

SAVING FRESHWATER FISHES AND HABITATS

Newsletter of the IUCN SSC/WI Freshwater Fish Specialist Group

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Photo: José Sabino

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Wetlands
INTERNATIONAL

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Front cover image:
The dorado, *Salminus
brasiliensis*, a
potadromous species
from South America.
Photo credit: José
Sabino

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51 Upcoming events and conferences

FFSG UPDATE

Message from the FFSG Global Chair

Dr. Richard Snieder

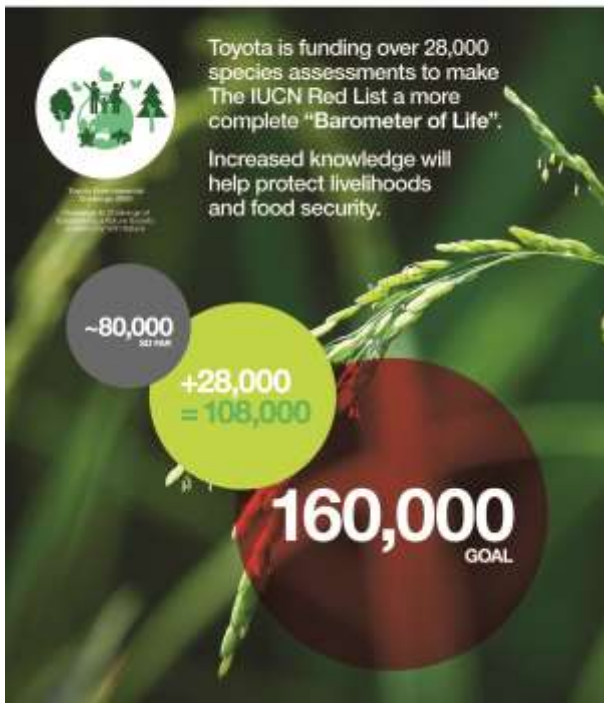


Welcome to the May 2016 issue of our FFSG newsletter. The beginning of the year has been busy for the Secretariat and for many of the FFSG members. This week sees the culmination of a lot of work in preparation for World Fish Migration Day 2016 (May 21), as discussed on pages 8-13 of this newsletter. The 2016 World Fish Migration Day is even larger, in terms of number of events (over 400!) and global extent, than the 2014 Day.

We have also been planning several events, focused on freshwater ecosystems and freshwater fishes, for the World Conservation Congress in Hawaii in September. Many of the FFSG members are involved in this process, with at least 11 events where FFSG members are helping in planning, and more where we will be contributing. Ian Harrison and I will be circulating more information to you about these events in the near future; in the meantime, you can easily check on all the Congress activities via the Congress website (<http://www.iucnworldconservationcongress.org/>). You can also follow the Motions that have been submitted to IUCN, and comment on them via the electronic discussion process:

<http://www.iucnworldconservationcongress.org/programa/asamblea-de-miembros/motions>.

I encourage you to look at Motion 005 - *Promotion of Anguillid eels as flagship species for aquatic conservation* – submitted by Matt Gollock, Chair of the Anguillid Eel Specialist Group.



Over the next several weeks we must also start to review our priorities for FFSG for IUCN's 2017-2020 Quadrennium, so that we have a draft Strategic Plan ready by the time of the World Conservation Congress. Ian and I will be following up with FFSG members on this. We expect to have an FFSG members meeting during the World Congress, with as many of you as can make it. **Remember that, if you are planning to attend the Congress, you should book your registration before the end of May in order to get the early registration discount.** I look forward to seeing several of you in Hawaii.

Several of you will have seen IUCN's recent announcement that it has developed a five-year partnership with Toyota Motor Corporation to provide funding to broaden the scope of The IUCN Red List of Threatened Species. The grant will include support for work assessing freshwater fishes. Obviously there are many details that need to be finalized in terms of when and how this work is implemented; but, ultimately it is good news for FFSG.

We are continuing to develop some interesting new proposals for FFSG work, including plans for assessments on migratory fishes, and the *Blueprint for Freshwater Life* (which was discussed in Newsletter Issue 10, December 2015). We will be holding sessions on both of these subjects at the World Conservation Congress. Earlier this month we held an informal FFSG teleconference meeting, to review some of our recent progress and to discuss forward plans. We will aim to hold similar teleconference meetings every six to eight weeks, to give us all more of an opportunity to feel connected with each other. These meetings will also give us an opportunity to bring in input to our 2017-2020 Strategic Plan as we develop it further. There is plenty of work to be done over the next few months!

Regionally, our work is continuing to move forwards well with, for example, workshops held in the Sunda region, and several interesting projects in Europe and other parts of the world, as reported here. Last September I co-lead members of National Geographic's ICOA (International Council of Advisors) to do some underwater archeology in the cenotes of the states of Yucatan and Quintana Roo, in Mexico. In addition we were privileged to be hosted by Otto von Bertrab, to make a scientific tour of the Rio Secreto Aquifer, which part of a state wide system of underground



rivers and caves. Part of the Rio Secreto Aquifer is open to the public, and a substantial part is under exploration and research. The Mayan underground fresh water aquifer is one of the most exquisite sights you could ever visit, whether as a tourist, or better yet, as a scientist. The aquifer is an important natural benefit that supports the healthy functioning of many ecosystems of the area, and the people who depend on its freshwater resources. Guillermo de Anda, (<http://www.nationalgeographic.com/explorers/bios/guillermo-de-anda-alanis/>) one of the most renowned underwater archeologists, has agreed to share with us a small synopsis of his work in this newsletter (pages 18-19). I hope you find the article of interest and find relevance in what we all do in search of freshwater habitat preservation.

Once again, many thanks to the South African Institute for Aquatic Biodiversity for assisting with the preparation of the newsletter, especially Ann Wu, intern with Olaf Weyl at SAIAB.

Best wishes,

A handwritten signature in blue ink, appearing to read "Richard Sneider".

Richard Sneider
FFSG Global Chair

In Memoriam: Richard P. Vari, FFSG Steering Committee member

Richard Sneider & Ian Harrison

FFSG Global Chair and FFSG Technical Officer

As many of you already know, Rich Vari passed away on January 15, 2016. Rich had been a Curator of Fishes at the National Museum of Natural History in Washington DC for 36 years and he had been an enthusiastic member of FFSG for many years, as part of the Steering Committee and the Special Advisor for Systematics and Taxonomy.

Rich was a close professional colleague and friend to many of us in FFSG and we will dearly miss him. Rich brought outstanding expertise to our group, and he always had a great sense of commitment to, and enjoyment for our work. His contributions to our annual meetings were always thoughtful, engaging, and often delivered with a great sense of humour. He took our work very seriously, but never too seriously. Indeed, he always seemed to show that he was enjoying the social opportunity of meeting with his colleagues as much as anything else.

Full obituaries of Rich's very productive life will be published in *Copeia* and in the *Journal of Fish Biology*. We will notify FFSG members when they are published.



Rich Vari at a panel; discussion with Topis Contreras MacBeath at the 2012 Annual Meeting of the FFSG in Chester

FFSG Steering Committee member gives Tedx talk

Ian Harrison

FFSG Technical Officer

Earlier this year, FFSG Steering Committee member Zeb Hogan gave a TEDx talk at the University of Nevada, about freshwater biodiversity and the need to protect freshwater ecosystems. He uses his work on the world's largest fishes to illustrate many of the points. It is a great talk, with excellent images; it is well worth viewing. It is available at:

<https://www.youtube.com/watch?v=VkpOwXbz6g>



Sundaic Freshwater Fish IUCN Red List Workshop

Vinita Ramani

Wildlife Reserves Singapore

The Sundaic Freshwater Fish IUCN Red List Workshop was held at the [Wildlife Reserves Singapore](#) (WRS) from February 24th – 27th. Wildlife Reserves Singapore Conservation Fund (WRSCF), in collaboration with the Lee Kong Chian Natural History Museum (LKCNHM) and the Department of Biological Sciences (DBS), National University of Singapore (NUS), brought together local and international experts to prepare to assess species in the Sunda region according to IUCN guidelines, and to propose future conservation plans for vulnerable species.

Also see pages 42-46 for a report on some of the unusual fishes of the region.

FFSG at the North East Council of Aquarium Societies Annual Convention

Ian Harrison

FFSG Technical Officer

The North East Council (NEC) of Aquarium Societies held their 41st Annual Convention on April 8-10, 2016 (<http://northeastcouncil.org/NewNEC/>), at Rocky Hill, Connecticut, and FFSG was well represented. Paul Loiselle, our co-Chair for the Madagascar region, was the keynote speaker, giving his keynote presentation on *Aquarists and Conservation*, as well as a presentation on *What – If Anything – Is a Barb?*.

An objective of the 2016 meeting was to raise money for worthy projects to be supported by the NEC's James J. White Memorial Conservation Fund. Scott Dowd, the Chair of FFSG's Home Aquarium Fish Subgroup had suggested the Congo Project of the American Museum of Natural History, which is run by Melanie Stiassny, co-Chair with Paul Loiselle for the Madagascar region, and FFSG Steering Committee member. The convention organizers invited Melanie to give a presentation on the project; she had a pre-existing commitment so Ian Harrison stood in for her and gave two presentations, one on *Distribution and Conservation of fishes in the Congo River* - reporting on work done as part of the AMNH Congo project; and the other presentation on *Assessing Biodiversity for Conservation and Management of Freshwater Resources*.

Through an auction of ichthyological books donated by Melanie Stiassny and Ian Harrison, and via a silent auction of live fishes and ancillary aquarium items, we were able to raise approximately \$1400 to support a Congolese student to work on a review of possible options for a sustainable aquarium fish trade from the Congo, using Project Piaba (<http://projectpiaba.org/>) as a model.

Many thanks to the NEC for inviting our participation, and to Scott Dowd for coordinating much of it. The Convention was packed with excellent speakers, social events, and some exceptional fishes on display.



Ian Harrison delivering the Congo presentation

World Fish Migration Day, May 21, 2016

Kerry Brink

Project Coordinator

World Fish Migration Foundation

World Fish Migration Day is fast approaching and now has over 400 events in over 60 countries!



