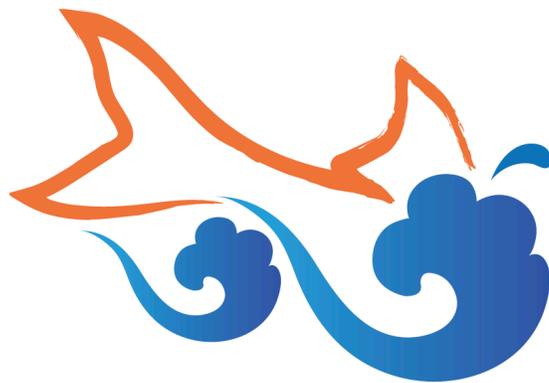


# International Mahseer Conference



DECEMBER 2-8, 2018  
ZHIWA LING HOTEL  
PARO, BHUTAN



## Welcome to the International Mahseer Conference, Dec 2-8<sup>th</sup> 2018

Zhiwaling Hotel, Paro Bhutan.

We welcome you to **Druk Yul**, the land of the Thunder Dragon. We are grateful to have each one of you here and look forward to showing you the famous hospitality of Bhutan. This week you will enjoy Bhutan's breathtaking landscape, and we hope you take time to wander among the prayer flags, visit one of our treasured Buddhist monasteries, and learn about our ancient culture.

We gather for this conference with a common interest in our love for Mahseer and a concern for their future. This diverse gathering of experts on Mahseer biology, fish conservation, large rivers and their development, recreational fishing, and fisheries management, will be an exciting opportunity not only to share the latest findings and concerns, but also to work on potential solutions and conservation strategies.

Understanding the connection between water and land is imperative not only for developing sound conservation strategies for managing rivers but also for identifying those components of the ecosystem that are needed to support Mahseer. As reported in the recent WWF Living Planet Report, freshwater fish populations are in significant decline, dropping 83% globally between 1970 and 2014. With the growing pressures on free-flowing rivers, the spotlight is increasingly focused on migratory fish and the time is ripe for innovation in research, training, community engagement and a call for transformation in the governance of the migratory Mahseer and ecosystems they inhabit.

During this week we will be engaged through oral and poster presentations, questions and discussions, sharing meals, and time to network. What better place than Bhutan to share our knowledge and foster new collaborations for the future of Mahseer? It is a country that holds the conservation of its incredible biodiversity as part of our core responsibility.

Tashi Delek,

The International Mahseer Conference Organizing Team



INTERNATIONAL  
MAHSEER  
CONFERENCE

# CONFERENCE SPONSORS



འབྲུག་རང་བཞིན་གནས་སྐྱབས་ཉམས་སྲུང་གྲོ་གཏང་མ་དངུལ།

**Bhutan Trust Fund for Environmental Conservation**



འབྲུག་སྐར་འབྲུང་གྲོག་མེ་ལས་འཛིན་ཚད།

**DrukGreen**



**Sigma Eight Inc.**

**Solutions for Wildlife Tracking**



International  
Fisheries

Section of the  
American Fisheries Society



**MAHSEER TRUST**  
RIVERS - FISH - PEOPLE



**IFC** | International  
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**WORLD FISH MIGRATION  
FOUNDATION**

## PRIVATE DONORS

Michael Philipp

Michael Mars

Michael and Marlis Douglas

David Philipp and Julie Claussen

## **Zhiwa Ling Hotel: Lodging and Conference Venue**

*Zhiwa Ling Hotel Satsam Chorten, Paro, Kingdom of Bhutan Phone: +975-8-271277*

The Zhiwa Ling hotel combines the sensibilities of a fine Bhutanese guesthouse with the best of 21st Century technology. The hotel's elaborate hand-carved wooden cornices and masterful stonework coexist beautifully with cutting-edge telecommunication systems and Swedish under-floor heating. Recently, the Tourism Council of Bhutan (TCB) announced their Tourist Accommodation classifications. The Zhiwa Ling Hotel is the first and only wholly Bhutanese owned hotel to receive a 5-star rating. Set on 10 acres, Zhiwa Ling has many amenities available to guests. The spa offers all the facilities guests could want; a fitness center, sauna, steam room, as well as a traditional Bhutanese outdoor hot-stone bath. There is a business center, Tea House, two fully equipped conference rooms, a Meditation House, and the hotel has its own greenhouse.

Honoring the spiritual heritage of this ancient Buddhist kingdom, a temple, the crowning glory of this new cultural landmark, has been built into the second floor of the hotel, made with 450-year-old timbers from the famous Gangtey Monastery.

The two restaurants specialize in contemporary international cuisine and classic Bhutanese dishes. Gathering at the Mad Monk Bar for a pre-dinner drink or after-hours fun is a highlight for guests.

*The Zhiwa Ling Hotel is the only Bhutanese owned hotel and one of only two in the country to be ISO22000 certified.*



## **GENERAL INFORMATION for CONFERENCE PARTICIPANTS**

### **Mobile Devices Etiquette**

Out of the courtesy to speakers and participants, please turn off your mobile devices, or put on mute or vibrate during the technical sessions.

### **Photography and Recording Policy**

You should feel free to take photos and videos, however, if any presenter expresses a wish not to have photos taken during their presentation, please respect this request.

Please do not take photos of individual slides during the talks as the information belongs to the speakers and her/his co-authors. Should you wish to obtain copies of a presentation we ask that you discuss this with the Speaker.

### **Social Media**

We strongly encourage you to post about the conference on social media.

- Please reference speakers appropriately.
- Use the hashtags: **#IMC** and **#Mahseer**
- Tag Twitter accounts associated with the conference:  
[@fishconserve](https://twitter.com/fishconserve)  
[@WWFBhutan](https://twitter.com/WWFBhutan)  
[@moafbhutan](https://twitter.com/moafbhutan)

### **Facebook accounts to follow:**

<https://www.facebook.com/BHUTAN.WWF/>

<https://www.facebook.com/fishconserve/>

<https://www.facebook.com/www.ncrlf.moaf.gov.bt/>

## **EMERGENCY CONTACT INFORMATION**

- The Mahseer Conference Secretary, **Kinley Dema**, will be your main Bhutanese contact while you are in country.
- You can provide her email and phone to your family in case you need to be contacted.
- We will be monitoring the conference email for messages - mahseer@fishconserve.org
- If you have medical considerations, please let Kinley know and provide her with the necessary contacts ahead of your travel.
- Please have Kinley's contact information with you in case of an emergency or your need assistance:

**Kinley Dema**

**Mobile Phone:** +97517287491

**Email:** kdema-temp@wwfbhutan.org.bt

## WHAT TO KNOW ABOUT BHUTAN

- ✓ We have asked Bhutan Taxi Association for their service. You can kindly contact them at +975 17614839, Dorji Wangdi.
- ✓ Electrical outlets are of Type C (two-pronged European style). The Zhiwa Ling has adapters in the hotel rooms, but it is a good idea to have an adapter if you require one for phone or computer charging during your travels.
- ✓ International phone service can be expensive, so please check with your provider for international phone use details. Local SIM card are available from the two telecom operators: Bhutan Telecom and Tashi Cell.
- ✓ The Zhiwa Ling does have WiFi.
- ✓ Spicy food: The Bhutanese believe a meal is unworthy without chili peppers. The country's national dish is *Ema Datse*, which translates as chilies and cheese. It is a simple, fiery staple paired with rice. We encourage everyone to try it!
- ✓ Tobacco and its products are banned in Bhutan and are not available for purchase.
- ✓ There are many dogs that roam the streets in the villages and towns. Although rarely a problem, it is best not to feed or pet wandering dogs.
- ✓ When visiting monasteries and temples:
  - Nicer casual dress is acceptable. A warm coat, longer skirts, long pants, long sleeves should be worn in colder weather.
  - Photography is not allowed inside temples. Please follow the posted rules.
  - Footwear is removed before entering a temple. Stone floors are quite chilly so you may want to bring some warm thick socks during your visit.
- ✓ Most people within Paro speak some level of English, so communicating with locals is easy.
- ✓ The official language of Bhutan is Dzongkha. *La* is often added the end of a phrase to signify respect. Here are some beginning phrases to learn:
  - Hello - Kuzu Zangpo *la*
  - Thank you - Kadrin Chhe
  - Blessings or good luck - Tashi Delek
  - Tourist or outsider – Chillip
  - To learn some more phrases, this YouTube video is a good place to start:  
<https://youtu.be/SyXtRZxL9EM>
- ✓ Tuesdays are considered the National “dry day” with the sale of alcohol prohibited.
- ✓ It is common for Bhutanese to enjoy Betel Nut, which is wrapped in a green leaf and chewed. It has a deep red color when chewed.
- ✓ Bhutan is organized into 20 districts. For the IMC, you are allowed to be in the districts of Paro, Haa and Thimphu. Travel outside these districts require a special permit.

- ✓ Each district has a large Dzong that serves as the monastery and administrative headquarters for the area. The Rinchen Dzong is in Paro and the Tashichho Dzong is in Thimphu.
- ✓ You will see many Buddhist symbols painted on most buildings and houses. A common symbol you may see painted on houses is the Phallus (Po in Dzongkha) which has religious significance to it. Please don't be alarmed, this symbol is belief to ward off the evils and misfortunes.
- ✓ The eight auspicious symbols of Bhutanese Buddhism are seen in many places. One of these is the *Serna* (fish). This makes the Golden Mahseer an especially revered symbol.
- ✓ There are ample shopping opportunities in Paro and Thimphu. Be sure to look for the "Made in Bhutan" tag to support the local arts.

## **MONEY**

- ✓ Bhutan currency is called Ngultrum (written as Nu) and runs on the same exchange as the Indian Rupee. Cash may be exchanged at the airport, banks, and hotels.
- ✓ Some restaurants and stores do take credit cards, but it is generally limited so please plan to bring cash with you.
- ✓ You can get cash at an ATM with a debit card, but you will receive this cash only in Ngultrums.
- ✓ The Zhiwa Ling does accept Mastercard and Visa credit cards as well as Debit cards.

## **International Mahseer Conference Organizational Team:**

### **Conference Chair:**

Rinzin Dorji, Secretary, Ministry of Agriculture and Forests

### **Conference Co-Chairs:**

Dechen Dorji, Country Representative, WWF–Bhutan

Michael Philipp, Board of Directors, Fisheries Conservation Foundation

### **Executive Committee:**

Tashi Samdup, Director General, Department of Livestock

Phento Tshering, Director, Department of Forests and Park Services

Dechen Dorji, Country Representative, WWF–Bhutan

### **Conference Organizing Team (COT):**

Co-Chairs:

David Philipp, Fisheries Conservation Foundation

Kesang Wangchuk, Ministry of Agriculture and Forests

Members:

Julie Claussen, Fisheries Conservation Foundation

Singye Tshering, National Research Centre for Riverine and Lake Fisheries, DoL, MoAF

Karma Wangchuk, National Research Centre for Riverine and Lake Fisheries, DoL, MoAF

Namgay Dorji, National Centre for Aquaculture, DoL, MoAF

Sonam Wangdi, Department of Forests and Park Services, MoAF

Lhendup Tharchen, Department of Forests and Park Services, MoAF

Vijay Moktan, World Wildlife Fund – Bhutan

Sonam Choden, World Wildlife Fund – Bhutan

Jigme Tsendrup, World Wildlife Fund – Bhutan

Conference Secretariat: Kinley Dema (WWF)

IMC Program Committee:

Co-Chair: Julie Claussen, FCF,

Co-Chair: Singye Tshering, DoL

Co-Chair: Rajeev Raghavan, Kerala University of Fisheries and Ocean Studies, India

Sonam Choden, WWF

Gopal Prasad Khanal, DoL

Karma Wangchuk, DoL  
Steven Cooke, Carleton University, Canada  
Adrian Pinder, Mahseer Trust

**Conference Staff:**

Chief Protocol Officer: Ganga Maya Rizal, Department of Livestock, MoAF

Accounting: Tashi Wangmo, Department of Livestock, MoAF

Transportation: Ganga Maya Rizal, Department of Livestock, MoAF

Poster Coordinator, Gopal Prasad Khanal, DoL

Master of Ceremonies: Sonam Yangchen, Department of Livestock, MoAF

Logistics:

Leki Wangmo, Department of Livestock, MoAF

Sonam Choden, Department of Livestock, MoAF

Pema Zangmo, Department of Livestock, MoAF

**Conference Rapporteurs**

Karma Wangchuk, Department of Livestock, MoAF

Gopal Prasad Khanal, Department of Livestock, MoAF

Tyler K. Chafin, University of Arkansas

Zachery D. Zbinden, University of Arkansas



དབལ་ཕྱན་འབྲུག་གཞུང་།  
International Mahseer Conference  
2-8 December 2018  
MINISTRY OF AGRICULTURE AND FORESTS  
THIMPHU, BHUTAN



International Mahseer Conference

## News Release

### INTERNATIONAL MAHSEER CONFERENCE 2018

December 2, 2018, Paro, Bhutan

The Ministry of Agriculture and Forests (MoAF), in collaboration with the World Wildlife Foundation (WWF) and Fishery Conservation Foundation (FCF), is hosting the first ever International Mahseer Conference (IMC) in Bhutan from 2-8 December, 2018, at Zhiwa Ling Hotel, Paro. Mahseer is a critically endangered species of fish in the Himalayan region. The conference is putting Bhutan on the international stage as a leader in science-based management of its rivers, protecting aquatic biodiversity and using Mahseer as a focal aquatic species. The conference aims to bring scientists and resource managers together to share information on mahseer; draw roadmap for mahseer conservation; and highlight Bhutan's collaborative mahseer research programs with international institutions.

