FIThydro

Fishfriendly Innovative Technologies for Hydropower

Funded by the Horizon 2020 Framework Programme of the European Union

D5.2 Stakeholder feedback on tools and products of FIThydro

Part 1: Summary report of the 4th FIThydro regional stakeholder workshop for the Alpine region

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Coordinator	TUM
Authors/Contributors	Ecologic Institute (Eleftheria Kampa), TUM (Kordula Schwarzwälder), ETHZ (Robert Boes, Ismail Albayrak), Verbund (Walter Reckendorfer)
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FIThydro

Contents

1. Introduction

1.1 FIThydro background

FIThydro (Fishfriendly Innovative Technologies for Hydropower: http://www.fithydro.eu) is a 4-year EU research and innovation action (funded under Horizon 2020; duration 2016-2020) which aims to support decisions on commissioning and operating hydropower plants (HPP) by use of existing and innovative technologies. It concentrates on mitigation measures to develop cost-effective environmental solutions and strategies to avoid fish damage and to support the development of self-sustainable fish populations, with main emphasis on run-of-river low-head hydropower plants (HPP).

FIThydro brings together 26 partners (13 research, 13 industrial) from 10 countries, involving several of the leading companies in the renewable and hydropower energy sector in Europe. Solutions, Methods, Tools and Devices (SMTD) are applied and evaluated at 17 test sites all over Europe, covering four regions: Alpine region, Scandinavia, north-west Europe and Iberian Peninsula. Scenario modelling in the four different geographic, climatic and topographic regions will allow the quantification of effects, resulting costs and comparisons of the test case regions to draw conclusions about future hydropower production mitigation options in Europe.

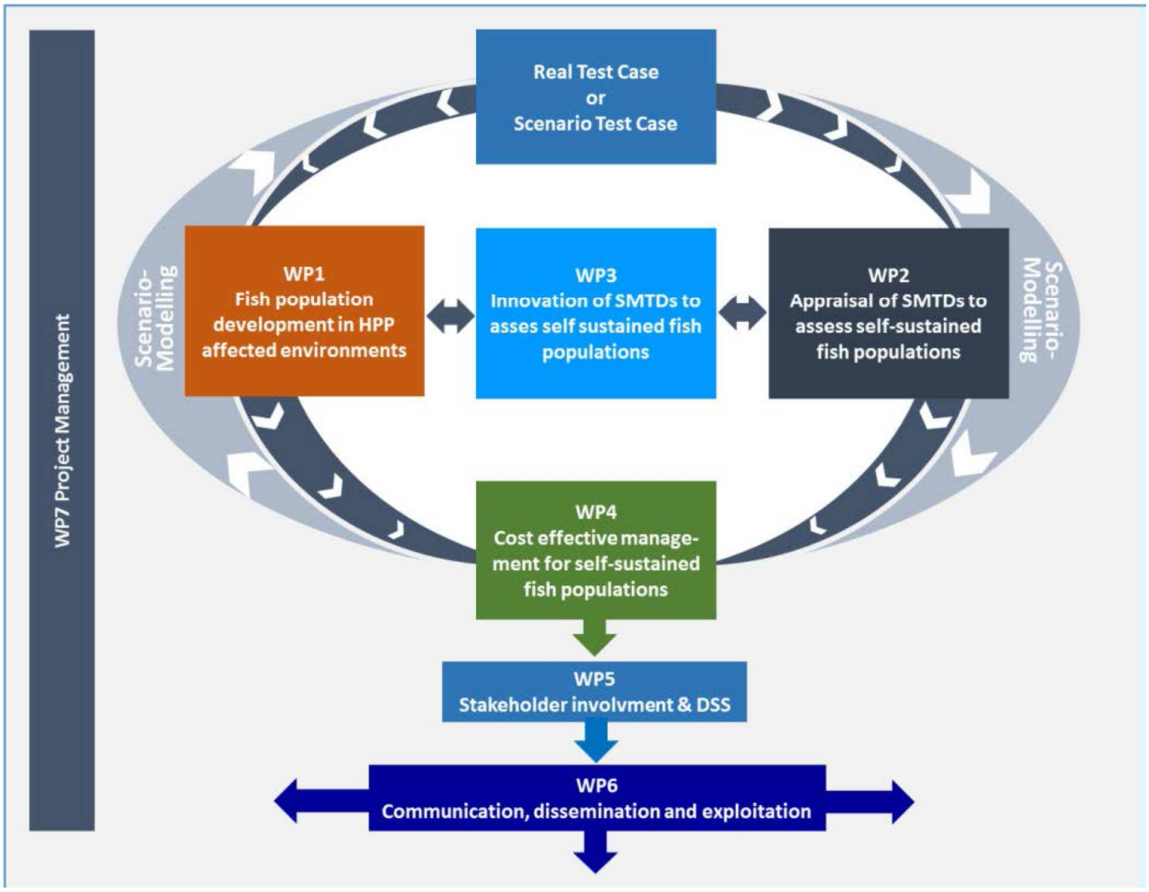

Figure 1 FIThydro approach and key work-packages

1.2 Aims of the stakeholder workshop

The 4th FIThydro Regional Stakeholder Workshop on Fish-friendly Hydropower took place on 10-11 September 2018, at the Bavarian Environment Agency (Bayerisches Landesamt für Umwelt) in Augsburg, Germany.

