

Protected Area Analysis with respect to Freshwater Biodiversity and Reptile Assessments, and Development of National Policy for inclusion in legislation

Project # 60073

Start Date: 1/1/2012; End Date : 30/09/2014



Report Submitted by
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Zoo Outreach Organization Trust

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Contents

Chapter 1	Freshwater policies in India	1-20
Chapter 2	Are Western Ghats endemic threatened freshwater fish protected? An analysis of the existing protected area network	21-28
Chapter 3	Preliminary analysis of protected area effectiveness for Western Ghats reptiles	29-38
Chapter 4	Conservation prioritization of freshwater fishes in the Western Ghats.	39-50
Chapter 5	Green Certification – is it really 'green'? Freshwater fish threatened by ornamental trade	51-58
Chapter 6	Freshwater conservation and management in a protected area: Periyar Tiger Reserve	59-70
Chapter 7	Freshwater conservation and management outside protected areas: Nelliampathy Hills.	71-76
Chapter 8	Minutes of meetings related to Freshwater policy project	77-106
Chapter 9	Directory of Stakeholders	107-119
Chapter 10	Material developed and Distributed as Policy Outreach	121-128

Freshwater policies in India

India is one of the few countries in the world home to four biodiversity hotspots (Western Ghats, Himalaya, Indo-Burma and Sunda), and this richness of diversity is a fact of pride for the country. However, by the very definition of a hotspot all these four sites are recognized by the alarming threats and pressures of an increasing population of humans within those biodiversity-rich sites. The Western Ghats is one of the 34 recognized hotspots of the world, while it is also one of the 11 megadiversity regions of the world—a real competition for space and resources between humans and rest of biodiversity.

The hotspots especially Himalaya and Western Ghats are primary sources of water originating in the highest points and throughout the slopes and flowing down as rivulets, streams and rivers through the plains of India providing a lifeline for biodiversity, agriculture, industry, and power generation. The use of this invaluable and limited resource is of great concern within the country and the various purposes for which aquatic resources are used are increasingly regulated through legislations and policies.

Freshwater resource use policies are centered mainly around human needs with emphasis on equitable distribution, rights of people, drinking, irrigation and power generation. Policies dealing with conservation of aquatic biological diversity and abiotic diversity are addressed superficially or marginally, or secondarily as a resource for human use. The issue of conservation of freshwater diversity (biological and abiotic) is most neglected in almost all of the policies framed in India today.

In the history of management practices of resource use, India has until date 1140 Acts on record including amendments to some Acts. The oldest Act was passed in 1836 (Bengal Districts Act) and the first water related Act was introduced in 1838 (Coastal Vessels Act) followed by the next one in 1873 (Northern India Canal and Drainage Act) (India Code Legislative Department 2014).

In this report, only relevant national Acts and policies that have a biodiversity component or a scope of adding one have been addressed. One of the earliest policies passed in relation to fisheries protection and management is addressed in this chapter; it is the Indian Fisheries Act, 1897.

As a follow up of the Western Ghats freshwater biodiversity assessments by the IUCN Freshwater Biodiversity Unit and Zoo Outreach Organization in 2010 of four taxonomic groups (freshwater fish, aquatic molluscs, odonates and aquatic plants; Molur et al. 2011) funded by the CEPF, this project was to understand the freshwater policies of India with respect to conservation. Again funded by the CEPF, Zoo Outreach Organization assess the implications of the existing policies and gaps, analyse the effectiveness of the existing protected areas with reference to freshwater fishes and suggest recommendations to develop freshwater biodiversity conservation strategies and policies in the future

Freshwater fish in India

India consists of over 800 freshwater fish species of which 290 species are found in the Western Ghats drainage and 520 are found in the Eastern Himalayan drainage (Allen et al. 2010, Molur et al. 2011), although the numbers have increased to more than 850 in India and more than 320 in the Western Ghats since these publications. It is one of most threatened groups of vertebrates (37% of Western Ghats species are threatened) in the country with high conservation, commercial and livelihood values. The diversity of freshwater fish contributes to maintaining stability to an already stressed ecosystem. In fact certain charismatic species such as the Mahseers and the goonch also influence tourism. They are an extremely important group of vertebrates in terms of their conservation value but in addition to that they have very high commercial value and livelihood values and despite being the most threatened group of vertebrates, there are next to no conservation initiatives for this group.

Threats

Some of the threats plaguing Indian freshwater fish are invasive species introduced deliberately or accidentally from outside the country (namely, African Catfish, Guppies, armored sucker-mouth catfish and Tilapia among others) and species from within the country but released in different river systems, under the garb of supporting livelihoods, which are exotic to the Western Ghats river systems (Indian major carps); aquarium trade of fish species threatened with extinction in the international market in large numbers (Raghavan et al. 2013), some of which are found only within protected areas; pollution through run-off from pesticides used in plantations (e.g., cardamom, coffee, tea) and habitat degradation and modifications (e.g., loss of riparian & aquatic vegetation used by fish for egg-laying), destructive fishing practices (poisoning, dynamiting and electrocuting) and, last but definitely not the least, development (e.g., dams, sand mining).

And ultimately, the lack of an effective, science-based, implementable freshwater fish conservation policy results in these threats continuing in a rampant fashion with no control or mitigation.

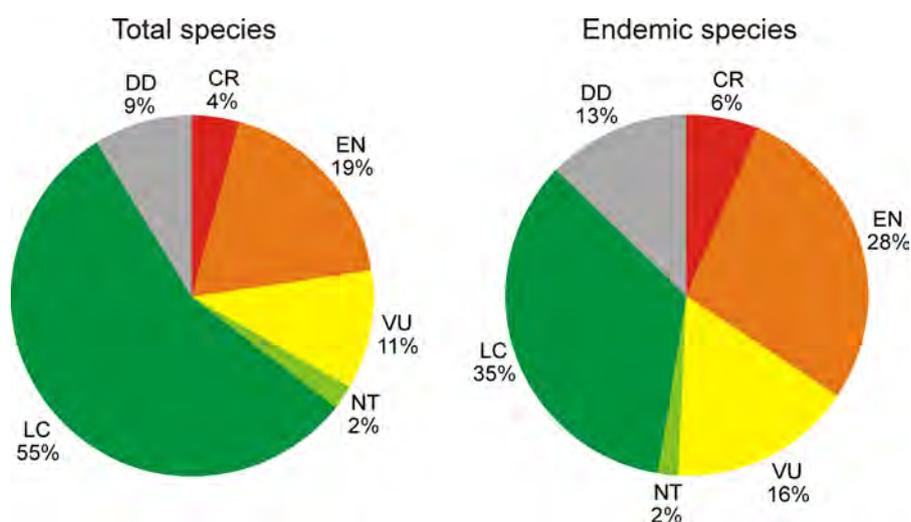


Figure 1. Distribution of total and endemic freshwater fishes of Western Ghats in different IUCN categories.

Introduction to policy situation

Freshwater conservation and policies have been a matter of contention for many years globally. Most freshwater policies are set up to protect and propagate inland fisheries and for water resource management. There are no explicit policies on freshwater biodiversity conservation and some of the existing policies either have components related to biodiversity use or have superficial reference to conservation, which are mostly never implemented. In fact, many policies are affected by political boundaries, views, and commercial lobbies but rarely are they affected by scientific research and conservation strategies. Freshwater fish conservation policies have always been a subject that has foxed conservationists, livelihoods and policy makers. The different policies around the world have their own system of working with endangered and threatened species but very few address freshwater fish biodiversity conservation (Leidy & Moyle 1998). Most look at inland fisheries and how to ensure its sustainability (Elvira 1996).

The reasons for lack of a policy on freshwater fish diversity conservation may be over-lapping jurisdiction, which is unavoidable considering the number of departments and ministries involved in the management of an aquatic system. The economic and political interests involved in freshwater systems such as power generation, the ongoing river interlinking plans and inter-state water body disputes majorly influence the policy making process. Urban water bodies have a different set of problems such as lack of civic amenities in over-crowded cities, ownership issues and problems concerning pollution control and release of untreated wastes.

In protected areas and other forest areas, there is a lack of management of aquatic systems as most management and working plans are terrestrial in their approach. In addition to this, even within protected areas the ownership of the river system is unclear and may have multiple agencies having a stake in different parts. As a result, the aquatic ecosystem is not maintained by any of the concerned departments.

In India freshwater fish is one of the most threatened group of vertebrates and there is no freshwater biodiversity conservation policy in place. This is the status of all of the major vertebrate fauna of inland waters, aquatic plants and invertebrates such as crabs, snails, dragonflies and mayflies may suffer a worse prospect.

India has a history of conservation policy right from the era of medieval kings; King Asoka had put it down as a rule during his reign that no life form shall be harmed and all organisms have a right to live. Much later, during the British Raj, an officer namely Francis Day was very interested in fisheries and he was among the instrumental people for the setting up of the Indian Fisheries Act, 1897. Since independence, it has quite a few wildlife and environmental laws and each of them have been set up to address certain gaps in wildlife conservation.

India has some policies with freshwater fisheries components and some water resource management such as the Wetland Rules, 2010 and the National Water Policy 2012. In terms of wildlife policies there is the Wildlife (Protection) Act of 1972 and the Biological Diversity Act of 2002 but both do not have any specific provision for freshwater fish diversity conservation. In terms of environmental laws we have the Water (Prevention and control of Pollution) Act 1956, which comes under the Environment Protection Act 1986. But these environmental policies are

not being implemented on ground and this makes them paper laws that are of no or limited consequence. Finally, the livelihood, equitable sharing and forest resource use aspects fall under the Forest Rights Act, 2006.

Policy makers need to take into account biodiversity, livelihoods, commerce, research and conservation aspects while setting up a policy. Out of these aspects, livelihoods and commerce are addressed adequately, while biodiversity and conservation (which is imperative to the sustainability of these systems) are not addressed objectively or with scientific rigour. The Indian population of a billion plus people directly depend on freshwater systems for sustenance and livelihoods and yet the attention it receives is remarkably poor.

Freshwater biodiversity and the local stakeholders are the ones directly affected by these policies.

Freshwaters and the biodiversity therein are divided among many departments in India. Each of these departments manages different aspects of the water body. The water belongs to irrigation (agriculture) and may lease it out to the fisheries for food fish production. The water may also be leased out to the tourism department if it is a lake or river that is popular and scenic. The Marine Products Export Development Authority under the Ministry of Commerce to export ornamental fish for aquarium trade also uses freshwater fish. Ministry of Environment and Forests manage the terrestrial area adjoining any river or stream that may fall with the protected area definition as per the WPA.

Overview of existing legislation

Indian Fisheries Act 1897

The Indian Fisheries Act was set up in 1897 by the British in India based on views from Francis Day. This act was set up with a view to protect and sustain fisheries for future generations and to harvest fish in a more damage-free and efficient manner. The act prohibits destructive fishing practices such as dynamiting, poisoning and setting up permanent fishing structures.

Protection of fish in selected water by rules of state government. Some of the state-level fisheries acts: Inland Fisheries Act 2010 Kerala, Karnataka Inland Fisheries [Conservation, Development and Regulation] Act (year), Maharashtra Act of 1961

Gaps:

The Indian Fisheries Act 1897, does not seem to have changed with changing times. The punishments still are the same and this is not enough to dissuade people from flouting the law. There is also the problem of implementing the law, there is not much clarity on who is to implement the act but considering it pertains to fisheries one may assume that the fisheries department may be involved. And yet whether the fisheries department has the bandwidth to implement this law is unclear.

To illustrate, dynamite fishing is still rampant in many major river systems including the Cauvery River system in Karnataka, which flows through the Cauvery Wildlife Sanctuary.

What we need:

To start with, a component on identifying relevant authorities to ensure implementation on ground needs to be put into place. The law needs to be amended to fit with the times and in a country where rivers were/are worshipped there is a need for a strict implementation authority to curtail destructive fishing practices.

The Act may also need an advisory board which has ichthyologists/fish biologists and fisheries experts who ensure problems like introduction of exotics as food fish does not happen. On communicating with the locals in several places within the Western Ghats, one can understand that they prefer native fish and not exotics introduced from Gangetic river systems and other countries.

Biological Diversity Act 2002

The Biological Diversity Act was set with the aim of sustainable, commercial and local biodiversity use. This act is followed and implemented by the National Biodiversity Authority and the state biodiversity boards.

The act mainly looks at all biodiversity and natural resource harvest and benefit sharing in a sustainable manner. It also works with communities and helps set up Biodiversity Monitoring Committees (BMCs). The BMCs have a mandate to promote conservation, sustainable use and preserve habitats. They also have the responsibility to conserve local breeds including domestic stocks and breeds of animals. Each BMC is to maintain a Biodiversity Register and as the name suggests monitor and record all the biodiversity in and around the village. Lastly, the BMC may levy charges in the form of fees for commercial use of biodiversity from the area falling under its jurisdiction.

Some biodiversity may also be harvested for commercial use but there is a need to take permits from the National Biodiversity Authority for the same. Most of these include both aquatic and terrestrial medicinal plants.

Among other things, the Biological Diversity Act has an interesting section 38 which speaks about curbing trade of species threatened with extinction and its exact words are "Without prejudice to the provisions of any other law for the time being in force, the Central Government, in consultation with the concerned State Government, may from time to time notify any species which is on the verge of extinction or likely to become extinct in the near future as a threatened species and prohibit or regulate collection thereof for any purpose and take appropriate steps to rehabilitate and preserve those species."

Gaps:

Locals harvest fish not only for subsistence but also for aquarium pet trade at certain locations. There is no inspection of the number of fish caught by locals and the use of this biological resource.

Even though locals are permitted to harvest fish, in many cases, outsiders and not locals lease freshwater ponds. These outsiders introduce exotic freshwater fish to these ponds, feed them at regular intervals or divert the sewage water into the water body as fish feed. And once the fish have attained a certain length the lessee harvests the fish.

The Biological Diversity Act does not permit sending out any genetic material as comparative material for research purposes whereas the MPEDA exports live fish as part of the ornamental fish trade. This seems to be a contradiction in existing mandates and policies. This needs to be looked at with utmost rigour. Also, despite section 38, threatened species trade is encouraged by MPEDA under the garb of promoting local livelihoods wherein the exporter reaps most of the high profits and the locals are paid a meager sum.

Lastly, there are no authorities assigned on ground to implement the Act on ground and the biodiversity boards are understaffed with only the chairman and the secretary to handle all the management. And in many cases the chairman and secretary have not been designated and as a result the biodiversity boards are inactive in many states.

Wetland Rules 2010

The Wetland (Conservation and Management) Rules, 2010 focuses on wetland ecosystem conservation and management.

The rules protect wetlands that are Ramsar Sites (26 in India), wetlands that fall with protected areas, non-protected forest areas, and sensitive marine habitats. The rules include wetlands lying within a UNESCO World Heritage site, which means wetlands within the Western Ghats should be included. High altitude wetlands at or above an elevation of 2500m with an area equal to or greater than five hectares are protected whereas wetlands below an elevation of 2500m with an area equal to or greater than 500ha are protected under these rules.

In addition to these, wetlands identified by the Central Wetland Regulatory Authority fall under the protection of the Wetland Rules. The extent of protection awarded under these Rules include prohibition of reclamation, setting up industries, and handling, storage or release of hazardous chemicals, construction of permanent structures and any other activities negatively impacting a wetland ecosystem.

The Rules list specific activities permitted/not permitted in wetland based on its classification and in addition to this it also mention activities that require prior permission of the state. The state governments need to prepare a brief document identifying and classifying wetlands within their jurisdiction. As a part of a process to regulate more laws under the Wetland Rules, the central government in consultation of the Central Wetland Regulatory Authority shall issue a final notification. The Central Wetland Regulatory Authority includes an ornithologist, limnologist and hydrologist.

Gaps:

The Central Wetland Regulatory Authority does not have an ichthyologist, experts on aquatic invertebrates, botanists with specialization on aquatic plants, sociologist, ecologist on the team and this may impair decision making in recognizing wetlands suggested by specific states. This seems to be a biased approach and considering the conservation, livelihood and commercial value of freshwater fish it is a gap that needs to be addressed. There is a need for clarity on the definition of the word "wetland" mentioned in the rules.

What we need:

There is an urgent need for awareness about the gamut of the rules and its provisions. And integrated working/management process involving communities where possible may be considered. Inputs from organizations such as wetlands International and others in terms of science-based process are needed. The Central Wetland Regulatory Authority needs a holistic team of experts such that biases are reduced and scientific and objective decisions are achieved.

National Water Policy 2012

The national water policy has 16 sections and almost all of them refer to water use and management. There are a few sections referring to research, training and implementation of the policy. The preamble, which is the first section, recognizes the problems facing water resource management, use, climate change and the disasters possibly caused by it and some aspects of conservation. But the section does not refer to biodiversity explicitly and mainly covers concerns impacting human livelihoods and commerce. The subsection six under section one (Preamble) also dictates the order in which water use may be organized and conservation of water as a resource for humans comes last in priority and aquatic biodiversity are totally ignored.

"(vi) Safe Water for drinking and sanitation should be considered as pre-emptive needs, followed by high priority allocation for other basic domestic needs (including needs of animals), achieving food security, supporting sustenance agriculture and minimum eco-system needs. Available water, after meeting the above needs, should be allocated in a manner to promote its conservation and efficient use."

There is also a section 2 devoted to developing a "water framework law" where it talks about assigning governing powers to the centre, state and local governing bodies through the law. This section also addresses the need for a comprehensive legislation on managing water resources spanning across states and considering basin or sub basin as a unit of holistic management.

The sections have been divided based on conservation, management, use and research values. Sections (3,5,6 and 11) deal with use values starting with describing the different uses of water, enhancing water available for use, demand for management and water use efficiency which talks about setting up water audits, and water supply and sanitation which mainly refers to hygiene related issues.

The sections (4 and 8) refer to climate change and conservation of which, the solution to tackling climate change seems slightly vague and may not necessarily be science based. It mainly refers to building more storage via reservoirs and using climate resilient technological options. Section 8 titled 'conservation of river corridors, water bodies and infrastructure' refers to conservation twice in the text and both times are general statements with no mention of specific river corridors that require special attention. Also, most statements seem to concern general management and protection of water as a resource for human use. There is no mention of any key species or even biodiversity as a whole.

The two sections (14 and 15) referring to research mainly talk about collecting hydrological, glacial and climate related data and the research priorities seem to be water management and technological advancement for the same. Also, there is a mention of setting up an autonomous centre for conducting research on water policies and the impact of policy decisions on water and to evolve policy directives according to changing water resources. Lastly, there is a mention of developing more courses connected to training in water resource management, innovative technologies and a national campaign to spearhead water literacy.

The implementation of this Policy seems to be with the National Water Board as approved by the National Water Resources Council.

Wildlife Protection Act

The Wildlife Protection Act (WPA) was set up in 1972 possibly with the aim of protecting wildlife from dangers such as poaching and indiscriminate trade. It has defined protected areas such as national parks, wildlife sanctuaries, tiger reserves, conservation areas and community reserves. It has six schedules with Schedule 1 species enjoying the highest degree of protection and Schedule 5 include species (house crow, fruit bats, rats and mice) that are considered vermin. Schedule 6 includes a perfunctory list of plants. The list of species protected under the Indian Wildlife (Protection) Act (IWPA) has approximately 200 mammals, 1100 birds, 319 reptiles, 474 butterflies & moths (though technically there are no moths listed), 6 plants and a host of marine invertebrates. It also includes one family of amphibians namely Ranidae but the schedules do not have freshwater fish listed except for one family Syngnathidae which includes a handful of freshwater and brackish-water fish (Sea Horses and Pipefish).

The WPA is a good framework and has tried to counter the threats faced by wildlife such as hunting, poaching for trophies and trade among other things. But considering the diverse freshwater ecosystems and the species in our country and changing trends of threats, the WPA needs some alterations with reference to conservation of freshwater fish. There is a need to explore possibilities of incorporating a freshwater fish conservation component into the framework of the Act. The lacuna of lack of science and scientific assessments in the listing of species in the Schedules are the problems that were highlighted by Kunte (2008) and Mohanraj & Veenakumari (1996).

Implementation of the WPA:

The 1986 and 1991 amendments provided more teeth to WPA and removed many loopholes. But a study conducted by Wildlife Protection Society of India in 1995 on the impact of WPA, showed that the major weakness in wildlife crime law enforcement is the snail's pace at which cases 'progress' in the courts of law. In most cases of illegal trade, the traders and poachers receive bail and the cases progress in lower courts at a snail's pace. Many wildlife traders and poachers are believed to be continuing their illegal activities, despite several cases pending against them. So far the Act has not proved to be much of a deterrent to offenders, comments Kumar (1998).

In addition to this, there may be a problem with implementation considering that the taxonomy of many species is outdated and this may create problems in the court of law.

The listing process:

The latest version of the Wildlife Protection Act has 6 schedules; schedule 1 species are awarded the highest protection and include mammals, amphibians and reptiles, marine fishes and sea horses, birds, butterflies and one dragon fly and one marine crab and marine invertebrates. Schedule 2 includes some more mammals and beetles (and butterflies under the heading of beetles) and some reptiles and a bird. Schedule 3 includes some more mammals and all calcareans (sponges). Schedule 4 includes a few mammals but largely birds, reptiles, butterflies and some marine invertebrates. Schedule 5 differs from all the schedules in the fact that the species listed here are considered vermin: this includes House crow, fruit bats, rats and mice. Schedule 6 includes plants, namely, Beddome's Cycad, Blue Vanda, Kuth, Ladies' slipper orchids, Pitcher plant and Red Vanda.

Rationale:

There is no published material explaining/expanding the rationale as to why the species listed in the schedules are listed that way. There is no published reasoning for putting a particular species in a schedule. This seems the most important gap that needs to be addressed urgently. The Act needs a science-based rationale for listing species with due consideration to implementation problems, taxonomy, reasoning for listing, and a dynamic system for additions or deletions based on research.

Status of current listing:

The WPA has many taxonomic inconsistencies due to the difference in the pace of changes in taxonomy and amendments of the WPA. This taxonomic inconsistency can cause problems in implementing the law since certain species names mentioned in the Act no longer exist in science as they have been updated to different families or names. There is also the problem of repetition of some species in the schedules and this seems unnecessary and something that has been overlooked during the multiple amendments.

There are some species/taxa that have been listed but close to no information is available on these species. To illustrate: many marine invertebrates are listed to protect them from trade and yet these species exist in trade. As a result, the only people affected by the law are researchers who find it extremely challenging to obtain permits to gather science-based data on these data deficient species.

Most importantly there are no freshwater fish species listed in the Wildlife Protection Act. And the commercial lobby seems to have considerable pressure in the matter. The best example for this is that of the sharks that were listed and delisted within a week as a knee-jerk reaction.

Freshwater fish are still a matter of contention as to which department they fall under. Food fish are considered to be the responsibility of the fisheries department whereas freshwater biodiversity that are not food are not protected.

The Act is very restrictive in its approach and this may be a problem considering livelihoods and freshwater fish, which are in need of a more dynamic approach.

Act	Gaps	What we need
Mainly looks at wildlife protection especially species listed in Schedules 1-4 & 6 and within protected areas.	No freshwater fish. No science-based prioritizing system in schedules. Subsistence use of resources by communities is encouraged, however, the exploitation for commercial purposes is unchecked. Does not have any protection mechanism in place for aquatic system.	A special section looking at aquatic biodiversity and a mechanism that is more suited and is based on sound science for its protection. More awareness regarding the gamut of the act. A science-based dynamic system of listing and delisting species in the schedules.

Recommendations

1. A prioritizing system to list freshwater fish taxa in the schedules taking into consideration biological values, cultural, aesthetic, commercial values (see Chapter 6 of this Report).
2. Protecting biodiverse stretches of the river as fish sanctuaries and designating & training special forest staff to manage and protect an aquatic sanctuary.
3. Adding a new section on 'aquatic system management and conservation' to the Act as the Act in its present form is heavily terrestrial in its approach (for e.g., see Chapter 4 & 5 of this Report).
4. A dynamic process based on science for listing and delisting of species that is specific to areas. To illustrate: Axis Deer are listed in Schedule 1 but are introduced and have become pests in the Andaman and Nicobar Islands. Because they are listed in the WPA they cannot be persecuted on the islands.
5. A close monitoring on trade of 'ornamental' freshwater fish using the local communities
6. Better implementation of the WPA
7. Training of special officers in the forest department to follow up with cases pertaining to illegal activities in the court of law
8. A scientific system that encourages research on fauna, flora and fungi to inform the utility and functioning of the Act.

General issues in wildlife and environmental policies

Lack of implementation of existing policies, poor record keeping at various levels of management by different departments, lack of science and dynamism are the general gaps that need to be addressed.

Also inconsistencies such as contradiction between the different mandates of the ministries should be studied in detail. To illustrate, Marine Products Export Development Authority (Ministry of Commerce) promotes trade of threatened species whereas the National Biodiversity Authority under the Biological Diversity Act speaks about regulation of trade of threatened species. There is a growing need for integrated management mechanisms between the various policymakers and stakeholders to avoid losing freshwater systems/biodiversity to silly mismanagement issues.

Stakeholders in the government involved with freshwater systems and their mandates

Department of Dairying, Animal Husbandry and Fisheries

The mandate of the Fisheries department is to ensure high freshwater fish production, advise the state in formulation of policies and expand aquaculture in freshwater, brackish water and marine water. The Fisheries department works with national institutes such as National Bureau of Fish Genetic Resources, Central Inland Fisheries Research Institute and Central Marine Fisheries Research Institute among others but the department itself does not have a research division. The National Fisheries Development Board assigns target numbers of fish to be introduced into reservoirs, lakes and other water bodies in different state and regional offices. One of the parameters used to assign these numbers is the area of the water body in question.

One of the major policies falling within the purview of this department in the Indian Fisheries Act 1897 which talks about destructive fishing practices and the inland fisheries acts at the state level which varies depending on the requirements of the state.

State inland fisheries acts:

Some states have an inland fisheries policies specific to their jurisdiction and needs. A brief overview of some of the Western Ghats state inland fisheries policies namely such as Maharashtra, Karnataka and Kerala, are given in this section. The Maharashtra Fisheries Act (MFA) of 1961 has provisions similar to the Indian Fisheries Act with respect to the state. The MFA also has the provision to prohibit or regulate the use of any fishing gear or weapons in select regions/ water bodies with an aim to protect fish. But there is no clear understanding on how the area for protection or conservation area will be selected. According to this Act the fishery office in-charge for a region may be a police officer but not below the rank of a Sub-inspector. The fishery officer also has the right to arrest any person - who may use fishing gear where it is prohibited to do so and/or not adhere to any of the provisions - under the act. The Act seems to aim at conserving and protecting fisheries, which generally refers to food fishes that are naturally found or introduced by the fisheries department with a view of supporting livelihoods. The Act does not have provisions for community based fish sanctuaries or any protective measures for freshwater fish that play a crucial role in the functioning of an ecosystem and are not necessarily used as food.

The Karnataka Inland Fisheries (Conservation, Development and Regulation) Act, 1996 has similar provisions but in addition it has an Inland Fisheries Advisory Board that discusses and advises the actions/rules. The Board has senior faculty members from the state fisheries colleges who generally focus on food fish production and related topics. There is no one in the board representing natural/native populations of fish like an ichthyologist, conservationist or an ecologist. The Karnataka Fisheries Act also has provisions to set up a fish sanctuary and "The State Government may, by notification, declare any area of water to be a fish sanctuary, for the purpose of protecting, propagating or development of fisheries.". This effectively is self-explanatory and informs that the act is focused on protecting and developing fisheries and not fish diversity. Most fisheries refer to the food fishes (Indian Major Carps – Rohu, Catla and Mrigal), which are found in the Gangetic river systems and not in southern India. This makes these species exotic or alien to southern India, for even though they are found in India they are native to a different river system and their introduction may already have adversely affected native fish species of southern India. In effect, the Fisheries acts are protecting the non-native or exotic taxa under the garb of supporting livelihoods with no scientific and systematic working process. And this could be a major threat to inland fish diversity.

The Kerala Inland Fisheries Act, 2010 is one of the more recent inland water conservation policy which includes linear systems (rivers, streams). "An Act to codify and amend the laws relating to inland fishery sector and to provide for the sustainable development, management, conservation, propagation, protection, exploitation and utilisation of the inland fishery sector in the State and for promoting social fisheries and to regulate and control responsible aquaculture activities and to ensure protection of livelihood and traditional rights of fishermen and to ensure the availability of nutritious fish and food security to the people and for matters connected therewith or incidental thereto."

The Act seems to focus on development and management of fisheries in Kerala and the rights are vested with the local government organizations or water resources department and technical advice is sought from the Fisheries Department. This act has provisions for putting restrictions on fishing in select water bodies and/or at select time periods and recommendations for the same is with the Fisheries Department. With reference to aquaculture it states that "No other species of fish seed collected from the natural sources other than the species specified by the Government by notification shall be used for aquaculture".

But the Kerala fisheries Act is unique in the sense that it has provision for declaration of fish sanctuaries if an area is considered "having fishery related or zoologically or naturally or ecologically sufficient importance in protecting and propagating fish or its environment". The dos and don'ts of a fish sanctuary rest with the office in-charge and this results in inconsistencies in management of fish sanctuaries. The onus of fish sanctuaries lies with anyone "The Director of Fisheries or any other officer authorized by him, not below the rank of an Assistant Director of Fisheries, shall be the officer to manage and preserve the protected fish sanctuary". The technical committee that advises the declaration and working of a fish sanctuary includes a biologist, a social scientist, an environmental scientist, a hydrologist and an expert in management. Taking the various aspects into account, the Kerala Fisheries Act seems to be a relatively better policy on paper. The act also has a provision for an advisory committee, which has representatives from

livelihoods that are dependent on inland waters. The implementation of this policy still remains to be seen and it may be too soon to say so, but this act may be headed in the general direction of a positive step of science-based policy making.

Ministry of Water Resources mainly focuses on planning, policy-making and use of water resources for irrigation, flood control etc. The water bodies falling under the irrigation department are sometimes leased out to the fisheries department to introduce fish to support livelihood.

The National Water Policy 2012 falls under the purview of the Ministry of Water Resources, which again refers to water management.

Ministry of Commerce – Department of Commerce

The department's mandate is to regulate, promote international trade and formulate policies to support this endeavor. The main aim of the department is to ensure a conducive atmosphere for accelerated growth of international trade. The department implements and monitors foreign trade & foreign trade policies and the Marine Products Export Development Authority (MPEDA) fall under the Department of Commerce.

The MPEDA promotes international trade of ornamental taxa and aims for increasing the percentage of India's market share in the international ornamental fish trade.

Freshwater fish ornamental trade at the global scale mainly uses captive bred fish, in fact 90% of the fish at the global scale is captive bred (REF). India has a very small share in this trade and 90% of fish sent out for trade are wild caught. The freshwater fish ornamental trade fall within the purview of the Marine Products Export Development Authority under the Ministry of Commerce.

As per Raghavan et al. (2013) which has looked at fish being sent of Bangalore and XYZ airport, certain high demand species such as the Red-line Torpedo Barb *Sahyadria denisonnii* are export in very large numbers (ranging between xx-xx between the year 2005-2012). This species is a endangered species with restricted distribution. In fact some of the fish recorded in trade as per the customs records are species with distribution only within protected areas. This points towards, illegal collection of fish from protected areas thus violating the WPA.

Mr. Ramachandran, MPEDA, had quoted at the Aqua Aquaria India expo that these species suffer from 70% mortality. As a result, this trade can turn out to be a factor that can make a significant impact on species population. Also, this goes in contradiction with section 38 of the Biological Diversity Act which recommends curbing trade of threatened species.

In addition to this, exact numbers and species composition of freshwater fish being exported for trade is unknown. Many shipments are sent simply labeled as "fish" and no checking or database is maintained of home many numbers and which species are being sent out of the country. This is a major lacuna in understanding the overall impacts of ornamental fish trade on fish populations and conservation impact.

Policies and Trade

Export Import policy:

The export import policy does not seem to have any freshwater fish under the restricted list of traded species. Freshwater fish fall within the category of normally traded commodities.