Migratory fishes all over the world depend on open rivers. These migratory fishes are an important part of many riverine ecosystems around the world and are also essential for millions of communities who are dependent on these migratory fish as an important food source. Today, barriers like dams, weirs and sluices threaten many fish species' survival. With the help of organizers of local events on one global day we are creating more global awareness, to achieve a big impact on fish migration policies, measures and management! There is still time for you to join in the celebrations by organizing an event on World Fish Migration Day 2016. To host an event all you need to do is register using our online form: <http://www.worldfishmigrationday.com/join-wfmd>.

Events can be: river-cleanups, festivals, celebration on a dam/weir removal, inauguration of a fishway or a river restoration project, research activities in the field, special school programs and involving students/citizens, special trainings/workshops, etc. For more information see the flyer on pages 9-13, or visit our website and follow us on Facebook (<https://www.facebook.com/WorldFishMigrationDay>) and Twitter (#WFMD2016, @fishmigration).

If you have any questions or would like to get involved, please don't hesitate to contact Kerry Brink (Kerry@fishmigration.org) or connect with us on Facebook or twitter.



WORLD FISH MIGRATION DAY

May 21st, 2016

CONNECTING FISH, RIVERS AND PEOPLE

www.worldfishmigrationday.com

Organized by
the World Fish
Migration Platform



WHAT IS WORLD FISH MIGRATION DAY (WFMD)?

WFMD 2016 is a one day event to create worldwide awareness of the importance of freshwater migratory fish and open rivers for the general public, especially students and their teachers, resource managers and engineers, and commercial and recreational anglers, as well as those individuals who influence public policy that affect rivers. It is a global initiative with activities organized to reach these audiences.

Around the world, coordination and promotion is done through local activities inspired, supported and coordinated by a central office of the World Fish Migration Platform in Washington DC (USA).

At the individual event level, organizations undertake the development of an activity to raise awareness and involve local people and media about fish migration and open rivers. Local events include a range of activities: field trips, events at a school or aquaria, the opening of fishways, races, food festivals, etc. At this local level, the logo and central message of the WFMD, **Connecting fish, rivers and people**, will be used to connect sites around the world. The day will start in New Zealand and will follow the sun around the world, ending in Hawaii.



VISION

World Fish Migration Day (WFMD) 2016 will raise global attention to the need for restored river connections for migrating fish to achieve healthier fish stocks and more productive rivers. WFMD 2016 will bring a greater understanding worldwide to the issues around migratory fish to the general public and those individuals who influence fishery and water management policies. Raising awareness and creating commitments, at multiple levels, to improve the health of our rivers is essential to change behaviors and make progress in restoring rivers and in avoiding catastrophic mistakes when developing new resources.



WHY DO WE CARE?

Humans have been using and modifying rivers for millennia to improve our quality of life. Rivers provide many services: water supply, irrigation, navigation, flood control, hydropower, fishing and more. However, these activities are often carried out at a high environmental cost: **river and fish stock degradation**. We have caused river fragmentation, water quality deterioration, flow regime modification, and habitat alteration and destruction, collectively leading to decline in fish stocks. We also build barriers, such as weirs, dams and sluices for water management, hydropower and land drainage. These barriers in rivers and on coasts prevent fish migrations for reproduction, feeding and other purposes. Currently, migratory fish that require access to and within our freshwater ecosystems are threatened around the world and **the majority of native commercial and recreational fish stocks are declining rapidly**.

Many species like salmon, shad, giant catfishes, dourada, sturgeons and eels migrate between the sea and the rivers to complete their life cycle. Other species must make extensive migrations within their home rivers to reach critical habitats. Free migration routes for fish are crucial to their survival. If they cannot reach their breeding ground, the species will decline and eventually become locally or globally extinct. This fate has already fallen on many fish species all over the world.

Around the globe, millions of people rely on freshwater migratory fish as a primary food source and for their livelihoods. For example in the Mekong River basin, 50 million people depend on the river and the food it provides for nutrition and an income. In other areas migrating fish or their offspring provide critical forage for other commercially or ecologically important freshwater and marine species. The collapse of many fish stocks has a devastating effect on the food security of these people, which includes millions of the world's poorest people.



WFMD 2014 events

WHAT CAN BE DONE?

Conservationists, engineers and natural resource managers are working together to improve migration options for fish in rivers and deltas. It is our shared responsibility to find solutions and restore free fish migration. We are working to recover healthy rivers and prevent future degradation and species extinction. We do this to improve ecological conditions, which we owe to future generations, and to ensure the sustenance of the millions of human lives that depend on rivers. To accomplish this brighter future, we need to start by educating people and raising awareness of the current situation as well as solutions to the problems. World Fish Migration Day 2014 proved to be an effective strategy for raising awareness at local, regional, national to international levels. We want to grow this strategy even more, reaching more people with more stories, examples and solutions in 2016.

THE GOALS OF WFMD

- Activate citizens and our colleagues around the world to join in the celebrations and take action.
- Create commitments for free flowing rivers and open swimways for migratory fish.
- Create awareness for the importance of migratory fish and healthy-productive rivers among the general public, experts, river managers, fishery associations, NGO's and politicians around the globe.
- Foster partnerships, dialogue and cooperation around fish migration.
- Highlight local, national and international organizations working to restore and protect migrating fish.
- Stimulate agreements to develop improvements or avoid negative impacts to key river resources between NGO's, governments and commercial enterprises.

WFMD KEY MESSAGES

- Connecting fish, rivers and people.
- Freshwater migratory fish are the primary source of protein and livelihood for millions of people around the world.
- Barriers such as weirs, dams and sluices threaten fish migration.
- When fish migration is blocked, fish stocks become depleted and this can result in loss of key protean sources for millions of people and degrade rivers and nearby marine ecosystems.
- Highlight local, national and international organizations working to restore and protect migrating fish.



HOW CAN PEOPLE GET INVOLVED?

1 ORGANIZE AN EVENT

Participating organizations will organize their own events (e.g. activity sessions, field events workshops or talks) and outreach communication, under the umbrella of WFMD. Promotional material will be available to download from the website and can be shared with visitors. The WFMD partnership is responsible for central coordination, international publicity and maintaining the website. The projects will be highlighted on the website, social media and in the press. Register events online [here](#).

2 PARTICIPATE IN A LOCAL EVENT

Events are being organised around the world and details of local events are listed on the WFMD website. There are a range of activities being organised, and the local organisations strongly encourage more people to take part in their planned events. Find out more [here](#).



3 SPREAD THE WORD ABOUT WFMD2016

Follow us on [Facebook](#) and [Twitter](#) to keep up to date with all the latest WFMD activities and share the news with colleagues, friends and family. Get word of local events and our key message to media outlets and include politicians, resource agencies, schools, energy and food source businesses (fishing communities, processing, food sales, restaurants, etc.). Use #WFMD2016 on social media.

SUPPORTERS OF WFMD

A wide range of organizations worldwide supports the WFMD. At this moment there are more than 40 organizations involved. A list of these organisations can be found [here](#).

PARTNERS OF WFMD



SPONSORS OF WFMD



CONTACT

Web www.worldfishmigrationday.com
 Email info@fishmigration.org
 Facebook www.facebook.com/WorldFishMigrationDay
 Twitter www.twitter.com/fishmigration
 Social media #WFMD2016

NEWS FROM AROUND THE WORLD

Fisheries and aquaculture research in Kazakhstan

Bakhtiyor Karimov

FFSG Central Asia Chair

The main research activities in Kazakhstan in the field of fisheries and aquaculture are concentrated in the Kazakh Research Institute of Fisheries (KazRIF). The institute is headed by Dr. K.B. Isbekov – a well-known scientist in the fisheries sector of Kazakhstan. The work includes: scientific support of biodiversity conservation in reservoirs, sustainable use of fish stocks, the development of commercial aquaculture, and the overall functioning and development of fisheries in the Republic of Kazakhstan.

The administration of KazRIF is located in Almaty city, and has six regional branches that cover all the major research fishery regions of Kazakhstan. KazRIF is a body of CITES; it cooperates and participates in the activities of FAO, on a continuous basis; and it conducts joint research with VNIRO Astrakhan Technical University, the Zoological Institute, CaspNIRH (Russia), Sintszyan Institute of Fisheries (China), the Azerbaijan Research Institute of Fisheries, the Institute of Fisheries Finland, and other institutions.

At present the Institute carries out the scientific-research program *“Applied research in the field of fishing industry for conservation of biodiversity and restoration of fish resources and other aquatic organisms in water bodies of international and republican significance of the Republic of Kazakhstan”*. The objectives of the program are: the development of scientifically based recommendations for protection, reproduction and use of fish resources and other aquatic animals; conservation of aquatic biodiversity; and provision of recommendations on sustainable fisheries in water bodies of the Republic of Kazakhstan.



Dr. Saule Assylbekova (second from left) at the regional FAO workshop in Ankara, Turkey: “Strengthening measures to adapt aquaculture and pasture fisheries to climate change in Central Asia (TCP / SEC / 3402)”, December, 2015

Biodiversity conservation is the responsibility of the state. Kazakhstan has ratified the International Convention on Biological Diversity. Today the population of Siberian sturgeon, thorn, white salmon, trout, barbel, marinka, and Balkhash perch have almost disappeared and are in need of special protection measures. But the inclusion of these species in the IUCN Red List is just one part of the process. It is necessary to take urgent measures to restore populations of these species in nature, including by capture of representatives of the rare and endangered species for the formation of broodstock and the subsequent artificial reproduction.

FFSG Member for Central Asia, Dr. Serik Timirkhanov receives top state award for work on sturgeon

Bakhtiyor Karimov

FFSG Central Asia Chair

On 15th December, 2015 seven groups of scientists of the Republic of Kazakhstan were awarded with the highest state Award for the utmost achievements in science and technology at the Kazakhstani president residence in the capital city of Astana. Dr. Serik Timirkhanov was among them, receiving his award for research on problems of preserving Kazakhstan sturgeons.