The workshop was the last in a series of four regional workshops and served as a platform for consultation and exchange between FIThydro scientists, stakeholders and water users on key open issues and possible solutions relevant to the assessment and planning of ecologically compatible hydropower production in the alpine region.

Presentations were given by the FIThydro team as well as energy providers, authority representatives and scientists involved in the field of hydropower and environment in Germany, Austria and Switzerland.

Key aspects of the FIThydro work-program were presented and participants were invited to give their feedback and highlight, from their perspective, the key open issues on the assessment and planning of ecologically compatible hydropower production.

Thirty-nine (39) participants attended the workshop, including scientific partners of the FIThydro consortium, hydropower producers, other research institutes, technical/engineering consultants and authorities.

The key sessions covered the following topics:

- Ecology of endemic species
- Sediments and habitats
- Compensational habitats
- Fish migration
- Combination of mitigation strategies & socio-economic/policy challenges for decision-making.

A cover note was prepared for the workshop participants. The purpose of the cover note was to stimulate dialogue by outlining the key topics and by proposing some key questions to guide the discussions in the main sessions.

For each of the 5 specific topics of the workshop, which are outlined further below, the following were proposed as **guiding questions** for interactive exchange with the participating stakeholders:

Guiding questions for discussion with stakeholders

a) What do you consider as the **major issues (key problems, open questions)** relevant to the assessment and planning of ecologically compatible hydropower production in the Alpine region (specifically on the 5 key topics below)?
b) What **approaches and solutions** are applied **to address the key problems and open issues** in the Alpine region?
c) What are your **recommendations or requests to the work-programme of FIThydro** (with specific relevance to the 5 key topics below)?

These questions were used to structure the interactive discussion after the presentations in each session of the workshop. Participants also received a paper hand-out to provide voluntary written feedback to these questions during and after the workshop, so that each participant had the opportunity to make a contribution to each topic.

1.3 About this summary report

Sections 2 to 7 of this report present a summary of the discussions and key conclusions of the workshop based on the presentations and ensuing discussions, as well as the participant feedback forms collected for each session.

Please note that the FIThydro consortium plans to give written feedback to the recommendations made by stakeholders during this workshop in Augsburg. This written feedback is expected to be provided in winter 2018/2019 in order to take into account stakeholder recommendations raised across all regional stakeholder events.

The Annexes to this report include the programme of the workshop, the list of participants and the written feedback provided by participants via the feedback forms.

All presentations are available online at:

https://syncandshare.lrz.de/filestable/MjdqNnZyZzVZUHlEVTZiTXpQQnVL

2. Introductory session

To open the workshop, welcome and brief introductions were given by Peter Rutschmann - TUM (coordinator of FIThydro and FIThydro regional test case leader for Germany), Robert Boes – ETHZ (FIThydro regional test case leader for Switzerland), and Walter Reckendorfer – Verbund (FIThydro regional test case leader for Austria).

The opening talks introduced the FIThydro project, including an overview of the project's test cases and the challenges at these testing sites.

3. Ecology of endemic species (Session 1)

This session covered key issues regarding fish population ecology of species endemic to the Alpine region, the challenges which fish populations are exposed to in regulated rivers as well as fish response and resilience to river fragmentation and hydropower. From the FIThydro work-programme, first steps towards a fish population hazard index for hydropower were also presented. Furthermore, the issues related to fish ecological monitoring were discussed.

The presentations given covered the following:

- **FIThydro activities related to endemic species (Christian Wolter, IGB)**.
  - This addressed FIThydro's work towards developing a European Fish Population Hazard Index and in detail species biological sensitivity, type-specific and site-specific mortality as well as population effects. It also addressed challenges related to habitat improvement in order to compensate losses from hydropower operation.
- **Fish ecological monitoring at innovative hydropower plants (Piet Linde, LfU)**
  - This presented ongoing work in Bavaria on connectivity mainly for downstream migration, exploring the effects of innovative HPPs at multiple test sites. The aim of the project presented is to quantify and characterize fish injuries at

different corridors of the various HPP sites and to assess innovative mitigation methods, with a focus on small hydropower plants.