Green Certification:

Green certification is a document that informs regarding best management practices for collection of ornamental freshwater fish for commercial trade. The aim of this policy is that, a fish that has been collected by following the best management practices will be certified as green. This certified fish can be sold at premium rates since there seems to be a demand for eco-sensitive and responsibly collected animals in the pet trade. Marine Products Export Development Authority (Ministry of Commerce) has brought out the green certification guidelines document.

But unfortunately, the guidelines do not dissuade or curb collection of freshwater fish from the wild it only suggests methodology of collection, holding, quarantine and transport. While this may help in reducing fish mortality during collection and transport, the methodology may not necessarily be the "best" management practice.

Also, the guidelines document includes a freshwater fish species list and many of the species listed are threatened with extinction as per the International Union for Conservation of Nature and Natural Resources Red List assessments (Green certification threatened species Table 1).

Table 1. Freshwater fishes included in Green Certification scheme.

Scientific name	Red List Status
<i>Hypselobarbus thomassi</i> (Day, 1874)	CR
<i>Pethia pookodensis</i> (Mercy & Jacob, 2007)	CR
<i>Horabagrus nigricollaris</i> Pethiyagoda & Kottelat, 1994	EN
<i>Badis tuivaiei</i> Vishwanath & Shanta, 2004	EN
<i>Barilius canarensis</i> (Jerdon, 1849)	EN
<i>Botia striata</i> Narayan Rao, 1920	EN
<i>Devario neilgherriensis</i> (Day, 1867)	EN
<i>Etroplus canarensis</i> Day, 1877	EN
<i>Garra hughii</i> Silas, 1955	EN
<i>Garra surendranathanii</i> Shaji, Arun & Easa, 1996	EN
<i>Glyptothorax anamalaiensis</i> Silas, 1952	EN
<i>Glyptothorax madraspatanus</i> (Day, 1873)	EN
<i>Hypselobarbus curmuca</i> (Hamilton, 1807)	EN
<i>Homaloptera montana</i> Herre, 1945	EN
<i>Labeo potail</i> (Sykes, 1839)	EN
<i>Lepidopygopsis typus</i> Raj, 1941	EN
<i>Schistura striata</i> (Day, 1867)	EN
<i>Dawkinsia arulius</i> (Jerdon, 1849)	EN
<i>Sahyadria chalakkudiensis</i> (Menon, Rema Devi & Thobias, 1999)	EN
<i>Sahyadria denisonii</i> (Day, 1865)	EN
<i>Dawkinsia exclamatio</i> (Pethiyagoda & Kottelat, 2005)	EN

Scientific name	Red List Status
<i>Pethia manipurensis</i> (Menon, Rema Devi & Vishwanath, 2000)	EN
<i>Echathalakenda ophicephalus</i> (Raj, 1941)	EN
<i>Dawkinsia tambraparniei</i> (Silas, 1954)	EN
<i>Tor malabaricus</i> (Jerdon, 1849)	EN
<i>Travancoria elongata</i> Pethiyagoda & Kottelat, 1994	EN
<i>Travancoria jonesi</i> Hora, 1941	EN
<i>Aborichthys garoensis</i> Hora, 1925	VU
<i>Opsarius dogarsinghi</i> (Hora, 1921)	VU
<i>Botia rostrata</i> Günther, 1868	VU
<i>Danio jaintianensis</i> (Sen, 2007)	VU
<i>Channa diplogramma</i> (Day, 1865)	VU
<i>Horabagrus brachysoma</i> (Günther, 1864)	VU
<i>Indoreonectes keralensis</i> (Rita & Nalbant, 1978)	VU
<i>Laubuka fasciata</i> (Silas, 1958)	VU
<i>Physoschistura elongata</i> Sen & Nalbant, 1982	VU
<i>Pseudosphromenus dayi</i> (Köhler, 1908)	VU
<i>Pethia ornatus</i> (Vishwanath & Laisram, 2004)	VU
<i>Dawkinsia rohani</i> (Rema Devi, Indra & Knight, 2010)	VU
<i>Rasbora ornata</i> Vishwanath & Laisram, 2005	VU
<i>Salmostoma horai</i> (Silas, 1951)	VU
<i>Schistura prashadi</i> (Hora, 1921)	VU
<i>Carinotetraodon travancoricus</i> (Hora & Nair, 1941)	VU
<i>Syncrossus berdmorei</i> Blyth, 1860	NT
<i>Microphis deocata</i> (Hamilton, 1822)	NT
<i>Channa bleheri</i> Vierke, 1991	NT
<i>Dawkinsia filamentosus</i> (Valenciennes, 1844)	LC
<i>Haludaria fasciata</i> (Jerdon, 1849)	LC
<i>Puntius sahyadriensis</i> Silas, 1953	LC
<i>Pethia meingangbii</i> (Arunkumar & Tombi Singh, 2003)	LC
<i>Pethia narayani</i> (Hora, 1937)	LC
<i>Hypselobarbus jerdoni</i> (Day, 1870)	LC
<i>Systemus sarana</i> (Hamilton, 1822)	LC
<i>Garra stenorhynchus</i> (Jerdon, 1849)	LC
<i>Devario malabaricus</i> (Jerdon, 1849)	LC
<i>Labeo calbasu</i> (Hamilton, 1822)	LC
<i>Barilius bakeri</i> Day, 1865	LC
<i>Opsarius barna</i> (Hamilton, 1822)	LC
<i>Laubuka dadiburjori</i> Menon, 1952	LC
<i>Osteochilichthys nashii</i> (Day, 1869)	LC
<i>Osteobrama bakeri</i> (Day, 1873)	LC
<i>Mesonoemacheilus triangularis</i> (Day, 1865)	LC
<i>Mesonoemacheilus guentheri</i> (Day, 1867)	LC
<i>Schistura nilgiriensis</i> (Menon, 1987)	LC
<i>Schistura denisoni</i> (Day, 1867)	LC
<i>Schistura semiarmata</i> (Day, 1867)	LC

Scientific name	Red List Status
<i>Acanthocobitis mooreh</i> (Sykes, 1839)	LC
<i>Nemacheilus anguilla</i> Annandale, 1919	LC
<i>Nemacheilus monilis</i> Hora, 1921	LC
<i>Indoreonectes evezardi</i> (Day, 1872)	LC
<i>Lepidocephalichthys manipurensis</i> Arunkumar, 2000	LC
<i>Botia almorhae</i> Gray, 1831	LC
<i>Botia dario</i> (Hamilton, 1822)	LC
<i>Psilorhynchus sucatio</i> (Hamilton, 1822)	LC
<i>Psilorhynchus balitora</i> (Hamilton, 1822)	LC
<i>Chaca chaca</i> (Hamilton, 1822)	LC
<i>Akysis prashadi</i> Hora, 1936	LC
<i>Hara hara</i> (Hamilton, 1822)	LC
<i>Microphis cunocalus</i> (Hamilton, 1822)	LC
<i>Leiodon cutcutia</i> (Hamilton, 1822)	LC
<i>Badis badis</i> (Hamilton, 1822)	LC
<i>Trichogaster lalius</i> (Hamilton, 1822)	LC
<i>Trichogaster fasciata</i> Bloch & Schneider, 1801	LC
<i>Pseudetroplus maculatus</i> (Bloch, 1795)	LC
<i>Macrognaathus guentheri</i> (Day, 1865)	LC
<i>Pristolepis marginata</i> Jerdon, 1849	LC
<i>Oryzias setnai</i> (Kulkarni, 1940)	LC
<i>Betadevario ramachandrani</i> Pramod, Fang, Rema Devi, Liao, Indra, Jameela Beevi & Kullander, 2010	DD
<i>Horaglanis krishnai</i> Menon, 1950	DD
<i>Horaglanis alikunhii</i> Subhash Babu & Nayar, 2004	DD
<i>Akysis manipurensis</i> (Arunkumar, 2000)	DD
<i>Conta pectinata</i> Ng, 2005	DD
<i>Carinotetraodon imitator</i> Britz & Kottelat, 1999	DD
<i>Badis assamensis</i> Ahl, 1937	DD
<i>Dario dario</i> (Hamilton, 1822)	DD
<i>Channa barca</i> (Hamilton, 1822)	DD
<i>Channa aurantimaculata</i> Musikasinthorn, 2000	DD
<i>Nandus andrewi</i> Ng & Jaafar, 2008	DD
<i>Horadandia brittani</i> Remi Devi & Menon, 1992	NE
<i>Puntius melanostigma</i> (Day, 1878)	NE

Recommendations:

The green certification requires inputs from conservationists and ecologists to ensure a truly sustainable method of freshwater fish trade. There is an urgent need to promote trade of fish that are captive bred as opposed to fish collected from the wild. Some of the endemic Western Ghats threatened freshwater fish have breeding technology that are already developed in Malaysia, to illustrate: the Red-lined Torpedo Barb a high demand threatened fish, is already being bred in captivity in Malaysia. Also, there is a need to understand the trends undertaken by the species promoted by MPEDA for trade in the past and their present status. Before these studies are conducted, promoting any species for trade may have adverse impacts that are beyond the

understanding of man. And considering that India is a signatory to the CBD it is imperative that immediate action is taken to avoid species extinction as a result of lack of understanding and knowledge.

Ministry of Power

The Ministry of Power is responsible for perspective planning, policy formulation, monitoring of the implementation of power projects. They also undertake training and manpower development and the administration. The enactment of legislation in regard to thermal, hydro power generation, transmission and distribution also falls within its mandate.

All matters relating to hydro-electric power (except small/mini/micro hydel projects of and below 25 MW capacity) and thermal power and transmission & distribution system network fall under the purview of this Ministry. It also undertakes research, development and technical assistance relating to hydro-electric and thermal power, transmission system network and distribution systems in the States/UTs.

Administration of the Energy Conservation Act , 2001 (52 of 2001) fall within its mandate. The National Hydro-electric Power Corporation (NHPC) Limited falls under the gamut of work of this Ministry. The NHPC also has an environment wing which highlights the need for conserving biodiversity, endangered species and wildlife. It also mentions the Environmental Impact Assessments (EIAs) that are conducted and appraised by the MoEFCC in order to accord environmental clearance to any project. But this may be an eye-wash taking into account the multiple times that adverse impacts of unplanned projects are suffered by wildlife and communities alike.

Ministry of New and Renewable Energy

This ministry started off as a department to ensure energy security after the growing prices of oil in India. This ministry is concerned with unconventional sources of energy and it also includes small hydel projects that fall between 2-25mw. These small hydel projects are exempted environmental clearance, environmental impact assessment from the MoEFCC and they do not solicit public consultation either. This has resulted in some private agencies taking undue advantage and the most recent example is from Himachal Pradesh wherein a small hydel project (Aleo ii) constructed on a tributary of Beas collapsed on its trial run. The local communities were not informed regarding a trial run but out of sheer luck there are no casualties reported. There is a need for better management of these projects in order to ensure clean energy that truly takes into consideration livelihoods and wildlife equally.

Ministry of Tourism

The mandate of this department is to formulate policies and coordinate activities of central, state government nodal agencies and private sector companies to develop and promote tourism. In reference to freshwater and this ministry, many lentic and lotic water bodies are leased to the tourism department especially if they are scenic and popular. To illustrate, in the Periyar Tiger Reserve the forest department works along with the tourism department in promoting tourism within the protected area.

Ministry of Environment Forests & Climate Change

The Ministry of Environment, Forests and Climate Change mainly looks at forestry and wildlife management and advises the state departments about management. It includes all the protected areas (wildlife sanctuaries, national parks and tiger reserves) and non-protected forest areas. Most management oriented initiatives are terrestrial though it also includes the National River Directorate and the relatively recently set up National Programme on Conservation of Aquatic Ecosystems. But none of the major national policies connected to protected areas have mandates connected to freshwater systems. The three major policies, which have some connection to wildlife and fall under the purview of this ministry are the Wildlife Protection Act, Biological Diversity Act and the Forest Rights Act.

The only freshwater conservation initiatives revolve around the 26 Ramsar sites in India.

National Biodiversity Authority

The authority acts under the Ministry of Environment and Forests and its mandate mainly includes the Biological Diversity Act and resource management. The authority advises the state biodiversity boards regarding biodiversity management and resource use by the local communities. It helps set up Biodiversity Monitoring Committees (BMCs) and Biodiversity Monitoring Registers which local communities maintain. These registers are maintained with the view that scientists and researchers cannot study and survey all the different biodiverse regions in the country and so the local communities can be sought to collect this data.

The NBA also grants or declines permits for collection of natural resources through locals for commercial usage (e.g., harvest of medicinal plants).

Integrated management process

As is the situation in other countries, in India also freshwater systems and the biodiversity therein involve a myriad policymakers and stakeholders. After all everyone needs water to survive and that includes all human activities from producing food to running industries.

In India, freshwater systems have been compartmentalized beyond count. The water from a river in most cases belongs to the irrigation department, which may lease it out to the fisheries department. The fisheries department in turn introduces food fish that may be exotics or even invasives for 'sustenance and promotion of livelihoods'. The target numbers of fishes for these introductions are set by the National Fisheries Development Board who base it on the area of the water body and not on the needs of the local communities.

The substrata or river bed may belong to the mining department for sand used in construction. The banks are technically something known as 'patta land' that are, in most cases, encroached by plantation owners if they exist in the area. Depending on the part of the river in question the land surrounding it may belong to the forest department, the Public works department or the electricity board/power generation.

In some cases stretches of the river are leased out to the tourism department in order to cater to their mandate. The Marine Products Export Development Authority under the Ministry of

Commerce promotes harvest of wild populations of freshwater fish for international trade. The Ministry of Health has released many exotic and invasive species in the past as biological control for mosquito larvae as a measure to curb the spread of malaria. This is strange considering that A.G.K. Menon published a book on native larvivorous fish in the early 1990s and yet exotic fishes are being used till date. This is so because breeding techniques for these exotic species were already developed and there was no need to invest time and money in research and development of breeding techniques for natives. Hence, this may have proven to be a more economical option as opposed to breeding and releasing native species.

There is an urgent need to bring these various departments, ministries and agencies together to make sure that there is coordination in the activities and that no ecosystem is exploited beyond repair.

Freshwater Key Biodiversity Areas (KBAs)

Key biodiversity areas assessments for freshwater taxa in the Western Ghats assessment region was conducted as one of the follow-ups of the IUCN status assessments. The concept of Key Biodiversity Areas arose from the need for identifying sites of high biodiversity significance and is similar to earlier concepts such as Important Bird Areas and important Plant Areas. The criteria for identifying KBAs are that - the species must be assessed as Critical Endangered, Endangered or Vulnerable based on the IUCN categories and criteria; it should have a restricted distribution and the site may be vulnerable to destruction considering the level of threats and irreplaceable considering that the entire population or a large population of the trigger species is found within that site (Table 1).

Table 1. Criteria used to identify a freshwater KBA (Holland *et al.* 2012)

<p>Criterion 1: A site is known or thought to hold a significant number of one or more globally <u>threatened species</u> or other species of conservation concern. <i>Threshold: The presence of one or more CR, EN or VU species will trigger the site as a potential freshwater KBA.</i></p>
<p>Criterion 2: A site is known or thought to hold non-trivial numbers of one or more species (or infraspecific taxa as appropriate) of <u>restricted range</u>. <i>Threshold: A threshold value of 20,000 km² should be applied for crabs, fish and molluscs and a threshold value of 50,000 km² applied for odonates.</i></p>
<p>Criterion 3: A site is known or thought to hold a significant component of the group of species that are <u>confined to an appropriate biogeographic unit</u> or units. <i>Threshold: To trigger qualification at least 25% of the total species from a specific taxonomic group must be restricted to the freshwater ecoregion in which the catchment is located.</i></p>

During freshwater KBA identification exercise, 34 freshwater KBAs were identified for the Western Ghats states of Kerala, Tamil Nadu and southern Karnataka. Trigger species belonged to crabs, odonates, molluscs, aquatic plants and fish. The workshops for identification, delineation and validation were followed by the end-user workshop. The participants discussed policy implications and uses of KBAs. The participants deliberated the existing policies and the possibility of working KBAs within their framework.

KBAs play a significant role in understanding gaps in conservation of freshwater biodiversity when overlaid with the protected area layer. Many of these sites, which are drainages, fall outside protected areas and the trigger species that are already threatened suffer a grave risk of extinction. The policy brief aimed at policy makers will carry the message of conserving these species and these sites to target audience and hopefully trigger some positive response.

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Are Western Ghats endemic threatened freshwater fish protected? An analysis of the existing protected area network

The system of protected areas (PAs) in India is well established. A cursory look at the PAs indicates a distinct focus on terrestrial systems although many protected areas within the Western Ghats have been established as a combination of preservation of timber monoculture forests and catchments for reservoirs. The extent of freshwaters under the PA network in the Western Ghats is very poor as there are no dedicated freshwater protected areas. Fresh waters within a PA are not included specifically under any management, the terrestrial management focus confers no direct benefit to the system.

Based on the recent assessments of the Western Ghats fishes, and surveys conducted thereafter, analysis of species distribution, IUCN Red List status and protected areas were conducted to understand the effectiveness of the existing PAs for freshwater fish conservation. Distribution data from 100 Western Ghats endemic species of fish categorized as threatened were used for determining the effectiveness. Preliminary analysis using assessment data were used as the baseline and surveys conducted after the assessments were incorporated to fine tune the distribution. The assessment maps were produced using Hydrosheds with an average area of the drainage polygons at 1,500km². In the present analysis, Hydrobasin layer with an average area of drainage polygons at 100km² were used.

Distribution of point localities and hydrobasins of threatened and endemic freshwater fishes in given in Figure 1. Distribution of most of the threatened species does not coincide with the terrestrial protected areas. This is especially true for the northern Western Ghats. This trend is consistent even for the three threatened categories (Figure 2).

Only three of the total 12 Critically Endangered species are represented 100% in the existing protected areas while five species are outside protected areas (Table 1). With low median values of percent distribution in protected areas (Table 1) most of the threatened species predominantly lie outside the current terrestrial protected areas.

Table 1: Statistics of endemic and threatened freshwater fish species in protected areas.

Statistic	Critically Endangered	Endangered	Vulnerable
N	12	52*	30*
Median of distribution in PA	11	18	7
Mean (standard deviation) of distribution in PA	33 (43)	30 (32)	30 (41)
100% in PA	3	5	6
50-100% in PA	0	6	2
1-50% in PA	4	33	14
0% in PA	5	8	8

* One species each in these categories was synonymized to LC species after the 2011 Red List assessments. These two species are not considered for analysis.

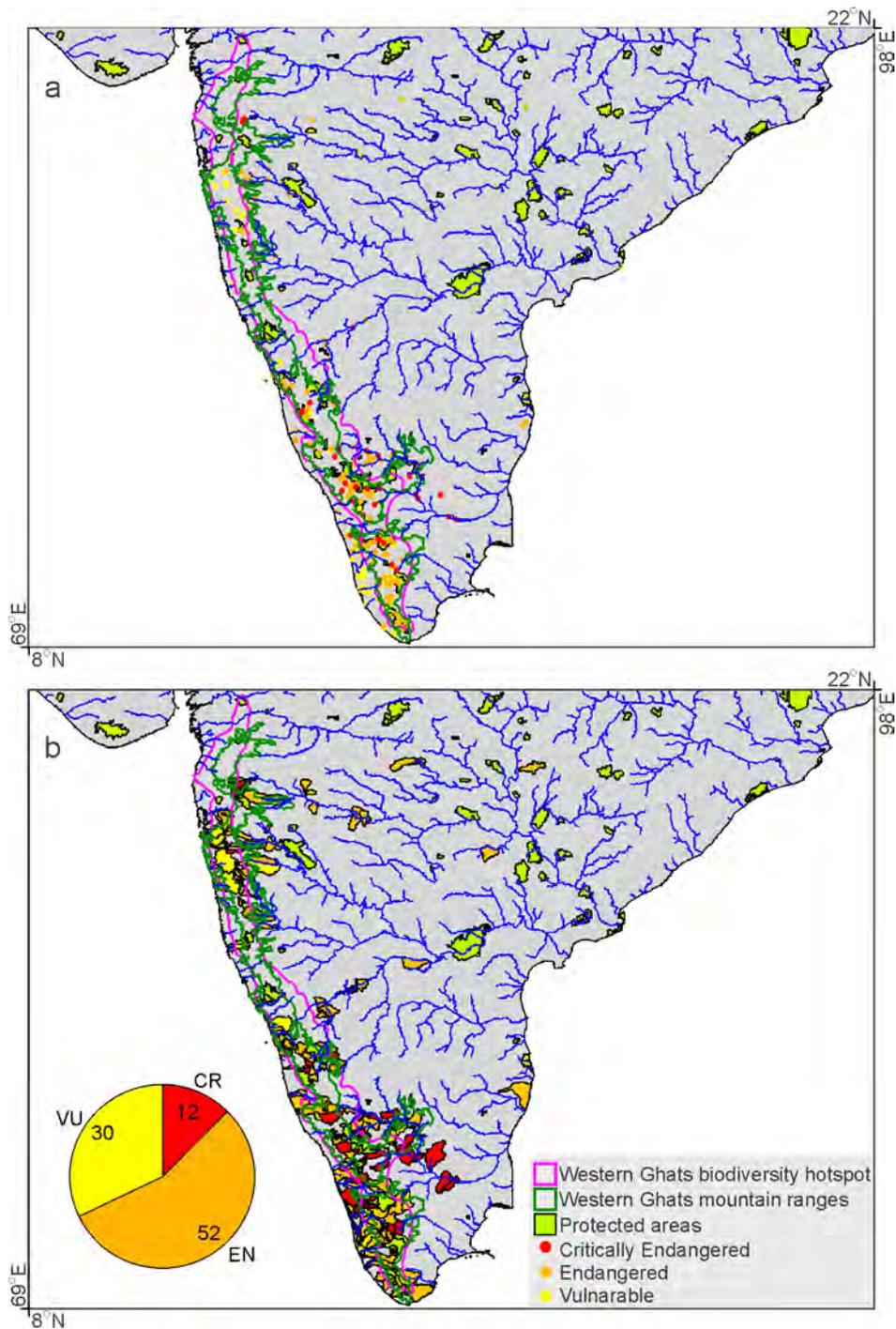


Figure 1: Distribution of threatened and endemic freshwater fish species in the Western Ghats as indicated by (a) point localities, and (b) hydrobasins.

There is an exponential decrease in the number of species with increase in the percent population in protected areas (Figure 3). This trend however is likely to be biased by the point endemics present exclusively in protected areas. We have not considered these point endemics in the analysis. See Appendix 1 for percent protected of threatened species.

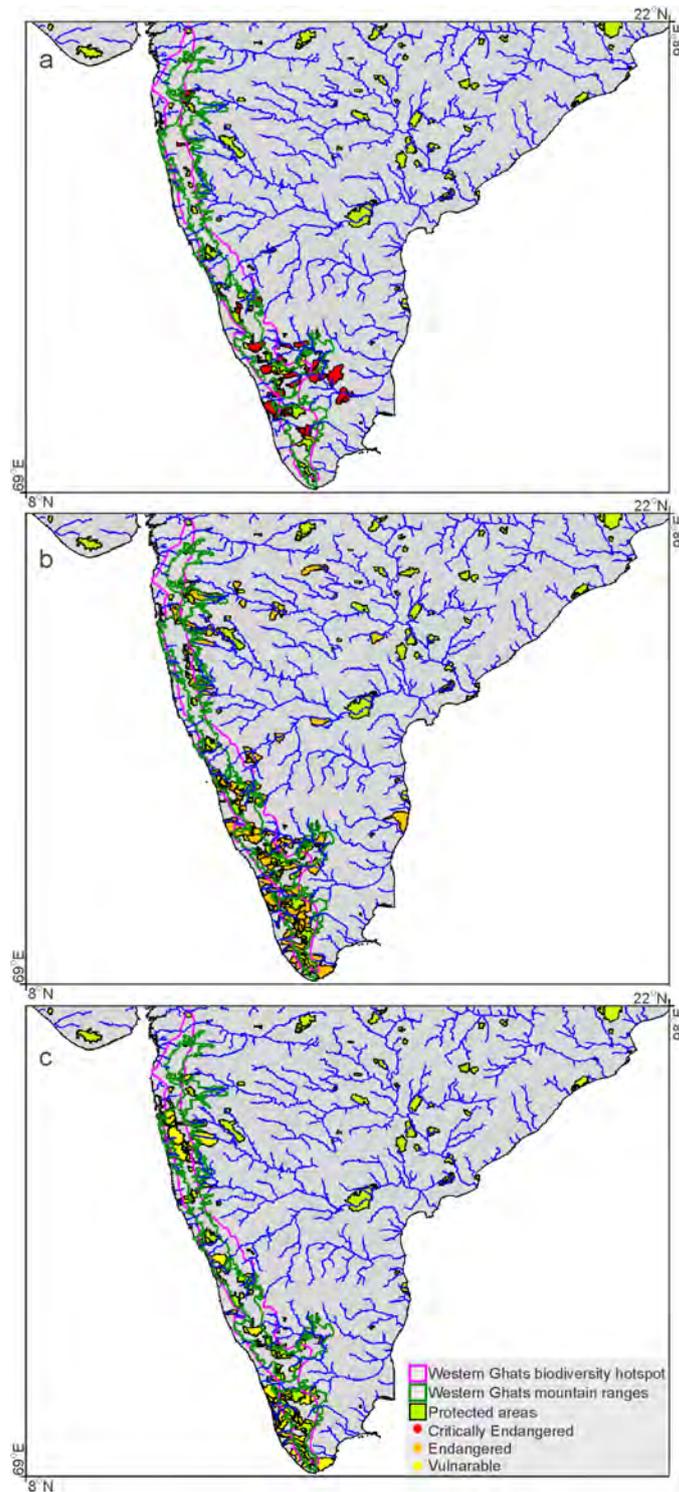


Figure 2: Distribution of (a) Critically Endangered, (b) Endangered, and (c) Vulnerable species in hydrobasins within the Western Ghats drainage.

Distribution of threatened species in various IUCN categories in protected areas is shown in Figure 4. More species have less than 50% distribution in protected areas (Figure 5). Appendix 1 is a list threatened species with proportion of population present in protected areas.

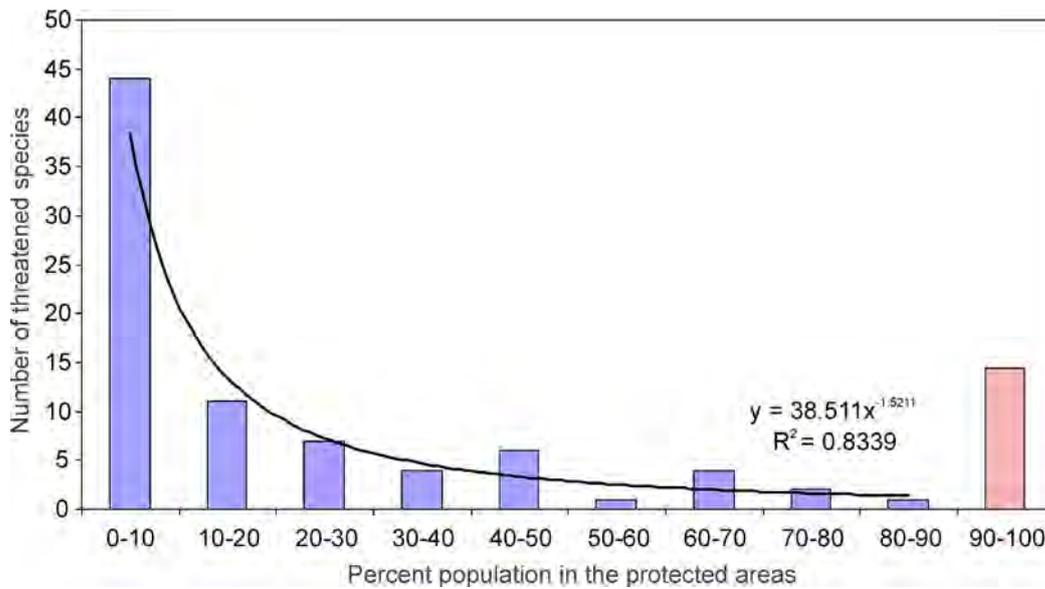


Figure 3: Frequency distribution of threatened and endemic species in protected areas. The red bar is biased by point endemics found only in protected areas, so it is not considered for finding the trend line.

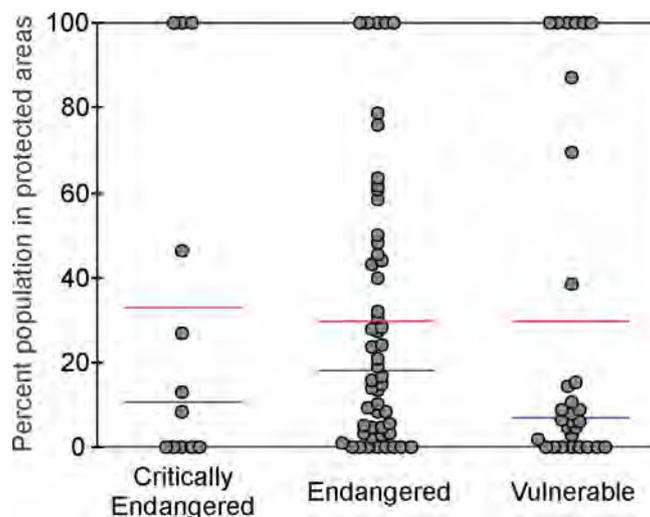


Figure 4: Distribution of threatened species in protected areas. Red line is the mean and blue line is the median.

Three out of nine proposed AZE species and five out of 12 suggested AZE species lie completely within protected areas (Fig. 6). This is an indication of the lack of freshwater specific conservation in the management plans of the protected areas, which traditionally show a bias towards terrestrial fauna and flora.

Several species in the Green Certificate proposed by MPEDA and freshwater fish species promoted as ornamental species in the poster distributed by MPEDA actually occur in protected areas. The lack of protection to freshwater fishes within or outside of protected areas indicates a direct conflict of the legal status of protected areas in the Wildlife Protection Act and the commonly traded commodities of the Ministry of Commerce. Presence of threatened fish in aquarium trade (Raghavan et al. 2013; Figure 6), especially those that are only in protected

areas suggests illegal harvesting of the fishes. While several species have a decreasing population trend, the species, which are found only in protected areas and are still decreasing casts severe doubts on the role of terrestrial protected areas on fish conservation. Population trends of several species found in protected areas are not known and studies of these species are essential. However, with the current hurdles in getting access to protected areas for scientific studies, gathering baseline data for conservation of these species will be problematic.

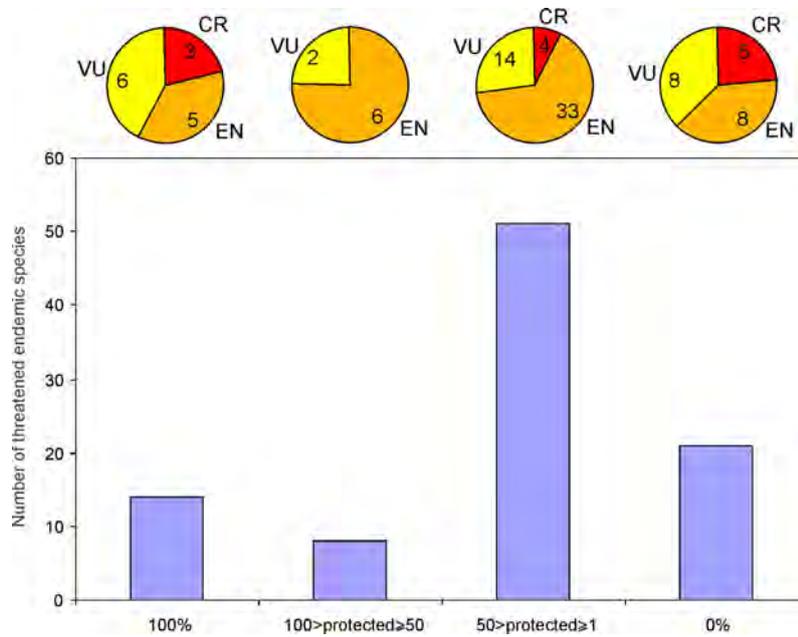


Figure 5: Species under different threatened categories in four bins of percent distribution in protected areas.