The conference has international participants from five continents of United States of America, South America, Australia, Europe and Asia. The conference is the first international gathering engaging stakeholders interested and involved in mahseer, including renowned fisheries scientists, managers, culturists, policy-makers, eco-tourism specialists, large river conservationists, who are concerned with the long-term sustainable management of mahseer.

The conference meeting is divided strategically into four major technical sessions starting from fish biology to recreational fishing. The important points of technical sessions are discussed further in the round-table workshop where policy makers and scientists make important scientific and policy decisions on mahseer. The conference ends with the field trips to National Research Center for Riverine and Lake Fisheries in Haa and Punatsangchu sites in Punakha-Wangdue valley.

The organizing sponsors of the conference are MoAF, FCF and WWF. These organizers are sharing responsibilities defined in the conference Memorandum of Understanding. Other conference sponsors are: Bhutan Trust Fund for Environmental Conservation-Bhutan, Druk Green Power Corporation-Bhutan, The International Section of the American Fisheries Society, The World Council of Fisheries Societies, UN-FAO Inland Fisheries Consortium, Indian Society of Fisheries Professionals, Zoological Society of Pakistan, The Mahseer Conservancy, The Mahseer Trust, Migratory Fish Platform, Recreational angling companies, Universities, etc. The main intent of hosting the conference is also to advertise Bhutan as a renowned destination for high-end tourists and to promote local economies of Bhutan.

Conference website: <http://mahseerconference.org>

*Officials to be contacted for more information:* Dr. Kesang Wangchuk ph: 17820119  
Mr. Singye Tshering ph: 17584606

# INTERNATIONAL MAHSEER CONFERENCE PROGRAM AGENDA

## Sunday 02 December

18:00 Informal Opening Reception, hosted by WWF-Bhutan

## Monday Morning 03 December

8:00 – 9:00 Registration Table Open

8:30 Buses pick up participants from respective hotels

### CONFERENCE OPENING

Master of Ceremonies: Sonam Yangchen, Department of Livestock, Ministry of Agriculture and Forests

09:15 Arrival of Participants and Guests

09:30 Arrival of Chief Guest

9:35 *Marchang*, Dasho Rinzin Dorji, Secretary, Ministry of Agriculture and Forests

Welcome Addresses by Conference Hosts:

Dasho Rinzin Dorji, Secretary, Ministry of Agriculture and Forests

Mr. Michael Philipp, IMC Co-Chair, Fisheries Conservation Foundation

Mr. Dechen Dorji, Country Representative, WWF Bhutan

Opening Address: Minister of Ministry of Agriculture and Forests

Keynote Address: Chief Guest

Acknowledgments and Gifts to Chief Guest, Dignitaries, and Supporters, David Philipp

10:30 Plenary Presentation: Developing Bhutan's Conservation Strategy for the Golden Mahseer, Dr. David Philipp, Fisheries Conservation Foundation

11:00 Launching of 2018 Living Planet Report, WWF Bhutan

11:00 Launching of Fisheries Website, Department of Livestock

11:10 Vote of Thanks, Dr. Tashi Samdup, Director General, Department of Livestock, MoAF

11:15 Poster Session Opening

11:20 Photo Session and Refreshments

**12:30 Lunch**

## Monday Afternoon 03 December, 2018

13:55 Introduction of session and announcements

### SESSION THEME: BIOLOGY OF MAHSEER

Chairperson; Michael Douglas, Professor, University of Arkansas, USA

14:00 KEYNOTE: Mahseers (*Tor spp.*) of the World Status Review

*Presenter: Adrian Pinder, Bournemouth University, Director of Research at Mahseer Trust*

14:30 Reproductive Behavior and Response of Sahar (*Tor putitora*) in Tropical Region of Nepal

*Presenter: Jay Dev Bista, Agriculture and Forestry University, Nepal*

14:50 Distribution and Status of Mahseer Populations in Pakistan

*Presenter: Muhammed Rafique, Pakistan Museum of Natural History*

15:10 Distribution status of Golden Mahseer in Uttarakhand India and way forward  
*Presenter: Bhawna Dhawan, Wildlife Institute of India*

**15:30 Tea Break**

Chairperson: Dr. Tashi Samdup, Director General, Department of Livestock, Bhutan

15:45 Mahseer as a component of Fish Biodiversity in Bhutan  
*Presenter: Karma Wangchuk, National Research Centre for Riverine and Lake Fisheries, Bhutan*

16:05 A molecular assessment of population connectivity among Golden and Chocolate Mahseer in Bhutanese rivers  
*Presenter: Marlis R. Douglas, University of Arkansas*

16:25 Technological advances in wildlife telemetry: Insight into real-time behaviour of animals  
*Presenter: John Grant, Sigma Eight, Inc*

Chairperson Poster Session; Julie Claussen, Fisheries Conservation Foundation

16:45 Poster Presentation Session and Reception, hosted by Bhutan Trust Fund for Environmental Conservation and Druk Green Power Corporation (\*posters listed on page 5)

18:00 Bus transportation to downtown Paro: Dinner on your own at local restaurant.

## Tuesday Morning 04 December

08:55 13:55 Introduction of session and announcements

### SESSION THEME: THREATS TO MAHSEER AND MITIGATION

Chairperson: Rick Williams, Fisheries Conservation Foundation

9:00 KEYNOTE: All Tor are not the same! Status and challenges for stock enhancement of mahseer in India  
*Presenter: Rajeev Raghavan, Kerala University of Fisheries and Ocean Studies*

9:30 On the brink: population status of the world's largest and most threatened mahseer  
*Presenter: Anoop V.K, Kerala University of Fisheries and Ocean Studies*

9:50 Impacts of non-native fish on the ecological security of mahseer species in the Indian Himalayan biodiversity hotspot  
*Presenter: Nishikant Gupta, International Centre for Integrated Mountain Development*

10:10 Pattern of abundance, habitat, threats and conservation priority of Narmada: The State fish of Madhya Pradesh  
*Presenter: Shriparna Roy Saxena, Barkatulla University, India*

10:30 Ecological flow requirement for Golden Mahseer – estimation based on habitat suitability criteria  
*Presenter: Jeyaraj Antony Johnson, Wildlife Institute of India*

**10:50 Tea Break**

Chairperson; Mr. Phento Tshering, Director, Department of Forests and Park Services, MoAF

11:10 Hydroelectricity and Fish Species- A Combined or Separate Chapter  
*Presenter: Mohan Bikram Shrestha, Wildlife Educator*

11:30 Potential to apply eDNA technology in the process of assessing and managing cumulative impact of cascading hydropower in the Trishuli River watershed Nepal.  
*Presenter: Pablo Cardinale, International Finance Corporation*

11:50 Monitoring of impacts of Gulpur hydropower project on populations of Mahseer and other fish species  
*Presenter: Ahmad Shoaib, Hagler Bailly Pakistan*

- 12:10 An overview of bioengineering solutions for effective passage or blockage of aquatic organisms  
*Presenter: Donald L. Pereira, Senior Fisheries Biologist at HDR*
- 12:30 KEYNOTE: Keeping the Mahseer moving: working together for sustainable river basin management  
*Presenter: Leeanne Alonso, Biodiversity Specialist, International Finance Corporation, World Bank*
- 13:00 LUNCH**

## Tuesday Afternoon 04 December

13:55 Introduction of session and announcements

### SESSION THEME: CONSERVATION OF MAHSEER AND RIVER ECOSYSTEMS

Chairperson; Nawang Norbu, Director, Bhutan Ecological Society

- 14:00 KEYNOTE: Valuing Rivers: How the diverse benefits of healthy rivers underpin economies and ecosystems  
*Presenter: Stuart Orr, Leader of WWF Freshwater Team, World Wildlife International, Switzerland*
- 14:30 Mahseer in Thailand and Conservation  
*Presenter: Apinun Suvarnaraksha, Maejo University*
- 14:50 Multi-stakeholder engagement in the conservation, restoration and management of Golden Mahseer: An initiative in Nayar River Valley, Uttarakhand, India  
*Presenter: Saurabh Dewan, National Bureau of Fish Genetic Resources, India*
- 15:10 Grassroots reserves benefit Mahseer-dominated tropical river food webs  
*Presenter: Aaron A. Koning, Cornell University*
- 15:30 The multiple roles of Mahseer supporting a diversity of cases for their conservation  
*Presenter: Mark Everard, University of West England*

### **15:50 Tea Break**

Chairperson: Marlis Douglas, Professor, University of Arkansas, USA

- 16:10 Experience in Implementation of Biodiversity Action Plan for Protection of Mahseer  
*Presenter: Naeem Dar, Director, Fisheries and Wildlife Department, Pakistan*
- 16:30 Conservation planning for Mahseers  
*Presenter: Sanjay Molur, Zoo Outreach, IUCN Conservation Planning Specialist Group*
- 16:50 Towards conservation of Mahseers and their habitats in Eastern Ghats, India  
*Presenter: Paromita Ray, Wildlife Institute of India*
- 17:10 KEYNOTE: Restoring swimways for fish migration: Lessons from local to global  
*Presenter: Arjan Berkhuisen, Managing Director, World Fish Migration Foundation, Netherlands*
- 18:15 Buses leave from Zhiwa Ling for Banquet**
- 19:00 Conference Banquet hosted by the Honorable Minister, Ministry of Agriculture and Forests, RGOB**  
Transportation will leave from the Zhiwa Ling.

## Wednesday Morning 05 December

08:55 13:55 Introduction of session and announcements

### SESSION THEME: MANAGEMENT AND RECREATIONAL FISHING

Chairperson: Sonam Wangdi, Department of Forests and Park Services, MoAF

- 9:00 KEYNOTE: In search of responsible and sustainable inland recreational fisheries  
*Presenter: Steve Cooke, Canada Research Chair, Carleton University, Canada*
- 9:30 Pioneering Mahseer conservation through Eco-Tourism in South India  
*Presenter: Sandeep Chakrabarti, Wildlife Association of South India*
- 9:50 An overview of the Native Fish Conservation Area approach to watershed, fisheries, and aquatic conservation and management: implications for mahseer in Bhutan  
*Presenter: Richard N Williams, Fisheries Conservation Foundation*
- 10:10 A Science-Based Model for a Recreational Fishing Program for Mahseer in Bhutan  
*Presenter: David Philipp, Fisheries Conservation Foundation*
- 10:30 **Tea Break**

Chairperson: Liane Nowell, Kenauk Institute

- 10:50 Community Fisheries Programs in Bhutan: Cooperation in Conservation and Management  
*Presenter: Singye Tshering, National Research Centre for Riverine and Lake Fisheries, Bhutan*
- 11:10 Perception of stakeholders: challenges and opportunities for Golden Mahseer *Tor putitora* conservation along Rivers Nayar and Kosi, Uttarakhand; India  
*Presenter: Asghar Nawab, World Wide Fund for Nature-India*
- 11:30 Special Recognitions  
*Presenters: David Philipp*
- 11:45 Closing Remarks  
*Kesang Wangchuk, Ministry of Agriculture and Forests and Julie Claussen, FCF*
- 12:00 **LUNCH**
- 12:15 Departure for Tiger's Nest Field Trip (pack lunch)  
*\*for registered participants*
- 1:30 Departure for Paro Dzong & National Museum Tour  
*\*for registered participants*

## Thursday 06 December

- 8:30 Field trip to National Research Centre for Riverine and Lake Fisheries, Haa, Bhutan  
*\*for registered participants*

## Friday 07 December

- 9:00 Roundtable Workshop, Zhiwa Ling Heritage Conference Room  
*\*by invitation*

## POSTER PRESENTATIONS

### **Assessing the efficiency of fishways in Bhutan**

*Gopal Prasad Khanal, Singye Tshering, Sangay Norbu, National Research Centre for Riverine and Lake Fisheries*

### **Assessing fish fauna in Bhutan's three major river basins**

*Karma Wangchuk, Pema Norbu, Sonam Dorji, Chunglu, National Research Centre for Riverine and Lake Fisheries*

