Advancing sustainable hydropower: biodiversity assessment and management Webinar series

International Good Practice for Biodiversity Mitigation for Hydropower Projects

January 26, 2021

IFC International Finance Corporation
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IN PARTNERSHIP WITH

Australian Aid

Norwegian Ministry of Foreign Affairs

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Welcome and Housekeeping

Leeanne Alonso
Biodiversity Consultant
IFC

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Next up in the IFC Webinar Series

In February, IFC is offering a 6 webinar workshop on the **Trishuli Assessment Tool**: a standardized field methodology for aquatic biodiversity assessment and monitoring

Join us to learn about this new approach designed by Nepalese and International aquatic specialists

- February 2: Overview of the Trishuli Assessment Tool
- February 4: Electrofishing
- February 9: Environmental DNA (eDNA)
- February 11: Macroinvertebrate Sampling
- February 17: Himalayan Fish Identification
- February 18: Data Analysis for Long-term Monitoring

Sign up for all 6 webinars or for individual webinars. Participants who attend all 6 will receive a Certificate from IFC and be considered for in-person training on these topics.

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Agenda

Time	Event	Presenter
19:00-19:05	Welcome and Housekeeping	Leeanne Alonso Biodiversity Consultant, IFC
19:05-19:10	Opening remarks	Jan Erik Studsrød Counsellor/Energy and Climate Royal Norwegian Embassy, Nepal
19:10-19:45	International Good Practice for Biodiversity Mitigation for Hydropower Projects	Atle Harby Ana Adeva-Bustos SINTEF
19:45-20:00	Biodiversity Mitigation for the Gulpur Hydropower Project, Pakistan	Fareeha Irfan Ovais Technical Manager Hagler Bailly Pakistan
20:00-20:25	Q & A	Moderated by: Leeanne Alonso Biodiversity Consultant, IFC
20:25-20:30	Closing Remarks	Kate Lazarus Senior Asia ESG Advisory Lead, IFC

Opening Remarks

Jan Erik Studsrød,
Counsellor/Energy and Climate
Royal Norwegian Embassy, Nepal

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Presenters:

Atle Harby, Sintef, Norway

Ana Adeva Bustos, Sintef, Norway

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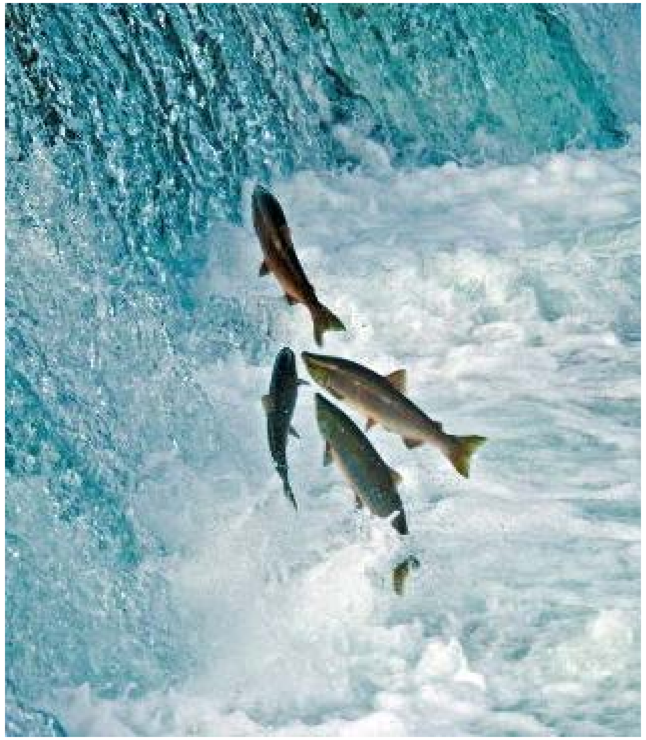
Dams

- Migration barrier
- Loss of connectivity (fish, sediments, nutrients)
- Fragmentation
- Loss of biodiversity



THE WORLD BANK

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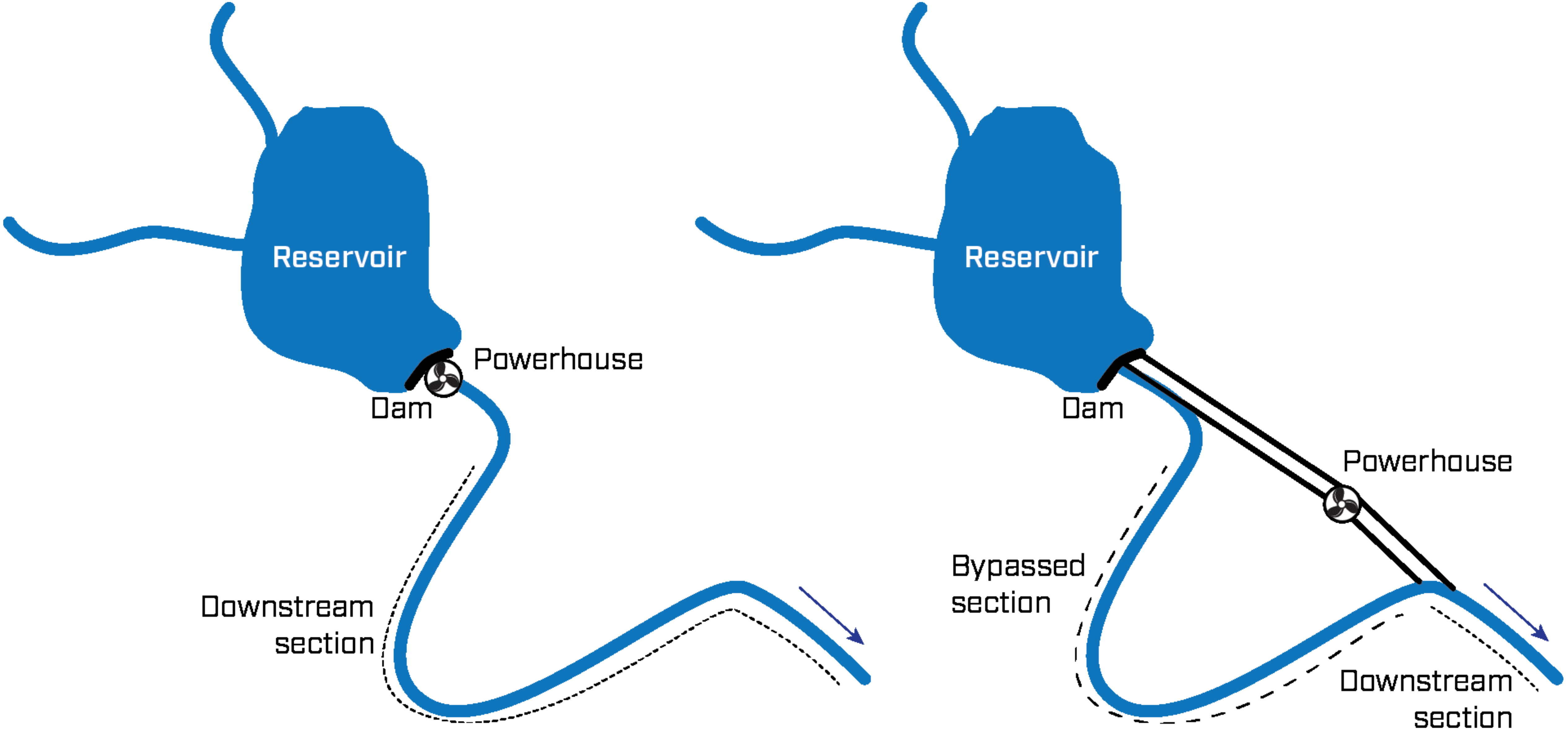
Running water upstream the dam turned into a lake


Reservoir
Powerhouse
Dam
Downstream section
Reservoir
Dam
Powerhouse
Bypassed section
Downstream section

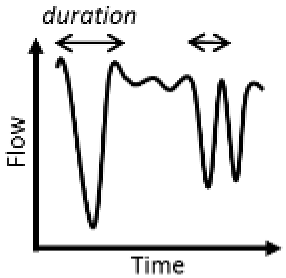
Degraded habitat in bypassed sections

River with diverted water in Norway

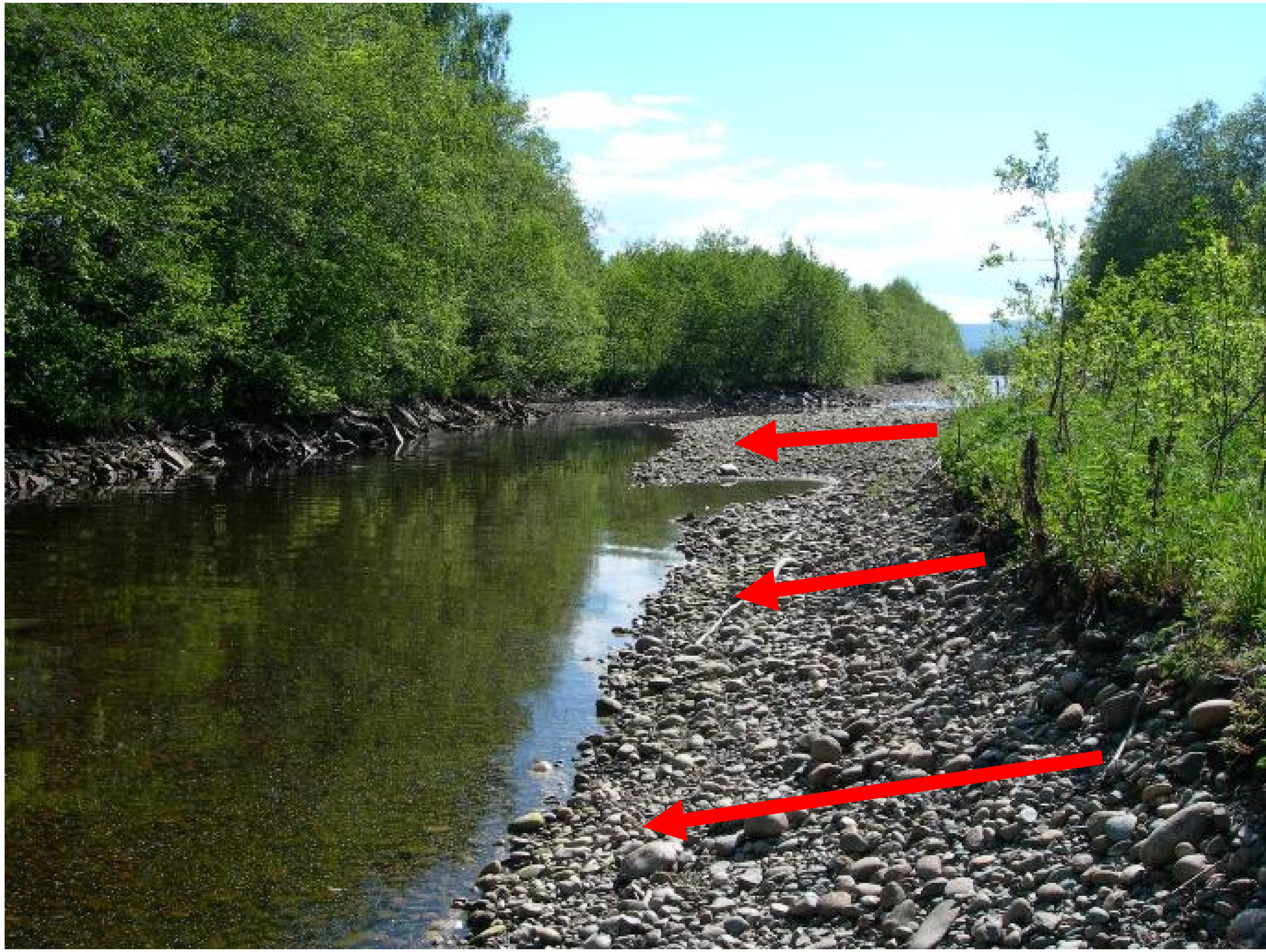
Change in flow regime downstream the power plant outlet

What is hydropeaking?

Hydropeaking is variations in production to stabilize the grid or to adjust to short-term variations in load



Hydropeaking impacts



Rapid dewatering

Stranding of fish and invertebrates

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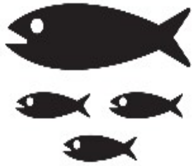
Mitigation measures – improving:

- Flow and temperature regimes

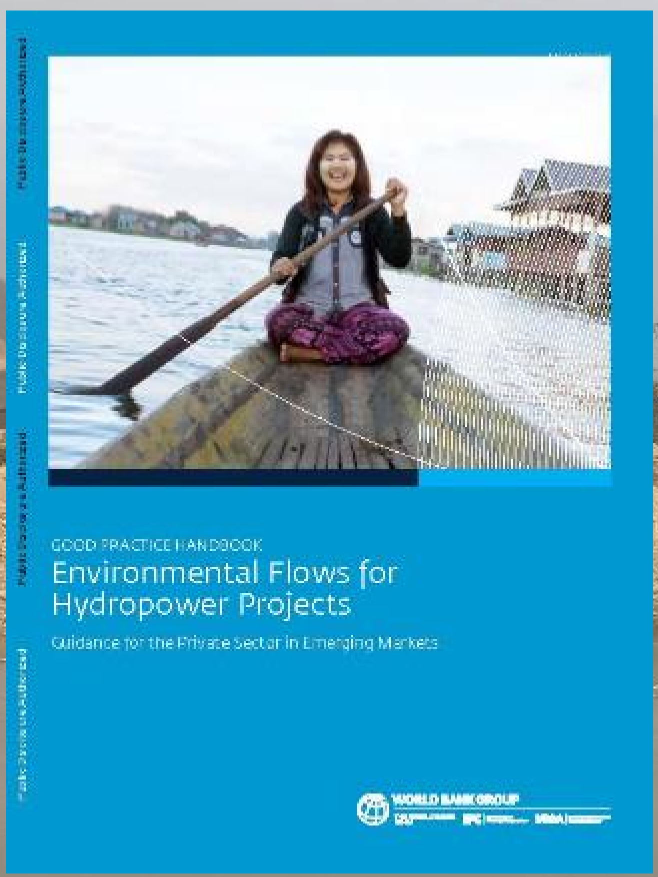
- Alterations and loss of habitats

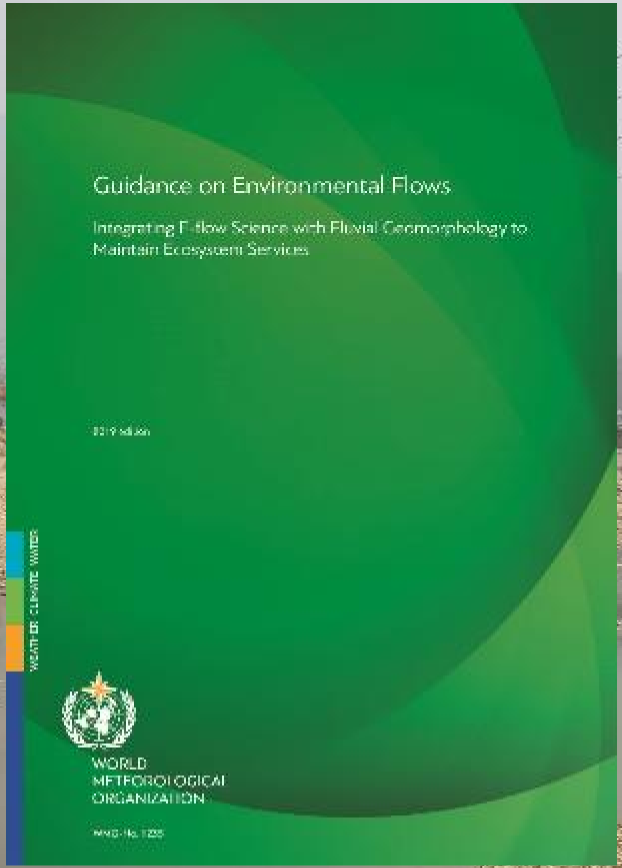
- Downstream fish migration

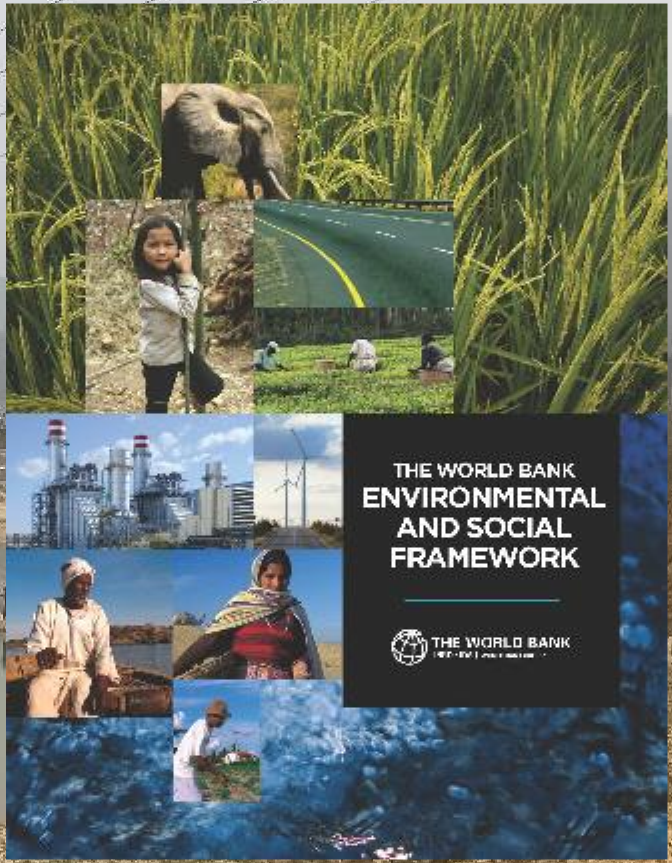
- Upstream fish migration



- Declining fish populations

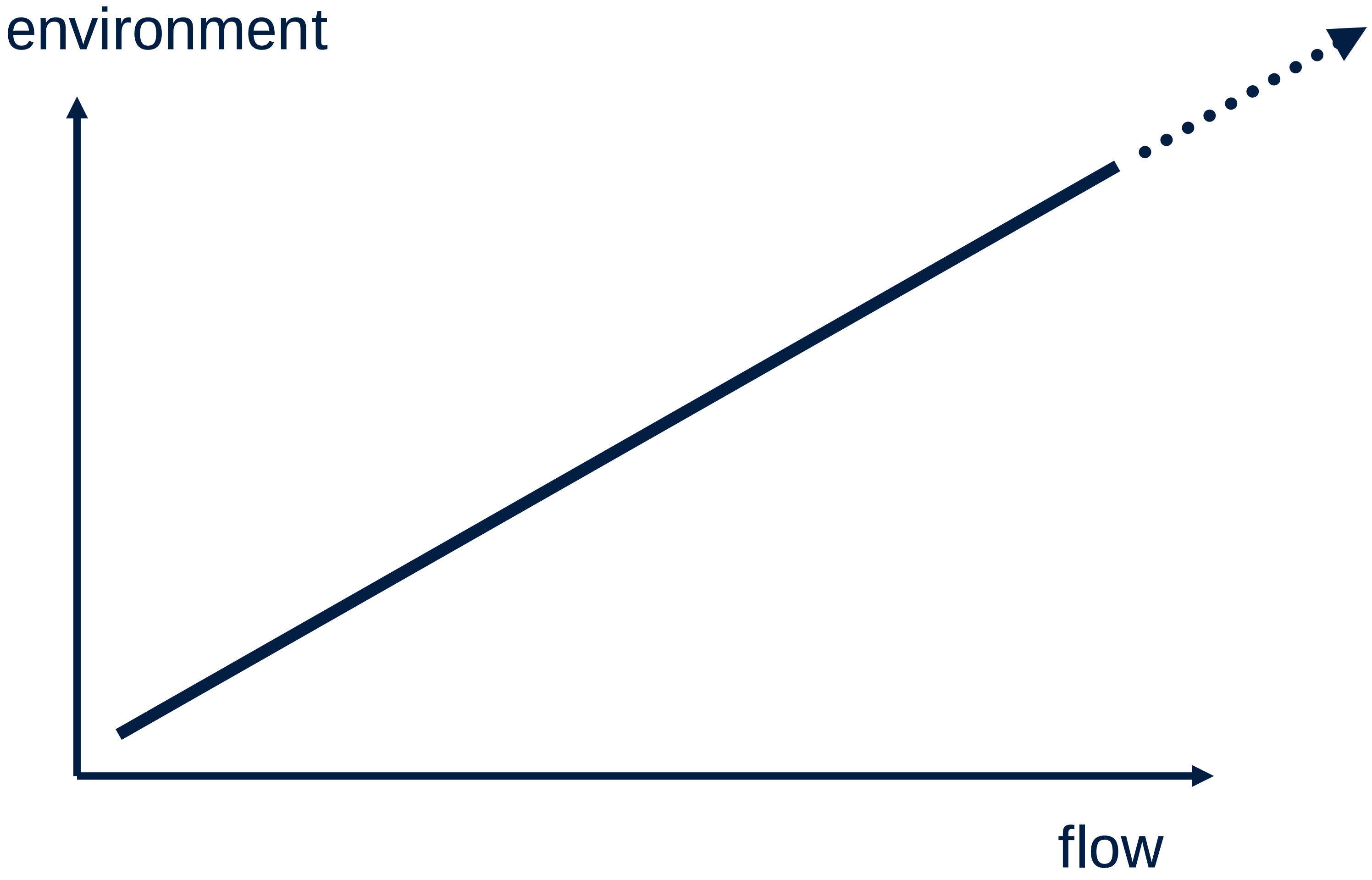




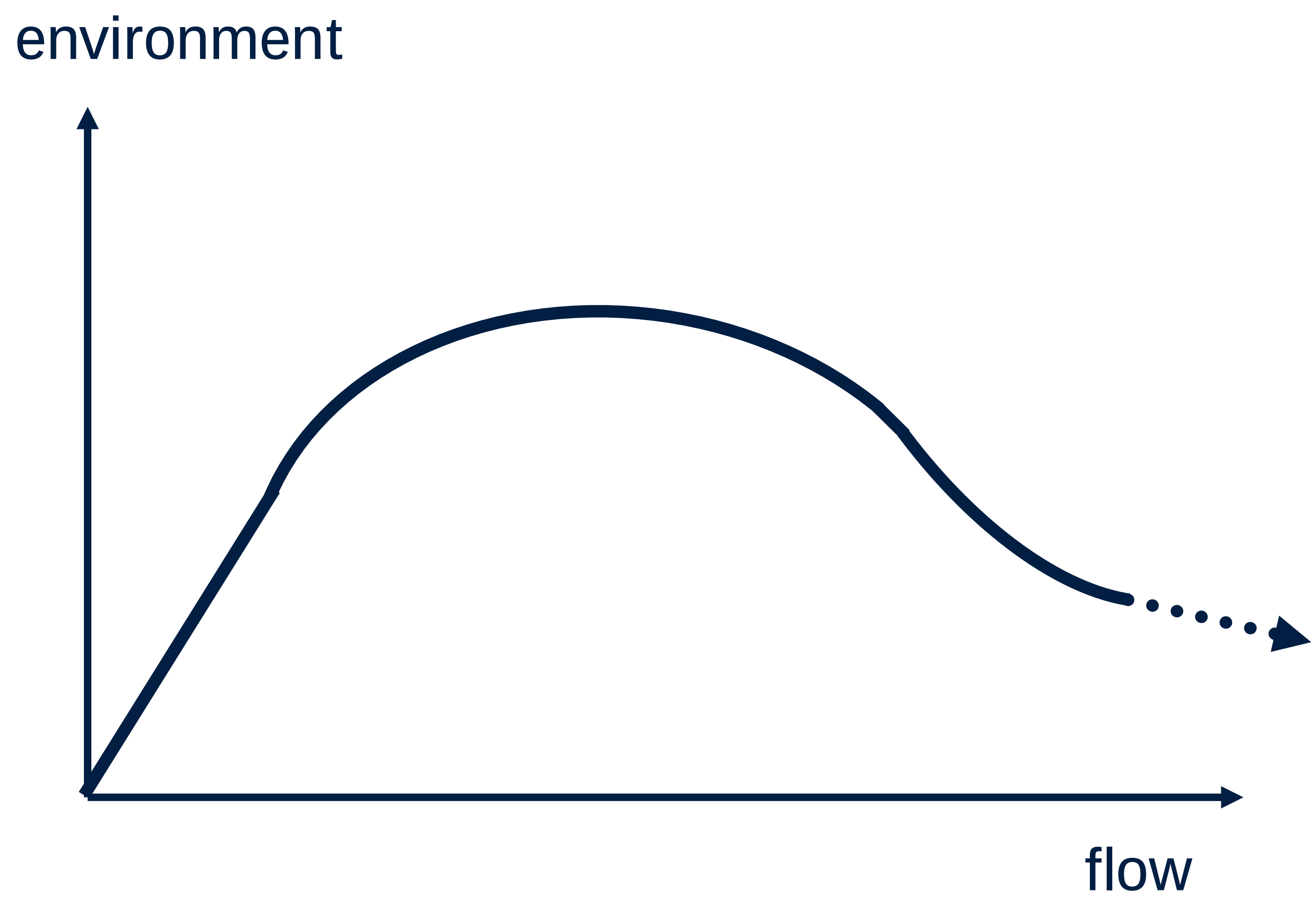


Release of eFlow year-around
(environmental flow; ecological flow)

Flow and the environment



Flow and the environment



Improve habitat in diverted reaches

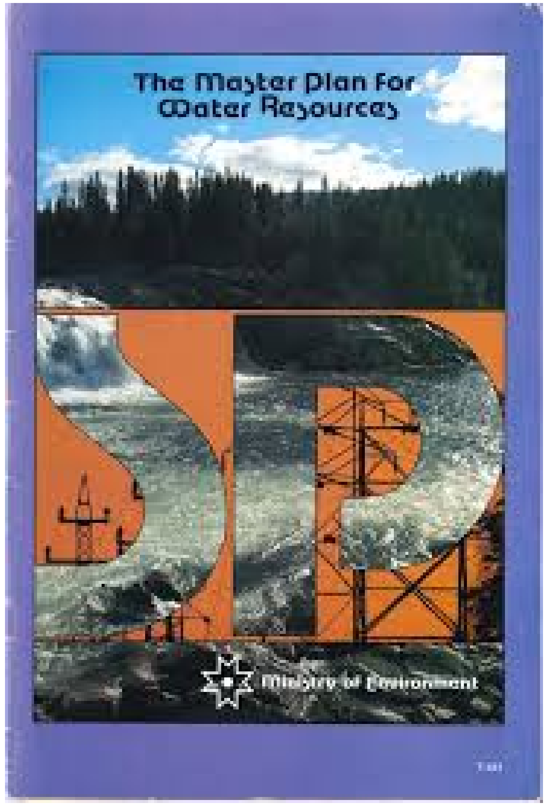
No loss of water for electricity generation

Safe downstream fish migration

Safe upstream fish migration

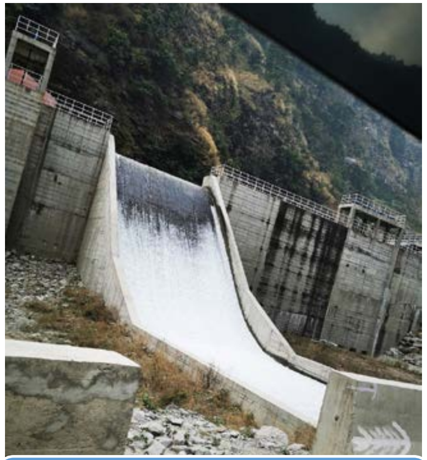
Legislation, regulation and strategic planning

- Developing a **Master Plan** of hydropower development at country level is a good strategy
- **Licenses and permits** need to be given with certain terms and conditions to mitigate impacts on the ecological and social environment
- The terms and conditions need to be subject to **oversight by the authorities**
- There should be **penalties** for non-compliance to the terms
- Environmental and Social Impact Assessment (ESIA) can be used to set the **terms of the license**

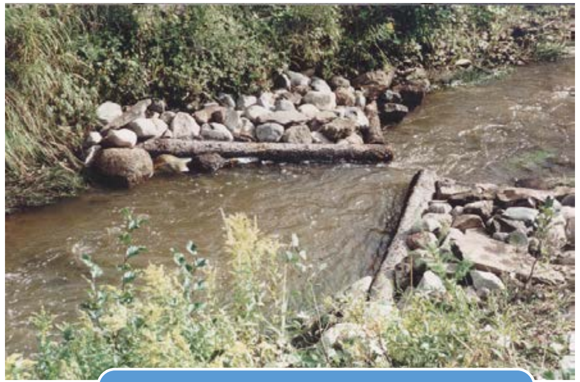


Examples of good international practice

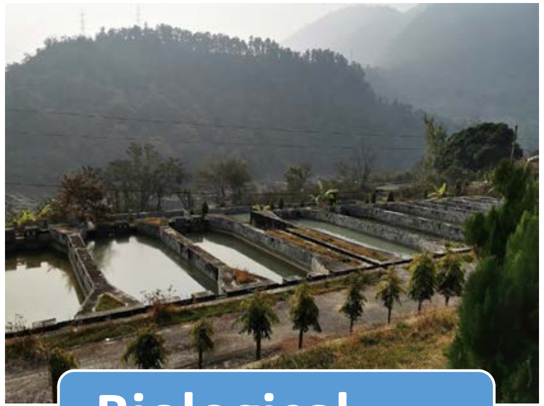
Operational



Technical



Structural



Biological

Dr Ana Adeva-Bustos, SINTEF Energy Research

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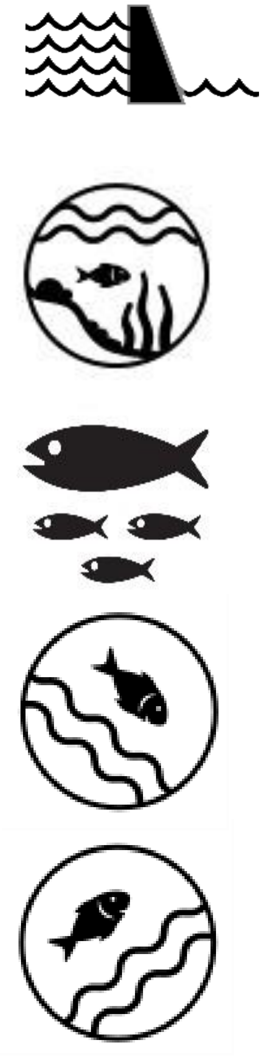
Presenters:

Ana Adeva Bustos, Sintef, Norway
Atle Harby, Sintef, Norway

Good International practice examples

- Operational
- Technical
- Structural
- Biological

Impacts



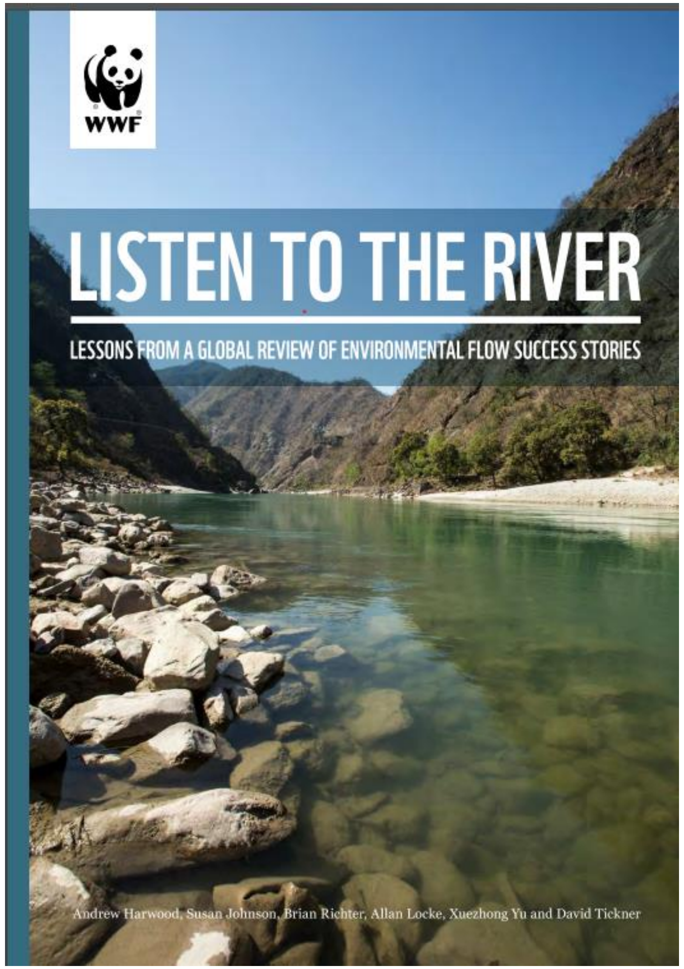
- Flow and temperature regimes
- Alterations and loss of habitats
- Declining fish populations
- Downstream fish migration
- Upstream fish migration

E-flow methods

More than 200 methods….