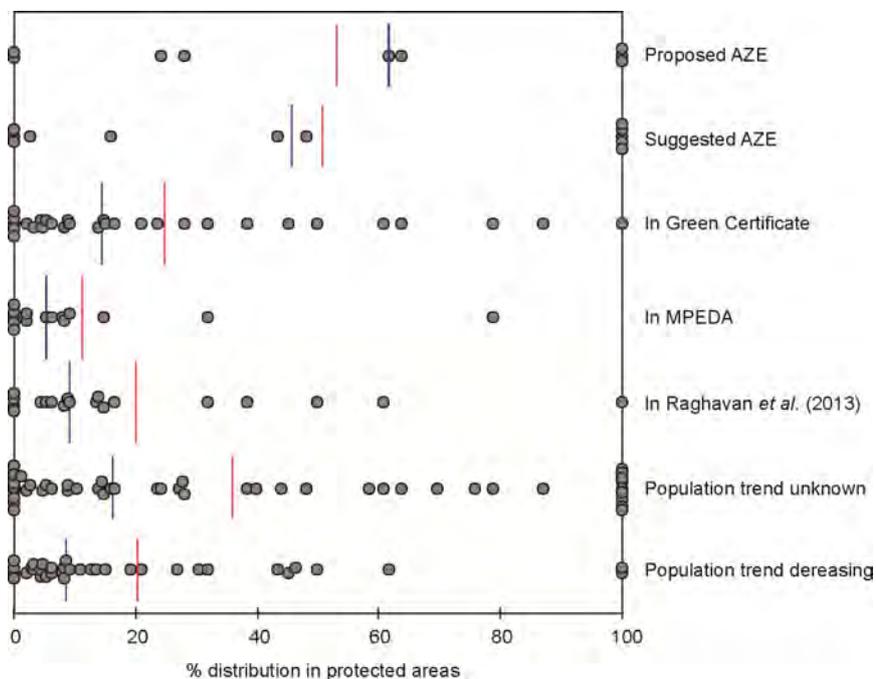


Figure 6: Distribution of different threatened and endangered fish species in protected areas according to their proposed and suggested Alliance for Zero Extinction (AZE) status, presence in green certificate, MPEDA listing and listing in Raghavan et al. (2013) aquarium trade analysis paper and their population trends. Red line is the mean and blue line is the median.

Freshwater fish have seldom been considered 'wildlife' and their conservation issues have rarely occupied the minds of the common public in India (and elsewhere around the world). Nevertheless, they are one of the most threatened groups of vertebrates with more than one third of the species on the verge of extinction. In the Western Ghats alone more than 50% of the described endemic fish species are threatened with extinction.

The freshwater ecosystems of the Western Ghats harbour an extraordinary diversity and endemism of fish, some of which are confined to the network of protected areas that dot the landscape. Yet protected areas in the region have never looked beyond the charismatic mega-vertebrate centric approaches. Take the case of the Periyar Tiger Reserve (PTR), which remains globally renowned for its large mammal diversity, especially for its tiger conservation efforts. Few know that it also harbours a unique assemblage of endemic freshwater fishes.

The park harbours the remaining populations of one genus, *Lepidopygopsis*, and eight species *Crossocheilus periyarensis*, *Garra mlapparaensis*, *G. periyarensis*, *Homaloptera silasi*, *Hypselobarbus periyarensis*, *Lepidopygopsis typus*, *Nemacheilus menoni* and *N. periyarensis* of endemic freshwater fish of which three have been listed as 'Endangered' and three as 'Vulnerable' in the IUCN Red List of Threatened Species.

Three of the eight endemic fishes are categorized as 'Endangered' qualifying the Periyar Tiger Reserve as an Alliance for Zero Extinction (AZE) site, which represent high conservation priorities. Species that are restricted to a single location and with a very high risk of extinction (i.e., Critically Endangered or Endangered) and falling within a single management unit qualify as AZE species.

Although these endemic and threatened species are 'protected' in view of their distribution inside the boundary of the national park, no conservation efforts focused on 'fish' are currently in place. Indiscriminate introduction, escape and proliferation of exotic species, and pollution are posing serious threats to these fish species. Several organizations including those represented by the authors of the present communication are now working together to eliminate the existing threats - holding the key to the continued survival of this unique assemblage of freshwater fishes.

Sanjay Molur & Rajeev Raghavan in Protected Area Update.

Appendix 1. Percent protected of threatened freshwater fishes of Western Ghats

Species	Category	Proportion in protected areas
<i>Crossocheilus periyarensis</i>	Endangered	100%
<i>Garra menoni</i>	Vulnerable	100%
<i>Garra periyarensis</i>	Vulnerable	100%
<i>Glyptothorax housei</i>	Endangered	100%
<i>Glyptothorax kudremukhensis</i>	Critically Endangered	100%
<i>Hypselobarbus periyarensis</i>	Endangered	100%
<i>Lepidopygopsis typus</i>	Endangered	100%
<i>Mesonoemacheilus herrei</i>	Critically Endangered	100%
<i>Mesonoemacheilus pambarensis</i>	Vulnerable	100%
<i>Nemacheilus menoni</i>	Vulnerable	100%
<i>Nemacheilus periyarensis</i>	Vulnerable	100%
<i>Parapsilorhynchus elongatus</i>	Endangered	100%
<i>Psilorhynchus tenuta</i>	Critically Endangered	100%
<i>Puntius mudumalaiensis</i>	Vulnerable	100%
<i>Garra hughi</i>	Endangered	50.1-99.9%
<i>Garra surendranathanii</i>	Endangered	50.1-99.9%
<i>Homaloptera montana</i>	Endangered	50.1-99.9%
<i>Horabiosia joshuai</i>	Endangered	50.1-99.9%
<i>Nemacheilus keralensis</i>	Vulnerable	50.1-99.9%
<i>Osteochilus longidorsalis</i>	Endangered	50.1-99.9%
<i>Puntius ophicephalus</i>	Endangered	50.1-99.9%
<i>Schistura sharavathiensis</i>	Vulnerable	50.1-99.9%
<i>Balitora mysorensis</i>	Vulnerable	0.1-50%
<i>Barbodes wynaadensis</i>	Critically Endangered	0.1-50%
<i>Barilius canarensis</i>	Endangered	0.1-50%
<i>Batasio sharavatiensis</i>	Endangered	0.1-50%
<i>Batasio travancoria</i>	Vulnerable	0.1-50%
<i>Botia striata</i>	Endangered	0.1-50%
<i>Carinotetraodon travancoricus</i>	Vulnerable	0.1-50%
<i>Channa diplogramme</i>	Vulnerable	0.1-50%
<i>Devario fraseri</i>	Vulnerable	0.1-50%
<i>Devario neilgherriensis</i>	Endangered	0.1-50%
<i>Gagata itchkeea</i>	Vulnerable	0.1-50%
<i>Garra kalakadensis</i>	Endangered	0.1-50%
<i>Glyptothorax anamalaiensis</i>	Endangered	0.1-50%
<i>Glyptothorax davissinghi</i>	Endangered	0.1-50%
<i>Glyptothorax madraspatanus</i>	Endangered	0.1-50%
<i>Glyptothorax trewavasae</i>	Vulnerable	0.1-50%
<i>Hemibagrus punctatus</i>	Critically Endangered	0.1-50%
<i>Homaloptera santhamparaiensis</i>	Endangered	0.1-50%
<i>Horabagrus brachysoma</i>	Vulnerable	0.1-50%
<i>Hypselobarbus curmuca</i>	Endangered	0.1-50%
<i>Hypselobarbus dubius</i>	Endangered	0.1-50%
<i>Hypselobarbus micropogon</i>	Endangered	0.1-50%
<i>Hypselobarbus mussullah</i>	Endangered	0.1-50%
<i>Hypselobarbus pulchellus</i>	Critically Endangered	0.1-50%

Species	Category	Proportion in protected areas
<i>Hypseobarbus thomassi</i>	Critically Endangered	0.1-50%
<i>Labeo potail</i>	Endangered	0.1-50%
<i>Laubuca fasciata</i>	Vulnerable	0.1-50%
<i>Longischistura striatus</i>	Endangered	0.1-50%
<i>Monopterus indicus</i>	Vulnerable	0.1-50%
<i>Nemacheilus pulchellus</i>	Endangered	0.1-50%
<i>Nemachilichthys shimogensis</i>	Endangered	0.1-50%
<i>Parapsilorhynchus discophorus</i>	Vulnerable	0.1-50%
<i>Pseudeutropius mitchelli</i>	Endangered	0.1-50%
<i>Pterocryptis wynaadensis</i>	Endangered	0.1-50%
<i>Puntius arenatus</i>	Vulnerable	0.1-50%
<i>Puntius arulius</i>	Endangered	0.1-50%
<i>Puntius cauveriensis</i>	Endangered	0.1-50%
<i>Puntius chalakkudiensis</i>	Endangered	0.1-50%
<i>Puntius crescentus</i>	Endangered	0.1-50%
<i>Puntius denisonii</i>	Endangered	0.1-50%
<i>Puntius rohani</i>	Vulnerable	0.1-50%
<i>Puntius setnai</i>	Vulnerable	0.1-50%
<i>Puntius tambraparniei</i>	Endangered	0.1-50%
<i>Schismatorhynchus nukta</i>	Endangered	0.1-50%
<i>Schistura nagodiensis</i>	Endangered	0.1-50%
<i>Silonia childreni</i>	Endangered	0.1-50%
<i>Thynnichthys sandkhol</i>	Endangered	0.1-50%
<i>Tor kulkarnii</i>	Endangered	0.1-50%
<i>Tor malabaricus</i>	Endangered	0.1-50%
<i>Travancoria elongata</i>	Endangered	0.1-50%
<i>Travancoria jonesi</i>	Endangered	0.1-50%
<i>Barbodes bovanicus</i>	Critically Endangered	0%
<i>Cirrhinus cirrhosus</i>	Vulnerable	0%
<i>Etroplus canarensis</i>	Endangered	0%
<i>Glyptothorax poonaensis</i>	Endangered	0%
<i>Horabagrus nigricollaris</i>	Endangered	0%
<i>Horalabiosa arunachalami</i>	Critically Endangered	0%
<i>Horalabiosa palaniensis</i>	Vulnerable	0%
<i>Hyporhamphus xanthopterus</i>	Vulnerable	0%
<i>Monopterus fossorius</i>	Endangered	0%
<i>Nemacheilus kodaguensis</i>	Vulnerable	0%
<i>Nemacheilus petrubanarescui</i>	Endangered	0%
<i>Parapsilorhynchus prateri</i>	Critically Endangered	0%
<i>Pseudosphromenus dayi</i>	Vulnerable	0%
<i>Puntius assimilis</i>	Vulnerable	0%
<i>Puntius deccanensis</i>	Critically Endangered	0%
<i>Puntius exclamatio</i>	Endangered	0%
<i>Puntius fraseri</i>	Endangered	0%
<i>Puntius pookodensis</i>	Critically Endangered	0%
<i>Puntius sharmai</i>	Endangered	0%
<i>Salmophasia belachi</i>	Vulnerable	0%
<i>Salmophasia horai</i>	Vulnerable	0%

Preliminary analysis of protected area effectiveness for Western Ghats reptiles

In a recent assessment of reptiles of the Western Ghats, a total of 227 species belonging to 20 families were assessed of which 107 species (47.13 per cent) are endemic to the hotspot. The reptilian diversity of Western Ghats is represented by Crocodylia (crocodiles), Testudines (terrapins & tortoises) and Squamata including Sauria (lizards) and Ophidia (snakes) (Table 1). In the assessment however testudines were not considered.

Table 1: Family-wise species richness in reptiles of the Western Ghats

Reptile family	No. of species	Western Ghats endemics
Crocodylidae	1	0
Agamidae	14	7
Boidae	3	1
Chamaeleonidae	1	0
Colubridae	43	14
Elapidae	9	1
Eublepharidae	2	0
Gekkonidae	50	23
Gerrhopilidae	2	2
Lacertidae	5	0
Natricidae	6	2
Psammophiidae	3	0
Pseudoxyrhopiidae	1	0
Pythonidae	1	0
Scincidae	34	16
Typhlopidae	6	2
Uropeltidae	35	33
Viperidae	7	3
Xenodermatidae	3	3
Varanidae	1	0
Total	227	107

The assessments indicate that more Western Ghats endemics are categorized as threatened compared to the non-endemic species.



Of the Western Ghats endemics, 16% are threatened (Endangered or Vulnerable; no Critically Endangered) and 8% are Near Threatened (Table 1; Fig. 1). The reasons for threats include some of the common factors such as conversion of forest tract to human habitation, commercial plantations & agriculture, logging, illegal mining activities, extensive use of pesticides in plantations, and tourism-related infrastructure development.

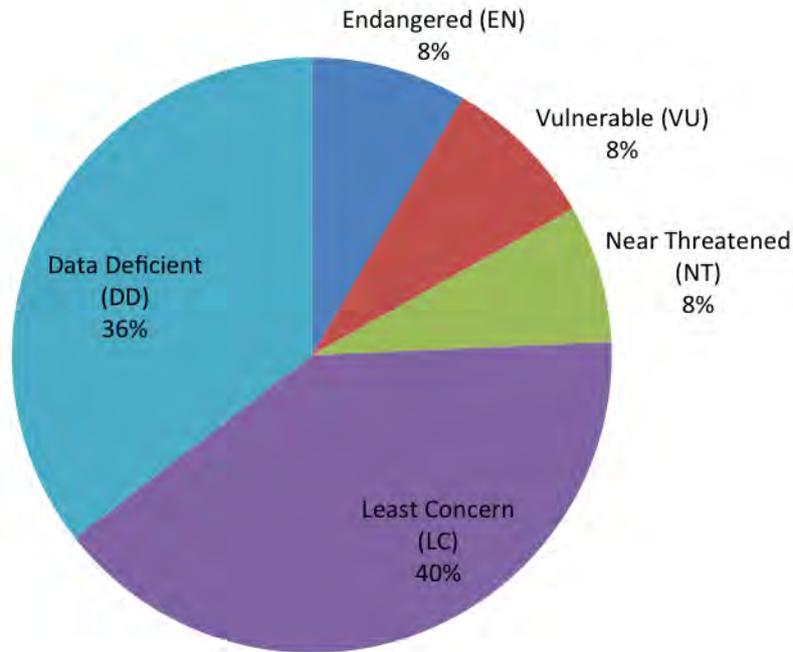


Figure 1: Percent representation of Western Ghats endemic reptiles in various IUCN Red List categories.

The knowledge about reptiles of Western Ghats is poor. There is a general lack of understanding of life history traits, population and ecology. This lack of knowledge has greatly impeded our ability to formulate action plans and strategies to conserve these species and their habitats. For a majority of the species there are no species-specific conservation measures.

Research into the ecology, biology, population trends, habitat requirements of the reptiles is a very high priority for any reasonable and effective conservation plan to be conceived and acted upon.



Of the species endemic to both Western Ghats 36% are Data Deficient! No data other than the original descriptions exist for them. The assessments and the several recent publications on reptile diversity indicate that the group is plagued by taxonomic uncertainties. This impedes conservation action. Taxonomic research is highly recommended along with concerted efforts to locate and study Western Ghats reptiles is needed to re-evaluate their status and accord them protection.

Reptilian species included under the protection schedules of the Indian Wildlife Protection Act are: *Crocodylus palustris*, *Elachistodon westermanni*, *Varanus bengalensis* (Schedule I part II); *Naja naja*, *Ophiophagus hannah*, *Daboia russelii*, *Xenochrophis piscator*, *Ptyas mucosa*, *Atretium schistosum* (Schedule II part II); all other snakes belonging to families Boidae, Colubridae, Elapidae, Hydrophiidae, Typhlopida, Uropeltidae, Viperidae and Xenopeltidae (Schedule IV). Although these species are accorded protection, human apathy, superstitious beliefs, man-animal conflicts, hunting for subsistence, hunting for food, for skin, pet trade, and for traditional medicine is taking a toll on the populations of majority of the reptilian species. Education and awareness about the reptiles and the ecosystem services provided by them is needed to better conserve the species and their habitats.



Reptiles in protected areas of Western Ghats

The protected area system in India including the Western Ghats is more inclusive of terrestrial biodiversity and their preservation. Land reptiles are therefore assumed to have a better representation in the existing protected areas albeit the fact that protected areas were initially not created to protect wildlife, but to protect natural resources for harvest (timber forests) and modified landscapes for human use (watersheds and reservoirs).

In the human-dominated Western Ghats landscape, protected areas are subject to intense land use conflicts ranging from timber harvests, monocultures, alien invasive species, minor forest produce collection, livestock grazing, tourism, mining, water harvest, damming and others. This situation and the lack of a master plan for creating protected areas for wildlife conservation has created other conflicts, the most common and increasing one – human-wildlife conflict around protected areas.

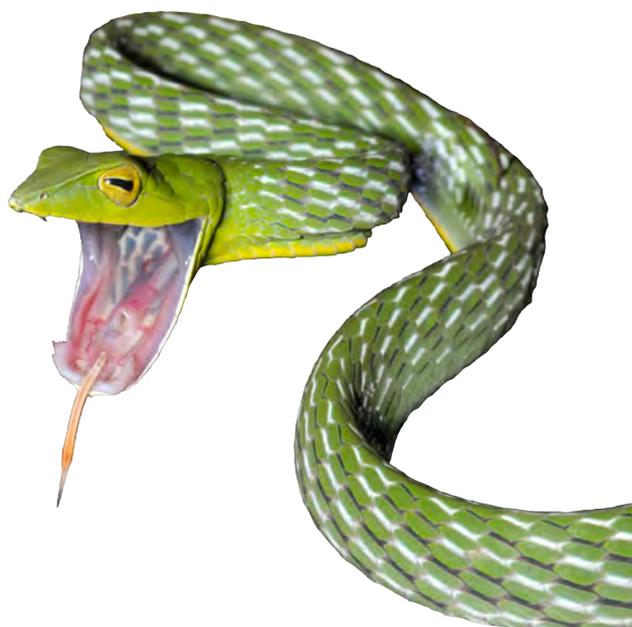


Table 2: Representation of percent range of reptile species in the Western Ghats protected areas

Family	Scientific name	Status	% area in protected area
Agamidae	<i>Calotes aurantolabium</i>	DD	50.1-99.9
Agamidae	<i>Otocryptis beddomii</i>	EN	0.1-50
Boidae	<i>Eryx whitakeri</i>	NT	0.1-50
Colubridae	<i>Ahaetulla dispar</i>	NT	0.1-50
Colubridae	<i>Ahaetulla perroteti</i>	EN	0.1-50
Colubridae	<i>Boiga dightoni</i>	DD	0.1-50
Colubridae	<i>Boiga nuchalis</i>	DD	0.1-50
Colubridae	<i>Dendrelaphis chairecacos</i>	DD	0.1-50
Colubridae	<i>Oligodon brevicauda</i>	VU	0.1-50
Colubridae	<i>Oligodon nikhili</i>	DD	0
Gekkonidae	<i>Cnemaspis australis</i>	DD	50.1-99.9
Gekkonidae	<i>Cnemaspis beddomei</i>	DD	0.1-50
Gekkonidae	<i>Cnemaspis goensis</i>	EN	0.1-50
Gekkonidae	<i>Cnemaspis heteropholis</i>	NT	0.1-50
Gekkonidae	<i>Cnemaspis indica</i>	VU	0.1-50
Gekkonidae	<i>Cnemaspis indraneildasii</i>	VU	0.1-50
Gekkonidae	<i>Cnemaspis jerdonii</i>	VU	0.1-50
Gekkonidae	<i>Cnemaspis kolhapurensis</i>	DD	0
Gekkonidae	<i>Cnemaspis littoralis</i>	DD	0.1-50
Gekkonidae	<i>Cnemaspis monticola</i>	DD	0
Gekkonidae	<i>Cnemaspis nilagirica</i>	DD	0.1-50
Gekkonidae	<i>Cnemaspis ornata</i>	NT	0.1-50
Gekkonidae	<i>Cnemaspis sisparensis</i>	NT	0.1-50
Gekkonidae	<i>Cnemaspis wynadensis</i>	EN	0.1-50
Gekkonidae	<i>Hemidactylus albofasciatus</i>	VU	0.1-50
Gekkonidae	<i>Hemidactylus anamallensis</i>	NT	0.1-50
Gekkonidae	<i>Hemidactylus satarraensis</i>	VU	0.1-50
Gerrhopilidae	<i>Gerrhopilus beddomii</i>	DD	0.1-50
Gerrhopilidae	<i>Gerrhopilus tindalli</i>	DD	0.1-50
Scincidae	<i>Chalcides pentadactylus</i>	DD	0
Scincidae	<i>Dasia subcaerulea</i>	EN	0.1-50
Scincidae	<i>Eurylepis poonaensis</i>	EN	0
Scincidae	<i>Eutropis clivicola</i>	EN	0.1-50
Scincidae	<i>Eutropis gansi</i>	DD	0.1-50
Scincidae	<i>Kaestlea palnica</i>	DD	0
Scincidae	<i>Lygosoma goensis</i>	DD	0.1-50
Scincidae	<i>Ristella guentheri</i>	DD	0.1-50
Scincidae	<i>Ristella rurkii</i>	DD	0.1-50
Scincidae	<i>Ristella travancorica</i>	DD	0.1-50
Typhlopidae	<i>Typhlops exiguus</i>	DD	0
Typhlopidae	<i>Typhlops thurstoni</i>	DD	0.1-50
Uropeltidae	<i>Melanophidium bilineatum</i>	VU	0.1-50
Uropeltidae	<i>Platyplectrurus madurensis</i>	EN	0
Uropeltidae	<i>Platyplectrurus trilineatus</i>	DD	0.1-50

Family	Scientific name	Status	% area in protected area
Uropeltidae	<i>Plectrurus aureus</i>	DD	0.1-50
Uropeltidae	<i>Plectrurus canaricus</i>	DD	0.1-50
Uropeltidae	<i>Plectrurus guentheri</i>	DD	0.1-50
Uropeltidae	<i>Rhinophis fergusonianus</i>	DD	0.1-50
Uropeltidae	<i>Rhinophis travancoricus</i>	EN	0
Uropeltidae	<i>Uropeltis beddomii</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis bicatenata</i>	NT	0.1-50
Uropeltidae	<i>Uropeltis broughami</i>	DD	0
Uropeltidae	<i>Uropeltis dindigalensis</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis liura</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis macrorhynchus</i>	DD	50.1-99.9
Uropeltidae	<i>Uropeltis maculatus</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis myhendrae</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis nitidus</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis petersi</i>	DD	0.1-50
Uropeltidae	<i>Uropeltis phipsonii</i>	VU	0.1-50
Viperidae	<i>Peltopelor macrolepis</i>	NT	0.1-50
Viperidae	<i>Trimeresurus strigatus</i>	DD	0.1-50
Xenodermatidae	<i>Xylophis stenorhynchus</i>	DD	50.1-99.9

The Table 2 and Figures 2 & 3 indicate highly skewed distribution of endemic and threatened reptiles in the Western Ghats compared to the proportion of distribution within protected areas. On an average around 15% of the total distribution area of threatened species (EN and VU) are in protected areas and around 20% for Near Threatened and Data Deficient species. The median values are lower in all the cases (Figure 3). A cursory look at the point locality distribution of threatened reptiles plotted on the protected area layer also indicates minimal overlap (Figure 3).

A similar trend is seen in the point locality distribution map of Near Threatened reptiles on the protected area overlay with very few points overlapping protected areas albeit the representation is gross and not to scale (Figure 4).



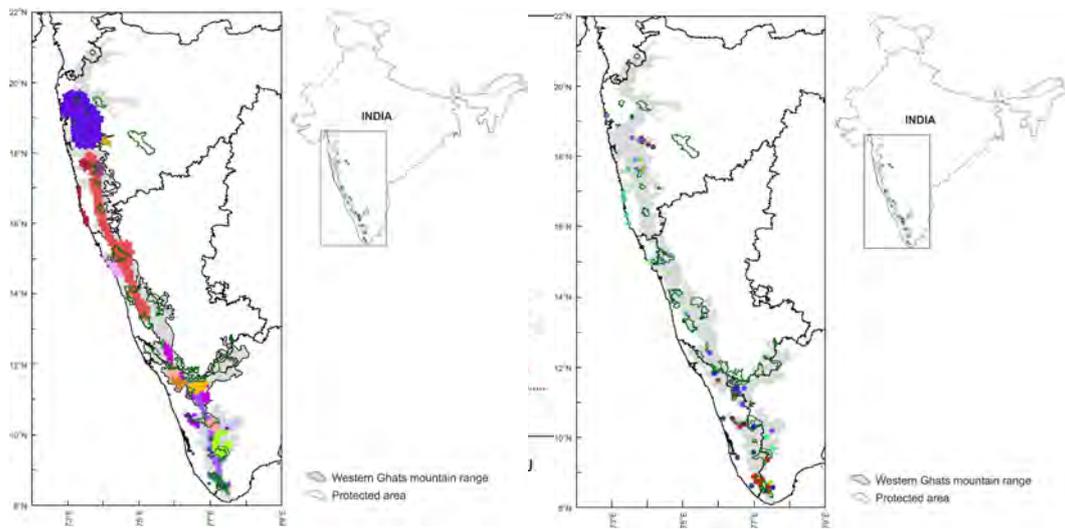


Figure 2: Distribution of Western Ghats endemic and threatened reptile species. Note that this is overlay of different distribution maps.

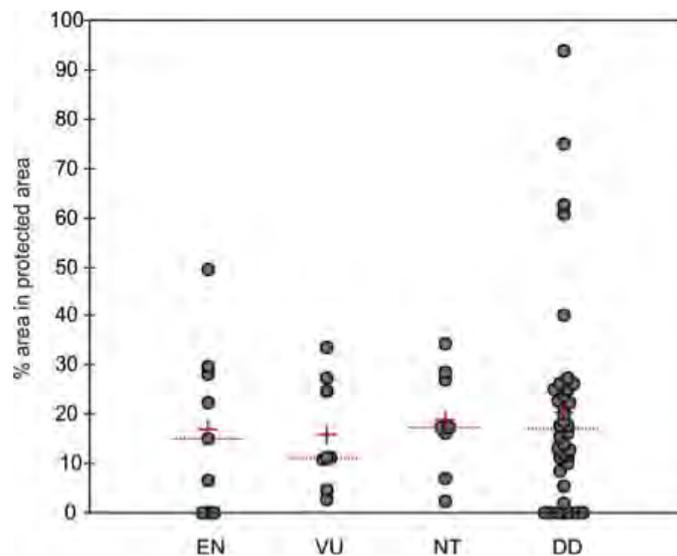


Figure 3: Percent area under protected area occupied by Western Ghats endemic reptile species under different categories.

As expected, the total area of all Endangered and Vulnerable reptiles is much lower than total area of Near Threatened species in the Western Ghats (Figure 5). However, when compared with the Data Deficient species, the total area falls much lower than the area of the few Vulnerable species. This is significant from the point of view of inadequate information of very poorly studied, understood and taxonomically resolved group of animals.



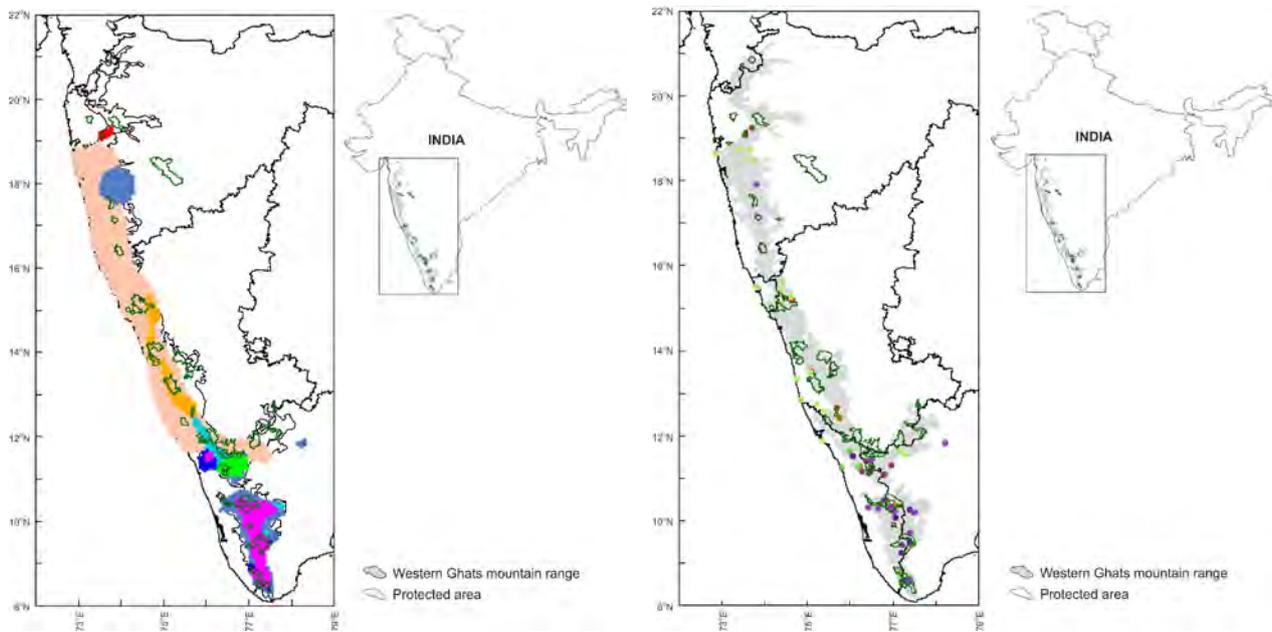


Figure 4: Distribution of Western Ghats endemic and Near Threatened reptile species. Note that this is overlay of different distribution maps.

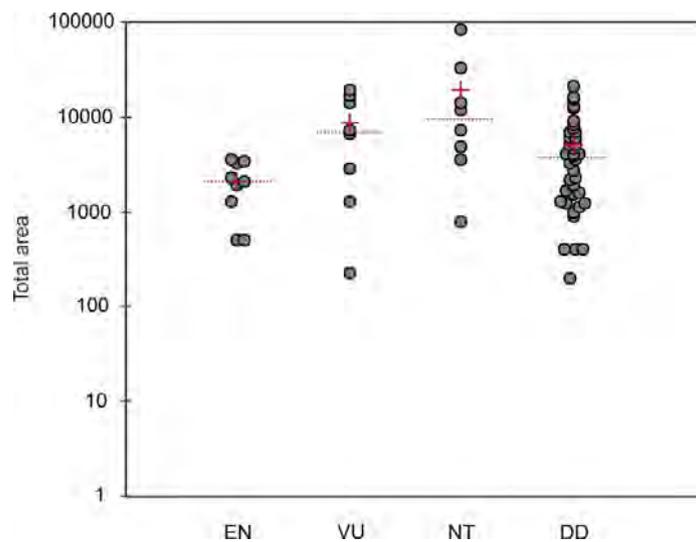


Figure 5: Total area occupied by Western Ghats endemic reptile species under different categories. Mean total area of distribution increased from EN to VU and NT. For DD the mean total area is lower than for the VU category.

In gross area of reptiles in protected areas (Figure 6), the Near Threatened species are the best represented with an average of around 2000km² of the overall extent of

occurrence occurring within protected areas. However, for threatened species, this gross area reduces to under 900km² for Vulnerable species and under 700km² for Endangered species. The average for Data Deficient species is lower than for Vulnerable species indicating the need for a thorough assessment and higher levels of protection. The median value for all the categories, except Endangered is higher than the average area in protected areas.

