Biological Conservation 164 (2013) 158–169

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

# Uncovering an obscure trade: Threatened freshwater fishes and the aquarium pet markets

Rajeev Raghavan [a,b,c,d,*], Neelesh Dahanukar [e,f], Michael F. Tlusty [g], Andrew L. Rhyne [g,h], K. Krishna Kumar [b,i], Sanjay Molur [e], Alison M. Rosser [j]

[a] Durrell Institute of Conservation and Ecology (DICE), School of Anthropology and Conservation, University of Kent, Canterbury, United Kingdom
[b] Conservation Research Group (CRG), St. Albert's College, Kochi, India
[c] Research Group Zoology: Biodiversity and Toxicology, Center for Environmental Sciences (CMK), University of Hasselt, Diepenbeek, Belgium
[d] Institute of Aquaculture, Faculty of Fisheries and Protection of Waters, University of South Bohemia, Ceske Budejovice, Czech Republic
[e] Zoo Outreach Organization (ZOO), 96, Kumudham Nagar, Vilankurichi Road, Coimbatore, India
[f] Indian Institute of Science Education and Research (IISER), Pune, India
[g] New England Aquarium, John H Prescott Marine Laboratory, Boston, MA, United States
[h] Department of Biology and Marine Biology, Roger Williams University, Bristol, RI, United States
[i] Community Environmental Resource Center (CERC), Ashoka Trust for Research in Ecology and Environment (ATREE), Alleppey, India
[j] Species Programme, United Nations Environment Programme–World Conservation Monitoring Center (UNEP–WCMC), Cambridge, United Kingdom

ARTICLE INFO

*Article history:*
Received 10 September 2012
Received in revised form 30 January 2013
Accepted 23 April 2013

*Keywords:*
Aquarium trade
Biodiversity hotspots
Conservation
Endemic
Red Lined Torpedo Barb

ABSTRACT

While the collection of fish for the aquarium pet trade has been flagged as a major threat to wild populations, this link is tenuous for the unregulated wild collection of endemic species because of the lack of quantitative data. In this paper, we examine the extent and magnitude of collection and trade of endemic and threatened freshwater fishes from India for the pet markets, and discuss their conservation implications. Using data on aquarium fishes exported from India, we try to understand nature of the trade in terms of species composition, volume, exit points, and importing countries. Most trade in India is carried out under a generic label of "live aquarium fish"; yet despite this fact, we extracted export data for at least thirty endemic species that are listed as threatened in the IUCN Red List. Of the 1.5 million individual threatened freshwater fish exported, the major share was contributed by three species; *Botia striata* (Endangered), *Carinotetraodon travancoricus* (Vulnerable) and the Red Lined Torpedo Barbs (a species complex primarily consisting of *Puntius denisonii* and *Puntius chalakkudiensis*, both 'Endangered'). Using the endangered Red Lined Torpedo Barbs as a case study, we demonstrate how existing local regulations on aquarium fish collections and trade are poorly enforced, and are of little conservation value. In spite of the fact that several threatened and conservation concern species are routinely exported, India has yet to frame national legislation on freshwater aquarium trade. Our analysis of the trade in wild caught freshwater fishes from two global biodiversity hotspots provides a first assessment of the trade in endangered and threatened species. We suggest that the unmanaged collections of these endemic species could be a much more severe threat to freshwater biodiversity than hitherto recognized, and present realistic options for management.



## 1. Introduction

The aquarium fish trade is a large, biodiverse, global industry (Tlusty et al., 2013), worth around 15–30 billion US$ (Penning et al., 2009) and involving ~5300 freshwater and 1802 marine fish (Hensen et al., 2010; Rhyne et al., 2012a). Ninety percent of the trade volume revolves around tropical freshwater fishes of which all but 10% are captive bred, and the remainder comprise of diverse wild-caught species (Olivier, 2001).

Collection of freshwater fishes for the aquarium trade is also a practice that divides opinion (Watson and Moreau, 2006). While some authors consider them an important contributor to local economies that can provide incentives for environmental conservation if well managed (Tlusty et al., 2008; see also Rhyne et al., 2012b for a marine example), others question its sustainability vis-à-vis the unmanaged nature and population decline of important species (FAO, 2003; Gerstner et al., 2006; Moreau and Coomes, 2007; Rowley et al., 2008). For example, in Malawi, South Eastern Africa, collection of aquarium fish has been known to support the

* Corresponding author at: Durrell Institute of Conservation and Ecology (DICE), School of Anthropology and Conservation, University of Kent, Canterbury, United Kingdom. Tel.: +44 754061435.
*E-mail address:* rajeevraq@hotmail.com (R. Raghavan).

0006-3207/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biocon.2013.04.019

employment of at least 1500 people (SM. Grant cited in Helfman, 2007). But on the other hand, it has been demonstrated that profitable aquarium trade cannot be sustained on the basis of wild caught freshwater fish in Cameroon (Brummet et al., 2010), and that around 82 species of African freshwater fishes seen in the aquarium trade are threatened (UNEP-WCMC, 2008). Moreau and Coomes (2007) while acknowledging that ~10,000 people in the Iquitos region of Peru earned at least some income from collecting aquarium fishes, also cautions that the trade presents new conservation concerns. Similarly, Gerstner et al. (2006) estimated that 3000 families made a living from the trade and that 100,000 people benefited economically in Peruvian villages, where few other economic opportunities were available. Yet, there was no evidence to support that wild caught aquarium trade was sustainable, and added that anecdotal evidence indicated that the number of species available was declining.

