Ornamental Fish Welfare in India

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Acknowledgements

This research was supported by People For Animals Uttarakhand and India Animal Fund.

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I. Introduction

Ornamental fish include thousands[1] of fish species with unique and individualistic needs captured, cultured, and traded across the world for their aesthetic appeal. The practice of keeping ornamental fish for aesthetic purposes has existed for over 1,000 years and likely began in China with the domestication of goldfish and koi.[2] Ornamental fishkeeping has now spread worldwide with advances in aquarium technology and transportation, and this sector is experiencing rapid growth bolstered by an increase in disposable income for consumers and strong financial incentives for the industry.

Ornamental fishkeeping is a multi-billion dollar industry and one of the most popular hobbies in the world[3]. At present, India is not a leader in this global sector.[4]
The Indian ornamental fish industry is poised for enormous growth, expected to nearly double in value by 2030[5], catalyzed by the sizable investments[6] made by the Indian government and given the context of its standing in global aquaculture production.[7]

As with other animals, the upkeep of fish must take into account species-appropriate needs at various stages of the production cycle. For ornamental fish, this involves capture/rearing, handling, transportation and conditions at the end of the supply chain, i.e. the aquaria in which the fish are kept for the majority of their lifespan. Owing to poor public awareness and technical

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[1] N. Sharma, S. Yengkokpam, P. Das & D. Bordoloi, *Aquapost: Ornamental Fisheries of Northeast India* (Apr. 2023), available at https://krishi.icar.gov.in/jspui/bitstream/123456789/80426/1/2023_AQUAPOST_ORNAMENTAL%20FISHERIES%20OF%20NE%20%28APR,%202023%29.pdf.
[2] David Alderton, Pg. 22, *Encyclopaedia of Aquarium and Pond Fish* 22 (2005).
[3] Sharma et al., *Aquapost* supra note 1; Food and Agriculture Organization, *Ornamental Fish* (2004), available at https://www.fao.org/4/x4933e/X4933e10.htm.
[4] Department of Fisheries, *Ornamental Fisheries Development under PMMSY* (2020), available at https://dof.gov.in/sites/default/files/2020-07/Ornamental_fisheries_development_under_PMMSY.pdf.
[5] Verified Market Reports, *Global Ornamental Fish Market 2019 by Manufacturers, Regions, Type and Application, Forecast to 2024* (2019), available at https://www.verifiedmarketreports.com/product/global-ornamental-fish-market-2019-by-manufacturers-regions-type-and-application-forecast-to-2024/.
[6] Press Information Bureau, *Press Release by PIB on Pradhan Mantri Matsya Sampada Yojana* (May 20, 2020), available at https://www.dof.gov.in/sites/default/files/2020 08/PressReleasebyPIBonPradhanMantriMatsyaSampadaYojanaon20-05-2020.pdf.
[7] Press Information Bureau, *Press Release* (2023), available at https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1910415.

expertise of handlers as well as the paucity of adequate regulatory frameworks governing the sector, millions of fish face a continual onslaught of stressors at every stage of the production cycle each year.

In the absence of minimum standards for ornamental fish keeping and weak enforcement of existing laws, adverse environmental and public health impacts are grave concerns in addition to animal welfare in the burgeoning sector.

This paper aims to highlight the prevalence and interconnectedness of these issues, examine the existing regulatory framework in India, and propose interventions to mitigate the harmful effects of the ornamental fish industry as it stands today. While the authors recognise the importance of species-specific information, it is not possible to approach a highly unregulated sector with species-specific requirements alone without first addressing the lack of basic sectoral and industry-level regulations. This paper therefore limits the extent to which it addresses species-specific interventions to improve fish welfare and focuses on interventions that can benefit many species in certain ways.

II. Overview of the Ornamental Fish Sector

The global ornamental fish market, which was valued at USD 6.38 billion in 2023, is expected to grow to USD 11.5 billion by 2030, with an 8.6% CAGR.[8] This surge in demand is being driven by the growing popularity of keeping ornamental fish as a hobby, which has attracted over 100 million enthusiasts worldwide.[9] According to the World Bank's 2023 export-import data, Asian countries dominate the ornamental fish trade, with Japan, Singapore, and Sri Lanka being the biggest exporters[10], respectively and the largest importers being the United States, the European Union, and China, in that order.[11]

The ornamental fish trade in India, though not yet on par with India's global seafood trade, is steadily growing, with nearly a million domestic hobbyists[12], driving domestic demand. While accurately determining the domestic market size of the ornamental fish sector in India is difficult due to insufficient data reporting and collection, there are some estimates available, though not recent. For example, the Central Marine Fisheries Research Institute (CMFRI) in a 2021 publication[13] estimates that the domestic ornamental fish trade in 2017-18 was valued at INR 500 crores (about USD 67 million), with a CAGR of 11-12%. Additionally, the same report estimated the export value at INR 8.4 crores (approximately USD 1.1 million).

Thus, India accounts for less than 1% of the worldwide ornamental fish market[14] and was only the 28th largest exporter in 2019[15], with total exports amounting to a mere USD 1.59 million. In comparison, India has a far greater presence in the worldwide fish and seafood industry,

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[8] Verified Market Reports, *Ornamental Fish Market Size, Share, Growth | Global Report,* 2030 1 (2023), available at https://www.verifiedmarketreports.com/product/global-ornamental-fish-market-2019-by-manufacturers-regions-type-and-application-forecast-to-2024/.

[9] Sharma et al., *Aquapost* supra note 1.

[10] World Bank, *Live Ornamental Fish Exports by Country* (2023), available at https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2023/tradeflow/Exports/partner/WLD/product/030110.

[11] World Bank, *Live Ornamental Fish Exports by Country* (2023), supra note 1.

[12] K. A. R. S. De Silva, *Ornamental Fish Farming: Successful Small Scale Aqua Business in India* 14 (2015), available at https://www.academia.edu/21203445/Ornamental_Fish_Farming_Successful_Small_Scale_Aqua_business_in_India

[13] Shinoj Parapurath, *Status and prospects of ornamental fish and fish feed industry in Southern India* 7 (2021), available at https://eprints.cmfri.org.in/15228/1/MFIS_248_Shinoj%20Parapurath_2021.pdf.

[14] Department of Fisheries, *Ornamental Fisheries Development under PMMSY* (2020), available at Ornamental_fisheries_development_under_PMMSY.pdf

[15] World Bank, *Live Ornamental Fish Exports by Country* (2019), available at https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2019/tradeflow/Exports/partner/WLD/product/030110.

accounting for 8% of the market and ranking third in production.[16] Recognizing this gap and striving to turn it into an opportunity, the Department of Fisheries under the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, introduced the Pradhan Mantri Matsya Sampada Yojana (PMMSY) in September 2020[17] to establish India as a leader in the global ornamental fish trade and mirror its prominence in the global fish and seafood trade. The scheme had an outlay of INR 576 crores[18] for the ornamental fish sector, and aimed to finance new production units along with other marketing, promotional, and skill development activities.
While the precise impact of PMMSY on domestic market size is challenging to determine due to scant domestic gathering and reporting of data, World Bank statistics on live ornamental fish imports and exports show that India's export competitiveness in the sector has increased considerably. As previously stated, in 2019, India was the 28th largest exporter, with exports valued at USD 1.59 million, and by 2023, it had climbed up to become the 15th largest exporter, with exports worth USD 4.97 million.[19] This noteworthy improvement translates to an increase in exports of over 212% from 2019 to 2023. Thus, it is reasonable to infer that India's ornamental fish market is primed for additional expansion, with international trade showing signs of promise. While India primarily exports to Asian countries such as Indonesia, Malaysia, Singapore, and China[20], future exports may be aimed at penetrating larger and more prominent markets such as the EU and the US.

However, this growth is not without its costs. Inadequate data collection along with insufficient reporting and monitoring presently pose challenges for the sector. The data available is based on predictions from outdated models and is obsolete. The Ornamental Fisheries Training and

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[16] Press Information Bureau, *Press Release on Pradhan Mantri Matsya Sampada Yojana* (2020), available at https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1910415.

[17] Press Information Bureau*, Press Release* (2020), available at https://dof.gov.in/sites/default/files/2020-08/PressReleasebyPIBonPradhanMantriMatsyaSampadaYojanaon20-05-2020.pdf.

[18] Department of Fisheries, *Promotion of Ornamental Fisheries under PMMSY* 16 (2020), available at PROMOTION OF ORNAMENTAL FISHERIES UNDER PMMSY

[19]World Bank, *Live Ornamental Fish Exports by Country* (2023), available at https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2023/tradeflow/Exports/partner/WLD/product/030110

[20] World Bank, *Live Ornamental Fish Exports by Country* (2023), available at https://wits.worldbank.org/trade/comtrade/en/country/IND/year/2023/tradeflow/Exports/partner/ALL/product/030110

Research Institute (OFTRI) has also emphasized these challenges.[21] OFTRI, recognized as a Project Monitoring Unit for Ornamental Fisheries Development by the National Fisheries Development Board (NFDB) under the Ministry of Agriculture and Farmer's Welfare, monitors NFDB-funded ornamental fisheries development projects in many states. The acknowledgement of these issues by a government-recognized institute is especially concerning, given the considerable public expenditure under the PMMSY.

The lack of effective data collection and monitoring suggests inadequate oversight from regulators and raises additional concerns about whether environmental sustainability and animal welfare claims are accurate. This creates further issues since, in a market driven by enthusiasts, fish health, welfare and sustainability are important considerations and often primary drivers of demand, typically outweighing price.[22] If these issues remain, India's market and export potential may be jeopardized, as sustainability and welfare concerns might stymie the sector's success and expansion.

Market Analysis

This sector is driven by a diverse group of buyers, including hobbyists, pet owners, private and government aquarium owners, pet shop owners, retailers, exporters, Self Help Groups, fishermen and aquaculture farmers.[23] There is also a growing trend of displaying ornamental fishes for entertainment, to generate revenue through entry fees at various exhibitions, like the ornamental fish exhibitions held in various cities across India.[24][25][26][27]

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[21] Ornamental Fisheries Trade Research Institute, *Issues Concerning Export Promotion of Ornamental Fisheries Trade in India* (2023), https://www.oftri.org/issues-concerning-export-promotion-of-ornamental-fisheries-trade-in-india/

[22] Shyam S. Salim & R. Sathiadhas, *Hobbyists' preferences for marine ornamental fish: A discrete choice analysis of ecolabeling and selected product attributes* (2009), available at https://www.researchgate.net/publication/242706433_Hobbyists'_preferences_for_marine_ornamental_fish_A_discrete_choice_analysis_of_ecolabeling_and_selected_product_attributes[1].

[23] *Id.* 13; Ornamental Fisheries Trade Research Institute, *Lesson 3.2: Filters for Aquarium - Types of Filters* (2023), available at https://www.oftri.org/lesson-3-2-filters-for-aquarium-types-of-filters-2/.

[24] The Dilli, *Underwater Tunnel Aquarium in Dwarka,* Delhi (2024), available at https://www.thedilli.in/2024/03/underwater-tunnel-aquarium-delhi-dwarka.html.

[25] Dainik Bhaskar, *Walk-Through Underwater Tunnel Built in TT Nagar Dussehra Ground, Bhopal* (2024), available at https://www.bhaskar.com/local/mp/bhopal/news/walk-through-underwater-tunnel-built-in-tt-nagar-dussehra-ground-132274359.html.

[26] Hindustan Times, *This Tunnel Aquarium Show in Bengaluru is a Must-Visit* (2023), available at https://www.hindustantimes.com/cities/bengaluru-news/this-tunnel-aquarium-show-in-bengaluru-is-a-must-visit-101674026898312.html.

[27] News18 Hindi, *Fish Tunnel Set Up in Jhansi Mahotsav and over 1 Lakh Fish on Display* (2023), available at

The domestic sector is growing at a projected rate of 20% and demand outweighs supply.[28] Within the domestic market, 99% of the fish are exotic, consisting of approximately 288 varieties of ornamental fish that are not indigenous to India[29].

Freshwater ornamental fish contribute to about 80%[30] - 90%[31] of the ornamental fish trade in India with the remaining 10[32]- 20%[33] being from marine and brackish waters.[34] The north-eastern states contribute around 85% of the total freshwater fish market, with the rest originating from southern states.[35]

Trade Cycle

The ornamental fish production and trade sector is largely unorganised.[36] Ornamental fish that enter this trade are either caught from fresh, brackish or marine aquatic bodies or cultured.
There is significant scope for a rapid increase in ornamental fish aquaculture in India, given that India ranks second for aquaculture, globally.[37] The government is currently trying to boost both supply and demand side interventions with a focus on rapidly increasing production systems and utilising ornamental fish aquaculture to generate employment.

Although approximately 98% of India's freshwater ornamental trade are cultured, around 90% of India's freshwater ornamental fish exports consist of wild-caught indigenous species.[38] At

https://hindi.news18.com/news/uttar-pradesh/jhansi-jhansi-fish-tunnel-set-up-in-jhansi-mahotsav-over-1-lakh-fish-on-display-7936505.html.

[28] Aslasha Shraborni, Sagar C. Mandal & Janmejay Parhi, *Freshwater Ornamental Fishes of India: Sustainable Management and Conservation* (2023), available at https://www.fisheriesjournal.com/archives/2019/vol7issue2/PartA/7-1-48-550.pdf.

[29] *Id.* at 162.

[30] Aslasha Shraborni et al., *Ornamental Fish Keeping as Cottage Industry in India* 636 (2023), available at https://www.academia.edu/66847003/Ornamental_Fish_Keeping_as_Cottage_Industry_in_India.

[31] *Id.* at 158.

