Too Many Dammed Rivers: Dam Removal in Sweden

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DAM REMOVAL EUROPE

Hudiksvalls kommun

@EcologyRachel

Dam Removal in Sweden

Rivers and Dams in Sweden

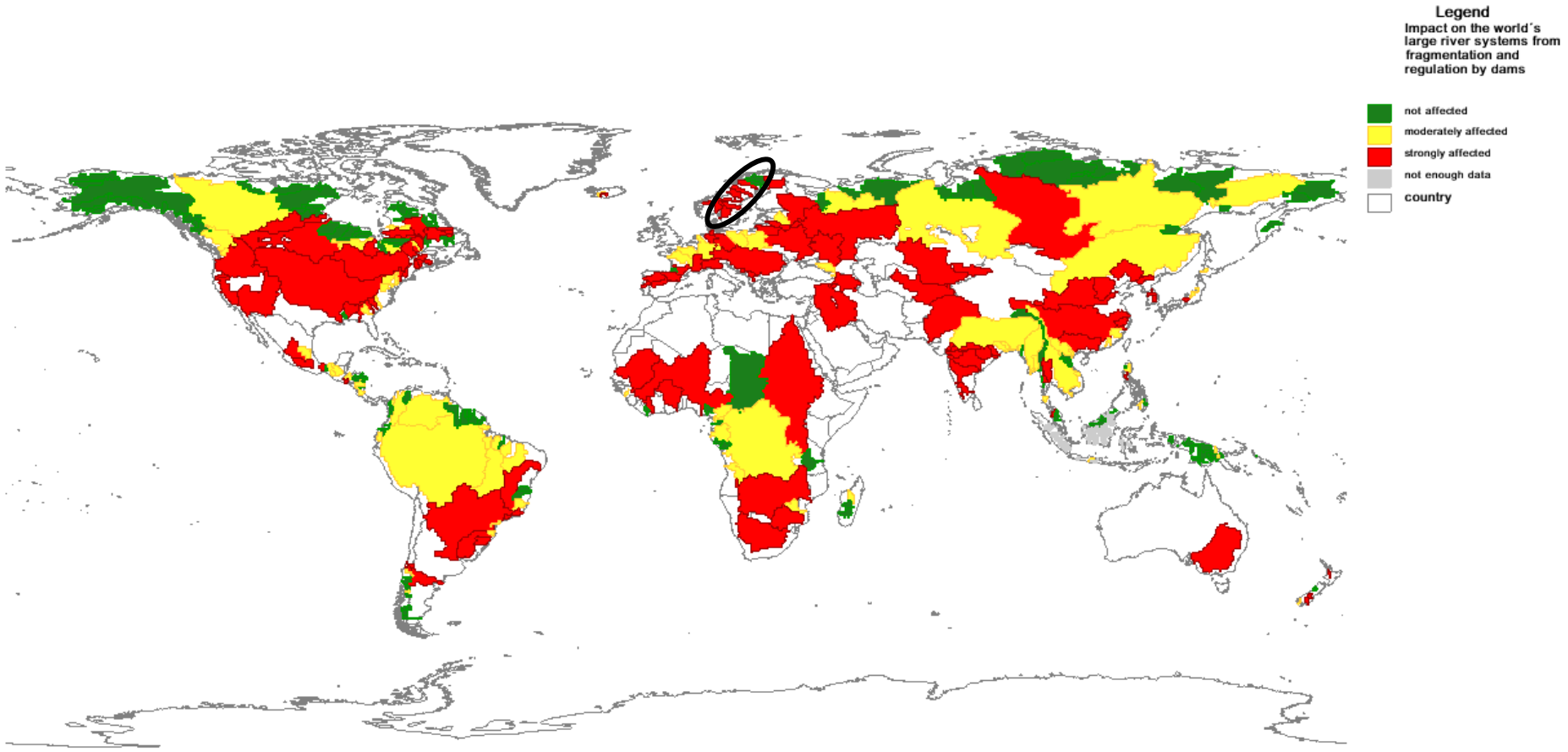
- Why and who is removing dams
- Obstacles to dam removal
- Case studies: Hudiksvall