It is well-known that sturgeon populations have seriously declined due to intense anthropogenic impacts during the last few decades on their natural habitats of rivers, lakes and water reservoirs. The threats to the sturgeons include hydrotechnical construction, irrigation, water pollution, and illegal and unregistered fishing. Sturgeons, a well-known gourmet item, are on brink of extinction not only in the Kazakhstan region, but also all around the globe. At present, the restoration measures for sturgeons in the Kazakhstan region are impossible without significant human intervention. Today research on methods of artificial reproduction and restoring sturgeon populations in the rivers and seas of Kazakhstan is an absolute priority for Kazakhstani fish science. This complicated ecological problem was investigated by the group of scientists with active participation of Dr. Timirkhanov.



Award Ceremony at the presidential Residence of the republic of Kazakhstan

Based on the results of the group's long-term research, a basic technology was developed and the test production facility has been established at the West Kazakhstan University. It has already produced over 110 kg of black caviar without killing the fish, which was the usual practice until now. According to Dr.

Timirkhanov, this technology is well known around the world, however is quite new for Kazakhstan. The first plant, in the history of Kazakhstan, to use this technology is now under construction in the city of Uralsk, under sponsorship of a private investor. "The plant is striving to become the top sturgeon farm not only in Kazakhstan, but also in the neighboring countries, and even the Europe", Mr. Timirkhanov has stated. The expected capacity of the plant under construction is about eight tons of black caviar per year. It is strongly anticipated that production of caviar under farmed conditions will result in a sharp decrease of anthropogenic stress on wild populations of sturgeon in Kazakhstan and neighbouring countries of the region.

Let us congratulate Dr. Serik Timirkhanov with highest State Award – the first in the history of the freshwater fish scientist's society of Central Asia.

The Great Maya Aquifer project

Professor Guillermo de Anda

National Geographic Emerging Explorer; Underwater Archaeologist

(original text translated and edited by Richard Sneider)

The Yucatan Peninsula has extensive underground water resources, where natural wealth and archaeological heritage converge. The Mexican states of Quintana Roo and Yucatan are well known for having an extensive network of flooded caves that cover more than 2,000 square kilometers, many of which have not yet been explored. The Yucatan Peninsula aquifer is a karst, coastal aquifer, comprising limestone and coastline deposits, which is very permeable and remarkably heterogeneous in terms of its hydrological characteristics. The thickness of the aquifer layer that is saturated with freshwater is reduced to about 30 meters because of a seawater wedge underlying the aquifer; however the freshwater saturated layer increases in thickness inland, reaching approximately 60 meters.



The features of the aquifer, one of the world's largest, represent not only an enormous wealth of natural resources, but also a great opportunity for researching and exploring in the area of the Yucatan Peninsula. But they also highlight the challenges in terms of preserving the natural and historical heritage of these geological formations.

The Great Maya Aquifer Project was conceived as a response to the need for a better knowledge of the different variables that can serve as indicators of the status of this important natural resource. This initiative is supported by important organizations such as the Banco Para el Desarrollo de America Latina, (Bank for Development of Latin America), the Aspen Institute Mexico, UNAM (Universidad Nacional Autónoma de México),

Part of the complex network of underground network of rivers and waterways supporting ecosystems, and providing drinking water and recreational services, near Akumal, Quintana Roo. Photo credit: Paul Nicklen/SeaLegacy

UTRM (Universidad Tecnológica de la Riviera Maya), and the National Geographic Society. The project aims to obtain data to support the efforts of various international organizations that are focused on achieving sustainable water management policies. Such is the case of the United Nations through “UN Water”, whose 2014-2020 strategic plan has stressed the need to place water on the list of sustainable development priorities among the member nations of the organization. Indeed, water is a focus of Sustainable Development Goal 6 (target 6.6) (to protect and restore water-related ecosystems in recognition of their importance for water-related services, including wetlands, rivers, aquifers and lakes), and Sustainable Development Goal 15 (target 15.1) (the conservation, restoration and sustainable use of inland freshwater ecosystems and their services)

Our assignment for the first phase of the Great Maya Aquifer Project is a five-year research plan, which involves a series of expeditions into different underground water sources all along the Yucatan Peninsula, with the purpose of collecting data and samples that will allow us to quantify and analyze the variables that describe the conditions of such natural resources. The assimilated data can then be used by other organizations and individuals who propose solutions, from a public policy perspective, to achieve the sustainable management of these underground water resources.

The project activities will include the participation of specialists in the study of caves and cenotes. One of the main features of this proposal is that, for the first time, a multidisciplinary group of experts (archaeologists, biologists, and oceanographers among others) will conduct systematic research through exploration and sampling *in situ* (that is, under the water). From there, the group of experts will make a selection of the areas that are more susceptible to disturbance, to provide accurate information regarding the hypogean zones with the highest rates of contamination, as well as the submerged archaeological contexts they contain. Both fields of work will help identify the specific conservation and management actions required for the selected spots within the aquifer. Endemic fauna will also be registered. We will choose the optimal places to perform a systematic record of all forms of human interaction with the bodies of water, including, for example, well exploitation, proximity with local communities and possible external sources of contamination, and the effects of tourism. The passage of water through mangroves on its way to the ocean, and its effects on coastal coral communities, will also be an important part of our research.

This endeavor will join different scientific research criteria, which will considerably enrich the amount of information available and will also set a precedent for future research protocols. The future of the peninsular underground water must rely on the expertise of specialists of diverse fields of knowledge, brought together to achieve a proper consensus, based on holistic criteria. That multidisciplinary approach will enable us to formulate a conceptual framework that can support the creation of public policies, urgently needed to preserve the extensive, yet fragile water systems of the caves and cenotes of the Yucatan Peninsula. The most unique feature of this project is the fact that, for the very first time, a group of experts from different scientific fields, as well as experts on the techniques of cave diving, will join together. This is the reason why we believe that we are filling a gap in the important mission of preserving this invaluable source of fresh water.

Conservation of *Salmo cettii* and *Anguilla anguilla*: different needs and perspectives in Sardinia, Italy

Cesare Mario Puzzi¹, Daniele Tamborini¹, Stefania Trasforini¹

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The issues of restoring river connectivity in response to damming has been considered in both the scientific and engineering fields. In most cases the focus has been on the re-establishment of fish migration: the present work highlights how the needs of two autochthonous species can differ in an environment altered by allochthony.

The project "Attuazione del piano di gestione del SIC Foresta di Monte Arcosu. Recupero del ceppo autoctono della trota sarda (*Salmo cettii*)" (Provincia di Cagliari, Settore Ambiente, 2012-2015) intended to define a management and conservation plan for Mediterranean trout, *Salmo cettii*, in "Foresta di Monte Arcosu" (SCI ITB041105, Sardinia, Italy). The plan provided a study of the trout sub-populations and their habitats, defining the main threats for the species in the SCI area.



Figure 1. A specimen of *Salmo cettii*. Photo taken by Graia Srl.

The Mediterranean trout is the unique native salmonid in Sardinia: it is also native in the Tyrrhenian basins of Italian mainland and in Sicily. Compared to other salmonids it is very tolerant to low dissolved oxygen concentrations, high temperatures, and it can live in small streams with some prolonged dry periods or sudden high flows.

The main threats to its survival are presented by the excessive water abstraction, pollution, channelization or other artificial modernization of streambeds, the presence of allochthonous species (causing competition, predation and hybridization) and climate change.

The Mediterranean trout is listed (as *Salmo macrostigma*) in the Habitat Directive 92/43/CEE (Annex II) and is also classified as *Near Threatened* (NT) in Europe by the IUCN (Freyhof & Brooks, 2011). A study on the SCI fish community was carried out in order to assess whether allochthonous species caused any negative impacts on

Salmo cettii. The sites that were sampled (by electrofishing) showed that *Anguilla anguilla* and *Salmo cettii* had similar distributions.



Figure 2. Current distribution of *Salmo cettii* in Italy (left); map of the SCI "Foresta di Monte Arcosu" (right) with the distribution of *Salmo cettii* within the SCI (red); dry (orange) and wet (light blue) streambeds in August 2014.

The SCI ITB041105 "Foresta di Monte Arcosu" covers a 30,353 hectare area in the southwest of Sardinia: four river basins lie within it (Cixerri, Santa Lucia, Pula and Palmas). The streams are affected by a long summer dry season (with complete drying of some streams) and some frequent winter large flows. Two artificial lakes (Medau Zirimilis Lake and Bau Pressiu Lake) are present in the SCI. The streams of the SCI extend a few kilometers outside of the region until their outlet to the Tyrrhenian Sea.



Figure 3. Rio Monte Nieddu Stream: a wintertime photo (left) and a summertime photo (right). As with the majority of the water bodies in the SCI, it is totally dry in summer. Photo taken by Graia Srl.

Salmo cettii lives in the Cixerri and Pula basins, colonizing a 50 km stretch of the streams (based on the water availability). Studies have confirmed that the species is able to survive at temperatures of 28 C° and at dissolved oxygen concentrations of 3 mg/l. According to the results of the monitoring campaign, the SCI environment shows a high degree of natural conditions; in most cases the anthropogenic alterations are low or absent. There are no significant traces of organic/inorganic pollution. Climate change plays (and will play) an important role in survival of the species: it causes both a precipitation decrease and an increase of disastrous flooding, which affects the water regime of these ephemeral streams. The climate change effects are particularly strong in the Mediterranean Sea area and must be monitored in order to activate some temporary mitigation measures.

Some cases of fragmentation of stream connectivity across streams were identified. We found isolated evidences of riparian vegetation removal, which can lead to an increase of water temperature (lack of shading). In such extreme environments ($T_{\text{water}}=28\text{ C}^{\circ}$ and $\text{DO}=3\text{ mg/l}$ recorded) even a slight increase of water temperature can be lethal for resident aquatic organisms.

The SCI area is affected by some cases of fragmentation of longitudinal stream connectivity: we recorded the presence of dams and dikes. These obstacles were listed and mapped to be useful for a possible plan of restoration of stream connectivity.



Figure 4. Dikes on Rio de Su Casteddu Stream: upstream (left) and downstream (right) Medau Zirimilis Lake.