[32] *Id.*

[33] Karthick Raja, et. al., *Present Status of Freshwater Aquaculture in India - A Review* 12 (2017), available at https://www.fisheriesjournal.com/archives/2017/vol5issue6/PartB/5-5-45-128.pdf.

[34] *Id.*

[35] *Id.*

[36] *Id.* at 115.

[37] *Id.*

[38] Shraborni et al., *Freshwater Ornamental Fishes of India* supra note 28., at 157.

present, only 2[39]- 5%[40] marine ornamental fish are cultivated through aquaculture, while a staggering 95%.[41]-98%[42] are captured from the wild.[43]

Over 98% of the marine ornamental fish in the global trade originate from Southeast Asian countries, including the Maldives, Indonesia, and Sri Lanka, as well as from Pacific Island nations such as Australia.[44] Marine ornamental fish species, particularly in the context of India, offer substantial export potential but also pose serious ecological and environmental challenges.

Due to high demand and prices, ornamental fish are being captured, harvested and supplied in greater volumes and with higher frequency, threatening the viability and sustainability of this sector. [45] This, coupled with extremely high mortality rates, further exacerbates the pressure on our natural ecosystems, as the supply of wild-caught ornamental fish is not inexhaustible. Signs of overfishing are becoming apparent in localized areas, and it is imperative to ensure there is some regulation to ensure sustainability.[46]

In response to these sustainability concerns about wild-caught ornamental fish, aquaculture is being pushed as a solution despite having its sustainability concerns. India is also working on hatchery technology for producing marine ornamental fishes to increase production without straining wild resources. The Central Marine Fisheries Research Institute (CMFRI), Kochi, under the Indian Council for Agricultural Research, has already developed and 'perfected' hatchery technology for animals such as seahorses, clown fishes, damsels, and serranids.[47]

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[39] Shraborni et al., *Freshwater Ornamental Fishes of India* supra note 28. Pg 158.
[40] *Ornamental Fish Farming Project Profile 21 (2023),* available at https://msmedi-chennai.gov.in/GARMS_Admin/basictools/images/ProjectProfiles/OrnamentalFishFarming.pdf
[41] *Id.* at 40.
[42] Shraborni et al., *Freshwater Ornamental Fishes of India* supra note 28. Pg 158.
[43] *Id.* at 40.
[44] Karthick Raja, et. al., *Present Status of Freshwater Aquaculture in India - A Review* 12 (2017), Supra Note 33.
[45] University of Florida, *The Ornamental Fish Trade: An Introduction With Perspectives For Responsible Aquarium Fish Ownership* (2023), available at https://edis.ifas.ufl.edu/publication/FA124.
[46] *Id.*
[47] Archana Sinha, P. K. Pandey & S. Ghosh, *Editorial: Ornamental Fishing Industry, Front.* Mar. Sci. 10:1245218 (Aug. 22, 2023), available at https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2023.1245218/full.

Unfortunately, up to 90% of the fish in the ornamental fish trade will die due to improper welfare and management standards, particularly during transportation.[48] Many of the animals that do survive to the destination of sale will be discarded due to illness or injury like fin damage.[49] The non-discarded survivors are then stored in holding tanks at wholesalers and retailers until they are bought and transported to the final consumer. During this time, they receive minimum care, only to the extent that will yield enough fishes of sufficient quality to turn a profit. [50]

The high mortality rates resulting from compromised fish welfare at every stage of the trade cycle have a high economic cost for the industry. Although it is impossible to quantify the exact number of fish in the ornamental fish trade.[51] It is staggering to note that the size of the sector and its market is essentially the value of a small fraction of the number of fish entering and suffering through this trade cycle.

[48] Thomas Torgersen, *Ornamental Fish and Aquaria*, in *The Welfare of Fish* 370 (T.S. Kristiansen et al. eds., 2020).
[49] *Id.*
[50] *Id.*
[51] Food and Agriculture Organization, *The Ornamental Fish Trade Production and Commerce of Ornamental Fish: technical-managerial and legislative aspects*, (2023), available at
The Ornamental Fish Trade.

III. Welfare of Ornamental Fish

Fish are fascinating animals that, despite ongoing debate, display clear signs of sentience. Recent research has shown that fish possess good memory capacities, live in intricate social communities where they recognize individuals, learn from one another and exhibit signs of reconciliation and cooperation. Fish construct complex structures, are capable of tool use and some species have also displayed the ability to recognise themselves. Their primary senses are comparable to those of humans, and in some cases their sensory capacities supersede us. They employ similar methods as humans for keeping track of quantities.[52] This information underscores the ethical obligation to address the impact of the ornamental fish sector on the welfare of these complex sentient beings.

Although there is no universally accepted definition of fish welfare, most definitions encompass the principles in this section. For this paper, fish welfare is described as "striving for a positive state of well-being that allows the fish to be able to exhibit natural behavioural, social and physiological characteristics"[53] This definition includes the principles of the "five freedoms" developed by the World Organisation for Animal Health (hereinafter "**WOAH**") for terrestrial animals, which has been read into Section 3 and 11 of the Prevention of Cruelty to Animals Act, 1960 (applicable to all animals, including fishes), by the Hon'ble Supreme Court of India.[54]

Ensuring fish welfare requires providing an appropriate environment that meets all relevant parameters. These parameters include but are not limited to, maintaining optimal water quality, selecting suitable tank size and layout, fostering a compatible fish community, and providing proper nutrition.[55]

To evaluate fish welfare effectively, several key indicators can be measured. Stress, which can be measured through cortisol levels using both invasive and non-invasive methods (like testing the

[52]Culum Brown, *Fish Intelligence, Sentience and Ethics,* 18 Animal Cognition 1–17 (2015), Available at Fish Intelligence, Sentience and Ethics

[53] Stephen A. Smith, *Fish Welfare in Public Aquariums and Zoological Collections*, 13 Animals 2548 (2023), available at Fish Welfare in Public Aquariums and Zoological Collections - PMC.

[54]AWBI vs Nagaraja & Ors [(2014) 7 SCC 547]**.**

[55] *The Welfare of Fish* pg 366

water in which the fish are held), serves as a primary indicator.[56] Additionally, behavioural indicators like natural swimming patterns and functional indicators like fin damage and mortality help identify issues in fish welfare.[57]

Understanding these welfare indicators is particularly important when considering the life cycle of ornamental fish, which encompasses multiple stages, each presenting its unique challenges and stressors. Unfortunately, mortality rates for ornamental fish are exceedingly high, with most ornamental fishes succumbing to a range of welfare issues either before or after reaching the customer.[58]

Fish display exacerbated responses to stress when forced to endure multiple or sequential stressors. Providing 24-hour recovery periods between stress can reduce the cumulative impact of stress on these animals.[59]

For wild-caught ornamental fish, the process begins with several transient but stressful stages, including capture, handling, holding, transport, transfer, and purchase. In contrast, ornamental fish bred through aquaculture undergo a different initial experience. Captivity, due to stressors from an inadequate, artificial environment and the absence of a natural ecology, induces changes in fish morphology, physiology, and behaviour. Fish are extremely sensitive to changes in temperature, salinity and water chemistry with sub-optimal conditions resulting in stress and even mortality. Improving these conditions can enhance fish performance, reduce parasitism, and decrease morphological abnormalities, which, in turn, increases the monetary value of the fish.[60] In many ways, aquaculture is more challenging and prone to higher issues than terrestrial animal culture.[61]

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[56] C. H. Stevens, D. P. Croft, G. C. Paull & C. R. Tyler, Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture?, 10 J. Fish Biol. 1, 11 (2017).
[57] *Id.* at 6
[58] Thomas Torgersen, *Putting Ornamental Fish Welfare On Display*, Faunalytics (2020), available at Putting Ornamental Fish Welfare On Display - Faunalytics.
[59] *Supra* 56 at 11.
[60] D. Almeida, A. Almodóvar, G.G. Nicola & B. Elvira, Fluctuating Asymmetry, Abnormalities and Parasitism as Indicators of Environmental Stress in Cultured Stocks of Goldfish and Carp, 279 Aquaculture 120–125 (2008).
[61] F.S. Conte / Applied Animal Behaviour Science 86 (2004) 205–223

Cultured fish are spawned, hatched, or born live, transported and raised in restricted and often stressful environments until they reach marketable size. After they reach this size, they undergo the same trade cycle as wild-caught fish, facing similar stress and welfare challenges.[62]

The typical ornamental fish destined for an aquarium, irrespective of species, will be transported to a retailer, through middlemen and wholesalers, kept in a display tank and be dip-netted into a bag for transport to the customer's aquarium, usually in their home, where it is released. The final and typically longest phase is in the tank of the hobbyist or aquarium that purchases the fish.[63] Aquarium fish often live in suboptimal conditions and unlike fish in their natural habitats, cannot escape a potentially harmful environment. Even the preeminent outfitted aquarium, combined with meticulous concern for water quality parameters, can never fully recreate the conditions available to these animals in the wild.[64]

Capture

Most marine ornamental fish and exported freshwater fish are captured and not cultured in India. Capture methods in addition to causing stress to the animal due to being chased or constrained tend to cause injury and death, particularly if they are invasive methods like cyanide and blast fishing.[65] Mortality rates of cyanide-caught fish range from 5-75% within hours post-capture.[66] The fish that do survive may suffer irreversible damage due to sub-lethal cyanide exposure.[67] Blast fishing kills nearly all animals at the epicentre of the blast and also destroys surrounding habitats.[68] The pressure from the bombs creates stressful conditions for surviving fish. Most captured fish are not discarded because of their species or size, but because of fin damage, wounds or emaciation as a result of capture and post-capture treatment.[69]

[62] The Welfare of Fish pg 365
[63] The Welfare of Fish pg 365
[64] https://pdfs.semanticscholar.org/d3f2/39d349eed36df6f40a51c02da75739ba8828.pdf pg 128
[65] The Welfare of Fish 371
[66] C. Wabnitz, From Ocean to Aquarium (2003).
[67] D. J. Baird, The Role of Aquaculture in Sustainable Fisheries, in 14 Aquaculture and Fisheries Management 1 (2008), available at https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470513712.ch14
[68] A. C. Alcala & E. D. Gomez, Dynamiting Coral Reefs for Fish: A Resource-Destructive Fishing Method, in Human Impacts on Coral Reefs: Facts and Recommendations 52–60 (1987).
[69] The Welfare of Fish 371

In addition to the alleviation of stressors on fish caused by illegal capture methods, a comprehensive ban on destructive fishing practices such as blast fishing, cyanide and bottom trawling will aid in the conservation of marine life in the area. While there are some attempts to regulate these practices,[70] In different ways, across India, the lack of a comprehensive ban helps these destructive fishing practices continue unchecked.

Culture

The domestic freshwater ornamental fish trade is primarily reliant on aquaculture. In aquaculture, many stressors occur including poor water quality, handling, confinement, poor social and physical environment and disease.[71]

Chronically or repeatedly stressed fish experience immunosuppression and as a consequence are more at risk of disease. Poor facilities and filtration of water can also lead to the concentration of pathogens in recirculating culture systems. Many diseases of ornamental fishes are caused by pathogens that are extremely common and tend to manifest opportunistically in times of stress.[72]

Diseases can be either of parasitic, bacterial, viral or fungal origins and common symptoms include ulcers, fin and tail rot, dropsy, constipation, clamped fins, swim bladder inflammation, pop eyes and cloudy eyes, flip over disease, skin abnormalities and lesions. The resulting losses negatively affect the financial and socioeconomic status of the ornamental fish farming community.[73]

Although intensive breeding in Asian countries has produced socio-economic benefits for the local population, the welfare and health of the fish being cultured have not been appropriately

[70]Sec. 4(1)(f), Kerala Marine Fishing Regulation Act (1980); Guideline 1.4(2), Guidelines for the States for Framing a Bill on Inland Fisheries and Aquaculture (2020), available at https://dof.gov.in/sites/default/files/2020-01/Guidelines%20for%20the%20States%20for%20framing%20a%20bill%20on%20inland%20fishereis%20and%20Aquacul%20ture%20%201.pdf

[71] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56.

[72] *Id.* at 9.

[73] Seyed Hossein Hoseinifar et al., *Sustainable Ornamental Fish Aquaculture: The Implication of Microbial Feed Additives*, ANIMALS 13, no. 2548 (2023), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10215764/.

addressed.[74] Furthermore, intensive breeding and the abuse of genetic selection which tends to standardize size and colour variation has reduced disease resistance and health in ornamental fish. The resistance of some of the most popular ornamental fish species has decreased, with a subsequent increase in induced pathologies.[75]

Handling

Handling fish, even briefly, can cause considerable stress, raising cortisol, in many species.[76] The proficiency of the handlers plays a significant role in mitigating stress, which has a resultant impact on mortality rates.[77]

Handling stressors are often repetitive, and reducing these stressors plays a tangible role in improving the welfare and survival of fish.[78] Effective stress-mitigation techniques can include using wet, gloved hands, specially designed nets that safeguard the skin's mucous layer and scale, as well as the use of pain relievers such as clove oil to sedate fish before intense handling.[79]

This highlights the necessity to improve and create new methods of handling as well as encourage comprehensive training for individuals handling fish.

Transportation

The transit routes of ornamental fishes are intricate and dynamic, spanning thousands of miles from their production origins and countries of source through various holding and transshipment facilities, from wholesale traders to retailers. The welfare of ornamental fish during transportation often raises significant animal welfare concerns.