Holistic Ecological Evaluation of Dam Removal

- Water and sediment
- System metabolism
- Food webs
- Flora and fauna
  - Riparian plants and terrestrial invertebrates
  - Mussels and benthic fauna
  - Fish movement and eDNA

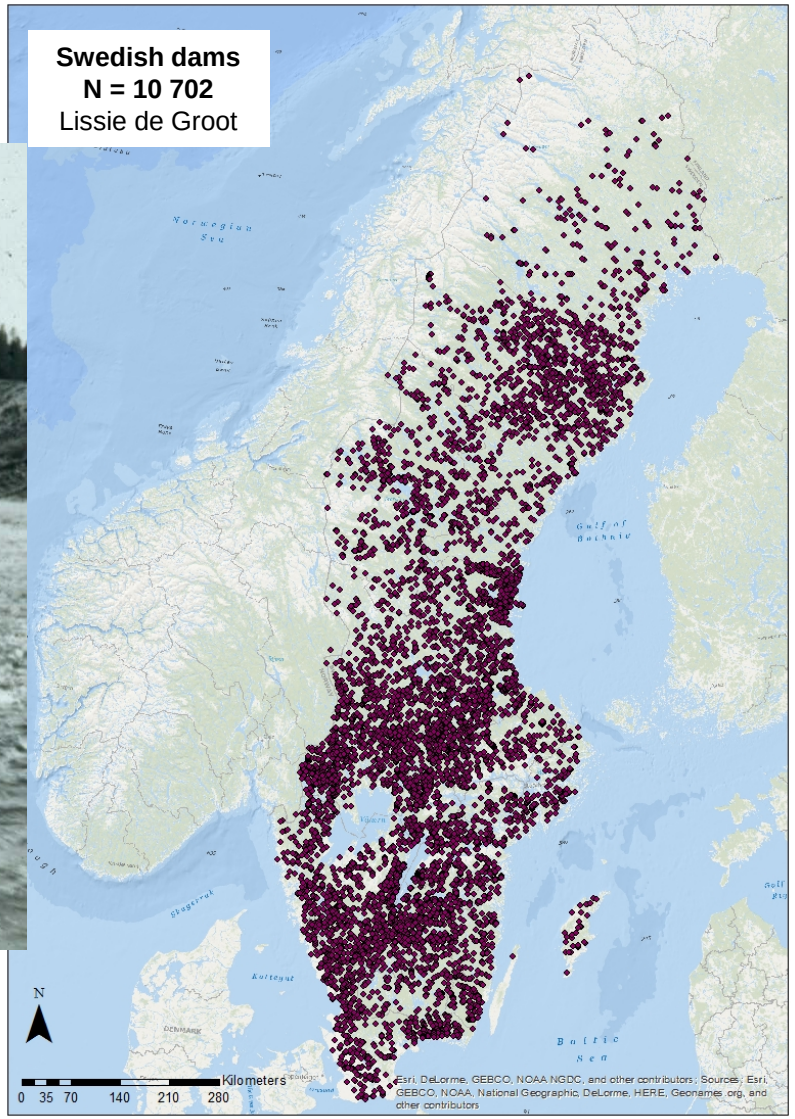
Rivers and Dams in Sweden

The world is dammed.



Sweden: Dammed Nation

Photo from Daniel Holmqvist
Ume/Vindelälvens Fiskeråd



Rivers and Dams in Sweden:
Why and who is removing all these dams?

Why all these dam removals?

1. Water Framework Directive + public awareness
2. Swedish environmental objectives:
   1. Flourishing lakes and streams
   2. Flourishing coastal areas and archipelagos
3. It is also a matter of definition… Dams vs. barriers?