Subpopulations of *Salmo cettii* do not currently show significant negative effects due to habitat fragmentation, maybe because they are naturally evolved to small habitats (summer crowding of fishes in small pools) or to a scarce habitat availability (small home range). In support of this hypothesis we found a high intraspecific genetic variability, which means that the sub-populations are healthy despite the habitat fragmentation. The genetic analysis also confirmed the autochthony of each of the sub-populations sampled: hence our results exclude the possibility of previous hybridization with *Salmo trutta*. The possibility for any future hybridization should be prevented by avoiding (or at least supervising) every possible introduction of salmonids.

The electrofishing sampling highlighted an inverse correlation between the presence of artificial barriers and the occurrence of *Anguilla anguilla* upstream from them, indicating that these structures are interfering with the species' natural inclination to migrate upstream.

Cixerri and Medau Zirimilis dams have a strong impact on eel distribution: the species is very scarce upstream from these dams, and any such upstream presence is probably due to the existence of some small irrigation channels.

A plan for the restoration of river connectivity in the SCI area should take into account that:

- the artificial obstacles of the upper stretches (in the *Salmo cettii* zone) are generally passable by eels and partially passable by *Salmo cettii* (at least in the rainy season/reproductive period);
- the two dams have a two positive effects on the survival of *Salmo cettii*, (i) by preventing the upstream migration of allochthonous species, and (ii) by creating some refuges (the thermal stratification of the basins creates a summer hypolimnic refuge);
- the two dams affect eel distribution;
- we cannot exclude *a priori* that allochthonous species (e.g. *Cyprinus carpio*, *Micropterus salmoides*) would colonize the upper stretches in case of complete restoration of stream connectivity.

Standard fish passages could represent a good solution for both the upper stretch (*Salmo cettii* zone) and lower stretch (mulletts zone) of the drainages, but a different solution is desirable to keep isolated the trout

sub-populations isolated while allowing eel migration through Medau Zirimilis and Bau Pressiu dams: this is **the artificial eels passage**.



Figure 5. The eels passage at Casteldoria dam (Santa Maria Coghinas, Sardinia, Italy)

This device is absolutely species-specific, granting the eels migration without allowing the passage of other species. In the northern part of Sardinia (River Coghinas basin, Provincia di Olbia) some dams have been recently equipped with these devices. They require just a small amount of space and water to work, they are very adjustable to the existing structures, and it is possible to monitor the eels' passage by trapping or video monitoring.



Figure 6. Details of the sluice (left), of the monitoring cabin (centre); a juvenile specimen trapped during the first monitoring phase (right).

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Assessing the status of a recently discovered endemism from the floodplains of the lower Tagus River (western Iberian Peninsula)

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The freshwaters of the western Iberian Peninsula are home to a considerable diversity of native fishes dominated by small to medium sized cyprinids (c. 17 species out of 66). In-depth studies of such diversity are still revealing many new species to science, although some are in fact very old residents in Iberian freshwaters. One such species is the Lisbon arched-mouth nase, *Iberochondrostoma olisiponensis* (Figure 1). First discovered in 2006 from tributaries of the lower Tagus River basin, the species was formally described in 2007 as *Chondrostoma olisiponensis* (Gante *et al.*, 2007) but was later proposed to be included in the genus *Iberochondrostoma* (Sousa-Santos *et al.*, 2014). Despite its recent discovery, phylogenetic studies established it as an old species, having diverged from its closest relatives around 10 million years ago (Gante *et al.*, 2010). Another remarkable feature of this small cyprinid, uncommon among its European relatives, is its sexual dimorphism with males having longer pelvic fins than females (Gante *et al.*, 2007). The function of the extended pelvic fins in males is still unknown but it may be associated with courtship and spawning.



Figure 1 - *Iberochondrostoma olisiponensis* (voucher MB05-2198, MUHNAC – Lisbon, Portugal), paratype, female, 98.6 mm standard length, lateral view. Photo by H.F. Gante.

This remarkable species has a very restricted distribution range. Despite many surveys conducted in the lower Tagus tributaries, the presence of the Lisbon arched-mouth nase has been detected only in three small river basins (Gante *et al.*, 2007). Indeed, the extent of occurrence of this species is estimated to be less than 10 km² with an area of occupancy of about 3 km² in the rivers where its presence has been confirmed. The current distribution of *I. olisiponensis* is also highly fragmented, likely with little or no contact between populations. This situation is of conservation concern since replenishment from neighboring populations in the event of localized depletion is limited or even impossible. Localized depletion may already be occurring in one of the populations of *I. olisiponensis* (i.e. Rio Trancão) where the species' abundance is known to be declining since the late 1990s (Gante & Santos, unpublished data). There are also two other rivers where the species has not been recently detected but where historical records indicate its former occurrence. For all the above reasons, the Lisbon arched-mouth nase was classified as critically endangered by the IUCN in 2012, and requires urgent conservation efforts (Gante *et al.*, 2012).

Threats to the short-term survival of the Lisbon arched-mouth nase likely come from human-induced pressure. The species seems to be associated with floodplain areas that are presently under intensive agricultural practices and continued human development (e.g. industrial, domestic and agricultural pollution, introduction of exotic species, and land reclamation). These threats are especially problematic during extreme drought events, which lead to an overall degradation of habitat quantity and quality. An additional threat to the integrity of this species is its hybridization with another critically endangered sympatric relative, the Portuguese arched-mouth nase *Iberochondrostoma lusitanicus* (Crivelli, 2006; Gante *et al.* 2010; Sousa-Santos *et al.* 2014). Continued introgression of *I. olisiponensis* into this comparatively more abundant relative, *I. lusitanicum*, could lead to its genetic dilution.

An *ex-situ* conservation program was initiated in 2008, and successful reproduction in captivity has since been achieved for *I. olisiponensis*. The *ex-situ* stock of individuals has been maintained and grown to the present day. Also, monitoring efforts have been developed in one of the populations (i.e. River Trancão) and have confirmed its pronounced declining trend. Recently, a research project was initiated to evaluate extensively the current status of the three known populations of *I. olisiponensis*, and to conduct exhaustive field surveys aiming at establishing the full distribution range of the species and detecting possible additional populations. Also, the project aims to raise awareness of the public at large for the existence of this remarkable species, and to develop adequate conservation efforts ensuring its long-term survival. All the data collected will constitute the basis to propose the first dedicated conservation areas (i.e. sanctuaries) for the Lisbon arched-mouth nase, as well as to inform future actions aiming at reverting the current decline of their abundance and potential loss of genetic diversity. For further information, check the project website at <https://iberochondrostomaolisiponensis.wordpress.com/> and follow us on Twitter (@olisiponensis) for live updates.

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Fish passes developed into the context of the LIFE+ SEGURA RIVERLINK project

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Habitat connectivity is a central factor in shaping aquatic biological communities and fish assemblages, however, few tools exist to maintain and restore this attribute at a large scale in fluvial Mediterranean systems. The Segura-Riverlink is a LIFE Programme project (see FFSG newsletter, *Saving Freshwater Fishes and Habitats* Issue 5, June 2014) which aims to promote and support the environmental recovery of a fluvial sector of the Segura River Basin (more than 50 km long along the main river). The main purpose is to demonstrate and validate management measures for the development of a *Green Infrastructure (GI)* approach into the context of Mediterranean river basins characterized by a high impact to their connectivity. The project will restore the longitudinal connectivity, removing a significant number of small artificial barriers (Figure 1) to re-establish fish movement, and will also support other best practices of riverine restoration. The restoration actions will include the removal of a small weir and the construction of effective fish passage systems, and monitoring will assess the performance of these actions with the hope of validating the *GI* approach to river basin management and its possible extension to official management programmes. The project will also develop a Land Custody Network to integrate private owners in the river management and in agreeing good practices.

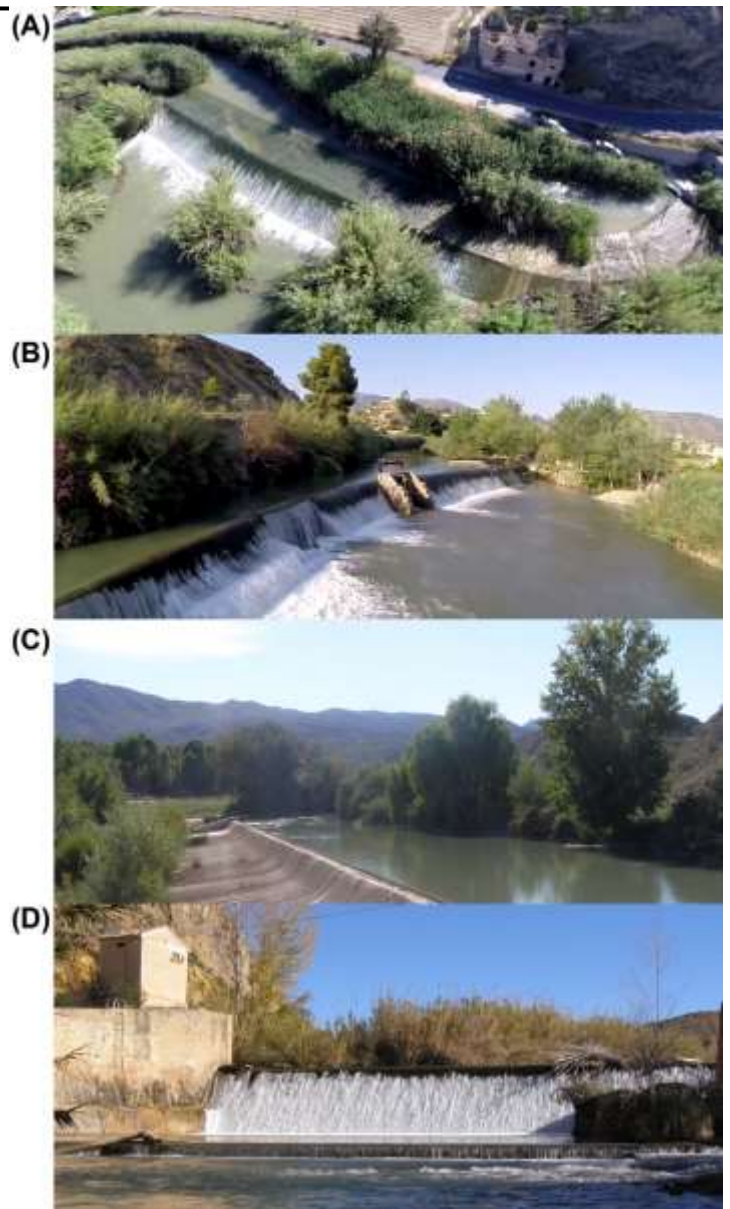


Figure 1. Examples of small artificial barriers where the fish passages will restore longitudinal connectivity in the context of the LIFE+ SEGURA RIVERLINK. A) Aerial view of the El Menjú weir (A); Low aerial view of the El Jarral weir (B); Hoya-García and Cañaverosa small dams (C and D).