During transit, fish may experience stress due to overcrowding, poor water quality, temperature

[74] Food and Agriculture Organization, *The Ornamental Fish Trade: Production and Commerce of Ornamental Fish: Technical-Managerial and Legislative Aspects* 3 (2010), available at https://openknowledge.fao.org/server/api/core/bitstreams/b02939ef-3536-4e8e-be33-2524d8452738/content.
[75] *Id.* at 3.
[76] C. R. Tyler et al., The Role of Endocrine Disruptors in Fish, 28 Aquatic Toxicology 1 (2008), available at https://www.sciencedirect.com/science/article/pii/S0166159108002529?casa_token=MAfxEHSA4YAAAAAA:7cAmyR1lLp5ZgqQo0C7fEhsJGNqgV5uEI_NpPfnne7cZvVfpCpxWevMtLfZx2vxmvRi813MsSQ
[77] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56.
[78] *Id.* at 7.
[79] *Id.* at 7-8.

fluctuations, and inadequate oxygen levels. These stressful conditions can lead to increased susceptibility to diseases, injuries, and mortality. Ensuring humane handling, proper packing techniques, and maintaining optimal water conditions are crucial to minimizing mortality caused by welfare issues faced by ornamental fishes during transportation. [80]

During their transportation, fish may be placed in poorly packed containers like plastic bags, experience sudden changes in temperature, or experience events such as being dropped in their shipping boxes or loss of water through damaged and leaking bags.[81] Rapid temperature changes, blunt force trauma and constriction are known causes of stress and often death.

Tank-based transportation is ideal for monitoring water quality and maintaining welfare but is an impractical solution due to the added costs associated with it. Maintaining water quality is the primary way to minimize mortality during transportation, and techniques such as placing pure oxygen in the remaining space within the plastic bags can significantly help improve water quality during transportation which often lasts more than 12 hours[82] or slow-release oxygen tablets, This is particularly important for warm-water ornamental fish species, which represent the majority of the ornamental fish trade in India[83], as there is less dissolved oxygen stored in higher-temperature water.[84] Reducing waste buildup during transportation can also improve fish health and welfare but is slightly harder to ensure as different species' waste production systems and adaptability to water conditions can vary significantly.[85]

The stress endured by ornamental fish is further exacerbated in cases of import and export because of the organizational structure of the industry. Ornamental fish for export are usually flown to their destination country in journeys that have several parts and last many hours after which they are collected by a wholesaler or distributor and finally transported to the retailer. The

[80]Mbawuike Belema et al., *Handling and Packaging of Ornamental Fishes for Successful Transportation*, IJFAS 5(5): 263-265, pg 264 (2017), available at E-ISSN: 2347-5129 P-ISSN: 2394-0506 (ICV-Poland) Impact Value: 5.62 (GIF) Impact Factor: 0.549 IJFAS 2017; 5(5): 263-265 © 2017 IJFAS

[81] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56 at 8.

[82] *Id.* at 6.

[83] Shraborni et al., Ornamental Fish Keeping as Cottage Industry in India supra note 28., at 636.

[84] *Id.* at 6.

[85] *Id.* at 6.

journey often also involves passing through middlemen at each stage between the farmer and the exporter. [86]

Implementing packaging and transport standards for ornamental fish can significantly improve fish welfare and reduce mortality rates.[87] Unfortunately, in India, there is currently no regulation that prescribes even minimum standards for the transportation of these animals unlike most other commonly traded and transported terrestrial species that have species-specific standards under the Transport of Animals Rules, 1978[88]. Although there is technically a Bureau of Indian Standards' Code, IS 10449:2024, on the Transportation of Ornamental fish[89], it is not mandatory and therefore limited in its application.

Physical Environment

Ornamental Fish include fishes from a wide range of families and environments, sharing only one common feature, the purpose for which they are used. Their needs such as space, water quality, temperature etc. vary significantly.[90]

Most ornamental fish will spend a significant portion of their life in man-made environments in a tank of some sort, either with a hobbyist or in an aquarium. They are also subject to artificial environments in culture tanks and retail stores. The poor welfare of these fish can generally be attributed to discrepancies between their needs and the environment provided by the fishkeeper.[91] Certain conditions are detrimental to all fish, such as unsuitable water quality parameters including temperatures that deviate significantly from preferred ranges, or high ammonia and pH levels. However, the critical values of such parameters vary widely among species. Thus, the guideline for ornamental fish, in general, must be supplemented with species-specific standard

[86] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56., at 8.
[87] T.S. Kristiansen et al., *The Welfare of Fish* (2020).
[88] Transport of Animals Rules, 1978 (Covers minimum standards for Cats, Dogs, Sheep, Goats, Equines, Monkeys, Cattle, Poultry and Pigs).
[89] Bureau of Indian Standards, *IS 10449: 2024 BIS Freshwater Fish Seed and Ornamental Fish Code for Transport* (First Revision).
[90] T.S. Kristiansen et al., *The Welfare of Fish* 364 (2020).
[91] *Id.* at 366.

operating procedures, otherwise, they will be limited in their ability to effectively address all parameters of ornamental fish welfare.[92]

When fish are dissatisfied with their current environment, they have three possible coping methods. *First,* they can adapt their physiology to suboptimal conditions through acclimation, gradually overcoming the mismatch between themselves and their environment. *Second,* they can migrate to a location with better conditions, a preferred tactic for many marine fish species. *Third,* they can resign themselves to poor welfare conditions and do their best to survive.[93]

The aquarium trade is particularly challenging for marine fish who primarily migrate to cope with mismatched environments. These fish are generally less adaptable than their freshwater counterparts and therefore suffer from increased levels of stress when they are unable to successfully relocate themselves away from unsuitable conditions.[94]

Water Quality

Water quality encompasses salinity, pH level, temperature, ammonia, nitrate, nitrite, dissolved oxygen, hardness, carbon dioxide,[95] alkalinity, turbidity, chlorine[96] and chloramines[97]. The importance of water quality and composition in fish exhibits and habitats is essential to the health and well-being of all fish species.[98] Stress responses to poor water quality in fishes cause changes in blood chemistry, haematology, cellular permeability and osmoregulatory needs in fishes. This triggers the fish's adaptive responses. When the fish fail to adapt effectively, noticeable behavioural changes and visible lesions or deformities occur. The point at which the

[92] S. A. Smith et al., *Fish Welfare in Public Aquariums and Zoological Collections,* ANIMALS 13, no. 16, 2548, (2023),
available at https://www.mdpi.com/2076-2615/13/16/2548.
[93] T.S. Kristiansen et al., *The Welfare of Fish* 368 (2020).
[94] Thomas Torgersen, *Putting Ornamental Fish Welfare on Display*, Faunalytics (2020), Supra Note 58.
[95] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56., at 7-8.
[96] *Chlorine: An Effective Disinfectant in Aquaculture,* Global Seafood (2021), available at https://www.globalseafood.org/advocate/chlorine-an-effective-disinfectant-in-aquaculture/.
[97] *Chlorine and Chloramine in Aquaculture,* Koinet (2021), available at https://www.koinet.net/j/index.php/articles/aquaculture/17-chlorine-and-chloramine.
[98] S. A. Smith et al., *Fish Welfare in Public Aquariums and Zoological Collections,* (2023), Supra Note 87, at 3.

stress response becomes visibly noticeable is usually after the welfare of the fish has been significantly compromised. [99]

Optimal ranges for water quality parameters differ for each species. Besides the obvious differences in water quality parameters for fish such as salinity, some fish require different water quality parameters for various stages of their life cycle.[100] In mixed tanks, ensuring optimal ranges for all species therefore becomes invariably complex. Even if members of one species can survive in a tank, they may still undergo chronic stress if the variables are unsuitable.[101] Therefore, when choosing species for a mixed community tank, it is essential to consider species-specific ranges and compatibility to minimize stress, allowing for mere survival rather than thriving. Regular monitoring and keeping permanent records of water quality parameters help balance and enhance aquatic environments for fish.

Habitat Design

Though little is known about the impact of long-term captivity on fish,[102] designing habitats that cater to each species' needs can significantly increase their welfare.

Any physical habitat for fish should be designed to ensure fish are not exposed to materials toxic to them. The interior of the system should be free of sharp edges, and abrasive surfaces.[103] Tank shape and size can significantly affect fish behaviour and well-being. Wider tanks may provide more space for fish to escape disturbances from keepers or viewers, hence, reducing stress compared to narrower tanks. Moreover, larger tanks also tend to maintain more stable water physio-chemistry.[104] Stocking densities should reflect the size of the tank and the species' social tendencies.[105]

Environmental enrichment can enhance the well-being of captive fish. Its goal is to offer new

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[99] *Id*. at 3-4.
[100] T.S. Kristiansen et al., *The Welfare of Fish* 365 (2020).
[101] https://www.mdpi.com/2076-2615/13/16/2548 pg 3
[102] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56 at 8.
[103] *Id*. at 5.
[104] *Id*. at 6-7.
[105] *Id*. at 8.

sensory and motor stimulation to help fulfil their behavioural, physiological, morphological, and psychological needs, while also reducing stress and the occurrence of abnormal behaviours. Fish display a strong preference for certain tank features and structures.[106] Enriching the physical environment by increasing its structural complexity—through the introduction of physical structures, artificial plants, substrates, or other objects[107]—has been shown to lower stress responses in fish.[108] Providing shelters, shaded areas, and hiding spots can offer visual separation and protection.[109]

Although hobbyists tend to be more willing to provide enrichment, when it comes to aquaculture, the design of rearing environments is typically based on convenience for farmers and economic factors, with minimal attention to animal welfare.[110]

An often-ignored facet of fish welfare is that fish also have unique social needs. [111] Even within shoaling species, for example, group size will affect different species in unique ways. Ornamental species encounter further challenges in community tanks and aquariums when interacting with incompatible species or predators. Social factors, such as hierarchy and bullying can also cause stress to fish in aquariums. [112]

Additionally, lighting intensity, duration or wavelength in their artificial environments can also provoke different physiological responses in fish, which vary based on parameters like the species, stage of development of the fish and natural light levels in their normal habitat.[113]

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[106] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56 at 8.
[107] Zhang Zonghang et al., *Physical Enrichment for Improving Welfare in Fish Aquaculture and Fitness of Stocking Fish: A Review of Fundamentals*, Mechanisms and Applications, Aquaculture (2023), available at https://www.sciencedirect.com/science/article/abs/pii/S0044848623004258.
[108] Compassion in World Farming, Environmental Enrichment for Fish in Aquaculture (2020), available at https://www.ciwf.org.uk/media/7443855/environmental-enrichment-for-fish-in-aquaculture.pdf.
[109] S. A. Smith et al., *Fish Welfare in Public Aquariums and Zoological Collections,* (2023), Supra Note 87.
[110] Pablo Arechavala-Lopez et al., *Environmental Enrichment in Fish Aquaculture: A Review of Fundamental and Practical Aspects,* Aquaculture Research 53, no. 1 (2021), available at https://doi.org/10.1111/raq.12620.
[111] C. H. Stevens et al., *Stress and Welfare in Ornamental Fishes: What Can Be Learned from Aquaculture,* Supra Note 56 at 9.
[112] *Id*. at 9.
[113] *Id*. at 6.

Nutrition

Food plays an important role not just in the health, well-being and immunology of the fish but also in their colour and, consequently, their value. In natural conditions, fish can regulate their diets more easily, reducing the likelihood of nutritional deficiencies, in comparison to confined tanks and spaces.[114]

Fish can be classified as carnivores, herbivores and omnivores based on their species. Fish also exhibit diverse feeding patterns, including surface, column and bottom feeding. Additionally, different fish species range in frequency of consumption, from once-a-day feeders to continuous grazers, and factoring these diverse needs is essential to maintain welfare.

Providing appropriate diets for ornamental fish species can enhance nutrient digestibility, meet metabolic needs, reduce water pollution,[115] increase fish immunology and improve survival rates. Nonetheless, most of the information on the nutritional requirements of fish comes from studies that anchor on the aquaculture of fish for food, which is insufficient to effectively understand the needs of ornamental fish.[116] It is therefore important to conduct research to better ascertain the nutritional needs of ornamental fish.

Aligning Fish Welfare and Industry Profitability

Improving the welfare of fish through minimizing unnecessary stress has obvious benefits for the aquaculture, fisheries and ornamental fish trades by yielding better economic returns.[117] Despite substantial economic support from the government, no comparable funding has been allocated specifically to the welfare of ornamental fish.

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[114] M. A. Badhul Haq et al., *Nutritional Requirements of Freshwater Ornamental Fish: A Review*, Aquaculture Research 46, 2460 (2015), available at https://www.researchgate.net/publication/262755433_Nutritional_requirements_of_freshwater_ornamental_fish_A_review.

[115] Central Coastal Agricultural Research Institute, Extension Folder No. 117 2 (2017), available at https://ccari.icar.gov.in/Extension%20Folder%20No.%20117.pdf.

[116] *Supra Note 109.* at 2466.

[117] T.S. Kristiansen et al., *The Welfare of Fish* 255 (2020).

Research indicates, particularly for marine ornamental fish, that hobbyists are less price sensitive and are comfortable paying premiums for higher 'quality' ornamental fish, including parameters like health, higher welfare, and sustainability.[118]

Given that the industry's interests align with ornamental fish welfare, it is important that bodies, entities and organizations that promote ornamental fish trade, also prioritize research on species-specific needs and higher animal welfare standards.

[118] Sherry Larkin et al., *Hobbyists' Preferences for Marine Ornamental Fish: A Discrete Choice Analysis of Ecolabeling and Selected Product Attributes,* Aquaculture Economics & Management 19, no. 4, 1-20 (2015), available at https://www.researchgate.net/publication/242706433_Hobbyists'_preferences_for_marine_ornamental_fish_A_discrete_choice_analysis_of_ecolabeling_and_selected_product_attributes1.