- **Fish-ecological part of the Swiss test cases of FIThydro and etho-hydraulic modelling (Armin Peter, Peter FishConsulting)**
  - This addressed the methods used at two Swiss test case sites to study the efficiency of fish passes for upstream migration and of downstream migration facilities, including tagging and radiotelemetry. In addition, information was given on the etho-hydraulic experiments carried out in a flume at ETHZ to identify fish guidance structure configurations with high guiding efficiencies for downstream migration.

3.1 Discussion and participant feedback

The key issues raised during discussions and feedback from the participants addressed the following:

Key problems, open questions

1. When it comes to migration and mortality, we focus often on large species but it is very important to consider also **small species** (with similar size to juvenile of larger fish). Small species move, migrate and have high mortality rates when going through turbines. In addition, small species cannot easily be diverted.
2. Further research is needed on the **relation of fish mortality with total fish populations**, and the role of compensation in this context. We need more information on how mortality at the HPP affects the fish population. Proposing to work only with compensational measures is a too simplistic approach.
3. There is **lack of long-time quantitative studies** on the effects of (restoration/mitigation) measures on fish population in impounded areas.
4. There is a need to **define a "population"**: How many individuals make a „good" population? Because of the requirement of the WFD to protect fish populations, we need more knowledge on **how large the population has to be**, in order to be self-sustainable in the long-run. This is an important issue also in terms of permit conditions for HPP.
5. We also need to improve knowledge on **corridor choice and corridor behavior** at different sites. Observations in the lab and in the field, e.g. on the River Rhine, show that fish behaviour when they enter a fish ladder is very complicated and there is need to further analyze this.
6. **Turbine induced mortality of larvae** (for different species) and relevance to population remains an open issue.
7. Concerning the **drift phase of larvae** in the dynamic river environment, there is no feasible way so far to capture larvae and measure larvae mortality in the field.
8. In many cases of large HPP, we should be talking about **natality/recruitment**, and not only about mortality. The missing natality/recruitment is an important issue and there is too little focus so far on this.
9. Given limitations of financial resources, we have to focus on the **most cost-effective solutions**. In the case of large HPP, it was argued that habitat development may have a larger effect for certain species (e.g. cyprinids) than measures for upstream and downstream migration. We need to work out what are the most important aspects to stabilise and improve the fish population, instead of taking measures for which it is largely unclear if they will influence the population.

Approaches and solutions to handle key problems

1. Etho-hydraulic experiments to evaluate damage of fish at different corridors, both in the laboratory and field
2. Studies on fish pass and downstream migration facility efficiency

Stakeholder recommendations

1. **Assessed sensitivity of species** should not take account only of the percentage of fish dying in the turbines but also the share of the fish population, which approach the turbines.
2. Concerning the FIThydro work on mortality, it is important to use at least two different categories for **Kaplan turbines**: small and large, because the effects are different.
3. Care is needed when trying to make recommendations on measures based on studies in flumes. Flumes are a very technical surrounding with limitations on the number of fish that may enter the turbine. It was recognised that **etho-hydraulic flume experiments** are not the only aim, and we need to go into the field for further research. However, there are still many open questions and it makes sense to carry out this type of experiments.
4. Pros and cons of **measurements** and their **statistical validation** should be examined; what can be extrapolated to other sites?
5. FIThydro should benefit from the **research** undertaken by the German Federal Institute of Hydrology (BfG) **on large rivers and fish passes**.

4. Sediments & habitats (Session 2)

This session addressed the activities and challenges related to sediment management within FIThydro, as well as habitat-related sediment work in the project. It also included a presentation and discussion on integrative sediment management and monitoring in Alpine reservoirs.

The presentations given covered the following:

- **FIThydro activities and challenges related to sediment management (Robert Boes, ETH Zurich)**
  - This presentation focused on the importance of bedload/sediment continuity and gave an overview of different types of possible measures for (re)-establishing bedload continuity. It also presented FIThydro's work on bedload transport monitoring and quantification at a Swiss test case.
- **Habitat-related sediment work in FIThydro (Nils Ruther & Kordula Schwarzwälder, NTNU)**
  - This addressed techniques for evaluating hydromorphology and habitat quality, particularly related to issues of sediment management, thereby showing experiences at the FIThydro test sites.
- **Integrative sediment management and monitoring in alpine reservoirs: Case study Gespatch – Hydropower plant Kaunertal, Tyrol (Martin Schletterer, TIWAG)**

- This presented the approach for integrative sediment management related to emptying the Gepatsch-reservoir in Austria due to revision works. Results of the monitoring carried out were presented and discussed.