Current outcomes

The initial fish-based assessment at the river sector of the project area was completed in spring of 2014 with significant baseline data showing a worrying conservation status of the Southern Iberian barbel (*Luciobarbus sclateri*), the target species of the project. In addition to this native species, we have obtained population level information for three cyprinids, Pyrenean gudgeon (*Gobio lozanoi*), Iberian nase (*Pseudochondrostoma polylepis*) and bleak (*Alburnus alburnus*) to assess changes during the period of the project, in other words as sentinel species. Moreover, we detected the updated distribution of fish species in the fluvial sector of the action project. In fact, the traits of the present fish community reflect a marked degradation compared to the historical status. The number of species has significantly increased due to introduction on alien species, and the turnover rate in species composition has been extremely high.

Since September 2015, six fish passes [‘natural appearance’ fishways (bypass and rocky-ramp) and ‘technical fishways’ (vertical-slot fishway)] have been implemented according to their suitability for each action site (Figure 2). Understanding the site topography, channel morphology, river hydrology, and characteristics of the barrier has been valuable in planning and designing fishways. Moreover, the knowledge of the biological needs of target species has influenced the final parameters in the fishway structure. Regardless of the type of structures built, experience has shown that the most effective means to develop successful solutions has occurred when engineers and biologists worked together systematically to design passage structures based on the ability and willingness of fish to seek and accept the hydraulic conditions presented to them. This is the case in the development of the fish passage structures implemented in the context of the LIFE+ SEGURA RIVERLINK (Figure 2).

Our fishway design process for upstream migrating fishes has provided an opportunity to develop safe, timely, and effective fish passage structures. We hope that these structures will be appropriate for each specific obstacle and for the target species. During 2016 and 2017, the main objective in the monitoring

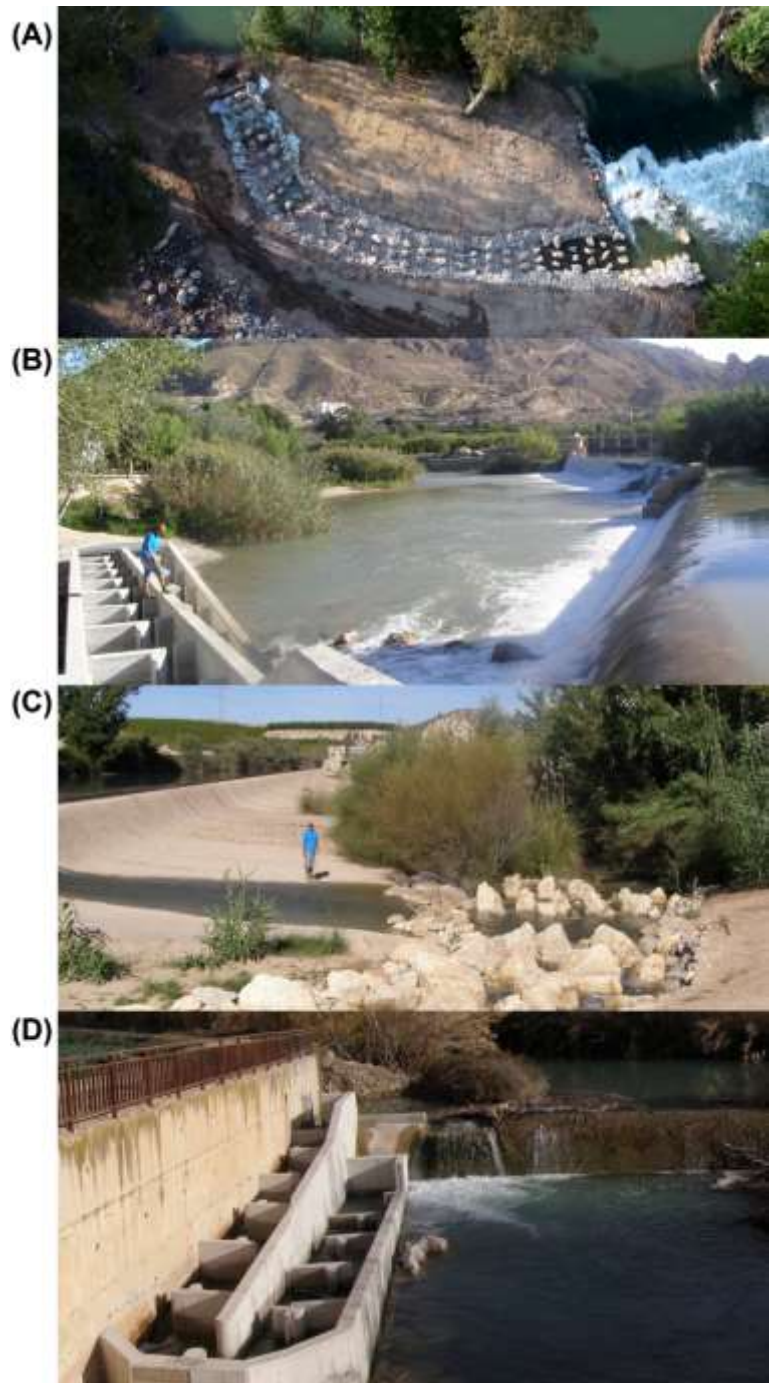


Figure 2. Different fish passage structures implemented in the Segura River Basin in the context of the LIFE+ SEGURA RIVERLINK. Views of the natural appearance fishway or bypass fishway of the El Menjú and Hoya-García weirs (A and C); Images of two technical fishways (B and D), El Jarral (vertical-slot) and Postrasvase (pool and weir).

programmes will be the evaluation of their effectiveness. Identifying the most appropriate and cost effective fishway design to achieve this goal will aid in meeting fishery management objectives, including minimizing injury, stress, and migration delays; river restoration; and supporting sustainable diadromous fish populations of the target species in the future. The three types of fish passes were selected.

Since Autumn 2014, two main fish-based assessment programs have been developed. The first one focused on the fish assemblage and populations, and the second is a specified mark-recapture program only with *Luciobarbus sclateri*. About 500 individuals larger than 25 cm total lengths have been marked by Anchor-Tag since November 2014 (Figure 3). The aims of the mark-recapture program are (1) to obtain information about fish movements, and (2) to develop an informative campaign for sport fishing anglers. We now have recapture data for fishes in some fluvial sectors next to the barriers, and the analysis of fish movement will be initiated in 2016.



Figure 3. Fish sampling and hydrological data collection in the fish passage structures (A, B and C) and images of the liberation of barbels for the mark-recapture program (D).

As mentioned above, during the next two migration periods we will evaluate the effectiveness of each fishway. At present, the hydraulic approach has shown a good design in the majority of structures, however, the information we currently have must be contrasted with biological data. Since September 2015, the occurrence of individuals of *Luciobarbus sclateri*, *Gobio lozanoi* and *Pseudochondrostoma polylepis* has been confirmed for the 'natural appearance' fishways that have been implemented.

In conclusion, the project's outcomes will protect local aquatic and riverine habitats; allow fish reproductive movements along an important fluvial sector; improve ecosystem services; and build a framework of scientific and social knowledge that can improve the quality of river management, as well as help the implementation and enforcement of EU policy, and the legislation to support biodiversity conservation.

For more information: www.segurariverlink.eu; www.facebook.com/segurariverlink

Population status of freshwater fish in Tunisian reservoirs

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Farming of freshwater fishes is a recent activity in Tunisia. It began with an experience of stocking reservoirs with fry of mullet (*Mugilidae*). The majority of reservoirs are located in the north of the country (Figs. 1 & 2). The fisheries in these reservoirs involve a large number of fishermen and it was considered as an important economic activity, especially in the disadvantaged region of the country (Mili *et al.*, 2015). As these fisheries become increasingly important they must be effectively managed. This exploitation activity can be maintained and developed only by monitoring the fish stocks and the status of populations of freshwater fishes in the reservoirs. Despite the numerous cited studies on the biology of the freshwater fishes in Tunisian reservoirs, no details on population status, distribution and abundance of these species are available.



Figure1: Location of Tunisian reservoirs



Figure 2: Some Tunisian reservoirs: Bekbaka (left) and Sidi Saad (right)

Given the lack of data related to these fisheries and the necessity of management, a research/development project was made in collaboration between the Technical Center of Aquaculture in Tunis and the Higher Institute of Fisheries and Aquaculture in Bizerte, in order to develop an adequate management plan.

The methodology for fish sampling used multi-mesh gillnets, based on the methods used for the European program prEN 14575 (CEN 2005) for fishes in lakes. This was the first time that the multi-mesh gillnet technique, often used in European lakes (Deceliere & Guillard, 2008), has been applied in Tunisian freshwater reservoirs (Fig.3). The sampling was made between April 2014 and May 2015.



Figure 3: Fishing operation using multi-mesh nets

The results show that eight species of freshwater fishes are present in Tunisian reservoirs: barbel (*Luciobarbus callensis*), carp (*Cyprinus carpio*), mullets (*Mugil cephalus* and *Liza ramada*), pike-perch (*Sander lucioperca*), phoxinel (*Tropidophoxinellus callensis*), rudd (*Scardinius erythrophthalmus*) and roach (*Rutilus rutilus*). Additionally, the biomass distribution of these resources was governed by the depth, and the most abundant species are located in the upper water layers. Yields (CPUE) by number and weight are summarized in Figure 4. Barbel and phoxinel represent the only remaining autochthonous species of Tunisian continental waters. The decline of the stocks of these species is caused by the introduction of carnivorous predatory species, the late sexual maturity for females (5.6 years), and the relatively low fertility (Kraiem, 1994).