IV. Cascading Effects

Environmental Degradation

Ornamental fish farming systems, whether outdoors or indoors, aim to optimize resources such as land, operational costs, and labour. However, this optimization frequently incurs a significant environmental cost. The ornamental fish sector adversely affects soil, water and air quality contributing to environmental degradation.

Ornamental fish aquaculture impacts soil quality by introducing excessive nutrients through feed, chemical contaminants, and organic waste, which can lead to soil degradation, reduced soil fertility, and erosion.[119]

The ornamental fish sector affects water quality, by utilizing toxic chemicals to capture ornamental fish, such as sodium cyanide, which is proven to have detrimental effects on both aquatic life and human health.[120] [121] [122] [123] When these toxins enter water bodies, they can rapidly contaminate aquatic ecosystems, harming other aquatic animals and impacting the underground water tables in surrounding areas. Human consumption of this contaminated water can lead to severe and deadly health implications, such as cyanide poisoning.[124]

The improper disposal of fish excretory products, carcasses and waste materials can lead to harmful accumulation in water bodies[125] Dead fish discarded in this manner decompose rapidly,

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[119] Agrifarming, *Water and Soil Management for Sustainable Aquaculture,* accessed July 26, 2024, available at https://www.agrifarming.in/water-and-soil-management-for-sustainable-aquaculture.

[120] Rachael Bale, *The Horrific Way Fish Are Caught for Your Aquarium—With Cyanide,* National Geographic, March 10, 2016, accessed July 26, 2024, available at https://www.nationalgeographic.com/animals/article/160310-aquarium-saltwater-tropical-fish-cyanide-coral-reefs?loggedin=true&rnd=1719994806160.

[121] *How Dangerous Is It to Use Cyanide to Catch Fish?,* Scientific American, accessed July 26, 2024, available at https://www.scientificamerican.com/article/cyanide-fishing/.

[122] *Ethical and Ecological Implications of Keeping Fish in Captivity*, Animal Welfare Institute, accessed July 26, 2024, available at https://awionline.org/awi-quarterly/2015-fall/ethical-and-ecological-implications-keeping-fish-captivity.

[123] National Oceanic and Atmospheric Administration, *The Importance of Coral Reefs,* accessed July 26, 2024, available at https://oceanservice.noaa.gov/education/tutorial_corals/coral07_importance.html.

[124] Rachael Bale, *"The Horrific Way Fish Are Caught for Your Aquarium—With Cyanide,"* National Geographic, March 10, 2016, accessed July 26, 2024, https://www.nationalgeographic.com/animals/article/160310-aquarium-saltwater-tropical-fish-cyanide-coral-reefs?rnd=1720250652783&loggedin=true.

[125] *Supra Note* 115.

releasing ammonia, which is highly toxic to fish and causes ammonia spikes that negatively impact other aquatic life.[126]

Ornamental fish farming can deteriorate air quality through the release of ammonia, hydrogen sulfide, and volatile organic compounds from fish waste and decomposing matter, leading to unpleasant odors and harmful pollutants.[127]

Biodiversity Loss

The ornamental fish sector poses significant biological and ecological threats to both aquatic and terrestrial ecosystems. These impacts can lead to localized species depletion and, in some cases, extinction. The aquarium fish trade can devastatingly affect coral reefs and their occupants,[128] as well as inland fish biodiversity, threatening the existence of many endangered species of fish that are already subject to the effects of global warming and habitat destruction.[129]

Biodiversity loss caused by the ornamental fish trade is primarily related to destructive capture practices, and the introduction of invasive species and exotic diseases.

1) Destructive Capture Practices

A major contributor to the loss of aquatic biodiversity occurs when ornamental fishes are captured using destructive fishing practices. Fish collectors practice cyanide fishing, which is done by crushing and dissolving sodium cyanide tablets in squirt bottles that are sprayed on the target fish for easy capture.[130] This practice severely damages the reef and the plethora of life forms that rely on it.[131] Some collectors also physically destroy coral to capture target fish.[132]

https://fishyfeatures.com/how-to-dispose-of-dead-fish-heres-what-you-need-toknow/#Prevents_Spread_of_Diseases.

[126] *Id.*

[127] *Id.*

[128] Monica V. Biondo & Rainer P. Burki, *A Systematic Review of the Ornamental Fish Trade with Emphasis on Coral Reef Fishes—An Impossible Task*, Animals 10, no. 11 (2020): 2014, https://doi.org/10.3390/ani10112014.

[129] Environmental Reviews, *"The Social, Economic, and Environmental Importance of Inland Fish and Fisheries,"* 24, no. 2 (2016): 115-121, https://doi.org/10.1139/er-2015-0064.

[130] *Supra Note* 115.

[131] Cyanide Fishing, Scientific American, accessed July 26, 2024,

https://www.scientificamerican.com/article/cyanide-fishing/#:~:text=While%20there%20is%20not%20much%20evidence%20of%20cyanide-caught,and%20of%20course%20larger%20doses%20can%20cause%20death.

[132] *Ethical and Ecological Implications of Keeping Fish in Captivity,* Animal Welfare Institute, accessed July 26, 2024, https://awionline.org/awi-quarterly/2015-fall/ethical-and-ecological-implications-keeping-fish-captivity.

Since corals play a pivotal role in aquatic ecosystems, this damage destroys their ability to support the numerous creatures that inhabit them, further compromising the ecological balance in these vital habitats.[133]

Some corals are protected under the law[134] and the use of destructive practices is prohibited around them. The Department of Fisheries, Government of India recommended banning the use of noxious and harmful chemicals and poisons for fishing.[135]

2) Invasive species

Invasive fishes are non-native species that are introduced into ecosystems where they harm native species, biodiversity, habitats, or human interests. These species often outcompete native species for resources, hence disrupting the ecological balance and leading to economic loss in fisheries and aquaculture.

Invasive fish species can be introduced intentionally or unintentionally through activities such as aquarium releases and fish farming. Exotic species often escape into the wild from hobbyists, pet owners, and traders, subsequently evolving into invasive species that cause irreparable damage to India's aquatic diversity.[136] Their potential to cause ecological, and economic damage and loss of native biodiversity, is a concern globally.

The ornamental fish trade has significantly contributed to the introduction of several invasive fish species for ornamental, aquaculture, and other purposes. Over time, some of these species managed to escape into the wild and became invasive to the ecosystem.[137] Studies have concluded that ornamental alien fishes frequently alter the aquatic ecology by changing water chemistry — such as increasing nitrogen and phosphorus concentration—- damaging the native

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[133] National Oceanic and Atmospheric Administration, *The Importance of Coral Reefs*, accessed July 26, 2024, https://oceanservice.noaa.gov/education/tutorial_corals/coral07_importance.html.
[134] Schedule 1 (Part K), Wildlife Protection Act, 1972; Coastal Regulation Zone Notification, 1991.
[135] Guideline 1.4(2), Guidelines for the States for Framing a Bill on Inland Fisheries and Aquaculture (2020): https://dof.gov.in/sites/default/files/2020-01/Guidelines%20for%20the%20States%20for%20framing%20a%20bill%20on%20inland%20fishereis%20and%20Aquacul%20ture%20%201.pdf
[136] S. Sandilyan et al., *A Review on Impacts of Invasive Alien Species on Indian Inland Aquatic Ecosystems*, 11 (2018), available at http://nbaindia.org/cebpol/pub/iasinland.pdf.
[137] *Id.* at 18. (Impacts of Exotic Fishes on Indian Inland Wetlands)

vegetation and competing for food resources. This has resulted in an unnatural decline of native fishes through predation, destroying the eggs, and larvae.[138]

The occurrence and impact of invasive ornamental fish species are poorly documented in India.[139] Introduced ornamental/aquarium fish can be a major source of ecological destruction, particularly if left unregulated. Additionally, the hybridization of several fish species in the wild, dilutes the wild genetic stock and leads to long-term introgression of gene pools.[140]

Non-native fish species have started establishing local populations throughout India largely due to the flourishing aquarium trade. Examples of invasive ornamental fishes are recorded throughout southern India, ranging from the tiny guppy fish (Poeciliareticulata) to the large and aggressive Red Piranha. In addition to P. reticulata, ornamental fishes such as Osphronemus goramy, and Xiphophorus maculatus have been recorded from the Chalakudy River, a biodiversity hotspot in Kerala. The Alligator Gar (*Atractosteus Spatula)*, [141] is another invasive species that has been found in Bhopal's Upper Lake in 2023[142] also known as *Bhoj Wetland* which is listed as a protected area[143].

Invasive species of fish that have taken advantage of the aquarium trade are emerging as significant threats to fragile aquatic habitats. For example, The Pterygoplichthys sp., a non-native ornamental fish breed has become an invasive species, which has significantly disrupted the aquatic food chain. This disruption is caused by the overgrazing of the benthic algae and detritus, as well as, changes in the aquatic plant systems due to tail lashing, and substrate plowing. Competition and egg destruction by these fish have led to the decline of an abundance of native fish species. Furthermore, this has resulted in the increased mortality of shorebirds due to

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[138] *Id.* at 21. (Impacts of Invasive Ornamental Fishes)
[139] *Id.* at 9 (Entry through Ornamental Trade)
[140] J.D.M. Knight, *Invasive Ornamental Fish: A Potential Threat to Aquatic Biodiversity in Peninsular India, Journal of Threatened Taxa* 2(2): 700-704 (2010).
[141] Sandilyan et al., *supra note* 129, at 9.
[142] Anas Khan, *Alligator Gar: North American Predator Fish Caught in Bhopal Stumps Experts*, Times Now News, accessed July 26, 2024, https://www.timesnownews.com/viral/alligator-gar-north-american-predator-fish-caught-in-bhopal-stumps-experts-article-99672477.
[143] Ramsar Convention, *Bhoj Wetland, Ramsar Site No. 1206*, designated on August 19, 2002, available at https://rsis.ramsar.org/ris/1206.

choking on the dorsal and pectoral spines of these fish. The nesting burrows of Pterygoplichthys sp. have also caused bank erosion.[144]

The regulations for this trade are inadequate, and the data on the ecological impact of invasive fish species is severely lacking. Although a third of the world's worst aquatic invasive species are aquarium or ornamental species.[145] Globally, managing invasive species in aquatic ecosystems remains a formidable challenge, highlighted in the Strategic Plan for Biodiversity 2011-2020 by the Convention on Biological Diversity (CBD).[146] Target 9 of this plan specifically addresses invasive alien species, aiming to identify, prioritise, control, or eradicate them by 2020.

India trades 300 fish species, several of which get sold in the global ornamental fish industry. Concerningly, most of them are on the endangered species list or threatened with extinction, which again emphasizes the need for stricter enforcement of laws regulating the trade in pet animals.[147]

If strict regulations are not implemented to oversee the aquarium fish trade and prevent the accidental release of exotic species into our waters, these non-native species could eventually eliminate our indigenous freshwater fish and other aquatic life.

3) Exotic Diseases

Transportation of ornamental fish across different regions can lead to disease transmission which can significantly harm local fish populations. While transporting ornamental fishes in different batches, the same water is used, which increases the spread of diseases between fish. This water itself contains pathogens, which are subsequently disposed of into natural water bodies, leading to contamination.[148]

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[144] Knight, *supra note* 113, at 700-701.
[145] *Id.* at 700-704.
[146] David Coates, *Strategic Plan for Biodiversity (2011–2020) and the Aichi Biodiversity Targets*, in THE WETLAND BOOK (2018), ISBN: 978-90-481-3493-9.
[147] Sandip D. Tapkir et al., *Far from Home: Tracking the Global Ornamental Fish Trade in Endangered Zebra Loach, Botia striata, from Freshwater Ecoregion and Biodiversity Hotspot in India, Aquatic Conservation*: MARINE AND FRESHWATER ECOSYSTEMS (2021), available at https://www.sciencedirect.com/science/article/abs/pii/S1617138121000546.
[148] *Ethical and Ecological Implications of Keeping Fish in Captivity,* ANIMAL WELFARE INSTITUTE QUARTERLY (FALL 2015), available at https://awionline.org/awi-quarterly/2015-fall/ethical-and-ecological-implications-keeping-fish-captivity.

Large-scale international transfers of aquatic animals have been implicated as vectors for the introduction of exotic pathogens, resulting in substantial ecological and economic repercussions in the recipient countries.[149] There have been documented cases of introduced non-native fish diseases in the wild causing threats to coastal ecosystems in the US and Caribbean.[150]

Carbon Emissions

Ornamental fish farming and aquarium keeping, much like other forms of aquaculture, require substantial energy for water pumping, heating, filtration, aeration, and lighting, all of which contribute to the industry's carbon footprint. Key factors influencing this footprint include energy-intensive fish feed production, transportation, and farm management practices.[151] The production of fish feed for ornamental species is particularly energy-demanding and a major source of carbon emissions.[152]

Capture practices that impact the coral reefs also increase the carbon footprint of this sector. Since the corals contribute to carbon and nitrogen cycling,[153] their destruction can disrupt these essential aquatic ecological processes. Habitat destruction for the culture (breeding, storage) of ornamental fishes can contribute to biodiversity loss[154] which leads to carbon sequestration loss.[155]

The transportation of ornamental fish, often via airfreight, measurably increases the energy emissions of this industry due to the high energy input needed to maintain appropriate conditions during transit. This can be mitigated by decreasing the import of ornamental fish for trade.[156]

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[149] Rodolfo del Río Rodríguez, *Ornamental Fish: Economic, Ecologic and Health Implications of the Trade*, Centro EPOMEX-UAC, available at https://openknowledge.fao.org/server/api/core/bitstreams/b02939ef-3536-4e8e-be33-2524d8452738/content.