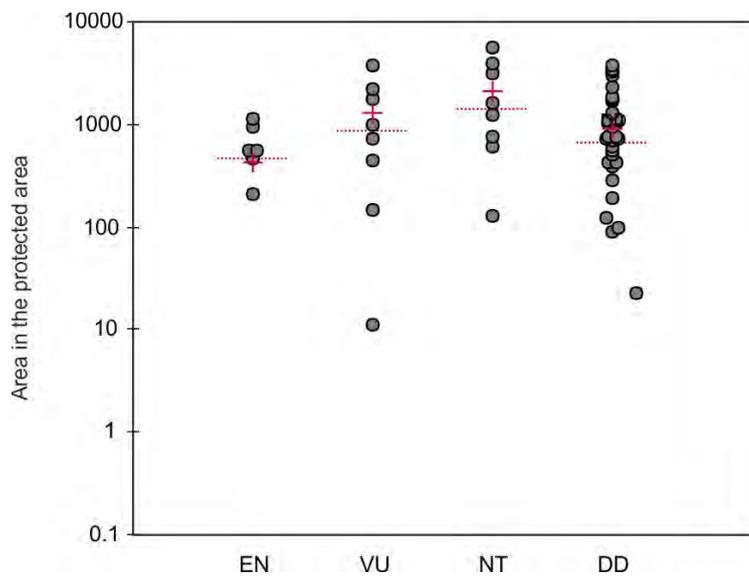


Figure 6: Area under protected area occupied by Western Ghats endemic reptile species under different categories.

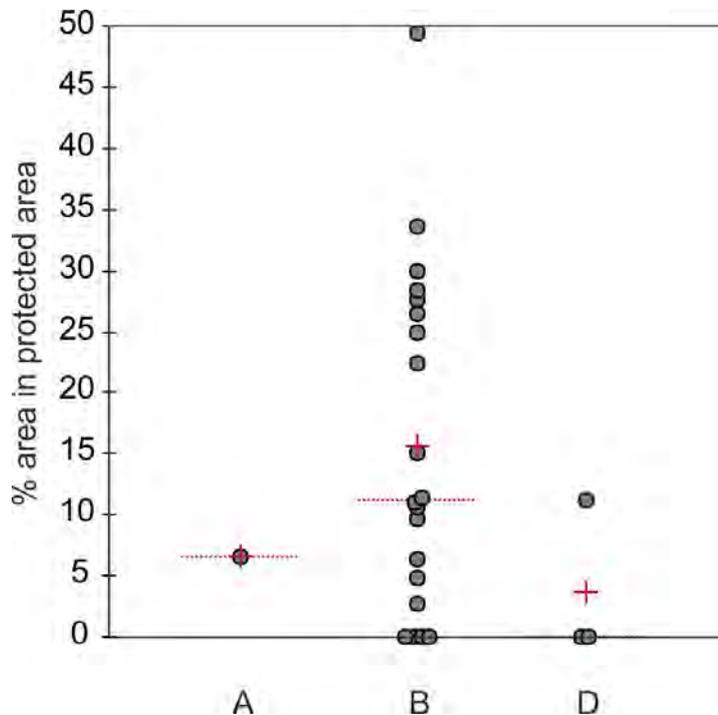


Figure 7: Percent area under protected area under different criteria.

The best representation of the percent area of reptile in existing protected areas is in Figure 7, where reptiles assessed as threatened due to population decline (criterion A) have a very low representation in protected areas, perhaps a significant insight to the need for holistic on-the-ground protection of species that are in rapid decline due to harvests. The graph also shows a very low percent area of highly restricted species as per criterion D, a reflection of two extremely vulnerable species with no representation in any protected area. As Criterion B (restricted distribution and continuing decline) was most frequently used in assessing threatened species, the graph shows a defining ineffectiveness of the existing protected area network in protecting reptiles in the Western Ghats. A mere 15% of the area of threatened reptiles are within protected areas on an average and the median indicates closer to 12%.

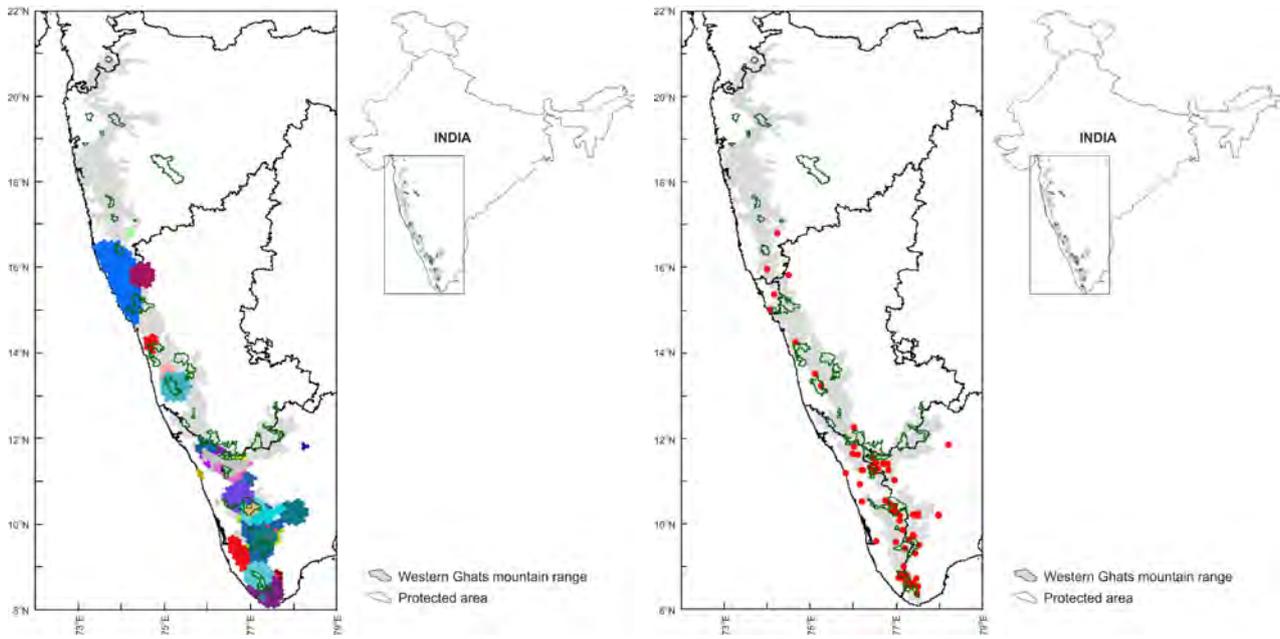


Figure 8: Distribution of Western Ghats endemic and DD reptile species. Note that this is overlay of different distribution maps.

Existing information on the total area of endemic and threatened Western Ghats reptiles indicates an increase in the mean total area of species distribution as the risk of extinction decreases (Fig. 5). Similarly, widely distributed species have a better chance of being represented in the existing protected areas (Fig. 6) and in reality the higher the threatened a species is, the lower is the probability of it being recorded from protected areas. Figures 5 and 6 also indicate the average total area and average area within protected areas is more for Data Deficient species as compared to Vulnerable or Near Threatened Species. This is an artefact of the assessment process where due to lack of taxonomic clarity many reptiles were categorized as Data Deficient even though the distribution range of the species complexes revealed a wide distribution. This disparity will be resolved as taxonomic clarity and further surveys provide better and detailed distribution maps. In that instance the representation of endemics within protected areas may increase in proportion as well as those not represented within the existing protected areas due to small distribution ranges outside.

In summary, the present knowledge on endemic reptiles of the Western Ghats correlated with the existing protected area network indicates a gross mismatch with very few threatened endemics represented fairly well (>50% of the total distribution area) in protected areas. With increasing knowledge on taxonomy and better surveys, it is likely that more restricted species will be identified from within protected areas.



Conservation prioritization of freshwater fishes in the Western Ghats.

Freshwater fish in India, totaling more than 900 species known to science, is one of the largest vertebrate groups. The knowledge on the diversity in this taxonomic group is one of the least compared to all other vertebrates, with an estimate of less than 20% described until date. Fishes are popular as food and as pets. Their existence is often taken for granted and generally disregarded during conservation planning or prioritization. Fishes are commonly lumped with other freshwater taxonomic groups and neglected as 'out-of-sight-and-out-of-mind'.

The Western Ghats is home to more than 300 species of freshwater fishes with more than 50% of those endemic to the hotspot. It is estimated that the region could hold anywhere up to 1500 species, most of the species restricted to very small areas of distribution in highly specialized niches.

Status of Freshwater fishes in the Western Ghats

Freshwater fish play a vital part of the livelihood of many communities in India and inland fisheries contributes to about half of the total fisheries of our country. They play a vital role in the ecosystem of controlling insect populations indicate the health of an aquatic system. But this resource is threatened and needs immediate conservation action. The assessment of 290 species from the Western Ghats informs that close to 40% of these species are threatened with extinction and over 50% of these threatened species are endemic to the Western Ghats (Molur et al. 2011; Fig. 1).

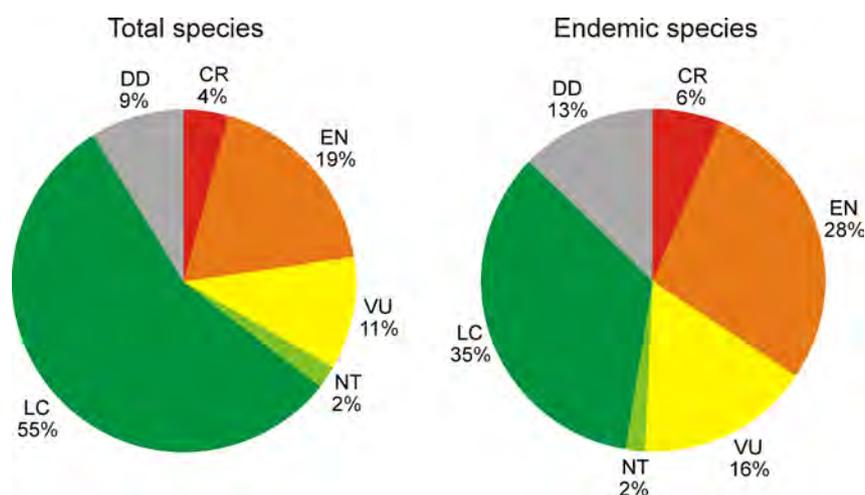


Figure 1 | Distribution of total and endemic freshwater fishes of Western Ghats in different IUCN categories.

Some of the threats plaguing fish are invasive species introduced from outside the country (namely, African Catfish, Guppies and Tilapia among others) and exotic species from within the country but different river systems; aquarium trade of fish species threatened with extinction in the international market in large numbers (Raghavan et al.), some of which are found only within protected areas; pollution through run-off from pesticides used in plantations

(cardamom, coffee and tea) and habitat degradation and modifications (loss of riparian & aquatic vegetation used by fish for egg-laying, building dams and sand mining). Following the IUCN Red List Categories and Criteria guidelines (see Molur et al. 2011), the threat assessments were made based on either population decline, restricted distribution & continuing decline, and restricted area. In some instances threatened species qualified for more than one criterion. Figure 2 indicates the qualifying criteria of the threatened fishes of the Western Ghats. While most threatened species qualified based on restricted distribution & continuing decline (Criterion B), some qualified on a precautionary principle of restricted area and having no current threats, but perceptible ones in the near future (Criterion D). Nearly 20% of the species qualified under Criterion A for population declines due to overexploitation.

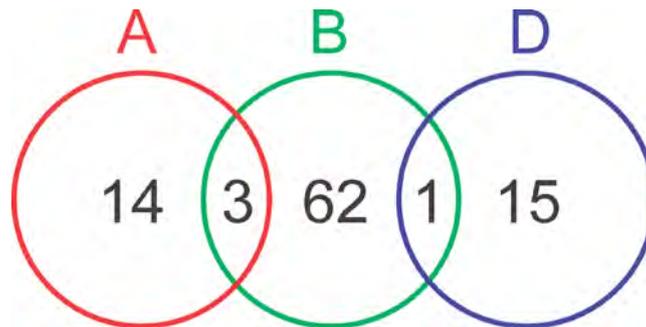


Figure 2| Venn diagram showing various criteria used for assessing the threatened fishes of the Western Ghats. Criterion A implies population decline, B implies restricted geographical distribution and D implies small population size or spread. A species can be assessed as threatened based on multiple criteria.

Most species were assessed as Endangered as also most families. The total number of Critically Endangered species and families are relatively small compared to the next high Vulnerable category (Fig 3). Most of the EN species categorization was based on restricted distribution and continuing decline as species with a distribution range of less than 5000km² and/or area of occupancy of less than 500km² found in typically less than 5 locations or in severely fragmented locations were negatively influenced by various threats like habitat loss, pollution, fragmentation, alien invasive species, or degradation in habitat quality due to sand mining, solid waste disposal, pesticides, among other human-influenced activities.

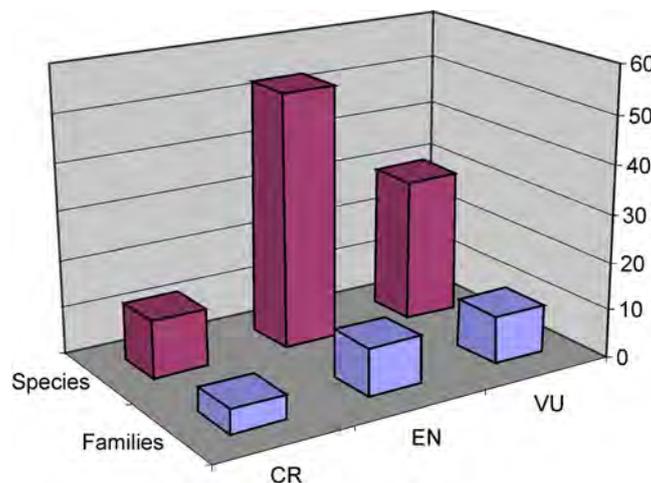


Figure 3| Species and family wise distribution of freshwater fishes of Western Ghats in different IUCN categories.

Threats to freshwater fishes in the Western Ghats include those that directly impact habitat and species. Pollution from urban/domestic and agriculture/forestry wastes is one of the major threats impacting all freshwater fishes followed by harvests (Figs. 4 & 5). Invasive alien species introduced either as food fish or by accident, and escapees from ornamental trade have impacted negatively on the native fishes of the Western Ghats. This threat is increasing with more exotics introduced into the systems. In addition other major threats include development and natural resource modifications such as damming.

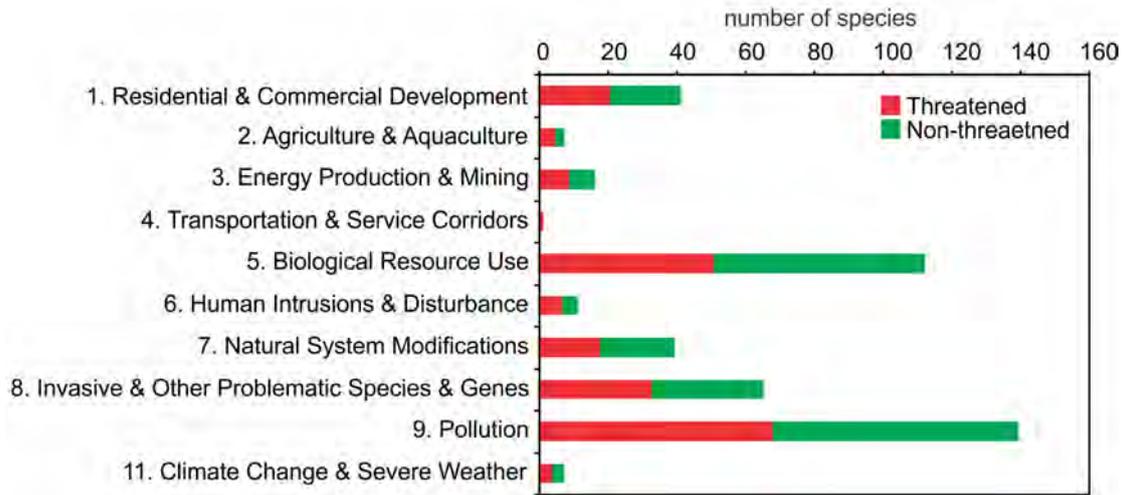


Figure 4| Threats to the freshwater fishes of Western Ghats.

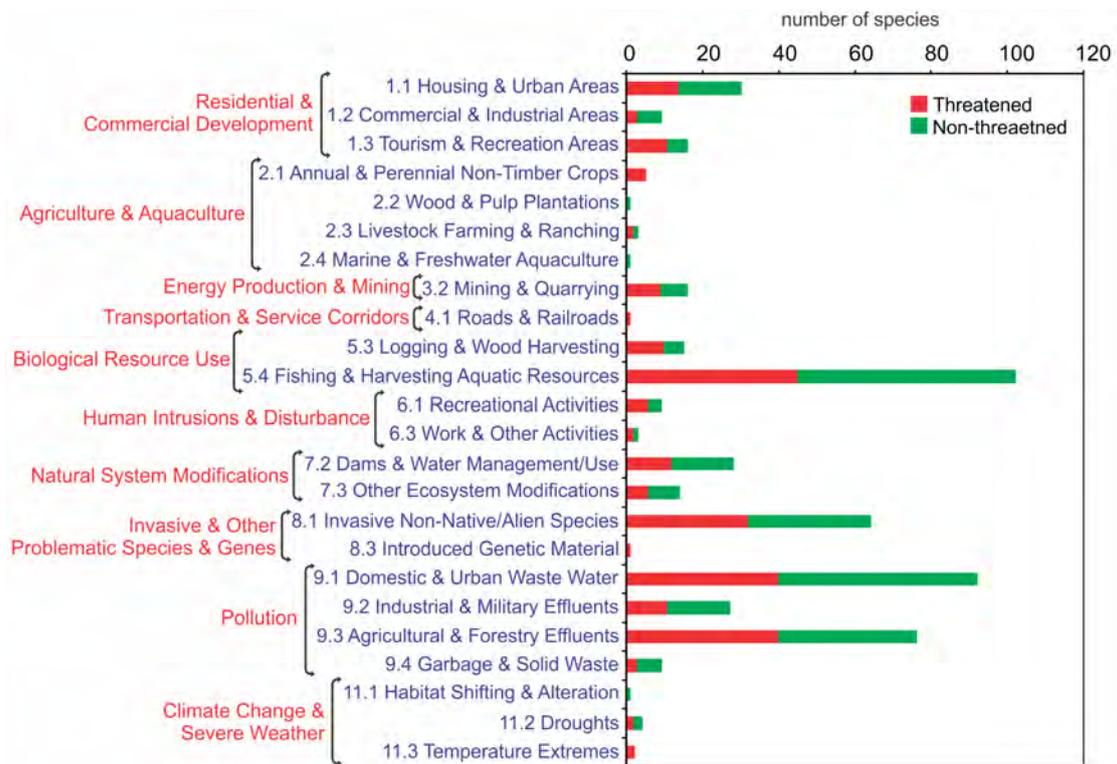


Figure 5| Detailed threats to the freshwater fishes of Western Ghats.

Resource use as a threat to freshwater fishes in addition to all other threats have a major impact on the status of species. Each of these threats needs to be addressed with specific laws. However, given that most laws on freshwaters in India deal with livelihoods, benefit sharing, development, and other issues, it is best to address the threats posed directly to species at this point in time.

Freshwater fishes are exploited for food and for aquarium trade. While many native species are in trade for food, due to the increasing use of exotic species introduced by the fisheries department, fishing communities in many parts of the Western Ghats are now forced to fish introduced fisheries such as carps and tilapia. These species have also replaced many native species in local markets. However, some native fishes are still preferred by the locals, especially species like mahseers, which are sought after. Thirty of the 95 threatened species in the Western Ghats are fished for sustainable and commercial purposes. These fishes, in many parts, are important to sustain local livelihoods, especially sustenance. However, many of these species are also commercially exploited on a large scale thereby impacting the populations in the wild.

In addition, 19 threatened species are harvested from the wild in the ongoing trade of native species as ornamental fishes for export (Raghavan et al. 2012). In view of the increasing economic benefits from exports, the Ministry of Commerce’s Marine Products Exports Development Authority has identified 30 threatened species for export under the Green Certificate scheme. The certification process is an attempt to set in place responsible collection of fish from the wild with adequate importance to benefit sharing and equitable resource use. The certification process does not include a captive breeding plan for sustainable captive populations to encourage exports. Given the direct conflict between conservation and exploitation and that fishes are not included in the Indian Wildlife Protection Act, an attempt is made here to introduce a balanced approach of conservation and sustenance.

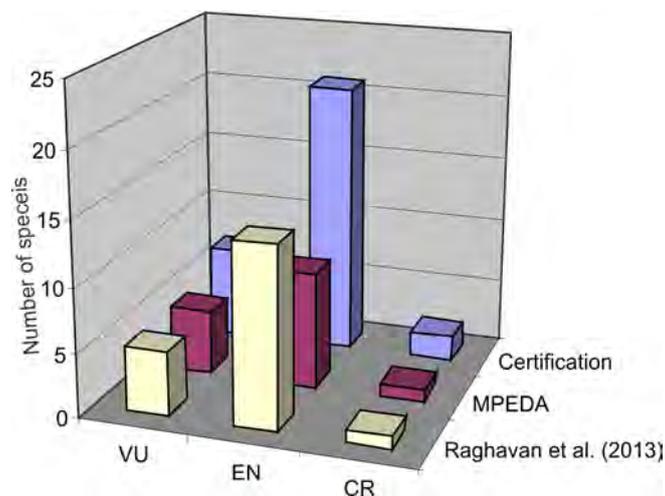


Figure 12| Distribution of threatened freshwater fishes of Western Ghats in different IUCN categories, which are either in trade (MPEDA and Raghavan et al. 2013) or are promoted in trade by enlisting in green certification. Note that the number of species across trade categories are not additive as same species can be present in different lists.

From the various meetings and one-on-one informal interviews with several people from different stakeholder agencies, it is clear that including fish in the WPA is not advisable. Hence a series of approaches were tried out from looking at linear analyses to multi-layered analyses of threats, use and conservation, and finally a system of ranking the fishes has been adopted. The idea of the exercise is not to discourage sustainable fisheries and livelihoods, rather to introduce achievable goals for compliance by commercial fisheries and traders by encouraging captive breeding and sustenance for exports and local trade.

Ranking system for conservation prioritization

The system is mainly to identify species that are in absolute need for legislative protection as provided by the Indian Wildlife Protection Act as well as for comprehensive conservation action without legislative inclusion. Heeding the advice from local communities and other stakeholders including those from the Ministry of Environment & Forests, various personnel of the Western Ghats states Forest Departments, academics, NGOs, conservationists and field directors of protected areas, the system has been developed to address the issue of sustainable livelihood practices as a priority while addressing the conservation action needed to save species from the risks of extinction.

The system is only for native species and is not set up for exotic species. The system also best addresses, at this point in time, only threatened species and not those assessed as Least Concern. Least Concern species are not included in this evaluation system. Species assessed as LC can be encouraged for commercial exploitation keeping in place all of the ethics and sustainability practices. In case the species is re-categorised as threatened either due to threats or from change in the taxonomic and distribution knowledge, then the same will become eligible for the evaluation system for conservation prioritization.

Freshwater fish species

Category	Criteria	Points	Remark
Origin	Native	1	
	Introduced	0	
Status (IUCN Red List status at the global level)	Threatened	3	Least Concern species are not included in this evaluation system.
	Near Threatened / Data Deficient	2	
	Not Assessed	1	
	Not Evaluated	0	
Value (Food, commercial, aesthetic, use, economic, biological, etc.)	Commercial (Aquarium/Food)	3	In case of a species harvested for subsistence and commercial purposes, the value for subsistence (1) is used for species prioritization ranking and not of the commercial value (3)
	Aesthetic / By-catch	2	
	Subsistence	1	
	None	0	
Protection (Proportion of population estimated to be present within protected areas)	<50%	3	
	50.1-80	2	
	80.1-95	1	
	95.1-100	0	
Captive technology (Breeding technology)	None	3	
	Developed/Not implemented	2	
	Implemented	1	

Generating ranks

Prioritization score = Origin × (Status + Value + Protection + Breeding technology)

Species prioritization for conservation action

11-12 (Extremely High Priority Species) — Research + Monitoring + Definite inclusion in a protection schedule of the IWPA.

9-10 (Very High Priority Species) — Research + Monitoring + Implement strict conservation action including halting aquarium trade and implement breeding plans. Subsistence encouraged. Commercial sales (both food and aquarium) permitted only from captive breeding.

6-8 (High Priority Species) — Research + Monitoring + Increase protection* + Develop breeding technology* {* Depending on the need for the species}

1-5 (Medium Priority Species) — Research + Monitoring + Trade

0 (Exotic Species) — Research + Monitoring + cultivation only in well controlled, bio-secure conditions + differential removal/population check strategies

Caveats:

(i) Research and monitoring of populations, habitats and conservation actions are a must throughout for the system to be dynamic and to work successfully.

(ii) Species recommended for captive breeding need to follow strict protocols of sustainability, scientific principles of maintaining and augmenting brood stocks including strict taxonomic and population identity protocols.

(iii) Ranking system is meant only as indicator of species prioritized for conservation planning/action. Points do not indicate the superiority or inferiority of a species in relation to others in the list.

In following the above ranking system/evaluation process, of the 300 species of freshwater fishes known from the Western Ghats, only 30 species (10%) were identified for inclusion in one of the protection schedules of the IWPA. The rest of the threatened fishes (70 species) were identified for different levels of management and conservation action.

The Extremely High Priority Species (11-12 total points) identified for inclusion in the IWPA are all threatened species, which are not harvested by local communities for subsistence fishing, and basic livelihoods are not dependent on these species (Table xx). Most of the recommended species are those that are either in ongoing trade for commercial purposes of aquarium trade, or are identified by MPEDA under the Green Certification scheme for exploitation from the wild for exports. The evaluation attests the importance of immediate conservation action for these species, which is possible only by inclusion in the IWPA protection schedules. This will provide the required impetus for the MoEFCC to encourage the Ministry of Commerce to delist these EHPS species from trade.

In case of Very High Priority Species and High priority Species, while subsistence fishing is encouraged, explicit recommendations are suggested for conserving wild populations either through effecting protection through tackling alien invasive species, increasing the area for freshwater protected areas, developing freshwater specific management and conservation actions within the existing protected areas, and/or developing breeding technologies and setting up protocols for sustainable captive breeding as the sole source of export of aquarium fishes or for commercial sales as food fishes.

The system of evaluation or ranking is a dynamic system, which emphasizes the need for research and monitoring of species, populations and status. This scientific and objective conservation and resource use prioritization system will function successfully only if research and monitoring are followed systematically and regularly.

Implementing agencies and responsibilities

Research and Monitoring – Zoo Outreach Organization, Coimbatore, along with the Freshwater Fish Specialist Group, South Asia regional network of the SSC IUCN, Coimbatore/ Kochi, and the Indian Institute for Science Education and Research, Pune, will develop the methodology, conduct research and monitor freshwater fish species in the Western Ghats. This core team will network with local NGOs, forest department personnel and local communities in establishing research and monitoring baselines and evaluate the same on a regular basis.

Training and capacity building – The core team will provide training and build capacity among participants of local communities, NGOs and forest department personnel in taxonomy, field techniques, ecological framework, water quality testing and other aspects needed for primary research and annual monitoring of fish species in local areas.

Systematic assessments and evaluation – The core team along with network members will assess the status of species, and along with departments such as the MoEFCC, MPEDA and fisheries will evaluate the ranking system for suitable action.

Co-ordination – Since there is no central body to coordinate between the different ministries and departments, and there is a recognized difficulty in the different ministries working together, the authorities at MoEFCC and related institutes of ICAR indicated that ZOO as an NGO is best placed to form the linkages and bring about such a conservation effort.

Table 1. Ranking of Western Ghats freshwater fish for conservation prioritization.

Species Name	Rank	Strategy	Action
<i>Barilius canarensis</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Batasio travancoria</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Botia striata</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Carinotetraodon travancoricus</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Devario fraseri</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Etoplus canarensis</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Glyptothorax anamalaiensis</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Glyptothorax madraspatanus</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Longisichistura striatus</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Nemacheilus petrubanarescui</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Pseudosphromenus dayi</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Puntius arulius</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius denisonii</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius exclamatio</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius rohani</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius tambraparniei</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.

Species Name	Rank	Strategy	Action
<i>Travancoria elongata</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Travancoria jonesi</i>	12	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Glyptothorax davissinghi</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Homaloptera montana</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Laubuca fasciata</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Nemachilichthys shimogensis</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Parapsilorhynchus discophorus</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius arenatus</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius assimilis</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius cauveriensis</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius chalakkudiensis</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius crescentus</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Puntius pookodensis</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks.
<i>Puntius setnai</i>	11	EHPS -- Research + Monitoring + Definite inclusion in a protection schedule of the IWPA	Commercial sales permitted only from captive bred stocks. By-catch should be addressed.
<i>Barbodes bovanicus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Barbodes wynaadensis</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks..

Species Name	Rank	Strategy	Action
<i>Channa diplogramma</i>	10	VHPS -- Research + Monitoring + Improve protection status	Subsistence encouraged. Commercial sales (aquarium & food) permitted only from captive bred stocks.
<i>Cirrhinus cirrhosus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Gagata itchkeea</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (aquarium & food) permitted only from captive bred stocks.
<i>Hemibagrus punctatus</i>	10	VHPS -- Research + Monitoring + Improve protection status	Subsistence encouraged.
<i>Horabagrus nigricollaris</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hyporhamphus xanthopterus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hypselobarbus dubius</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hypselobarbus micropogon</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hypselobarbus mussullah</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hypselobarbus pulchellus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Hypselobarbus thomassi</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food & aquarium) permitted only from captive bred stocks.
<i>Labeo potail</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food & aquarium) permitted only from captive bred stocks.
<i>Monopterus indicus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Nemacheilus keralensis</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Commercial sales (aquarium) permitted only from captive bred stocks.
<i>Osteochilus longidorsalis</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Pseudeutropius mitchelli</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.

Species Name	Rank	Strategy	Action
<i>Pterocryptis wynaadensis</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Puntius fraseri</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Salmophasia belachi</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Salmophasia horai</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Schismatorhynchos nukta</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food & aquarium) permitted only from captive bred stocks.
<i>Silonia childreni</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Thynnichthys sandkhol</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Tor kulkarnii</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Tor malabaricus</i>	10	VHPS -- Research + Monitoring + Improve protection status + Develop breeding technology.	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Balitora mysorensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Batasio sharavatiensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Devario neilgherriensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Garra hughi</i>	9	VHPS -- Research + Monitoring + Improve protection status	Subsistence encouraged. Commercial sales (aquarium & food) permitted only from captive bred stocks.
<i>Garra surendranathanii</i>	9	VHPS -- Research + Monitoring + Improve protection status	Subsistence encouraged. Commercial sales (aquarium & food) permitted only from captive bred stocks.
<i>Glyptothorax housei</i>	9	VHPS -- Research + Monitoring + Improve protection status	Commercial sales (aquar- ium) permitted only from captive bred stocks.
<i>Glyptothorax poonaensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Glyptothorax trewavasae</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Homaloptera santhampara- iensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	

Species Name	Rank	Strategy	Action
<i>Horlabiosa arunachalami</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Horlabiosa palaniensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Lepidopygopsis typus</i>	9	VHPS -- Research + Monitoring + Improve protection status	Commercial sales (aquarium) permitted only from captive bred stocks.
<i>Monopterus fossorius</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Nemacheilus kodaguensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Nemacheilus pulchellus</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Parapsilorhynchus prateri</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Puntius deccanensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Puntius ophicephalus</i>	9	VHPS -- Research + Monitoring + Improve protection status	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Puntius sharmai</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Schistura nagodiensis</i>	9	VHPS -- Research + Monitoring + Improve protection status	
<i>Garra periyarensis</i>	8	HPS -- Research + Monitoring	
<i>Horabagrus brachysoma</i>	8	HPS -- Research + Monitoring + Increase protection + Develop breeding technology	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Horlabiosa joshuai</i>	8	HPS -- Research + Monitoring	
<i>Hypselobarbus curmuca</i>	8	HPS -- Research + Monitoring + Increase protection + Develop breeding technology	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Parapsilorhynchus elongatus</i>	8	HPS -- Research + Monitoring	
<i>Schistura sharavathiensis</i>	8	HPS -- Research + Monitoring	
<i>Garra kalakadensis</i>	7	HPS -- Research + Monitoring	
<i>Hypselobarbus periyarensis</i>	7	HPS -- Research + Monitoring + Develop breeding technology	Subsistence encouraged. Commercial sales (food) permitted only from captive bred stocks.
<i>Crossocheilus periyarensis</i>	6	HPS -- Research + Monitoring + Increase protection	Impacts of exotic species within PA to be addressed
<i>Garra menoni</i>	6	HPS -- Research + Monitoring	
<i>Glyptothorax kudremukhensis</i>	6	HPS -- Research + Monitoring	
<i>Mesonoemacheilus herrei</i>	6	HPS -- Research + Monitoring	
<i>Mesonoemacheilus pambarensis</i>	6	HPS -- Research + Monitoring	
<i>Nemacheilus menoni</i>	6	HPS -- Research + Monitoring	
<i>Nemacheilus periyarensis</i>	6	HPS -- Research + Monitoring	
<i>Psilorhynchus tenura</i>	6	HPS -- Research + Monitoring	
<i>Puntius mudumalaiensis</i>	6	HPS -- Research + Monitoring	

EHPS – Extremely High Priority Species; VHPS – Very High Priority Species; HPS – High Priority Species

Green Certification – is it really ‘green’?