Challenges still found today

- Lack of political will and stakeholder support
- Insufficient resources and capacity
- Institutional barriers and conflicts of interest



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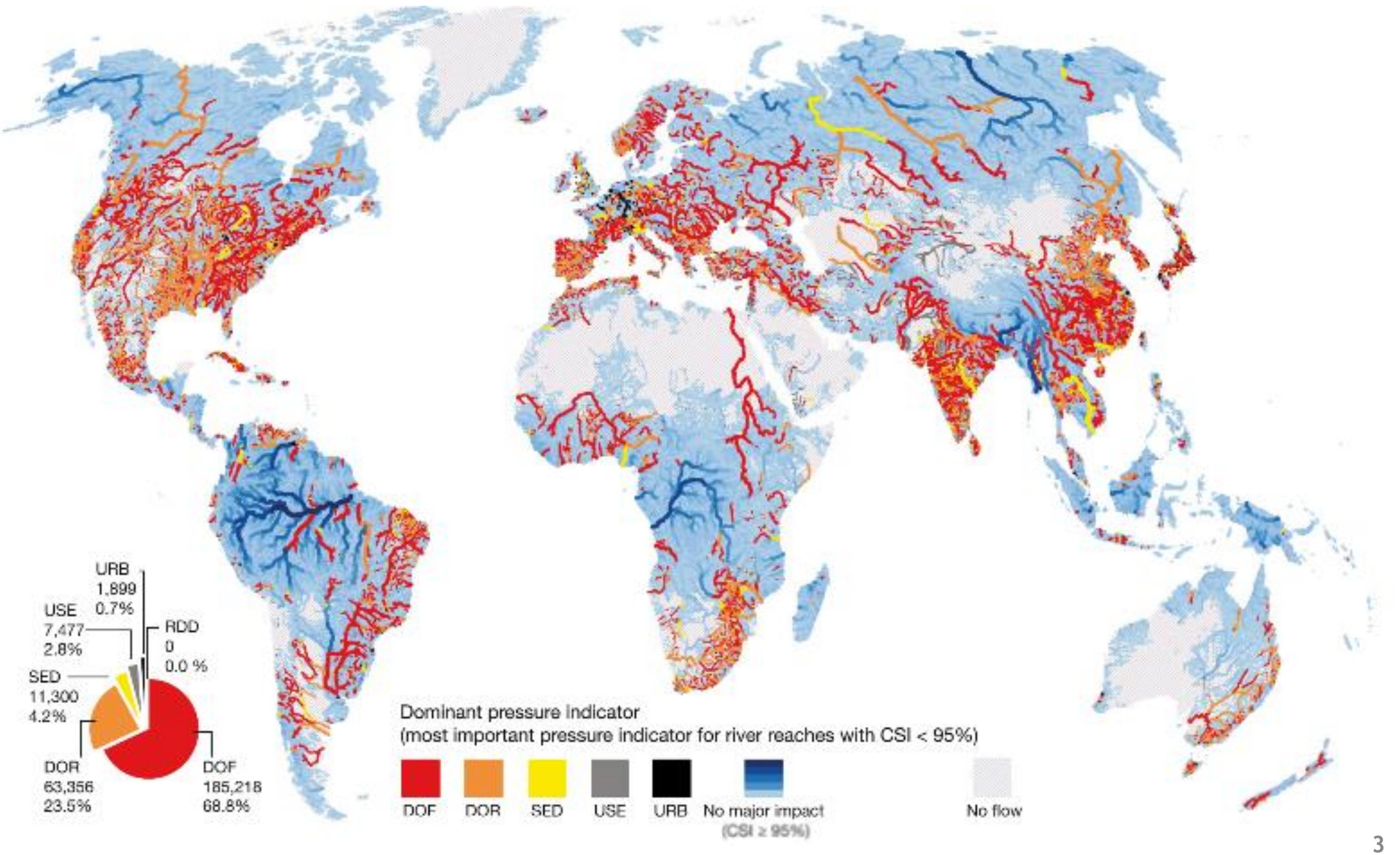
E-flow methods

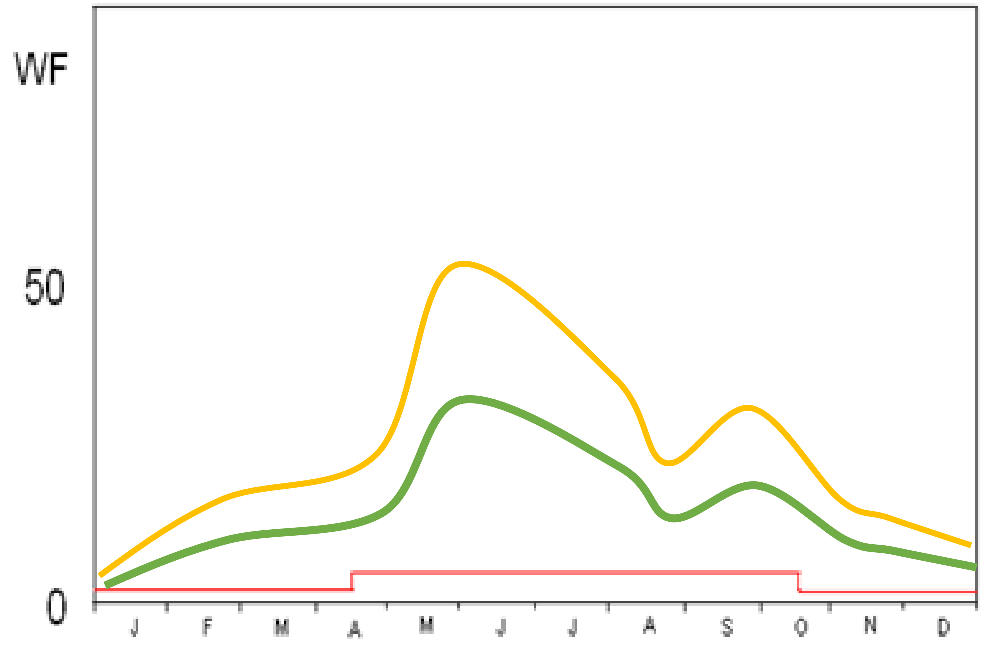


(Grill, Lehner et al. 2019)

E-Flow, Habitat & Migration→Mandal case, Norway

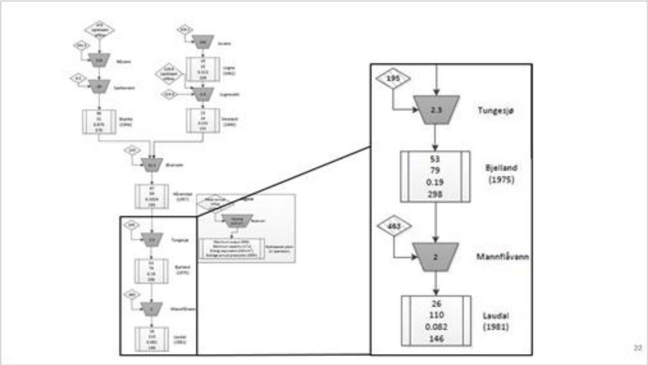
E-Flow, Habitat & Migration→Mandal case, Norway

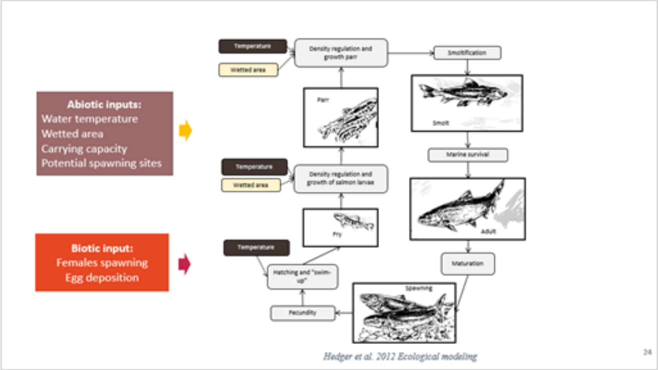
INCREASED IN FLOW

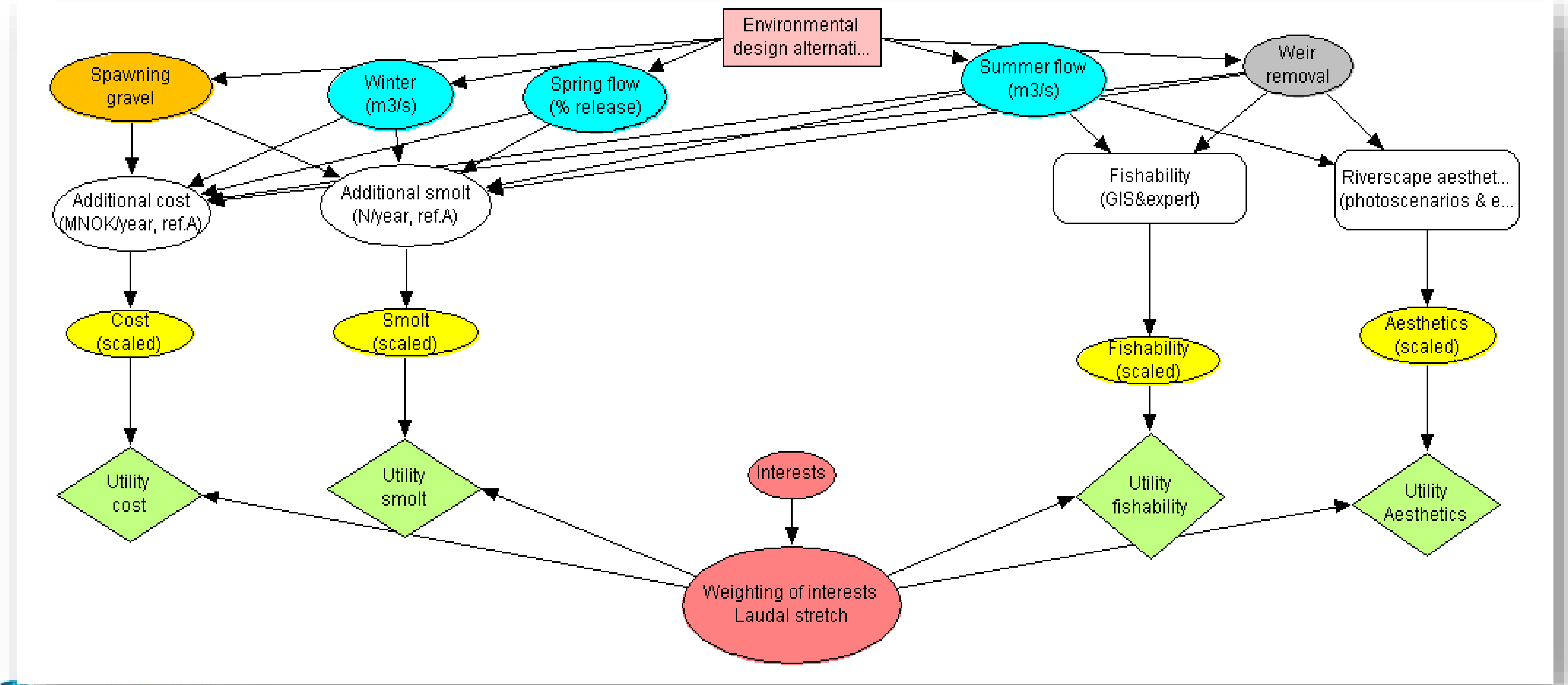


REMOVAL OF WEIRS

ADDITION OF SPAWNING GRAVEL







(Barton, Sundt et al. 2020)

E-Flow, Habitat & Migration→Mandal case, Norway

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E-flow assessment in Nepal

Today→10% of minimum monthly flow

WESTERN NEPAL ENVIRONMENTAL FLOW CALCULATOR (WENEFC)

NISHADI ERIYAGAMA, RAM DEVI TACHAMO SHAH, AKRITI SHARMA AND LUNA BHARATI

CHALLENGE

Many rivers in Nepal are relatively unregulated but have much untapped potential for hydropower development with associated economic gains. The rivers also serve a number of other purposes – supporting livelihoods and meeting the social and cultural needs of riparian communities. When a river's water resources are used for various purposes, it is often not realistic to maintain its natural flow regime. Therefore, a compromise has to be reached between satisfying human demands for economically important uses of water, maintaining the ecological health of a river, and satisfying communities' livelihood, social and cultural needs. Environmental flow estimation tools help make this compromise in a scientifically sound manner.

NEXT STEPS

WENEFC can be used for environmental impact assessments and water infrastructure planning to define the quantity and timing of water flows required to sustain river biodiversity, ecosystem services and livelihoods. This is the first step in a continuous process to provide a simple user-friendly tool for rapid analysis of environmental flow requirements for Western Nepal, before any major water resources development projects are initiated in the region. There is ample scope for improving the calculator by extending the ecological surveys to larger segments of the Karnali-Mohana and Mahakali Rivers, and

Environmental Flow Assessment of Hewa Khola A and Lower Hewa Khola Hydropower Projects in Nepal

Narayanhari Rijal, Hari Krishna Shrestha and Bert Bruins

Abstract: One of the elements of sustainable hydropowe (Eflows). This Eflows is meant to ensure that prior use(r riverine ecosystem functions are maintained. This paper p hydrological index method, of Hewa Khola A and Lower He projects are being developed in the tributaries of Tamor R results are compared with the current releases made from to lead to severe degradation and social conflict. Based o on the power production, the paper concludes with recomm socially and environmentally sustainable operations of the

Keywords: Sustainable hydropower development, en downstream water uses, Nepal

Introduction

Nepal has a huge potential for hydropower development, because the country is endowed with a large number of snow fed perennial rivers with topographical variation within a short stretch. After the introduction of Hydropower Development Policy, 2001, there has been active involvement of the private sector in hydropower development. However, it is only recently that sustainable operations of the hydropower projects became a priority.