[150] Ethical and Ecological Implications of Keeping Fish in Captivity*, supra note 141.*

[151] William Bernard Perry, *The environmental impact of keeping a tropical aquarium in northern Europe,* Journal of Fish Biology 101, no. 4 (2022): 700-701, https://onlinelibrary.wiley.com/doi/epdf/10.1111/jfb.15478

[152] Perry, *supra note* 144, at 700-701

[153] Ke Pan et al., *Nitrogen cycling in a tropical coral reef ecosystem under severe anthropogenic disturbance in summer: Insights from isotopic compositions,* Water Research 197 (2021): 117059, https://www.sciencedirect.com/science/article/abs/pii/S0043135421010186#:~:text=Coral%20reefs%20play%20important%20roles%20in%20marine%20N,on%20a%20global%20scale%20%28Cardini%20et%20al.%2C%202014%29.

[154] Cristina Banks-Leite et al., *Countering the effects of habitat loss, fragmentation, and degradation through habitat restoration,* Science of The Total Environment 730 (2020): 139211, available at https://www.sciencedirect.com/science/article/pii/S2590332220306060

[155] Weiskopf, S.R., Isbell, F., Arce-Plata, M.I. et al. *Biodiversity loss reduces global terrestrial carbon storage.* Nat Commun 15, 4354 (2024). https://www.nature.com/articles/s41467-024-47872-7

[156] Perry, *supra note* 144, at 700-701.

Aeration systems and water pumps can increase local energy use, raising greenhouse gas emissions if powered by fossil fuels. Energy consumption in ornamental fish farming and aquarium keeping leads to significant greenhouse gas emissions.

Water Consumption

Water is an irreplaceable abiotic input for both the culture of ornamental fishes and in aquariums and tanks for housing and display of fish and effective water quality maintenance. Let us look at the yearly water consumption for weekly water changes of 6%–25% for aquariums and tanks, which varies by tank size. On average, for a small tank with a capacity of 50 litres, the water consumption ranges from 156 to 650 litres per year. A medium tank, holding 200 litres, uses between 624 and 2600 litres annually. For a large tank with a capacity of 400 litres, the yearly water consumption ranges from 1248 to 5200 litres.[157] If the water used for aquariums and tanks is from Reverse Osmosis (RO), the consumption and wastage rise significantly. An approximate 5 litres of water is wasted for every litre of water produced using RO technology. This takes the annual rejected RO water produced weekly for water changes of 6%–25%, varying by tank size, to staggering levels. Approximately, by taking the average reject water per litre of water produced using RO as 5 litres, for a small tank with a capacity of 50 litres, the reject water ranges from 780 to 3250 litres per year. A medium tank, holding 200 litres, generates between 3120 and 13,000 litres of rejected water annually. And a large tank with a capacity of 400 litres, the annual rejected water produced is between 6240 and 26,000 litres[158]. This projected use does not include aquaculture, which also places an additional strain on water resources.

This makes water consumption of the sector a particularly crucial factor for India to consider, where groundwater depletion is severe, and many regions are experiencing droughts and water shortages. Major cities such as Delhi and Bangalore are grappling with this crisis already. Recently, the Jal Shakti Ministry confirmed in the Rajya Sabha that India will be in a water stress situation by 2030[159]. A 2020 World Wide Fund report highlighted that 30 Indian cities are

[157] Perry, *supra note* 144, at 700-701.
[158] Perry, *supra note* 144, at 700-701.
[159] *India to be in water stress by 2030, Jal Shakti Ministry confirms in Rajya Sabha response,* The Print, accessed July 26, 2024, https://theprint.in/india/governance/india-to-be-in-water-stress-by-2030-jal-shakti-ministry-confirms-in-rajya-sabha-response/2198303/.

expected to face water scarcity by 2050[160]. This issue could become a key point of focus for ensuring the sustainability of the sector.

Public Health

Reports suggest that individuals exposed to ornamental fish, whether through hobby or work, may face an increased risk of zoonotic infections. Consequently, clinicians recommend exercising caution when handling ornamental fish and aquaria, especially for vulnerable populations.[161]

There are several public health issues associated with this sector, such as zoonotic pathogens, and antimicrobial resistance (AMR).[162]

As the global trade for Ornamental fishes increases, propelled by government policies, investments and incentives, so does the threat of potential zoonotic diseases. The seemingly innocuous hobby of fish keeping, in all its colourful allure, is in reality, a substantial threat to transmission of contact zoonosis for millions of people involved in the trade across the supply chain, bringing the risks and vectors of these zoonotic pathogens from across national and state borders, right into the homes of unknowing and unsuspecting fish hobbyists. There are a variety of zoonotic pathogens in ornamental fishes that can cause illnesses of varying degrees of severity, and in some exceptional cases can also be fatal in humans.[163] Import regulations concerning health and safety for ornamental fish can vary significantly between countries further exacerbating the risk of transboundary spread of disease and zoonosis.[164]

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[160] *WWF identifies 100 cities, including 30 in India, facing severe water risk by 2050*, Down to Earth, accessed July 26, 2024, https://www.downtoearth.org.in/water/wwf-identifies-100-cities-including-30-in-india-facing-severe-water-risk-by-2050-74058.

[161] Weir, M., Rajić, A., Dutil, L., Cernicchiaro, N., Uhland, C., Mercier, B., & Tuševljak, N. *Zoonotic bacteria, antimicrobial use and antimicrobial resistance in ornamental fish: a systematic review of the existing research and survey of aquaculture-allied professionals,* Epidemiology and Infection 140 (2011): 192–206, Cambridge University Press. Available at

https://www.cambridge.org/core/journals/epidemiology-and-infection/article/zoonotic-bacteria-antimicrobial-use-and-antimicrobial-resistance-in-ornamental-fish-a-systematic-review-of-the-existing-research-and-survey-of-aquaculturallied-professionals/C52F5342E0676A7B22D350231BDC9DFB

[162] *Id.*

[163] *Id.*

[164] *Id.*

Routine or improper medication used to control fish diseases, along with inadequate veterinary supervision of exports and imports, are prevalent in the industry exacerbating AMR[165].

The practice of ornamental fish culture also presents significant public health implications, as it can facilitate the transmission of zoonotic diseases to humans and other animals.[166]

The most common pathway for transmission of diseases to humans i.e. zoonosis via ornament fishes is through direct skin contact with fishes, holding water or residues via wounds, cuts, punctures or sores. The handlers of ornamental fishes are most at risk, both in the country of origin and upon importation, including transfer ports where fish bags are refreshed, and in destination countries where live warmwater fish are unpacked for the ornamental fish trade as pets. Additionally, other professionals across the ornamental fish industry supply chain can also be exposed and vulnerable to zoonotic pathogens and diseases for example, inspectors, and to a lesser extent, hobbyists and sometimes recreational fish anglers. These pathogens native to various aquatic environments that cause contact zoonoses have also been linked to disease outbreaks in food fish.[167]

Human infections through ornamental fish are more common in vulnerable populations. These infections have mostly been reported in tropical or subtropical areas and therefore are of more concern to India as tropical fish and aquaria can be possible vectors of disease. Young infants and neonates have been reported to contract infection from ornamental fishes.[168] Additionally, Immunocompromised patients including adults with malignancies, diabetes or hepatobiliary disease are more at risk of contracting these diseases.[169]

Worldwide, the most commonly cited zoonotic pathogen associated with human infections linked to exposure to ornamental fish was *Mycobacterium marinum*. This bacterium has shown various levels of resistance to antibiotics in 11 studies. There were three fatalities recorded as well from this bacteria in immunocompromised patients of varying ages.[170]

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[165] *Id.*
[166] Knight, *supra note* 113.
[167] Rajić, A., Weir, M., Dutil, L., Cernicchiaro, N., Uhland, C., Mercier, B., & Tuševljak, N. *Contact-Zoonotic Bacteria of Warmwater Ornamental and Cultured Fish*, Asian Fisheries Science 33.S1 (2020): 39–45.
[168] Vandepitte, J., Lemmens, P., & De Swert, L. *Human edwardsiellosis traced to ornamental fish*, Journal of Clinical Microbiology 17 (1983): 165–167.
[169] *Contact-Zoonotic Bacteria of Warmwater Ornamental and Cultured Fish, Asian Fisheries Science 33.S1 (2020):39–45)*
[170] Rajić, *supra note* 160.

In India, heightened risks from zoonotic pathogens are worsened by inadequate training, regulatory gaps, and poor enforcement. Warmer water temperatures, typical in subtropical and tropical regions and indoor warmwater aquaculture systems, foster optimal conditions for the growth of contact-zoonotic bacteria (above 25 °C), intensifying public health concerns. There is an urgent need for government action and regulation on public health risks from zoonotic pathogens and antimicrobial resistance (AMR) in ornamental fishes. Educating hobbyists and building the capacity of industry workers and enforcement agencies about these risks, public education campaigns for awareness and preventive measures are the need of the hour. The aspirations of the government to invest and expand this sector for creating jobs and revenue must take into consideration the precautionary approach before there is an outbreak.

V. Regulatory Landscape

The regulatory framework in India, utilizing central, state and international laws, provides for animal and environmental protection through a multi-faceted approach. In India, Fisheries, including ornamental fish, are governed by the State List[171] Therefore, Inland fisheries are entirely managed by state/UT governments. States jurisdiction also extends to the development and regulation of marine fisheries within the 12 nautical mile territorial waters limit. Fishing and fisheries beyond territorial waters are governed by the Union Government[172], therefore the centre holds the responsibility for the management and regulation of marine fisheries in the Exclusive Economic Zone (EEZ), extending from 12 nautical miles up to 200 nautical miles.[173]

Animal welfare; protection of wild animals and birds and forests (environment, biodiversity and wildlife); the prevention and control of the spread of infectious or contagious diseases affecting humans or animals (diseases affecting fish and zoonosis), fall under the Concurrent List,[174] allowing both central and state authorities to regulate this area.

The Constitution of India outlines the duties of citizens and the State through various Fundamental Duties and Directive Principles of State Policy. Notably, it obliges the State to improve public health, nutrition, and the standard of living;[175] Directs the State to organise animal husbandry along modern and scientific lines;[176] tasks the State with the protection and betterment of the environment, forests and wildlife;[177] and calls on citizens to have compassion for all living creatures.[178] These articles in the constitution of India, while not being justiciable, are still valuable because they promote an ecocentric lens towards policy making.

Listed below is a cursory explanation of the various laws applicable to the ornamental fish trade in India. In addition to the regulatory framework detailed, numerous policies, guidelines, action

[171] *Constitution of India* (1950), Seventh Schedule.
[172] *Id.*
[173] *Territorial Waters*, *Continental Shelf, Exclusive Economic Zone and Other Maritime Zones Act*, 1976, § 7.
[174] Supra note 164.
[175] *Constitution of India* (1950), art. 47.
[176] *Constitution of India* (1950), art. 48.
[177] *Constitution of India* (1950), art. 48A.
[178] *Constitution of India* (1950), art. 51A(g).

plans and schemes are implemented by the Department of Fisheries, Government of India. The noteworthy schemes include the Pradhan Mantri Matsya Sampda Yojana (including the National Surveillance Programme on Aquatic Animal Diseases Phase-II), the Blue Revolution scheme, the Fisheries Infrastructure Development Fund (FIDF) and the Kisan Credit Cards scheme. Other significant initiatives include the Sanitary Protocol for Import of Ornamental Fishes, Action Plan for Development of Ornamental Fisheries: 2020 - 2025 and Action Plan for Development of Ornamental Fisheries in India: AquaRainbow Vision - 2030.

A. Central Laws

Laws Relating to Ornamental Fish Welfare

The primary anti-cruelty legislation in India is the Prevention of Cruelty to Animals Act,1960 (*hereinafter "PCA")* which aims to ensure basic welfare and prevent unnecessary suffering of animals.[179] The PCA is applicable to all animals, including fish.[180] Although there are no specific Rules for fish, certain provisions of Rules framed under the PCA like the Pet Shop Rules, the Regulation of Livestock Market Rules, 2017, Transport of Animals Rules, 1978 are also applicable.

The Act and the rules framed thereunder unfortunately do not prescribe any fish-specific minimum standards enabling ambiguity in implementation and leading to the suffering of millions of fish.

Furthermore, Indian criminal law such as the Bharatiya Nyaya Sanhita, 2023, read with the procedural law Bharatiya Nagarik Suraksha Sanhita, 2023, contains provisions[181] that can be applied for mischievous killing and maiming or wanton cruelty to ornamental fishes, depending on the facts of a case.

Laws Relating to Protecting Wildlife and Biodiversity

The ornamental fish trade has grave sustainability concerns as discussed in the previous section of this paper. As a result, some of the laws relating to the conservation of wildlife, natural

[179] *Prevention of Cruelty to Animals Act*, *1960*, Preamble.
[180] *Prevention of Cruelty to Animals Act,* 1960, § 2.
[181] Bharatiya Nyaya Sanhita, § 325 (2023) (India) (Mischief by killing or maiming animal).

ecosystems and biodiversity also apply to the ornamental fish sector. The government has made some attempts to address sector-specific environmental concerns like the ban on cyanide fishing.

Although there are some laws applicable, they are not comprehensive enough to adequately target the issue. The primary central legislations applicable are the Biological Diversity Act, of 2002[182] and the Wildlife Protection Act, of 1972 as amended in 2022.[183]

The Biological Diversity Act, 2002 along with its amendments and the Biological Diversity Rules, 2004, is aimed at preserving biological diversity, ensuring sustainable use of its components, and fair sharing of consequent benefits. The Act establishes the National Biodiversity Authority (NBA), State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) at the local level to implement its provisions. The Act also addresses access to biological resources and associated traditional knowledge, requiring prior approval for commercial use and research.