4.1 Discussion and participant feedback

The key issues raised during discussions and feedback from the participants addressed the following:

Key problems, open questions

1. Globally, reservoirs will be filled with sediment soon, e.g. by 2080 in Europe. This is an area where **HPP companies should be investing a lot of resources and knowledge** in order to deal with this problem.
2. Possibilities to work with measures like sediment replenishment, reservoir flushing and artificial floods depend on the **legal context and involved stakeholders**. It was mentioned that, in Austria, it is feasible but sometimes difficult to carry out such actions, whereas in Switzerland, it is feasible to get a legal permission and such measures are being implemented.
3. The lack of natural bed-forming floods were highlighted as a key problem.
4. It is important to define **what is the target of sediment management**, e.g. to stabilise the river bed or to meet the need to remove sediment or to take other action from an ecological perspective.
5. It is also important to differentiate between different sediment compounds (bed load, suspended solids) and their ecological function in different river stretches and habitats. From an ecological perspective, we need to know what are the **effects of suspended sediments on downstream ecology and fisheries**, ideally by looking at reference river systems. Important questions in this respect are: *What is the annual graph for suspended sediment concentrations in a natural and in an impacted river? What are similarities and differences? How to promote sediment continuity? In which time-window is it possible to do this?*
6. In terms of links to ecology, there is evidence that **sediment flushing** can affect fish Generally, it seems that a periodic flushing regime in concordance with the hydrograph. thereby mimicking the timing, magnitude, frequency, and duration of natural suspended sediment pulses and gravel transport, minimizes adverse downstream environmental impacts and maximises benefits.
7. We should also take into account that we have changing river systems. For example, due to **climate warming and glacial retreat**, more sediments will be released from the glaciers into river systems.

Approaches and solutions to handle key problems

1. In Switzerland, both reservoir flushing and artificial floods are regularly done in selected dams.
2. In Austria reservoir flushing is regularly done in selected impoundments. There is a research project on sediments led by BOKU (CD-Labor Sedimentforschung und –management). BOKU is also investigating the Vjosa river system in Albania to use it as a reference, showing that fine sediments play an important role in the river system.

Stakeholder recommendations

1. FIThydro should provide statistically robust statements.
2. FIThydro should make clearer how it is going to extrapolate conclusions, which are based on test cases, to more general recommendations for other HPP in other rivers and other regions. Sediment management is very broad and FIThydro only applies very specific solutions in its test cases. It will not be possible to give general solutions to every situation.

5. Compensational habitats (Session 3)

This session presented experiences of compensation habitats and typical measures, offering the opportunity for a general discussion on compensational habitats related to hydropower plants.

The presentations given covered the following:

- **Ecological functions and the research programme at the fishway Freudenau (Kurt Pinter and Paul Meulenbroek, BOKU)**
  - This presentation focused on ongoing research at the fishway Freudenau in Austria to explore the issues of the ecological function of a fish bypass system, related management aspects and migration paths of fish.
- **Typical compensation measures and fish monitoring campaign on the Rhine River (Jochen Ulrich, Energiedienst)**
  - This gave an overview of compensation measures in place (including fish passages, minimum flow, gravel addition, vegetation addition and reconnecting of floodplain, amongst others) at two HPPs along the Rhine River as well as the results of these measures to date.
- **Compensatory habitats: Existing measures and options for the future in large river impoundments (Clemens Ratschan, EZB)**
  - This presentation presented options for compensatory habitats related to large river impoundments. It also discussed compensatory habitats in relation to fish migration and protection, discussing both technical and nature-like approaches for fish passage.

5.1 Discussion and participant feedback

The key issues raised during discussions and feedback from the participants addressed the following:

Key problems, open questions

1. Overall, **habitats** are very **important for achieving self-sustainable fish populations**.
2. A key question though is **whether habitat mitigation measures alone can support a population**.

3. In most rivers with a **series of impoundments**, it is very difficult to create compensational habitat and provide additional spawning grounds. In these situations, there are hardly any free-flowing sections, including close-to-natural hydro-dynamic sediment processes.
4. **Nature-like fish passes** can be **good habitats but not for all life stages**. For example, the population development of the nase was discussed. A lot of small fish and large fish can be detected in fish passes but not medium-size fish. Different interpretations were mentioned, e.g. that this size of fish does not prefer the conditions in the fish pass, there is little knowledge of the size at which they start spawning migrations, or that medium-size fish sit in some other specific habitats in high concentrations, e.g. to avoid predation.
5. There is need for **long-time quantitative studies**.

Approaches and solutions to handle key problems

1. Restoration of rheophilic habitats
2. Habitat measures / compensation measures such as reconnecting oxbows and improving structural diversity of river banks and river bed.
3. Fish bypass systems as new and/or alternative habitat with spawning grounds.