Environmental assessment and environmental flows are an important aspect for sustainable hydropower

sustainability MDPI

Article

Environmental Flows Assessment in Nepal: The Case of Kaligandaki River

Naresh Suwal [1,*], Alban Kuriqi [2,*], Xianfeng Huang [3], João Delgado [2], Dariusz Młyński [4] and Andrzej Walega [4]

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2 CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisbon, Portugal; joao.borga.delgado@tecnico.ulisboa.pt
3 College of Water Conservancy and Hydropower Engineering, Hohai University, Gulou District, Nanjing 210098, China; hxfhuang2005@163.com
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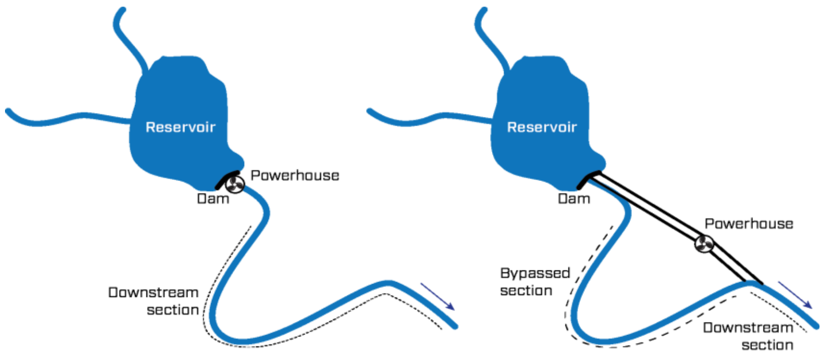
check for updates

Abstract: Environmental flow assessments (e-flows) are relatively new practices, especially in developing countries such as Nepal. This study presents a comprehensive analysis of the influence of hydrologically based e-flow methods in the natural flow regime. The study used different hydrological-based methods, namely, the Global Environmental Flow Calculator, the Tennant method, the flow duration curve method, the dynamic method, the mean annual flow method, and the annual distribution method to allocate e-flows in the Kaligandaki River. The most common practice for setting e-flows consists of allocating a specific percentage of mean annual flow or portion of flow derived from specific percentiles of the flow duration curve. However, e-flow releases should mimic the river's intra-annual variability to meet the specific ecological function at different river trophic levels and in different periods over a year covering biotas life stages. The suitability of the methods was analyzed using the Indicators of Hydrological Alterations and e-flows components. The annual distribution method and the 30%Q-D (30% of daily discharge) methods showed a low alteration at the five global indexes for each group of Indicators of Hydrological Alterations and e-flows components, which allowed us to conclude that these methods are superior to the other methods. Hence, the study results concluded that 30%Q-D and annual distribution methods are more suitable for the e-flows implementation to meet the riverine ecosystem's annual dynamic demand to maintain the river's health. This case study can be used as a guideline to allocate e-flows in the Kaligandaki River, particularly for small hydropower plants.

Flow regimes/Habitat



01

Inventory of the reaches type

02

Are reaches totally dry?

03

Are there priority reaches?(Habitat)

04

Is there a technical way to release the water? If no, modify it

05

Monitor the release of the water/adapted

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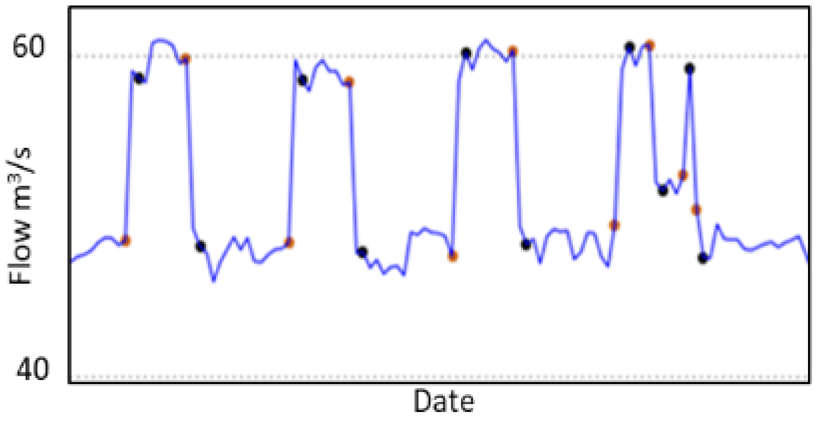
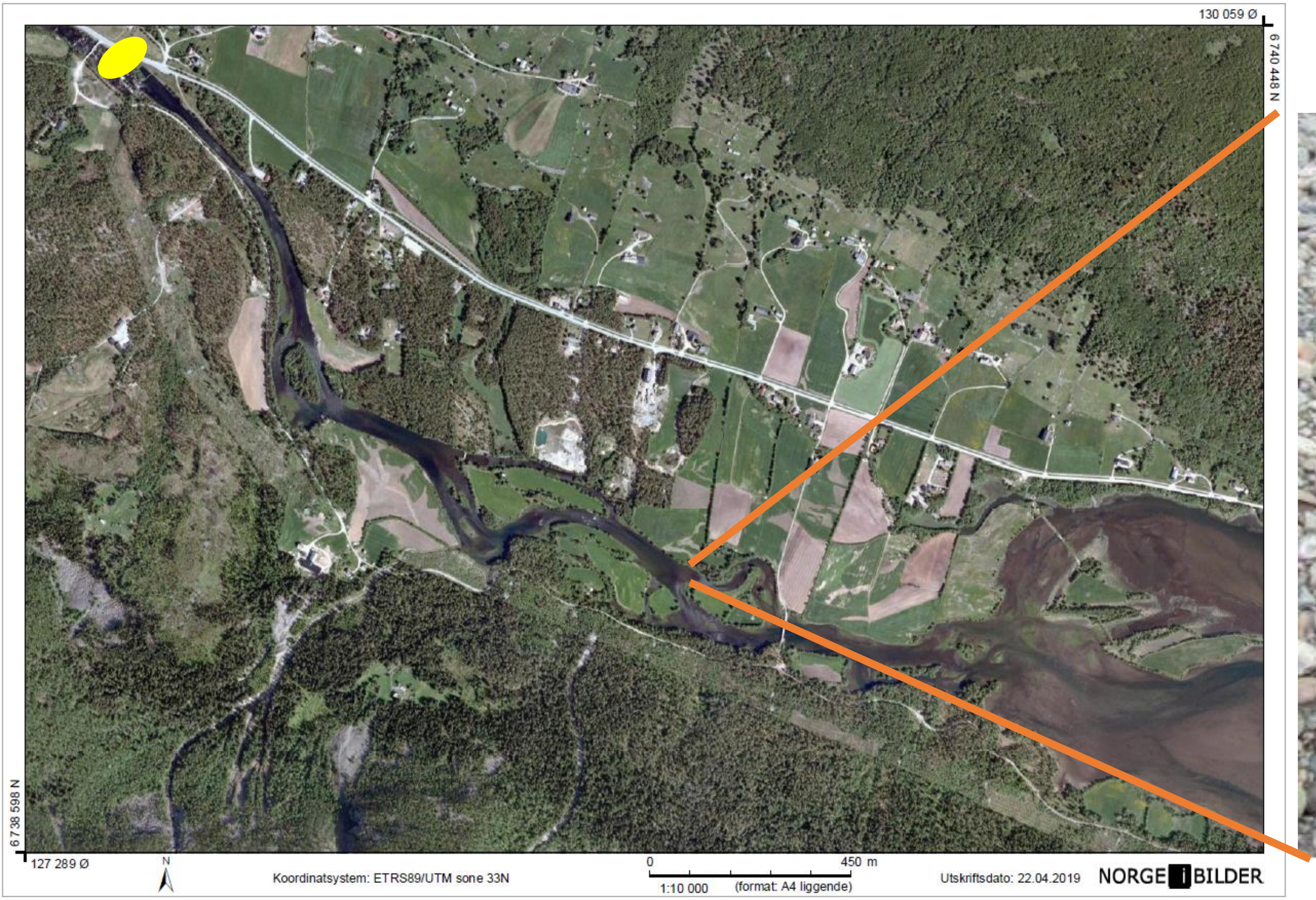
Hydropeaking→Storåne case, Norway

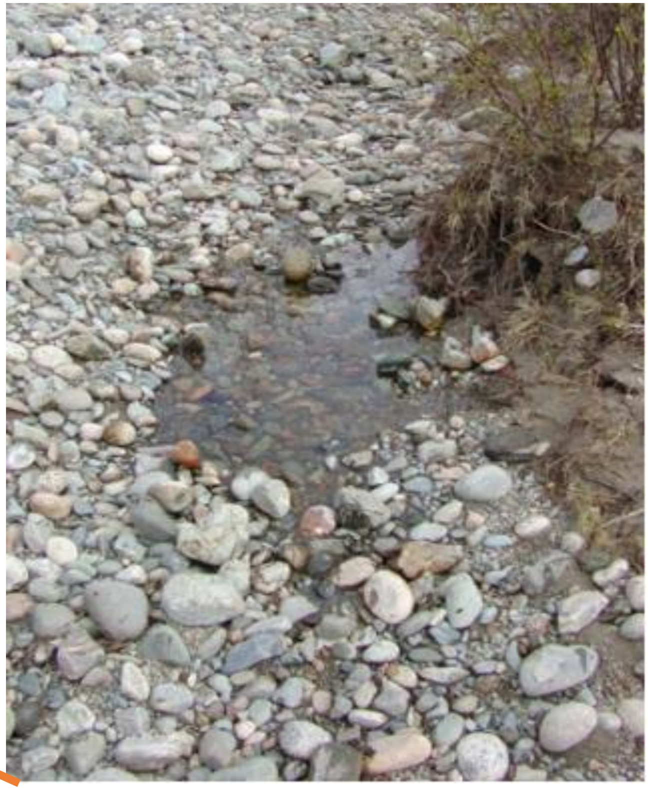
Hydropeaking→Storåne case, Norway

COSH Tool



(Sauterleute and Charmasson, 2014)





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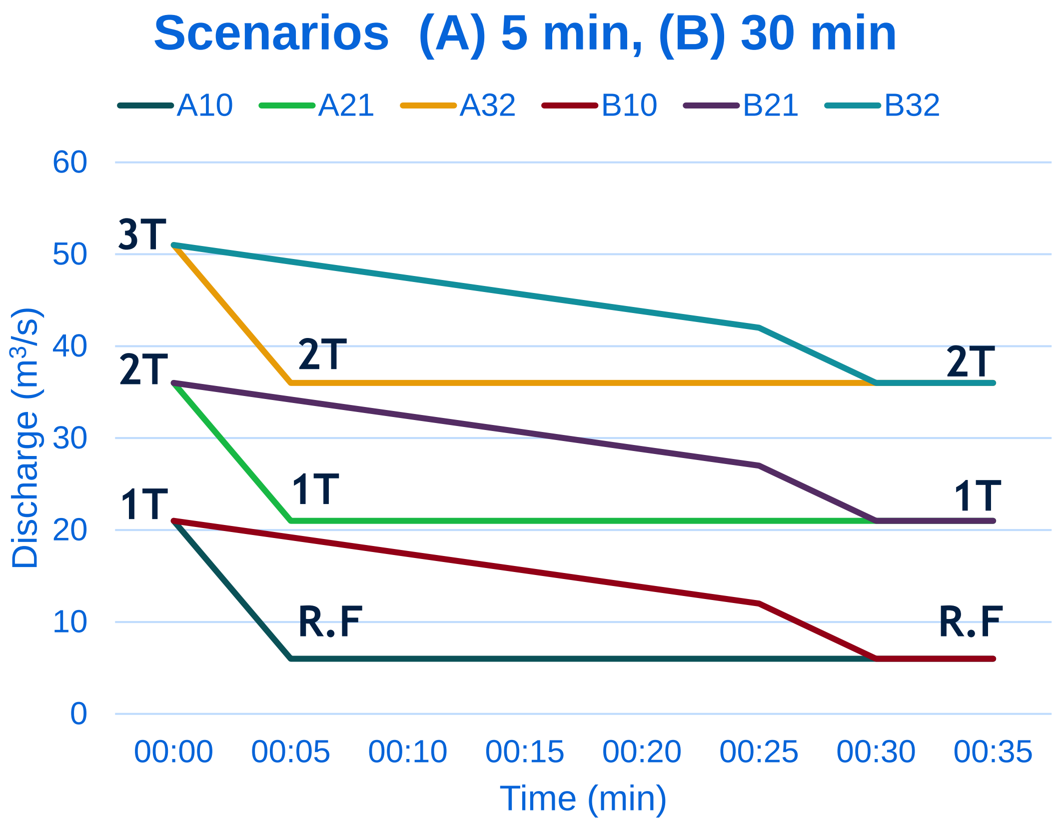
Hydropeaking→Storåne case, Norway



(Juárez, Adeva-Bustos et al. 2019)

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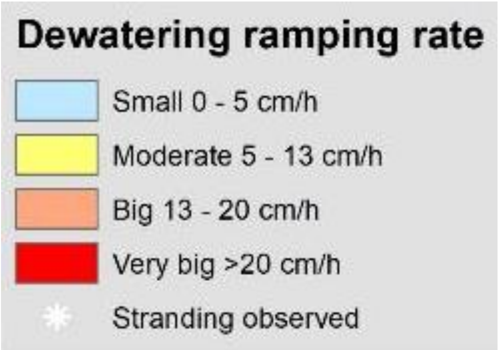
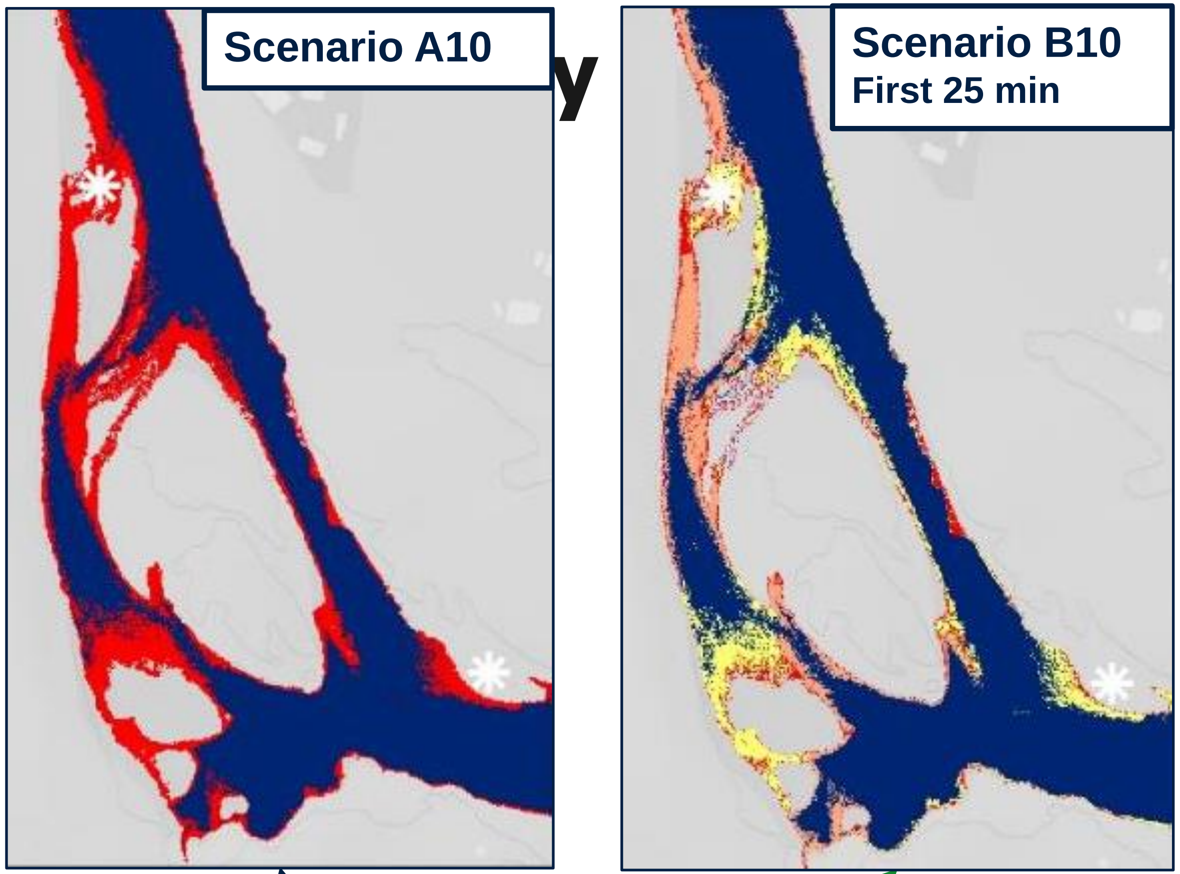
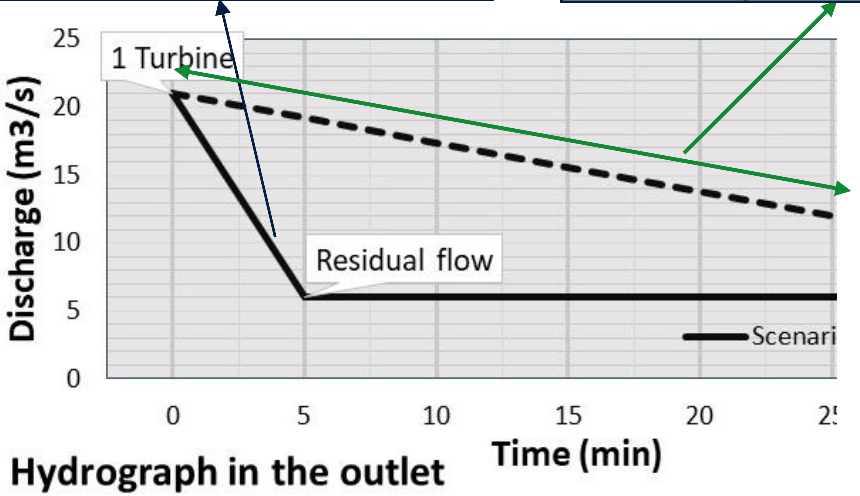
Hydropeaking→Storåne … y