The Centre for Biodiversity Policy and Law (CEBPOL), established within the NBA in 2013, a collaborative program between India and Norway, aims to develop expertise in biodiversity policies and laws and enhance stakeholder capacity. CEBPOL focuses on various thematic areas, including mainstreaming biodiversity, Nature Index, Access and Benefit Sharing, Multilateral Environment Agreements, Invasive Alien Species, and Capacity Building. Since the Central government addresses national and international biodiversity policy needs whilst ensuring effective rule-making and implementation, NBA and CEBPOL can be worked with to implement some targets from the United Nations Convention on Biological Diversity (CBD) to which India is a signatory.

For example, the NBA as a statutory body, can advise the central government to notify threatened (over-fished) species or habitats. Another engagement avenue is towards the study and inclusion of more Invasive Alien Species (IAS). Drawing from the example of the African catfish, many other fish species need to be earmarked and prioritised for effective population control and enforce preventative measures against their introduction and establishment.

[182] *Biological Diversity Act, 2002*, Act No. 18 of 2003.
[183] *Wildlife Protection Act, 1972,* Act No. 53 of 1972

The Wild Life (Protection) Act, of 1972, along with its amendments also play an important role in addressing some of the negative externalities of the ornamental fish trade. Some ornamental fish are protected species listed[184] under the act which prohibits their hunting and trade. It also addresses the management of invasive species by including specific provisions[185] to regulate and control the introduction and spread of alien species in India through the National Board for Wildlife. The Act aims to conserve fish species by regulating and monitoring their exploitation, ensuring sustainable use, and preventing overfishing, invasive species and habitat destruction.

The Environment Protection Act, 1986 (EPA) was enacted in furtherance of the decisions taken at the United Nations Conference on the Human Environment held in Stockholm in June 1972 (Stockholm Conference, 1972) to protect and improve the environment.

The Coastal Regulation Zone notification was first issued under the EPA in 1991, followed by various amendments.[186] Superseding previous versions, the 2019 notification declares specified stretches of coastal land as Coastal Regulation Zones (CRZs) across 4 categories. The setting up of new industrial activities and expansion of existing operations is prohibited across all CRZs. This includes fish processing units and the disposal of plastic waste into the ocean to further safeguard aquatic life. Exceptions to prohibited activities and regulation of permissible processes such as fishing are given under specific CRZ categories.[187] The notification also provides for the regulation of marine and brackish water fish-rearing units, in addition to the policies of the Coastal Aquaculture Authority.

Mangroves and coral reefs are important habitats for wild fish and invertebrates, providing ecosystems for feeding, spawning, shelter etc. The notification declares them to be Ecologically Sensitive Areas (ESAs) under CRZ-I. It states the need to conserve mangroves in the management[188] of Critically Vulnerable Coastal Areas. Declared mangroves are further protected under the Forest (Conservation) Act, 1980 and undeclared ones by the concerned State

[184] *Wildlife Protection Act, 1972,* Schedule I-IV (India).
[185] *Wildlife Protection Act, 2022*, § 62A (India).
[186] *Coastal Regulation Zone Notification,* available at https://environmentclearance.nic.in/report/Crz_notificationPage.aspx?CRZ=B.
[187] *Coastal Regulation Zone Notification, 2019*, Ministry of Environment, Forest and Climate Change, Government of India.
[188] *Coastal Regulation Zone Notification, 2019,* § 10.

Government/Union Territory.[189] The destruction of corals and coral reefs is prohibited and other activities are regulated as given in the notification.[190] This is crucial for the prevention of destructive practices such as the use of explosives or cyanide and other poisonous compounds which harm mangroves, corals and others within the coastal aquatic ecosystem.

Aquaculture as discussed earlier falls under the subject matter of the state. This has led to vast discrepancies in the efficacy of regulation frameworks with some states having no regulation at all. In 2011, The Marine Products Export Development Authority (MPEDA) constituted a "Task Force" to develop the Guidelines for Green Certification of Freshwater Ornamental Fish,[191] the only certification of its kind in India. The initiative aims for the conservation and sustainable development of the freshwater ornamental fish sector, covering collection, farming, and marketing through a certified value chain system. The Certification was proposed to be introduced voluntarily in phases, with mandatory certification for wild-caught native ornamental fish after a three-year transition period. It includes missions such as raising societal awareness, promoting ecosystem management, reducing wild stock dependency through captive breeding, establishing protected areas, adopting eco-friendly practices, preventing the release of farmed species into natural water bodies, and maintaining proper documentation at all stages. However, through an RTI,[192] it was gathered that these guidelines have not been implemented since 2011 and not a single Green Certificate for freshwater ornamental fishes has been issued by MPEDA to date.

Laws Relating to Disease Transmission in the Ornamental Fish Sector

Zoonotic outbreaks that can affect local populations and ecosystems are a risk to the ornamental fish trade therefore certain laws that aim to prevent the spread and occurrence of zoonotic diseases are also applicable to the ornamental fish trade.

The Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009 (*hereinafter* "PCICDA, 2009") mandates the identification, prevention, and control of infectious and contagious diseases among animals, including provisions for aquatic animals.

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[189] *Coastal Regulation Zone Notification, 2019,* Annexure - I, Clause 1.1.
[190] *Coastal Regulation Zone Notification, 2019,* Annexure - I, Clause 1.2.
[191] Silas, E.G., Ramachandran, Alappat, et al., *Guidelines for Green Certification of Freshwater Ornamental Fish* (2011).
[192] Ref. ADMN-GEN/RTI(RPLY)/1/2023-ADMN dated 12.06.2024.

The PCICDA, 2009 requires the reporting of disease outbreaks, allows for quarantine and isolation of infected animals, and mandates treatment and vaccination protocols. The Act empowers authorities to enforce these measures and establish disease-free zones to prevent the spread of diseases, thereby protecting aquatic animal health and ensuring biosecurity in aquaculture. The Act includes a schedule that lists specific fish diseases that are subject to the prescribed control measures.

The Livestock Importation Act, 1898 focuses on the importation of livestock and preventing the introduction of infectious diseases. It specifically grants the central government various powers to regulate, restrict or prohibit the importation of livestock, including aquatic animals such as live fish, live crustaceans and molluscs. The Centre has exercised these powers in matters affecting ornamental fish imports vis-à-vis Sanitary Import Permits, Procedure for Import of Live Animals into India, Pre-import Requirements for the Importation of live stock, Post-Import Requirements for the Quarantining of live stock etc.

B. State Laws

Fisheries is a State subject under the 7th Schedule of the Constitution of India[193]. Inland fisheries are entirely managed by state/UT governments that also develop and regulate marine fisheries within the 12 nautical mile territorial limit.

However, the lack of consistency in policies and regulations across states presents significant challenges. Different states, through their respective state fisheries departments, have varying levels of regulatory frameworks and enforcement, leading to disparities in the development of fisheries and aquaculture and their sustainable management. Inconsistencies can result in overfishing in some areas, and fluctuating impacts on biodiversity, aquatic ecosystems and the environment. Additionally, an inconsistent approach complicates efforts to address issues such as illegal fishing, habitat destruction, and the introduction of invasive species.

[193] Article 246 lays down the subject-matter of laws made by the Parliament and the State Legislatures. This subject-matter is allocated into three lists contained in the Seventh Schedule, In the Concurrent List, both the Centre and the States have the power to legislate on Item 17 and Item 17B

The fragmented regulatory landscape makes it challenging to monitor and control the spread of diseases in aquaculture, ensure food safety standards, and manage the use of antibiotics and other chemicals. These divergences necessitate a more coordinated, reconciled and holistic approach, with the central government playing a more active role in standardizing policies to ensure alignment with national objectives of environmental protection, sustainability, food safety, public health and animal welfare, all of which fall within the purview of the Union government. Enhanced harmony and uniformity in policies will help in mitigating risks and ensuring the long-term sustainability of the industry across India.

An example of this discrepancy is best highlighted by comparing the state regulatory frameworks of Andhra Pradesh and Madhya Pradesh, two states currently growing their aquaculture production.

Andhra Pradesh, the top aquaculture producer, has a robust and detailed regulatory regime that governs aquaculture and fisheries The Andhra Pradesh State Aquaculture Development Authority Act, 2020 (APSADA Act) and Rules; Andhra Pradesh Fish Seed (Quality Control) Act, 2006 and Rules; and Andhra Pradesh Fish Feed (Quality Control) Act, 2020 and Rules play a crucial role in regulating the aquaculture sector in Andhra Pradesh. Additionally, the State Fisheries Department has issued several Government Orders (G.Os)[194] that govern the aquaculture and fisheries supply chain. This legal framework covers registration and licensing of all aquaculture farms; mitigation of environmental impact; disease management; financial assistance; insurance schemes; development of infrastructure; monitoring and surveillance; inspection and testing; capacity building; market access; record keeping; consumer protection and imposition of penalties for non-compliance. However, enforcement is still poor and issues such as water pollution and over-extraction of water resources are prevalent. Farmer awareness is low and consistent quality control standards and procedures need to be enhanced.

Madhya Pradesh, in contrast, is an emerging player in the sector and lacks comprehensive

[194] G.O.MS. No. 20, dated November 27, 2014 (India); G.O.MS. No. 16, dated April 20, 2018 (India) and G.O.MS. No. 7, dated March 16, 2013 (India). [operational to the extent of the provisions not covered under the APSADA Act]

policies for aquaculture. The state does not have any legislation focused on aquaculture and only regulates fishing through licensing.[195] There is a need for states like Madhya Pradesh to develop comprehensive policies and enact future-proof laws to ensure the growth of fisheries and especially aquaculture is balanced with environmental sustainability, public health and animal welfare.

C. International Laws

India is a signatory to two international agreements and part of a membership union, which play a role in the enforcement of animal and environmental protection for ornamental fish in India by preventing unsustainable animal trade. Furthermore, due to the environmental and public health aspects intertwined with the ornamental fish trade, it greatly affects various Sustainable Development Goals adopted by the United Nations, which India is committed to advancing, thus placing an obligation to enact supporting laws and policies.

The United Nations is the world's largest international organization, made up of 193 Member States, and provides a common platform for nations across the world to solve global issues and work towards international well-being and prosperity.[196] Adopted by the United Nations in 2015, the Sustainable Development Goals (SDGs) represent a vision for a sustainable future.[197]
Of the 17 SDGs, those that are of direct significance to this project are Responsible Consumption and Production (SDG 12), Life Below Water (SDG 14) and Life on Land (SDG 15). These goals address the mindful use of resources, conservation of biodiversity, and protection of the ocean and all aquatic life. However, in stark contrast to most other goals, there are no financial resources allocated for SDG 14 in India, highlighting a disconcerting gap that needs urgent intervention considering India's standing in global fish consumption and trade.[198]
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a global pact designed to ensure the sustainable trade of endangered animals and plants, regulating only those species listed in its appendices. Being listed under CITES is a crucial step,

[195] *Madhya Pradesh Fisheries Act* (India).
[196] United Nations, About Us, https://www.un.org/en/about-us.
[197] United Nations, *Sustainable Development Goals*, https://www.un.org/sustainabledevelopment/sustainable-development-goals/.
[198] United Nations, *Sustainable Development Goals - India*, https://india.un.org/en/sdgs.

as it mandates thorough data collection and requires non-detriment findings to ensure that trade does not harm these species. If sustainability is ever in doubt, a significant trade review is conducted to safeguard their survival, applying equally to captive-bred or captive-reared species.[199] Despite this measure, challenges persist. In India, the lack of strong regulatory mechanisms at the central level, such as the strengthening of the National Biodiversity Authority, hinders effective management. The National Biodiversity Strategy and Action Plan of 2014 offered numerous recommendations for managing invasive alien species, emphasising the integration of *in situ* and *ex-situ* conservation, and the sustainable use of natural resources. However, these recommendations remain largely unimplemented, because we lack a national mechanism to foresee and enforce them. India needs a more comprehensive policy to prohibit the introduction of invasive alien fish species.

The Convention on Biological Diversity, 1992 was ratified by India in 1994.[200] The CBD is dedicated to promoting sustainable development. It was conceived as a practical tool to help translate the principles of Agenda 21[201] into reality.[202] This significantly impacts ornamental fishes by encouraging practices that do not harm wild populations and ensures that collection methods are ecologically sustainable. It emphasizes the protection of aquatic ecosystems such as rivers, lakes and coral reefs, which are critical habitats for many ornamental fish species. The convention supports the regulation of trade in ornamental fishes to prevent over-exploitation, including monitoring and controlling the international trade of species listed under CITES. Furthermore, it promotes the conservation of genetic resources, through captive breeding programs, and gene banks. It addresses the threat of invasive species, to protect native fish populations.[203]

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[199] *Monica V. Biondo & Rainer*, supra note 123.

[200] Convention on Biological Diversity, *List of Parties,* https://www.cbd.int/information/parties.shtml.
[201] United Nations, *Agenda 21*, 15.1, https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf.
[202] Convention on Biological Diversity, *Convention*, https://www.cbd.int/convention.
[203]Convention on Biological Diversity, *India's National Biodiversity Action Plan*, 24, https://www.cbd.int/doc/world/in/in-nbsap-v3-en.pdf

VI. Institutions, Authorities and Regulatory Bodies

Various bodies are responsible for regulating and monitoring the ornamental fish sector in India both at the Central and State levels. Unfortunately, most of these bodies are falling short of their obligations towards fish, particularly ornamental fish and the sector remains largely unregulated and unmonitored.