Freshwater fish threatened by ornamental trade

Freshwater fish are a highly diverse group and India has over 850 species with 300 in Western Ghats and 500 in Eastern Himalaya regions. They have various use values such as biological values, socioeconomic values, commercial values and even aesthetic values. Despite being used extensively by humans, this group is extremely under-rated and little is done to mitigate the threats. In fact, this ‘taken-for-granted’ group is among the most threatened group of vertebrates in India. Freshwater fish are plagued by over-harvest, introduction of alien exotics, ornamental trade, habitat degradation, destructive fishing and developmental activities.

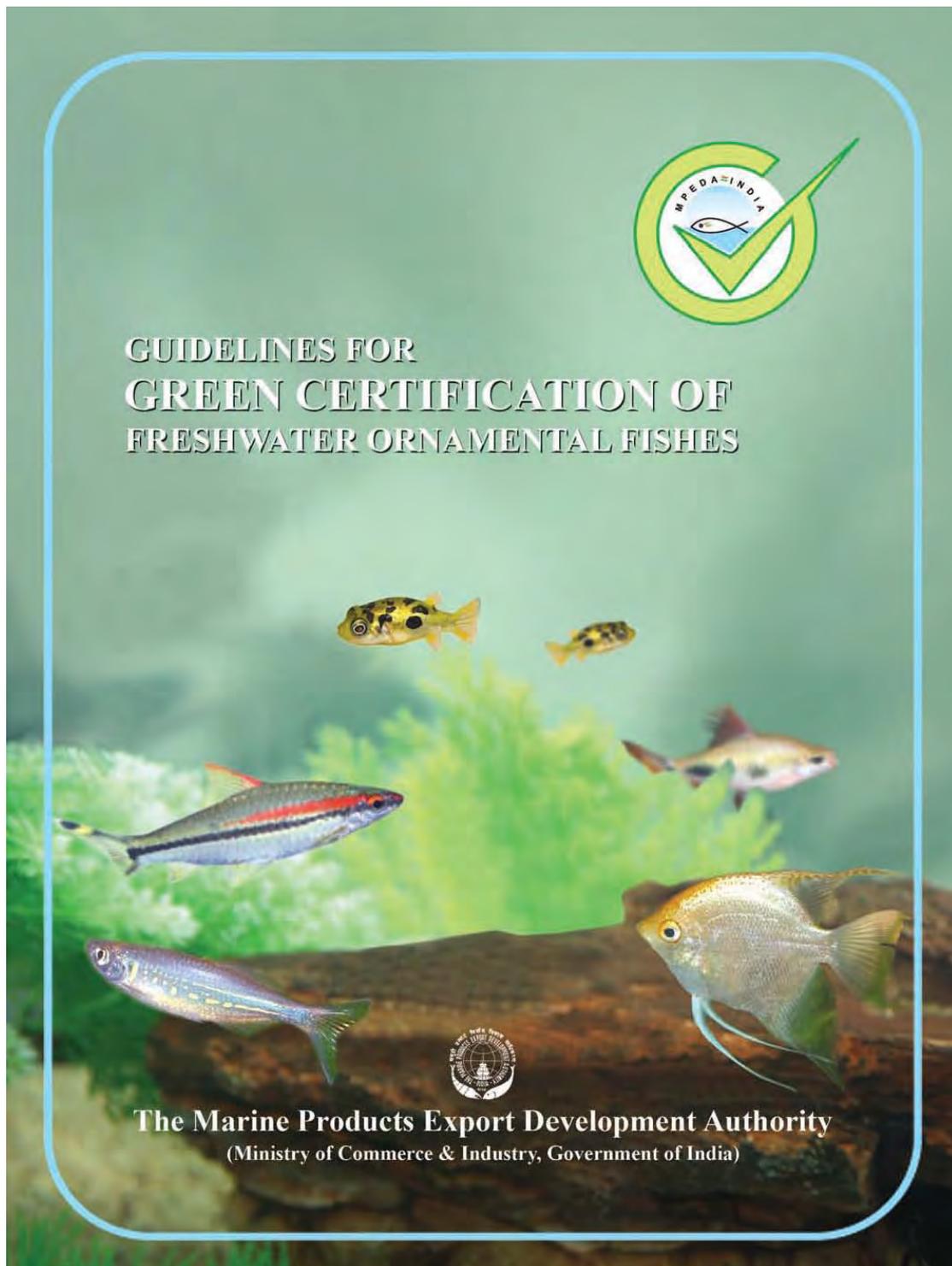
Protected areas in India are mostly terrestrial in their approach and very little or no management initiatives are taken towards freshwater fish conservation on ground. In fact, despite the stringent Wildlife Protection Act, fish species within protected areas are easily procured and sold in the aquarium market. Also, there are gaps in the existing protected area networks wherein, high priority sites and Key Biodiversity Areas (KBAs) with high species diversity are left out of the network.

Out of the 300 species found in the Western Ghats over 50% are endemic and 37% are threatened with extinction (Molur et al. 2011). And some freshwater fish species and sites have been recognised by the Indian Alliance of Zero Extinction. These species have been assessed as Critically Endangered or Endangered as per the IUCN Red List categories and have been recorded from a single location only.

Introduction to freshwater fish ornamental trade

Colourful and aesthetically pleasing freshwater fish are used and promoted for aquarium trade throughout the globe. The global freshwater fish ornamental trade is growing with ever-increasing demand for new fish. In the international market, 90% of ornamental freshwater fish come from captive bred stock. This is in direct contradiction with India where 90% of ornamental freshwater fish are wild caught.

Over 50% of total species of freshwater fish found in the Western Ghats are endemic to the region and 37% are threatened with extinction. The Marine Products Export Development Authority (MPEDA) (under the Ministry of Commerce) promotes many of these species for export as ornamental fish for aquarium pet trade. Statistics from peer-reviewed publications suggest that some species such as the Red-lined Torpedo Barb *Sahyadria denisonii* and *S. chalakudiensis* are exploited in large numbers (Raghavan et al. 2013). Recently published literature shows that *Sahyadria denisonii* may be highly restricted in its distribution and collection from the wild in such large numbers may be pushing it towards edge of extinction. Captive breeding technology for some these Indian endemic species has already been perfected in other countries and yet India does not seem to be focusing its energies on implementing these techniques and there are no takers for it in the market either (Anna Mercy pers. comm. 2013). As with every new system, there is a need to provide motivation and incentives to the ornamental fish trade community to help them understand the need for imbibing and implementing these techniques.



Policies

Green Certification:

Green certification is a guidelines document brought out by MPEDA aiming to establish best management practices for collecting freshwater fish, maintaining and transporting them for ornamental fish trade. The document has a list of species that are proposed for certification and by default promoted for trade (Table 1). Out of the 102 species listed, 43 are threatened with extinction as per the IUCN Red List. But the document does not in any way suggest or encourage captive breeding technologies for these threatened species. In addition to this two Indian Alliance for Zero Extinction species namely, *Puntius pookodensis* (CR) and *Lepidopygopsis typus* (EN) are also listed in the species list promoted for trade. These species are only found in a single

location each, in fact, *L. typus* is found only within the Periyar Tiger Reserve and MPEDA intends to promote its trade. This seems to be a direct violation of the Wildlife Protection Act, 1972, which does not allow removing any living being from within a protected area for any purpose. Eighteen of the 43 threatened species are already in trade as per Raghavan et al. (2013).

In section 12 of the guidelines on standards of assessments, there is a mention of studying fish stocks which needs to be conducted by 'concerned authorities' but there is no mention on who the concerned authorities are and what will their role be in the process. In the same section there is also a mention to understand the 'Minimum Legal Sizes and exploitable stock of each region' that is to be organized. Once again, there is no mention on who is conduct these studies and what is the protocol that has to be followed for these studies. MPEDA only claims responsibility for being the repository and disseminating agency for this information.

In essence green certification seems to be a marketing strategy with an aim to increase India's market share in the global ornamental fish market (Ramachandran & Sathiadhas 2005). And considering that there is no mention of captive bred fish trade in the guidelines document, the intention of making freshwater fish pet trade sustainable is in question.

Lepidopygopsis typus Photo credit: K. Krishnakumar



Biological Diversity Act & MPEDA:

The Biological Diversity Act (BDA) focuses on benefit sharing of biological resources and also has components on the biological resources that may be used at commercial or subsistence level. The section of relevance in relation to freshwater fish ornamental trade is section 38, which suggests curbing trade of species that are threatened with the risk of extinction. Yet MPEDA does not seem to take this into account. This is just one example of the inconsistencies in policies spanning across different ministries with reference to freshwater and freshwater biodiversity.

Verbatim from BDA, Section 38: "Without prejudice to the provisions of any other law for the time being in force, the Central Government, in consultation with the concerned State Government, may from time to time notify any species which is on the verge of extinction or likely to become extinct in the near future as a threatened species and prohibit or regulate collection thereof for any purpose and take appropriate steps to rehabilitate and preserve those species."

Implementation

The official export records of aquatic animals in India very poorly maintained and many exporters provide no details regarding the species name or quantity of fish, in fact they simply label them as "live ornamental fish" or "tropical freshwater fish" (Raghavan et al. 2013). The data that is provided by some of the exporters does not seem to get catalogued with the MPEDA as a part of record keeping process and many of the exporters provide details as part of the importers requirements. This maybe because fish fall within normally traded commodities section and are not legally protected.

This is a major gap that needs to be addressed in order to have a clear idea as to what is the status of ornamental fish trade and a realistic estimate of the species and quantities being exported. This in combination with identification charts with customs officials will also help catch the trade of species found only within protected areas.

Implementation of the green certification guidelines may have some hurdles since the process of collection, holding, quarantine and transport as per the guidelines seem expensive and how the collectors are to accommodate this into their budget is unanswered. Also, whether MPEDA is going to provide any subsidies or schemes to motivate aquarists is to be seen.

Recommendations

1. Encourage captive breeding technology for threatened ornamental fish and phase out wild caught fish
2. Ban trade of AZE freshwater fish until sufficient information has been gathered regarding their population
3. Maintain detailed records of freshwater ornamental fish exports
4. Education and awareness charts for customs and Wildlife Crime Control Bureau officials
5. Involve select environmentally sensitive traders, hobbyists, exporters and fish conservationists in revising the Green Certification guidelines in order to ensure implementability.

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Table 1. List of species proposed for Green Certification as per the MPEDA Guidelines document

Green certification name	Valid scientific name	IUCN
<i>Gonoproktopterus thomassi</i>	<i>Hypselobarbus thomassi</i> (Day, 1874)*	CR
<i>Puntius pookodensis</i>	<i>Pethia pookodensis</i> (Mercy & Jacob, 2007)**	CR
<i>Horabagrus nigricollaris</i>	<i>Horabagrus nigricollaris</i> Pethiyagoda & Kottelat, 1994*	EN
<i>Badis tuivaiei</i>	<i>Badis tuivaiei</i> Vishwanath & Shanta, 2004	EN
<i>Barilius canarensis</i>	<i>Barilius canarensis</i> (Jerdon, 1849)*	EN
<i>Botia striata</i>	<i>Botia striata</i> Narayan Rao, 1920*	EN
<i>Devario neilgherriensis</i>	<i>Devario neilgherriensis</i> (Day, 1867)	EN
<i>Etroplus canarensis</i>	<i>Etroplus canarensis</i> Day, 1877*	EN
<i>Garra hughi</i>	<i>Garra hughi</i> Silas, 1955*	EN
<i>Garra surendranathanii</i>	<i>Garra surendranathanii</i> Shaji, Arun & Easa, 1996	EN
<i>Glyptothorax anamalaiensis</i>	<i>Glyptothorax anamalaiensis</i> Silas, 1952	EN
<i>Glyptothorax madraspatanam</i>	<i>Glyptothorax madraspatanus</i> (Day, 1873)	EN
<i>Gonoproktopterus curmuca</i>	<i>Hypselobarbus curmuca</i> (Hamilton, 1807)	EN
<i>Homaloptera montana</i>	<i>Homaloptera montana</i> Herre, 1945	EN
<i>Labeo potail</i>	<i>Labeo potail</i> (Sykes, 1839)	EN
<i>Lepidopygopsis typus</i>	<i>Lepidopygopsis typus</i> Raj, 1941**	EN
<i>Longischistura striata</i>	<i>Schistura striata</i> (Day, 1867)	EN
<i>Puntius arulius</i>	<i>Dawkinsia arulius</i> (Jerdon, 1849)	EN
<i>Puntius chalakkudiensis</i>	<i>Sahyadria chalakkudiensis</i> (Menon, Rema Devi & Thobias, 1999)*	EN
<i>Puntius denisonii</i>	<i>Sahyadria denisonii</i> (Day, 1865)*	EN
<i>Puntius exclamatio</i>	<i>Dawkinsia exclamatio</i> (Pethiyagoda & Kottelat, 2005)	EN
<i>Puntius manipurensis</i>	<i>Pethia manipurensis</i> (Menon, Rema Devi & Vishwanath, 2000)*	EN
<i>Puntius ophicephalus</i>	<i>Eechathalakenda ophicephalus</i> (Raj, 1941)	EN
<i>Puntius tambraparniei</i>	<i>Dawkinsia tambraparniei</i> (Silas, 1954)*	EN
<i>Tor malabaricus</i>	<i>Tor malabaricus</i> (Jerdon, 1849)	EN
<i>Travancoria elongata</i>	<i>Travancoria elongata</i> Pethiyagoda & Kottelat, 1994*	EN
<i>Travancoria jonesi</i>	<i>Travancoria jonesi</i> Hora, 1941*	EN
<i>Aborichthys garoensis</i>	<i>Aborichthys garoensis</i> Hora, 1925	VU
<i>Barilius dogarsinghi</i>	<i>Opsarius dogarsinghi</i> (Hora, 1921)	VU
<i>Botia rostrata</i>	<i>Botia rostrata</i> Günther, 1868*	VU
<i>Brachydanio jaintianensis</i>	<i>Danio jaintianensis</i> (Sen, 2007)*	VU
<i>Channa diplogramme</i>	<i>Channa diplogramma</i> (Day, 1865)	VU
<i>Horabagrus brachysoma</i>	<i>Horabagrus brachysoma</i> (Günther, 1864)	VU
<i>Indoreonectes keralensis</i>	<i>Indoreonectes keralensis</i> (Rita & Nalbant, 1978)	VU
<i>Laubuca fasciata</i>	<i>Laubuka fasciata</i> (Silas, 1958)*	VU
<i>Physoschistura elongata</i>	<i>Physoschistura elongata</i> Sen & Nalbant, 1982	VU
<i>Pseudosphromenus dayi</i>	<i>Pseudosphromenus dayi</i> (Köhler, 1908)*	VU
<i>Puntius ornatus</i>	<i>Pethia ornatus</i> (Vishwanath & Laisram, 2004)	VU
<i>Puntius rohani</i>	<i>Dawkinsia rohani</i> (Rema Devi, Indra & Knight, 2010)*	VU
<i>Rasbora ornatus</i>	<i>Rasbora ornata</i> Vishwanath & Laisram, 2005	VU
<i>Salmostoma horai</i>	<i>Salmostoma horai</i> (Silas, 1951)	VU
<i>Schistura prashadi</i>	<i>Schistura prashadi</i> (Hora, 1921)	VU

Green certification name	Valid scientific name	IUCN
<i>Tetraodon travancoricus</i>	<i>Carinotetraodon travancoricus</i> (Hora & Nair, 1941)*	VU
<i>Syncrossus berdmorei</i>	<i>Syncrossus berdmorei</i> Blyth, 1860	NT
<i>Microphis deocata</i>	<i>Microphis deocata</i> (Hamilton, 1822)	NT
<i>Channa bleheri</i>	<i>Channa bleheri</i> Vierke, 1991	NT
<i>Puntius filamentosus</i>	<i>Dawkinsia filamentosus</i> (Valenciennes, 1844)	LC
<i>Puntius fasciatus</i>	<i>Haludaria fasciata</i> (Jerdon, 1849)	LC
<i>Puntius sahyadriensis</i>	<i>Puntius sahyadriensis</i> Silas, 1953	LC
<i>Puntius bizonatus</i>	<i>Pethia meingangbii</i> (Arunkumar & Tombi Singh, 2003)	LC
<i>Puntius narayani</i>	<i>Pethia narayani</i> (Hora, 1937)	LC
<i>Puntius jerdoni</i>	<i>Hypselobarbus jerdoni</i> (Day, 1870)	LC
<i>Puntius sarana subnasutus</i>	<i>Systemus sarana</i> (Hamilton, 1822)	LC
<i>Garra stenorhynchus</i>	<i>Garra stenorhynchus</i> (Jerdon, 1849)	LC
<i>Devario malabaricus</i>	<i>Devario malabaricus</i> (Jerdon, 1849)	LC
<i>Labeo nigriscens</i>	<i>Labeo calbasu</i> (Hamilton, 1822)	LC
<i>Barilius bakeri</i>	<i>Barilius bakeri</i> Day, 1865	LC
<i>Barilius barna</i>	<i>Opsarius barna</i> (Hamilton, 1822)	LC
<i>Laubuca dadyburjori</i>	<i>Laubuka dadiburjori</i> Menon, 1952	LC
<i>Osteochilichthys nashii</i>	<i>Osteochilichthys nashii</i> (Day, 1869)	LC
<i>Osteobrama bakeri</i>	<i>Osteobrama bakeri</i> (Day, 1873)	LC
<i>Mesonoemacheilus triangularis</i>	<i>Mesonoemacheilus triangularis</i> (Day, 1865)	LC
<i>Mesonoemacheilus guentheri</i>	<i>Mesonoemacheilus guentheri</i> (Day, 1867)	LC
<i>Schistura nilgiriensis</i>	<i>Schistura nilgiriensis</i> (Menon, 1987)	LC
<i>Schistura denisoni</i>	<i>Schistura denisoni</i> (Day, 1867)	LC
<i>Schistura semiarmatus</i>	<i>Schistura semiarmata</i> (Day, 1867)	LC
<i>Acanthocobitis mooreh</i>	<i>Acanthocobitis mooreh</i> (Sykes, 1839)	LC
<i>Nemacheilus anguilla</i>	<i>Nemacheilus anguilla</i> Annandale, 1919	LC
<i>Nemacheilus monilis</i>	<i>Nemacheilus monilis</i> Hora, 1921	LC
<i>Oreonectes evezardi</i>	<i>Indoreonectes evezardi</i> (Day, 1872)	LC
<i>Lepicephalichthys manipurensis</i>	<i>Lepidocephalichthys manipurensis</i> Arunkumar, 2000	LC
<i>Botia almorhae</i>	<i>Botia almorhae</i> Gray, 1831	LC
<i>Botia dario</i>	<i>Botia dario</i> (Hamilton, 1822)	LC
<i>Psilorhynchus sucatio</i>	<i>Psilorhynchus sucatio</i> (Hamilton, 1822)	LC
<i>Psilorhynchus balitora</i>	<i>Psilorhynchus balitora</i> (Hamilton, 1822)	LC
<i>Chaca chaca</i>	<i>Chaca chaca</i> (Hamilton, 1822)	LC
<i>Akysis prashadi</i>	<i>Akysis prashadi</i> Hora, 1936	LC
<i>Erethistes hara</i>	<i>Hara hara</i> (Hamilton, 1822)	LC
<i>Microphis cunocalus</i>	<i>Microphis cunocalus</i> (Hamilton, 1822)	LC
<i>Tetraodon cutcutia</i>	<i>Leiodon cutcutia</i> (Hamilton, 1822)	LC
<i>Badis badis</i>	<i>Badis badis</i> (Hamilton, 1822)	LC
<i>Polycanthus lalius</i>	<i>Trichogaster lalius</i> (Hamilton, 1822)	LC
<i>Polycanthus fasciatus</i>	<i>Trichogaster fasciata</i> Bloch & Schneider, 1801	LC
<i>Etroplus maculatus</i>	<i>Pseudetroplus maculatus</i> (Bloch, 1795)	LC
<i>Macrogathus guentheri</i>	<i>Macrogathus guentheri</i> (Day, 1865)	LC
<i>Pritolepis marginata</i>	<i>Pristolepis marginata</i> Jerdon, 1849	LC
<i>Horaichthys setnai</i>	<i>Oryzias setnai</i> (Kulkarni, 1940)	LC
<i>Betadevario ramachandrani</i>	<i>Betadevario ramachandrani</i> Pramod, Fang, Rema Devi, Liao, Indra, Jameela Beevi & Kullander, 2010	DD

Green certification name	Valid scientific name	IUCN
<i>Horaglanis krishnai</i>	<i>Horaglanis krishnai</i> Menon, 1950	DD
<i>Horaglanis alikunhii</i>	<i>Horaglanis alikunhii</i> Subhash Babu & Nayar, 2004	DD
<i>Akysis manipurensis</i>	<i>Akysis manipurensis</i> (Arunkumar, 2000)	DD
<i>Conta pectinata</i>	<i>Conta pectinata</i> Ng, 2005	DD
<i>Carinotetraodon imitator</i>	<i>Carinotetraodon imitator</i> Britz & Kottelat, 1999	DD
<i>Badis assamensis</i>	<i>Badis assamensis</i> Ahl, 1937	DD
<i>Dario dario</i>	<i>Dario dario</i> (Hamilton, 1822)	DD
<i>Channa barca</i>	<i>Channa barca</i> (Hamilton, 1822)	DD
<i>Channa aurantimaculata</i>	<i>Channa aurantimaculata</i> Musikasinthorn, 2000	DD
<i>Nandus andrewi</i>	<i>Nandus andrewi</i> Ng & Jaafar, 2008	DD
<i>Horadandia attukorali brittani</i>	<i>Horadandia brittani</i> Remi Devi & Menon, 1992	NE
<i>Puntius melanostigma</i>	<i>Puntius melanostigma</i> (Day, 1878)	NE

* Species currently in trade, ** Indian Alliance for Zero Extinction species



Freshwater conservation and management in a protected area: Periyar Tiger Reserve

The Management Plan of the Periyar Tiger Reserve, a comprehensive document created by the Kerala Forest Department in keeping with the guidelines of Project Tiger, is a very detailed body of text pertaining to the workings of the protected area. The document indicates a level of detail much more for terrestrial fauna and flora and some mention of aquatic biodiversity. From the recent assessments of freshwater biodiversity of the Western Ghats (fishes, odonates, molluscs and aquatic plants), several gaps in research, monitoring and conservation have been identified. The Periyar Lake and Stream System (PLSS) and the Pamba River Drainage (PMB) in Periyar Tiger Reserve are identified as regions of very high endemism among freshwater taxa with a very high number of freshwater fishes restricted to PTR.

Protected Area management ideally should cover all terrestrial and freshwater biodiversity and we provide data and recommendations under different sections of the existing Management Plan that will help identify aquatic systems and focus conservation efforts on aquatic biodiversity. These additions and recommendations will also provide baseline information while developing the next Management Plan for PTR.

3.2.11 Habitat Management

Apart from the restoration of Eucalyptus areas, the following habitat intervention programmes are being carried out.

a. Vayal Maintenance

The marshy lands are known as 'Vayals'. The

b. Creation of Shallow Water Bodies

The lesser number of aquatic birds in Periyar lake ...

c. Vista-line Clearance

Vista-line clearance was made all along the roads in the park. The ...

d. Fire management

Fire line Clearance

The activity is being carried out in the fire prone areas ...

Controlled pre-burning

This activity is practiced in the tall grass ...

e. Creation of Artificial Nests for Water Birds

At present the dead trees in the submerged area, ...

f. Planting of ficus seedlings

Planting of ficus species was tried along the traditional paths ...

g. Creation and maintenance of patrolling routes

There are a number of trek paths crisscrossing the Reserve ...

h. Creation of water holes along pilgrimage routes

Water facilities for pilgrims along the traditional paths ...

Suggested addition:

i. Management of existing aquatic system for native aquatic flora and fauna:

Removal of exotic plants around the waterways and reintroduction of native aquatic plants after adequate research into species compositions, ecology and need. Management of freshwater systems especially areas with AZE species.

j. Control of water pollution and solid waste disposal within PTR:

Adequate measure for controlling water pollution and disposal of solid waste from adjoining townships into the PLSS.

3.2.14 Research and monitoring

The present set up has a research range officer and a tiger monitoring unit. A Research Officer on deputation from a University was in position from 1991 to 1998. The post is vacant at present.

The first scientific study on the Wildlife of Periyar ...

Suggested addition:

A team of researchers led by the research officer trained in research and monitoring freshwater biodiversity follow a holistic plan developed for conservation of native freshwater fauna, flora and fungi. Research and monitoring to be carried out in collaboration with established subject experts and conservationists following science-based and unbiased methodologies. A dynamic system of management based on research findings made an integral part of PTR's wildlife management plan.

3.2.15 Trainings and workshops

A large number of trainings were conducted for officers at various levels, staff, EDCs and other stakeholders. Similarly workshops involving various categories of stakeholders for formulation of different strategies were organized. The outcome of all these workshops are duly reflected in the new management plan (Annexure - 13).

Suggested addition:

There is a need to create awareness and train forest officials and local communities to identify and monitor the threatened freshwater fish of Periyar in the long run. This will help understand the population trends of these rare species. There is a need to have workshops with fish taxonomists to ensure effective and systematic data collection and monitoring.

3.3 Summary of threats to wildlife

Threats to biodiversity could be broadly categorized into four.

1. Problems of ecological boundaries:
2. Problems due to activities of other agencies like pilgrimage, tourism etc.
3. Problems related to poaching, ganja, felling etc.
4. Problems due to subsistence pressures of fringe area people.

There is considerable overlap between these problems.

Suggested addition:

Lack of knowledge (e.g., research, taxonomy, monitoring) on biodiversity, especially freshwater biodiversity is the biggest threat to aquatic wildlife.

Invasive freshwater fish species:

Periyar Tiger Reserve is plagued by the hardy invasive African Catfish *Clarias gariepinus* which may impact the native freshwater fish adversely. This is a growing threat to freshwater fishes of Periyar which has fishing communities dependent on fishing as their primary source of food and livelihood. The invasive catfish is being caught by the Eco-Development Committees but there is little or no preference for this species as food fish. There is a need to come up with innovative methods based on invasive-removal case studies from across the world, to remove this exotic catfish and other exotics such as the Common Carp and Tilapia from Periyar.

8.4.5 Management of Endangered species

PTR supports several endangered species. As the majority of studies are concentrated around the lake, the current level of knowledge regarding the status, distribution, and movement of the target species in the evergreens and the reed breaks is scanty. Scientific management strategies in terms of conserving viable stock of such species can evolve with more studies. However, using available information prescriptions are made for some of the flagship species representing different ecosystems.

i. Fishes

Removal of accidentally introduced exotic fishes like Tilapia and Gold fish are presently carried out under the Microplan of Mannakudy and Paliyakudy as subsistence use. This activity will be fine tuned by a sub plan for the fishermen user group of the above communities. The plan will focus on conservation of indigenous species like mahseer and selective removal of exotic species. A participatory study will be carried out by the ecologist for the above purpose.

Suggested additions to the existing text:

Periyar has 14 threatened species as per the IUCN Red List of Threatened Species and out of these, three freshwater fish species (*Crossocheilus periyarensis*, *Hypselobarbus periyarensis* and *Lepidopygopsis typus*) are found only in Periyar Lake and Stream System (PLSS) and these species are assessed as Critically Endangered and Endangered. These species are single location endemics and qualify as Indian Alliance for Zero Extinction (AZE) species.

AZE is a global alliance that is identifying species that are extremely high priority for conservation considering their restricted distribution and irreplaceability values. Special management initiatives need to be undertaken to gather more data regarding these three species that are endemic to Periyar's unique habitat and to protect them from habitat threats and bycatch.

Two of the AZE species namely, *Hypselobarbus periyarensis* and *Lepidopygopsis typus* are highly preferred food fish by the local fishing communities. As a result, there is also a concern to manage the harvest of these species sustainably and also involve Eco-Development Communities in conserving these threatened species. There is a need to train local forest officials and local EDCs in scientific and systematic monitoring of the three highly threatened AZE species.

In addition to the three AZE species, five more are endemic to PTR, viz.: *Garra mlapparensis*, *G. periyarensis*, *Homaloptera silasi*, *Mesonemacheilus menoni* and *M. periyarensis*. Of these, *Garra mlapparensis* and *Homaloptera silasi* are newly described species and their conservation status has not yet been evaluated. However, given their restricted distribution and the prevailing threats in the ecosystem (e.g., invasive alien fishes) it is likely that they have a high risk of extinction and therefore, are potentially threatened species. The remaining three endemic species are categorised as Vulnerable.

The Tor (Mahseer) in Periyar Lake is exploited at high levels and fishery management measures should be put in place.

A major concern for all endemic and threatened fishes of Periyar is from introduced alien species such as *Cyprinus carpio* (Common Carp), *Oreochromis mossambicus* (Tilapia) and *Clarias gariepinus* (African Catfish) and other potential invasives such as *Pterigoplichthys* spp. (American Sucker-mouth Armored Catfish) that are likely to find their way into PLSS.

Management of threatened and endemic freshwater fish species in Periyar is an immediate concern with strategies involving, but not exclusive to, (i) removal of invasive aliens, (ii) research into population dynamics of native fishes, (iii) developing captive breeding technologies for native species, (iv) research and conservation action such as reintroduction of native species, (v) population monitoring of native species, (vi) discourage introduction of exotics either through the practices of fisheries department or through intentional release, (vii) evaluation of facilities and practices of hobbyists and traders around PLSS and PTR to monitor and educate about ill effects of irresponsible fish keeping practices and set in place adequate measures to discourage/inhibit release of exotics into PLSS and Pamba drainage, (viii) develop a holistic management plan for freshwater biodiversity (fish, molluscs, odonates, mayflies, crustaceans and other aquatic fauna, and aquatic flora).

13.3 Strategy

13.3.1 Research priorities

The research priorities in PTR have been identified in series workshops involving scientists, stakeholders and managers. New directions in management necessitate social scientific studies along with ecological studies. The identified priority areas are:

- regular monitoring of tiger population.
- population structure and movement of elephants
- status of endangered species like Nilgiri tahr, Lion tailed macaque, Great Indian Hornbill, Nilgiri Marten etc.
- effect of fire in grasslands
- studies on the impact of Thelli collectors and MalamPandaram.
- aquatic ecosystem
- impact of Ecodevelopment

Apart from Research Institutions, the Forest Department also will undertake studies through the Research Officer and by linking up with Universities.

Suggested addition:

Monitor threatened and endemic aquatic flora and fauna.
Impact of tourism on freshwater systems and biodiversity.
Impact of aquatic pollution, solid waste disposal and leaching
Impact of increasing populations and diversity of aquatic alien invasive species.

Also collaborate with NGOs, research and conservation organizations apart from universities.

13.3.2 Design for monitoring

Suggested addition:

Monitoring of aquatic flora and fauna must be designed according to taxonomic groups and implemented as an integral part of PTR's Management Plan.