Who is removing them?

SWEDISH DRE CASE 1

Johan Tielman

(Uniper)

→ *River Mörrumsån*

SWEDISH DRE CASE 2-3

Johan Andreasson

(Hudiksvall municipality)

→ *River Nianån*

→ *River Gnarpsån*

SWEDISH DRE CASE 4-11

Daniel Maio Bergdahl

(Örebro County Admin.)

→ *Örebro County*

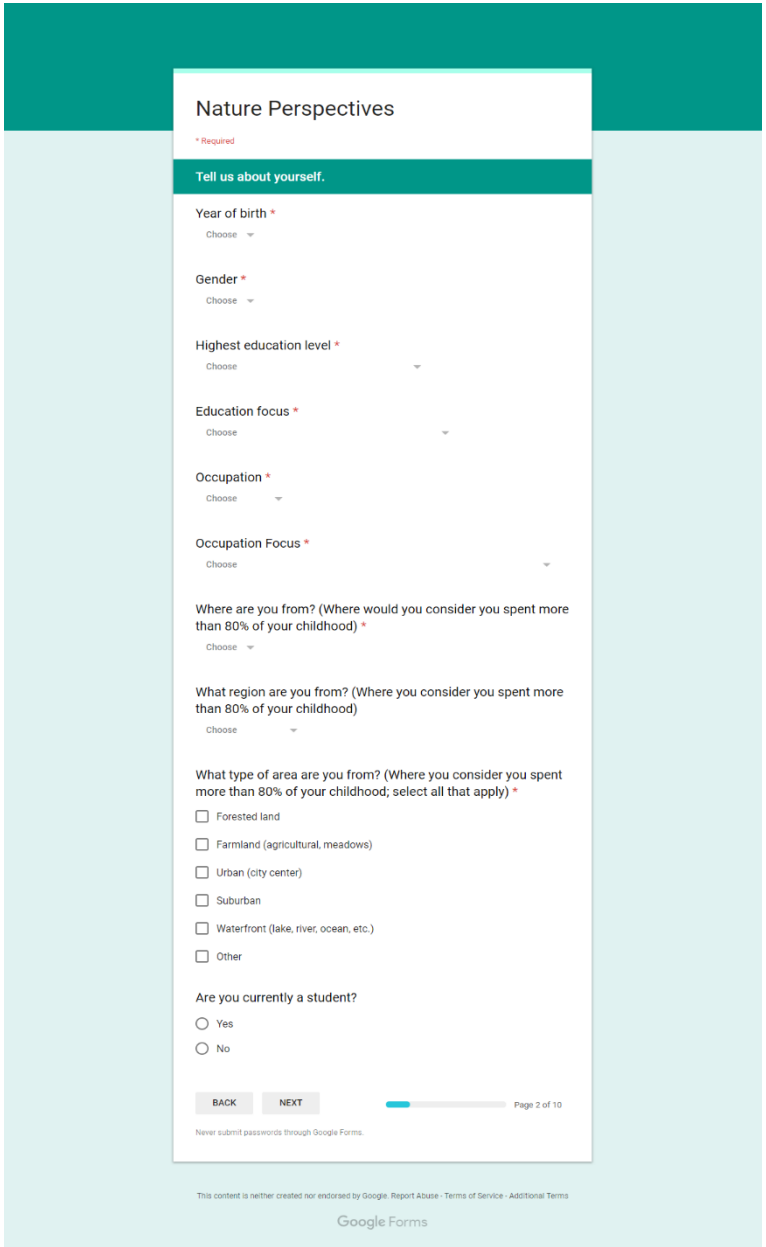
To date, Sweden has removed over 1,600 in-stream obstacles.

Rivers and Dams in Sweden:
Obstacles to dam removal

Obstacles to dam removal in Sweden

1. Financing
2. Cultural-historical values
3. Threatened species
4. Balance what society wants with the needs of the ecosystem

Public perspectives of rivers and human impacts on ecosystems (i.e. dams) can be a major obstacle to dam removals in Sweden.