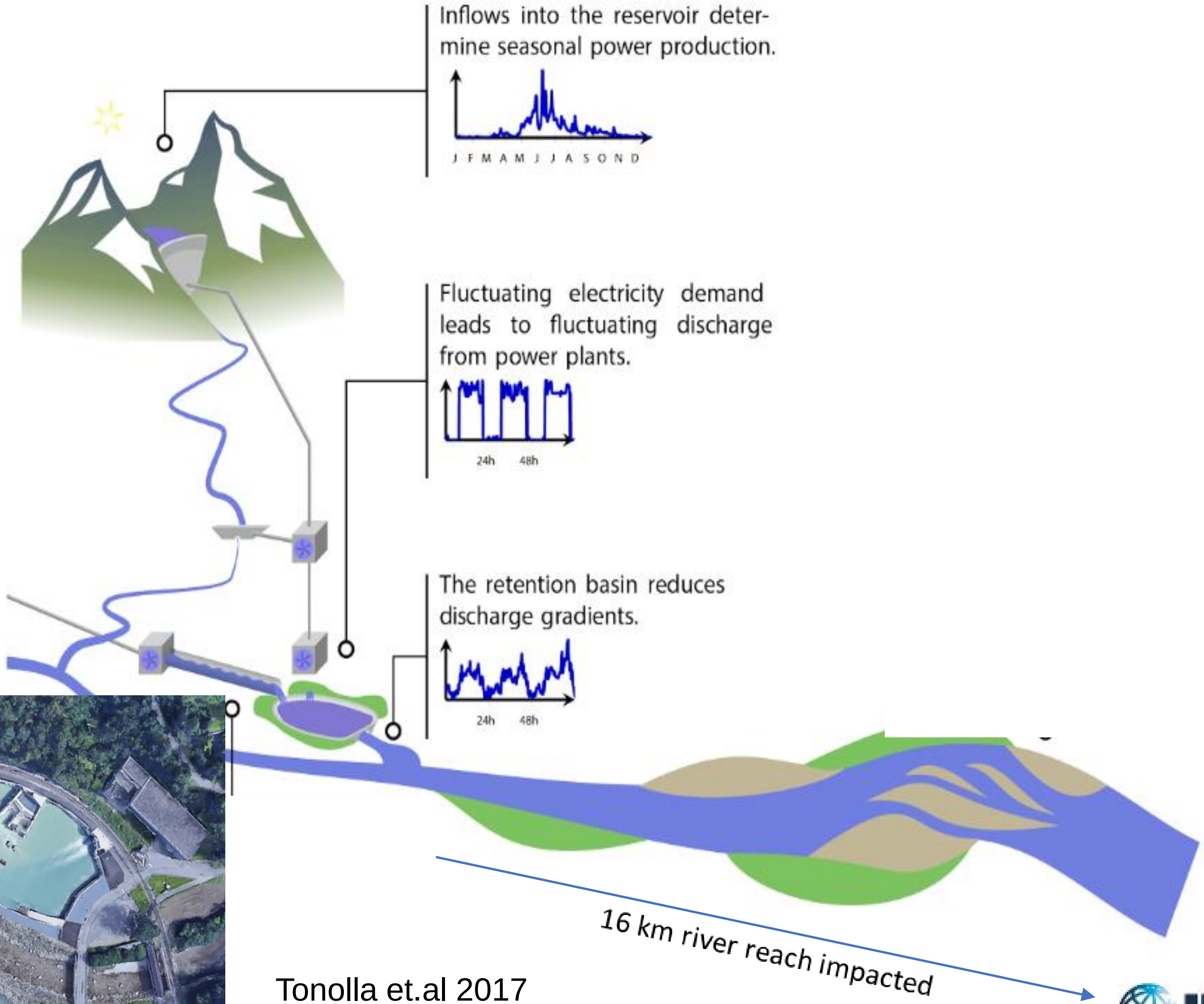




(Juárez, Adeva-Bustos et al. 2019)

Hydropeaking→Aare case, Switzerland

Hydropeaking→Aare case, Switzerland



Tonolla et.al 2017

Person, 2013

Source: www.sccer-soe.ch & Google Earth

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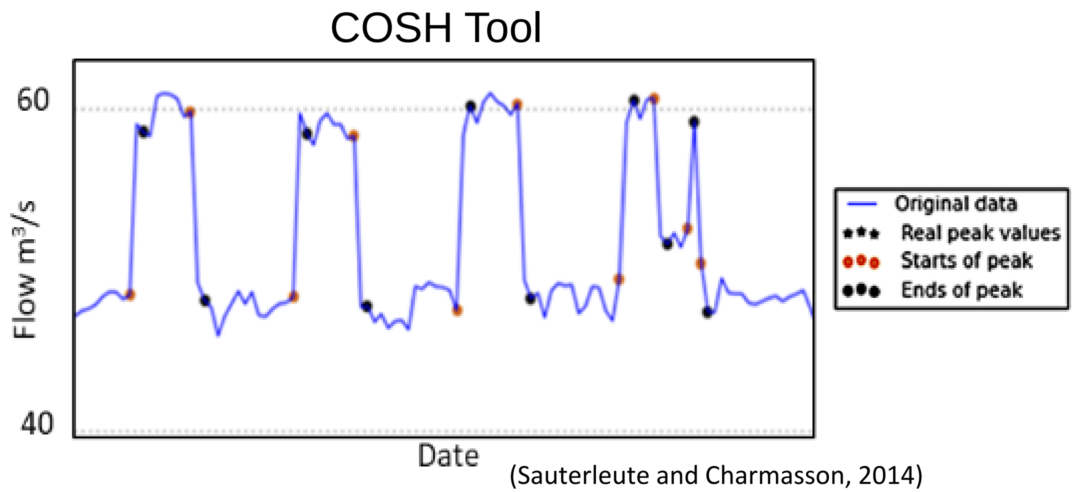
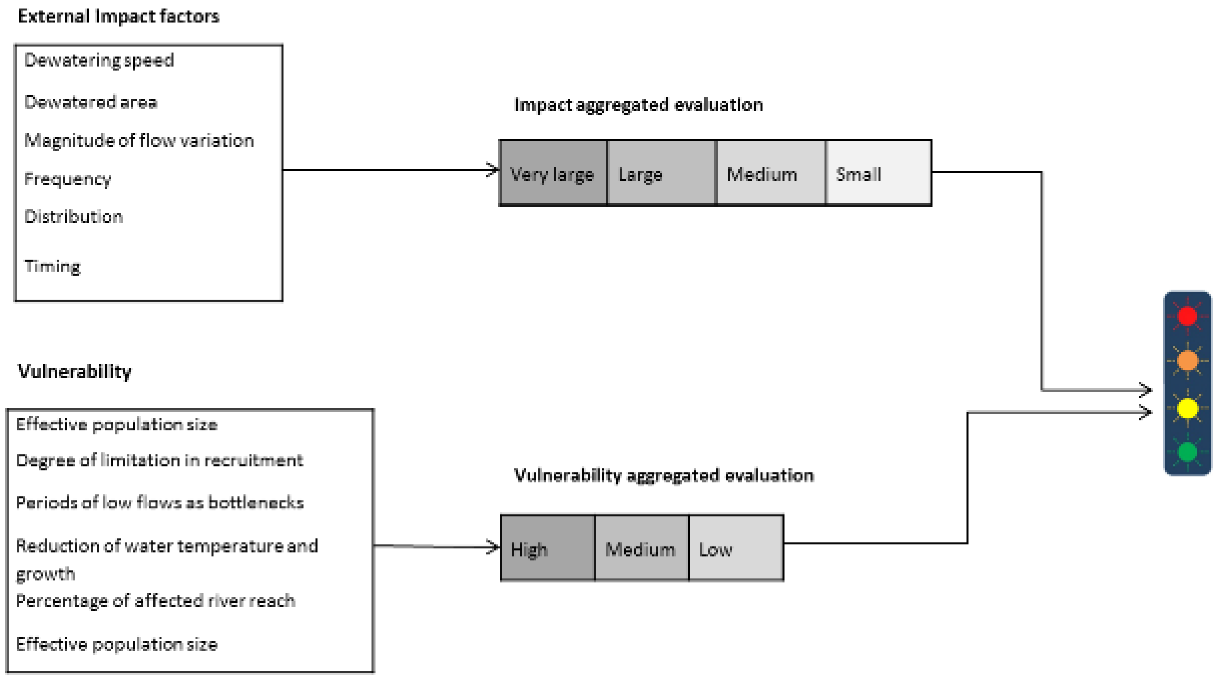
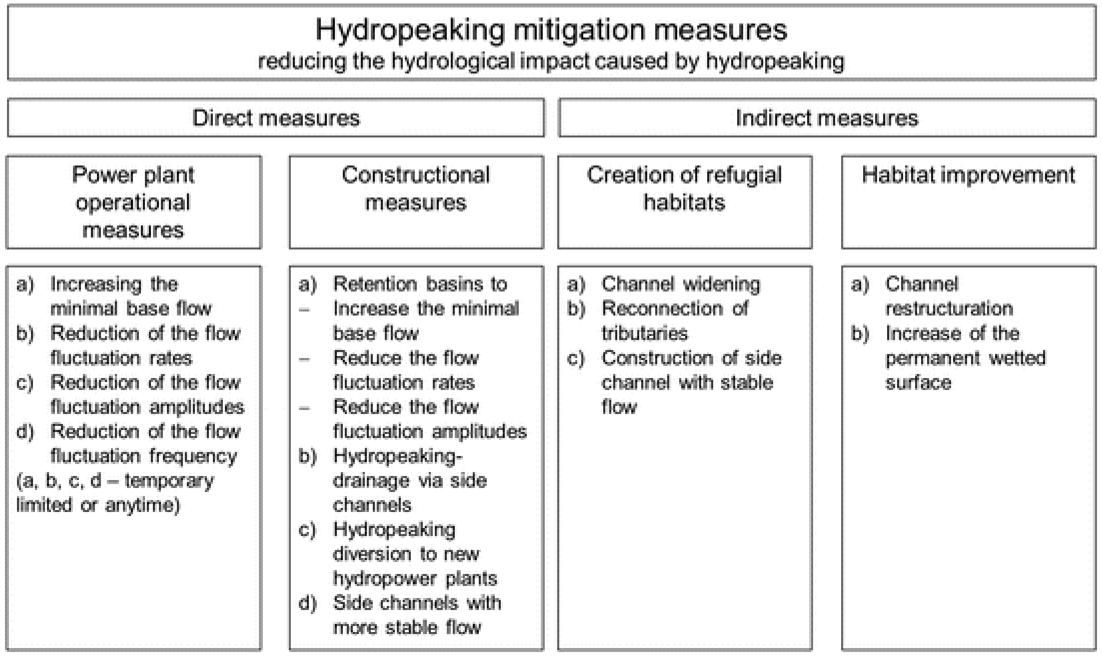
Hydropeaking in Nepal



(Sauterleute and Charmasson, 2014)





(Greimel, Schülting et al. 2015)