In India, the country that harbours the most number of endemic freshwater fishes in continental Asia (Froese and Pauly, 2012), collection of such species for the aquarium trade is entirely open-access, unregulated and even encouraged by certain governmental and semi-governmental agencies (Raghavan, 2010). Most wild caught aquarium fish originating from India come from the Eastern Himalaya and Western Ghats, hotspots known for their remarkable freshwater biodiversity and endemism (Allen et al., 2010; Molur et al., 2011). Approximately 200 species of freshwater fish from the Eastern Himalaya have been collected for the trade, although less than half are exported regularly (Allen et al., 2010). Similarly, of more than 100 species that have entered the trade from Western Ghats (Raghavan, 2010), close to two dozen are regularly exported. The remaining species are non-viable in trade as they are rare, and therefore extremely hard to collect and thus cannot meet a constant market demand, or are extremely sensitive to handling and transportation.

At the centre of attraction of India's aquarium trade are the charismatic Red Lined Torpedo Barbs (RLTBs), a species complex of colourful cyprinids, whose unmanaged collection during the last two decades is associated with severe population declines, and an 'Endangered' listing in the IUCN Red List of Threatened Species (Ali et al., 2011; Raghavan and Ali, 2011). The increasing global attention on the need for conservation of RLTBs led the Department of Fisheries in the southern Indian state of Kerala to issue a Government Order in 2008, restricting collection and exports, and proposing several management measures including quotas, gear restrictions, minimum catch size, and a seasonal trade ban (Mittal, 2009). However, recent studies indicate that these regulations were developed with minimum scientific input and offer little protection for the species (Solomon et al., 2011). For example, a seasonal closure of the fishery was implemented based on the assumption that the RLTBs breed in June, July and October (Clarke et al., 2009). However, research on biology of the species showed that the actual breeding season extends from October to March, and that the seasonal closure is therefore mistimed (Solomon et al., 2011). In general, efforts to manage collection and exports of freshwater aquarium fishes in India have been hindered by the lack of empirical data about the trade.

The status of freshwater fish as 'wildlife' and its conservation is also somewhat anomalous in India. The main wildlife conservation legislations in India are the Wildlife Protection Act (1972), which lists protected species and prescribes regulations for hunting or harvesting wild animals; the Biological Diversity Act (2002), which implements aspects of the Convention on Biological Diversity (CBD) and the Indian Forest Act (1927), which provides for habitat protection and use of forest products. None of these legislations relate explicitly to the conservation of freshwater fish. Several states have also passed 'Inland Fisheries' acts (Dahanukar et al., 2011), but without any focus on conservation and sustainable use of aquarium fishes. In general, freshwater fish is viewed as an open access resource, and a free commodity that can be collected from nature (Raghavan, 2010), resulting in the precarious state of freshwater biodiversity (Allen et al., 2010; Molur et al., 2011).

In this paper, we assess the levels of exports of threatened freshwater fishes from India for the aquarium trade, while specifically focusing on the endangered RLTBs. For the first time, we provide information on species, export quantities, trade routes, airports and importing countries. Where data allow, we also examine the impacts of trade on the conservation of these endangered species.

## 2. Materials and methods

The official export records of aquatic animals in India, maintained by the Marine Products Exports Development Authority (MPEDA) under the Central Ministry of Commerce, contains only a general quantification of aquarium fish exports and does not provide details of common names, genera, or species (see MPEDA, 2010). Currently, there is also no legislation or official reporting system in place that requires the declaration of 'species' or their 'numbers' prior to export. It is known that while some individual exporters do provide data on the details of the cargo (species and numbers), others simply list aquarium fish exports under the general label 'live ornamental fish' or 'tropical freshwater fish' (see Smith et al., 2008). Some airports in India (e.g., Bangalore/Bengaluru/BLR) require the labelling of consignments at the genus/species level before exports, while others (e.g., Kochi/Cochin/COK) do not. Exporters may also declare the names of species (and their size ranges) during export due to such requirements from the importers side. However, such information is not passed onto the MPEDA for aggregation in a database.

Our search for detailed information on aquarium fish exports from India led us to Tips Software Service Private Limited, a company that maintains a database on export and import related information including foreign trade statistics (see www.dailyexportimportdata.com). The company collects data on all commodities exported from India including live animals, from the customs records available at various airports and seaports. Using the database at Tips, we obtained customs-level data on the daily exports of aquarium fishes from the international airports in India from April 2005 until March 2012.

For the present study, we considered only freshwater fish. All species of marine and brackishwater fishes, as well as freshwater shrimps were excluded. Data were extracted in the form of a matrix with information regarding date of export, descriptive label on the cargo (species/trade name, or general label such as 'live ornamental fish', 'ornamental live fish', 'live aquarium fish', 'live aquarium ornamental fish', 'ornamental fish', 'assorted live ornamental fish'), export and import airports, quantity, size ranges (wherever mentioned by the exporter) and units (under four categories: 'PCS', pieces; 'NOS', numbers; 'DOZ', dozen; 'KGS', kilograms). After consulting with the data provider, the units 'PCS' and NOS were considered as same, which indicated the number of individuals in the cargo. Unit 'DOZ' was converted to 'NOS' by multiplying the value by 12. Since it was not possible to decipher the number of individuals shipped as KGS, we omitted this data from the analysis of numbers in trade. However, we did a separate analysis on the data in KGS so as to decipher the volume of trade in KGS. Currency exchange rates (Indian Rupee to US Dollar) during the years covered by the study were obtained from http://www.oanda.com/currency/historical-rates/.

Additional information on the trade was gathered during field research in the Western Ghats, in retail shops in Europe and South East Asia, and extensive internet searches for aquarium fish