### **My affiliation with Mahseer in India**

*Dr. A.J.T. Johnsingh, Wildlife Institute of India (retired)*

### **Can genetic connectivity in *Garra* (Cyprininae: Labeonini) serve as a model for fish communities in Trans-Himalayan riverscapes?**

*Tyler K. Chafin, University of Arkansas*

### **Rheophilic fishes as potential bookmarks for hydrologic alterations of trans-Himalayan riverscapes**

*Zachery D. Zbinden, University of Arkansas*

### **Is there connectivity among Trans-Himalayan drainages? Snow trout (*Schizothorax spp.*) (Cyprininae: Schizothoracini) as a test case**

*Michael Douglas, University of Arkansas*

### **Kenauk as a model for community-based conservation in Bhutan.**

*Liane Nowell, Doug Harpur, and Mari Hill Harpur, The Kenauk Institute, Dominic Monaco, William Nowell, and Deborah Perzow, Kenauk Nature, Canada*

### **Kenauk Nature as a vacation and fishing destination.**

*Liane Nowell, Doug Harpur, and Mari Hill Harpur, The Kenauk Institute, Dominic Monaco, William Nowell, and Deborah Perzow, Kenauk Nature, Canada*

### **A model program for training and certifying fishing guides in Bhutan**

*David Philipp and Rick Williams, Fisheries Conservation Foundation, Jigme Tsendrup, WWF Bhutan, Pat Johnson, Kenauk Nature, Greg Vincent and Jason Franklin, H2O Bone fishing*

### **Illegal fishing and the potential effects on Mahseer**

*Tshering Dorji and DK Gurung, Department of Forests and Parks, Bhutan*

### **Bhutan's aquaculture program: What we have learned about mahseer**

*Drukpol, National Research and Development Centre for Aquaculture, Bhutan*

### **Designing a community managed catch-and-release Mahseer fishery for Mae Ngao River, Thailand**

*Aaron Koning, Cornell University, USA*

### **Population response of mahseers (*Tor spp.*) to catch-and-release fishery management practice: conservation lessons from the former recreational fisheries of the River Cauvery, South India**

*Adrian Pinder, Rajeev Raghavan and Robert Britton, Mahseer Trust*

### **How inland fisheries support the UN Sustainable Development Goals**

*Julie Claussen, Fisheries Conservation Foundation and Monique Perret-Gentil, Venezuela*

### **International Fisheries Section of the American Fisheries Society**

*Julie Claussen, Fisheries Conservation Foundation and Steven Cooke, Carleton University, Canada*

### **Sigma Eight Telemetry Display**

*John Grant, Haley Mutch, Sigma Eight, Inc, Canada*

### **Freshwater conservation in Malaysia**

*Hafida Bolhen, WWF, Malaysia*

### **Bhutan for Life: A conservation story**

*Tashi Jamtsho and Sonam Yangchen, WWF Bhutan*

### **Water in Bhutan's Economy: Risks and opportunities for a sustainable future**

*Sonam Choden, WWF Bhutan and National Environment Commission*

# INTERNATIONAL MAHSEER CONFERENCE OVERVIEW

## Sunday 02 December

18:00 Informal Opening Reception, hosted by WWF-Bhutan

## Monday Morning 03 December

8:00 – 9:00 Registration Table Open

### CONFERENCE OPENING

Master of Ceremonies: Sonam Yangchen, Department of Livestock, Ministry of Agriculture and Forests

09:15 Arrival of Participants and Guests

09:30 Arrival of Chief Guest

9:35 *Marchang*, Dasho Rinzin Dorji, Secretary, Ministry of Agriculture and Forests

Welcome Addresses by Conference Hosts:

Dasho Rinzin Dorji, Secretary, Ministry of Agriculture and Forests

Mr. Michael Philipp, IMC Co-Chair, Fisheries Conservation Foundation

Mr. Dechen Dorji, Country Representative, WWF Bhutan

Keynote Address: Chief Guest, Minister of Ministry of Agriculture and Forests

Acknowledgments and Gifts to Chief Guest, Dignitaries, and Supporters, David Philipp

10:30 Plenary Presentation: Developing Bhutan's Conservation Strategy for the Golden Mahseer

11:00 Launching of 2018 Living Planet Report, WWF Bhutan

11:00 Launching of Fisheries Website, Department of Livestock

11:10 Vote of Thanks, Dr. Tashi Samdup, Director General, Department of Livestock, MoAF

11:15 Poster Session Opening

11:20 Photo Session and Refreshments

**12:30 Lunch**

## Monday Afternoon 03 December, 2018

14:00 – 16:45 Technical Session: Biology of Mahseer

16:45 Poster Session

Bus leaves for Paro at 17:15 and 17:45 *\*Dinner on our own at the restaurant of your choice: See Map*

## Tuesday 04 December

09:00 – 13:00 Technical Session: Threats to Mahseer and Mitigation

14:00 – 18:00 Technical Session: Conservation of Mahseer

19:00 Conference Banquet hosted by Minister, MoAF

## Wednesday Morning 05 December

09:00 - 12:00 Technical Session: Management and Recreational Fishing

Afternoon Conference Field Trips. *\*Dinner on our own*

## Thursday 06 December

8:30 Field trip to National Research Centre for Riverine and Lake Fisheries, Haa, Bhutan

*\*for registered participants \*Dinner on our own*

## Friday 07 December

9:00 Bhutan Roundtable Workshop, Zhiwa Ling Heritage Conference Room *\*by invitation*

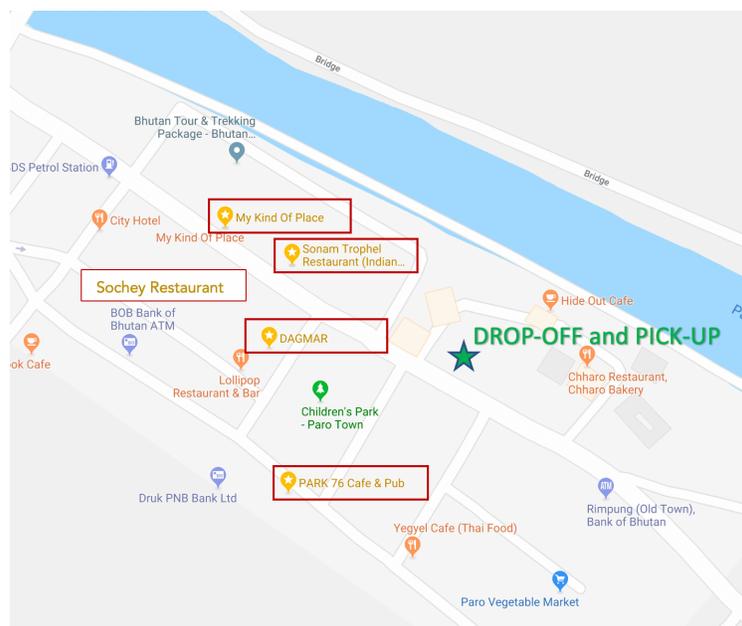
## MONDAY EVENING in PARO

Paro town is a 15-minute drive from the hotel. It is surrounded by beautiful, traditional house nestled in the heart of Paro valley with roads leading from one corner to another. You will find lots of recommended tourist's hotspot restaurants and café. You will also find good amount of handicraft store along the way.

On Monday evening you will have an opportunity to experience some local restaurants. Transportation will be provided from the Zhiwa Ling. Our bus will drop you at a central location (see map) . Buses will leave from the Zhiwa Ling at 6:15 and at 6:45pm and will return to the Zhiwa Ling starting at 7:30pm and 8:30pm. Below is a list we recommend and a map of places

### Local Restaurants

Name	Address	Description
<b>Sonam Trophel Restaurant</b>	Paro Tshongdue, above Paro canteen	Serves Asian, Vegetarian Friendly, Vegan Options.
<b>My Kind of Place</b>	Main town, Paro	Malaysian Laksa, Indonesian noodles, baked beans and sausages, Traditional Hoentey from Haa available
<b>Sochey Restaurant</b>	Town Square, Paro	Serves international Dishes
<b>Dangmar Restaurant</b>	Near Children's Park	Serves Bhutanese, Chinese and other international food.
<b>Park 76</b>	Near Children's Park, Paro Town	A hub consisting of bar, with dishes from Asia, India and also has fast food to serve with.



## ABOUT THE CONFERENCE KEYNOTE SPEAKERS

### **Dr. Leeanne E. Alonso**

*Biodiversity Specialist, International Finance Corporation, World Bank Group*

Dr. Leeanne E. Alonso is a Biodiversity Consultant to the International Finance Corporation (IFC), the private lending arm of the World Bank, where she advises private sector companies on mitigation of impacts of their development projects on the natural environment. She works on hydropower projects in Asia and Africa, particularly with the Mahseer in Pakistan and Nepal, where she and her IFC Hydro Advisory colleagues are approaching biodiversity management at a basin-wide scale in order to bring together private sector developers, government, NGOs and international lenders to reduce cumulative impacts. Leeanne has a PhD in Biology from Harvard University and over 25 years of experience working in the biodiversity conservation field, particularly in the tropics. As the Director of the Rapid Assessment Program (RAP) at Conservation International from 1998–2011, and Director of Global Wildlife Conservation’s Global Biodiversity Exploration Program from 2012–2015, Leeanne has coordinated and led more than 45 biodiversity field surveys around the world in terrestrial and freshwater habitats. While her background is in terrestrial ecology (in particular, ants), Leeanne is expanding her knowledge of fish migration, fish passages and fish monitoring so that she can guide IFC hydropower clients toward better management of their impacts on aquatic ecosystems.



### **Arjan Berkhuisen**

*Managing Director, World Fish Migration Foundation, Groningen, Netherlands*

Arjan is passionate about people and nature. He believes man is part of nature, and he likes to work toward a future where man and nature coincide. Arjan has worked as head of the water programme of WWF Netherlands, where he focused on restoration and protection of estuaries worldwide. He has worked in the Netherlands restoring natural dynamics in the delta to bring back the sturgeon in the Netherlands. Arjan has served as director of the Waddenvereniging, a Dutch NGO protecting the UNESCO World heritage Waddensea. Together with the local population, the Waddenvereniging managed to stop gas exploration plans in the area, and Arjan successfully lobbied for changing the governance of the area. Arjan is particularly proud to have started the innovative Fish Migration River Project on the lower Rhine, with the goal of restoring the great and crucial Rhine Swimway routes. This project made him so enthusiastic on the issue of fish migration that he did not hesitate when he was asked to work for the World Fish Migration Foundation, where he now serves as Managing Director.



## **Dr. Steven Cooke**

*Professor of Fish Ecology and Conservation Physiology and Canada Research Chair, Institute of Environmental Science and Department of Biology, Carleton University (Canada)*

Dr. Steven J. Cooke's research covers many disciplines in the areas of fish ecology, physiology, and behaviour, as well as research in human dimensions, knowledge mobilization, and policy. In 2015, he founded the Canadian Centre for Evidence-Based Conservation, which synthesizes information for policy makers. His research findings (600+ peer-reviewed publications) have ranged from fish passage solutions and habitat restoration activities, to addressing issues related to fish and turtle bycatch and innovations in recreational fisheries management. He has worked diligently to raise the profile of inland fish and fisheries to resource development globally. Steve's hard work in creative approaches in science and his



ability to engage in partnership research has been recognized with several awards, including the Roderick Haig-Brown Award, the Latornell Leadership Award, NSERC E.W.R. Steacie Award (given to the top six under-40 Canadian scientists), and elected into the College of the Royal Society of Canada. Steve is an active member of the American Fisheries Society and is currently serving as President of the International Fisheries Section.

## **Stuart Orr**

*Leader of WWF Freshwater Team, World Wildlife International, Switzerland*

Stuart Orr is the Leader of WWF's Freshwater Practice, driving the freshwater strategy of the world's largest independent conservation organization. A global authority on water stewardship, Stuart has spent the past decade devising and testing innovative approaches to freshwater conservation at WWF by engaging business and finance, and focusing on emerging themes such as the water-food-energy nexus, economic incentives and water-related risk. He has written numerous scientific papers and mainstream publications on issues ranging from corporate water governance to fish protein in the Mekong. Stuart has also sat on various advisory panels and boards, including the World Economic Forum's Water Security Council and the IFC's Infrastructure & Natural Resources Advisory Steering Committee.



## **Adrian C. Pinder**

*Bournemouth University (UK) and Director of Research at Mahseer Trust*

Adrian Pinder is a UK-based fisheries scientist with a career extending over 30 years. During this period, he has spent 20 years under the employment of the UK Government's Centre for Ecology and Hydrology, prior to joining Bournemouth University where he currently heads "BU Global Environmental Solutions (BUG)," a research consultancy specializing in fishery investigations and the development of sustainable environmental solutions throughout the UK and abroad. It was a lifelong passion for angling that first led Adrian to South India's River Cauvery in search of the mighty



hump-backed mahseer, a legendary fish that had been luring him to the subcontinent since first seeing pictures of this fish as a young boy. Since returning from his first trip in 2010, Adrian has served in a voluntary capacity as a Director and Trustee of the Mahseer Trust, an NGO he established to coordinate an international scientific effort to conserve some of South and Southeast Asia's most threatened fish species. On behalf of the Mahseer Trust and Bournemouth University, Adrian has traveled throughout India and hosted a number of international conferences and workshops. He has published extensively on a range of studies, from resolving the taxonomy of the genus *Tor*, to the utility of angler data to define population trends, to the imminent extinction threat to South India's hump-backed mahseer.