Fish Stocking→Aurland, Norway

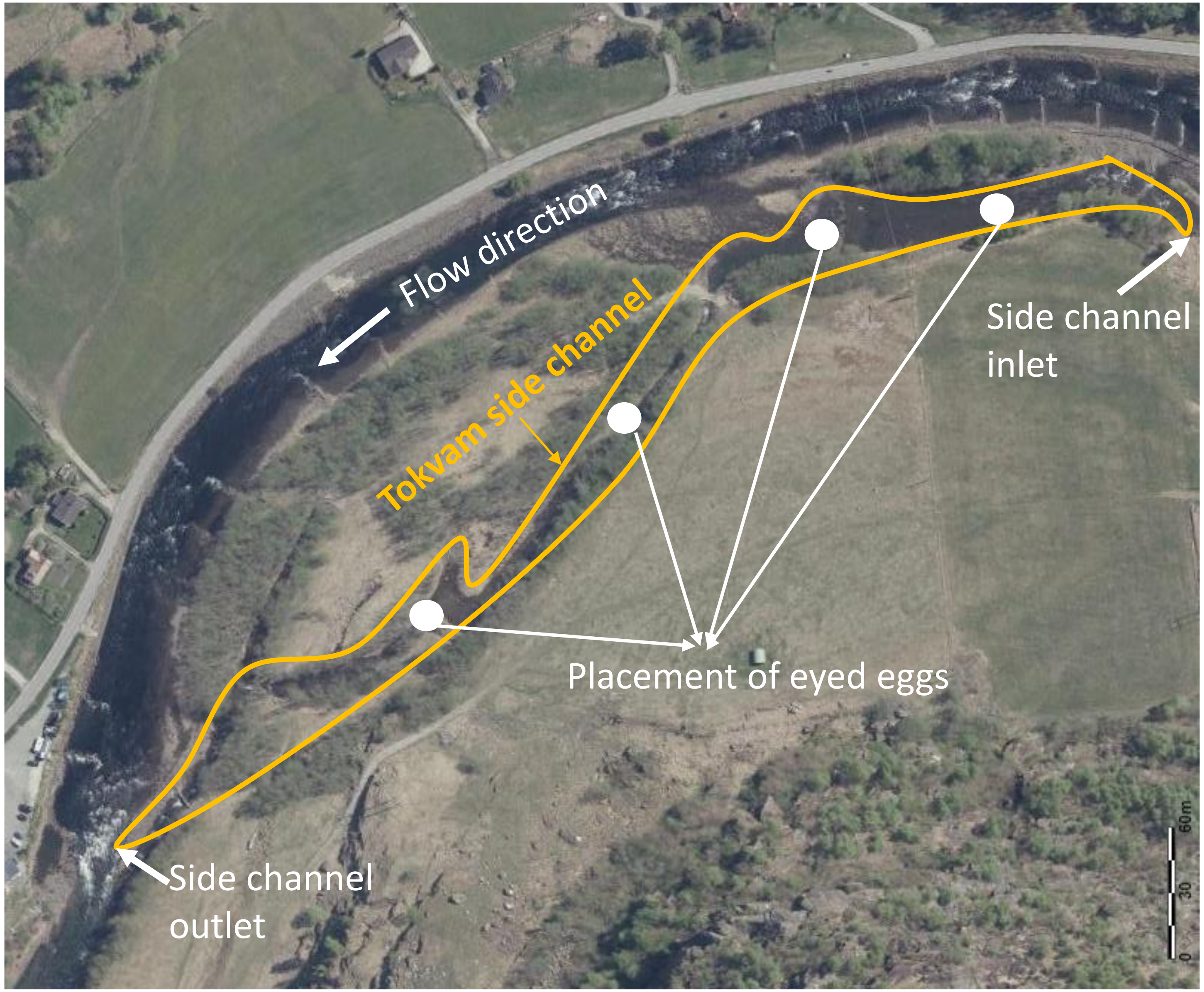
Fish Stocking→Aurland case, Norway

Tokvam BEFORE

Tokvam AFTER

Figure: NORCE

Fish Stocking→Aurland case, Norway



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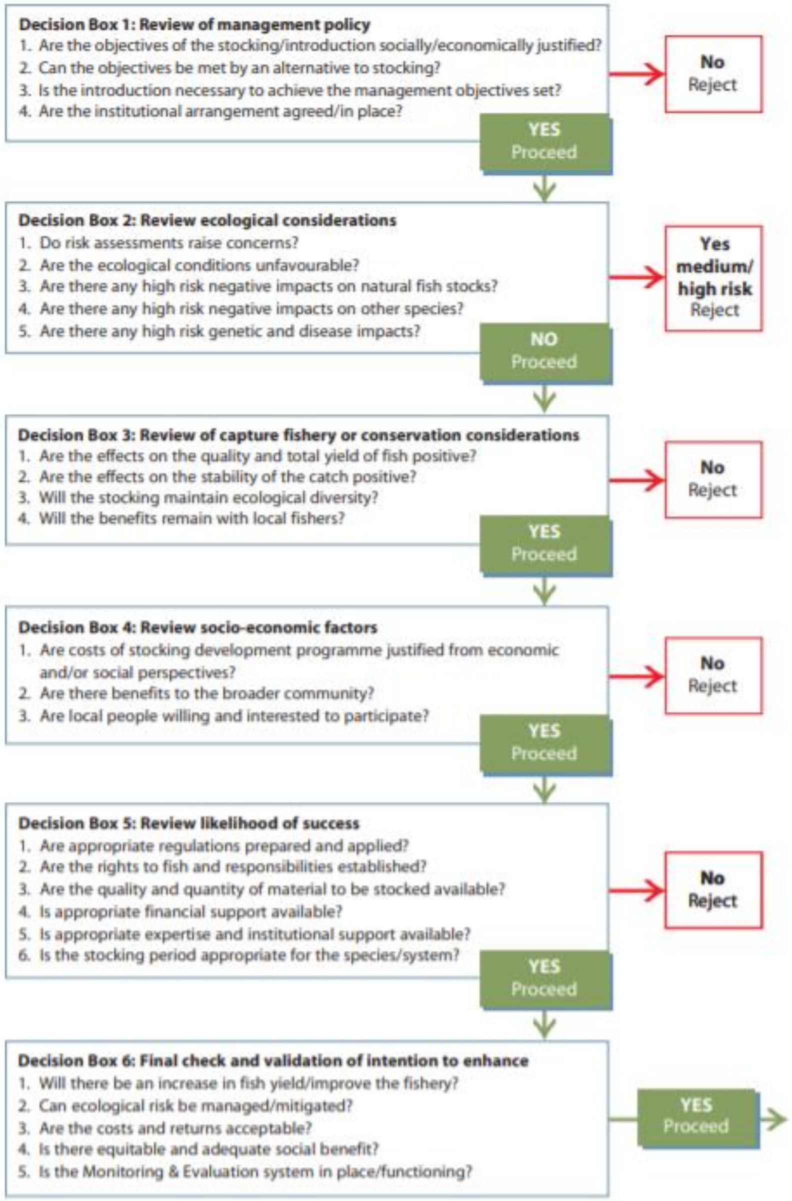
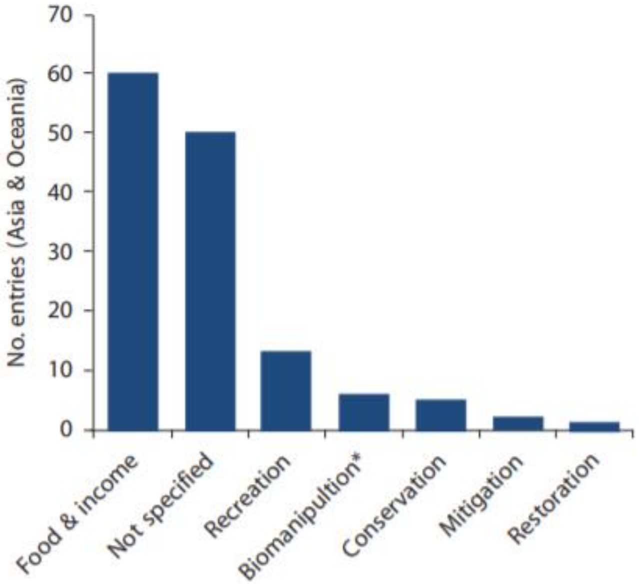
Guidelines Stocking



Note: Modified from Cowx (1998a).

(De Silva 2015)



Data source: FAO Inland Water Resources and Aquaculture Service (1999) Adapted from Ingram and De Silva (2015)

Figure 1 Reasons for stocking in Asia and Oceania regions

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Stocking in Nepal

01

Develop a systematic approach for fish stocking

02

Ensure monitoring after the stocking plan/adaptation

03

Ensure hatcheries with conditions able to provide suitable native fish stocks

04

Consider fisheries for local communities

Fish migration→Las Rives case, France

Fish migration→Las Rives case, France

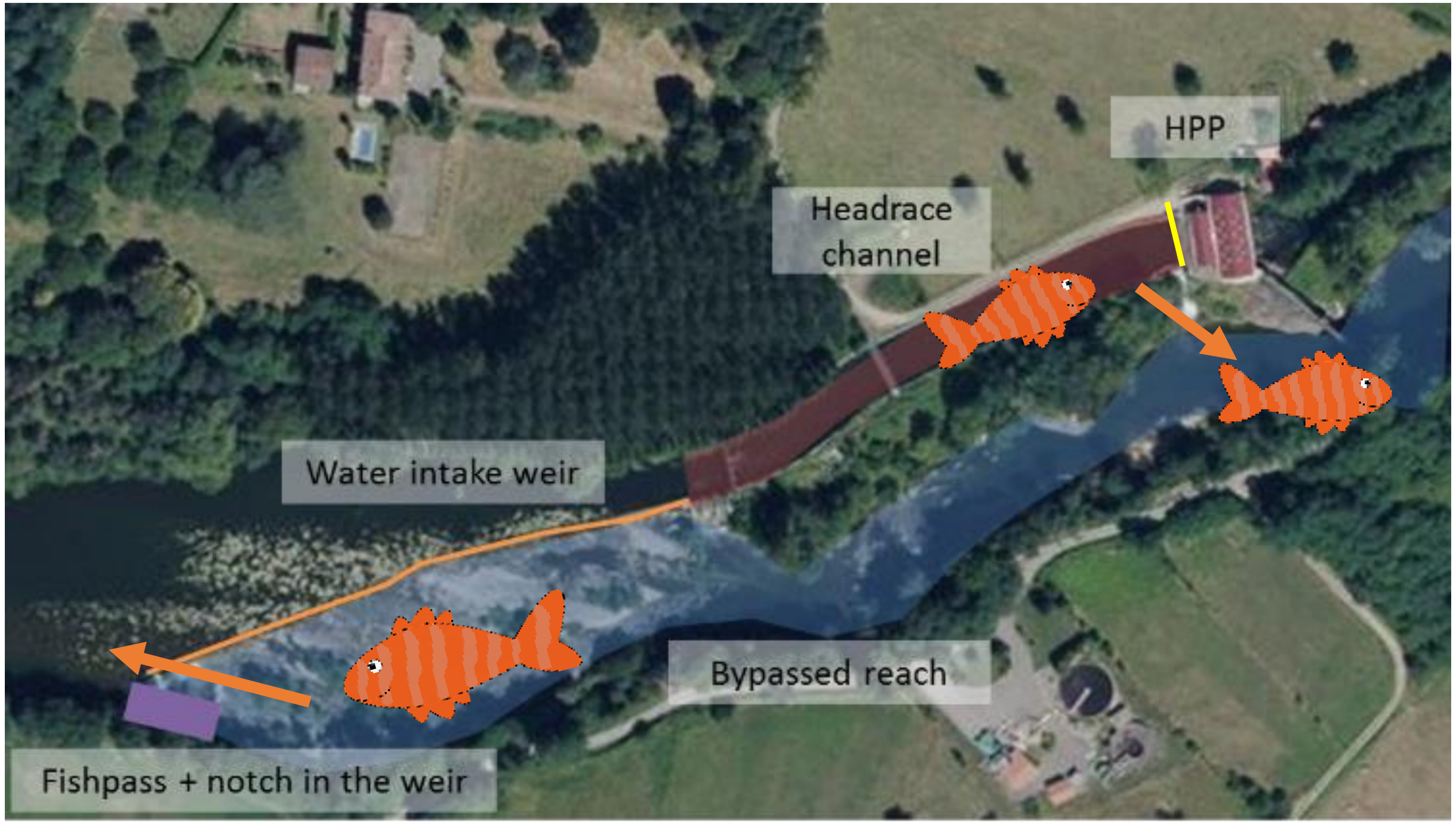

Figure: Dewitte, M

Fish migration→Las Rives case, France

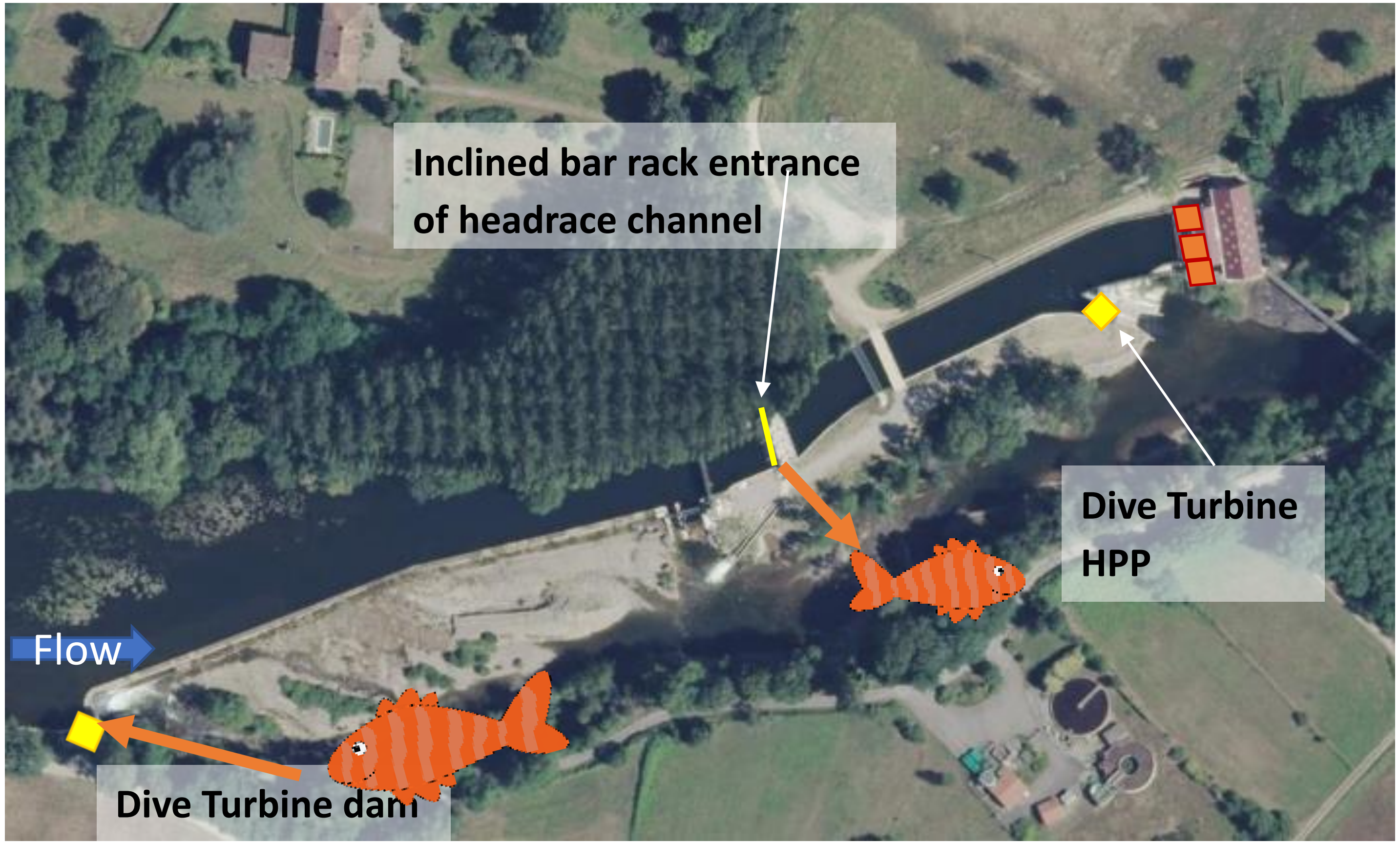

Figure: Dewitte, M

Energy

Attraction flow both at the entrance and at the dam

SINTEF

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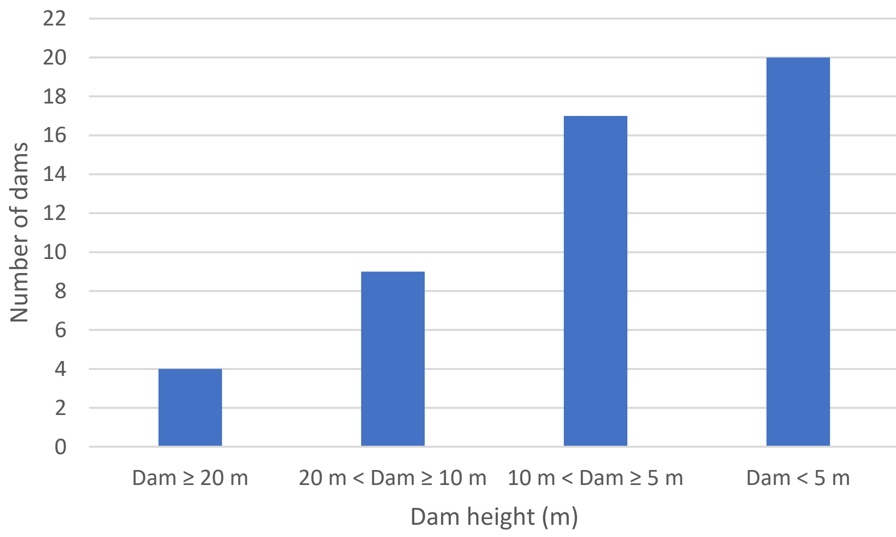
Nepal→Upstream fish migration