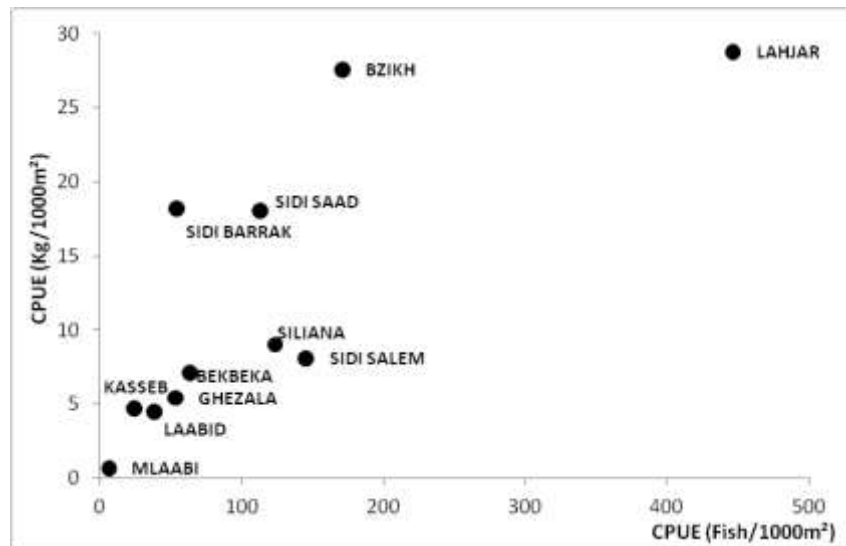


Figure 4: Comparison of CPUEs in Tunisian reservoirs

Through this work we can conclude that most Tunisian reservoirs have poor diversity and productivity in terms of fish resources. These reservoirs need large support from managers to improve their productivity and to resolve the problem of overfishing. Future work must pair sampling techniques using multi-mesh nets with other sampling methods such as acoustics, in order to have complementary information about fish population.

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Project Fartet, Barcelona (2007-2013): a case of conflicting interests

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The Spanish toothcarp, *Aphanius iberus* (Valenciennes 1846) (Figure 1), originally inhabited wetlands along the majority of Spain's Mediterranean coastline between Catalonia and Almería, but a 2006 assessment by the IUCN concluded that its numbers had decreased by as much as 50% in the previous decade due to introduction of exotic species, drainage of wetlands, and other forms of habitat degradation. Its area of occupancy is less than 500 km², and the remaining populations are highly fragmented with little-to-no genetic exchange (Crivelli, 2006).



Figure 1. *Aphanius iberus* 'Delta del Llobregat' male.

This species was thought to have been extirpated from the delta of the Llobregat River, close to Barcelona, several decades prior to the turn of the century. The region originally comprised an extensive network of oak and pine forest, coastal wetlands and dunes, but by the early 20th century was almost entirely dominated by agriculture. From the 1960s, the delta began to be occupied by major logistics and transportation infrastructure, including the port, airport, road and rail networks, and became increasingly urbanised. Today, only around 3% of the original marshland remains, supplemented by a small number of artificial lagoons created in 2004 when the original river mouth was desiccated and a new one was created some 2.5 km to the south in order to accommodate expansion of the port.

In 2005 a consortium comprising officials from the Catalan Government and local councils was formed to manage these wetland areas, which collectively form a natural park, '[Espais Naturals del Delta del Llobregat](#)'. A few years prior to this, a small population of *A. iberus* (said to be 100 or more specimens) was apparently discovered inhabiting a private pond owned by a local angler who was breeding small fishes to use as bait. These were said to have been collected from Can Dimoni and were transferred to a newly-excavated lagoon at Remolar-Filipines (for locations, see map at end of this article; Figure 12). The latter measure was considered necessary since the majority of water bodies in the delta are infested with invasive *Gambusia holbrooki* and *Procambarus clarkii*, while the larger sites also hold *Cyprinus carpio*, *Micropterus salmoides* and species of *Lepomis*, all of which are considered detrimental to the presence of native species. Unfortunately, the area in which this artificial lagoon is located floods regularly, thus *A. iberus* was soon outnumbered by *G. holbrooki* and ex situ breeding became a priority.

Roberto Sáez of the Sociedad de Estudios Ictiológicos (SEI) became involved in the project during 2007, when he applied for permission to collect a few fish for a proposed educational program (Figure 2) at the Ventós I Mir School. There was some initial resistance, since captive breeding attempts at the park had not been successful, but eventually he was allowed to collect three pairs of adult fish. Under his supervision the school managed to produce several hundred individuals in the space of a few months, and the children were invited to the delta to release their young fish into the lagoon where their parents had been collected.



Figure 2. Educational program

Things began to move rather swiftly after that, and I joined the project in 2008. That year, a total of 10 schools from the Barcelona area participated in the education program, and the consortium provided funding in order to purchase aquaria for one or two classrooms in each of them. A series of fun classes were designed which allowed the children to understand the contrasting reproductive biology of *A. iberus* and *G. holbrooki*, the physical differences between them, competitive interactions, and so on. The 'Fiesta de Fartet' (fartet being the local vernacular name for *A. iberus*) concept was also introduced, whereby the children were shown how to collect *Aphanius* eggs and raise fry, after which they would bring their young fish to the delta on a prearranged day and release them, receiving a special certificate afterwards.

During the latter part of 2008, we were invited to conduct field surveys within the delta area in the hope of identifying some potential sites for introduction of *A. iberus* at a later date. These proved relatively fruitless due to the presence of the aforementioned alien species plus an ongoing concern regarding the quality of groundwater throughout the park, and the consortium was informed as such.

The park contains a number of areas which flood temporarily following heavy rain, and which provide perfect breeding conditions for mosquitoes. It was made clear to us that fish should be released somewhere, so in 2009 we suggested the creation of several new habitats in these zones. These would consist of a pool sufficiently deep to hold permanent water, with a shallow canal permitting fish dispersal under flood conditions. The plan was approved, with the Mosquito Control Service (MCS) selecting the locations and agreeing to cover the cost of machine hire and labour. The 2009 Fiesta de Fartet again proved popular, this time attracting some local media coverage, and by now we had a waiting list of schools wishing to join the program.

In early 2010 fish were introduced to the first of the newly-excavated pools, an event which attracted the presence of several local officials and was featured briefly on the evening news of TV3 (the most widely-viewed Catalan television channel). We also stocked the other new pools with fish, and began to check them on a regular basis. Unfortunately, two were quickly colonised by *Procambarus clarkii* and we failed to recollect a single specimen from either of them. The third, which is completely isolated at Pineda de Can Camins (Figs. 3 & 12), was a complete success, and continues to hold a reproductive population of *A. iberus* at time of writing. The MCS also report that mosquitoes are now far less of a problem for beachgoers in this area



Figure 3. Pineda de Can Camins, site of the only self-sustaining population introduced during this project

The 2010 Fiesta de Fartet was a triumph, with several hundred children participating and a half-hour documentary about the project being produced by TV3 (Fig. 4). The consortium were very happy with our

work, offering us a small space within the park itself and enough funds to purchase three 1500 litre plastic (Fig. 5) pools in order to produce more fish. These were installed in late summer, and by December we had raised more than 2000 individuals. Although it appeared that the project was headed in the right direction, privately we were concerned about where the fish originated from (only rumours and limited scientific evidence were available) and their genetic viability (by this point specimens with a reduced number of dorsal fin rays and other morphological defects were not uncommon). We had also been continuing with our regular habitat surveys throughout the park, reporting each time that in the absence of funding for certain equipment and additional fieldwork it was not possible to confidently predict whether a given locality might be suitable for *A. iberus*.



Figure 4. Interview during filming of documentary for Antenna 3, June 2010



Figure 5. Original breeding pools, September 2010

Following our breeding success with the plastic pools, we were offered the use of a disused camp site in early 2011. This contains a leisure area with three very large swimming pools (Fig. 6), and two of these were earmarked for breeding *Aphanius*. There were also some buildings on the site which had been mooted as a possible educational centre to include a laboratory, and we were asked to help secure funding to develop this. By March, the swimming pools had been filled with water and an inauguration ceremony took place at which a contract between the SEI and local council was signed, with the Mayor himself in attendance amid plenty of media presence.



Figure 6. One of the swimming pools used to breed *A. iberus* in this project



Figure 7. *Aphanius iberus* bred ex situ in the swimming pools

The swimming pools proved enormously successful (Fig. 7), and by late summer we estimated them to contain between 30-40,000 fish. This information was received enthusiastically by the consortium, who informed us of their plan to expand the Fiesta de Fartet (Fig. 8) to a second date each year at which members of the public would be invited to the delta to witness the release of thousands of *A. iberus*. The site they had chosen was Ca l'Arana (Fig. 9), a large coastal lagoon which periodically receives influx from the sea and contains *Liza* and other marine fishes. Thus, on 16th October 2011, 15,000 specimens of *Aphanius* were released into this lagoon (Fig. 10) during a ceremony presented by the environmental manager of the park. Prior to this we had agreed that we would need to sample the lagoon periodically in order to check the status of the fish, but after the event we were denied access.



Figure 8. Fiesta de Fartet, June 2011

In early 2012 we began to use the plastic pools to produce *Daphnia* as a supplementary feed for the fish (Fig. 11), and this worked very well. Unfortunately, we did not receive funding for the educational program meaning only a single school was able to participate. Communication also became extremely limited and we were still not permitted to revisit Ca l'Arana to see if the fish were surviving and hopefully breeding there. We also realised that the fish population in the swimming pools suddenly seemed much lower, and subsequently discovered that park staff had been removing fish and releasing them into various habitats without consultation. As a result, we were only able to provide 1200 specimens for the public release day which again took place in October.



Figure 9. Laguna Ca l'Arana



Figure 10. Releasing fish at Ca l'Arana, October 2011

We continued to visit the swimming pools, maintaining the *Daphnia* colonies and performing maintenance duties throughout 2013, but motivation was fairly low by then. As a last resort, we obtained letters of support from more than 50 scientists and institutions, including many members of the FFSG, all of which contained the message that introduction of species to sites in the absence of sound biological reasoning is indicative of poor management and rarely results in positive outcomes. These were submitted in late 2013, but no acknowledgement was received, thus our participation in the project came to an end.