## **Dr. Rajeev Raghavan**

*Kerala University of Fisheries and Ocean Studies (Kochi, India) & IUCN Freshwater Fish Specialist Group*

Rajeev Raghavan is an Assistant Professor at the Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, India. Over the last 15 years, Rajeev has been involved in interdisciplinary research that generates information for conservation decision making in tropical aquatic ecosystems, with particular focus on the Western Ghats Biodiversity Hotspot. His work cuts across multiple disciplines from taxonomy to evolutionary biogeography, inland fisheries management and conservation policies, and ranges from local to global scales. Closely involved with the work of the IUCN's Species Survival Commission (IUCN-SSC), Rajeev wears multiple hats, including that of the "South



Asia Coordinator" of the IUCN-Freshwater Fish Specialist Group and IUCN's "Freshwater Fish Red List Authority Coordinator" for the regions of Southern, Northern, Eastern Asia and Oceania. In addition, he is also a member of the IUCN SSC/WCPA Joint Task Force on Biodiversity and Protected Areas, the WCPA-Freshwater Specialist Group, and the IUCN Conservation Planning Specialist Group. Rajeev has over 125 publications in peer-reviewed literature, several of them on mahseer conservation.

## Conference Field Trips

If you have signed-up for a Conference Field Trip, here is what you need to know:

After the scientific portion of the conference ends at lunch on Wednesday, December 5<sup>th</sup>, optional field trips will be available for an additional cost

### WEDNESDAY

#### Afternoon tour of the Paro Dzong and the National Museum Hike (Cost \$30)

**Paro Dzong** is a large Buddhist monastery and fortress. The dzong's name is Rinchen Pung Dzong, which means "Fortress on a Heap of Jewels", and is treasured for its amazing architecture, Buddhist art and history.

#### The National Museum of Bhutan

Perched above Paro Dzong is *ta dzong* (watchtower), built in 1649 to protect the undefended dzong and renovated in 1968 to house the National Museum. The unusual round building is said to be in the shape of a conch shell, with 2.5m-thick walls. The collection of the museum includes textiles, gears, costumes, manuscripts, paintings, appliqué and embroidered Thangkas. On the top, there is a chapel in the form of a life-sustaining tree, with icons representing various Himalayan Buddhist traditions.



#### Afternoon hike to Tiger's Nest Monastery (Cost \$25)

*Taktsang, or Tiger's Nest Monastery, is one of Bhutan's most sacred religious sites. It hangs on a cliff and stands above a forest of blue pine and rhododendrons. To take part in this afternoon hike to Tigers Nest Monastery, you should be in good physical shape (total hiking time is approximately 4 hours with 1,700 feet elevation gain).*

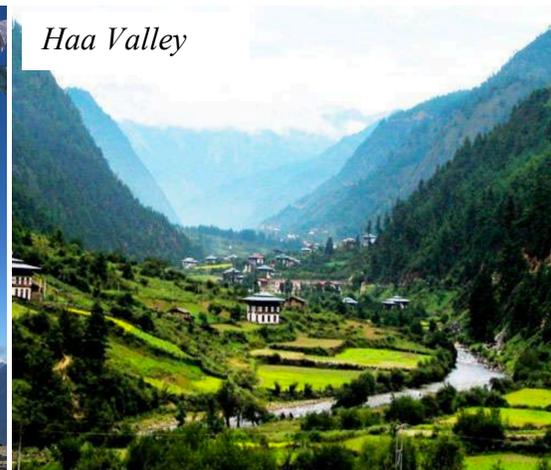
*Taktsang* is one the most iconic sights and a popular tourist attraction in Paro. Padmasambava (also called *Guru Rinpoche*) was a Brahmin royal who spread Tantric Buddhism through Bhutan and Tibet in the 700s, and is seen in those areas as nearly as holy as the Buddha himself. As legend has it, Padmasambava landed at Paro Taktsang to meditate when he brought Buddhism to Bhutan in the seventh century. He is said to have arrived on a flying tiger which had recently been his Tibetan concubine. He then meditated in a cave high on the mountain for four months after which he subdued the local 'demons' and began the conversion of the Bhutanese to Buddhism.



## THURSDAY

**Tour of the National Research Centre for Riverine & Lake Fisheries and the Haa Valley. This is a day-long trip to (Cost \$50)**

*This optional day-long field trip will take you by bus over the Chele la Pass (the highest pass in the country) and into the valley of Haa. The itinerary will include a tour of the National Research Centre for Riverine & Lake Fisheries and the village, where you will enjoy a traditional Bhutanese lunch and experience local life among the villagers.*



## KEYNOTE ABSTRACTS

### **Mahseers (*Tor* spp.) of the World Status Review**

**Adrian Pinder**, *Bournemouth University, Director of Research at Mahseer Trust,*  
*apinder@bournemouth.ac.uk*

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#### **Abstract:**

We are living in a changing world, where rapidly increasing anthropogenic interferences are impacting both directly (e.g. pollution, habitat destruction, harvest etc.) and indirectly (e.g. climate change) on the health of aquatic ecosystems across the globe. With a biogeographic range extending across the fast flowing rivers of South and Southeast Asia, the 'mahseers' represent an iconic group of fishes which are now facing unprecedented population pressures. Despite their large size, attractive appearance and cultural/recreational importance, taxonomic clarity and population distribution knowledge across the genus *Tor* remain severely limited, with fundamental aspects of biology and autecology still unknown for many species. With interest rapidly growing across stakeholder groups (e.g. scientists, conservationists, recreational anglers, land and water resource managers) to conserve this group of iconic fishes, there is an immediate urgency to provide the scientific community, stakeholders and policy makers with standard points of reference to benchmark the current state of knowledge pertaining to the genus *Tor*. Based on a multidisciplinary approach incorporating examination of type specimens, original descriptions, historic photographs and morphological/genetic analysis, this paper resets the knowledge base pertaining to the genus *Tor* in presenting a current list of valid species, their distributions, population status and revised IUCN Red List assessment status. In highlighting the many evidence gaps still required to resolve remaining uncertainties, the authors also hope to invite and

stimulate further study to challenge and build on the current evidence base, to effect the conservation of mahseer into the future.



### **In Search of Responsible and Sustainable Inland Recreational Fisheries**

**Steve Cooke**, Canada Research Chair, Carleton University, Canada



### ***Keeping the Mahseer Moving: Working Together for Sustainable River Basin Management***

**Leanne Alonso**, Biodiversity Specialist, International Finance Corporation, World Bank Group

#### ***Abstract:***

The Golden Mahseer (*Tor putitora*) and other mahseer species are flagship species across the Himalayas and India. Despite their economic, cultural and biological importance, they are threatened throughout their range. *T. putitora* is categorized as Endangered on the IUCN Red List, while *Tor tor* is Data Deficient and *Tor remadevii* is Critically Endangered. The threats to these species are diverse but all stem from the same source: human activities that lead to changes in the aquatic ecosystem or have direct impacts on the mahseer. The wide range of threats discussed in this session, including non-native fish, stocking, hydropower and other water diversion projects, and cumulative impacts of development requires innovative mitigation actions to reduce these threats. Mitigation such as adequate ecological flow, fish passage, environmental flow scenario assessment, and monitoring of fish migration and populations. These threats are complicated and cannot be addressed by any one group or stakeholder alone. The International Finance Corporation (IFC) has been exploring a wide range of approaches to minimize impacts of hydropower to the Golden Mahseer and other migratory fish in Nepal and Pakistan. These approaches require collaboration between developers, governments, NGOs, scientists and communities. A discussion of the contribution of each of these stakeholders will be held with session participants. Examples from IFC and other projects will be provided to illustrate the possibilities and challenges of mitigating these threats and to highlight the role that each of us can play to achieve a sustainable outcome for the mahseer.



***Valuing Rivers: How the Diverse Benefits of Healthy Rivers Underpin Economies and Ecosystems***  
***Stuart Orr, Leader of WWF Freshwater Team, World Wildlife International, Switzerland***

**Valuing Rivers: Saving the Golden Mahseer...and so much more**  
**Stuart Orr, World Wildlife Fund International**

Traditionally, rivers have been valued primarily as water sources to drive the economic engines of irrigation and hydropower. But along with ensuring the survival of the Golden Mahseer and other freshwater biodiversity, healthy rivers also provide a broader set of services that deliver immense benefits to communities, companies and countries – benefits that underpin economies and sustainable development. Yet far too often, these ‘hidden’ values are not understood, recognized or valued and so are not a priority for river management – until clear problems emerge from their neglect. Decision makers continue to overlook values such as flood-risk reduction, sediment delivery that keeps deltas from sinking and shrinking, and thriving freshwater fish stocks.

This short-sighted approach has proven costly across the globe and will result in even greater biodiversity and economic losses in the future. Already, 19 per cent of global GDP comes from watersheds with high or very high water risk, while most of the world’s great deltas – including the Ganges, Indus, Mekong and Yangtze – are sinking and shrinking.

With rivers under growing pressure from dam development, climate change and soaring demand for water to irrigate farms and fuel hydropower plants, there is an urgent need for societies to properly measure, value and promote rivers’ diverse benefits – to ensure that the best overall decisions are taken and that progress is sustainable.

Healthy rivers provide benefits that are part of the solution to a range of our most pressing problems. We have ignored and neglected these critical values for far too long. It is time for a ‘new deal’ for the world’s rivers.



**All Tor are not the same! Status and Challenges for Stock Enhancement of Mahseer in India**  
**Rajeev Raghavan, Kerala University, Mahseer Trust & IUCN Freshwater Fish Specialist Group**

**Abstract:**

Stock enhancement, the release of hatchery-produced fish into the wild, has been widely regarded as the ultimate and immediate solution to declining fish populations. They have been used as a popular conservation tool in both freshwater and marine realms in both the developing and the developed world. Despite the worldwide expansion of stock enhancement programs, its outcome and impacts remain poorly understood. Mahseer comprise a major group of freshwater fish subjected to stock enhancement programs across India, having been introduced to various biogeographic zones. Considered as the biggest conservation effort for any group of freshwater fish in India, hatchery-assisted stocking of mahseer, often from few founder populations has resulted in the movement of fry

and fingerlings to both within, and outside the native range of the various species involved. Artificial propagation and stocking, for example, has resulted in expansion of distribution range of some species (Tor khudree and T. tor) and resulted in the extirpation of others (endemic species such as T. remadevii). Despite published evidence on the conservation issues associated with unregulated stocking, various species of mahseer (within Tor and Neolissochilus) continue to be artificially bred and moved across the country, increasing risks to endemic species with a restricted range. My presentation aims to highlight the issue of misinformed stocking of mahseers in India, raise urgent awareness of the impacts of past and present stock enhancement activities within the context of both conservation and sport fisheries, and discuss the need for improved captive breeding and stocking programs in the backdrop of 'taxonomic uncertainties' and 'precautionary principle' and following the framework of the 'IUCN guidelines for ex-situ conservation and reintroduction'.



### **Restoring Swimways for Fish Migration: Lessons from Local to Global**

**Arjan Berkhuisen**, Managing Director, World Fish Migration Foundation, Groningen, Netherlands

Co-Author: Herman Wanningen, World Fish Migration Foundation, [herman@fishmigration.org](mailto:herman@fishmigration.org)

#### **Abstract:**

Around the world, researchers, managers and governments have been working for many years to improve the situation for migratory fish by developing fishways, removing dam, rehabilitating rivers and exploring other solutions. However, the continued deterioration in fish populations demonstrates the need for more optimized approaches within the policy cycle and for ongoing refinement. During this presentation we will explore how developing strong fish migration visions, together with good cooperation's, communications, subsidy coordination and knowledge exchange from local to global level can lead to effective implementation of solutions. Lessons learnt from projects such as the World Fish Migration Day, From Sea To Source Vision, Dam Removal movement in Europe and Fish Migration River project, will be shared. Recently the World Fish Migration Foundation launched a new international book on Fish Passage experiences, called "From Sea To Source 2.0". This book provides a practical guidance to tackle river connectivity worldwide. There are over a million obstacles in European rivers alone. More and more rivers are now opened up again to improve fish stocks, of for example salmon, sturgeon and eel. "From sea to source 2.0" is a unique collaboration of over 100 international fisheries professionals from the fish passage network. It is supported by river managers, angling associations, governments, research institutes and NGOs including WWF and the Nature Conservancy. The book is full of inspiring stories, hard lessons learned and great successes from nearly every continent on the planet.