Stakeholder recommendations

1. Best practice examples should be collected.
2. Success criteria for compensational habitats should be defined.

6. Fish migration (Session 4)

This session covered fish migration and fish passage solutions (upstream/downstream) and presented how these issues are being assessed in the test cases of the FIThydro project.

The presentations given covered the following:

- **FIThydro activities related to downstream fish migration for small-to-medium hydropower plants (Laurent David & Manon Dewitte, CNRS)**
  - This introduced the issues associated with downstream fish migration and gave an overview of the different solutions and how they are being considered in FIThydro. Specific results on efficiency of fish-friendly intakes from test sites in France were presented.
- **FIThydro activities related to downstream fish migration for medium-to-large hydropower plants (Ismail Albayrak, ETH Zurich)**
  - This presentation focused on measures related to downstream fish migration in larger HPPs, with findings from a FIThydro test case and laboratory studies in Switzerland.
- **Fish downstream passage at hydropower plants: current knowledge and perspectives (Joachim Pander, TUM)**
  - This presentation discussed reasons for fish to move or migrate and factors determining the success of fish-friendly turbines.
- **FIThydro activities related to fish migration in Iberia (António Pinheiro, IST)**

  - This gave an overview of the technical solutions, methods, tools and devices (SMTDs) being developed through FIThydro, as well as the outputs produced by various project partners. In addition, the presentation addressed FIThydro activities on fish migration at HPP sites in Spain and Portugal.
- **FIThydro Iller case study on fish upstream migration (Tobias Epple, BEW)**
  - This presentation gave an overview of the Iller Strategy 2020 and specifically efforts to restore the good ecological potential at the river Iller via construction of bypass channels (also to serve as compensational habitat), installation of trash racks and monitoring of fish damages.

6.1 Discussion and participant feedback

The key issues raised during discussions and feedback from the participants addressed the following:

<u>Key problems, open questions</u>

Migration behaviour

1. For many species, there is **lack of species-specific knowledge on migration behaviour** patterns.
2. Many more species probably migrate than we think and all fish species move. It was proposed not to use the term migration only but also **movement and drifting**.
3. Concerning **potamodromous fish**, data shows us that they migrate. For instance, downstream migration or lateral movement to the floodplain are usual ways of fish species to escape from floods. The issue of whether or not protection measures are needed for potamodromous species to ensure a stable population was seen very differently by the different stakeholders taking part in the discussion.
4. The movement behaviour of potamodromous species depending on habitat availability requires further research.

Role of habitat improvements

1. Some studies indicate that habitat changes in rivers caused by hydropower affect fish composition and populations much more than fish injury or mortality in turbines.
2. Overall, improvements are not only needed in migration routes but also in habitats.

Upstream migration

3. For upstream migration, there is a lot of knowledge already. However, we have to deal with and improve several sites, where (based on today's knowledge) the **existing fish passes for upstream migration are not state-of-the-art**.
4. A fish pass alone cannot solve the problem of very low population density. A fish pass is a tool to bring fish to the next level, but many other factors affect the fish population.

Downstream migration

5. For **downstream migration**, we need to distinguish between different situations and address these specifically. It is important to define the **target species** (diadromous or potamodromous fish), the **biocenotic region** (e.g. alpine river with 3-5 species present or a lowland river with 30 species present) and **the type of HPP**

distinguishing between small HPP with low discharge and large HPP with high discharge.

6. The majority of available studies focus on diadromous species and best practice examples from central Europe mainly concern small HPP. **Further research is needed on large HPP** in different river types, including etho-hydraulic experiments to find solutions which are practical for large hydro. The biological functioning of fine screens with bypass at large HPP requires further attention.
7. Concerning **fish guidance structures**, there is a lot of experience in North America and evidence shows that they seem to work relatively well. We have to adapt this experience to European conditions in each river system.
8. We often focus too much on single parts of HPP. More work should be done on how the **flow in the turbine and the spillway can be used to guide fish**.

Nature-like vs technical fishways

9. There are different pros and contras of technical fish passes and nature-like passes. The decision which solution is better depends on the **conditions at a specific site**.
10. The **lack of available land** is often a problem for nature-like fish passes and bypass channels. In addition, quite some effort of the operators is needed to maintain a nature-like fish passes stretching over 2-3 km. Therefore, other solutions for locations with limited land availability are needed. When land is not available and in steep landscapes, technical fish passes are often the only solutions possible.
11. Nature-like fish passes are **providing important habitat**, especially when there is a series of impoundments. Overall, the habitat function of nature-like fish pass systems for fish populations is very high, and according to some experts, they are a preferred solution to measures that ensure 100% migration. Furthermore, **small fish species** would usually enter a nature-like pass but would normally not use a long technical fish pass, even if it is well designed.
12. However, nature-like fish passes are affected by **sediment problems** and they can act as **ecological traps**. The risk of nature-like fish passes acting as ecological traps is mainly valid for long-distance migrators but not for typical potamodromous species.

