fish are a comparatively low biosecurity risk because they won't survive in the UK's colder water (needing consistent temperatures above 20°C) and are kept in 'closed' systems (an aquarium). They also all arrive with health certificates and are visually inspected at the border.

A bigger issue of concern for our industry is anti-microbial resistance (AMR). There is a growing body of research highlighting the role of aquaculture in promoting the development of AMR because of the potential overuse of antibiotics to prevent disease as opposed to treat it⁴³. In the UK, the use of antibiotics in fish is regulated and can only be prescribed by a specialist vet but

there are legitimate concerns about the import of AMR bacteria and pathogens from ornamental aquaculture facilities abroad^{44,45}.

Both academia and industry groups such as OATA and OFI recognise the danger of overuse of antibiotics and improved international efforts to monitor and reduce this practice are needed.

The trade plays a key role in preventing the spread of invasive species

Our industry is highly aware of its role in preventing the spread of invasive species, particularly aquatic plants. OATA recommended a voluntary ban on a number of aquatic plants many years before they were banned by Defra. OATA also actively supports campaigns such as Be Plant Wise. Businesses provide an active role in raising awareness of invasive risk by including labelling on their products explaining that aquatic species should not be released into the wild.

A fuller examination of the health and biosecurity risks of the UK ornamental aquatic trade is at Annex 3.



HOW THE INDUSTRY HELPS

SETTING STANDARDS

To be a member of the UK's representative body for the ornamental aquatic trade, OATA, all member businesses must adhere to its **Code of Conduct**²² which requires members to be able to practically demonstrate they operate a biosecurity plan and take all reasonable precautions to prevent the import, outbreak and spread of diseases.

ADVICE AND GUIDANCE

OATA's **Biosecurity document**⁴⁶ provides comprehensive advice to businesses on the measures they can adopt to make informed decisions on where to buy fish from and how to minimise the chances of either receiving or passing on disease or health problems in fish.

OATA provides advice on appropriate hygiene standards to avoid the transmission of zoonotic diseases⁴⁷ and OATA customer care sheets carry advice on good hygiene practices, such as hand washing and not to use the mouth to siphon water during water changes.

A key way to prevent the spread of invasive non-native species is by raising public awareness. Many of the industry's leading manufacturers carry **'No release' messaging** on aquarium product packaging, and some also include it on till receipts, with the potential to reach the estimated 8.5 million customers annually who visit aquatic pet shops. Similar messaging is carried on all OATA customer care sheets and fish bags which are available for pet shops to use when packing fish for customers to take home. The **Pet Code of Practice**⁴⁸, co-authored by OATA and the Reptile and Exotic Pet Trade Association (REPTA), provides guidance on the responsible keeping of non-native pets, for both owners and traders.

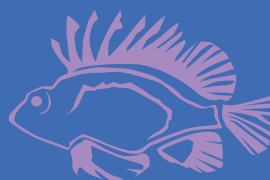
OATA has produced a range of additional guidance to help businesses ensure health and biosecurity risks are minimised, such as on the packing, transportation and acclimatisation of fish^{22,49,50} to minimise stress and reduce disease risk. Guidance has also been produced on hazardous aquatic animals⁵¹, genetically modified fish⁵², the use of antibiotics⁵³, and recommendations not to sell fish if they are to be used for some cultural practices³² because of concerns about animal welfare or illegal release into the wild.

TRAINING

OATA has developed **City & Guilds accredited training**³³ for the industry, covering the risks of invasive non-native species and how biosecurity measures can prevent and/or reduce the risk of their introduction and spread.

AFFIRMATIVE ACTION

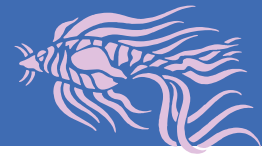
The industry works closely with the GB Invasive Non-Native Species Secretariat in developing advice, guidance and other measures aimed at removing or minimising the risk of spread of invasive species. Industry action can be and often is more responsive than Government action and the aquatics industry has demonstrated this by taking voluntary action to stop trading in species it has identified of concern. For example, the industry voluntarily stopped trading in five plant species considered an invasive risk, including Floating Pennywort and Water Primrose, before regulations were introduced. More recently, the industry has promoted trading only in native specimens of certain snails and mussels⁵⁴ and has issued guidance to avoid the unintentional import of zebra mussels⁵⁵.



Sustainable sourcing

PET FISH ARE MOSTLY CAPTIVE REARED

Ornamental fish in the aquarium trade are captive reared or collected from the wild in low volumes using non-destructive fishing techniques.



Any trade that relies on the direct or indirect use of natural resources is rightly subject to questions about its sustainability, whether it impacts the conservation of species in the wild, and whether the species in trade are sourced using environmentally damaging methods⁵⁶. These are all common misconceptions about the ornamental fish trade given that independent research indicates the majority of fish sold in the ornamental aquarium trade are sourced sustainably with minimal impact on wild populations^{5,57,58}.

The majority of ornamental fish in trade are not wild sourced

77% of UK pet fish are freshwater fish which by and large are sourced from aquaculture, with marine species that are mostly collected from the wild representing just 23% of fish in trade⁶. Only 5% of freshwater fish are collected from the wild compared with 90% of marine ornamental fish¹². Tropical freshwater fish are generally easier to keep, with wide tolerance of water parameters, adaptability to food types and easier to breed in captivity. Marine fish, which rely on ocean currents and suitable coral reefs to breed, make them harder to captive rear successfully, although recent breakthroughs in captive-rearing techniques is changing that^{59,60}. Marine fish are generally collected from the wild in smaller volumes than freshwater fish because the market is smaller, generally because it is more complicated to maintain marine aquariums and marine species are usually more expensive to buy.

Around three quarters of the fish found in UK home aquariums and garden ponds have not been sourced from the wild but sustainably from aquaculture farms. There is currently little commercial rearing of tropical freshwater fish in the UK because of the costs associated with large scale production. Many of these farms are found in low to medium economically developed countries, such as Thailand and Sri Lanka, where the industry represents an important year-round income for local communities⁶¹.

The trade in wild collected fish is high value, low volume with low environmental impacts

In contrast to food fisheries, catching fish for the home aquarium industry is considered 'high value, low volume', meaning fishers collect fewer fish but get more money per live fish³.

Where fish are collected from the wild, efforts are made to ensure they are sourced sustainably and there is no over-exploitation¹⁵, for example by the seasonal rotation of collection sites. For example, the most common species in trade, *Chromis viridis*, is abundant in the Indian and Pacific oceans (from east Africa to Hawai'i) and collected from across dozens of collection points in order to avoid over exploitation in any one region. Importers will often only order what they require and not accept alternatives helping to avoid the over-collection of easy-to-target species. Due to the large distributions and breeding strategies of most coral reef fish, population replenishment is likely to mitigate

the relatively small portion of fish collected for the ornamental trade⁶⁴.

As the value is in healthy, non-stressed fish, non-destructive, low stress methods of collection are favoured. Fish for the UK ornamental trade are commonly collected by hand, using hand-held nets and live traps^{12,57}. Practices, such as using cyanide to stun fish to make them easier to handle and which can damage coral reefs, are not supported by the UK industry. Businesses and fishkeepers want healthy, long-lived fish so there is no market in the UK for fish collected in this way. Recent years have seen a decline in usage of such techniques in favour of low-impact hand fishing alongside the implementation of local management measures⁵⁹. Many UK importers work closely with their overseas suppliers and regularly audit their supply chains to ensure animals are healthy and not collected using destructive fishing techniques.

A fuller examination of sustainability in the ornamental fish trade is at Annex 4.



HOW THE INDUSTRY HELPS

SUPPORTING CONSERVATION

OATA is a strategic partner to the Shoal conservation initiative⁶⁵ which aims to halt extinctions and recover populations of threatened freshwater species in the wild. Through its role, OATA seeks to ensure the sustainability of freshwater fisheries in order to contribute towards freshwater fish conservation on a global scale. OATA also provides a formal advisory function for Shoal, providing advice on how it can better achieve its objectives in concert with the home aquarium trade.