## **CONFERENCE ABSTRACTS** *\*In order of presentation*

### **Reproductive Behavior and Spawning Response of Sahar, *Tor putitora*, in Tropical Region of Nepal**

Presenting Author:

**Jay Dev Bista**, Department of Aquaculture, Agriculture and Forestry University, Nepal, jdbista@gmail.com

Co-Authors:

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Madhav Kumar Shrestha, Agriculture and Forestry University

James S Diana, State University of Michigan, USA

#### **Abstract:**

Mahseer (*Tor putitora*) also known as Sahar in Nepal, is a high value indigenous riverine species which is declining in its natural habitat and has been declared an endangered species in Nepal. Limited seed production using natural propagation has restricted its expansion in culture as well as rehabilitation in natural waters. Sahar is an intermittent in spawning behavior, can breed twice or more than that in a year. Maturation time of this species is much shorter than carps and can get over maturity within a short period in natural spawning. It is long migratory during spawning season when river and rivulets are full of flood. We achieved success in artificial propagation of sahar using synthetic hormone. The breeding program was conducted at the Agriculture and Forestry University (AFU), Rampur, Chitwan and the Center for Aquaculture Research and Production (CARP), Kathar, Chitwan, Nepal during February to April 2017. One hundred male (0.4-1.5 kg) and sixty-five female (0.75-2.5 kg) brood fish were reared in 500 m<sup>2</sup> earthen ponds at 1000 kg/ha. Fish were fed with 35% crude protein feed at 3% of body weight per day. Maturity was observed in two days interval by sampling fish and testing softness of the abdomen. Female broodfish with a soft and extended abdomen were injected with synthetic hormone (Ovulin) at 0.5 mL/kg body weight. Males did not receive any hormone. After 24-26 hours of injection, ova from injected females were obtained by simple hand stripping and fertilized with milt collected from males. The fertilized eggs were incubated in Atkin hatching trays. A total of 16 females were induced to spawn, and they produced 1630-3552 eggs per kg body weight. Egg fertilization, hatching and larval survival rates were 90-97, 75-80 and 70-75, respectively. This study demonstrated that mass seed production and larval rearing of sahar is possible in the tropical region of Nepal using induced breeding. When using natural spawning, a high frequency of females is not taken until they are overly mature, even with daily evaluation of maturity. Induced spawning reduces the number of over-matured females by synchronizing the stripping time of injected brood fish.

**Key Words:** Endangered, Migratory, Maturation time, Intermittent, Induced spawning

## **Distribution and Status of Mahseer Populations in Pakistan**

Presenting Author:

**Dr. Muhammed Rafique**, Pakistan Museum of Natural History, Islamabad, Pakistan, rafique59@yahoo.com

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### **Abstract:**

Mahseer was originally widely distributed in the Indus Basin in Pakistan and occurred in its migratory range extending from the Kabul River and its tributaries in the Hindukush Range in the west to Sutlej River in the Himalayan Range towards the east. Its principle breeding and feeding areas lay in the mountain streams that provide ideal sequences of riffles and pools in single or multi-channels configuration. In the winter, the migratory range of the fish extended as much as 500 km into the plains in the Indus Basin where it was found as far downstream in the Indus River at the city of Multan. Geologic changes first resulted in diversion rivers in Punjab that used to flow into the Ganges Basin towards the Indus Basin thus segmenting the habitat of Mahseer in the Himalayas, and later in the separation of Hingol River in Baluchistan from the Indus Basin where a healthy population of Mahseer is still found. Finally, in the last century, construction of irrigation barrages in Indus plains and storage dams in the mountains have resulted in drastic modifications in continuity and flows, resulting in at least 13 populations of Mahseer that have been separated with varying degrees of genetic isolation. A framework has been developed for a strategic assessment of the impact on habitats and degradation that has resulted from imposed modifications in flows and continuity, present threats to habitat from economic activities such as unregulated fishing and sediment mining, and expected impacts on habitats from future developments. This framework can provide guidance to biodiversity managers for development of strategies and plans to rehabilitate populations of Mahseer and other migratory fish.



## **Distribution Status of Golden Mahseer, *Tor putitora*, in Uttarakhand India and Way Forward**

Presenting Author:

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### **Abstract:**

The golden mahseer, *Tor putitora* (Hamilton, 1822) is distributed along foot hills of the Himalaya and in Uttarakhand state; this species has its distribution range from 300m to 1500m altitude. Historically, it was

distributed from west, Alakhnanda- Bhagirathi river system to river Kali in the east, along the border of Nepal. A migratory species, Golden mahseer, used to migrate from lower reaches of Ganga to the upper reaches of its tributaries for spawning. But presently, the river habitat have been drastically modified and fragmented because of construction of hydro-power dams/barrages built downstream to upper reaches of Himalayan river systems. Due to these barrier effects, breeding and spawning grounds of golden mahseer habitats have considerably lost. Even, fish population of Saryu and Kali River may suffer in the coming years due to the proposed Pancheswar dam. Currently, the fragmented population of golden mahseer occurs from Rishikesh to Srinagar in Alkahnanda River; upto Koteshwar dam in Bhagirathi River to Tehri dam till Maneri hydro power plant and in tributaries of River Ramganga (Kohlu, Kosi and Khoh). Hence, it is necessary to protect these river systems and this majestic fish species from extinction. To conserve and restore this species, we need to understand its habitat, migratory pattern and spawning biology. For this, a study is being initiated by Wildlife Institute of India and WWF-India in collaboration with Uttarakhand Forest Department to understand the abundance, movement, migration and spawning grounds of golden mahseer in apprehension to the present scenario using Radio Telemetry techniques.



### **Mahseer as a component of Fish Biodiversity in Bhutan**

Presenting Author:

**Karma Wangchuk**, National Centre for Lake and Riverine Fisheries, Bhutan

Co-Authors:

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#### **Abstract:**

Bhutan is endowed with rich natural water bodies in the form of rivers, streams and lakes that display a rich diversity of aquatic life. Bhutan's rich water resources are being used for many development activities ranging from fish production to hydropower. To ensure that aquatic resources are being utilized sustainably, it is important that management plans be developed based on sound scientific data. Because there currently is no comprehensive database on the fishery resources of Bhutan, it is imperative that such a database be developed. The National Research Centre for Riverine & Lake Fisheries in this regard is in the process of assessing fish fauna both in terms of species composition and distribution in Bhutan major river systems.

Study in the western part of Bhutan has already been completed with 104 species of fish in total listed.

Assessment of fish fauna in the remaining parts of the country (central and eastern) is currently on-going. The study when completed will provide a baseline information for Species Account in each river systems of Bhutan, which will then provide a basis for fishery specific management and conservation needs to be in place.

## **Riverscape genetics defines population connectivity in Golden (*Tor putitora*) and Chocolate mahseer (*Neolissochilus hexagonolepis*) (Cyprininae: Torini) in Bhutan**

Presenting Author:

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### **Abstract:**

The landscape of Bhutan is defined by elevational gradients that promote vulnerability to climate change. To preserve terrestrial biodiversity, Bhutan is constitutionally committed to conserving >60% of its land as protected areas. However, its aquatic biodiversity is poorly understood and the conservation status of native fishes virtually unknown. One charismatic species, the Golden Mahseer (*Tor putitora*) has gained attention as a result of potential hydropower threats. A recent telemetry study of adult movement patterns suggests extensive migrations to spawning habitats in tributaries. The present study extends telemetry findings by collecting genetic data on Golden Mahseer and contrasting it against data gathered for Chocolate Mahseer (*Neolissochilus hexagonolepis*). We defined fine-scale population structure using a genomic approach (ddRADseq: double-digest Restriction Associated DNA sequencing) with variation assayed at over 40,000 nuclear loci (SNPs: single-nucleotide-polymorphisms). Initial results indicate population connectivity is defined by riverscape characteristics, including drainage patterns and stream-networks. Analysis of juveniles from tributaries suggests a population structure defined by localized reproduction. These results promote management decisions aimed at long-term conservation of native fishes in general. They also provide a baseline from which to gauge economic development of aquatic resources that will benefit the Bhutanese people without jeopardizing aquatic biodiversity.

## Technological advances in wildlife telemetry: Insight into real-time behaviour of animals

John Grant, Sigma Eight, Inc, [jgrant@sigmaeight.ca](mailto:jgrant@sigmaeight.ca)

### Abstract:

Most radio telemetry studies currently require researchers to physically visit receivers to collect observational data. Receivers in remote, hard to access areas will have long times between visits, risking unreliable data (unknown power outages, antennas blown down, etc.), and site visits are often expensive. A new system has been developed that integrates multiple device connections to the internet and records the data to a centralized database in real-time. This system, called the Multi-protocol Integrated Telemetry Acquisition System (MITAS), allows for near instant receiver status checks, real-time analysis of the observations made by the receivers, and resource savings for obtaining data. In this experiment, Sigma Eight Inc. receivers (model Orion) were placed on either a wired network, or wireless cellular network connection in Aurora, Ontario, Canada and transmitted data to a MITAS server located in Sydney, Australia. There was over 99.68% transmission efficiency from the receiver to the database, using a 30Mbps connection for the wired receivers, and a LTE connection for the wireless receivers.



## On the Brink: Population Status of the World's Largest and Most Threatened Mahseer

Presenting Author:

**Anoop V.K.**, Kerala University of Fisheries and Ocean Studies

### Abstract:

Of the 16 valid species of *Tor* mahseer occurring in the freshwaters of Asia, the hump-backed mahseer, *Tor remadevii*, growing to sizes >54 kg is one of the rarest and the only *Tor* assessed as 'Critically Endangered' on the IUCN Red List. The hump-backed mahseer is endemic to the River Cauvery and its tributaries in South India. Though known in both scientific and popular literature since the 1920s, as the 'hump-backed mahseer' and 'Tor musullah', the exact identity and nomenclature of the species was cleared only recently (2018), leading to a comprehensive range-wide survey to understand microlevel distribution, population status/trends and threats. Despite being common in the Cauvery Wildlife Sanctuary until the mid 2000's, surveys have only been able to confirm the current presence of the species in Moyar, Pambar and Bhavani tributaries of the Cauvery, with small numbers also present in the main stem of the upper Cauvery flowing through Kodagu. Potential yet limited presence of *T. remadevii* in the Kabini (a major tributary of Cauvery) is pending confirmation from genetic studies. At all confirmed sites, abundance is extremely low dominated by juveniles with records of adult fish rare. Local knowledge reveals that both number and size of individuals have declined over last few decades. In the last remaining sites of occurrence, *T. remadevii* is facing an array of stressors including indiscriminate fishing, habitat loss, pollution and alien species. We provide a site-based status overview of the most threatened mahseer species to inform conservation action and policy.

## **Impacts of Non-Native Fish on the Ecological Security of Mahseer Species in the Indian Himalayan Biodiversity Hotspot**

Presenting Author:

**Nishikant Gupta**, International Centre for Integrated Mountain Development, Nepal, nish200684@gmail.com

### **Abstract:**

Mahseer fish species are critical components of locally-adapted freshwater food webs, serve important roles as a nutrition source (a provisioning ecosystem service), and provide cultural values across the Indian Himalayan biodiversity hotspot. Associated fisheries along Himalayan mid-hill and foothill river stretches, including in the Shivalik Hills and parts of the Terai (region between the lower foothills of the Himalayas and the plains), provide livelihood security for millions of people. Diverse anthropogenic stressors, compounded by changing climatic variables (e.g. temperature and rainfall), have significantly depleted native mahseer fish populations over recent decades resulting in them now being considered locally vulnerable or endangered. Numerous hydropower projects have fragmented mahseer populations, impairing genetic exchange, obstructing migratory paths of species and changing the structure and functioning of riverine habitats, especially of formerly fast-flowing rivers. In-depth literature survey, focus group discussions and semi-structured interviews have revealed that the current increasing spread of non-native fish species compounds these threats to native mahseer species and overall freshwater ecology. The need for better understanding of the distribution, habitat requirement and movement behavior of non-native fish species is therefore essential to manage growing threats towards mahseer in the region.