14.3 Strategies under the chapter of Training

On the job training will be given to staff for capacity building. For this, resource persons will be selected from specialists and people who have worked in PTR. Trainings in weaponry, unarmed combat, participatory exercises, first-aid, veterinary care, intelligence gathering, mahazar preparation, investigation, public relations, wildlife sciences etc. will be provided in various reputed institutions.

EDC members will be trained in wildlife management, financial management, agriculture, cottage industries, law, basic computer operation for EDC executives, self help groups etc. The children will be provided opportunity for natural history studies during vacations.

PTR will offer formal training courses in sustainable tourism, capsule courses in wildlife management, Ecodevelopment, education and interpretation, extension, wildlife census, Bird and butterfly watching etc. The Rajiv Gandhi Center will be converted into a learning center for all these activities.

Suggested addition :

Training of forest staff for protecting and managing freshwater systems is imperative to ensure long term monitoring of the Periyar Lake and Stream System.

Build capacity of Local fishing communities in monitoring native and exotic fish populations, in parataxonomy and in basic observations on effects of pollution and other threats on native aquatic fauna and flora.

Freshwater fishes of Periyar Tiger Reserve

The Periyar Lake and Stream System (PLSS) occupies an area of 26km² within the Periyar Tiger Reserve with the streams approximately 75km long. A total of 57 species of freshwater fish are known to occur presently within the PLSS and the Pamba drainage (PMB) within PTR. Twenty-two species of fish occur in both PLSS and PMB, while additionally 22 species occur in PLSS and 12 species occur in PMB. One species, *Glyptothorax* sp. is to be identified and its distribution range yet to be determined.

The PLSS/PMB system is unique in southern Western Ghats home to several endemic species known and yet to be described. Of the 25 Western Ghats endemics occurring within PTR, eight species (32%) are exclusive to the PLSS/PMB landscape, viz: *Crossocheilus periyarensis*, *Garra mlapparaensis*, *G. periyarensis*, *Homaloptera silasi*, *Hypselobarbus periyarensis*, *Lepidopygopsis typus*, *Nemacheilus menoni* and *N. periyarensis*.

Of the 57 species of fishes recorded within the Periyar tiger reserve (PTR) 14 species are threatened with extinction as per the IUCN Red List of Threatened Species. Although none of the species are Critically Endangered, nine species are Endangered (EN) and five are Vulnerable (VU), three species are Near Threatened (NT), and two are Data Deficient (DD). *Garra mlapparaensis* and *Homaloptera silasi*, two newly described species not yet assessed for their conservation status, are potentially threatened due to their restricted distribution and on-going threats to habitat and populations. Currently, three species—*Crossocheilus periyarensis*, *Hypselobarbus periyarensis* and *Lepidopygopsis typus*—are Endangered, restricted to a single location within the PLSS and are therefore prioritized as species for immediate conservation under the Alliance for Zero Extinction.

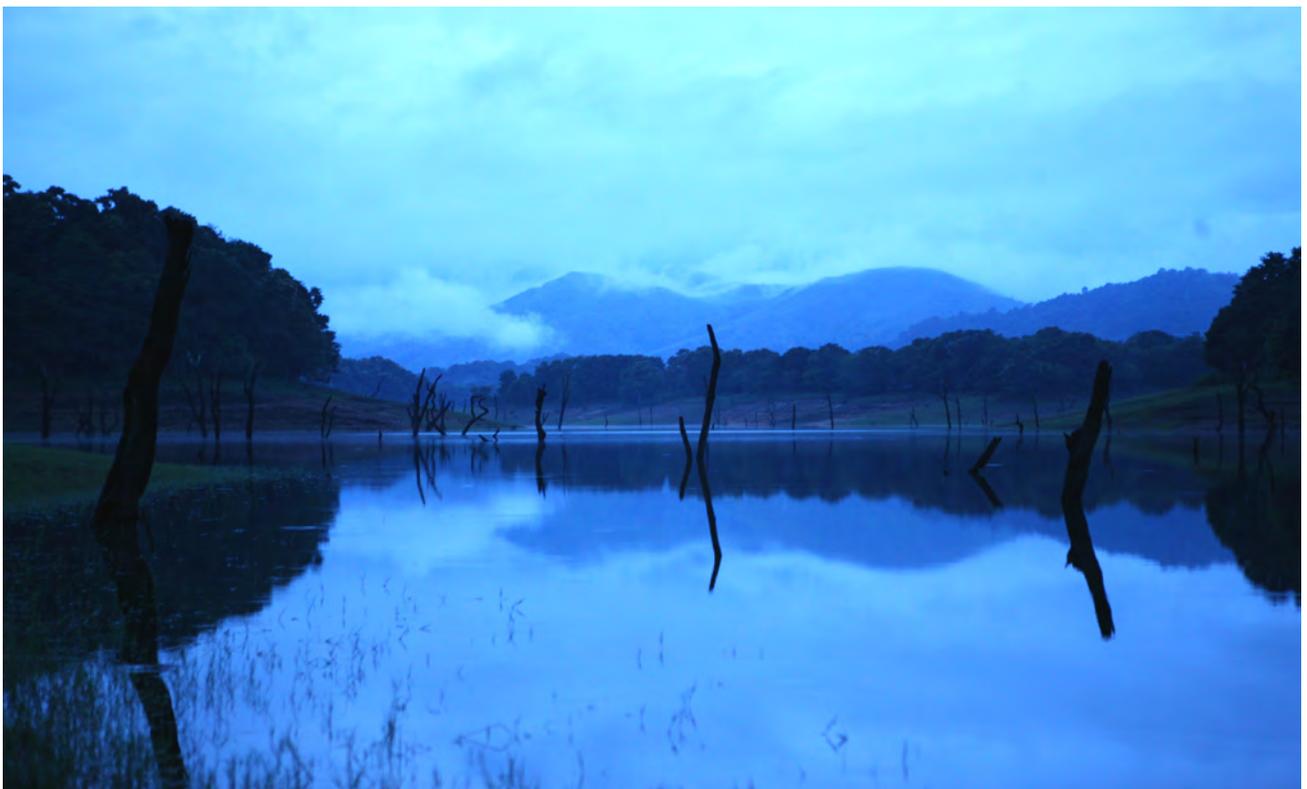
The freshwater system in PTR is faced with several threats, the evidence for alien invasive species impacting native freshwater fauna is building up. *Cyprinus carpio* (Common Carp) was identified as one of the first alien invasive fish in PTR, followed by *Oreochromis mossambicus* (Tilapia) and more recently, in the last decade by the deadly *Clarias gariepinus* (African Catfish). The American Suckermouth Armoured Catfish *Pterygoplichthys* spp., which are the newest entrants into Indian waters and the deadliest invasives may soon find their way into PTR waters if immediate measures are not adopted.

Table 1 | Information on Fish species within Periyar Tiger Reserve.

SN	Species	Distribution in PTR	Endemism	IUCN Red List status
1	<i>Anguilla bengalensis</i> (Gray)	PLSS	NE	LC
2	<i>Aplocheilus lineatus</i> (Valenciennes)	PLSS & PMB	NE	LC
3	<i>Batasio travancoria</i> Hora & Law	PMB	WG	VU
4	<i>Bhavana australis</i> (Jerdon)	PLSS & PMB	WG	LC
5	<i>Channa cf. gachua</i> (Hamilton)	PLSS	Unk	NA
6	<i>Channa marulius</i> (Hamilton)	PLSS & PMB	NE	LC
7	<i>Channa striata</i> (Bloch)	PLSS & PMB	NE	LC
8	<i>Clarias dussumieri</i> Valenciennes	PMB	WG	NT
9	<i>Clarias gariepinus</i> (Burchell)	PLSS	NE	NE
10	<i>Crossocheilus periyarensis</i> (Menon & Jacob)	PLSS	PTR	EN
11	<i>Cyprinus carpio</i> Linnaeus	PLSS	NE	VU
12	<i>Dawkinsia filamentosa</i> Valenciennes	PLSS & PMB	NE	LC
13	<i>Devario cf. aequipinnatus</i> (McClelland)	PLSS & PMB	Unk	NA
14	<i>Devario mabaricus</i> (Jerdon)	PMB	NE	LC
15	<i>Echathalakenda ophicephala</i> (Raj)	PLSS	WG	EN
16	<i>Garra mlapparaensis</i> Kurup & Radhakrishnan	PLSS	PTR	NA
17	<i>Garra cf. mullya</i> (Sykes)	PLSS & PMB	Unk	NA
18	<i>Garra periyarensis</i> Gopi	PLSS	PTR	VU
19	<i>Garra surendranathanii</i> Shaji, Easa & Arun	PLSS & PMB	WG	EN
20	<i>Glossogobius giuris</i> (Hamilton)	PMB	NE	LC
21	<i>Glyptothorax cf. annandalei</i> Hora	PLSS & PMB	WG	EN
22	<i>Glyptothorax</i> sp.		Unk	
23	<i>Hypselobarbus kurali</i> Menon & Remadevi	PLSS & PMB	WG	LC
24	<i>Haludaria melanampyx</i> (Day)	PLSS & PMB	NE	LC
25	<i>Heteropneustes fossilis</i> Bloch	PLSS & PMB	NE	LC
26	<i>Homaloptera silasi</i> Kurup & Radhakrishnan	PLSS	PTR	NA
27	<i>Hypselobarbus lithopidos</i> (Day)	PLSS	WG	DD
28	<i>Hypselobarbus periyarensis</i> (Raj)	PLSS	PTR	EN
29	<i>Lepidocephalichthys thermalis</i> (Valenciennes)	PLSS	NE	LC
30	<i>Lepidopygopsis typus</i> Raj	PLSS	PTR	EN
31	<i>Mastacembelus cf. armatus</i> (Lacepede)	PLSS & PMB	Unk	NA
32	<i>Mastacembelus guentheri</i> (Day)	PLSS	WG	LC
33	<i>Mystus armatus</i> (Day)	PMB	NE	LC
34	<i>Schistura denisoni</i> Day	PLSS	NE	LC
35	<i>Mesonoemacheilus guentheri</i> Day	PLSS & PMB	WG	LC
36	<i>Indoreonectes keralensis</i> Rita, Banerescu & Nalbant	PLSS	WG	VU
37	<i>Mesonoemacheilus menoni</i> Zacharias & Minimol	PLSS	PTR	VU

SN	Species	Distribution in PTR	Endemism	IUCN Red List status
38	<i>Mesonoemacheilus periyarensis</i> Kurup & Radhakrishnan	PLSS	PTR	VU
39	<i>Mesonoemacheilus triangularis</i> Day	PLSS & PMB	NE	LC
40	<i>Ompok bimaculatus</i> (Bloch)	PLSS & PMB	NE	NT
41	<i>Barilius bakeri</i> Jerdon	PLSS & PMB	WG	LC
42	<i>Barilius gatensis</i> (Valenciennes)	PLSS & PMB	WG	LC
43	<i>Oreochromis mossambicus</i> (Peters)	PLSS & PMB	NE	NT
44	<i>Parambassis dayi</i> (Bleeker)	PMB	NE	LC
45	<i>Parambassis thomassi</i> (Day)	PMB	NE	LC
46	<i>Poecilia reticulata</i> Peters	PLSS	NE	LC
47	<i>Pristolepis rubripinnis</i> Britz, Kumar & Baby	PMB	WG	NA
48	<i>Pseudetroplus maculatus</i> (Bloch 1795)	PMB	NE	LC
49	<i>Sahaydria denisonii</i> (Day)	PMB	WG	EN
50	<i>Puntius mahecola</i> (Valenciennes)	PLSS & PMB	NE	DD
51	<i>Puntius vittatus</i> Day	PMB	NE	LC
52	<i>Rasbora dandia</i> (Valenciennes)	PLSS & PMB	NE	NA
53	<i>Salmophasia boopis</i> (Day)	PLSS	NE	LC
54	<i>Tor</i> cf. <i>khudree</i> (Sykes)	PLSS & PMB	Unk	NA
55	<i>Travancoria elongata</i> Pethiyagoda & Kottelat	PLSS	WG	EN
56	<i>Travancoria jonesi</i> Hora	PLSS	WG	EN
57	<i>Xenentodon cancila</i> (Hamilton)	PMB	NE	LC

Abbreviations: PLSS-Periyar Lake Stream System; PMB-Pamba drainage; WG-Western Ghats; PTR-Periyar Tiger Reserve; NE-Not endemic; EN-Endangered; VU-Vulnerable; NT-Near Threatened; LC-Least Concern; DD-Data Deficient; NA-Not Assessed; Unk-Unkown



Freshwater Key Biodiversity Area (KBA)

The Periyar Lake and Stream System has been classified as an important biodiversity area with 36 species from five taxonomic groups (crabs, fish, molluscs, odonates and plants) triggering the drainage as a freshwater Key Biodiversity Area. The PLSS and the Periyar stream in Idukki District are identified as two focal areas within the KBA as they contain highly restricted endemics and/or Alliance for Zero Extinction species requiring additional attention for conservation.

Table 2| Freshwater species triggering the Periyar freshwater Key Biodiversity Area.

Taxonomic group	Species	Red List Status
Crabs	<i>Vela virupa</i>	NA
Fishes	<i>Crossocheilus periyarensis</i>	EN
Fishes	<i>Garra hughi</i>	EN
Fishes	<i>Garra periyarensis</i>	VU
Fishes	<i>Garra surendranathanii</i>	EN
Fishes	<i>Hypselobarbus kurali</i>	NA
Fishes	<i>Hypselobarbus periyarensis</i>	EN
Fishes	<i>Lepidopygopsis typus</i>	EN
Fishes	<i>Indoreonectes keralensis</i>	VU
Fishes	<i>Nemacheilus menoni</i>	VU
Fishes	<i>Mesonoemacheilus periyarensis</i>	VU
Fishes	<i>Eechthalakenda ophicephalus</i>	EN
Fishes	<i>Travancoria elongata</i>	EN
Fishes	<i>Travancoria jonesi</i>	EN
Molluscs	<i>Iravadia funerea</i>	NA
Odonata	<i>Esme mudiensis</i>	NA
Odonata	<i>Euphaea cardinalis</i>	NA
Odonata	<i>Idionyx minima</i>	NA
Odonata	<i>Idionyx saffronata</i>	NA
Odonata	<i>Idionyx travancorensis</i>	NA
Odonata	<i>Macromia flavocolorata</i>	NA
Odonata	<i>Merogomphus longistigma</i>	NA
Odonata	<i>Onychogomphus nilgiriensis</i>	NA
Odonata	<i>Platysticta deccanensis</i>	VU
Odonata	<i>Protosticta antelopoides</i>	NA
Odonata	<i>Protosticta davenporti</i>	NA
Odonata	<i>Protosticta hearseyi</i>	NA
Plants	<i>Anaphalis beddomei</i>	VU
Plants	<i>Anaphalis leptophylla</i>	VU
Plants	<i>Anaphalis wightiana</i>	VU
Plants	<i>Cyathea crinita</i>	EN
Plants	<i>Dimeria hohenackeri</i>	EN
Plants	<i>Farmeria indica</i>	EN
Plants	<i>Fimbristylis dauciformis</i>	EN
Plants	<i>Podostemum munnarensense</i>	EN
Plants	<i>Rotala ritchiei</i>	EN



Crossocheilus periyarensis



Hypselobarbus periyarensis



Lepidopygopsis typus



Freshwater conservation and management outside protected areas: Nelliampathy Hills.

India has over 850 species of freshwater fish, out of which over 300 species are found in the Western Ghats. Out of the 300 species over 50% are endemic and over 35% are threatened with extinction, and more than 50% of the endemics are threatened. Freshwater fish as a group has many use values which include livelihood, commercial and aesthetic and hence, there is an urgent need to conserve this highly threatened group of vertebrates.

Nelliampathys is highly rich in freshwater biodiversity and there are until date 22 freshwater fish species (Table 1). Silas (1947) had recorded 11 freshwater fish species from Nelliampathy Hills, which presently include the Parambikulam WS. He reports eight species from the Periyar drainage (present Chalakudy drainage), which is the present Parambikulam, not Nelliampathy. However, he reported five species from a small stream and a tank in the Nemmara division, which we assume is the Gayatriputzha drainage of Bharathapuzha River. In a recent field expedition, 12 species were recorded from the two drainages in Nelliampathy Hills.

Table 1. Fishes found in Nelliampathys (Silas 1947 and recent survey)

Species	Drainage	Red List Status	Source
<i>Glyptothorax cf. housei</i>	Chalakudy	EN	Recent Survey
<i>Garra cf. mullya</i>	Chalakudy		Silas 1947; Recent Survey
<i>Horallabiosa sp.</i>	Chalakudy		Recent Survey
<i>Haludaria sp.</i>	Chalakudy		Recent Survey
<i>Homaloptera montana</i>	Chalakudy	EN	Recent Survey
<i>Lepidocephalichthys thermalis</i>	Chalakudy	LC	Recent Survey
<i>Devario aequipinnatus</i>	Chalakudy	LC	Recent Survey
<i>Rasbora dandia</i>	Chalakudy		Silas 1947; Recent Survey
<i>Puntius cf. bimaculatus</i>	Chalakudy		Recent Survey
<i>Haludaria cf. fasciata</i>	Chalakudy & Bharathapuzha		Silas 1947; Recent Survey
<i>Mesonoemacheilus guentheri</i>	Bharathapuzha	LC	Recent Survey
<i>Channa cf. gachua</i>	Bharathapuzha		Silas 1947; Recent Survey
<i>Devario sp.</i>	Bharathapuzha & Chalakudy	DD	Silas 1947
<i>Devario malabaricus</i>	Bharathapuzha & Chalakudy	LC	Silas 1947
<i>Puntius cf. amphibius</i>	Bharathapuzha	DD	Silas 1947
<i>Barilius bakeri</i>	Chalakudy	LC	Silas 1947
<i>Puntius fasciatus</i>	Chalakudy	LC	Silas 1947
<i>Dawkinsia filamentosus</i>	Chalakudy	LC	Silas 1947
<i>Mesonoemacheilus triangularis</i>	Chalakudy	LC	Silas 1947
<i>Aplocheilus lineatus</i>	Chalakudy	LC	Silas 1947

The Nelliampathy Hills have been identified of high importance in freshwater biodiversity value. In an exercise to delineate high freshwater diversity focal areas, two freshwater Key Biodiversity Areas within the Nelliampathy Hills were recognised, viz: Chalakkudy River and Nila River KBAs. Apart from fishes, taxonomic groups such as odonates, molluscs, crustaceans and aquatic plants

together with fishes triggered the two drainages (including the Nelliampathy Hills) as freshwater Key Biodiversity Areas. While 29 species triggered the Nila River KBA (Table 2), 38 species were responsible in triggering the Chalakkudy River KBA (Table 3).

Table 2. Species triggering the Nila River freshwater Key Biodiversity Area including the Nelliampathy Hills

Taxonomic group	Species	Red List Status
Crabs	<i>Baratha pushta</i>	NA
Fishes	<i>Carinotetraodon travancoricus</i>	VU
Fishes	<i>Glyptothorax anamalaiensis</i>	EN
Fishes	<i>Hemibagrus punctatus</i>	CR
Fishes	<i>Homaloptera montana</i>	EN
Fishes	<i>Hypselobarbus thomassi</i>	CR
Fishes	<i>Laubuca fasciata</i>	VU
Fishes	<i>Pseudeutropius mitchelli</i>	EN
Fishes	<i>Dawkinsia assimilis</i>	VU
Fishes	<i>Sahyadria denisonii</i>	EN
Fishes	<i>Puntius mahecola</i>	NA
Fishes	<i>Homaloptera montana</i>	EN
Fishes	<i>Mesonoemacheilus herrei</i>	CR
Fishes	<i>Glyptothorax housei</i>	EN
Odonates	<i>Epithemis mariae</i>	NA
Odonates	<i>Phylloneura westermanni</i>	NA
Odonates	<i>Idionyx rhinoceroideus</i>	NA
Odonates	<i>Megalogomphus superbus</i>	NA
Odonates	<i>Onychogomphus malabarensis</i>	NA
Odonates	<i>Protosticta sanguinostigma</i>	VU
Odonates	<i>Onychogomphus nilgiriensis</i>	NA
Plants	<i>Anaphalis beddomei</i>	VU
Plants	<i>Anaphalis leptophylla</i>	VU
Plants	<i>Anaphalis wightiana</i>	VU
Plants	<i>Cyathea crinita</i>	EN
Plants	<i>Dimeria hohenackeri</i>	EN
Plants	<i>Fimbristylis hirsutifolia</i>	CR
Plants	<i>Brachiaria eruciformis</i>	NA
Plants	<i>Lipocarpa raynaleana</i>	NA
Shrimps	<i>Caridina shenoyi</i>	NA

NA – Not Assessed; CR – Critically Endangered; EN – Endangered; VU – Vulnerable

As there are diverse stakeholders in Nelliampathy Hills, viz., Forest Department, Plantation owners, estate labourers, local communities, and tourists. The following are strategies identified for research, monitoring and conservation of freshwater biodiversity in the region involving stakeholders.

Table 3. Species triggering the Chalakkudy River freshwater Key Biodiversity Area including the Nelliampathy Hills

Taxonomic group	Species	Red List Status
Crabs	<i>Vanni malabarica</i>	NA
Fishes	<i>Carinotetraodon travancoricus</i>	VU
Fishes	<i>Garra surendranathanii</i>	EN
Fishes	<i>Glyptothorax housei</i>	EN
Fishes	<i>Homaloptera montana</i>	EN
Fishes	<i>Horabagrus brachysoma</i>	VU
Fishes	<i>Horabagrus nigricollaris</i>	EN
Fishes	<i>Hypselobarbus curmuca</i>	EN
Fishes	<i>Hypselobarbus thomassi</i>	CR
Fishes	<i>Laubuca fasciata</i>	VU
Fishes	<i>Pseudeutropius mitchelli</i>	EN
Fishes	<i>Pseudosphromenus dayi</i>	VU
Fishes	<i>Dawkinsia assimilis</i>	VU
Fishes	<i>Sahyadria chalakkudiensis</i>	EN
Fishes	<i>Puntius mahecola</i>	NA
Fishes	<i>Tor khudree</i>	EN
Fishes	<i>Travancoria elongata</i>	EN
Fishes	<i>Travancoria jonesi</i>	EN
Fishes	<i>Osteocheilichthys longidorsalis</i>	EN
Fishes	<i>Mesonoemacheilus herrei</i>	CR
Fishes	<i>Batasio travancoria</i>	VU
Odonates	<i>Epithemis mariae</i>	NA
Odonates	<i>Idionyx minima</i>	NA
Odonates	<i>Idionyx saffronata</i>	NA
Odonates	<i>Idionyx travancorensis</i>	NA
Odonates	<i>Macromia flavocolorata</i>	NA
Odonates	<i>Platysticta deccanensis</i>	VU
Odonates	<i>Protosticta antelopoides</i>	NA
Odonates	<i>Protosticta davenporti</i>	NA
Odonates	<i>Protosticta hearseyi</i>	NA
Plants	<i>Anaphalis beddomei</i>	VU
Plants	<i>Anaphalis leptophylla</i>	VU
Plants	<i>Anaphalis wightiana</i>	VU
Plants	<i>Dimeria hohenackeri</i>	EN
Plants	<i>Farmeria metzgerioides</i>	VU
Plants	<i>Polypleurum filifolium</i>	VU
Plants	<i>Willisia selaginoides</i>	VU
Shrimps	<i>Caridina carli</i>	NA

NA – Not Assessed; CR – Critically Endangered; EN – Endangered; VU – Vulnerable

Management initiatives

Research & Training

There is a need for detailed research of this region to better understand the freshwater biodiversity found here and the impact of plantation and pesticide pollution and other threats on the fish and other aquatic species in the streams.

Forest staff has good expertise in term of terrestrial flora and fauna and manage it to the best of their abilities taking into account the resources. However, training in freshwater fish and aquatic taxa in order to manage the freshwater biodiversity-rich reserve forest and conserve the endemic and threatened species can benefit them.

Training and building capacity in local communities and estate staff will contribute to this process and help fill in data gaps.

Monitoring

Monitoring of some of the stretches of streams is of extreme importance to understand the population trend and probably changes in diversity of these threatened groups. The data will also be of utmost value over time and help design effective and efficient strategies for conservation.

Biodiversity Monitoring Committees (BMCs)

Local communities can come together to set up BMCs and monitor the status of the resources and the ecosystem services provided by the forest. Also, the fact that they interact with forest and the water system on a daily basis will help the forest department fill in data gaps and provide first hand on ground information. To illustrate, in the event of mass fish deaths, which will eventually impact livelihoods dependent on the water sources for drinking water, communities can report it in the Biodiversity Register. The information collected over time will help predict and mitigate threats in the future and secure wildlife and livelihoods.

Reference:

Silas, E.G. (1947). On a collection of fish from the Anamalai and Nelliampathi Hill Ranges (Western Ghats) with notes on zoogeographical significances. *Journal of the Bombay Natural History Society* 49: 670-681.

Molur, S., K.G. Smith, B.A. Daniel & W.R.T. Darwall (2011). *The Status and Distribution of Freshwater Biodiversity in the Western Ghats, India*. Cambridge, UK and Gland, Switzerland: IUCN, and Coimbatore, India: Zoo Outreach Organisation.



Minutes of meetings related to Freshwater policy project

Freshwater fish found in the Western Ghats (37% of the 290 species) and Eastern Himalayas are highly threatened as per the assessment conducted by Zoo Outreach Organization and Freshwater Biodiversity Unit, IUCN funded by the CEPF. As a follow up to the recommendations of this project an analysis of the freshwater biodiversity conservation policies and the relevant stakeholders was conducted. The objectives included networking with stakeholders, policymakers, national institutes and other wildlife conservation NGOs to help develop a draft policy framework linking various trigger values for WPA listing and understand protected area effectiveness and develop educational material for policy makers.

Given below are the minutes of the meetings that have helped understand the freshwater biodiversity policy scenario better, and to analyze critically viewpoints from major stakeholders and policy makers in decision making.

24-26 May 2012, Thiruvananthapuram

24.05.2012

Mr. Gopinathan Principal Chief Conservator Forests-Wildlife, Chief Wildlife Warden

We spoke about the status of freshwater fish in Kerala, high species richness, threats affecting freshwater fish such as invasive species, over harvesting and management issues.

He suggested contacting Inland Fisheries to discuss introduction of exotics into freshwater ecosystems and to understand their definition of indigenous species.

We also discussed recommendations from the IUCN Western Ghats Freshwater Assessments and the biodiversity rich sites identified in Kerala.

We discussed including freshwater system into the Periyar Tiger Reserve management plan and also work with Nelliampathy – Nemmara Division Assessments since they have high freshwater biodiversity.

We discussed scope for fish monitoring in Kerala, in collaboration with different agencies and forest department (includes training of ground level officials).

Mr. Yalakki Additional PCCF – Biodiversity Cell, Additional Charge Protection and Thrissur Zoo

He informed us that Nelliampathys – Nemmara Division is forested land while other areas have been leased to plantations and private lands. Forest department has taken over three estates and 25 still remaining. He seems quite interested in AZE concept.

He also wants us to consider sacred groves conservation by acting as liaison organization between the forest department and the communities to promote goodwill amongst people to accept conservation scheme on ground action.

As he suggested developing strategies for freshwater taxa including community participation in protecting species occurring in the area.

He suggested listing freshwater taxa occurring in Nelliampathys to understand complete species distribution with occurrences outside of protected areas (Nelliampathys) and survey Nemmara Division.

Sent Kodagu Model Forestry approach to Sacred Grove Conservation & Kushalappa's (Coorg) details to Yalakki.

Dr. B.S. Corrie, Additional PCCF

We discussed an education chart or educational material on types of streams and associated fish to incorporate in training of forest staff. The same was sent to him. He suggested inventorying and monitoring the selected freshwater body on a regular basis in collaboration with the forest department.

He requested for Karnataka Zoo authority details and contact of Mysore ZOO Director, which was sent to him. He suggested meeting Mr. Tege, HRD, (094479 79016) for details on training and education who we were unable to meet.

Dr. B. Shivaraju Additional PCCF – Working Plan and Research

He informed us about 24 divisional working plans and 11 protected area management plans that had just come out. He also informed that Nemmara is the proposed Buffer Zone of Parambikulam Tiger Reserve and that it would be good to develop a monitoring programme with the forest rangers (training) in the future.

He suggested meeting Shaju Varghese, ACF – Research, Olovacaud Railway Junction, Palakkad (094772 14922) regarding inventory of fish in Nemmara Division for inclusion in the Working Plan whom we spoke to and visited Nemmara, Nelliapathys and spoke to local forest officials.

He requested us to inform forest department post assessments regarding their role in AZE species conservation. We developed a local language poster on AZE species in Periyar in order to inform the forest department and the locals.

Raja Raja Varma, PCCF - Forestry

His personal opinion on the Wildlife Protection Act, 1972 (WPA) included the following:

The WPA is not people friendly, and is not acceptable to people's psyche. It is too technical and so it is difficult to implement. There is need for different enforcements for Commercial and non-commercial activities (local community). Fish protection in a forest is not a livelihood issue according to him.

He suggested submitting freshwater fish species list with threats and status for Kerala. Present clear findings of species within protected areas. He was supportive of species surveys and partnerships through sharing and networking with the forest department in Kerala.

25.05.2012

Dr. C.P. Shaji, Principal Scientific Officer, Kerala State Biodiversity Board

He informed us that the assessments do not reach people and are not reflected in People's Biodiversity Register. The National Biodiversity Authority has asked state biodiversity board to declare state's threatened taxa and IUCN report can be used in that context. He also believes ornamental fish pet trade is high and needs to stop.

With reference to fish research and fisheries policies, he informed that each state has a different interpretation of the Inland Fisheries Act. He also suggested declaration of No-Fishing Zone targeting range specific species.

There are also issues concerning exotic species. Violation of quarantine protocol etc at Aqua Show conducted by Fisheries department and bringing in of exotic species risking release and diseases is a problem that needs to be looked with more seriousness. For example, Pacu an exotic fish species is now found in Chalakudy River in Kerala.

Sixteen species proposed to be released in all 20 reservoirs and a letter was sent asking for C.P. Shaji's opinion but was not considered seriously. He informed that he will help in coming up with the list of fish species to be included in the Wildlife Protection Act, 1972. In his opinion, species facing multiple threats may be included into the list, species that are distributed outside PAs but are Threatened/Endangered may also be included.

He also enlightened us saying that local people's preference is not a consideration in the fish breeding programme conducted by the Fisheries department.

The most Highly Marketed food fish are – 1. Rohu, 2. Catla, 3. African Catfish, 4. Malaysian Catfish.

There is no standardized breeding protocol for many native species that have cultural value. Also, native fish that are considered in ornamental fish trade are not captive-bred cause of the difference in pricing of captive bred and individuals taken directly from the protected areas and forests.

He suggested contacting National Biodiversity Authority – Dr. Bala Pisupathy, whom we spoke to in our meeting at Chennai. He suggested looking at the Inland Fisheries Migration Act 2010 (Dr. Madhusoodhana Kurup) and talking to Fisheries department to discuss fish sanctuaries declared through the Inland Fisheries Act, 2010 of Kerala State.

He informed that there is a need for baseline data on exotics and requested us to get the message across to the committee and government. He also suggested contacting KAVIL – Kerala Aqua Ventures International Limited who deal with ornamental fish trade. We discussed calling inter-state representatives/experts from the five states of the Western Ghats to sit together to list out species at risk in their state. He suggests contacting the following people for the same: Dr. Sugunan, K.V. Jayachandran – 094464 93765 – Dean of Fisheries, Dr. Anna Mercy, Kerala University, Thiruvananthapuram, Dr. Silas – CMFRI, Cochin/ CIBA, Bhubaneshwar : 093888 74633.

Dr. R.V. Varma, Chairman, Kerala State Biodiversity Board, Government of Kerala

He opined that there is lack of implementation of protection in protected areas, which is a major lacuna in management. No dearth for facts but implementation and conservation is the problem. He suggested contacting Yashwant Shenoy Lawyer, Environment in Mumbai (099676 642195), in case any help in the legal situation was required.