Figure 11. *Daphnia* cultured at the camp site

So, can this project be considered a success, and is there anything to learn from the experience? In my personal opinion, breeding thousands of individuals *ex situ*, then releasing them into existing ecosystems without applying the necessary research or sound management does not amount to good conservation practice. Moreover, this approach appears to be fairly widespread here in Spain and is utilised for other populations of *A. iberus*, as well as for the critically endangered *Valencia hispanica*. In addition, the initial stock of fish we were allowed to collect was far too small, resulting in a probable genetic bottleneck. On the other hand, around 1500 local children will now never forget that a cute fish called fartet exists in their waters, while the media coverage generated was also extremely positive. The simple, cost-effective method used to breed the fish could potentially be applied to many species in the Mediterranean region and elsewhere if supported by appropriate project management. The introduced population at Can Camins seems stable, so the species has at least one refuge in the absence of *G. holbrooki* or other invaders. We also received a number of interesting international visitors as a result of the project, and presented details of it in

several countries. For these reasons I believe that, ultimately, the experience was fulfilling even if we remain clueless as to both origin and fate of the little fish which occupied our spare time for more than half a decade.

Project Fartet map



Figure 12. Map of project area

Many thanks to Roberto and Hyla Sáez of the Sociedad de Estudios Ictiológicos for giving me the opportunity to participate in this project. It is only through their passion and hard work that the educational program was initiated, and continues to this day, at the Ventós I Mir School in Badalona.

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Fishy Shades of Grey: The weird & wonderful Sundaic Freshwater Fishes

Vinita Ramani

Wildlife Reserves Singapore

You wouldn't exactly expect to attend a workshop organized by ichthyologists (scientists specializing in the study of fish) and hear someone referring to peculiar phalluses, fangs or rapid mating. But the world of miniature fish really does include species with mind-boggling anatomies and exotic mating practices.

If you think that minuscule organisms are insignificant because megafauna are so much more awesome, take a moment from your busy day to look at this intriguing (okay, slightly terrifying) suite of creatures:



Sex on his mind (Phallostethus cuulong)

If you're hoping that protrusion on Image B is a strangely warped fin of some kind, or a mysterious yet useless appendage, give up hoping now.

Yes, that is a penis and it includes a rod and a hook that comes in handy when the male needs to grip the female during sex.

All fishes in the Phallostethidae family have the same specialised anatomical features (penis, hook, rod); named “priapium” fish after Priapus, the god of fertility, it turns out we have two species of this family of fishes in Singapore’s mangrove areas. They are *Neostethus lankesteri* and *Neostethus bicornis*. *Phallostethus cuulong* can be found in Vietnam’s Mekong Delta and the female’s genital opening is also located at her throat. Unlike most fish, this species’ eggs are fertilized inside the female. So that hook and rod are actually practical tools to ensure that fertilization takes place.

Two more useful nuggets for readers to contemplate:

As painful as it all sounds, these priapium fish (a more polite and scientifically accurate way of referring to that useful apparatus) actually take their time with the mating. In summary, *Phallostethus cuulong* – a species that has head-to-head sex – are marvellously efficient procreators while they’re at it.

And in contrast....



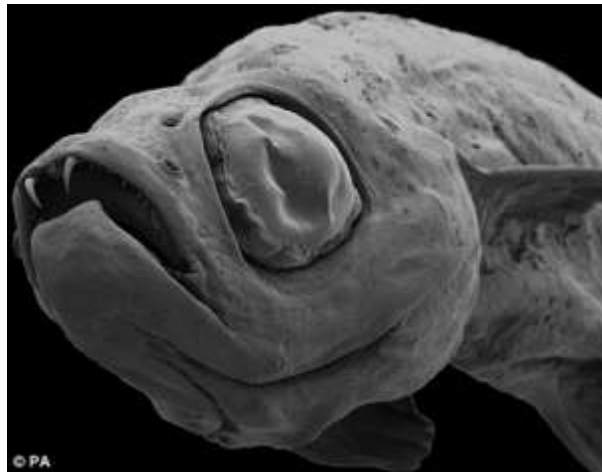
Topsy-turvy mating (Paedocypris progenetica)

Then there’s *Paedocypris progenetica*. Found in peat swamps in Sumatra, this translucent fish is one of the smallest vertebrates in the world, with females measuring at just 7.9mm.

Paedocypris progenetica have unique pelvic fins and enlarged (hypertrophied) muscles in the pelvic girdle – so, imagine a muscular torso. They use it to position themselves upside down on the underside of leaves to attract females. Females then approach them and also position themselves upside down in order to begin mating. For reasons as yet undetermined, it is an incredibly quick encounter – even quicker than the

expression “at the blink of an eye” attempts to communicate. So far, despite using the best technology available, scientists haven’t been able to clearly capture the actual mating process.

And finally...



Fanged & dangerous (Danionella dracula)

Found in a stream in northern Myanmar, the aptly named *Danionella dracula*, a close relative of the zebrafish which is often kept in home aquariums, is the only one of 3,700 species in the Cypriniformes (carp-like fishes) to have these unique, fang-like projections of the jaw bones.

However, measuring a mere 17mm, this almost transparent fish can only really inflict damage on fellow males. Having studied the behaviour, researchers believe the fangs are used by males to spar with each other during aggressive mating displays.

So what’s the deal with being a *sexually mature larva*?!

This might not be a question keeping you awake at night, but after you spend a little time with Dr Ralf Britz, an ichthyologist at the Natural History Museum in London, you will want to learn more about miniature fishes. “I have a weak spot for the weird fish and small things fascinate me, so I focus on them,” he tells me. “They are more difficult to study. At a microscopic level, you have huge anatomical complexity.”

He has also been studying another species from the eel family (Chaudhuriidae). “They are very strange fish. They are modified anatomically with very tiny skulls. They’ve lost a lot of bones, the skull shape is odd. They live burrowing in the banks of a river.”

That weird part about lost bones and modified anatomy (reminiscent of Wolverine from the X-Men, yes) is an evolutionary process called “developmental truncation”. It basically means that those crucial final stages of development that exist in the ancestor do not exist in the descendant. So, the result is a species like *Danionella dracula* or *Paedocypris progenetica* that resemble a larva; essentially a baby fish with mature sex organs. It sounds far worse than it is. Most of these creatures are actually quite lovely.

So as we end, keep these final thoughts in mind.

Every year when the haze makes its way to Singapore from Sumatra, words like “deforestation”, “palm oil”, “peat swamps” and “carbon sink” turn into popular hashtags. If you pay attention to the impact of the haze on wildlife in both Sumatra and Borneo (and not just humans), then orangutans are likely the first species you think of.

But maybe now you’ll think of weird and wonderful miniature fish too.

Ranging from 7.9mm to 17mm, these tiny creatures have managed to evolve in remarkably complex ways to survive in the most unexpected environments (a cave; a stream; brackish water; acidic peat swamps), even though we are doing untold damage to those very habitats.

If you’re still not convinced, consider this: peat swamp forests weren’t thought to be rich in biodiversity. Now we know that they support stenotopic organisms (i.e. an organism that is able to tolerate a restricted range of habitats or ecological conditions). So the peat swamps in our region are not just rich carbon sinks. They are microhabitats and support a range of interesting species.

If we lose them, we lose a large number of remarkable examples of what evolution has produced over millions of years. This is our evolutionary heritage. Prioritizing conservation action is not always about selecting the charismatic and the large over the nondescript or minuscule. It is about appreciating the fact that evolutionarily, the orangutan and the *Paedocypris* are unique events. While some events seem weirder than others, or too small to be noticed, they are not without value.

Vinita Ramani is Assistant Manager at the Conservation & Research department of the Wildlife Reserves Singapore and engages in both science communication and storytelling on critical conservation issues in the region. The piece was initially produced in the Newsletter of the World Association of Zoos and Aquariums (WAZA), and has been slightly adapted here.

QUICK FACTS!

Paedocypris progenetica

- Member of the carp family
- Found in peat swamps and blackwater streams
- One of the world's smallest known vertebrates, at 7.9mm.
- Retains many "larval" traits because more than 40 bones are absent. But able to sexually reproduce.
- Sexually dimorphic
- Males have unique pelvic fins and hypertrophied (enlarged) muscles in the pelvic girdle to position themselves upside down on underside of leaves to attract females
- Female will also position herself belly up to mate with the male in an embrace
- Mating is so fast that it is hard to properly record on video

Danionella dracula

- Member of carp family and a minnow.
- Lives in a stream in northern Myanmar
- Close relative of zebrafish. But has larval-like skeleton and over 40 missing bones.
- Sexually dimorphic (males and females differ anatomically)
- 17mm transparent body
- Has fangs, making it the only one of 3,700 species in its cypriniform group to have such projections of the jaw bones.

Phallostethus cuulong

- Part of Phallostethidae family
- Found in shallow river waters of Mekong basin in Vietnam
- Small skinny nearly transparent body
- Has its penis (priapium) on its head, attached to its throat
- Also has a rod-like protrusion and a hook to grab the female during mating
- Unlike most fish, for which fertilization takes place outside female's body, for this species and others in its family, eggs are fertilized inside.

Positive effects of biodiversity on inland capture fishery yields

Emma Brooks

Centre for Biological Sciences, University of Southampton, Southampton, UK

More than two billion people are thought to depend on inland water capture fisheries for their food and livelihoods worldwide. In 2010, global inland capture fisheries yielded over 11 million tonnes although estimates of unreported catch suggest that the real figure could be as much as four times higher than that, and total catch could be comparable to yields from marine fisheries. Unlike marine harvests however, inland fisheries tend to have very little by-catch and almost all species and all parts are usually eaten by the local communities. Globally there are hundreds, if not thousands, of freshwater species that contribute to food security, yet the relationship between species diversity and yield remains poorly understood in freshwater systems. A new study by Brooks et al. (2016), however, is putting the benefits of biodiversity on the map by showing that inland freshwaters with a greater diversity of fish species have higher-yielding and more stable fisheries.