## **Pattern of Abundance, Habitat, Threats and Conservation Priority of Narmada Mahseer (Tor tor): The State Fish of Madhya Pradesh**

Presenting Author:

**Shriparna Roy Saxena**, Department of Zoology & applied Aquaculture, Barkatullah University, Bhopal (M.P.-India), shriparnaroy saxena@gmail.com

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Conservation of Narmada mahseer (Tor tor. Ham.), the state fish of Madhya Pradesh province of India is emerging as a new challenge for biodiversity managers. Construction of a series of dams on many rivers in the state, in recent times is one the known major threats to the lotic breeding grounds of this flagship freshwater fish of Narmada and many other river systems in Madhya Pradesh. There remain significant gaps in the existing knowledge on pattern of abundance, distribution, stock, habitats and prioritization of important spawning

grounds of Narmada mahseer in recent times. Several studies have indicated declining trend of Narmada mahseer owing to the indiscriminate fishing of broodstock and juveniles, fast degradation and fragmentation of habitat and other anthropogenic pressures. Alarming decline in population of Narmada mahseer (25-30 % to roughly 3%) has been reported by different authors. Considerable alteration of substrate, sediment load and flow are considered to be the main reason for the decline of Narmada mahseer. Since mahseer (*T. tor*) has been declared as state fish of Madhya Pradesh, it is recommended to ensure that the habitat, spawning and migratory requirements of mahseer are fulfilled. This paper presents field observation based information on current pattern of abundance, distribution, habitat, ecology, biology, threats, conservation priority of *Tor tor* in river Narmada, identifies research gaps and advocates innovative strategies for their sustainable utilization and management. Protection of remaining suitable habitat in pristine forested zones of Madhya Pradesh is a ray of hope for bringing back the glory of this so called 'Tiger of Freshwater'. This paper suggests a reverse hierarchy of fish-freshwater-forests (3F) connection and evaluates potential role of foresters in conservation of Mahseer in dense forested watersheds of Madhya Pradesh. This paper recommends on the basis of field experience in Barwaha forest division, that field foresters can play a significant role in identification and mapping of mahseer habitat in forested zones, protection of identified habitat, monitoring of changes in Mahseer occurrence pattern, tracking of Mahseer migration pattern, species restoration in wild through in-situ conservation, conservation breeding and ranching and community based ecotourism including fish watching, angling and release.

In addition to studies of habitat and population dynamics of Narmada mahseer, the paper is also reporting an initial process of institutionalization towards mahseer conservation in India through a pan-Indian informal group of mahseer lovers, ie, Fans of Indian Mahseer (FIM) and outlines a unique MIRACLE (acronym) strategy for mahseer conservation which includes mapping of habitat, involving people, research and data collection, advocacy for policy and legal framework, conservation measures, livelihoods connections and extension and training of frontline foresters.



### **Ecological Flow Requirement for Golden Mahseer (*Tor putitora*) – Estimation Based on Habitat Suitability Criteria**

Presenting Author:

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#### **Abstract:**

Golden mahseer is one of the largest freshwater fish, inhabits in streams and rivers of Himalaya. The population of golden mahseer is declining all over its distribution range, due to river valley modifications, flow reduction, and habitat loss. One of the challenges in conserving this species is ensuring adequate flow for meeting the

biological requirement of species. Often flow estimation procedures for hydrological alternation are either arbitrarily or based on expert opinion. Most of the time, the suggested flow are inadequate for species to meet their life history traits. Therefore, a method that incorporates species habitat suitability criteria would yield better e-flow estimate than any other approach. In this context, we have estimated ecological flow requirement for golden mahseer based on their microhabitat requirement. In this method, we have generated depth, flow and substrate suitability curve for golden mahseer based on species use recorded in Kosi river in Uttarakhand state. The generated habitat suitability curves were fitted into the cross-sectional data (depth and flow) of the Kosi river in the Physical Habitat Simulation Model (PHABSIM). The model was simulated to generate weighted usable area (WUA) for golden mahseer at different flow discharge scenario. The WUA generated in the model was plotted against different flow discharge to detect the inflection point of the curve. The inflection point of the curve against given discharge was considered as ecological flow requirement for golden mahseer.



## **Hydroelectricity and Fish Species- A Combined or Separate Chapter**

Presenting Author:

**Mohan Bikram Shrestha**, Wildlife Educator, Shrmohan5@gmail.com; [shrmohan5@hotmail.com](mailto:shrmohan5@hotmail.com)

### **Abstract:**

Development and nature conservation have always been a flip side. The development of infrastructure fulfilling the necessities of mankind have degraded natural habitat posing threat to species toward extinction. In past few decades, many areas have also been subject to significant ecological change owing to demographic, land use change, soil spoil and unsustainable extraction and dredging, construction of dams for hydropower and irrigation and development of road connectivity. Fish species is no exception threatened by these activities. Primarily, hydropower installation and damming of water tailored with construction materials extraction from the river bear severe threat of extinction of the fresh water fishes. As with the numerous rivers in Nepal, hydropower development has been raised. Majority of the rivers with feasible of hydropower production have provided approval for electricity production. Trishuli, Gandaki, Mahakali, Karnali and Koshi are the major rivers with higher production capacity. These rivers too bear globally threatened Mahseer species such as; *Neolissochilus hexagonolepis*, *Tor chelyonides*, *Tor putitora* and *Tor tor*. Series of hydropower plants is under construction and is in progress in the river course unconcerned to required minimum distance between two hydropower plants. This has posed the severely hindered fish migration; has fragmented aquatic habitat isolating fish population, hindered fish migration, degraded spawning sites and finally decimated species and population. Neither there is definite minimum distance between two hydropower plants state in the rules and regulation in Nepal nor developers are concerned about the effect to fish. Through baseline studies and monitoring visit of several hydropower plants, it is found that fish conservation has major obstacle for developers and is the least prioritized agenda. This have been posing the threat to survival of fish species in their natural habitat.

**Keywords:** Hydropower, Infrastructure, Mahseer, Threats, Nepal

## **Potential to Apply eDNA Technology in the Process of Assessing and Managing Cumulative Impact of Cascading Hydropower in the Trishuli River Watershed Nepal.**

Presenting Author:

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### **Abstract:**

Nepal needs hydropower development to grow its economy with a domestic and cost-effective source of energy. However, if not assessed and managed properly, hydropower projects have the potential to create long term, diverse, and significant adverse environmental and social impacts. In the case of the Trishuli River, the river basin has already been impacted by five projects in operation and dozens under various stages of planning and construction. Despite all these projects being subjected to individual ESIA's, they have not considered the potential for cumulative impacts from their combined activities. The Nepal Water and Energy Development Co. Ltd (NWEDC) and the International Finance Corporation (IFC) are co-developing the Upper Trishuli-1 216 MW HPP (UT1). In compliance with good international practice and IFC Performance Standards on Environmental and Social Sustainability<sup>[1]</sup>, over the past three years the NWEDC-IFC consortium has been leading a Cumulative Impacts Assessment and Management (CIA) process not only to ensure that most significant potential cumulative impacts and risks are identified, but also to foster the creation of a multi-stake holder collaborative platform to coordinate environmental and social impacts and risks monitoring and management, comprehensive data sharing & permanent stakeholder communication, and a governance system to define trade-off in decision making and relevant adaptive management triggers. This CIA effort involved the Center for Molecular Dynamics Nepal (CMDN) to explore the use of eDNA to define existing aquatic biodiversity baseline condition, assess potential impacts of multiple cascading hydropower development in the Trishuli River, and their impact on longitudinal connectivity and habitat availability for key indicator species. This paper presents the preliminary eDNA results for *Tor putitora*'s presence along selected sites in the Trishuli River currently or expected to be impacted by cascading hydropower, describes the genetic markers / methodology used, and suggests a mid-to-long term monitoring eDNA methodology to be used at the watershed level to assess the effectiveness of the measures implemented / proposed to mitigated potential cumulative impacts over this endangered species in the Trishuli River.

## **Monitoring of Impacts of Gulpur Hydropower Project on Populations of Mahseer and Other Fish Species**

Presenting Author:

**Ahmad Shoaib**, Hagler Bailly Pakistan (Pvt) Ltd., Islamabad, AShoaib@haglerbailly.com.pk

Abstract:

The 100 MW Gulpur Hydropower Project is being constructed on the Poonch River in the Pakistan Administered Kashmir and is expected to start operation by mid-2019. The Poonch River provides a highly suitable habitat for the Golden Mahaseer *Tor putitora*. The full length of 104 km and associated tributaries were notified as a national park by the government in 2010. In addition to Golden Mahaseer, there are at least 35 species of fish in the river including the Critically Endangered Kashmir Catfish *Glyptothorax kashmirensis* and a number of migratory and restricted range species. The permission for construction of the project was given by the government that the project will achieve Net Gain in biodiversity consistent with the requirements of IFC Performance Standard 6 for projects falling Critical Habitat. A Biodiversity Action Plan inclusive of a Monitoring and Evaluation Plan was prepared for monitoring of the impacts of the project on aquatic biodiversity, and the outcome of actions for in-situ protection of the fish to achieve the Net Gain in biodiversity. Seasonal surveys following a defined protocol were initiated prior to construction of the project and the coffer dam that has created a barrier to fish migration, and have continued since. Results of monitoring show relatively higher increase in fish populations of most of the species upstream of the dam including the Mahaseer, while downstream the population of Mahaseer has remained stable. The results are largely consistent with the predictions of impacts made using the DRIFT DSS as a part of the project ESIA, and show that the impact of the barrier created by the cofferdam has been offset by the conservation program put in place. A special aspect which has been studied is the impact on fish populations of temporary diversion tunnels that allow fish to move downstream only. A separation has occurred in the populations of migratory fish, where species that prefer warmer water have accumulated downstream of the dam, while those that prefer cooler water have survived largely upstream of the dam.



### **An overview of bioengineering solutions for effective passage or blockage of aquatic organisms**

Presenting Author:

**Donald L. Pereira**, Senior Fisheries Biologist at *HDR*

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**Abstract:**

Many communities of aquatic organisms require a high degree of connectivity in order for individual species to access key habitats during all phases of their life history. Throughout the globe, humans have erected numerous barriers in riverine environments, for purposes including hydroelectric generation, irrigation, navigation, flood

mitigation, aquaculture, control of unwanted or invasive species, etc. This presentation will provide a broad overview of some of the bioengineering solutions available today that provide both upstream and downstream passage of desirable species, as well as blocking the movement of invasive species. These solutions are inherently complex and almost always require a detailed understanding of the target organisms ecology, including behavior and detailed life history dynamics, as well as the physical and operational environment within which a passage or barrier strategy is to be implemented. We will also describe some of the leading challenges and lessons learned in the design and implementation of effective fish passage and barrier systems.



### ***Mahseer in Thailand and Conservation***

*Presenting Author:*

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#### ***Abstract:***

The *Neolissochilus* group found in Thailand can be divided into two groups i.e. the first group with dorsal rays 8-9½ and body depth 2.6-3.6 times SL. This group can be divided into two main groups 1) small eye 1.5-2.4 times HL (*Neolissochilus subterraneus* and *Neolissochilus paucisquamatus*) and 2) moderate eye 2.5-2.9 times HL (*Neolissochilus soroides* (no lateral stripe, eye diameter with 2.6-2.9 times HL, 21-27 lateral lines scales and iii-iv, 9-9½ dorsal fin rays), *Neolissochilus vittatus* (with lateral stripe, 23-25 lateral lines scales and iii-iv, 8-8½ dorsal fin rays), *Neolissochilus sumatranus* (thick lip with fleshy lobe on lower lip to chin, lateral stripe absent) and *Neolissochilus stracheyi* (normal lip without fleshy lobe on lower lip to chin, lateral stripe present). And the second group had dorsal rays 10-10½ i.e. *Neolissocheilus sp.* The conservation status, it should be protect them from monoculture of commercial agriculture in the mountainous area.



### ***Multi-stakeholder Engagement in the Conservation, Restoration and Management of Golden Mahseer: An Initiative in Nayar River Valley, Uttarakhand, India***

*Presenting Author:*

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**Abstract:**

Conservation of Golden mahseer in the upper stretch of River Ganga is a serious concern owing to massive habitat fragmentation and indiscriminate fishing of brooders. A major challenge is bringing together all local stakeholders and reconciling differing social and ecological issues. With financial support under 'Conservation Leadership Programme', we initiated community-based approach towards management of mahseer stock, so as to build long-term and inclusive conservation strategy for critical breeding grounds in Nayar River valley. We made an attempt to identify all major stakeholders from regulatory authorities, to individuals or groups working in the region and identified their interests and concerns through structured interviews, questionnaires and secondary data. We also mapped social status and economic interests of fishermen communities in three villages along Nayar River to develop an understanding of potential areas of conflict, synergies and ways to reconcile their interests with our long-term conservation goals. Several discussions were held with state regulatory authorities to build consensus on providing alternative means of livelihood for local communities, as well as involving them in future decision-making. We observed number of challenges in fostering community involvement, stimulating government and managing conflict between them. Behaviour change in fishermen community is particularly difficult due to their socio-economic interest associated with fishing culture. However, building trust and economic empowerment through alternative avocations could be critical components in engaging the community. State regulatory authorities working as advocacy organizations often make it difficult to gain community trust. There is need to strategise whether advocacy or facilitation is most needed.