Dr. Hosagoudar, Fungus expert, - Jawaharlal Nehru Tropical Botanical Garden and Research Institute (JNTBGRI)

We intended to meet freshwater plant experts in JNTBGRI and talk to them regarding the present status and understand any possible policy interventions. But there were no freshwater aquatic plant experts in JNTBGRI at that moment.

However, Dr. Hosagoudar suggested meeting with Dr. R. Rajashekar (94465 57914) and that he may be working on policy for plants and Dr. Pushpaganathan (98950 66816) from Amity Institute for Herbal Medicine & Biotechnology in Trivandrum.

27.05.2012

Mr. V.S. Manoj, Ex-Officio Secretary, Fishermen Subgroup, Periyar tiger Reserve (094470 08190, forestloveswildlife@gmail.com)

There is the problem of bycatch along with fishing of exotics. He informed us that the net sizes used by the communities are – 2 inches are ½ inch, 1 ½ inches. June has been declared as a “no-fish” month. The fish catch in July came to about 300kg and gradually came down to 30-50kg in January – March and goes up to 70-100kg in April-May. The local communities prefer native freshwater fish species such as *Tor khudree* and they also prefer Tilapia that was introduced in India in the 1960s. There is also the African Catfish that has found its way into Periyar and is not preferred by the local communities. It is sold by the communities at very low prices. This fish is extremely hardy and is an aggressive invasive species.

The community is very supportive of freshwater fish conservation and is helping in fishing out invasive freshwater fish.

We discussed developing data cards or posters for the six Periyar single location endemic freshwater fish. We finished a poster with the six AZE species and the inauguration and following discussion was inaugurated by the Deputy Director of Periyar in the presence of the fishing communities.

Sanjayan, Deputy Director, Periyar Tiger Reserve (currently pursuing his PhD in Parambikulam on Ecosystem Services – environmental economics and quantification)

He directed us towards a data exchange gap in freshwater fish that needs to be filled. He also opined that there is a need to strengthen the mahseer population in Periyar. He suggested possibly restocking native endemic species through captive breeding. He also informed that the invasive African Catfish has found its way into the Periyar Lake and stream system with floodwater and it has also moved into the plains. A pilot exercise on an invasive removal exercise was conducted at Periyar Tiger Reserve to catch the invasive African catfish *Clarias gariepinus* with the help of the locals, volunteers and the forest department.

We also discussed that there is a need to closely monitor if the June closure helps native species or exotic species. Also, we also spoke about monitoring fish on an annual basis in Periyar Tiger Reserve.

16 June 2012, Bengaluru

Mr. Dipak Sarmah, PCCF Wildlife, CWW, Karnataka Forest Department

He is not open to working on research projects within tiger reserves in Karnataka. We discussed freshwater fish and frog conservation projects. We also informed him about the freshwater taxa rich sites in Karnataka State. Also we tried to learn his views on management of freshwater biodiversity in Karnataka.

We also spoke about the Chytrid Project and Freshwater policy project details and he suggested submitting a proposal highlighting work only in non-project tiger areas, give reference and history of affiliations and work done with the ministry in the past, copy of permission letters of other state forest departments.

Mr. Ramchandra, CCF, Working Plans (09449863557)

He was very enthusiastic about the freshwater taxa and fungal amphibian disease project. He informed that he has contacts in Belgaum.

He suggested us to cull out information related to reserve forests in Kabini (Mysore Division), Kemphole-Gundiya and near Anshi. We also discussed the need for a list of priority areas where surveys need to be conducted especially keeping in mind lost species.

Mr. T.S. Sugara, Additional PCCF and Member Secretary, Karnataka Biodiversity Board (Forest, Ecology and Environment Department) (09448189516, kbb.kar@gmail.com)

He informed that the biodiversity board has only two members including himself and that very little can be implemented with such a small work force. We discussed putting together details of fauna (mainly fish species) and flora that can be culled out from the Assessment report found in the 16 probable fish sanctuaries (list filed). Some method for monitoring, training and capacity building of forest staff were discussed. He requested us to send ornamental trade fishery paper when published. He suggested us to download: Karnataka act 27 of 2003, Karnataka inland fisheries – dpal.kar.nic.in. This state fisheries law has been downloaded and analysed at the basic level. Lastly, we also discussed possible strategies for bio-monitoring roping in local communities. This may now be done through the biodiversity monitoring committees or BMCs under the National Biodiversity Authority.

28-30 June 2012, Nelliampathy Hills exploratory visit, Kerala

Nelliampathi Reserve Forest has been identified as a rich and biodiverse region among non-protected areas of Kerala. The Palakkad visit of the Freshwater Policy Project team (Dr. Sanjay

Molur, Dr. Rajeev Raghavan and Ms. Priyanka Iyer) from 28-30 June 2012 involved meeting Mr. Shaju Varghese, Assistant Conservator of Forests, Research and additional charge - Working plan of Nenmara Division, regarding providing inputs on freshwater fauna and flora (based on the freshwater report on Western Ghats and on field studies) into the current working plan. Mr. Kaler, Conservator of Forests, was presented with the Western Ghats freshwater report and he showed keen interest in setting up an Eco-Development Committee for Parambikulam Tiger Reserve. Areas for study were identified with help from Mr. Varghese and Mr. Raju Francis, District Forest Officer, Nenmara Division, Forest Department and reiki of certain sections of the Nelliampathy hills was conducted. There was an exchange of information to facilitate better understanding of the area. Points discussed included setting up a system for regular monitoring of freshwater biodiversity, mechanism behind the working plan and permission procedures among other things.



23-27 July 2012, Goa

24.07.12

Dr. P.V. Desai (Goa University – HOD Zoology) & IK Pai (Zooplankton)

He discussed the status of freshwater crustaceans and diseases affecting them. He also suggested reintroducing crabs in regions where they have been lost due to over-exploitation. He also opined that there is a need for freshwater fish gene bank. We also discussed re-introducing crabs that are lost due to overexploitation.

Baban Ingole – (Biodiversity NIO)

He was instrumental in getting Syngnathids into the Wildlife Protection Act and gave us insights on the process of listing species into the Wildlife Protection Act.

He gave a list of things that need to be ready to list species in the WPA namely, detailed classification (systematics of the species to be proposed for listing), distribution, abundance, present status (commercial exploitation or population status), threats (ongoing and projected in the future) and DNA barcoding.

Dr. Banakar (HRM – NIO)

He informed us about the freshwater program at a lake in the area and showed keen interest in having programs with students on freshwater taxa. He gave details regarding the course and suggested that the course work can have freshwater components.

Dr. Naqvi (NIO – possible next Director)

He is presently working with Dams (Idukki, Siloli, Tillari, Koyna and Supa) recently on freshwater algae on anoxygenic photosynthesis. His study includes understanding where the nitrogen and methane from the run off seeping into the river, goes since its effect are not recorded in the ocean/sea.

25.07.12

Dr. Sambhu (DCF – Planning and Statistics)

He is keen on capacity building for the forest staff with reference to managing freshwater systems.

Joseph R. D'Souza (Member Secretary GSBB, Geologist-mapping)

He informed that the Goa State Biodiversity Board (GSBB) could change any time, the GSBB could undergo a major re-vamp and gave some contacts.

Dr. Subramaniam (Fisheries ICAR)

He was keen on fish protected areas and artificial areas for local fish (like fish stocking). We also discussed artificial marine reefs for fisheries and coral reef conservation. We also discussed the fish ban period and issues concerning the time of the ban. He informed that they were presently working on identifying Potential fishing areas via satellite – SSt & Wind, which even shows up a two degree variation with relation to biological activity.

Richard D'Souza (APCCF/CWW)

He informed regarding the white water rafting programme that is being started at Mhadei to promote tourism. We also discussed capacity building for forest staff and locals, monitoring programmes. We also collected information regarding facilities available for conducting freshwater taxa field surveys.

Suggesting contacting Nirmal kulkarni, Paresch Porob, Parag Rangnekar and Prakash Salelkar's son.

Dr. Carvalho (DCF-North)

We discussed possible recommendations for freshwater biodiversity of Goa based on the IUCN status assessments. Both Netravalli and Mhadei have been notified 10 years ago but settlements are still on. The threats in Mhadei are water diversion by Karnataka and the road to Belgaum. Santosh Gaonkar, a poiria High School Teacher, collects freshwater fish but needs training in taxonomy and proper collection methods.

26.07.12

Dr. Janarthanam (HOD Botany – Goa University)

We discussed networking with plant experts to get them to work on one endemic species per month and at the end of the year have a some data for assessments and this can go as a notice in JoTT. He also mentioned discovery of a possible AZE species of *Dipcadi* sp.

Dr. Vijaya Kerkar (Botany – Goa University)

He is working on brackish water species and is interested in JoTT.

Dr. Manoj Borkar (Mt. Carmal College)

He has worked on fishes found in paddy fields and is very keen on providing the college facilities for freshwater surveys including labs etc. He is also keen on conducting a session in the college and collaborate on the freshwater outreach programme to be conducted by us in future. Daniel worked with him on this.

The AZE memorandum has been sent to Dr. Borkar for the college to join and we are awaiting response.

Mr. Kamu (ACF-North Wildlife & Eco-tourism)

We discussed the status of freshwater biodiversity and the urgent need for its conservation. We also spoke about permits for Chytrid work in Goa.

9-12 August 2012, Preliminary meet on freshwater policy issues at ZOO

DAY 1 Aug 09 2012

Sanjay's Address followed by Priyanka's presentation on IWPA, and what has been done until now by the freshwater policy team in the three states of Kerala, Karnataka and Goa.

Things planned for the group

1. Plans to incorporate FW taxa in IWPA.
2. How to prioritize species to be protected, keeping in mind the different values – biological, cultural, aesthetic, commercial and the like.
3. Education and Outreach.
4. Revise IWPA.
5. Identify threatened freshwater taxa and establish PAs for the same over time.



Things planned for discussion

1. Policy Document
2. State Inland fisheries act and fish sanctuaries.
3. Approaching fisheries dept. for support and co-operation

4. AZE
5. FFSG –South Asia Activities
6. Approaching Forest Departments, State Biodiversity Boards and State Wildlife Boards into including aquatic ecosystems and its fauna into their agenda.



- Include public participation in every step of conservation planning.
- Attain support of community activists to mobilize communities at grassroots levels.
- Sensitize primary stakeholders.
- Fishery sector: sensitive area
- Need to have biological as well as commercial/economic perspectives in mind while moulding policy for the conservation of FW fauna.

Neelesh Dahanukar (ND) highlighted the importance of involving local communities as vital stakeholders and that their use value and livelihood patterns must be taken into consideration to avoid antagonism. Sanjay Molur (SM) pointed out the need for right approach when taxa needs to be incorporated in the IWPA and need for educational programme for local communities - a time consuming process - that needs to be planned out. He brought into focus the shark case study (listed in the IWPA and then the conflict and delisting of sharks) Important to keep in mind not to repeat the same story considering the aesthetic, commercial and use value for freshwater taxa. C. Srinivasulu (CS) referred to Primary stakeholder (Local communities) sensitization; Use biodiversity act and the concept of Heritage sites – ecological value, conservation value, heritage value; local communities can form a committee and conserve, take responsibility. Krishnakumar (KK) informed about the Biodiversity Register for each Panchayat in Kerala. Also, he raised the point that the laws and acts only followed in Protected Areas but there is no awareness outside Protected Areas. CS pointed out the need to shuttle between Government organizations and primary stakeholders and keeping in mind ground level realities.

SM highlighted the example of the Arabian Oryx reintroduction wherein the population shot up and was considered a great success until hunting and collection by the Arabs pushed the population back to critical levels – reason being no programme was conducted with the communities.

Payal Molur (PM) mentioned the need to figure out which species are prioritized for conservation through education and which species through listing in the IWPA.

B.A. Daniel (BAD) presented Freshwater Education and Outreach:

- Important to disseminate finding to the public through education.
- Follow up on the conservation issues and work with stakeholders over time.

Importance of education materials, teaching guides and the like in regional tongue for spreading the need and importance of conservation (Local language translations of the manual – Konkani Goa - Manoj Borkar).

Target group:

1. Educators/Journalists (Use Sally Walker's guidelines on interacting with journalists)

2. Locals

- Identify educators/trainees (focal points and assistants) – train them and create network.
- Train educators on how to communicate with journalists in an effective and positive manner and provide guidelines on the same.

Pursue implementation of conservation policies through education, posters – policy makers

SM suggested that we have point persons set up long-term education plans for their respective areas since education is relative slow process. Keerthikrutha (K2) came up with the idea of having online networks for effective communication and exchange of ideas between point persons and educators; corporate groups interested in natural history can team up (weekend activities) and volunteer.

SM suggested that FW components could be added to Conservation India website.

Rajeev Raghavan (RR) introduced the group to the fish project of the Indian Alliance for Zero Extinction:

As the name suggests these are species found in a single location in the world. The need for conserving such species is very high. The first project is to study and implement conservation measures for 8 AZE species of fish of Kerala. SM and RR spoke about the possibility of having Brand ambassadors for AZE species.

RR highlighted that pollution affected fish/water samples need to be analysed to see the impacts and in the course of discussion it came up that Murlidharan charges Rs. 2000/- per sample. ND suggested that his integrated students can work on water/soil/tissue samples.

Josin Tharian (JT) volunteered to draw the map for Indian AZE sites.

CS suggested that we could attract public support for conservation through issues directly affecting them like water pollution and quality and the like. He also spoke about how researchers can contribute by writing a commentary on a taxon, its diversity and its status in the IWPA and also, highlight some of the taxonomic inconsistencies. These could help offering recommendations to the governing body to make necessary amends. Ascertain real/actual status of a species before planning conservation.

SM suggested conducting Population Habitat Viability Assessment + Vortex for *Puntius denisonii* and *Tor khudree*.

ND suggested backtracking history of a species listed on the IWPA and also species not listed, grade them accordingly to list the changes needed. We need to find how **status: protection: values** given to a species correlate with each other and influence the level of protection offered to them.

CS informed that the SBB (bound by the biodiversity act) would help support stakeholders for protecting areas but wouldn't identify such areas unless approached with justifying reasons; Biodiversity Heritage Sites = legally bound protection: perfect for non-PA protection status for biota. Temple fish sanctuaries could be declared as BHS, Legal standing based on Biodiversity Act.

RR raised the point of talking to Bahar Dutt about Indian AZE sites and freshwater conservation issue;

Also, IUCN SIS species assessments FW fish needs to be updated; an approximately seven day taxonomy workshop on FISH based on ICZN could be worked on with support from FFSG, and Pethiyagoda & Ralph could be approached for the same.

SM took on the responsibility of putting up the FFSG webpage on the ZOO website explore the idea of sanctuaries based on specific taxa. Also, the group needs to find contacts in NWB and SWB

BAD and Marimuthu – Education and Outreach education Activity (Observation, communication, comparing animal attributes to human attributes, organizing, relating, inferring and applying)

Activities: songs, dance, drama, etc. Understand perspectives of the community and work on activities accordingly. Use a species cultural link to secure support of the local people.

Assessing people's attitude before and after education workshop

Brain map, Attitude assessment (survey with 10 Qs – trainees), mini dramas work for all age groups, Drama kit, activities related to animal characteristics, human perspective on mammals, timeline, cultural link, conflict resolution, mock conference, information on Hotspots and river systems

Activity for the day: Learning about the extent of Western Ghats and its river systems using maps.

SM focused on selecting all round values to assign to each species so as to justify its place in the IWPA.

Group came up with 17 values to understand biological, cultural, livelihood, commercial and other use values. The values were rated against each species on the WPA initially for four groups, mammals, odonates, fish and mollusks.

DAY 2 Aug 10 2012

The groups continued to work on populating the tables initiated the previous evening.

Listing and analysing different taxa based on the 17 values listed the day before that have been assessed – FW fishes, Odonates, Molluscs, Mammals, Aquatic Plants to analyze their status with regard to the values/ services they offer; this will in turn help in preparing recommendations for the WPA.

SM/K2/RR/PM: Speak about angling and fishing in Cauveri, Corbett (Golden Mahseer – Steve

Lal/ Anushree Bhattacharjee), Nameri - Assam, Jungle lodges fishing camps – Karthikeyan, Krishna, Cariappa, Swarna Ramki

DAY 3 Aug 11 2012

Josin presented on GIS mapping techniques:

He presented a case study on Chalakkudy drainage since it has very high diversity among west flowing rivers of the Western Ghats. Prioritisation of stretches of the river with high fish diversity is important for conservation. PA network are based on territorial fauna but must include high priority freshwater areas (Eg. Head water) Eg. Chalakudy Drainage:

Two methods of analyzing data: Key Biodiversity Areas (KBA) & Systematic Conservation Planning (SCP)

In KBA – three maps are initially generated based on threats, diversity and endemism. All three are overlaid to get the KBAs; it works well for policy level conservation

SCP – is based on Irreplaceable habitat (species specific habitat) & areas complimenting the PA (close to protected areas); it works well for field based conservation. Micro level point based application needed for conservation of some species/habitats

AK came up with the suggestion of integrated approach for terrestrial and aquatic life.

SM pointed out that this was being followed to some extent through a concept called Patta Land (buffer land between private property and protected wetland). But though 'Patta Land' is government property it is being used by private owners.

ND and RR said that predictive modeling of species lost based on historical distribution and present distribution will provide interesting data;

SM suggested that SCP could be done as a PHVA where more stakeholders and information is taken into consideration as opposed to a Population Viability Assessment.

ND presented the Canonical correlation analysis of the previous day's mammal assessment.

ND: Cross taxa analysis is necessary. He raised a vital question as to **How to tackle CR Species with high livelihood value?**

CS suggested two levels of outreach – scientific level and policy level. To understand the different roles played by species found in India and species listed in the IWPA we need four broad sets of values – Ecological, Conservation, Socio-economic and Biological; relevant subsets under that for analysis.

Mammal analysis values discussed and defined.

DAY 4 Aug 12 2012

Responsibilities:

Group: Commentaries on the various schedules and the inconsistencies discussed to be put together; each group of experts to take up a taxon and work on it and publish material; Online

regional level groups – moderated, masses can contribute, like a Facebook group; Corporate interested can team up (weekend activities) and volunteer, Brand ambassador for AZE

CS: Contact state biodiversity board for including FW taxa into mandate

CS/BS: mammal analysis

Josin & Brawin: Identify aquatic areas for probable Fish Sanctuaries on the map using available analysis

Josin: AZE map & drainage maps

Anvar Ali: Wayanad Thirunelli temple sanctuary details

Refer: WII publication on Temple tanks, Kalpavriksh & KFRI on sacred groves

RR: Identify AZE sites, FFSG – Newsletter – Something fishy! And JoTT special issue – contact regional chairs, Checklist of FW fish of India, Willingness To Pay & Willingness To Accept analysis for possible FPA

RR/KK/AA/JT/ND: Fish analysis

AK: help in setting up EDC, youth groups etc,

Marimuthu: Identify temple sanctuaries in Tamil Nadu

SM: State Wildlife Boards – Prerna Bindra, Divya Mudappa, Shanker Raman, Speak to Topis about membership for Neelesh in the IUCN FW Sub-Committee; Give RR point contacts of Pakistan, Sri Lanka and Bhutan, Talk to Ramki about adding freshwater issues on Conservation India website, FFSG webpage with ZOO website; Send John Paul Rodriguez's articles on Range contractions

BAD: Circulate portions of the education manual that were not discussed at the workshop.

ND: integrated students can work on water/soil/tissue samples.

SM & ND: Maharashtra AZE – Neelimkumar Khare – Katraj

SM/K2/RR/PM: Speak about angling and fishing in Cauveri, Corbett(Golden Mahseer – Steve Lal/ Anushree Bhattacharjee), Nameri - Assam, Jungle lodges fishing camps – Karthikeyan, Krishna, Cariappa, Swarna Ramki

RR/SM: AZE NDTV frog thing – Talk to Bahar Dutt

PI/SM: contact Balu Hegde – Sirsi, Karnataka (09448774778) – Conservation Area

ND: Backtrack history of a species listed on IWPA and also species not listed. Grade them accordingly to list the changes needed.

BAD: Use Sally Walker's guidelines on interacting with journalists

Additional Responsibility:

AK: Write a brief for the community conservation JoTT special issue

RR/KK/ND/AA: Fish New descriptions/records.

04-08 September 2012 Nagpur, Maharashtra

04.09.12

Mr. Anmol Kumar – Member Secretary – State Biodiversity Board, Maharashtra

We discussed the status of freshwater fish in India and the need for conservation. As we spoke about a possibility of fish sanctuaries, we were informed that fish sanctuaries are not a mandate of the state biodiversity board. We also understood that Biodiversity Heritage sites were not awarded the kind of legal protection that was necessary.

He suggested contacting Mr. A.K. Nigam – APCCF (wildlife) – western region, Borivli, Mr. Mohan Karnat CCF (Kolhapur) – Koyna, Contact Mr. M. Kundal Rao CCF (Pune) – Western Ghats Pune District before submitting proposal for any surveys.

Also he suggested emailing botanists Drs. M.K.V. Rao and Janarthanam (Goa plant expert) to work with aquatic plants.

He suggested bringing out a small publication - all 6 groups (fish, mollusk, odonate, aquatic plant, crustacean and amphibian) cull out information on Maharashtra only of approximately 100 pages and write a proposal outlining the index including checklists, assessments, photographs, endemic species pages (photo, data, map) with Marathi translation.

Mr. Naqvi – Chief Wildlife Warden/ PCCF (Wildlife)

We spoke about freshwater taxa conservation and the sites with high biodiversity in terms of freshwater. He suggested submitting proposal on Koyna, Vidarbha (Totladoh region) and chytrid before 1 October for field surveys. There was a meeting of technical committee planned on 13 October.

Mr. Ramanuj Choudhary, APCCF (NTEP, Monitoring & Evaluation) was also present for the meeting with the PCCF and we spoke about fish being harvested by local communities and also regarding monitoring freshwater systems.

Mr. Krishna Mohan – APCCF (Protection)

He suggested contacting Anil Mohan APCCF (Eco-tourism and wildlife), A.K. Joshi PCCF (HoFF) and N.B. Mazumdar (worked on wetlands).

Mr. Anil Mohan – APCCF (eco-tourism and wildlife)

We informed him regarding the status of freshwater taxa and the need for policy interventions and management initiatives. He suggested contacting Pravin Pardeshi, Secretary – 022-22023363 and his personal assistance Mr. Nair and Mr. J.S. Patil.

05.09.12

Dr. Bahar Baviskar, Wild CER, Veterinarian, rescue specialist

He suggested contacting Keerthi Sirothia an Associate Professor working on fish pathology in the Veterinary College in Nagpur.

Mr. Arun Jadhao – Fisheries professor, works on fish neuroscience, RTM Nagpur University

He informed that most of the fisheries curriculum pertains to food fish and does not have any biodiversity component. We discussed as to how this could be a lacuna in studying freshwater fish. As we spoke about this he mentioned of his experience with Bhandara District and the use of the stagnant water bodies by the locals and outsiders. He suggested that he could help by volunteering the university student force for analysis and field surveys.

Ms. Keerthi Sirothia , Associate Prof. Fish Pathology, Veterinary College

She has worked on fish diseases including lesions and can analyse specimens collected with specific permissions and via proper channel for lesions and changes in organs for fish pathology. She suggested contacting the fishery department as well.

Dr. T. Srinivasu, Botany Department, RTM Nagpur University

He has students surveying Vidarbha for plants (Madhuri Thakre) and has equipment and lab for study. He suggested contacting Alka Chaturvedi as she was the Head of the Department and a taxonomist. We tried meeting up with her but she was unavailable.

06.09.12

Hislop College Meeting:

Dr. Andrew Raymond – Odonates expert – Hislop College (also on FD's project approval committee)

Dr. Nitin Dongarwar – Aquatic plants – RTM Nagpur University

Dr. Sanyogita Verma – Plankton expert – Hislop

Dr. J.P. Kotangale – Mollusc expert – Nagpur

Dr. Dilip Bhagwanrao Sawarkar – Amphibian expert, Dharampet College

David Raju – Amphibian expert

Nilesh Thavkar - Odonates

- Neelesh Heda (09765270666) – Freshwater Fishes of Central India
- Identify study sites in Vidarbha – Totladoh-Pench, Wainganga, Wadgaon, Pohra
- Points to include in the Totladoh permission proposal – DNA samples essential and need of one male and one female, atleast two specimens,
- Students can pitch in with surveys and research



Contacts:

Dr. Ashwajit Fulzele

Dr. K.H. Makde

Dr. Mrunal Kale

07.09.12

A.K. Saxena – APCCF (Wildlife)

Neel Mazumdar – APCCF (Conservation)

He informed that with present day policies diversion of land and leasing of forest land is not allowed and that most leases are very old and are being extended or in many cases terminated with persuasion.

He also informed that he works on legal implementation of laws related to the territorial beat.

M.G. Bhruhundi (Former Deputy Director of Fisheries)

He is a former deputy director of fisheries for the state and has been trying to breed some of the local native fish species. But he believes that culture practices for native fish species not commercially viable as there is no research team in fisheries. He believes that it is not possible for fisheries to breed native fish at a very local scale. But agrees that local communities prefer native fish as opposed to the carps.

Suggested meeting the following:

State Fisheries Department, National Fisheries Department, Contact ICAR, MoEF, CIFA, CIFE & CIFRI for National Level action, Departments concerned with fisheries, Irrigation/ fisheries/communities/Commerce/MPEDA and we met with all these different departments to understand their stake in freshwater fish and how they may influence policy making.

Ashish Tiple – Butterfly and Odonate expert

Contacts:

Mollusca - Sachin Patil – Jr. Zoological Assisstant - ZSI Jabalpur, Aquatic Plants – Dr. Nana Ugamuge (Dharampet Science College) Nagpur, Dr. K.H. Makde – Former Botany Department Head (Hislop) – Nagpur, Mrs. Bhugavkar – BMV College – Amravati, Central Museum

October 2012, Hyderabad

Convention of Biological Diversity - Hyderabad

Briefly met with Hem Pandey, Additional Secretary in the Ministry of Environment, Forests & Climate Change. We introduced freshwater fish and its status to him at the CBD.

AZE side event:

A side event referring to the Alliance for Zero Extinction with special reference to Indian AZE species in collaboration with Island Conservation was held at the CBD. The event explained the criteria for recognizing AZE species such as single location endemics, which are assessed as Critically Endangered and are under one management. Sanjay Molur also highlighted the urgent need for conservation action and prioritizing on the part of the government by including it within the National Biodiversity Targets, which are based on the AICHI targets. Also, conservation of AZE species agrees with Target 12 of the AICHI biodiversity targets.

Met with:

Probir Banerjee and Sunaina Mandeem from PondyCAN spoke about the issues concerning unregulated and unplanned construction of ports on the coast of India and threats caused by thermal power production.

Braulio Ferreira de Souza Dias, CBD

We spoke to Valerie Hickey from The World Bank, USA regarding the freshwater conservation policy issues. And later on involved Anupam Joshi from The World Bank, India office.

Michael Dougherty, Head, Asia Communications – IUCN

We also initiated collaboration with Dr. Ritesh Kumar from Wetlands International on freshwater conservation policies and planned to meet later to discuss further.



Shyama Pagad, Manager Information Services, Invasive Species Specialist Group

Dr. Yong Shik KIM, Chair, Korean Plant Specialist Group

Olivier Langrand, Director Global Affairs, Island Conservation was a part of the AZE side event and was also keen to know about freshwater biodiversity AZE sites in India.

Bill Waldman, Executive Director, Island Conservation & Nick Holmes, Director of Science, Island Conservation were also part of the AZE side event

Diego Juffe Bignoli, Programme office, Global Species Programme, IUCN had been a part of the initial assessments and was keen to help with the follow up projects.

Steven Board, Executive Director, TRAFFIC International

Claire Beastall, Training and Capacity Building Coordinator, TRAFFIC International

Girish Jathar, Watershed Organisation Trust

Yuna Choi, Communication officer, East Asian-Australasian Flyway Partnership

Sumaira Abdulali, Awaaz Foundation hosted a side event on sand mining which was very interesting a presented an interesting case study form a region in Maharashtra. This case study highlighted declining fisheries resulting in sand mining as an alternate livelihood source that may prove fatal as the people dived to great depths to retrieve the sand and sometimes did not return to the surface.

Bhaskar Vira, Department of Geography, University of Cambridge

Ramki Sreenivasan, Conservation India offered to put up blogs and posts once the white papers were written up.

We discussed the issues plaguing inland water in India with David Coates, Environmental Affairs Officer – Inland Waters, CBD.

Farhad Vania, GIZ, New Delhi

4-6 February 2013 Ministry of Environment & Forests in Delhi

4.02.13

Dr. MeenaKumari, Fisheries Head:

Suggested meeting with - Guwahati CIFA – Mr. Jibin Kumar, MPEDA – Kochi, CMFRI – Kochi, Mr. Tarun Shridhar and Vishnu Bhatt, Fisheries Commissioner, Krishi Bhavan. She informed that fisheries does not look at research and conservation and hence suggested the aforementioned names.

Dr. S.N. Sharma, NIMR, drsnsharma@sify.com:

There is a need for area specific data on native larvivorous freshwater fish species.

He requested data on segregation of the species assessed with respect to larvivorous fish species and among them surface feeders, mid-level and bottom. He also provided NIMR publications.

Dr. Adak:

He provided a copy of the book titled, Native Larvivorous fishes of India by A.G.K. Menon. On questioning regarding using native larvivorous fish for mosquito control, he stated that non-native species were introduced and they survive in any water conditions including urban sewage. He informed that exotic larvivorous fish have been introduced in almost all water bodies in the countries including the islands of Andaman and Nicobar.

He was open to the idea of using native species provided that data was given to them and it was tested. He requested for an introductory paragraph on information regarding the impacts of invasive species that he would send across to the field units.

05.02.13

Pramod Krishnan, UNDP:

He is working on a Munnar Project and would like to collaborate with ZOO. He informed that AZE is not a strong enough component for GeF funding, which comes through the Ministry. He suggested contacting Nayanika Singh to get through the ministry working process and also suggested contacting the wetland division within the MoEFCC. He was interested to collaborate regarding the wetland studies and we also discussed the situation at Periyar Lake and Stream System.

Mr. Mohammad Ali:

He works with Mr. Jayaram Ramesh, former Union Minister in the Ministry of Environment & Forests who is now in the Ministry of Rural Affairs. We spoke to him regarding freshwater biodiversity status and policy interventions. He provided some contacts and we were able to meet them.

Mr. S.B. Negi, WCCB:

He suggested using CITES for controlling ornamental fish trade at an international scale. At the national level he suggests using the wildlife protection act for any trade concerning ornamental fish being illegally caught from within a protected area. Fish does not seem to be the mandate of the Ministry of Environment, Forests and Climate Change.

06.02.13

Mr. Prabhat Tyagi:

We discussed the CITES and COP that may happen in the next 3 years need to be used in terms of ornamental freshwater fish trade. EXIM policy can ban fish international trade but there is a need to speak with the Director General Foreign Trade. Also, there is a need to generate customs awareness material to ensure avoidance of trade of banned species.

He suggested writing up a research proposal worth Rs. 50 Lakh with conservation impact to the MoEFCC. He also suggested sending a brief letter request to set up committee for looking after Fish Conservation and give details of the issue in Annexure. And asked us to send data to support the document. Lastly, he suggested sending advisories to Chief Secretary. He also mentioned contacting Praveen Pardeshi, Principal Secretary Forests, Maharashtra.

As far as fish wildlife sanctuaries are concerned he informed that we would need to speak with respective states as policies differ at the state level.

He is at present transferred to the Ministry of Water Resources.

Mr. Bhatt:

We discussed the IUCN assessments of freshwater taxa but received no clear response regarding the same. He was interested in medicinal plants, as this seems to have become a mandate.

Mr. Vivek Saxena PS to Union Forest Minister and DIG:

We discussed freshwater fish and the threats faced by them and possible policy interventions. It was a very short discussion and he asked for a letter to be sent to him regarding the major points of discussion.