A number of UK importing and retailing businesses support the work of organisations such as LINI^{66,67}, the Indonesian Nature Foundation, which aims to support the conservation and management of marine ornamental fisheries throughout Indonesia by empowering coastal communities, providing training in practical skills, promoting fairer trade and more sustainable practices of marine resource use, and promoting sustainable fishing methods. Companies regularly send employers to work with LINI and to understand the work they do⁶⁷.

OPPOSING ILLEGAL AND DESTRUCTIVE PRACTICES

The industry plays its part in seeking to tackle illegal cyanide fishing. OATA and Merlin Welfare and Development (part of Merlin Entertainments which run the Sea Life Aquariums in the UK) commissioned the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) to produce two independent scientific reports^{18,70} examining the current challenges associated with the detection and prevention of cyanide fishing and how these could best be overcome to implement a robust and practical cyanide detection method. The suitability of current tests was also reviewed in a bid to come up with recommendations on ways forward to halt this illegal practice. Businesses in the aquatics industry have been active in working to develop the technologies required for a test that can detect whether ornamental fish were collected using cyanide. **Find out more by scanning this QR code using your smartphone camera app.**



ENCOURAGING SUSTAINABLE PRACTICES

UK businesses have provided financial and technical support for a Philippines-based enterprise which seeks to educate local fishermen in the use of sustainable and environmentally-safe collection practices, for example through educational workshops promoting the use of low impact netting over more destructive methods that have previously been associated with some ornamental fisheries in the Philippines¹⁹.

OATA works with Project Piaba⁶⁸, a non-profit organisation which seeks to increase the environmental, animal welfare, and social sustainability of the Amazonian home aquarium fish trade in the Rio Negro region of Brazil. **Watch this video about Project Piaba by scanning this QR code with your smartphone camera app.**



One of the UK's largest importers of marine ornamental fish and OATA member⁶⁹ supported the establishment of a seahorse breeding project, now associated with Project Seahorse and a local research group and environmental conservation group from the University of Algarve, who undertake projects and research on captive bred and local seahorse populations.

Many UK importers and businesses have systems in place to check their supply chains, and often send staff to source countries to monitor conditions and practices of the companies they do business with.



Ecological and societal benefits

FISHKEEPING CAN BE GOOD FOR PEOPLE AND THE PLANET



The ornamental fish trade can promote conservation in remote parts of the world and spark an interest in conservation in those who keep fish, along with improving fishkeepers' scientific literacy and health and well-being.

The COVID-19 pandemic showed the importance of pets to both our mental and physical wellbeing⁷¹ but even before that, research studies have demonstrated that home aquariums have beneficial effects on our mood, stress levels, heart and blood pressure^{72,73}.

What is also notable is the role that both public and home aquariums have on our engagement with the natural world and in developing a growing interest in conservation^{56,74,75}. Research has demonstrated that looking after pet fish in home aquariums can spark a personal interest in conservation as well as improving scientific literacy among fishkeepers as they get to grips with water chemistry and the 'ammonia cycle' and fish biology. This colourful slice of 'nature in the home' can have important benefits for those without access to green spaces in cities or who live in flats or houses without gardens^{76,77}.



Wild collection fisheries can play an important role in conservation

Although wild collection plays only a relatively small part in our industry, it nevertheless plays an important role in conservation. Communities that catch fish understand the need to conserve their local environment to ensure a longevity of supply and hence income – they are the stewards of their local ecosystems because their livelihoods depend on it⁷⁸. The absence of an ornamental trade that provides a livelihood involving the non-destructive use of ecosystems, increases the likelihood of alternative more destructive forms of employment, such as food fisheries or extractive industries, being taken up⁷⁹.

Consumer attitudes drive high ecological standards

Consumers are increasingly interested in understanding where their fish come from and companies respond because they do not want to be associated with unsustainable practices which can be reputationally damaging. The industry relies on the provision of live and healthy fish so companies invest in training and traceability and regularly audit the companies they interact with along the supply chain. Organisations such as Project Piaba, which supports the trade in wild collected freshwater fish in the Amazonas region of Brazil, tap into this with its motto 'buy a fish, save a

tree'⁸⁰. In addition, the growing captive breeding sector for marine ornamental fish⁶⁰ has provided initiatives that not only provide a sustainable supply of fish but also is increasingly providing a much needed new revenue stream for many poorer communities alongside traditional low-impact fishing techniques⁵⁹.

With the publication of the Dasgupta Review⁸¹, the need for industries to invest in natural capital to offset their use of nature is being increasingly recognised^{79,82-84}. In addition, conservation scientists increasingly advocate for nuanced solutions to biodiversity loss that empower local people to sustainably utilise and manage natural resources. The UK trade in ornamental fish is well placed to achieve these outcomes as an industry that is intrinsically linked to the non-destructive use of biodiversity in some of the most remote regions on earth. The UK ornamental fish industry is proactive in its efforts to preserve biodiversity and serves as a vehicle to encourage and achieve wider public engagement with the natural world.

A fuller examination of the ecological and societal benefits of the trade in ornamental fish in the UK is at Annex 5.

HOW THE INDUSTRY HELPS



SUPPORTING LOCAL COMMUNITIES

For more than 50 years the ornamental aquatics industry has supported the development of schools, churches, infrastructure and the local economy in dozens of countries and regions across the world.

Many UK companies support a variety of in-situ projects in countries which export ornamental fish such as Indonesia (the LINI Foundation⁶⁶), the Philippines¹⁹, Fiji and Brazil (Project Piaba⁶⁸), working with local communities to build sustainable livelihoods from the natural resources on their doorstep. Industry support has helped capacity building in the form of staff training or training on low impact collection techniques.

DELIVERING POSITIVE CONSERVATION OUTCOMES

A major multi-national company and OATA member has pioneered a new approach to the restoration of coral reefs to help support the livelihoods of those in its supply chain whilst also doing what it can to increase the health of ocean ecosystems by bringing them back to life⁸⁶. Working in partnership with local communities the company uses locally produced steel structures which are coated with coral sand extracted from the site of the restoration and attached with coral fragments rescued from the local reefs. The structures are connected together underwater to provide a solid platform for corals to rapidly grow and fish to colonise. At its site in Indonesia, and in just three years, coral cover increased from 5% to 60%, fish abundance increased threefold, biomass twofold, and the structures now cover over 40,000m² of reef^{87,88}.

Watch a video about this work here by scanning the QR code with your smartphone camera app.












ENSURING ETHICAL PRACTICES

One of the UK's leading importers of marine ornamental fish and OATA member⁶⁹ signed up all its supply lines to SEDEX⁸⁵ which works with businesses to improve working conditions in global supply chains. This ensures a socially responsible supply line which monitors human rights and ensures local legislation is respected and in place, and that correct and sustainable working practices are implemented throughout the whole supply chain. This business funds companies in its supply chain to ensure they can maintain the standards required from source to destination, supporting training, local compliance, boat repairs, improving work conditions and ensuring audits occur in situ by suppliers' staff.