There are various ministries, departments and authorities that oversee and specifically regulate the import and export of live ornamental fish in India. They include the Department of Fisheries under the Ministry of Fisheries, Animals Husbandry and Dairying; MPEDA and the Export Inspection Council (EIC). The Directorate General of Foreign Trade (DGFT) under the Ministry of Commerce and Industry also has powers to regulate international trade through various policies, approvals, registration and licences and also have import protocols, certificates and permits to be complied with, in addition to voluntary certifications like the *Green Certification of Freshwater Ornamental Fishes*. The Department of Revenue, under the Ministry of Finance, deals with the taxation for such trade.

1. Department of Fisheries, Government of India

The Indian Government, through the central Department of Fisheries, governs and regulates marine fishing and fisheries in the Exclusive Economic Zone (EEZ), which extends beyond the 12 nautical mile territorial water limit up to 200 nautical miles. Because fisheries is a state subject, it offers model Acts and policy guidelines[204] for states to use as templates within their jurisdictions. Additionally, it enhances the efforts of States and Union Territories (UTs) by implementing various schemes[205], action plans[206] and programs[207] dedicated to the advancement of fisheries and aquaculture on a national scale.

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[204] Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, *Guidelines for the States for framing a bill on inland fisheries and Aquaculture*, available at https://dof.gov.in/sites/default/files/2020-01/Guidelines%20for%20the%20States%20for%20framing%20a%20bill%20on%20inland%20fishereis%20and%20Aquacul%20ture%20%201.pdf.

[205] Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, *Schemes*, https://pmmsy.dof.gov.in/

[206] Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, *National Surveillance Programme on Aquatic Animal Diseases (NSPAAD) Phase-II*, https://pib.gov.in/PressReleasePage.aspx?PRID=1909226

[207] Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, *Action Plan for Development of Ornamental Fisheries: 2020 – 2025*, https://dof.gov.in/sites/default/files/2020-07/Ornamental_fisheries_development_under_PMMSY.pdf

2. The Coastal Aquaculture Authority (CAA)

Established under the Coastal Aquaculture Authority Act, of 2005 which aims to specifically regulate coastal aquaculture, the CAA oversees and regulates activities, ensuring they do not harm coastal environments or communities, and safeguarding against over-exploitation. The framework includes provisions for registering and licensing aquaculture farms, setting construction and operation standards, monitoring environmental impacts, guidelines and promoting sustainable practices to protect coastal ecosystems and biodiversity. This may apply to ornamental fish production units in coastal areas.

3. The Animal Welfare Board of India (AWBI)

The AWBI is a central statutory and advisory body established in 1962 under The Prevention of Cruelty to Animals Act, 1960.[208] The AWBI plays a critical role in ensuring compliance with animal welfare laws, providing grants to animal welfare organisations, and advising the government on related issues. It has issued several circulars, guidelines and advisories related to the welfare of terrestrial animals. However, the AWBI has not yet stated its position on the welfare of fish which is a disappointing and unacceptable oversight[209].

4. The National Fisheries Development Board (NFDB)

It is a key stakeholder and an autonomous body under the Department of Fisheries, Ministry of Fisheries, Animal Husbandry, and Dairying, Government of India. Its primary mission is to enhance fish production and productivity across the country, ensuring development in an integrated and holistic manner. The NFBD employs modern tools and techniques, training programs and funds for fish farmers in inland and marine ornamental fish culture, financial and other assistance provided to colleges and women's Self Help Groups/cooperatives etc. to support the sector, along with a 50% subsidy for ornamental fish breeding and culture farm establishment[210] for eligible beneficiaries The NFDB published basic guidelines for the stocking of ornamental fish in aquaria in their 2015 newsletter.[211]

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[208] *Prevention of Cruelty to Animals Act,* 1960, § 4 (India).
[209] RTI AWBIC/R/E/24/00076 (2024).
[210] https://cifa.nic.in/sites/default/files/Ornamental_fish.pdf
[211] National Fisheries Development Board, *NFDB Newsletter*, April-June 2015, https://nfdb.gov.in/PDF/NEWSLETTERS/7_NFDB%20Newsletter_April-June2015.pdf

5. The Marine Products Export Development Authority (MPEDA)

Established under the Marine Products Export Development Authority Act, MPEDA prescribes regulations and is also responsible for inspecting marine products and raw materials, setting standards and specifications, providing training, and undertaking all necessary steps for marketing overseas. It regulates the export of Indian ornamental fish by ensuring quality, sustainability, and compliance with standards in facilities for breeding, rearing, handling & packing live fish. It conducts capacity-building programmes for farmers and registers breeding units and exporters. Additionally, it sets general conditions that live ornamental fish handling centres are to comply with, along with a provision for the survivability and health of live fish, during storage and transport, record keeping and basic biosecurity.[212]

The Rajiv Gandhi Centre for Aquaculture (RGCA) is the research and development arm of MPEDA and focuses on building and sharing technological knowledge to develop a sustainable, world-class aquaculture infrastructure in India. RGCA undertakes the execution of projects handed over by various government agencies. It also conducts numerous seminars and workshops to engage with multiple stakeholders and impart training on the latest scientific advances in the field, including ones specifically focused on aquariums and ornamental fish held in 2013, 2015, 2017 and 2019[213].

6. The National Bureau of Fish Genetic Resources (NBFGR)

An institute under the Indian Council of Agricultural Research (ICAR), the NBFGR has a mandate for database development, genotyping, registration of aquatic germplasm, gene banking and evaluation of endangered and exotic fish species along with capacity building in terms of expertise and necessary infrastructure. Recently, the NBFGR has carried out various activities to strengthen the ornamental fish sector including the establishment of live germplasm resource centres, research to upscale breeding and larval rearing techniques of commercially important

[212] Marine Products Export Development Authority, *Guidelines for Registration of Ornamental Fish Handling Centre*, https://mpeda.gov.in/wpcontent/uploads/2023/08/Guidelines_for_registration_of_Ornamental_Fish_Handling_Centre.pdf.

[213] Rajiv Gandhi Centre for Aquaculture, *Seminars & Workshops*, https://v2.rgca.co.in/f_semin.php

endemic ornamental fishes,[214] investigation of disease outbreaks and the development of vaccines and diagnostic kits.[215] In furtherance of capacity building and awareness efforts, the NBFGR provided training,[216] seeds/fishes, and technology transfers to farmers for breeding and rearing, constructed ornamental fish-rearing units for beneficiaries, created a marine ornamental village in the state of Maharashtra, enhanced resources for sustainable livelihood generation, etc. It also developed draft versions of a National Strategic Plan for Aquatic Exotics and Quarantine as well as Aquatic Exotics and Quarantine Guidelines.[217]

Additionally, ICAR has several institutes dedicated to fisheries and aquaculture research, education, capacity building and technology dissemination - Central Institute of Fisheries Education (CIFE), Central Marine Fisheries Research Institute (CMFRI), Central Institute of Freshwater Aquaculture (CIFA), Central Institute of Brackishwater Aquaculture (CIBA), Central Inland Fisheries Research Institute (CIFRI), Directorate of Coldwater Fisheries Research (DCFR), and Central Institute of Fisheries Technology (CIFT).

CIFA conducts research for the breeding, standardization and commercialisation of Indigenous ornamental fish; one of its notable projects involved successful technology development for captive breeding of the endangered ornamental fish *Dawkinsia tamraparnii*[218]. Apart from conducting regular training for farmers and entrepreneurs on ornamental fish production, CIFA has developed CIFACURE, a medicine for controlling bacterial and fungal diseases which can be used for ornamental fish[219]. The institute recently launched 'Rangeen Machhli', a multilingual mobile app for connecting various stakeholders in the sector, promoting trade and to provide resources and training via the app[220].

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[214] National Bureau of Fish Genetic Resources, *Annual Report 2022*, 26, https://www.nbfgr.res.in/site/writereaddata/siteContent/NBFGR-%20AR-2022%20WEB.pdf

[215] National Bureau of Fish Genetic Resources, *Salient Achievements*, https://www.nbfgr.res.in/en/page/salient-achievements

[216] National Bureau of Fish Genetic Resources, *Corrigendum*, https://www.nbfgr.res.in/site/writereaddata/UploadNews/corrigendum/pdf/C_202402260842296374.pdf

[217] National Bureau of Fish Genetic Resources, *Fish Health Management*, https://www.nbfgr.res.in/en/page/fish-health-management1

[218] https://cifa.nic.in/sites/default/files/Ornamental_fish.pdf

[219] https://cifa.nic.in/sites/default/files/Ornamental_fish.pdf

[220] https://www.outlookbusiness.com/news/icar-cifa-launches-mobile-app-rangeen-machhli-to-promote-ornamental-fishery

CMFRI is focused on developing captive breeding technologies for marine ornamental fish to combat overfishing, and unsustainable fishing practices and protect coral reefs. As of 2023, the institute had developed hatchery technology for about twenty-seven marine ornamental fish species[221]; the institute sells these seeds through a Single Window System and operates two seed counters at its marine hatcheries in Mandapam and Cochin. The institute has various publications on marine ornamental fish production and development including a *Marine Ornamental Fish Culture - Package of Practices*[222] and *Handbook on Marine Ornamental Fish Seed Production*[223]. It also conducts training for building the capacity of entrepreneurs along with organizing exhibitions, student awareness camps, awareness programs, and exhibits on marine aquaria species and research[224].

7. The Bureau of Indian Standards (BIS)

It is the national standards authority for India and plays a crucial role in standardising practices within the fisheries and aquaculture sectors in India, ensuring the quality, safety, traceability, and sustainability of fishery products and aquaculture operations and also provides certifications for Good Aquaculture Practices.[225] The scope of BIS extends to fish feed and feed ingredients, establishing standardised terminology, technical specifications for equipment and their operation, characterization of aquaculture sites, and maintenance of appropriate physical, chemical, and biological conditions. It also encompasses environmental monitoring, data reporting, traceability, waste disposal, transport codes and the development of physical, chemical, microbiological, and organoleptic methods of testing. Through its Fish, Fisheries, and Aquaculture Sectional Committee under the Food and Agriculture Department, BIS has published some standards specific to ornamental fish, for example, IS 10449: 2024 Freshwater Fish Seed and Ornamental Fish Code for Transport.

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[221] K. Madhu, Rema Madhu, Abhilash K. S., Mrudhula Mohan K. & N. H. Harikrishna, *Marine Ornamental Fish Culture: Means for Economic Growth*

[222] https://eprints.cmfri.org.in/8395/1/CMFRI%20SP%20101.pdf

[223] https://eprints.cmfri.org.in/13882/1/Hand%20book%20on%20Marine%20Ornamental%20Fish%20Production_2019_Mandapam.pdf

[224] https://eprints.cmfri.org.in/17849/1/AARDO_2023_Madhu%20K.pdf

[225] Bureau of Indian Standards, *Indian Standards on Dairy Animal Husbandry*, https://www.bis.gov.in/wp-content/uploads/2021/09/Indian-Standards-on-Dairy-Animal-Husbandry.pdf.

8. Ornamental Fisheries Training and Research Institute (OFTRI)

Unlike the other institutions and authorities in this list that are part of the government, OFTRI is a private institution that serves as a nodal skill development centre and works towards the promotion of skilled ornamental fishkeeping. It is a Project Monitoring Unit as recognised by the National Fisheries Development Board and hence oversees development projects across the country. OFTRI undertakes research projects such as the breeding of native species, market surveys, colour enhancement etc., and assists entrepreneurs by suggesting business models, preparing Detailed Project Reports for government funding and networking with groups that have similar business interests.[226]

International Bodies

There are a few private and intergovernmental organisations and institutions working on the welfare and sustainability implications of the ornamental fish trade. Despite this, a large portion of this trade remains unregulated and ineffectively monitored. Some of the international bodies that do work on ornamental fish welfare are listed below and their work on this subject matter can serve to inform Indian policymakers on how to navigate some of the concerns associated with ornamental fish.

1. The World Organisation for Animal Health (WOAH)

WOAH is an intergovernmental organization established in 1924, of which India is a member country. WOAH through its Aquatic Animal Health Code[227] and The Manual of Diagnostic Tests for Aquatic Animals,[228] establishes international standards for improving the health, welfare, and biosecurity of aquatic animals and advocates the use of 'handling methods appropriate to the biological characteristics of the fish and a suitable environment to fulfil their needs'. Although it excludes ornamental species in the Aquatic Code, general safeguards can be leveraged for ornamental fishes, e.g. recommendations related to transport, disease and health management. The epizootic list of diseases requiring notification includes several pathologies affecting fish.

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[226] Ornamental Fisheries Training and Research Institute, *Oftri.org* (2023), https://www.oftri.org/.

[227] World Organisation for Animal Health, *OIE Aquatic Animal Health Code*, https://rr-europe.woah.org/app/uploads/2020/08/oie-aqua-code_2019_en.pdf

[228] World Organisation for Animal Health, *Codes and Manuals*, https://www.woah.org/en/what-we-do/standards/codes-and-manuals/aquatic-manual-online-access/

2. The International Union for Conservation of Nature (IUCN)

The International Union for Conservation of Nature is a membership union of government and non-government organisations working towards sustainable development and bridging the gap between government bodies and civil society. It is a global authority on biodiversity conservation and influences policy-making across the world. India is a part of this international union.