Approaches and solutions to handle key problems

1. Technical constructions
2. By-pass channels: Sediment management (e.g. via small floods once a year) is important to avoid filling up the spawning ground with fine sediment.

Stakeholder recommendations

1. Field monitoring of fish guidance screens at large HPP is needed.
2. “All” species and sizes should be considered.
3. Habitat and technical measures should not be considered separately from each other.

7. Combination of mitigation strategies & socio-economic/policy challenges for decision-making (Session 5)

This session presented FIThydro's ongoing work on a cost-effective combination of mitigation measures as well as the public acceptance survey of hydropower, to be carried out soon by the project in different regions of Europe. This session also addressed issues with regard to opportunities and challenges of the policy and socio-economic framework for taking decisions on the planning and operation of hydropower plants in the Alpine region.

The presentations given covered the following:

- **FIThydro activities related to the combination of mitigation strategies (Atle Harby, SINTEF)**
  - This presentation described the aim of combining mitigation measures and FIThydro's work on developing guidance to find the main bottlenecks and cost-effective solutions for HPP.
- **Combination of mitigation strategies & challenges for decision-making in Switzerland (Martin Huber Gysi, BAFU)**
  - The presentation gave an overview of the Swiss approach to refurbishment of HPPs, as well as lessons learned (particularly the high costs and time requirements) and open challenges.
- **Mitigation strategies & socio-economic/policy challenges for decision-making in Austria (Robert Fenz, Austrian Federal Ministry Sustainability & Tourism)**
  - This presentation gave an overview of the current situation regarding mitigation measures for HPPs in Austria, highlighting supporting tools, incentives, and strategic planning approaches.
- **FIThydro Public Acceptance Survey (Terese Rutkowski, TUM)**
  - The FIThydro Public Acceptance Survey was introduced and lessons learned from a pilot public acceptance survey in Landshut, Germany, were presented.

7.1 Discussion and participant feedback

The key issues raised during discussions and feedback from the participants addressed the following:

<u>Key problems, open questions</u>

1. A key question is how to define proportionate costs and how to select which measures are cost-effective and under which circumstances.
2. In the context of implementing the WFD, biotic components (and fish populations in specific) have not responded yet to measures, although there are improvements in sediments and flows. It was mentioned that a period of 5-15 years is needed to really get a response but the monitoring sites often do not match the restoration sites. Therefore, it is difficult to measure restoration success.
3. Concerning effectiveness, it was argued that what is functional and what not depends on the indicator we use. We need indicators of the goal we wish to achieve, in order to check functionality, e.g. of habitat measures or fish-friendly turbines, and effectiveness against this goal. The assessment of success depends on the species we consider to indicate success.
4. Key challenges also include work capacity of organisations involved in decision-making for relevant measures, knowledge transfer & adaptive management.

Approaches and solutions to handle key problems

1. Knowledge transfer and stakeholder involvement.
2. In Switzerland, costs of ecological measures have been added onto the price of electricity. Can this be an approach for other countries?
3. In Switzerland, costs and effects of mitigation measures are evaluated in general for a single installation. However, in a catchment with many installations, all authorities are involved to monitor the activities, as it would not make sense to look at this too locally.
4. In Austria, the process is different and evaluation of costs and effects of mitigation measures comes from the regional planning. The River Basin Management Plan (RBMP) is the highest level of the planning instruments, where costs (including energy losses) are calculated for a combination of no-regret measures (upstream migration, e-flows and some morpholological measures). On the basis of the RBMP, the provinces made ordinances indicating which HPP had to build a fish pass or enhance the e-flow, with an additional cost-effectiveness assessment for river stretches. For single schemes, a cost-effectiveness assessment is only done, if an operator has any objections.

Stakeholder recommendations

1. Provide guidance on how to forecast the effectiveness of recommended measures.
2. A system to check quality of data collected on effects and costs by FIThydro is needed, for data to be credible. E.g. information on effectiveness of measures should be based on monitoring.