Nature Perspectives

* Required

Tell us about yourself.

Year of birth *
Choose

Gender *
Choose

Highest education level *
Choose

Education focus *
Choose

Occupation *
Choose

Occupation Focus *
Choose

Where are you from? (Where would you consider you spent more than 80% of your childhood) *
Choose

What region are you from? (Where you consider you spent more than 80% of your childhood)
Choose

What type of area are you from? (Where you consider you spent more than 80% of your childhood; select all that apply) *
- [ ] Forested land
- [ ] Farmland (agricultural, meadows)
- [ ] Urban (city center)
- [ ] Suburban
- [ ] Waterfront (lake, river, ocean, etc.)
- [ ] Other

Are you currently a student?
- ( ) Yes
- ( ) No

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Google Forms

Ask participants to rank the photos in order of:

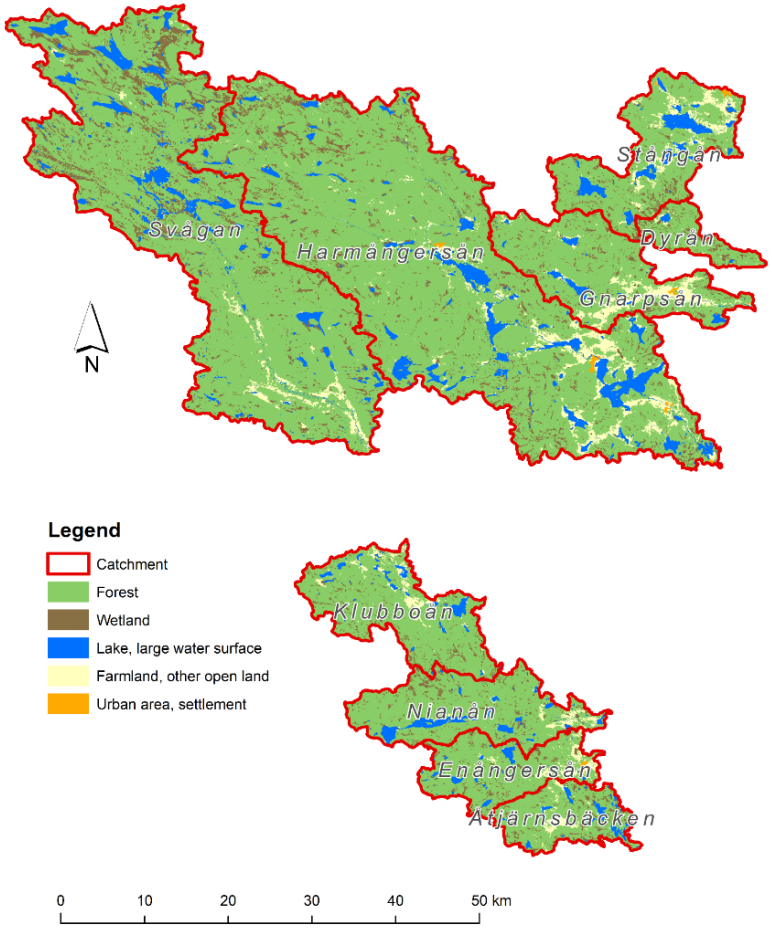
- Aesthetic value
- Economic value
- Ecological value
- Cultural and historical value
- Where they would most like to visit (tourist value)

Bruce Babbitt (U.S. politician and dam removal proponent):