Dr. Khanduri IG WL:

He wanted to understand a follow up on IUCN assessments and build capacity of BSI and ZSI for the same. He was unaware of ZOO being a part of IUCN assessments and was informed about this during this meeting. He suggested contacting Meenakshi Datta Ghosh for details on whats happening in IUCN India.

Mr. Garbiyal, ADG Wildlife:

Write a letter mentioning the points to be discussed and supporting scientific data, suggest people and organizations that can be part of a meeting - SM

Draft a list of FW species for WPA

General Notes:

Check out Solution Exchange for posting material.

Solutiionexchange-un.net.in

7-11 February 2013, Aqua Aquaria India Show, Vijaywada, Andhra Pradesh

A few of the speakers at the meet were suggesting that wild caught fish have better quality and stopping this would mean the loss of employment of several local communities dependent on it.

Dr. Ramachandran - MPEDA guidelines for green certification



His topic for the meet was "Significance of Green Certification for sustaining Ornamental fish resources with special emphasis on marketing wild-caught fishes". He introduced the green certification guidelines at the Aqua Aquaria India and best management practices such as fishing method, holding facilities and transport methods. He explained how these practices played a crucial role in reducing fish mortality after harvest. He also spoke about the need to follow it in order to get fish sold at a premium rate. And lastly he mentioned that state fisheries may reduce the certification cost. Dr. E.G. Silas also attended this session.



Hans George Evers

He showed photos of species that are used for ornamental trade and a syngnathid namely *Microphis deocata* was also listed. This is interesting since the family Syngnathidae is listed in the WPA.

3-5 March 2013, National Ramsar Sites Stakeholders meet and Wetland Conservation Seminar, Alappuzha, Kerala

The three-day meet was inaugurated by the Hon. Minister of State for Civil Aviation - Shri K.C. Venugopal. The meet was well represented by stakeholders from the Ramsar sites in many states across the country. Each of them presented a case study of their site and the community perspective on these sites and its management initiatives. The policies - "Wetlands (Conservation and Management) Rules, 2009." and the "National Water Policy, 2012" - were discussed and compared. The different data gaps in terms of biodiversity surveys were also



pointed out. The meet concluded with a quick visit to the Vembanad Lake and a bird's eye view of the management initiatives such as setting up of artificial fish breeding sites taken by the communities to ensure sustainable fishing.

The meeting was organized by ATREE and attended by Priyanka Iyer who discussed with the participants issues related to freshwater conservation strategies in wetland conservation across India.

25-26 March 2013, Kochi, Kerala

25.03.2013

Dr. Gopalakrishnan, NBFGR

Discussed captive breeding of freshwater fish used in ornamental fish trade. Captive breeding for six species have been perfected. Suggested to meet some other officials regarding green fishing and green certification in MPEDA.

Dr. Anna Mercy, Captive (ornamental) fish breeding expert

The situation of native fish is such that collectors and traders are not interested in captive breeding as it is more costly, time consuming and does not guarantee a success rate; whereas exotic fish are bred in India by fish aquarists since the breeding technology has been perfected and it is more economical to breed it in India rather than import it. Also many countries do not provide permits to import certain ornamental fish species.

The discussion with her on green certification informed that Green certification informs the collector of best management practices and fish collection methodologies and procedures. But

it does not discourage collectors from collecting fish from the wild and does not encourage captive breeding.

Most importantly, there is no record/data on how many fish are collected, from where, how and during what season. This gap is a major lacuna in the trade process.

In terms of fish mortality, she mentioned that *Sahyadria denisonni* suffered 75% mortality rate between 2007-2010 and its trade was started in 1998. She also informed that there is no facility to store fish no scientific collection method and no efficient transport of fish. The law states that *S. denisonni* above the size of 8-9cm should only be caught but illegal trade continues.

General discussion on different issues such as need for more awareness, threats such as dynamite fishing and polluting water bodies were held.

26.03.2013

Dr. Rani Palanisamy, Central Inland Fisheries Research Institute, Kochi

She stressed on need for setting up a meeting with all the different departments such as the Public Works Department, National Fisheries Development Board, State Electricity Board, Forest, Fisheries, Irrigation and Tourism departments involved in the management of an aquatic system. She also highlighted the need to focus on sustainable harvest of fisheries.

Dr. E.G. Silas, MPEDA

According to him the Wildlife Protection Act listing of species is not very effective as the WPA is restrictive. He is in support of ecosystem approach as opposed to species based conservation initiatives. Ornamental fish trade is not a major threat in his opinion just requires better management and breeding techniques.

Conservation initiatives such as protecting specific sections of the rivers identified based on criteria such as livelihoods, ecosystem values and species diversity is necessary. Also he is of the opinion that the primary stakeholders/local communities need to be involved in the management and conservation of freshwater systems. Temple sanctuaries should also be explored as a way of conserving freshwater fish.

1-3 April 2013, New Delhi

Kiran Rajashekariah, Head-Regional Programme (India, Bhutan China, Nepal & Pakistan)

He heads the freshwater wetland programme of WWF – High altitude lakes wherein they are working with communities on conservation policies

Also suggested networking with River research network – Latha Anantha, Kerala and International River Network – Sameer Mehta.

WWF has a Living Himalaya Network Initiative (LHNI).

Some suggested contacts

Diwakar Sharma – 9868878774 – Monitoring projects and has given the publications list

Somnath bandhopadhyay – save water/safe water initiative – 9999016954

Ruchi Pant and Anika:

She suggested that UNDP can support in proposing a policy change in rules. Most of UNDP's work is centered around community work and studies. Discussed policy write up and pointers that UNDP can support. We sent her a paragraph introducing AZE and also discussed the text submitted to the draft version of the National Biodiversity Strategic Action Plan.

She suggested sending a policy write-up on things to do on FW policy highlighting human aspects and that there is a need for more interactions between scientists and environmental lawyers.

Contacts

B.J. Krishnan – customary laws – check WGEEP

anika.bahra@undp.org

Anjana, WWF, apant@wwfindia.net

She is working with wetlands in northern India which include Surajpur wetland. Also, she is working with farmers and fisher folk.

Sajel Worah, Programme Director

WWF wetland programme director was interested in wetland policies and we shared information regarding freshwater including linear systems such as rivers and streams.

Shekhar Niraj, Traffic WWF

We discussed Export-Import policies and freshwater fish ornamental trade. There was an information exchange on the trade of Red-lined Torpedo Barb and their status in the wild. Also, data required for listing species in the Convention of International Trade of Endangered Species (CITES) was discussed with regards to freshwater fish. Discussed freshwater fish trade and need for policies pertaining to the same. We shared the trade paper later with him and also regarding the alarming rate of harvests of the Miss Kerala also known as the Red-lined Torpedo Barb.

Suresh Babu: WWF suresh@wwfindia, 09818997999

Discussed Mahseer conservation, the taxonomic ambiguities and threats such as dynamiting and lack of implementation of policies

Nayanika Singh:

Discussed the National River Conservation Directorate and possibility of talking to Mr. Hem Pandey regarding freshwater fish conservation policies.

Suggested meeting Dr. Khanduri, IG wildlife, MoEF and Rooprekha Dalwani and other contacts such as:

Hem Pandey, Additional Secretary (his PS is Ashok Gupta 624 extn) and send UNEP letter to Hem Pandey. And she also suggested meeting with the National river conservation directorate and she informed us that the policy making process and discussions can be made mainly with the Zoological Survey of India and Botanical Survey of India involved with conservation decision making.

Ritesh Kumar, Wetlands International

Discussed the National Programme on Conservation of Aquatic Ecosystems that is being set up by the Ministry of Environment and Forests. There was an information exchange on the case studies of Ramsar wetland conservation and the methodologies used for the same.

9 April 2013, New Delhi

09.04.2013

Dr. Khanduri, IG Wildlife, MoEF

We discussed the Wildlife Protection Act and the need for aquatic system related conservation provisions in the Act. The need for change in bats and rodents listed as vermin in the Wildlife Protection Act.

Discussed freshwater fish conservation and policies. We were informed that fisheries mainly fall under the purview of the fisheries department. Two page document on AZE species to be submitted to him. Interested in IUCN RedList assessments and wants us to rope in BSI and ZSI into the process. Also, interested in the chytrid disease study on freshwater frogs in the Western Ghats.

Sujata Arora, Scientist, CBD-Biodiversity, MoEF

Discussed the Convention of Parties for the Convention of Biological Diversity held at Hyderabad in India. She informed of the state-specific threatened species list and we also discussed the National Biodiversity targets and the National Biodiversity Strategic Action Plan (NBSAP). She requested us to send our inputs on the NBSAP to Dr. V.B. Mathur of Wildlife Institute of India (WII) and Dr. Bala Pisupathy, Chairman, National Biodiversity Authority (NBA).

We also discussed integrated management and she advised us to use existing mandates of national institutes and existing stakeholders to evolve a management mechanism/proposal. She informed that this may be more beneficial and practical.

Last but definitely not the least, the Friends of Target 12 concept (target 12- Species conservation) was discussed.

10 April 2013, NBFGR, Lucknow

Dr. Jenah, Head, National Bureau for Fish Genetic Research (NBFGR), Lucknow

He informed us about the Aquatic biodiversity Conservation Society hosted by NBFGR. He opined that endangered freshwater fish must not be placed in the Wildlife Protection Act schedules as this may cause practical problems. He suggested that zonation of a stretch of river as protected area may be a more effective method of conservation. He informed us of successful breeding programmes for the heavily traded Red-lined Torpedo Barb *Sahyadria dennisoni*.

He informed that NBFGR cannot take up conservation full-fledged, but can support it through its projects and activities. On raising questions regarding unauthorized introduction, he suggested raising awareness among general public and especially among the youth.

Talk to all scientists at NBFGR.

15-16 April 2013, New Delhi

15.04.2013

Dr. Ayyapan, DG (ICAR) DARE

He suggested bringing together all fisheries institutes to synergise the different aspects of fisheries research. And he also suggested a workshop or meeting to exchange information and ideas to promote sustainable methods.

16.04.2013

Meetings at Wildlife Trust of India regarding creating awareness about freshwater fish education with the help of their education department and support for freshwater fish conservation policies.



15 May 2013, Coimbatore

Siruthuli Meeting in Coimbatore

To set up a localized freshwater conservation NGO network, Education and awareness among district administrators, policy approach, urban freshwater management, pool resources and identify specific skill sets.

28 April-01 May 2013, Periyar

The AZE poster was launched at this meet in the presence of Sanjayan Kumar, Deputy Director of Periyar Tiger Reserve. Also, a two-day pilot exercise of removal of the invasive species African Catfish *Clarias gariepinus* was also conducted with help from volunteers.

22 June-2 July 2013, Bengaluru and Mumbai, miscellaneous meetings

Met with Aquarium traders in Bangalore and then met with officials of MPEDA in Mumbai and also visited the Bombay Natural History Society and Fisheries Survey of India.

13 July 2013, Coimbatore

Dr. James Erinjery, Vice Chancellor, Karunya University

Integrated management action plan and inter-disciplinary team are essential for conserving wetland and freshwater systems. Need to submit proposal regarding the same based on existing data sets though there is need for more research on baseline aspects of freshwater systems in India. Try and collaborate with the National Programme on Conservation of Aquatic Ecosystems (NPCAE). There is a need for catchment management for wise use of wetlands.

22-24 July 2013, Nelliampathy Hills, Kerala

Met with the ground level forest staff and discussed freshwater fish to gain an understanding of their perception and exchange information. We also spoke to them regarding the estates and plantations within the reserve forest. We conducted freshwater fish surveys and found some fishes with deformities and pustules.

31 July 2013 – 3 August 2013, New Delhi

31.07.2013

Meeting with GIZ office in Delhi to discuss their areas of interest and regions that they had identified for awareness and conservation action. Their thrust area includes marine life and fisheries. The major partner is the Ministry of Environment and Forests.

01.08.2013

S.B. Negi, Wildlife Crime Control Bureau (WCCB), MoEF

We discussed the threat of ornamental trade faced by endangered freshwater fish species and the policies that may help to affect a change in the present scenario. Policies concerning wildlife in India were discussed and they were categorized in the following manner. Policies concerning protected areas within the country include the Wildlife Protection Act and falls within the purview of the state government and then the Supreme Court. Wildlife law concerning outside India include the EXIM policy and the CITES to which India is a signatory. We discussed various human-animal conflict scenarios such as problems with macaques.

Mr. Hem Pande

He informed us of help needed with coding species and we discussed issues regarding trade, WPA, dedicated funds for freshwater species conservation, freshwater conservation policies, GEF funding for freshwater AZE species as part of the WorldBank initiative and CBD Target 12 to ensure zero extinction.

Dr. S.K. Khanduri, IG Wildlife, MoEF

Proposals submitted and we were asked to consult fisheries for the fish proposal. He informed us of conflict between the forest department and the fisheries department. We shared the chytrid paper published in PLoSOne and the ornamental fish trade paper.

2.08.2013

Dr. Sujata Arora

Discussed the state-specific threatened species list compiled by us based on the IUCN threatened species list. Also, we spoke about planning a meeting discussing ornamental freshwater fish trade issues along with ZSI. We planned to call a meeting of all the government stakeholders involved in the management and resource use of freshwater systems to discuss integrated management.

Dr. J.R. Bhatt

He was interested in working on invasive species impacting native species.

Mr. Garbyal

He suggested submitting a letter to on integrated management so it could be presented in the inter-ministerial meeting.

National Program on Conservation of Aquatic Ecosystems – Chairman

Data and addition to notification yet to come from the states to facilitate action from the centre.

24 August 2013, Chennai

Dr. Thirunavukarasu, Central Institute for Brackish Aquaculture (CIBA), Chennai

On discussing the status of freshwater systems in India, he opined that there is a need for consultative meeting between the various stakeholders and policy makers. The other interesting issue raised by him was that the catch has large volumes but the size of the fish is diminishing with passing years. And this could be a matter that requires urgent attention as half of India fisheries come from inland fisheries.

Mr. Lakshmi Narayan, Principal Chief Conservator of Wildlife – Chief Wildlife Warden

Discussed the problems faced by freshwater fish in Tamil Nadu and the two AZE sites for freshwater fish and also the impact of the deadly chytrid fungus on amphibian populations. Also, discussed need for incorporating freshwater fish information in management and working plans of protected areas and non-protected areas respectively.

20 November 2013, International Ornithology Congress, Coimbatore

Dr. Taej Mundkar, Wetlands International

Need to identify critical sites on high priority and use them as case studies to replicate. Also, there is a need for implementable dynamic conservation policies that also take into account wise use of wetlands.

07 January 2014, Chennai

Dr. Balakrishna Pisupathy, Chairman, National Biodiversity Authority, Chennai

Concept note on state-specific threatened species information was discussed. He informed that the information would be shared with state biodiversity board. We discussed the trade versus the biological diversity act stating regulating trade of threatened species. And we also spoke about Biodiversity Monitoring Committees (BMCs) set up for local communities that help NBA and researchers in understanding ecosystems.

30 January – 5 February 2014, New Delhi

30.01.2014-02.02.2014

CMS-Vatavaran 2014

The CMS Vatavaran festival has been going on for a decade (2002-2012) and its aim has been to create impact using films as a medium. The audience of this fest include policy makers, students, media persons and conservationists alike. In 2013, they had various thematic sessions, one of which was on inland waters. Zoo Outreach Organization led this thematic session on inland waters as a part of the follow-up of the freshwater biodiversity status assessments and the ongoing policy and outreach projects. The fest was an ideal opportunity to get in touch with NGOs working with freshwater biodiversity conservation and with some of the government officials since it was based in New Delhi. The fest fuelled discussions on the various issues plaguing freshwater systems. The following talks were given across the days of the festival by different subject experts to cater to the varied audience and create awareness.



Freshwaters: Forgotten biomes of high value. Where do we stand?

By Sanjay Molur, Rajeev Raghavan, Biju Kumar, Ritesh Kumar

This session focused on the status of the most important resource on earth and biodiversity that keeps it alive – Freshwaters!

Nice and exotic: the deadly alien syndrome

By Biju Kumar, Rajeev Raghavan, Sanjay Molur

This session focused on the critical and growing problem of exotic species that are invading the freshwater systems and conquering the natives!



Damned with or without: Succumbing to the pressures.

By Biju Kumar, B.C. Choudhury, Gopi Sundar, Ravi Chellam

This session focused on the growing problem of dams taking over rivers and questioning the need.

Putting Freshwaters on the map!

By Payal B. Molur, Priyanka Iyer, Sanjay Molur

This session focused on the need to mainstream freshwater systems through outreach and the need for freshwater biodiversity conservation policy through an integrated approach.



Protecting the 'tiger of the water': are anglers the best advocates for Mahseer conservation?

By Rajeev Raghavan, Sanjay Molur

This session focused on taxonomic ambiguity of Mahseer, angling and debated whether angling is a conservation strategy or a conservation tragedy.

Uncovering an obscure trade: endemic freshwater fishes and the global aquarium markets.

By Rajeev Raghavan, Shekhar Niraj, Sanjay Molur

This session focused on export of threatened ornamental freshwater fish, its cumulative possible impacts on populations taking into account the other existing threats.

Apart from these sessions, Sanjay Molur took part as a member of the panel discussions in other sessions on freshwater conducted by WWF India, Wildlife Institute of India and IUCN India.

03.02.2014

Anupam Joshi, World Bank, Delhi

We discussed the need for dialogues between the different ministries involved in exploiting freshwater systems. He informed that he is interested in using AZE species as case studies to support environmental safeguard policy.

05.02.2014

Shekhar Niraj

We spoke about the need to create awareness regarding policies and the plight of freshwater fish in India.

Ritesh Kumar, Wetlands International

We discussed some wetland case studies and the methodology used in order to work on their management, for e.g. Chilika Lake.

3-14 March 2014, KBA workshop, Kotagiri

Kevin Smith from the freshwater biodiversity unit of the IUCN and Sanjay Molur of Zoo Outreach Organization conducted a series of three workshops to identify freshwater Key Biodiversity Areas (KBAs) for the Western Ghats states of Kerala and Tamil Nadu with funding from the Critical Ecosystem Partnership Fund. Subject experts for the trigger species from both the states were called for the meeting. During the two workshops, 34 KBAs for Kerala and Tamil Nadu were identified, delineated and validated. This was followed by the end user workshop wherein the participants discussed the use of this exercise in building policies and making a difference on ground-level conservation activities. The results of the workshop were used in informing the policy project.



29 March 2014, Mahseer Workshop, Bannerghatta, Bengaluru

The Mahseer was well represented with passionate scientists and anglers alike. The Wildlife Protection Act was discussed and its restrictive framework with reference with freshwater fish conservation. The problem of dynamiting in Cauvery Wildlife Sanctuary and conservation actions were discussed.

Anglers as stakeholders for freshwater fish conservation and their participation and support was discussed especially in relation to Mahseers.

20-25 September 2014, Coimbatore

The freshwater fish team met up to finalize the protected area gap analysis, policy framework and the Wildlife Protection Act species prioritization process. While draft frameworks have been developed and presented in the Report, it was evident that actual policy briefs needed more inputs from stakeholders as there was no consensus on the different aspects. Hasty suggestions could only hurt the long-term conservation efforts for freshwater biodiversity and ecosystems and it was decided that a series of scientific outputs on the various aspects would first be published and later a more solid framework be built. The team began work on three scientific papers for publication in peer-reviewed journals.

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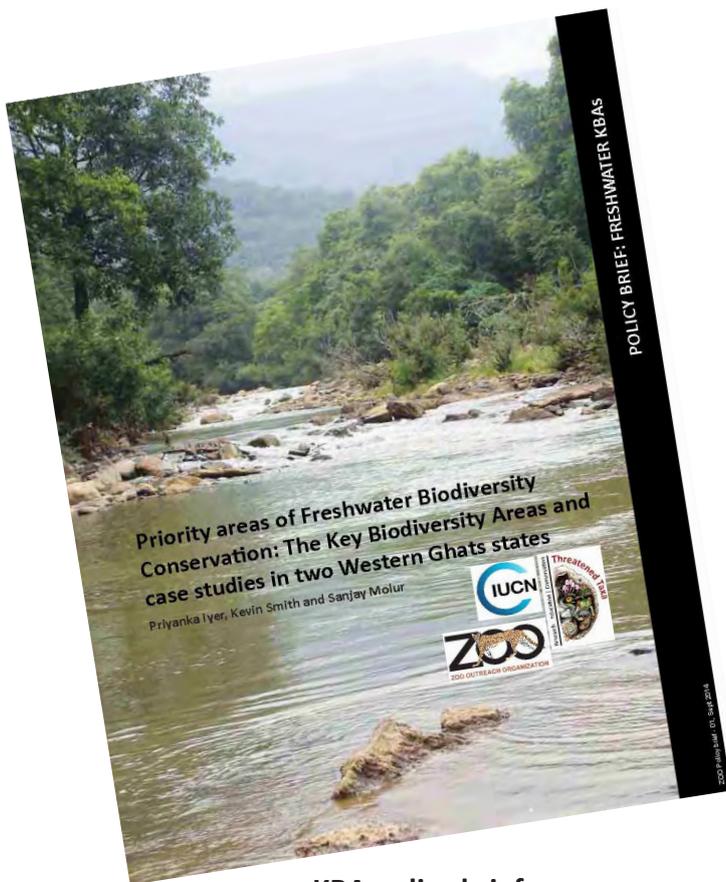
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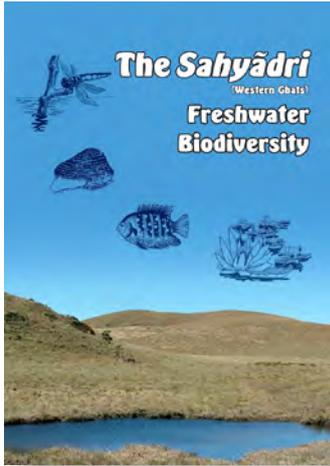
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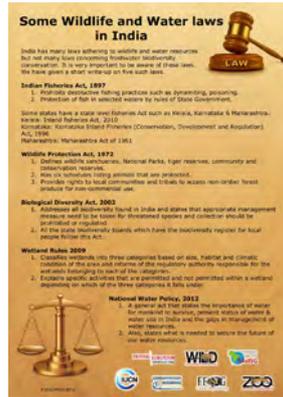


KBA policy brief and freshwater biodiversity bookmarks





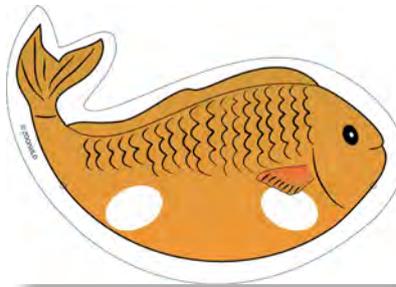
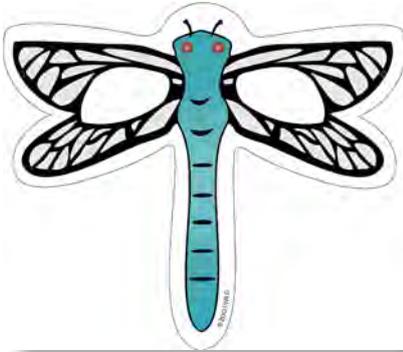
Booklet



Phamphlet on laws



Placard

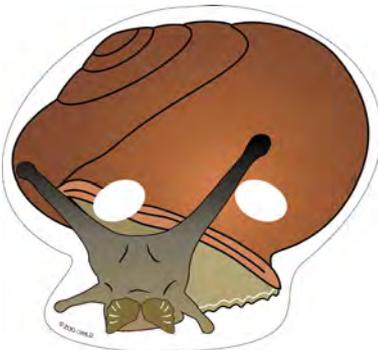


Masks



The Sahyādrī Odonates and Freshwater Fish

Sticker

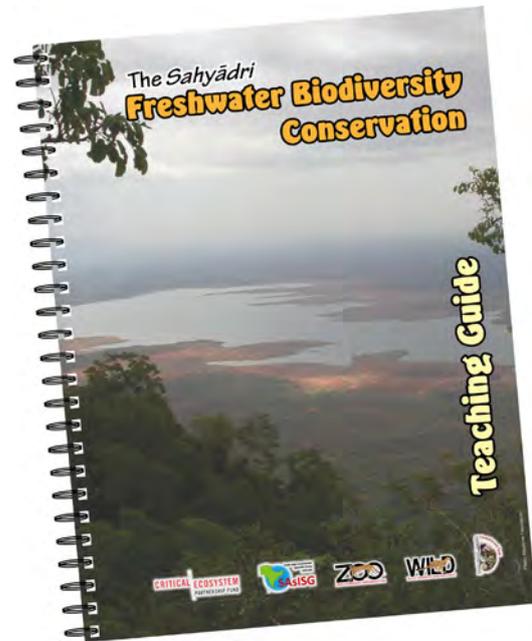
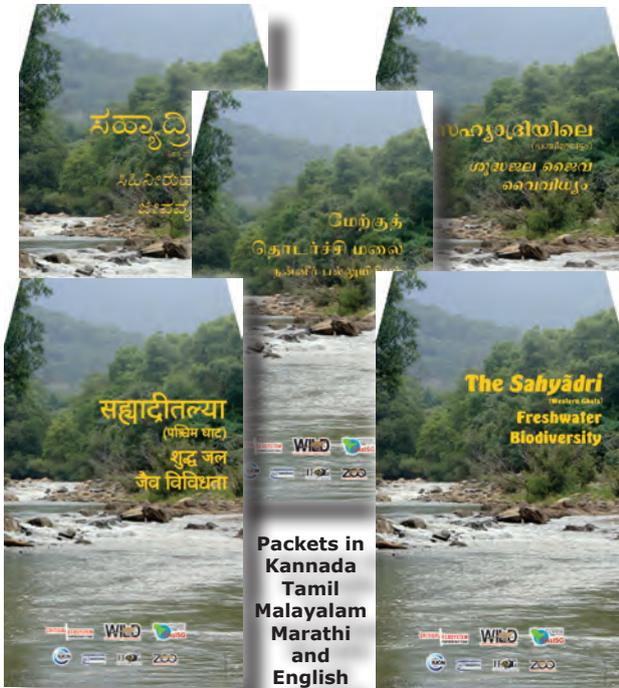
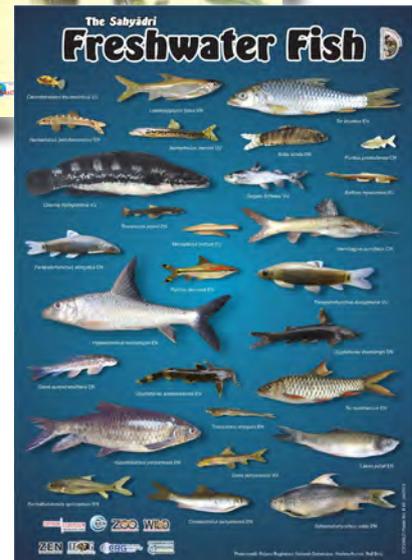


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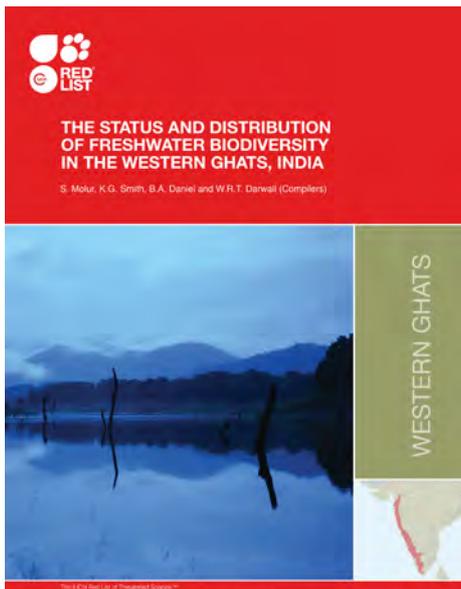


T-shirt for educators

Language being a major barrier in this region, conservation education and dissemination of information to local communities posed a big challenge. At the same time the conservation effort will not be effective without involvement of the local communities, governing bodies and all stakeholders. So it was inevitable education materials were in local language wherever possible.



Freshwater biodiversity posters, education manual and packets



Alliance for Zero Extinction freshwater fishes of Periyar Tiger Reserve (PTR) poster

Endemic and Threatened Fishes of Periyar Tiger Reserve

തേക്കടി പാണ്ടൻ കൊയ്മ



Periyar Blotched Loach
Nemacheilus menoni Zacharias & Minimol, 1999
Vulnerable

കരിയാൻ



Periyar Barb
Hypselobarbus periyarensis (Raj, 1941)
Endangered

***AZE species**

കരിമ്പാച്ചി



Periyar Lalia
Crossocheilus periyarensis (Menon & Jacob, 1996)
Endangered

***AZE species**

തേക്കടി കല്ലൊട്ടി



Periyar Stone Sucker
Garra periyarensis Gopi, 2001
Vulnerable

ബ്രഹ്മണകുണ്ട



Peninsular Hill Trout
Lepidopygopsis typus Raj, 1941
Endangered

***AZE species**

കടുവ കൊയ്മ



Periyar Reticulated Loach
Nemacheilus periyarensis Kurup & Radhakrishnan, 2005
Vulnerable

Scale 6mm = 8cm
Photos by K. Krishnakumar
CRG/ZOO Poster # 42 September 2012








* AZE (Alliance for Zero Extinction) species: Species prioritized by the Indian AZE, occurring in a single location and assessed as Critically Endangered or Endangered with a very high risk of extinction. അപരമസ്ഥിതിയിൽ സീമാന്തരം എടുത്തുകൊണ്ട് - വാസ്തവത്തിൽ ഇല്ലാതാകാനുള്ള കൂടുതൽ



Key Biodiversity Area Special Series

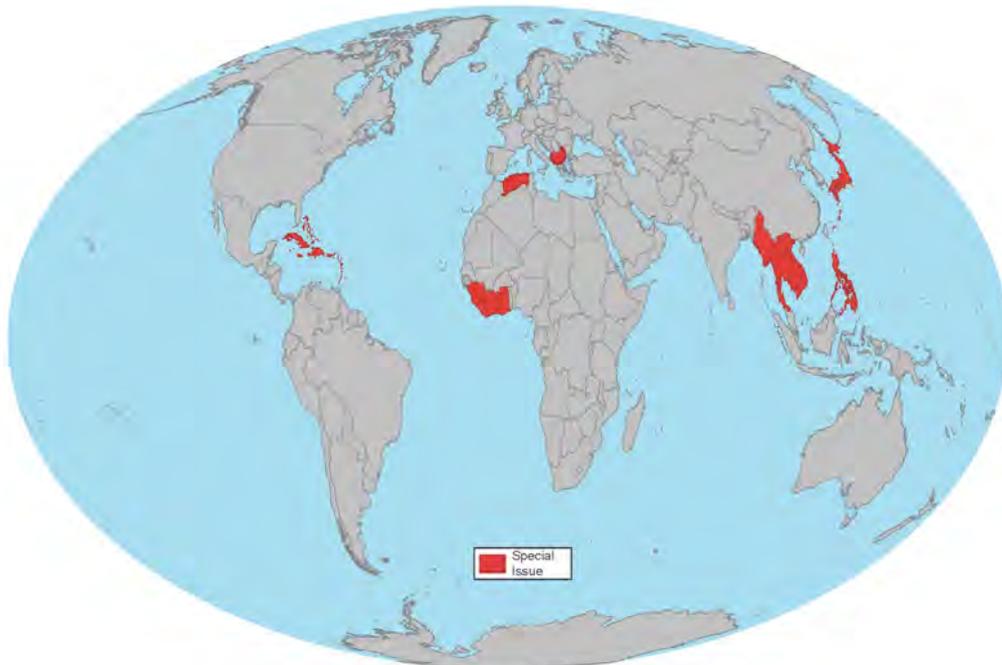
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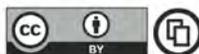
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Countries and regions with KBA processes described in this special issue



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Board game on freshwater fish conservation for policy makers, conservationists, ecologists, fishery biologists. Age 13+.