8. Annex 1 – Workshop Programme

Monday, 10 September

Time	Item	Presenter
9:00 - 9:30	Registration & coffee	
9:30 - 10:10	Welcome Presentation of FIThydro Project and of Stakeholders	Peter Rutschmann (TUM) Robert Boes (ETHZ) Walter Reckendorfer (Verbund)
10:10 - 12:30	**Session 1: Ecology of endemic species**	
10:10 - 10:40	FIThydro activities related to endemic species	Christian Wolter (IGB)
10:40 - 11:00	Fish ecological monitoring at innovative hydropower plants	Piet Linde (LfU)
11:00 - 11:30	***Coffee Break***	
11:30 - 11:50	Fish-ecological part of the (Swiss) test cases of FIThydro and etho-hydraulic modelling	Armin Peter (fishconsulting)
11:50 - 12:30	Discussion	All
12:30 - 13:30	***Lunch***	
13:30 - 15:20	**Session 2: Sediments & habitats**	
13:30 - 14:00	FIThydro activities and challenges related to sediment management	Robert Boes (ETHZ)
14:00 - 14:20	Habitat-related sediment work in FIThydro	Nils Ruther & Kordula Schwarzwälder (NTNU)
14:20 - 14:40	Integrative sediment management and monitoring in alpine reservoirs: Case study Gepatsch (Hydropower plant Kaunertal, Tyrol)	Martin Schletterer, TIWAG
14:40 - 15:20	Discussion	All
15:20 - 15:50	***Coffee Break***	
15:50 - 17:30	**Session 3: Compensational habitats**	
15:50 - 16:10	Ecological functions and the research programme at the fishway Freudenau	Kurt Pinter and Paul Meulenbroek (BOKU)
16:10 - 16:30	Typical compensation measures and fish monitoring campaign on the Rhine River	Jochen Ulrich (Energiedienst)

Time	Item	Presenter
16:30 - 16:50	Compensational habitats	Clemens Ratschan (EZB)
16:50 - 17:30	Discussion	All
17:30	End of first day	

19:00 Joint dinner at Restaurant König von Flandern (https://www.koenigvonflandern.de)

Tuesday, 11 September

9:00 - 12:15	**Session 4: Fish migration**	
9:00 - 9:30	FIThydro activities related to downstream fish migration for small-to-medium hydropower plants	Laurent David & Manon Dewitte (CNRS)
9:30 - 9:50	FIThydro activities related to downstream fish migration for medium-to-large hydropower plants	Ismail Albayrak (ETHZ)
9:50 - 10:10	Fish downstream passage at hydropower plants: current knowledge and perspectives	Joachim Pander (TUM)
10:10 - 10:30	Discussion	All
10:30 - 11:00	***Coffee break***	
Session 4: Fish migration - continued		
11:00 - 11:20	FIThydro activities related to fish migration in Iberia	António Pinheiro (IST)
11:20 - 11:50	FIThydro Iller case study on fish upstream migration	Tobias Epple (BEW)
11:50 - 12:15	Discussion	All
12:15 - 13:15	***Lunch***	
13:15 - 15:30	**Session 5: Combination of mitigation strategies & socio-economic/policy challenges for decision-making**	
13:15 - 13:35	FIThydro activities related to combination of mitigation strategies	Atle Harby (SINTEF)
13:35 - 13:55	Combination of mitigation strategies & challenges for decision-making in Switzerland	Martin Huber Gysi (BAFU)

13:55 - 14:15	Mitigation strategies & socio-economic/policy challenges for decision-making in Austria	Robert Fenz (Austrian Federal Ministry Sustainability & Tourism)
14:15 - 14:35	FIThydro Public Acceptance Survey	Terese Rutkowski (TUM)
14:35 - 15:15	Discussion	All
15:15 - 15:30	Closing remarks	
15:30	End of Workshop	

9. Annex 2 – List of workshop participants

4th FIThydro regional stakeholder workshop for the Alpine region

Augsburg, Germany, 10-11 September 2018

List of Participants

First Name	Last Name	Institution	Country
Hany	Abo El Wafa	Technical University of Munich	Germany
Ismail	Albayrak	ETH Zurich	Switzerland
Thomas	Ammann	WWF Switzerland	Switzerland
Lea	Berg	Technical University of Munich	Germany
Robert	Boes	ETH Zurich	Switzerland
Laurent	David	CNRS - PPrime	France
Manon	Dewitte	CNRS - PPrime	France
Tobias	Epple	BEW (Bayerische Elektrizitätswerke GmbH)	Germany
Cornelia	Felber	Uniper Kraftwerke GmbH	Germany
Robert	Fenz	Federal Ministry of Sustainability and Tourism	Austria
Franz	Geiger	Technical University of Munich	Germany
Christian	Göhl	Fichtner Water & Transportation GmbH	Germany
Atle	Harby	SINTEF	Norway
Martin	Huber Gysi	Federal Office for the Environment (BAFU)	Switzerland
Eleftheria	Kampa	Ecologic Institute	Germany
Jonas	Kötting	Federal Agency for Nature Conservation (BfN)	Germany
Serhat	Kucukali	Cankaya University	Turkey
Petr	Lichtneger	University of Natural Resources and Life Sciences	Austria
Piet	Linde	Bavarian Environment Agency	Germany
Ricardo	Mendez	Axpo Power AG	Switzerland