Nepal→Downstream fish migration

Operational

Species name Latin / English / Nepali	Migratory status	J	F	M	A	M	J	J	A	S	O	N	D	Spawning Season	Spawning Substrate
		Migratory Pattern (Months)													
Tor putitora (Golden Mahseer) Sahar	Long range						⬆	⬆	↑	↑	⬇	⬇	↓	Sept-Oct	Gravel bed (Adult-rest in deep pools)
Tor tor (Mahseer) Falame Sahar	Long range						⬆	⬆	↑	↑	⬇	⬇	↓	Sept-Oct	Stones and gravel
Anguilla bengalensis (Fresh water Eel) Raja Bam or Bam	Long range		↑	⬆	⬆	↑	⬇	⬇	↓					June-July	Mud & Sand detritus in sea water
Clupisoma montana (Jalkapoor) Jalkapoor	Long range							↑	⬆	↑	⬇	↓		Sept-Oct	
Bangarius bangarius (Bagarid catfish) Goonch	Long range			↑	↑	↑	↑	↑	⬆	⬆	⬇	↓	↓	July-Aug	Mud & Sand detritus (Adult-
Neolissocheilus hexagonolepis (Copper Mahseer) Katle	Mid range			↑	↑	↑	⬆	↓	↓	⬇				May-July	Gravel (Adult-resting in deep
Schizothorax richardsonii (Spotted snow trout) Buche	Mid range	↑	↑	⬆								⬇	↓	Sept-Oct March-April	Pebbels and gravel
Schizothorax plagiostomus (Spotted snow trout) Sun Asala	Mid range	↑	↑	⬆								⬇	↓	Sept-Oct March-April	Pebbels and gravel
Schizothorax progastus (Long nosed snow trout) Chuche Asala	Mid range	↑	↑	⬆								⬇	↓	Sept-Oct March-April	Pebbels and gravel
Labeo dero (River rohu) Gurdi	Short range			↑	↑	↑	↑	⬆	⬇	↓				June-July	Gravel bed

Technical

Fish migration

01

Combine and finish the fish passage inventory with fish monitoring

02

Adapt/fix already in place fish passage that are not functioning

03

Ensure the release of attraction flow through the fish passage

04

Monitor and adaptation

05

Promote courses and training

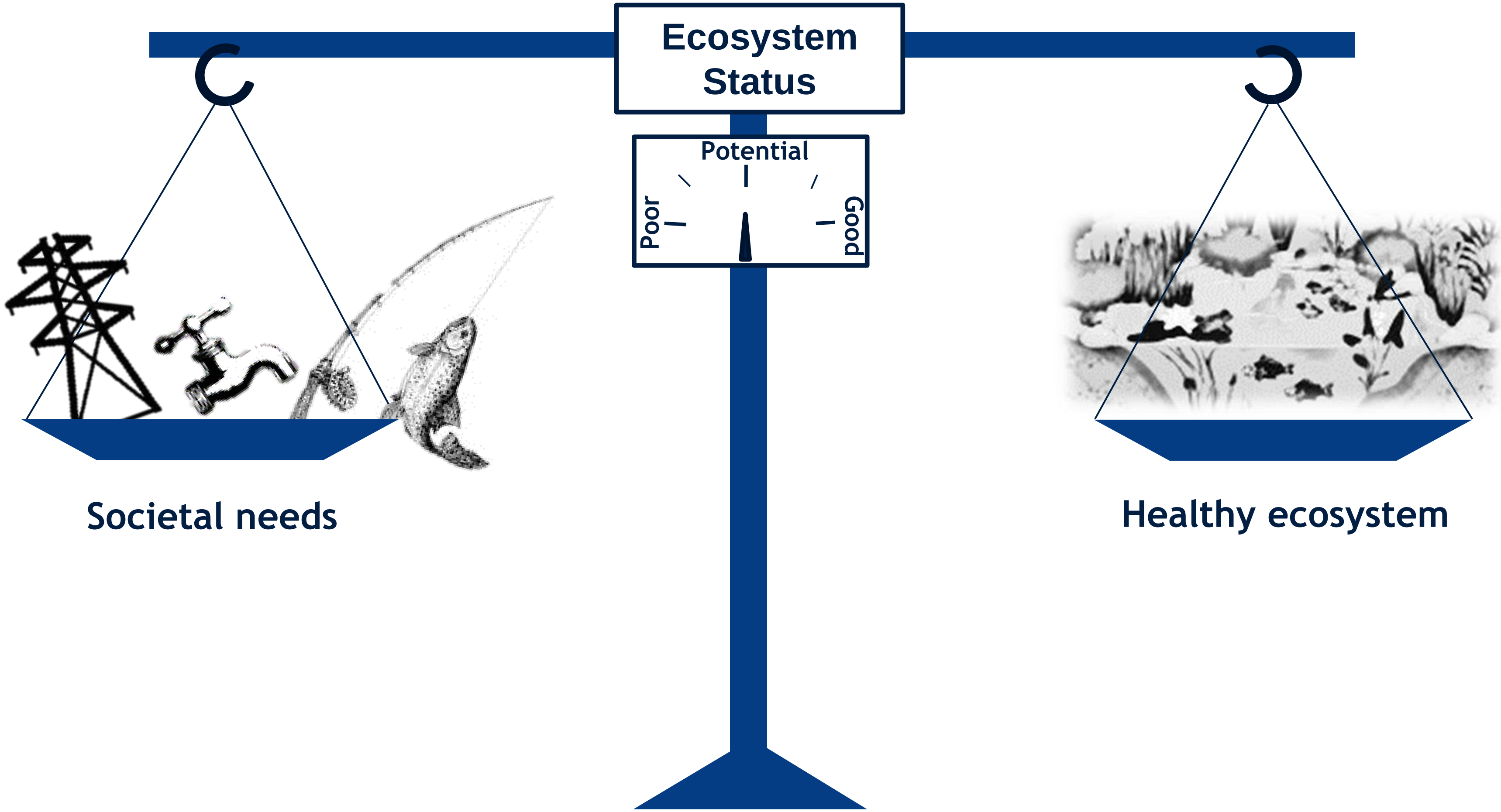
01

Monitoring campaign to know more about downstream migration

02

Combine biological knowledge with the hydraulic conditions - prioritize

Final remarks



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Biodiversity Mitigation for the Gulpur Hydropower Project, Pakistan

Presenter:
Fareeha Irfan Ovais,
Hagler Bailly Pakistan

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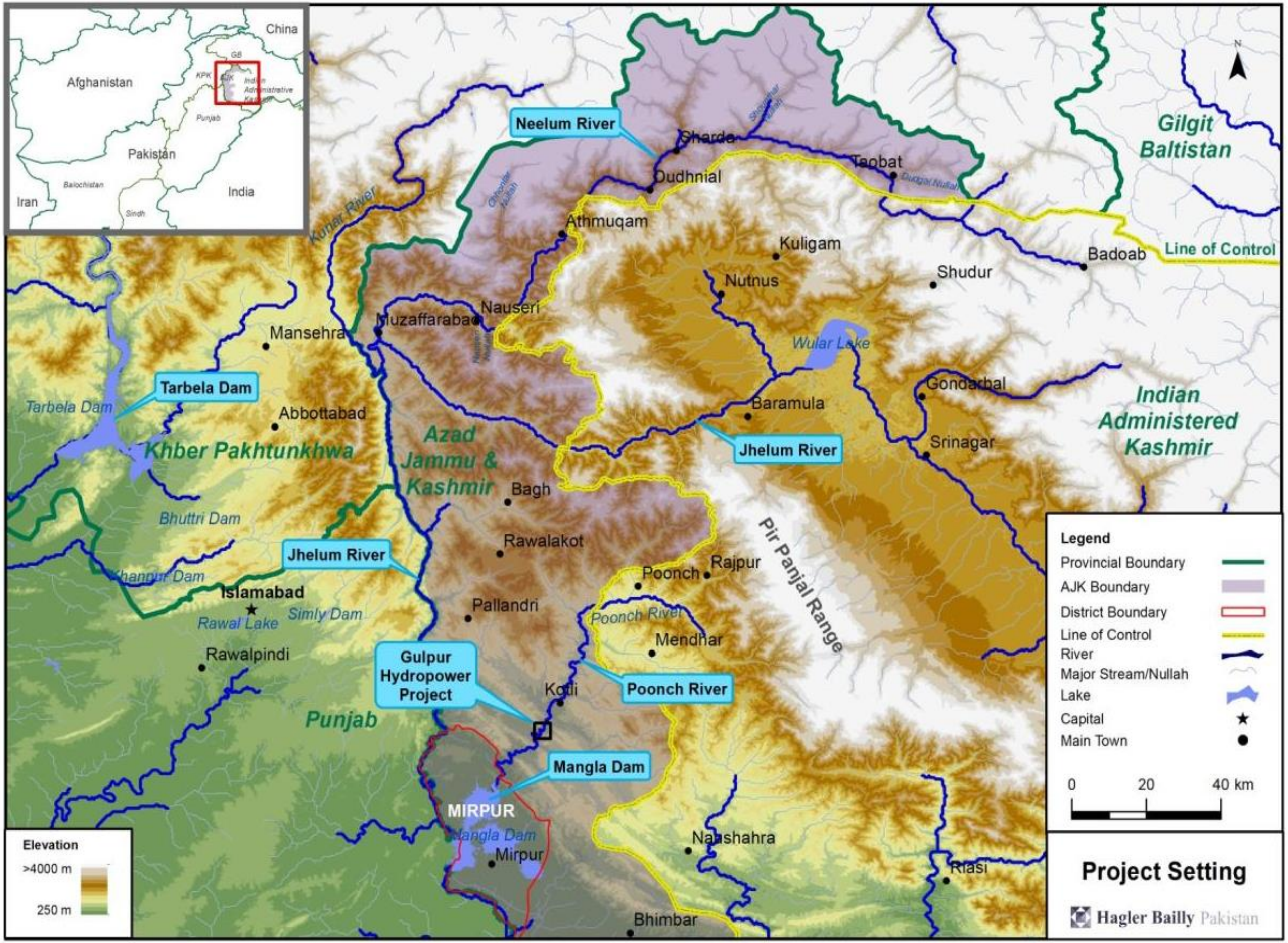
Background

- Site for proposed 100 MW Gulpur Hydropower Project located in Poonch River Mahseer National Park (PRMNP) in state of Azad Jammu and Kashmir (AJK) and was declared protected area in 2010

- Poonch River provides habitat to at least 38 fish species, of which at least 13 species are of special importance because of their economic importance or conservation status including Endangered Mahseer, Critically Endangered Kashmir Catfish and long-distance migratory Alwan Snow Trout

- DRIFT modelling showed that fish species of conservation importance will decline unless protection put in place to control anthropogenic impacts



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Gulpur Hydropower Project

Photographs of Some Fish Species of Poonch River (1)

Alwan Snow Trout *Schizothorax richardsonii*

Mahaseer *Tor putitora*

Pakistani Labeo *Labeo dyocheilus*

Photographs of Some Fish Species of Poonch River (2)

Reticulate Loach *Botia lohachata*

Pakistani Baril *Barilius pakistanicus*

Flathead Catfish *Glyptothorax pectionpterus*

Kashmir Latia *Crossocheilus diplochilus*

Threats

- Despite protected area status of PRMNP
    - Rampant illegal fishing using explosives, poison, electric current, gill net, cast net, rod and hook
    - Extraction of sand and gravel from riverbed and bank using donkey carts excavators, tractors, trolleys.
- Pollution in the river from nearby communities
- Lack of awareness among local communities
- Inadequate staff and resources of AJK Fisheries and Wildlife Department

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Sand, Gravel and Boulder Mining

Pollution

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Challenge

- Project located in Critical Habitat due to protected areas status of Poonch River as well as fish of conservation importance
- Project financed by international lenders such as IFC, ADB and Korea Eximbank and others
- According to IFC's Performance Standard 6, net gain required for those biodiversity values for which critical habitat was designated
- AJK Environmental Protection Agency (EPA) required betterment of the park' to approve actions and activities normally prohibited in a national park
- Robust analysis was required to demonstrate whether or not net gain would be achieved with design of project and mitigations which was done with DRIFT modelling

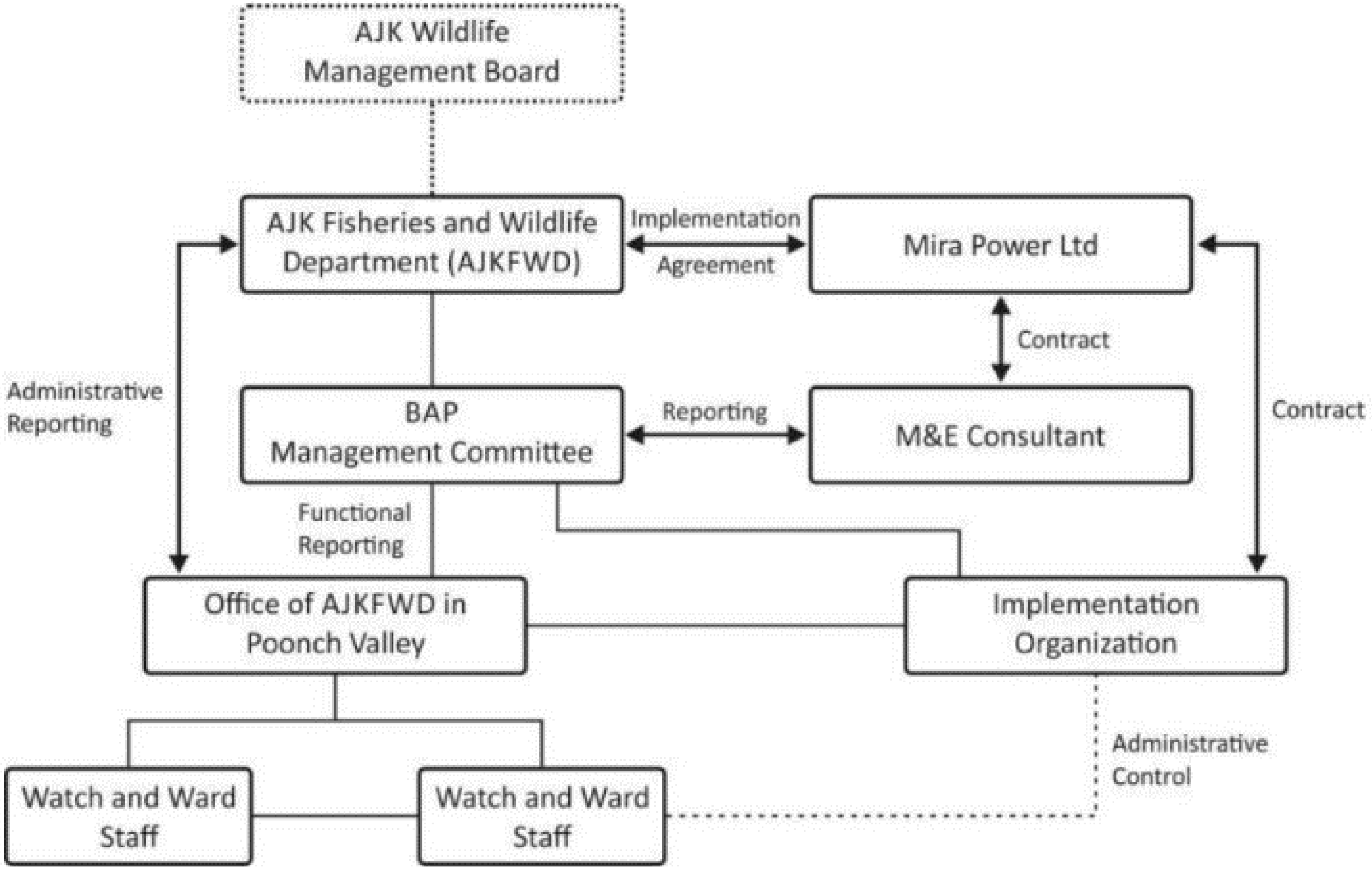
Strategy for BAP

- Putting in place a protection systems for rivers and national parks partly financed by the Project and implemented by an Independent Organization
- Active support from concerned AJK and Punjab departments by making available existing staff for protection and assistance in coordination with other government line departments such as police and district administration
- Commitment by Fisheries and Wildlife departments to provide legal authority to the staff of the Independent Organization for exercising powers under wildlife legislation
- Oversight and monitoring by the Wildlife Management Board
- Commissioning of the Mahaseer fish hatchery for stocking of fish downstream of the powerhouse
- Monitoring by an Independent Third Party on a long-term basis
- Supporting Sediment Mining Plan and National Park Management Plan