PETS ARE GOOD FOR US

Did you know:

-  Watching fish can help reduce blood pressure, heart rate, stress and anxiety⁷³.
-  Pets help children too. Research has shown interactions with home aquariums are effective therapies for regulating mood and stress in children generally, as well as those with Autism¹⁷⁵, and Attention Deficit/Hyperactivity Disorder¹⁷⁶.
-  Fish tanks can improve productivity at work⁸⁹.
-  Pets in care homes can help to lessen loneliness and stress levels. Aquariums have been found to improve behaviour and staff satisfaction in dementia units⁹⁰. An aquarium in the dining room improved appetite among residents⁹¹.
-  Pets help people connect with nature⁹². A tropical fish aquarium brings a direct connection with nature into our homes in an increasingly urbanised world.
-  67% of people believe having a pet provides companionship and friendship and 52% believe that pets help those who may be feeling lonely, even before the 2020 lockdown. Over 9 million people in the UK have said they often feel lonely⁷¹.
-  During the 2020 UK lockdown more than 90% of survey respondents said their pet helped them cope emotionally⁹³.
-  Animal ownership had a positive impact on mental and physical health during the COVID-19 lockdown phase through various mechanisms, including companionship and emotional support and encouraging physical activity which helped to distract owners from inner feelings of distress, providing a source of motivation to engage owners in activities, responding to owners in an intuitive manner and providing a sense of connectedness or normalcy⁹³.
-  Pets are estimated to save the NHS at least £2.7 billion every year, which could be a conservative estimate⁹⁶.

Summary of the key regulatory controls governing the UK ornamental fish trade

Many regulations exist to control the trade in ornamental fish and provide powers to Ministers to ensure welfare, biosecurity and other standards are maintained in the UK. This Annex outlines some of the main controls relevant to the UK ornamental fish trade but is by no means comprehensive.

Following the UK's exit from the EU many EU regulations have been retained in UK law which may subsequently change. Due to the Northern Ireland Protocol that administration remains subject to EU legislative requirements which are not covered here.

Animal Welfare

International Air Transport Association (IATA) Live Animals Regulations¹⁰

Sets the worldwide standard for transporting live animals by commercial airlines, ensuring all animals are transported safely and humanely by air. Packing and transport requirements are designed to minimise welfare impacts and mortalities during transport and are regularly reviewed. International carriers will not transport fish unless they meet IATA standards.

Welfare of Animals in Transport Orders
Similar regulations exist for all four UK administrations⁹⁷

Requires all road vehicles transporting animals for commercial purposes to be fit for purpose, be officially licensed, have contingencies in place for the safe care of animals in the event of emergencies, and places limits on travelling times.

Animal Welfare Act¹⁵

Places a duty of care on pet owners to ensure that the needs of animals they are responsible for are met, i.e. for a suitable environment, diet and housing, to be able to behave normally and to be protected from pain, suffering, injury and disease.

Licensing of Activities Involving Animals Regulations¹³

Regulations exist in England and are being developed for Wales and Scotland.

Requires commercial operators who sell animals to meet specified standards in order to be licensed to operate. English regulations are supported by statutory guidance specifying the welfare requirements that must be met,⁹⁸ including requiring pet shops to ensure potential buyers understand the welfare needs of animals prior to purchase and to provide information on the appropriate care of the animal.

Biosecurity/health/disease and pest transmission

Import of Live Fish Act⁴²
Similar regulations exist in Scotland

Lists the freshwater fish species that can be imported into England and Wales. Freshwater fish species considered to represent a biosecurity risk are excluded from the list⁹⁹.

Invasive Alien Species Regulations¹⁰⁰

Restricts the import, keeping, movement and trade of listed species and provides for measures to be taken in relation to invasive alien species.

Wildlife and Countryside Act¹⁶

Prohibits the release into the wild of any animal outside its native range.

Aquatic Animal Health Regulations¹⁰¹

Similar regulations exist in all four administrations.

Ensures that animals placed on the market are clinically healthy and free from disease, including requirements for Aquaculture Production Businesses to be authorised and to operate in a manner that will not lead to an unacceptable risk of spreading disease, to be accompanied by an animal health certificate, and for operators to notify regulators of any suspicion of the existence of listed diseases.

Sustainable sourcing

CITES Regulations¹⁰³

Implements the Convention on International Trade in Endangered Species (CITES) which provides a mechanism to ensure that the international wildlife trade is sustainable and does not threaten the conservation status of wild species. Requires the issue of import and export certification that confirms the trade is not detrimental to the conservation of wild populations. The 2019 CITES Conference of the Parties agreed to Decisions 18.296-18.298¹⁰³ on marine ornamental fishes which propose a comprehensive examination of the trade.

Animal Welfare

The industry plays a vital role in ensuring high welfare standards for all animals that are in trade throughout the supply chain. Organisations such as OATA, OFI and member businesses are proactive in ensuring high welfare standards not only because a healthy non-stressed fish has greater value but also because individuals within the trade have enthusiasm and care for the welfare of the fish they trade.

Sourcing of fish for the ornamental aquatic trade is subject to monitoring from Industry groups such as OATA, OFI and suppliers to ensure high standards of animal welfare. Methods used to ensure welfare standards are largely dependent on where species are sourced from. The majority of fish in trade are sourced from managed aquaculture where welfare standards are regularly monitored by those who are active in the supply chain. Importers in end countries will regularly check standards on fish farms, and in particular monitor water quality and fish health that can have knock on effects further down the supply chain if not optimal. Industry groups such as OFI set standards for members who produce fish for the trade¹⁰⁴.

The role of industry in driving up welfare standards is often overlooked. Industry bodies such as OATA and OFI monitor and contribute toward critical research that investigates animal welfare bottlenecks within the industry^{18,58}. Stakeholders within the supply chain, such as retailers and manufacturers, will fund both their own and independent, peer-reviewed research into methods that might improve welfare standards within the industry. For instance, a review into stress and welfare by Stevens et al⁵⁸ supported by industrial partners gave a broad ranging critique of trade practises with potential avenues for improvement. Such suggestions included the use of stress reduction techniques pioneered by food-fish aquaculture during key steps in the ornamental fish supply chain. Subsequent research supported by industry has identified effective methods for stress reduction, such as the addition of environmental supplements or early identification of certain behaviours – in line with suggestions made by earlier reviews¹⁰⁵⁻¹⁰⁷. In addition, industry bodies such as OATA regularly feed into government consultations on improving animal welfare^{13,14} utilising up to date scientific research to justify appropriate measures to ensure high welfare standards for fish in trade.

In addition to maintaining high welfare standards for the culture of live fish, the industry is rightly conscious of welfare issues associated with wild collection. It is important to consider that wild collected fish represent a small proportion of live fish imports and those that are imported for the UK trade are collected mostly using methods that ensure the least amount of stress possible¹⁵. The greatest market demand for the ornamental sector is for live healthy non-stressed fish and as such the dominant fishing methods reflect this.

In the case of freshwater fisheries, shoals of fish are encouraged into wide and shallow nets which are then lifted into wide tubs for transportation to holding pens. Other methods include the use of real or artificial refuges of cryptic species, that are lifted up and fish swim into the net as they leave the refuges². In some cases, active netting such as the use of seine nets are used to gather larger fish over a wider area, such as Discus and Arowana¹².

Marine fisheries can employ similar non-destructive methods to freshwater fisheries, such as the use of traps and artificial refuges. In addition, local divers and snorkelers can use sticks to chase fish out of crevices for capture in barrier nets¹². Destructive practises that were once common such as cyanide fishing or blast fishing are illegal in source countries and the UK trade actively monitors supply chains and in particular sourcing methods when importing wild collected fish³. In addition to the monitoring of supply chains, OATA has actively funded research into methods to detect cyanide in marine fish imported into the UK¹⁸.

Data for mortality on arrival is sometimes considered a proxy for stress levels in studies of welfare in transport of ornamental fish⁵⁸. However, the use of this statistic has been widely amplified by some recent literature²⁰, due to the findings of a particular study that estimated that global ornamental fish mortality in transport was as high as 73% mortality¹⁰⁸ which has been widely cited since. Notwithstanding that the age of this publication negates its relevance to the current trade, it has been widely disputed by a range of more recent work investigating the trade in ornamental fish. The figure of 73% has since been disputed, given that the initial assessment extrapolated from an isolated anecdotal set of samples from wholesalers³. Research also concluded that such high mortality rates would not be economically sustainable for industry to maintain¹⁷. Regarding death on arrivals (DOAs) into the UK, a review by King (2019) stated that “no formal records are kept of death on arrival (DOAs) into the UK” but inspections by border force veterinarians find that mortalities are “close to zero”¹¹. Such estimates of mortality rates on arrival are shared by the Fish Health Inspectorate¹². Further communication with various industry groups during the writing of this report confirm this, with figures ranging from 0%-1%. This no doubt is due to the high packing standards implemented throughout the supply chain.