IUCN maintains a database on the extinction risk status of flora and fauna in its Red List of Threatened Species, which is used by government and non-government organizations across the globe.[229] It includes several ornamental fish species such as the Emperor Angelfish,[230] Sucker Barb,[231] Red Line Torpedo Barb,[232] Redtail Sharkminnow,[233] etc. and other aquatic life commonly used in the aquarium trade like the Axolotl.[234] Compiled based on current scientific research, the Red List classifies extinction risk across various categories – Least Concern, Near Threatened, Critically Endangered, etc. 'Data Deficient' is another category that taxa are placed in when there is a lack of information regarding their distribution and/or population, thereby preventing them from being classified as threatened.[235] This is crucial in light of the general inadequacy of data collection throughout the ornamental fish trade, enabling authorities to acknowledge the knowledge gap as well as the possibility of extinction risk upon completion of the required research.

Other important specialist groups among IUCN Species Survival Commissions are the Freshwater Fish Specialist Group (FFSG), the Marine Fishes Red List Authority (MFRLA) and the Invasive Species Specialist Group. FFSG assists the IUCN Freshwater Biodiversity Unit in

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[229] International Union for Conservation of Nature, *The IUCN Red List of Threatened Species,* https://www.iucnredlist.org/about/background-history
[230] International Union for Conservation of Nature, *Pomacanthus imperator (Emperor Angelfish)*, https://www.iucnredlist.org/species/165862/6151184
[231] International Union for Conservation of Nature, *Puntius snyderi (Sucker Barb)*, https://www.iucnredlist.org/species/181277/1716358
[232] International Union for Conservation of Nature, *Puntius denisonii (Red Line Torpedo Barb)*, https://www.iucnredlist.org/species/169662/70082469
[233] International Union for Conservation of Nature, *Epalzeorhynchos bicolor (Redtail Sharkminnow)*, https://www.iucnredlist.org/species/7807/12852157
[234] International Union for Conservation of Nature, *Axolotl*, https://www.iucnredlist.org/species/1095/53947343
[235] International Union for Conservation of Nature, *IUCN Red List Categories and Criteria,* Chapter IV, https://portals.iucn.org/library/sites/library/files/documents/RL-2001-001-2nd.pdf.

completing Red List assessments for all freshwater fishes[236] whereas MFRLA does the same for all marine fishes as stated in its mission.[237]

IUCN works closely with the Convention on Biological Diversity, providing technical assistance and sharing knowledge products such as the Red List of Threatened Species, providing data to better inform goals and policies proposed by the CBD and strengthen overall implementation of the Convention.[238]

3. The Food and Agriculture Organization (FAO)

The Food and Agriculture Organization of the United Nations can play a crucial role in the ornamental fish sector by promoting sustainable practices and providing guidelines for the industry. It has various publications on marine and freshwater ornamental fish, ornamental fish trade and production, and some country-specific reports like the Production And Commerce Of Ornamental Fish: Technical-Managerial And Legislative Aspects, Globefish Research Programme, Vol. 102. Rome, FAO 2010[239] which presents an overview of production, trade and markets for ornamental fish species.

The FAO has also conducted seminars and conferences such as the International Ornamental Fish Trade and Technical Conference and the Technical Seminars, 2021 on Risk of AMR Development and Pathogen Transfer in Global Transport of Ornamental Fish.[240]

The FAO's One Health initiative recognises the interconnectedness of human animals and environmental health. It aims to use science, and research informing biosafety, preparedness and response to deal with emerging pandemics, zoonotic diseases and infections in animals and humans. India has a One Health policy framework which can facilitate better standards for the

[236] International Union for Conservation of Nature, *IUCN SSC Freshwater Fish Specialist Group Report 2023*, https://www.iucn.org/sites/default/files/2024-07/2023-iucn-ssc-freshwater-fishes-sg-report_publication.pdf.
[237] International Union for Conservation of Nature, *IUCN SSC Marine Fish Red List Authority,* https://www.iucn.org/our-union/commissions/group/iucn-ssc-marine-fishes-red-list-authority.
[238] International Union for Conservation of Nature, *UN Convention on Biological Diversity (CBD)*, https://www.iucn.org/our-work/informing-policy/international-policy/un-convention-biological-diversity-cbd
[239] Food and Agriculture Organization, The Ornamental Fish Trade, https://openknowledge.fao.org/server/api/core/bitstreams/b02939ef-3536-4e8e-be33-2524d8452738/content
[240] Food and Agriculture Organization, *Antimicrobial Resistance in Aquaculture*, https://www.fao.org/fileadmin/user_upload/faoweb/FI/news/AMR_in_aquaculture/12.pdf

import, export, and domestic trade of ornamental fish and ensure that fish health standards are met across the supply chain.

4. World Aquatic Veterinary Medical Association (WAVMA)

WAVMA has instrumentally advanced aquatic veterinary medicine on a global scale by fostering inter-organisational interactions, developing and disseminating knowledge of the science and ethics within the profession and supporting members across various countries. WAVMA collaborates with numerous veterinary and non-veterinary organisations worldwide, including the World Organisation for Animal Health (WOAH) and the Food and Agriculture Organization (FAO) to promote various aspects of aquatic veterinary medicine among both veterinarians and external stakeholders.[241]

5. Ornamental Fish International (OFI)

OFI is the leading trade association representing the ornamental fish industry with members from over 30 countries, including major exporting and importing nations. OFI actively lobbies on behalf of the industry in significant forums, including the European Union (EU) arena and CITES and with various governments and regulatory authorities worldwide, advocating for policies that facilitate industrial activities.[242]

VII Recommendations: The Way Forward

To address concerns in the ornamental fish sector, which is growing at a rapid pace, immediate and intersectional interventions need to be implemented. Some of these interventions are listed below.

(1) Research on Indian Ornamental Fish

Data forms the foundation for understanding any sector, especially when required to draw inferences from it. The most significant challenge ornamental fish trade, encompassing both national and international markets, faces is the lack of comprehensive, up-to-date data. India, categorically has a dearth of studies on this trade, with existing research either outdated or

[241] World Aquatic Veterinary Medical Association, WAVMA (2024), https://www.wavma.org/.
[242] Ornamental Fish International, *OFI* (2023), https://www.ofish.org/.

predominantly focused on the Northeast region, which though renowned for its rich biodiversity of freshwater ornamental fish, only paints a part of the picture. This scarcity of reliable data hampers the ability of stakeholders, including policymakers, industry participants, and conservationists, to develop effective strategies and policies for the sustainable management of this sector. We suggest a three-fold solution to this issue:

I. Conduct studies that assess not only the welfare of ornamental fish but also the impact of the sector's common practices at all stages of the trade cycle.

II. Specifically conducting research addressing sustainability concerns in this sector particularly the environmental impact of the current trade cycle. This research will help guide the adoption of best practices that protect local ecosystems and promote responsible sourcing thereby reducing the ecological footprint of the industry.

III. Developing a detailed database of Indian ornamental fish species, including information on their sourcing,[243] trading, and species-specific characteristics, is essential. This resource would serve as a critical tool for stakeholders, offering data on the most commonly traded, captured, and cultured species in India. It would also support conservation efforts by identifying species at risk of overexploitation and invasive species.

(2) Encouraging a Positive and Comprehensive Regulatory Framework

Law and policy interventions are essential to ensure the welfare of fish, public health, and the protection of the environment and biodiversity. To address these issues effectively, comprehensive regulations need to be formulated, covering all aspects of aquaculture and fishing of ornamental species, from wild-capture or breeding to trade, display and as pets.

I. Developing a comprehensive regulatory framework to address fish welfare, requires the law to consider multiple factors. Some of the facets of this framework are:

[243] S. K. Singh et al., *Ornamental Fisheries in Northeast India: State of the Art and Future Directions, ResearchGate (2023)*, https://www.researchgate.net/publication/371043572_Ornamental_fisheries_in_Northeast_India_State_of_the_art_and_future_directions.

A. Ensure minimum standards for fish welfare are defined, that take into consideration that the conditions in which they are reared, cultured, transported and kept need to be regulated.
B. Government authorities to develop SOPs must collaborate with academic institutions, research bodies, and industry experts for the maintenance and welfare of ornamental fish. These SOPs should be species-specific, offering guidelines on optimal conditions for handling, transport, and care.
C. Policies for central and state monitoring and tracking must be established to ensure environmental and socio-economic sustainability of the sector for activities such as illegal fishing and trade along with overfishing; licensing and registration of aquaculture and fisheries and mandatory environmental clearances.
D. Preparation of a priority list of exotic fish species with the potential to become invasive in the future and strengthening implementation of the Biological Diversity Act, 2002 which prohibits the import of such species into India is imperative to address the negative externalities of the ornamental fish sector.

II. Enforcement of the current regulatory framework.

A. Strict enforcement of the current laws and regulations is imperative. In furtherance of the same, sensitisation workshops can be carried out for enforcement agencies to take cognizance of cruelty to aquatic animals, at rearing units, pet shops, public aquariums and shows.
B. Ornamental fish are covered under the Prevention of Cruelty to Animals Act, 1960, yet very little is done to extend its implementation to them. Additionally, the fines under this Act are dismally low, compared to the implications of the violations.

III. Regulation by the Central Pollution Control Board (CPCB)

A. Include ornamental fish-rearing units within existing consent mechanisms, i.e., CTE (Consent to Establish) and CTO (Consent to Operate), and issue a public notice for the same.
B. Issuance of sector-specific guidelines similar to Effluent Standards and Guidelines; Waste Management Guidelines; Air Quality Management; Water

Quality Management; Sustainable Practices and Compliance; Monitoring and Reporting.

C. The imposition of Environmental Compensation must be thrust upon anyone who violates statutory provisions under the Air and Water Act, of the rules and regulations there under.

(3) Encouraging Monitoring and Tracking Methods

Tracking and monitoring this sector, as it currently functions, both on the domestic as well as global scale, would be a very important start. Currently, data in this sector is not tracked by the government of India which makes it difficult to assess the impact the heavy infusions of funds into this sector has caused. Hence, it is impossible to verify the sustainability claims purported by the sector which have economic and ecological implications.

A. Government bodies must dedicate a percentage of investment into the sector through various schemes and grants, towards monitoring how funds are disbursed and utilized within the ornamental fish sector.
B. The respective State Governments must institute licensing and registration policies with clear mandates for regular inspection and record-keeping.

(4) Voluntary Certifications

In the absence of minimum standards, it is important to encourage the industry to self-regulate and adopt voluntary certifications to ensure their standards align with acceptable industry practices.

A. Promotion of domestic certifications such as the Green Certification by MPEDA with both industry stakeholders and consumers can help encourage self-regulation by the industry.
B. Adoption of leading international certification standards like the Green Aquaria Certification and Ornamental Fish Sustainability by Friend of the Sea.[244]

[244] Friend of the Sea, *Sustainable Standards and Certifications: Sustainable Aquaria & Ornamental Fish Trade* (n.d.), https://friendofthesea.org/sustainable-standards-and-certifications/sustainable-aquaria-ornamental-fish-trade/.

(5) Capacity Building and Training

Against the backdrop of immense welfare concerns due to the unskilled handling of ornamental fish, there is an urgent need for capacity building. This is a must for individuals in the sector, who handle fish during all stages of trade.

A. Awareness of fish sentience and species-specific needs to be built for all stakeholders, including hobbyists.
B. Training programs covering species identification, sustainable harvesting methods, proper handling and transport techniques, biosecurity and the legal aspects of national and international trade.
C. Building capacity, and training veterinary and public health professionals on the identification and management of zoonotic diseases related to ornamental fish.

(6) Implementing Strategies to Prevent the Spread of Zoonotic Diseases

Strengthen surveillance systems to monitor and report zoonotic diseases linked to the ornamental fish trade in India. This includes establishing a centralized database for tracking disease outbreaks and trends, which will facilitate timely responses.

A. Strengthening regulatory frameworks in the import, export, and domestic trade of ornamental fish, including mandatory health checks and certifications to prevent the spread of infectious diseases.
B. Implementing biosecurity standards and protocols for handling, transportation, and quarantine of ornamental fish is essential to minimise disease transmission.
C. Strengthened surveillance, monitoring and reporting of zoonotic diseases associated with ornamental fish trade in India.
D. Implement routine inspections of fish farms, pet shops, and public aquariums to ensure compliance with health and safety standards, recordkeeping of diseases and associated mortalities, and subsequent disposal of deceased animals.
E. Collaborate with international organisations like the WHO and OIE to harmonize standards and practices for the ornamental fish trade. This collaboration will enhance the joint global efforts to combat the transmission of zoonotic diseases.

VIII Conclusion

As discussed in this paper the ornamental fish sector in India presents socio-economic opportunities alongside some serious challenges to sustainability, fish welfare, and environmental and public health risks.

The growth of this sector needs to be balanced with more regulation and capacity building for holistic development of the sector in keeping with our Constitution's mandate and in compliance with the laws of the land and our international obligations, in letter and spirit.

A necessary progression from this paper is the undertaking of an in-depth scoping study and report which should include comprehensive surveys, fieldwork and documentation to accurately assess the sector's impact and needs. This scoping study and report would help in more informed decision-making by demonstrating the on-ground realities and the need to prioritise specific areas requiring regulation.

Generally, central regulations for the protection of the fish welfare, environment, biodiversity and public health; invoking state-specific jurisdiction for registration, licensing and governance of aquaculture farms and wild-caught fishing activities; the development of Standard Operating Procedures (SOPs) for the health, management, biosecurity by ICAR; identifying pathways and tackling the issue of IAS and the adoption of recommendations made in the white paper are essential first steps forward. A priority-species list needs to be prepared by the government and its institutions under ICAR to help develop more species-specific standards after generic preliminary regulation is brought about.

By addressing these challenges with a structured approach and a comprehensive and cohesive policy framework, we can enhance the welfare of ornamental fishes, protect the environment and biodiversity, safeguard public health and mitigate negative socio-economic impact.