Photos: Will Darwall, IUCN Freshwater Biodiversity Unit

The study took advantage of the fish range maps from the IUCN Red List assessments for 100 countries (covering Africa, Europe and parts of Asia) and compared them to inland capture fisheries yield data from the Food and Agriculture Organization of the United Nations (FAO). After taking into account other factors that would be expected to have an effect on yield, such as the size of the local population, the size of the water bodies, and temperature and precipitation, it was found that fisheries with a higher number of species are also producing higher yields. In addition, in Africa, countries with higher fish biodiversity also have more stability in harvests year on year, but this relationship wasn't found in European data. It is possible that this is due to the heavy degradation and species losses already experienced in Europe, although more research would be needed to understand what functionality is underpinning this relationship.

While in many parts of the world fishers will harvest and utilise a wide range of species, it is clear that the majority of catch is still targeting single high-income species; a closer look at the FAO data shows that for many countries more than half of the reported yield comes from five or fewer species. It is likely that the relationships found here are at least in part due to the complementarity effect, where the functionality of all the species increases the productivity of the system above and beyond the targeted species. Ultimately, the results suggest that fish biodiversity may deliver benefits for human wellbeing and, as such, provide a powerful argument for placing biodiversity conservation centrally within fisheries management. This is particularly true in countries with the highest yielding inland fisheries as these also tend to have high freshwater biodiversity.

It will come as no great surprise that the study also highlights that there is a need for more freshwater data, including a thorough understanding of species compositions and distributions worldwide. Equally, a concentrated effort is required to increase reporting not only of inland fishery yields, but also of fishing efforts. Only by doing this will we be able to fully understand the extent of the role that biodiversity plays in underpinning inland fisheries. But overall this study is good news for freshwater conservation. It is imperative that the relationships uncovered by this study should be considered within freshwater and fisheries management; the protection and conservation of species diversity in freshwater systems is a win–win outcome for human food security and conservation efforts to preserve freshwater ecosystems.

The open access article is available at <http://onlinelibrary.wiley.com/doi/10.1111/geb.12435/full>.



Photo: Will Darwall, IUCN Freshwater Biodiversity Unit

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Videos of CEPF Western Ghats Program

Ian Harrison

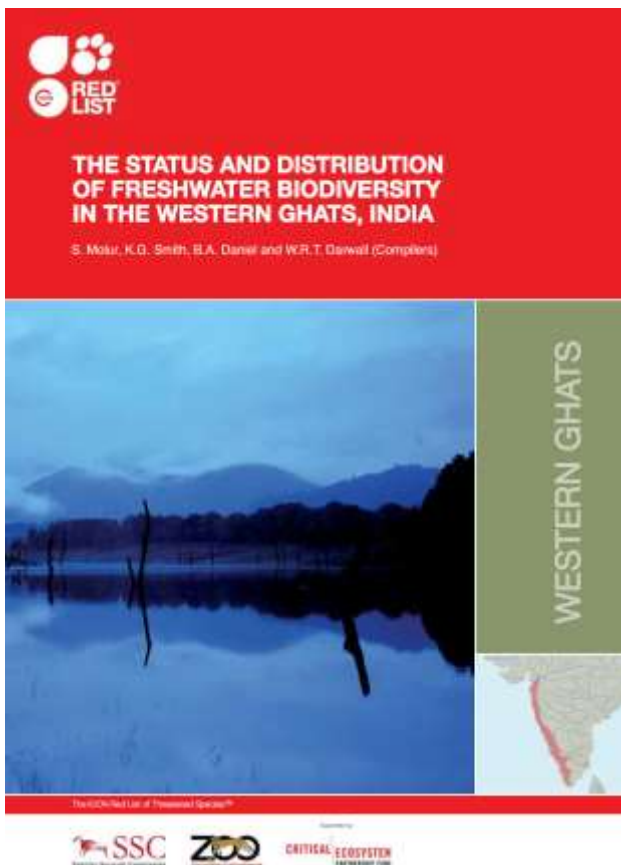
FFSG Technical Officer

Between 2010 and 2011 IUCN's Freshwater Biodiversity Unit worked with several partners, including members of the FFSG, to implement an assessment of the distribution and conservation status of freshwater biodiversity in the Western Ghats. A summary of that work, funded by the Critical Ecosystem Partnership Fund (CEPF) is given at:

The results of that study were published in 2011 and the report can be downloaded from:

http://www.iucn.org/about/work/programmes/species/our_work/about_freshwater/what_we_do_freshwater/western_ghats/

and the complete report, published in 2011, can also be downloaded from that webpage.



Using freshwater KBAs for informing conservation and development policy and action in Kerala and Tamil Nadu

Results from the 'Refining and validating freshwater Key Biodiversity Areas (KBAs) for Kerala and Tamil Nadu' workshops



IUCN (International Union for Conservation of Nature)
May 2014 (workshops: 3-14 March 2014, Keystone Foundation, Kotagiri, Tamil Nadu)
Funded by the Critical Ecosystem Partnership Fund (CEPF) www.cepf.net

The Critical Ecosystem Partnership Fund (CEPF) is a joint initiative of Agence Française de Développement, Conservation International, the European Union, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

In 2013, CEPF funded IUCN to build upon those freshwater biodiversity assessments, by working with relevant stakeholders to identify and validate Key Biodiversity Areas for Kerala and Tamil Nadu. This work provides reliable and accurate data on important sites for freshwater biodiversity, which can better inform

conservation and development activities in the Western Ghats region, and can identify policy (and conservation action) relevant opportunities.

CEPF and ATREE (Ashoka Trust for Research in Ecology and the Environment) have released an excellent set of eight videos outlining much of the work that was completed in the Western Ghats as part of their collaboration.

<http://www.cepf.net/ourstories/multimedia/Pages/Western-Ghats-Program-Videos.aspx>

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WESTERN GHATS PROGRAM

7/8 Endemic Species Conservation



9:19 / 11:45

YouTube

CEPF is a joint initiative of l'Agence Française de Développement, Conservation International, the European Union, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank.

All the videos are worth watching. FFSG members will be particularly interested in video #7 on “Endemic Species Conservation.” The second half of this is about freshwater fish conservation with some great footage highlighting the very good work done, and it has some interesting interviews and narration by Unmesh Katwate (Bombay Natural History Society).

NOTICEBOARD



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World
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Hawai'i 2016

Planet at the crossroads
Call for Contributions
Forum of the IUCN World Conservation Congress 2016



World Conservation Congress 2016

Save the date for the next World Conservation Congress – 1-10 September, 2016

The next IUCN World Conservation Congress will take place in Hawai'i, USA, from 1 to 10 September 2016.

Events at the Forum are varied and include Workshops, training and capacity-building sessions at the Conservation Campus, Posters and Knowledge Café sessions. It is a great platform to meet and discuss with like-minded people. So if you would like to engage and inspire others, this is your opportunity to do so!

Several events focused on freshwater or freshwater fishes are included in the Forum agenda. More information will be circulated to FFSG members in the forthcoming weeks.

Visit the Congress Website for the latest updates and information about the Congress
<http://www.iucnworldconservationcongress.org/>.



July 4-9, 2016

2016 GEO BON Open Science Conference: Biodiversity and Ecosystem Services Monitoring for the 2020 Targets and beyond

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SOCIETY FOR
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Photo by Tom Myers, Courtesy of the Sacramento Convention and Visitors Bureau

sfs2016

RUNNING ON EMPTY

SACRAMENTO CALIFORNIA, USA

MAY 21-26, 2016

Sacramento Convention Center

Running on Empty: Increasing Demands on Freshwater Resources in the Face of a Changing Climate

In many regions of the developed and developing world, large human populations live in arid environments that out of necessity depend on scarce or imported water. This is certainly true in California and the Western US where a complex infrastructure of dams, canals, and groundwater extraction provide freshwater for some of the world's most productive farms and some of the world's most opulent living conditions. Compounding this insatiable demand for freshwater is the effects that variable environmental conditions of a warming climate, changing precipitation, and increasing frequency and severity of droughts have on over-taxed water supplies.

While water resource managers contemplate these issues, the farms and cities keep consuming, despite dwindling supplies. The 2016 meeting of the Society for Freshwater Science will be held in Sacramento California at a time when the State is experiencing the worst drought in its modern history. Although droughts are not uncommon in the Western US and other semi-arid regions of the world, expanding human populations have accelerated the loss of freshwater resources and the impacts to aquatic organisms. The theme of the 2016 meeting of the Society for Freshwater Science will focus on declining freshwater availability and explore issues of freshwater depletion, the consequences for freshwater ecosystems, and potential solutions.

**To register for the Society for Freshwater Science Meeting,
and view the agenda, to go to:**

<http://sfsannualmeeting.org/>



VI Iberian Congress of Ichthyology

'Ichthyology: dedication to marine fish, freshwater fish and aquaculture'

The Iberian Society of Ichthyology congresses are celebrated every two years, to address scientific and management challenges relates to different aspects of Ichthyology.

The forthcoming edition of the Iberian congress aims at creating a meeting point between conservationists, researchers and managers working with marine fishes, freshwater fishes and aquaculture.

When: 21-24 June, 2016

Where: Auditorium and Congress Centre Victor Villegas, Murcia, Spain

For more information, please visit <http://www.um.es/sibic6/en/presentation/>



SIBIC2016

VI CONGRESO IBÉRICO
DE ICTIOLOGÍA / MURCIA
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Ichthyology: dedication to marine fish, freshwater fish and aquaculture

NEXT ISSUE OF 'SAVING FRESHWATER FISHES AND HABITATS'

Do you want to share news from your freshwater fish conservation project with a global audience? Are you doing fascinating research or organising an exciting event? Well, the FFSG Newsletter could be the perfect way to tell your story!

The deadline for submitting material for the next issue is 15th July 2016.

If you have any questions or if you want to submit material, please email info@iucnffsg.org



The Freshwater Fish Specialist Group is generously supported by IUCN's Species Survival Commission, Wetlands International, Project Piaba, and the Zoological Society of London.

Viewpoints expressed in this newsletter are those of the authors and do not necessarily reflect the official policy or position of any associated organizations.

Doring River, Western Cape,
South Africa © Bruce Paxton