Retailers that stock ornamental fish and industry groups such as OATA are active in ensuring the welfare standards of fish prior to and after the sale of live fish. Retailers have a large role to play in educating potential fish keepers of the different needs and requirements of species. Industry representatives such as OATA set standards for members to ensure that customers are given the right information before the purchase of fish for their home aquarium to ensure that the right animal goes to the right home. The Big Fish campaign

promoted by many OATA member retailers was highly successful in educating the public of the need to be aware of eventual body size of many species that have traditionally been popular for aquariums. The success of this campaign was due in no small part to the enthusiasm shown by those employed in the industry, who are often hobbyists themselves, providing advice to ensure high welfare standards both in store and in the hobbyist aquarium²¹. In addition to retailers, industry groups such as OATA provide care information for all species commonly found in the UK ornamental trade, as well as providing support to initiatives such as the Pet Portal and Pet Know How that aim to give current and prospective pet owners the information they need to understand the care needs of different pets.



Summary

The trade in companion animals, including fish, is often viewed in a highly subjective manner, with some perceptions conflating the ornamental trade with a lack of regulation and little regard for welfare. In reality, the trade in live ornamental fish is highly regulated by a suite of national and international legislation, applied throughout the supply chain to ensure high welfare standards from source to eventual home (see pages 8 to 9). The role of the ornamental aquatic industry in driving increased welfare standards throughout the supply chain is often overlooked. This is enacted through:

- Self-regulation by industry bodies setting high standards which often feed into the creation of new legislation or government guidance.
- Industry support of research that investigates sources of potential stress and tests novel methods for improved welfare.
- Strict adherence to existing legal frameworks that govern the entire supply chain.
- Proactive efforts by individuals employed in the trade to improve public understanding of good husbandry techniques.

In addition, common misconceptions about the trade are often the result of a failure to consider the specific context around individual studies or recent evidence published in peer reviewed journals.

Health risks and biosecurity

Human Health

In light of the COVID-19 pandemic, the role of animals as potential reservoirs for pathogens and spill over events which have detrimental effects on human health has gained increased scrutiny. There are many examples of diseases with high transmissibility between humans linked to contact with animals, either as a vector borne disease or as a zoonotic disease. A zoonotic disease is one that having previously infected an animal species, evolves to be able to make the species jump from its original animal host/s³⁸. A vector borne disease (VBD) is one in which a disease infects via another organism, carrying the pathogen from one host to another, such as malaria in mosquitos¹⁰⁹. Although there is certainly a potential for all animals to pose risk of infection, it is also the case that the specific context of human-animal interactions should be taken into account before the imposition of potentially inappropriate and harmful measures. The One Health approach considers health and disease at human, animal and environment interfaces to promote a whole society management of risk³⁸. This approach, advocated across scientific disciplines, considers appropriate actions to combat potential health risks whilst considering restrictions on people's livelihoods and wellbeing, animal health and welfare, and conservation of ecosystems^{83,110}.

Historically there have been few recorded cases of zoonotic disease jumps from fish to humans in multiple sectors, despite theoretically high levels of close contact and therefore exposure to potential pathogens^{111,112}. Fishermen, fishmongers, fish farmers, as well as those who work in the ornamental aquatic trade, have had routine exposure to fish pathogens for hundreds of years. Although there have been historical changes in exposure levels and medical knowledge, the lack of recorded zoonotic outbreaks is underpinned by clear biological principles that afford humans a significant degree of protection. Phylogenetic distance, i.e. the evolutionary distance between organisms, has been shown to be a good predictor of how likely a zoonotic disease is to emerge between species¹¹³. Recent work has shown that the greater the distance between hosts, the less likely it is that a disease may pass between them¹¹⁴. When talking of aquatic organisms, this manifests itself in clear bio-physical hurdles that potential pathogens would have to cross³⁹. Any pathogen that infects aquatic organisms is by definition adapted to infecting hosts in water. The main natural barrier to disease for humans in an aquatic context is skin, which is incredibly effective at protecting against pathogens¹¹⁵. Phylogenetic distance can be overcome by potential zoonotic pathogens by a variety of reasons, such as proximity and immune status of potential hosts. In the context of exposure via the ornamental aquatic trade, these factors are effectively controlled for by having appropriate health and safety measures in place (detailed below).

Some occupational risk to inhaled pathogens is posed by working within certain aspects of the ornamental aquatic industry. The transfer of some diseases is theoretically higher when working with outdoor ponds, such as Legionella or Weils disease⁴⁶. Although water features present in ponds can create aerosols through which these diseases can be transmitted the potential for infection is considered low¹¹⁶. This is due to generally low concentrations found in pond water of infectious pathogens but also high levels of ventilation due to ponds being situated outdoors. In addition, the widespread use of UV sterilisation in outdoor ponds with fish in is considered effective at reducing the effective load of pathogens such as legionella in the water column.

Disease incidences within the UK ornamental aquatic industry can be effectively protected against by the implementation of high standards of hygiene such as recommended by OATA and legal requirements on health and safety. All businesses that sell live animals in the UK must adhere to risk assessments and standard operating procedures on hygiene in order to qualify for a licence to operate. In addition to this, OATA provides detailed guidance on biosecurity to its members by encouraging aquatic-specific hygiene measures such as covering cuts on hands and arms, wearing appropriate PPE, net dips, and hand washing before and after handling animals⁴⁶.

Assessment of COVID-19 specific risk

The COVID-19 pandemic has been identified as a zoonotic disease and further investigations have highlighted that certain animal species may be a potential risk in spreading the disease that causes COVID-19, such as mink¹¹⁷, bats¹¹³ and others^{118,119}. Although the evidence for animal-human transmission of COVID-19 and indeed other Coronaviruses is varied, it is prudent for all industries to accurately assess the risk of COVID-19 transmission.

As discussed above, phylogenetic distance underpins the lack of recorded cases in fish and other aquatic animals. Research has found that there is negligible incidence of any Coronaviruses in aquatic animals, and those few are observed mostly in aquatic mammals¹⁷⁸. The key mechanism for the spread of COVID-19 and Coronaviruses is through respiratory infection via aerosols¹²⁰. Given that aquatic species in trade respire through the use of gills or similar structures there is minimal risk of COVID-19 transmission to hobbyists and workers in the ornamental aquatic industry from live animals¹²¹. That said, recent scientific literature has assessed the COVID-19 risks associated with exposure to fish and other aquatic animals. To date, there are no recorded zoonotic jumps of fish viruses to humans¹¹² and recent research has found minimal risk from food fish or their products¹²². A recent study found that the majority of fish species lacked the appropriate cell surface proteins to interact with the Sars-Cov-2 spike protein that causes initial infections¹²³.

It could be said that the largest potential risk is through contamination of surfaces from areas with high transmission. Studies have shown the viability of the COVID-19 virus on multiple surfaces which are used throughout the supply chain of live animals¹²⁴⁻¹²⁶. The virus remained viable up to 24 hours on cardboard and 48 hours on plastic surfaces such as polystyrene (insulated boxes) and polythene (transportation bags). The half-life, i.e. half the amount of viable virus present, was 6.8 and 3.5 hours for plastic and cardboard respectively¹²⁷. Given that fish are packaged to survive 48 hours in transit, it could be estimated that the likelihood of COVID-19 remaining viable on the surfaces of fish imports is quite low. In addition, guidance from the Scientific Advisory Group for Emergencies (SAGE) shows that respiratory transmission is more likely than from surfaces, particularly when guidance for regular hand washing is obeyed¹²⁶. Based on current available information from the scientific literature and from the UK Government, surface transmission from live animal imports carries minimal risk, similar to that of transmission of other goods.