**Grassroots Reserves Benefit Mahseer-Dominated Tropical River Food Webs**

Presenting Author:

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**Abstract:**

Intensive harvest has resulted in significant declines in biodiversity, abundance, and biomass of fisheries worldwide. No-take reserves have become critical components of marine ecosystem-based fishery management, yet the potential translation of spatial protection to river systems has not been fully realized. Several features of marine reserves have been found to predict reserve success regarding increasing fish

diversity, density, and biomass relative to fished areas beyond reserve boundaries. These features include reserve size, age, enforcement, and isolation. Using a network of 23 community-based riverine reserves located in the Mae Ngao River, a Salween River tributary in Thailand, we test the potential for these same features derived from the marine reserve literature, as well as the network properties of our study river, to benefit riverine fish communities dominated by *Tor* and *Neolissochilus* species. We find riverine reserves have strong positive impacts on overall fish richness, density, and biomass, with particularly strong effects on Mahseer. However, different reserve features were found to predict each conservation outcome (richness, density, and biomass). Additionally, we found that the dominant predictors of reserve success varied further when we considered fish assemblages based on functional traits. The effectiveness of small, community-initiated reserves offers a new, transferable model for protecting entire food webs and augmenting fishery yields in biodiverse tropical rivers. Yet, the complexity of the responses to reserve protection strongly suggest that networks of reserves composed of independently designed reserves having specific conservation targets will likely be required to achieve the full conservation potential of riverine reserves.



## **The Multiple Roles of Mahseer Supporting a Diversity of Cases for their Conservation**

Presenting Author:

**Dr. Mark Everard**, University of West England, Bristol, [mark.everard@uwe.ac.uk](mailto:mark.everard@uwe.ac.uk)

### **Abstract:**

Mahseer fishes across their South and South-eastern Asian range serve many functions within their host aquatic ecosystems, providing a range of human benefits. In terms of provisioning ecosystem services, mahseer fishes serve as a valued source of food as well as ornamental and genetic resources. These fishes also play key roles in the functioning of aquatic ecosystems, including as higher-level predators that, through their migratory behaviour, also redistribute nutrients in river systems whilst also grazing on snails and other potential disease vectors. Mahseer are imputed with cultural and spiritual meanings by many communities, inspiring art in various forms, and serving as a highly valued attraction for recreational angling and ecotourism. Mahseer are of inherent value but, indissoluble from the vitality of the freshwater ecosystems that support them, serve invaluable additional roles as indicators of the health of aquatic environments and the many services they provide to humanity. This breadth of values underlines the multiple reasons for prioritising conservation of mahseer and the protection or restoration the habitats that currently support, or formerly supported, these iconic fishes.

## **Experience in Implementation of Biodiversity Action Plan for Protection of Mahseer**

Presenting Author:

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Co-Author:

Mr. Naeem Dar, Director, Fisheries and Wildlife Department, Pakistan

### **Abstract:**

The 100 MW Gulpur Hydropower Project is a run-of-the river project being built on the Poonch River, a tributary of the Jhelum River. The river was designated as a national park to protect the Endangered Mahseer fish (*Tor piutora*), and is also home to the Critically Endangered Kashmir Catfish (*Glyptothorax kashmirensis*). Falling in a Critical Habitat as per IFC and ADB standards and policies and local regulations that mandate 'betterment of the national park', the project needed to demonstrate a net gain in species. A Biodiversity Action Plan (BAP) was prepared in 2013, approved by the government, and is being implemented to achieve this objective. Essential features of the BAP include protection of the river ecosystem through surveillance and patrolling, engagement with local communities, and monitoring and evaluation of the effectiveness of the BAP. Institutional and financial mechanisms were devised to address the constraints and gaps in the capacity of the Fisheries and Wildlife Department to implement the BAP. The Project Owner is providing financing for the BAP under a long-term agreement with the government with the costs built into the consumer tariff for electricity. Field support to the government for protection in terms of protection guards and logistics is being provided by the Himalayan Wildlife Foundation, an NGO contracted by the Project Owner in consultation with the government. Monitoring and evaluation is being carried out by a qualified and independent contractor also engaged by the Project Owner. A Management Committee headed by the Director of the department and with representation from the EPA, the forest department, district administration, civil society, and biodiversity specialist oversees the implementation of the BAP. Results to-date show improvement in population of Mahseer and other fish species. Areas in which challenges remain and are being addressed include increasing pressures from sediment mining operations, and streamlining a community based controlled program for angling of Mahseer under a revenue sharing arrangement with the communities.

## Conservation Planning for Mahseers

Presenting Author:

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## Towards Conservation of Mahseers and their Habitats in Eastern Ghats, India

Presenting Author:

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Abstract:

Eastern Ghats is a 1450-km long discontinuous chain of mountains along the eastern coast of India. Despite its importance in the biogeography and maintenance of freshwater fish diversity in Peninsular India, little information is available from this landscape. Distribution and habitat preference of *Tor* sp. was assessed in the hill streams of Eastern Ghats in Papikonda National Park, India from December 2017 to April 2018. Fish sampling was carried out in 12 streams; at each stream 100-m stretch was selected and different habitat type was sampled using cast nets, drag nets and block nets. Apart from the main river channel in the national park, the species was recorded from two large streams in the study area. Preliminary analysis indicates the species' preference for relatively deeper pools (above 39 cm) with moderate water flow (0.093-0.279 m/s). Results also indicate widespread habitat degradation of hill streams and a change in distribution of the *Tor* sp. in comparison to a previous study conducted in 2013. Apart from the potential impacts of river regulation, threats such as diversion of streams for farm irrigation and usage of poisons were also observed during the study period. One of the main objectives of the current project is to improve conservation of the threatened fish species in Eastern Ghats by raising awareness and building capacity of key stakeholders. In this regard, a training program on stream monitoring had been organized for local researchers in April, 2018 along with outreach campaigns for the local fishing community.

## **Pioneering Mahseer Conservation through Eco-Tourism in South India**

Presenting Author:

**Sandeep Chakrabarti**, Wildlife Association of South India

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### **Abstract:**

The wildlife Association of South India (WASI) has been engaged in Mahseer conservation in the Cauvery River in South India for the past 45 years. This not for profit organization leased a stretch of the river from the State Forest Department, recruited guards and fishing guides from the local community to protect the Mahseer. Several ex-poachers were offered legitimate employment and rehabilitated as guards and guides. The credo of 'catch & release' recreational angling was strictly followed, as were best fish handling practices, and the revenue generated from camping and fishing license fee, paid for the salaries. This Eco-Tourism model was pioneered by WASI and later adopted by the State run Eco-Tourism organization and scaled up (albeit for commercial reasons) to make a 40 km stretch of the Cauvery a Mecca for National and International anglers. Poor rainfall resulting in reduced water flow, depleting dissolved oxygen and other habitat impacting developments in recent years have adversely impacted the population of mahseer, in particular the "hump backed". The cessation of recreational angling has cut the flow of angling funds for mahseer conservation. A successful Eco –Tourism based conservation model has come to a standstill. WASI offers to share their experience with any organization willing to adopt this Eco-Tourism model for conservation.



## **An Overview of the Native Fish Conservation Area Approach to Watershed, Fisheries, and Aquatic Conservation and Management: Implications for Mahseer in Bhutan**

Presenting Author:

**Richard N Williams**, Research Associate, The College of Idaho, Caldwell, Idaho, US and Fisheries Conservation Foundation, [troutdna@gmail.com](mailto:troutdna@gmail.com)

### **Abstract:**

Native Fish Conservation Areas (NFCA) are watersheds where management primarily emphasizes conservation and restoration of native fish and other aquatic species, and their habitats, while also managing compatible recreational and commercial uses. The goal of Native Fish Conservation Areas is to sustain the integrity of key aquatic habitats in order to maintain long-term persistence of native aquatic species. NFCAs also provide a mechanism for a collaborative and coordinated approach among multiple partners at a watershed level to

accomplish the conservation of aquatic resources. This approach incorporates the knowledge and talents of technical and non-technical partners to accomplish conservation on waters flowing across public and private lands. A global system of highly visible NFCAs will increase the awareness of native fishes among the public and help communicate the importance of conserving native aquatic communities. Examples of established Native Fish Conservation Areas in the Little Tennessee River in the eastern U. S. and across Texas in the southwestern United States in North America will be discussed. The potential benefits of using an NFCA watershed approach to inform management of mahseer in Bhutan will be discussed.



### **A Science-Based Model for a Recreational Fishing Program for Mahseer in Bhutan**

Presenting Author:

**David Philipp**, Fisheries Conservation Foundation

Co-Author:

Julie Claussen, Fisheries Conservation Foundation

We propose a model for establishing a recreational fishery in Bhutan for Mahseer (both Golden Mahseer, *Tor putitora*, and Chocolate Mahseer, *Neolissochilus hexagonolepis*). This model, which represents just one possible scenario, is designed to promote community-based conservation activities through the formal development of both a Mahseer Conservation Fund and a Community Economic Assistance Fund. Those funds would be fueled through levies on anglers fishing for Mahseer in Bhutan's Waters. Those levies would use a tiered costing approach based upon the geographic area of the river(s) being fished and whether the angler had Bhutanese or foreign citizenship. We also recommend a set of regulations for managing the angling and propose a plan for implementing a pilot project to assess and fine tune such a program.



### **Community Fisheries Programs in Bhutan: Cooperation in Conservation and Management**

Presenting Author:

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**Abstract:** Bhutan is endowed with rich natural water bodies, which are being used for many developmental purposes such as hydroelectric project, irrigation, stone and sand quarry etc. In addition, many communities along Bhutan's rivers have relied on fisheries, even though fishing for consumption is not legal in

Bhutan. Through the development of community fishery programs at select locations, nutritional sources can be secured and socioeconomic enhancement through sale of fresh fish be established for riverside villages. By instituting a sustainable mode of fish harvest practice, coupled with training on the stewardship of river resources, community fishery program can curtail destructive fishing practices and ensure that fish biodiversity is protected. Community based fisheries management programs can therefore, bring about immense benefits both in terms of income generation, nutrition, and conservation.



### **Perception of stakeholders: challenges and opportunities for Golden Mahseer, *Tor putitora*, conservation along Rivers Nayar and Kosi, Uttarakhand**

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Golden Mahseer *Tor putitora* a large cyprinid inhabits foothills of the Himalayan rivers. Over the years owing to anthropogenic discontinuities freshwater habitat have degraded leading to loss in species assemblage and population decline. Interviews were conducted in December 2017 and May 2018 along Rivers Nayar and Kosi respectively. Questions were designed to map human-wildlife interactions to identify areas of conflict and positive association. There were 38 and 75 respondents along River Nayar and Kosi respectively. In most cases respondents were aware of the endangered conservation status and the distribution of Golden Mahseer. Fishermen at both survey sites solely depend on fish catch and for almost 50% of them, their entire family is dependent on it. Fishing is practiced illegally along River Nayar while along River Kosi the Forest Department sanctions license on annual basis. Fish catch ranges 2-5kg/day and during monsoon fishing becomes intensive. Generally, cast nets, line nets and hinges are used to fish while few fishermen also resort to dynamiting and use of bleaching powder. Golden Mahseer is considered a delicacy and being in high demand in local hotels is sold at Rs. 150-300/kg. Recognizing the urgent need to protect Golden Mahseer habitat, WWF-India in collaboration with diverse stakeholders in Uttarakhand state has initiated ecological studies and sensitization programmes for mobilizing community participation. An atlas as a single comprehensive reference point for information on Golden Mahseer conservation will be devised and propagated to focus on critical habitats and assist in advocacy campaigns enhancing legal protection for the species.

## Poster Presentations

### Assessing the efficiency of fishways in Bhutan

*Gopal Prasad Khanal, Singye Tshering, Sangay Norbu, National Research Centre for Riverine and Lake Fisheries*

### Assessing fish fauna in Bhutan's three major river basins

*Karma Wangchuk, Pema Norbu, Sonam Dorji, Chunglu, National Research Centre for Riverine and Lake Fisheries*

### My affiliation with Mahseer in India

*Dr. A.J.T. Johnsingh, Wildlife Institute of India (retired)*

### Can genetic connectivity in *Garra* (Cyprininae: Labeonini) serve as a model for fish communities in Trans-Himalayan riverscapes?