First Name	Last Name	Institution	Country
Paul	Meulenbroek	University of Natural Resources and Life Sciences	Austria
Joachim	Pander	Technical University of Munich	Germany
Armin	Peter	Peter FishConsulting	Switzerland
António	Pinheiro	IST	Portugal
Kurt	Pinter	University of Natural Resources and Life Sciences	Austria
Clemens	Ratschan	ezb (Eberstaller-Zauner Büros)	Austria
Walter	Reckendorfer	Verbund	Austria
Robert	Reindl	TIWAG	Austria
Terese	Rutkowski	Technical University of Munich	Germany
Peter	Rutschmann	Technical University of Munich	Germany
Martin	Schletterer	TIWAG	Austria
Lennart	Schönfelder	SINTEF	Norway
Kordula	Schwarzwälder	Norwegian University of Science and Technology	Norway
Nicole	Smialek	Technical University of Munich	Germany
Karl-Heinz	Straßer	BEW Augsburg	Germany
Claudia	Strobl	Technical University of Munich	Germany
Jochen	Ulrich	Energiedienst Holding	Germany
Veronica	Wiering	Federal Waterways Engineering and Research Institute (BAW)	Germany
Christian	Wolter	Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB)	Germany

10. Annex 3 – Participant feedback forms

Table 1: Session 1 – Ecology of endemic species

What do you consider as the **major issues (key problems, open questions)** with regard to **the ecology of endemic species in reaches influenced by hydropower** in the Alpine region?	Q2: What **approaches and solutions** are applied in the Alpine region to address the key problems and open issues with regard to **the ecology of endemic species in reaches influenced by hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **the ecology of endemic species in reaches influenced by hydropower**?
Open question: Turbine induced mortality of larvae (different species) Relevance to population	Restoration of rheophilic habitats	Habitat and technical measures should not be considered separately from each other
Lack of long time quantitative studies on the effects of (restoration mitigation) measures on fish population in impounded areas	Habitat measures	Examine pros and contras of measurements and their statistical validation; what can be extrapolated to other sites.
Movement behaviour of potamodromous species depending on habitat availability	Technical constructions	
Which species are being considered, only diadromous or also potamodromous species?		
What are success factors? E.g. for habitat measures, turbine mortality		
Definition of population -> how many individuals make a „good“ population?		

Table 2: Session 2 – Sediments & habitats

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **sediments & habitats in reaches influenced by hydropower** in the Alpine region?	Q2: What **approaches and solutions** are applied in the Alpine region to address the key problems and open issues with regard to **sediments & habitats in reaches influenced by hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **sediments & habitats in reaches influenced by hydropower**?
Missing, natural bed-forming floods		Statistically robust statements

Table 3: Session 3 – Compensational habitats

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **compensational habitats in reaches influenced by hydropower** in the Alpine region?	Q2: What **approaches and solutions** are applied in the Alpine region to address the key problems and open issues with regard to **compensational habitats in reaches influenced by hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **compensational habitats in reaches influenced by hydropower**?
Solutions for locations with limited land availability		Collect best practice examples Define success criteria
Long time quantitative studies ➔ Before after design		
Can habitat measures alone support a population?		
Availability of land		

Table 4: Session 4 – Fish migration

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **fish migration in reaches influenced by hydropower** in the Alpine region?	Q2: What **approaches and solutions** are applied in the Alpine region to address the key problems and open issues with regard to **fish migration in reaches influenced by hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **fish migration in reaches influenced by hydropower**?
Biological functioning of fine screens with bypass at large HPP		Field monitoring of fine screens at large HPP
Fish behaviour in front of screens		Consider “all” species and sizes.
Successful bypass solutions		
Fish behaviour and distribution in the water body		

Table 5: Session 5 - Combination of mitigation strategies & socio-economic/policy challenges for decision-making

What do you consider as the **major issues (key problems, open questions)** with regard to **mitigation strategies & socio-economic/policy challenges for decision-making** in the Alpine region?	Q2: What **approaches and solutions** are applied in the Alpine region to address the key problems and open issues with regard to **mitigation strategies & socio-economic/policy challenges for decision-making**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **the combination of mitigation strategies & socio-economic/policy challenges for decision-making**?
Add ecological measures onto the price of electricity (like in Switzerland) ?		
Work capacity		
Knowledge transfer & adaptive management		