Fish health

The trade in live fish by its very nature could be subject to potential outbreaks or high transmission of fish diseases¹²⁸. In particular, mixing of stocks from different sources and temporary periods of high fish density could arguably lead to issues of disease transfer. As such, the trade in ornamental fish adopts high standards on fish health with appropriate measures to reduce disease. This not only protects against stock loss and maintains high welfare standards, but also adheres to specific regulations on aquatic animal health¹⁰¹. The use of sterilisation equipment, such as UV sterilisers and Ozone, is widespread throughout the UK industry⁴⁶, as well as in many of the facilities that fish are sourced from^{129,130}. Checks on fish health are also carried out throughout the supply chain by trained officials such as the Fish Health Inspectorate (FHI)⁴⁰ and other border control agencies, such as the Animal and Plant Health Agency (APHA)⁴¹. These checks are applied to a greater extent on “cold-water” fish in trade as they have the greatest likelihood of acting as a vector to native fish populations. Some diseases in particular are heavily monitored, and are legally notifiable such as Koi Herpes Virus (KHV) and Spring Viraemia of Carp (SVC)¹⁰¹. Such diseases are kept at bay by high cooperation of industry who actively work with the FHI to report potential outbreaks. In contrast to cold-water species, “tropical” fish (the majority of species in trade) present a comparatively low risk of disease transfer to native populations as: a) they are unable to survive in the wild and b) are kept in self-contained environments (aquariums).

An issue of growing concern for scientists and industry alike is that of anti-microbial resistance (AMR). AMR is the growing trend of bacteria adapting to the use of anti-microbial agents, such as antibiotics, so that their use becomes ineffective⁴⁴. This is often promoted through the inappropriate use of these agents as preventative measures as opposed to targeted

treatment of diseases. There is a growing body of research that actively questions the role of aquaculture in promoting the development of AMR⁴³. In the UK the use of antibiotics in fish is regulated and can only be prescribed by a specialist vet but there are concerns about the import of AMR bacteria and other pathogens from ornamental aquaculture facilities abroad⁴⁵. At present, antibiotics are not widely used within the UK trade and are only ever prescribed by veterinarians under very specific circumstances.

Both academia and industry groups such as OATA recognise the danger of potential overuse of antibiotics by ornamental aquaculture facilities. Improved international efforts to reduce the practices that promote AMR are needed to reduce future potential outbreaks of difficult to treat pathogens.

Invasive species

The movement of species by humans outside of their natural ranges poses the potential risk of those species becoming established and invasive outside of their endemic range¹³¹. The impacts of these species becoming established in novel environments can cause various problems to native ecosystems, such as altering community structure, driving local extinctions, erosion and public health concerns¹³². As such, species in trade in the UK for the ornamental sector are subject to high levels of monitoring and regulation¹³³. However, the use of precautionary principle by decision makers may mean that some species are subject to bans that may have unintended consequences for the wellbeing of the industry, fishkeepers and local communities in source countries.

The majority of fish in the UK trade are classed as “tropical”, and as such require consistent average annual temperatures well above 20 degrees to survive. Therefore, the invasive potential for most species is quite low due to the physiological needs of most species in trade. Although there are reports of ornamental species becoming established in temperate countries such as Germany, these invasions are only facilitated by the use of river systems for cooling water in nuclear power plants^{134,135}. In the UK such power plants are generally located on coastal or estuarine sites with greater capacity for heat dissipation¹³⁶ and, as such, are unlikely to facilitate invasions in the same way.

Some species however may have a wide thermal tolerance and, as such, require regular monitoring for their invasive potential. In England and Wales, a permitted list of ornamental freshwater species in trade is regulated and kept under regular review by the Fish Health Inspectorate (FHI). Finally, the unregulated release of wild animals in the UK is illegal¹⁶, carrying a sentence of up to six months and an unlimited fine.

Species in trade that are able to persist – “cold-water species” – are highly regulated¹⁰¹ to ensure their sale is controlled. Imports of these species are subject to 100% checks at BCPs by the FHI to ensure there are no signs of disease, parasites or other species that pose an

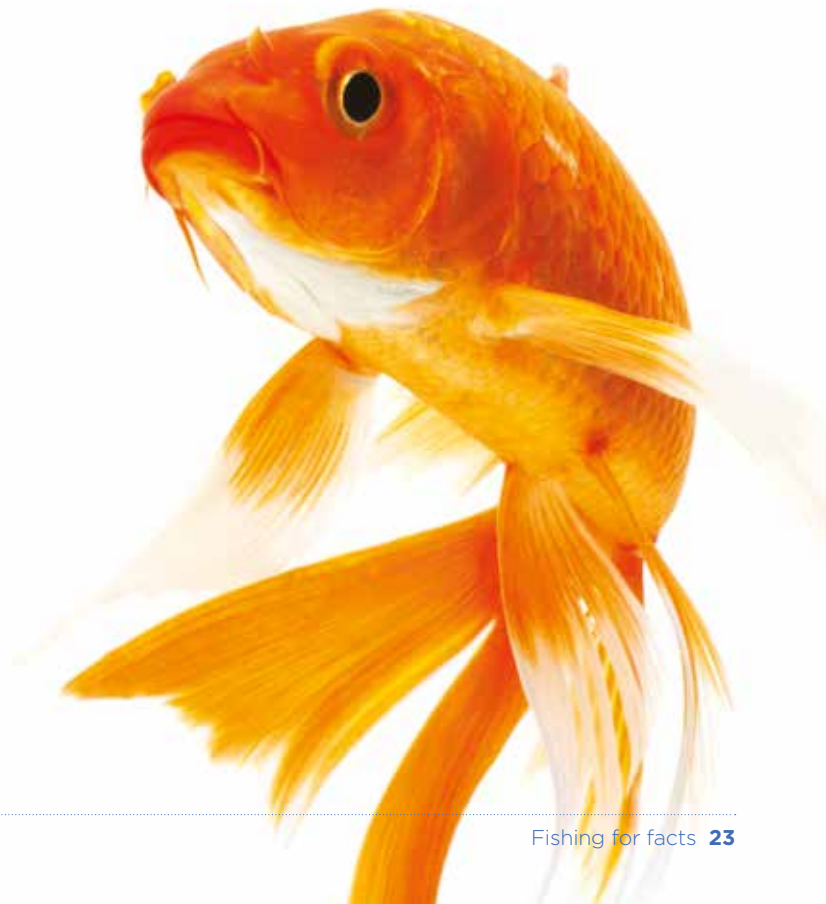
invasive or disease risk. Businesses that trade in these species are subject to more stringent checks on the biosecurity measures they have in place¹³⁷. In addition, many of the most popular ornamental varieties that exist in garden ponds, such as Koi, Golden Tench and Golden Rudd are selectively bred varieties of species already endemic or naturalised to the UK¹³⁸. Any escape of these species to localised water courses would be unlikely to result in significant ecological effects, particularly as garden ponds are closed systems not linked to natural water courses. In order to cause significant pressure on local species, fish have to overcome local predation, and exist in high enough numbers to spawn and breed¹³⁹. Prevailing environmental conditions also must be optimal for the survival of any released species¹⁴⁰. Simulation studies show that releases of non-endemic species in aquatic environments need to be in high enough numbers of individuals for establishment (survival and reproduction) to occur¹⁴¹. Given that ornamental species that are either illegally or accidentally released are generally released singly or in small groups, the risk of ornamental species becoming established is considered very low by industry bodies such as OATA¹³⁹. This does not however exclude the possibility of disease/parasite transfer to wild fish populations, an issue that has been highlighted in food fish aquaculture of non-native species¹⁴². Although this is a potential risk, it is worth highlighting that regulations for animal activities licensing ensure that all newly arrived fish are acclimated (and monitored for potential illness, stress, injury) and any infected fish are not available for sale until adequately isolated and/or treated.