Objectives of BAP

- Outline measures or actions for the conservation and enhancement of biodiversity
- Implement the mitigation and monitoring of biodiversity as proposed in the ESIA, and as refined and/or modified by the BAP itself
- Comply with national legislation and policy
- Comply with lender and other international requirements as specified by IFC's Performance Standard 6 and ADB's Safeguard Policy Statement 2009
- Address the concerns and expectations of the stakeholders
- Implement best practice and sustainable solutions

Institutional Arrangements for BAP Implementation



BAP Management Committee

- A BAP Management Committee was established by the AJKFWD with the following responsibilities:
- Reviewing on a quarterly basis the reports submitted by the Implementation Organization
- Reviewing the reports submitted by the M&E Consultant
- Organizing and conducting field inspections as and when warranted
- Reporting on an annual basis with Wildlife Management Board
- Providing directions to the staff of the AJKFWD, Implementation Organization, and the M&E Consultant for improving the effectiveness of the implementation of the BAP

AJK Fisheries and Wildlife Department

Responsibilities of AJKFWD in implementing Gulpur BAP:

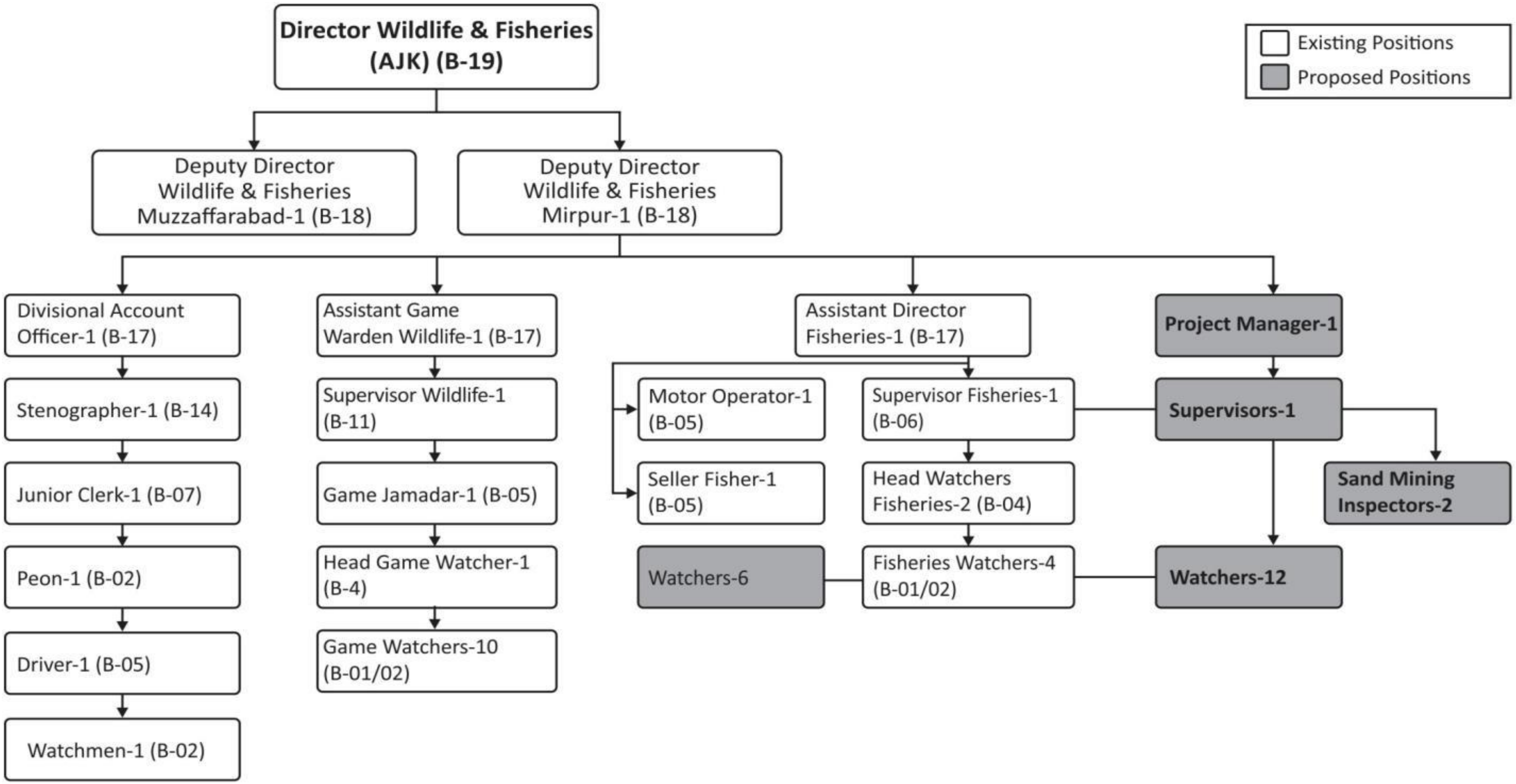
- Enforce the provisions of the Azad Jammu and Kashmir (AJK) Wildlife Ordinance, 2013 and other applicable legislation
- Make available existing staff for protection, and coordinate with other government line departments
- Provide legal authority to the staff of the Implementation Organization.
- Construct a hatchery for captive breeding of Mahaseer fish
- Place a system for registration and review of complaints

Implementing Organization (IO)

Responsibilities of IO in implementing Gulpur BAP

- Hire and manage the staff indicated for protection activities.
- Collect data and prepare reports on watch and ward and management of sediment mining
- Provide training to the staff of the Department in protection and management of national park and wildlife
- Maintain contact with local communities and stakeholders and promote awareness on biodiversity protection among them
- Advise the Management Committee on ways and means for improving the effectiveness of BAP

Proposed Support under BAP



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Monitoring and Evaluation

- Conducted field surveys since 2015 and investigations to assess the effectiveness of implementation of the BAP by using the Pressure, State and Response framework

- Preparation of the Seasonal M&E Reports and Annual M&E Report for submission to the Management Committee

- Provide advice for design and operation of the Mahaseer hatchery

Field Activities for Monitoring

Electrofishing

Cast Netting

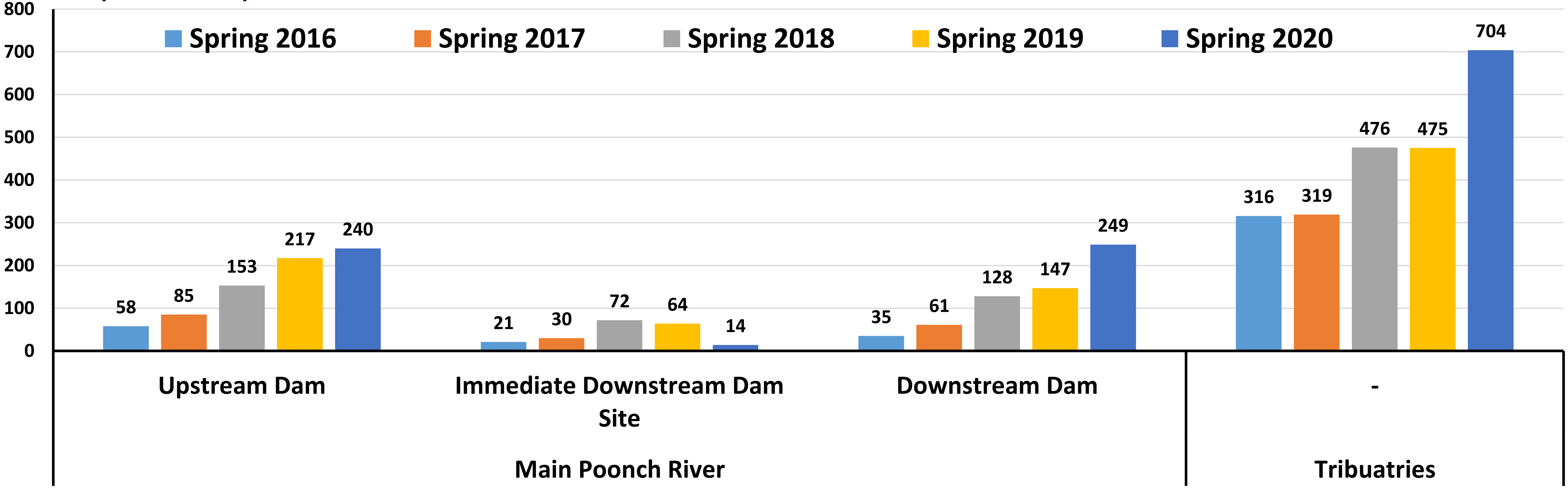
Setting up Gill Net

Data Keeping

Results of Spring Monitoring Surveys, Number of Fish Captured

Spring surveys are conducted with cast nets and electrofishing in main river and tributaries which give an indication of breeding population as well as juveniles.

Total specimens captured were 430 in 2016, 495 in 2017, 829 in 2018, 903 in 2019 and 1207 in 2020.



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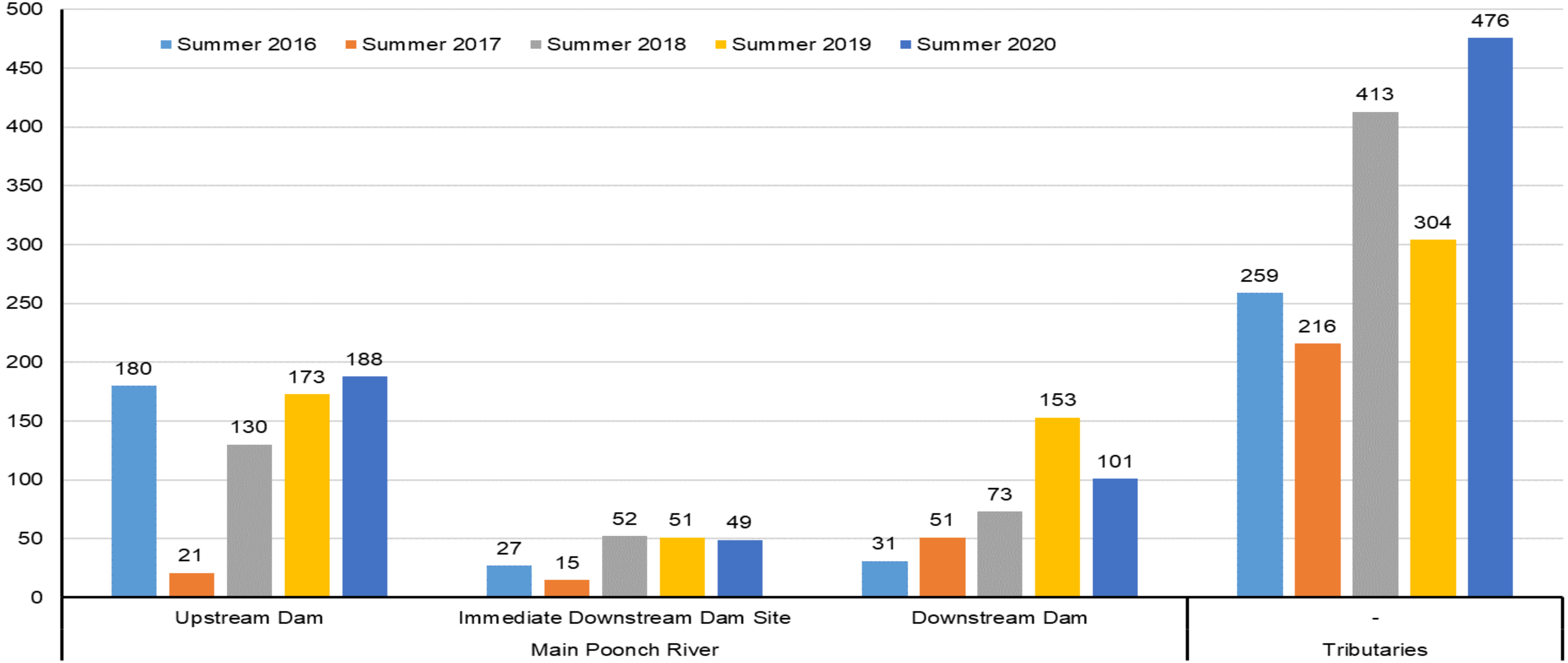
Results of Summer Monitoring Surveys – Number of Fish Captured



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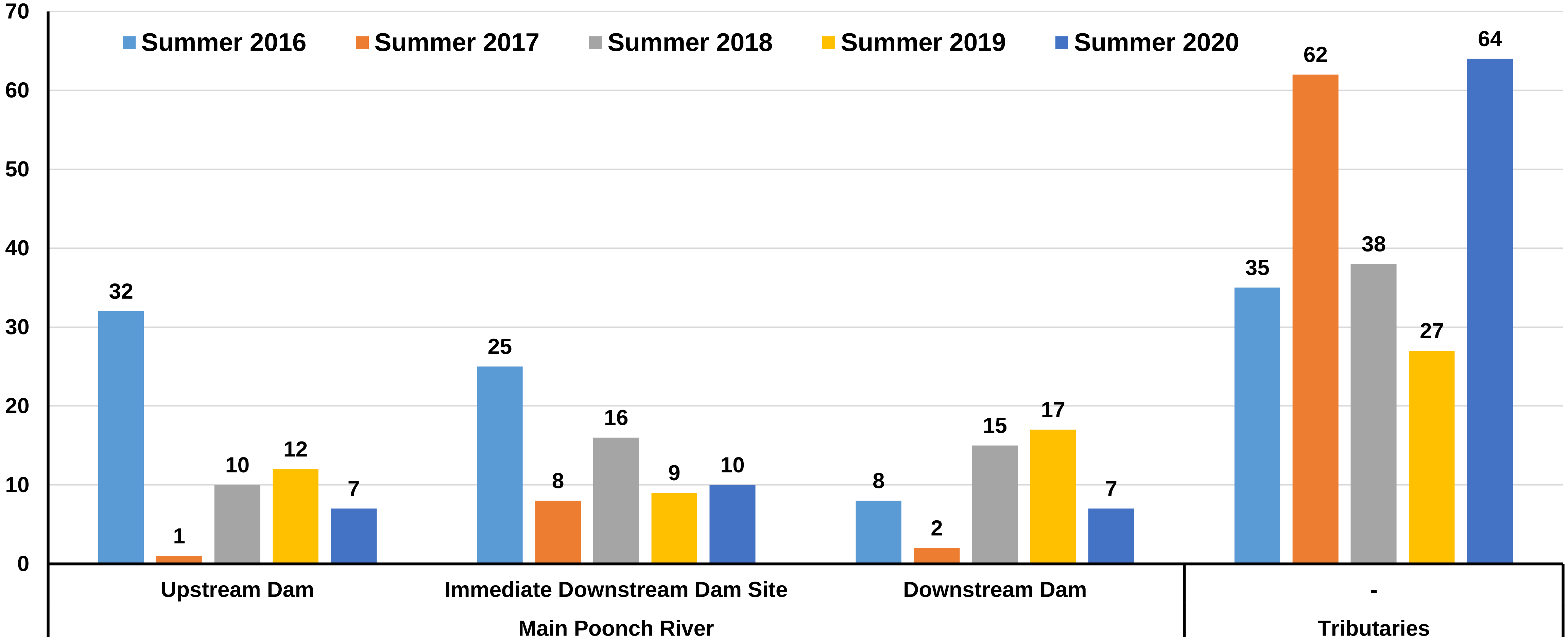
Summer Monitoring Surveys - Mahseer Abundance



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Q & A Session

Moderator:
Leeanne Alonso
Biodiversity Consultant
IFC

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Closing Remarks

Kate Lazarus
Senior Asia ESG Advisory Lead
IFC

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