*Tyler K. Chafin, University of Arkansas*

### Rheophilic fishes as potential bookmarks for hydrologic alterations of trans-Himalayan riverscapes

*Zachery D. Zbinden, University of Arkansas*

### Is there connectivity among Trans-Himalayan drainages? Snow trout (*Schizothorax spp.*) (Cyprininae: Schizothoracini) as a test case

*Michael Douglas, University of Arkansas*

### Kenauk as a model for community-based conservation in Bhutan.

*Liane Nowell, Doug Harpur, and Mari Hill Harpur, The Kenauk Institute, Dominic Monaco, William Nowell, and Deborah Perzow, Kenauk Nature, Canada*

### Kenauk Nature as a vacation and fishing destination.

*Liane Nowell, Doug Harpur, and Mari Hill Harpur, The Kenauk Institute, Dominic Monaco, William Nowell, and Deborah Perzow, Kenauk Nature, Canada*

### A model program for training and certifying fishing guides in Bhutan

*David Philipp and Rick Williams, Fisheries Conservation Foundation, Jigme Tsendrup, WWF Bhutan, Pat Johnson, Kenauk Nature, Greg Vincent and Jason Franklin, H2O Bone fishing*

### Illegal fishing and the potential effects on Mahseer

*Tshering Dorji and DK Gurung, Department of Forests and Parks, Bhutan*

### Bhutan's aquaculture program: What we have learned about mahseer

*Drukpol, National Research and Development Centre for Aquaculture, Bhutan*

### Designing a community managed catch-and-release Mahseer fishery for Mae Ngao River, Thailand

*Aaron Koning, Cornell University, USA*

### Population response of mahseers (*Tor spp.*) to catch-and-release fishery management practice: conservation lessons from the former recreational fisheries of the River Cauvery, South India

*Adrian Pinder, Rajeev Raghavan and Robert Britton, Mahseer Trust*

### How inland fisheries support the UN Sustainable Development Goals

*Julie Claussen, Fisheries Conservation Foundation and Monique Perret-Gentil, Venezuela*

### International Fisheries Section of the American Fisheries Society

*Julie Claussen, Fisheries Conservation Foundation and Steven Cooke, Carleton University, Canada*

### Sigma Eight Telemetry Display

*John Grant, Haley Mutch, Sigma Eight, Inc, Canada*

### Freshwater conservation in Malaysia

*Hafida Bolhen, WWF, Malaysia*

### Bhutan for Life: A conservation story

*Tashi Jamtsho and Sonam Yangchen, WWF Bhutan*

### Water in Bhutan's Economy: Risks and opportunities for a sustainable future

*Sonam Choden, WWF Bhutan and National Environment Commission*

## POSTER ABSTRACTS

### Assessing the Efficiency of Fishways in Bhutan

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#### Abstract:

Endowed with rich perennial water resources, Bhutan has an estimated hydropower potential of 30,000 MW of which 23,760 MW is accessed to be technically feasible from 70 run-of-the-river and 6 reservoir scheme hydropower projects. Bhutan's water reserves, besides being used for generating electricity, are also home to many native fish species that will be impacted by the construction of the hydroelectric dams, either through displacement and loss of habitat for resident species or through obstruction of spawning movement for migratory species.

In the wake of the evident impacts of dams on the native fish population, the Water Regulation of Bhutan (2014) stipulate maintaining a minimum environmental flow of 30% of the lean flow (e-flow) for all hydroelectric projects. In addition to this, it also requires dams to incorporate fishway or other facilities to facilitate the movement of migratory fish.

Till date, only 2 hydropower projects in Bhutan have fishways incorporated in their dams, namely the Kurichhu HHP and Dagachhu HHP. However, the effectiveness of these fishways is yet to be evaluated. The National Research Centre for Riverine & Lake Fisheries (NRCCR&LF) under DoL is therefore conducting a study to assess the effectiveness of these fishways with the aim to improve (for future projects) and improvise modifications on the existing structures.



### Artificial breeding of the endangered Golden Mahaseer, *Tor putitora*, at National Research and Development Centre for Aquaculture in Gelephu

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**Abstract:**

In order to replenish the future populace of critically endangered species in the depleted water bodies of Bhutan, National Research and Development Centre for Aquaculture (NR&DCA), Gelephu has conducted trial to artificially breed Golden Mahaseer in captivity from February, 2013 till date. 345 males of 0.6 kg to 1.87 kg and 343 females of 1.04 kg to 2.6 kg brood fish were reared inside the earthen pond. Breeder were provided with formulated fish feed along with the mixture of muster oil cake and rice bran at 2 % body weight per day. Chicken offal was provided twice a week to observe if there is improvement in their gonadal maturity. Maturity was observed by sampling fish and applying gentle pressure to the abdomen to express gonad and milt twice a week during February to April and September to December in a year. First eggs were successfully striped and incubated in February to April, 2013. Till date, NR&DCA, Gelephu has striped 147 females and 294 males producing more than 20000 viable fingerlings which are currently under successful rearing at NR&DCA, Gelephu. This breeding trial was first rudimentary breakthrough in the history of aquaculture and fisheries in Bhutan and trial demonstrated that natural breeding and fry/fingerling rearing is possible in the Sarpang region of Bhutan. However, further studies should be conducted to assure its possibilities to propagate under induced conditions and improved technology for mass seed production are needed in the future studies.

**A genetic survey of the genus *Garra* (Cyprinidae: Labeoninae) in Western Bhutan**

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**Abstract:**

Widespread and ecologically-conspicuous species often span both spatial and temporal environmental gradients and are thus good models from which to gauge the demographic impacts of climate and geography. The latter, in turn, have deposited genetic signatures within populations, and their

evaluation can clarify broader biogeographic patterns and also the processes involved in creating and maintaining biodiversity. Here, we evaluated several such species found within a primarily rheophilic genus (*Garra*) that spans ~110 Asian and ~30 African species. We focused specifically within the drainages of Bhutan where *Garra* is speciose, and as such represents an excellent model with which to examine Himalayan phylogeography. To this end, we sequenced 661 bases of the mitochondrial (mtDNA) COI gene for 314 individuals and placed these within a broader phylogenetic context by employing 1,457 broadly-distributed individuals from GenBank. We found considerable within-species diversity, with strong evidence of both cryptic and novel lineages, each requiring formal description. We also noted polyphyly and a need for revision. To conserve biodiversity, it is imperative to first delineate constituent elements. The phylogenetic approach presented herein is an effective framework not only to benchmark *Garra*, but also the broader trans-Himalayan fish community.



## **DNA Barcoding the Himalayan Torrent Ichthyofauna of Bhutan**

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### **Abstract:**

Morphologies and behaviors of rheophilic fishes have been shaped over evolutionary time by fast flowing waters and rocky substrates. These have also promoted their ability to withstand violently shifting substrates and downstream displacements. Yet the 'soft' hydrologic barriers (i.e., slow water reaches) effectively separating rapids can promote diversity not only across drainages but within as well. To gauge the potential for new species within these specialized habitats, we evaluated 98 loach (Cobitoidea) and 38 catfish (Siluriformes) collected in mid- and headwater streams of Bhutan. We did so by first sequencing a mitochondrial gene (COI), then using NCBI BLAST to assess if species-identity resides within GenBank. For loach, 94% of individuals (N=92) were taxonomically identified, representing 10 species and 8 genera. For catfish, 80% were so identified (N=30), representing 8 species and 6 genera. However, many of our specimens could not be so identified (loach=6%;

catfish=18%). This underscores potential issues with GenBank, such as the mis-identification of sequences previously-submitted, as well as the incomplete nature of the database. DNA barcoding is an effective means of identifying Himalayan loach and catfish but will be more functional as a biodiversity tool once additional sequences of Himalayan species are added.



## **Is there connectivity among Trans-Himalayan drainages? Snowtrout (*Schizothorax spp.*) (Cyprininae: Schizothoracini) as a test case**

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### **Abstract:**

Global biodiversity hotspots represent remote, tectonically active areas that have undergone significant geologic and climatic change. One such region, the Himalayan Mountains, was created by the gradual collision of the Indian plate with the Eurasian landmass. Drainages then downcut southward as the Tibetan Plateau uplifted, allowing fossil-poor aquatic taxa to disseminate and diversify. This riverine evolution provides a biogeographic template upon which phylogeographic relationships of Himalayan fishes can be superimposed. Here, we sequenced 1,140 base pair of mitochondrial (mt)DNA cytochrome-b (cytb) for five *Schizothorax* species (N=155) endemic to the Central Himalayas [i.e., Nepal (N=85) and Bhutan (N=70)]. We placed these data in context by acquiring an additional 110 GenBank sequences from trans-Himalayan and central Asian rivers, as well as 2 outgroups. Our data were evaluated using a maximum likelihood (ML) approach, with results indicating

that *Schizothorax* is much more diverse across basins than within, suggesting the presence of undiagnosed diversity. We also found species to be paraphyletic in the tree, reflecting either potential misdiagnoses in the field or unidentified cryptic species. *Schizothorax* in Bhutan is represented by two distinct clades that seemingly have affinities with Tibet and Nepal, respectively, indicating a previous Pleistocene stream connectivity that is now disrupted.



### **Kenauk as a Model for Community Based Conservation in Bhutan.**

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### **Abstract.**

On the property of Kenauk in Montebello, QC, Canada co-exist two mutually beneficial companies; Kenauk Nature and the Kenauk Institute. Kenauk Nature is an outfitter widely renowned as a fishing and eco-tourism destination while the Kenauk Institute is a research and education organization that promotes conservation through science. Using Kenauk as a model, we would like to demonstrate how recreational fishing can drive community based conservation which creates a feedback loop of sustainably managed fish populations, a successful long-term fishing industry and unique experiences for visiting anglers. Research through an organization like the Kenauk Institute can generate the information needed to inject science into conservation and benefit local recreational fishing through informed management recommendations.



### **A Strategy for Training and Certifying Fishing Guides in Bhutan**

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### **Abstract:**

Because catch-and-release recreational fisheries have been shown to be successful drivers of community-based fisheries conservation programs in many remote areas around the world, Bhutan and other countries in Southern Asia should consider establishing such a program for Mahseer. Before such a recreational fishery can be established, however, a certain level of programmatic and logistical infrastructure must be developed, including fishing regulations, travel procedures, accommodations, and guiding. There are currently no certified fishing guides in Bhutan and very few people experienced in fishing, much less fly fishing, for Mahseer, and this lack of trained personnel could prove to be a major impediment to successfully launching such a fishery. We outline a model process for addressing that need in Bhutan, one that includes establishing the training criteria for several tiers of guides (e.g., senior fishing guide, junior fishing guide, and trail guide), as well as the skills needed for each tier (e.g., safety, angling equipment, client relations, and best handling practices, as well as knowledge of the rivers, angling techniques, regulations, and data collection). The key to efficient development of a local cadre of guides will be to train and certify a small core of Bhutanese that are already familiar with Mahseer angling and let those individuals implement an in-country training program for the rest of the country.



### **How Inland Fisheries Support the UN Sustainable Development Goals**

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The fish and fisheries that are in all freshwater bodies including lakes, rivers, streams, wetlands, and reservoirs and considered a part of inland fisheries. These fisheries are an important source of employment, provide food and nutritional security, offer many sources of recreation, and are a key component in cultural values. They are especially significant in vulnerable communities in high poverty regions around the globe. It is estimated that globally, more than 57 million people are reliant on inland fisheries in some capacity for their employment. Millions more rely on freshwater fisheries for a main source of their food and nutrition. Despite their importance, inland fisheries are often an “invisible” resource due to the current lack of information and reporting or recognized economic value. The InFish Network is an international collaboration of government

entities, universities, independent researchers, and non-governmental organizations, that are working to raise awareness and increase the profile on the importance of inland fisheries in the success of achieving the UN Sustainable Development Goals.s



### **My affiliation with mahseer in India**

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#### **Abstract:**

My association with the Wildlife Institute of India since 1985 and a life spent as a wildlife biologist have given me unparalleled opportunities to visit different mahseer habitats in India, more in the north, north-east and in south India. The habitats I have visited are home to the golden (*Tor putitora*), blue-finned (*Tor khudree*), chocolate (*Neolissochilus hexagonolepis*) and the orange-finned mahseer. All these mahseer species face an insecure future largely as a result of habitat loss and over-exploitation which involves even unethical means of killing by dynamiting, use of poison and electricity. In most rivers and reservoirs in north India, the population is on the decline as the bulk of the fish that swim upstream for spawning after the rains end up in the pots of local people and in the markets. Other threats are pollution of the rivers and sand mining. There is an urgent need to rectify the situation which can be done only with the involvement of the people living in the mahseer habitat and they will support mahseer conservation only when they perceive some benefit from it. Protection of the rivers where mahseer occur naturally is much more important than restocking. More people, particularly the young, need to be involved in mahseer conservation. Catch and release angling, a time-tested conservation tool, should be made use of to generate revenue for the people living in the mahseer landscape. This tool needs the approval and support of the Governments and the conservation community.



### **Illegal Fishing and the Potential Effects on Mahseer**

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## **Designing a community managed catch-and-release Mahseer fishery for Mae Ngao River, Thailand**

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## **Population response of mahseers (*Tor* spp.) to catch-and-release fishery management practice: conservation lessons from the former recreational fisheries of the River Cauvery, South India**

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### **INFORMATIONAL POSTERS and DISPLAYS**

#### **Kenauk Nature as a Vacation and Fishing Destination**

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#### **WWF Malaysia: Freshwater Conservation**

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#### **International Fisheries Section of the American Fisheries Society**

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#### **Sigma Eight Telemetry Display**

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