In addition to the pressures above, industry and hobbyists actively engage with the prevention of invasive species. Industry groups, such as OATA, have recommended a voluntary ban within the industry on the trade in several aquatic plant species with invasive potential prior to official bans imposed by the Department for Environment, Food and Rural Affairs (Defra)^{48,143}. OATA has also supported successful campaigns in conjunction with government bodies to promote public and retailer awareness of invasion risk which has been considered highly successful e.g. Be Plant Wise¹⁴⁴. Reputable retailers that follow the OATA code of conduct also play a valuable role in educating customers on the future size and age of potential pets, and include no release messages on their fish bags, products and till receipts. Not only does this prevent animals ending up in unsuitable housing, but it also prevents owners from purchasing pets that they may end up releasing into natural watercourses. This is also promoted by active collaboration with other groups such as The Pet Charity and government agencies to develop materials to educate the public against spontaneous purchases in favour of ensuring the right pet ends up in the right home⁴⁸.

Summary

The trade in ornamental fish has its own set of challenges with regards to health and biosecurity for both those that work in the industry and the animals that are traded. Continual improvement and monitoring of standards is essential for the long-term sustainability of the trade as well as for the health of animals, people and environments linked to the industry.

- The potential impacts on the health of people involved in the trade is arguably quite low in comparison to other industries associated with the trade in live animals. This is not only underpinned by good practices and standards regarding hygiene and health and safety, but also clear biological barriers to disease between humans and fish.
- The industry is subject to strict legal controls on fish health and biosecurity throughout the supply chain. Controls already in place are designed to mitigate the potential spread of disease and species, and in the UK these are subject to inspections by the Fish Health Inspectorate where necessary. That said, industry groups such as OATA are alive to potential emerging challenges in fish health and biosecurity, such as that of AMR and believe that international and industry collaboration is needed to ensure existing high standards are maintained.



Sustainable sourcing

Any trade that relies on the direct or indirect use of natural resources is subject to questions about its sustainability, i.e. that its exploitation does not result in an overall reduction in its prevalence¹⁴⁵. Common misconceptions about the trade in ornamental fish are that fish are not sourced sustainably and use destructive fishing methods. Independent research indicates that the majority of fish sold in ornamental aquarium trade are sourced sustainably with minimal impact on wild populations^{146,147}, and the industry remains vigilant against the unsustainable practices of the illegal wildlife trade³. Moreover, the wider benefits (socio-economic and ecological) of the UK trade in ornamental fish are often overlooked due to conflation with the illegal wildlife trade.

Ornamental fisheries utilised by the UK fall into one of two categories: marine and freshwater. Each are characterised by differing methods of sourcing, dictated by the ecology and physiology of the fish groups in trade, i.e. the natural life cycles of traded species dictates their ease of culture (explored in more detail below).

Ornamental freshwater fisheries

According to OATA's 2019 annual trade report⁷ and Wild Caught Ornamental Fish: the trade, the benefits, the facts¹ and other published literature⁵ the majority of tropical freshwater fish species are sourced from aquaculture (approximately 95% of individuals sold) with wild collected freshwater fishes representing only around 5% of trade volume. It is important to consider that tropical freshwater fish represent the majority of species sold for home aquariums and garden ponds¹⁴⁸. In the UK, where of households that own fish (14% of UK households)¹, 77% are freshwater fish over the other sections of the trade⁶. As the majority of fish in trade are not sourced from wild populations but from managed fish farms sustainability can be inferred⁵. At present, there is minimal domestic production in the UK beyond private hobbyist breeding due to the costs associated with large-scale aquaculture such as heated systems and labour intensity. Many of these farms are found in low to medium economically developed countries, such as Singapore, Thailand and Sri Lanka^{145,147-149}. The presence of fish farming is vitally important to many rural communities that rely on ornamental aquaculture for income⁶¹. In particular, the nature of a consistent demand throughout the year allows rural communities a valuable income stream that supports workers who might otherwise have seasonal variation in their incomes⁶¹.

The remaining 5% of freshwater ornamental fish that are collected in the wild also can play a vital role, not only to the communities that trade them, but also to the surrounding ecosystems. Many of the locations where freshwater ornamental fisheries are found are under the greatest threats from habitat destruction and degradation due to anthropogenic changes of land use such as deforestation and hydroelectric dams^{150,151}. The

best examples of this include ornamental fisheries in the Amazon basin, which is severely threatened by logging, mining and burning of forest for agriculture¹⁵².

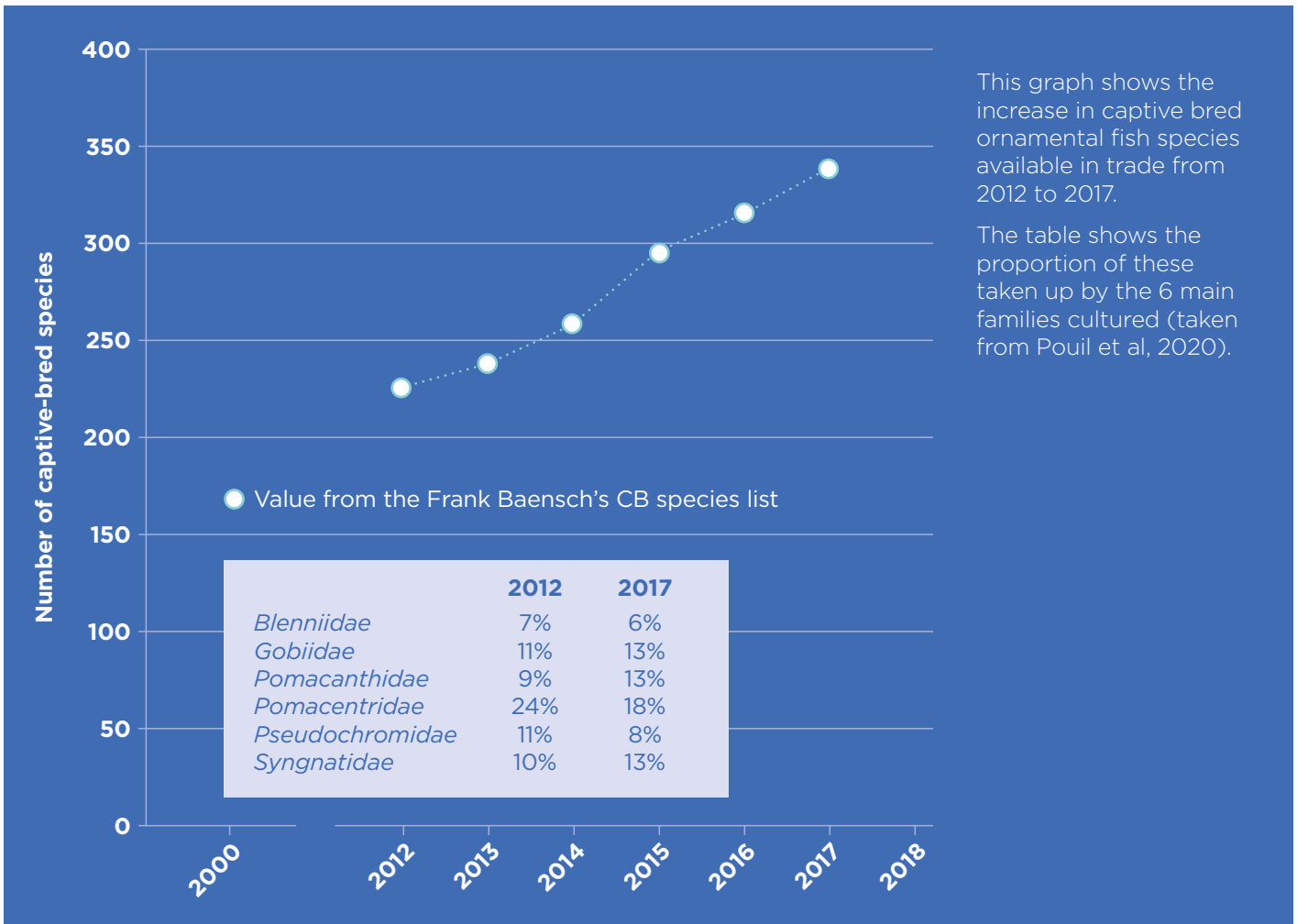
Productive ornamental fisheries rely on pristine ecosystems and, as such, local fishers know the value of protecting their local ecosystems in order to preserve their catches⁵⁷. For example, Project Piaba is a non-profit organisation and fishery initiative that works with fishers to protect large areas of Amazon rainforest and gives people an incentive to protect their habitats from more destructive uses of resources^{57,58}. This is incentivised to the end consumer with their tag line "Buy a fish, save a tree", which educates fishkeepers about the benefits of trade to the region and ecosystem. Rainforest fisheries such as this are well documented to have sustainable yields, driven largely by exploiting the natural boom and bust cycles that occur because of flood seasons. Fish that would otherwise die in the dry season are harvested for the ornamental aquatic trade, often prolonging their life far beyond what they would experience in the wild.

Ornamental marine fisheries

In contrast to freshwater fish, marine fish sourcing is dominated by individuals collected in the wild¹⁴⁸, supplemented by a smaller but growing sector in aquaculture¹⁴⁵. Typically, marine ornamental fish species tend to have more complex life cycles, with larval fish having a long planktonic phase before settlement as sub-adults in coral reef habitats¹⁵³. Replicating conditions in aquaculture presents significant challenges making it only viable for a smaller proportion of the species in trade. That said, there has been an increase in aquaculture in both volume and diversity of species for the ornamental trade in recent years⁶⁰ (see graph opposite). Recent breakthroughs in breeding and rearing techniques, such as replicating natural food sources, are allowing more aquaculture enterprises to produce greater numbers and diversity of marine fish for the ornamental trade⁵⁹.

When considering the impacts of wild collected ornamental fish, it is worth considering that marine fishkeeping makes up a relatively small portion of the overall trade in ornamental fish^{148,149}. This can be attributed to greater costs of aquarium equipment and maintenance, as well as increased effort needed to maintain water quality suitable for marine ornamental fish species. In addition, due to the limitations on stocking levels in marine aquariums (generally fewer fish by volume in comparison to freshwater), demand for marine fish within hobbyist's aquariums is for select individuals as opposed to groups of species. As such, the trade in ornamental marine organisms is considered as low volume, high value^{3,145}.

Ornamental fisheries in general target small-bodied individuals, as the market for hobbyists is for younger, small-bodied fish over large fecund adults that support overall population productivity. For instance, the full adult body size of the Common Clownfish, *Amphiprion*



This graph shows the increase in captive bred ornamental fish species available in trade from 2012 to 2017.

The table shows the proportion of these taken up by the 6 main families cultured (taken from Pouil et al, 2020).

percula, is around 10cm but individuals are commonly sold at 2-3cm¹⁷⁷. As such, the relative impact on overall fish stocks of targeted species is low. Targeting of small to medium sized individuals has long been a suggested strategy for reducing the impact of commercial food fisheries¹⁵⁴. Recent work on the export of ornamental marine fish from Indonesia found that approximately 85% of the species sold were listed as Least Concern on the IUCN red list⁶². In addition, recruitment of fish to coral reefs (where most ornamental species in trade are found) is often said to be space limited, not resource limited^{155,156}. Coral reefs are highly productive, and the removal of select individuals is likely to free up space for new individuals to settle there, maintaining high levels of fish biomass¹⁵⁷.

The methods of fishing for ornamental marine species has often been scrutinised due to the prevalence of local fishers employing destructive and illegal fishing techniques such as cyanide poisoning¹⁵⁸ and blast fishing¹⁵⁹. Such practices are not supported by the UK trade in marine ornamental fishes, with industry working with local fishers to discourage their use in favour of low impact, collected-to-order fisheries. Because of this, a general decline in the use of such practices has been observed in ornamental fisheries, with local fishers favouring low impact hand netting techniques⁵⁹. Businesses that supply marine ornamentals regularly audit their supply chains to ensure that the animals are

healthy and not the product of destructive fishing techniques.

Ultimately, the trade and hobbyists alike are dependent upon the provision of live, healthy fish, and there is no market for fish collected using cyanide fishing or other destructive techniques³. In the UK, OATA requires its members who sell aquatic animals not to stock animals that are illegally collected. OATA in its position as both representing the trade and setting high standards, has also been active in funding scientific research by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) to improve the detection of cyanide in traded fish species¹⁸.

Summary

The trade in marine and freshwater species are characterised by different methods of sourcing, with minimal impact overall on wild populations. This is why the ornamental fish trade is considered “high value, low volume”. The industry supports sustainable sourcing and the livelihoods of local people, through the aquaculture of species in trade, wild collection where it is sustainable and supports local communities, and the use of non-destructive fishing methods.

Ecological and societal benefits

The trade in ornamental fish has wide-ranging benefits for both people and wildlife. There is a growing body of evidence showing the positive role that the industry can play in both enhancing biodiversity and individual wellbeing.

Ecological benefits

The need for the sustainable use of natural resources by industries is becoming more apparent as time goes on. Industries that utilise the natural world are increasingly becoming aware of the need to reinvest in 'natural capital' to offset the resources they use from nature⁸¹. Initiatives such as investing in "Blue Carbon" have already been pioneered by multinational companies such as Apple¹⁶⁰ and Mitsubishi¹⁶¹. There is recognition in the ornamental aquatic industry of the role that biodiversity plays in its sustainability. The ornamental industry exists because of the natural diversity of fish, providing hobbyists with high variety of fish to keep as pets. Local fishers that supply the ornamental trade can and do act as stewards of aquatic ecosystems, because they rely on healthy fisheries for their livelihoods. Organisations that rely on wild collection also recognise the need for sustainable sourcing that protects the biodiversity of the areas they source from. Market demand by consumers is increasingly for animals that have been collected sustainably without damage to the ecosystems they inhabit³. As such, the industry as a whole makes efforts to protect the biodiversity of aquatic habitats, not only for economic sustainability but also as a community of people that value the natural world^{4,56}. In addition to clear traceability of traded animals, several companies associated with the UK trade invest back into natural systems in order to enhance biodiversity of potentially threatened ecosystems.

Case studies:

- a) A major multi-national company which produces a wide range of products, including pet food and aquarium products has, over the past 15 years, pioneered a new approach to the restoration of coral reefs to help support the livelihoods of those in its supply chain whilst also doing what it can to increase the health of ocean systems by bringing the most biodiverse marine ecosystem back to life⁸⁶. Working in partnership with local communities the company uses locally produced hexagonal steel structures called Reef Stars. Reef Stars are coated with coral sand extracted from the site of the restoration. Different members of the community attach coral fragments that are rescued from the local reefs. Many hundreds of Reef Stars are connected together underwater to provide a solid platform for corals to rapidly grow and fish to colonise. At its site in Indonesia, and in just three years, coral cover increased from 5 to 60%, fish abundance increased threefold and biomass twofold. To date the company has deployed over 20,000 Reef Stars and 300,000 coral fragments covering over 40,000m² of reef^{87,88}.
 - b) The Indonesian Nature Foundation (LINI) is a non-governmental organisation run by marine scientists that works with local communities in Indonesia to promote the sustainable use of coral reef ecosystems. LINI works with stakeholders throughout the supply chain to encourage investment in coral reef ecosystems and sustainable sourcing of fish and invertebrates for the aquarium trade. In 2018, UK businesses⁶⁷ provided financial support for a coral reef restoration project in Northern Bali, Indonesia, to promote increased recruitment of fish and live coral to degraded habitats. LINI also supports local fishers to use non-destructive techniques to harvest fish for the ornamental aquarium trade. These techniques have been pioneered by LINI since 2010 to improve local livelihoods but not at the expense of local biodiversity⁷⁸. In addition to restoration efforts, LINI has also set up an Aquaculture and Training centre to work with local people to culture fish species for the ornamental supply chain that otherwise might be fished from local reefs, such as the Banggai Cardinalfish and *Percula Clownfish*¹⁶².
 - c) Project Piaba is an initiative that promotes the sustainable capture of ornamental fish from the Rio Negro region in Brazil and incentivises local fishers to actively engage in the conservation of the local rain forest. These fisheries remain highly productive due to the lack of other damaging anthropogenic uses of forest that can occur in the region, such as logging, drainage for agriculture or bio-prospecting^{57,80}. The ornamental trade offers a high value, low impact way for local people to earn a living as an alternative to these more damaging industries. This initiative is an active collaboration between local fishing communities, conservation scientists and industry partners, with industry groups such as OATA, OFI and businesses supporting conservation and sustainable fisheries in the area⁶⁸.
 - d) With financial and technical support from industry groups, including some based in the UK, a Philippines based enterprise has delivered educational workshops to local fisherman on sustainable practices. In particular, recent workshops have promoted the use of low impact netting over more destructive methods that have previously been associated with some ornamental fisheries in the Philippines¹⁹.
- In addition to initiatives such as those above, the industry actively supports international efforts to protect endangered species through supporting work on CITES, either through representative bodies such as OATA or individual companies that rely on wild collected fisheries. It may well be said that the market demand for some of the listed species in trade has actively contributed to conservation effort through the investment in sustainable mariculture of species

endangered by habitat loss⁶⁰. Indeed, industry groups have actively provided funding to support the set-up of captive breeding initiatives led by academics and conservation groups such as Project Seahorse. This initiative now regularly supplies the UK trade with sustainably maricultured seahorses. It is important to remember that this demand for live seahorses for the ornamental trade is proportionally very low compared to the demand for the same species as dead/dried material. This is highlighted in recent research by the UN Food and Agriculture Organisation (FAO) that showed that demand for live seahorses represented 6.3% compared to 93.6% seahorse bodies⁶³ that are used as ornaments and for traditional medicine¹⁶⁴.

The ornamental industry in the UK supports the conservation of fish and other aquatic animals both in the hobbyist community but also in public aquariums. Industry provides both financial and technical support (in the form of equipment, food and supplements) to hobbyist groups that are engaged in the conservation of endangered species. Notable examples such as Zebra Pleco catfish¹⁶⁵, livebearing fish and cichlids are endangered in their endemic ranges by habitat destruction (deforestation, dam building, agricultural run-off) are protected by the trade and hobby community by acting as biological refugia through captive breeding efforts^{56,165}. This is also mirrored in some of the most popular species in the aquarium trade, where wild populations are heavily impacted or even functionally extinct in some populations, and exist almost entirely within the ornamental trade¹⁶⁶. Recently industry bodies, such as OATA, have also supported the establishment of a new initiative, Shoal, to support the conservation of freshwater biodiversity⁶⁵.

Societal benefits

Aquarium keeping, and the trade that supports it, is increasingly recognised for its ability to shape our behaviour and well-being. The need for public engagement with the natural world has been at the forefront of expert recommendations when attempting address the global threats of biodiversity loss and climate change^{81,167,168}. The role of zoos and public aquariums has long been recognised as valuable in improving the public engagement with positive action for the natural world, but what is less recognised is the role of home and pet shop aquariums in achieving similar objectives of conservation awareness. Individuals with exposure to high levels of captive biodiversity report increased awareness after these interactions, and greater levels of pro-conservation related behaviours in their everyday lives^{169,170}. These positive benefits of public aquariums have also been found to occur when individuals are exposed to biodiversity through their own home aquariums. Research on the hobbyist community in the USA found that aquarium keeping leads to a more personal attachment to conservation efforts, as well as improving scientific literacy among keepers regardless of experience in the hobby⁹².

The benefits of interactions with companion animals (pets), including ornamental fish, have been highlighted for mental health⁷². This has been further highlighted by the Coronavirus pandemic, with social isolation being linked to more people suffering with mental health issues. Recent research has shown the importance of companion animals in helping people through lockdown, with 86.5% of individuals who owned pets reporting that they had a positive impact on their mental health⁷¹. This same study also reported the importance of pets for maintaining social links throughout lockdown, with nearly half of all respondents stating that their animal was the reason they stayed in contact with people or social media groups.

It has also been found that the keeping of fish has been associated with widespread mental health benefits prior to lockdown. Watching fish has been shown to reduce stress levels, and has been shown to help alleviate symptoms of anxiety¹⁷¹. Experiencing biodiversity first-hand has been shown to help with reduced stress levels¹⁷² and has been linked to other health benefits such as improved immune response and more diversified gut microbiota⁷⁶. It has been shown that aquariums can be an effective substitute for experiencing biodiversity in open green spaces, providing similar benefits to walks in open countryside¹⁷³. This experience of “nature in the home” may have important benefits to those without access to green spaces in cities or apartments. Aquariums have also been suggested to be of use in a variety of healthcare settings⁷³. In particular, aquariums have been shown to have widespread benefits for dementia and Alzheimer’s patients, such as stimulation, nutritional uptake, stress levels^{90,174}. In addition, interactions with home aquariums has been shown as effective therapies for regulating mood and stress in children generally, as well as those with Autism¹⁷⁵, and Attention Deficit/Hyperactivity Disorder¹⁷⁶.

The ornamental aquatic industry plays an important role in supporting communities that rely upon it throughout the supply chain. Many fish that supply the industry are sourced from less developed regions and nations that rely heavily on it for their income. Aside from traditional sources of income from the trade, such as wild collection, there is a growing aquaculture sector in marine ornamental fish that aims to support local incomes as opposed to locating hatcheries in more developed nations⁵⁹. UK industry supports this, not only passively by buying their goods and services, but also by proactively supporting efforts to safeguard those individuals linked to the trade. UK-based businesses regularly audit their supply chains, ensuring a socially responsible supply line is in place. A major UK importer⁶⁹ of marine fishes uses the services of a company called SEDEX⁸⁵ that continuously monitors that local legislation and human rights are respected, and that correct, sustainable working practices are implemented throughout their entire supply chain. In addition, several UK businesses actively support local communities by providing funding for projects of wider social benefit, such as the building of schools, churches,

and paying for boats that are essential to people's livelihoods. These efforts, alongside those highlighted in the case studies above, illustrate that the UK trade in ornamental fish is one that strives to be socially and environmentally responsible in its sourcing of fish.

Summary

- 🐟 Fishkeeping has wide ranging benefits and has great potential as a positive force for safeguarding biodiversity and improving mental wellbeing in both adults and children. Industry groups actively engage in pro-conservation activities, by providing financial, practical and knowledge support to governments, NGOs and local people who work in the aquarium trade.
- 🐟 With the publication of the Dasgupta Review in 2021, the need for industries to recognise the value of biodiversity is greater than ever. The UK trade in ornamental fish is one that already is proactive in its efforts to preserve biodiversity and is a great channel to achieve wider public engagement with biodiversity outcomes.
- 🐟 The COVID-19 pandemic has highlighted the impact mental health issues can have on individual wellbeing. The keeping of fish and other companion animals is shown to help people cope with arising mental health issues and could be a valuable tool in managing the mental health needs of individuals.



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Ornamental Aquatic Trade Association

The voice of the ornamental fish industry

OATA
Wessex House
40 Station Road
Westbury
Wiltshire
BA13 3JN

Tel: 01373 301353
Email: info@ornamentalfish.org
www.ornamentalfish.org

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