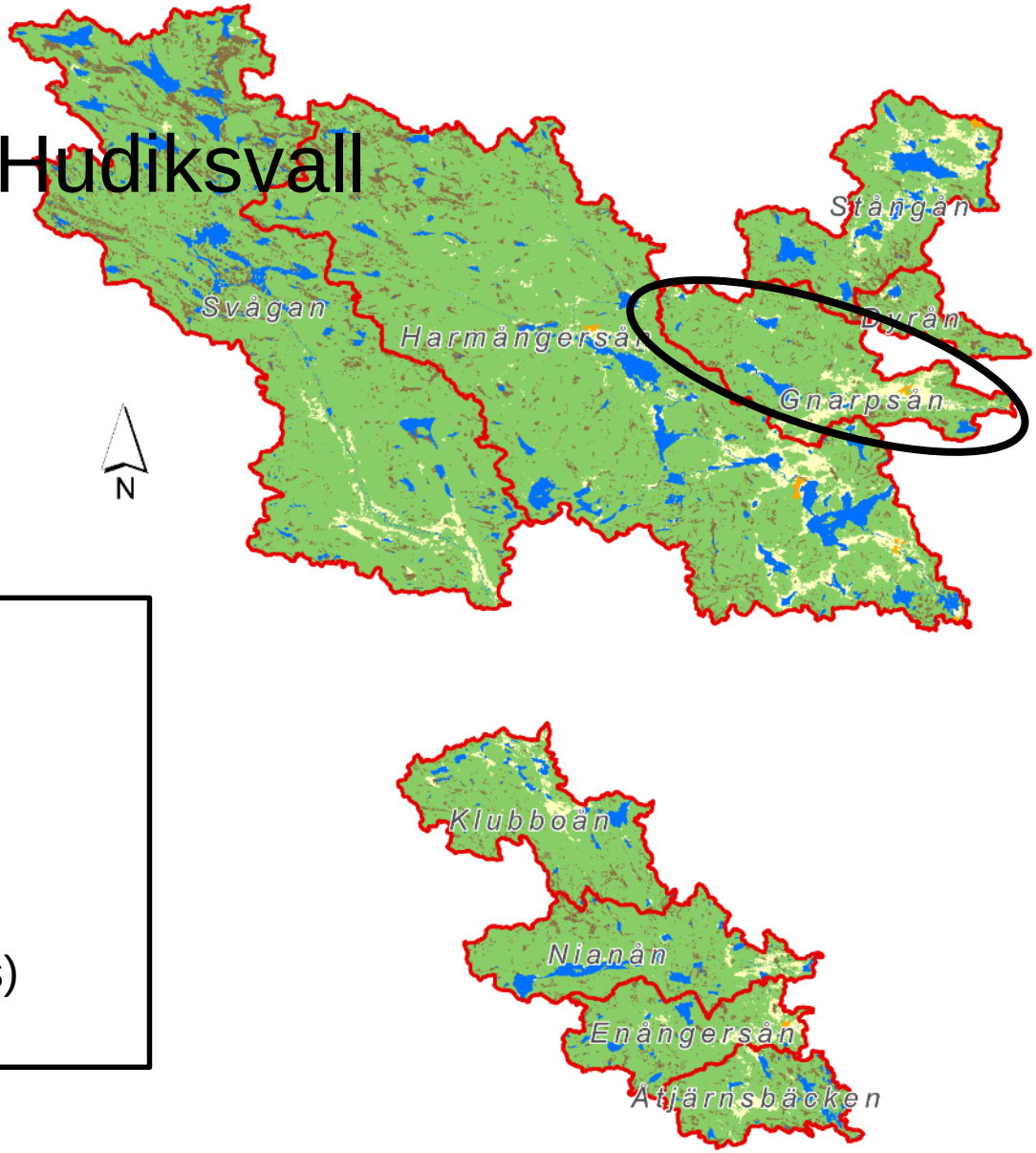
I always wonder what is it about the sound of a sledgehammer on concrete that evokes such a reaction? We routinely demolish buildings that have served their purpose or when there is a better use for the land. Why not dams? For whatever reason, we view dams as akin to the pyramids of Egypt—a permanent part of the landscape, timeless monuments to our civilization and technology.

Rivers and Dams in Sweden:
Hudiksvall

Dam Removals of Hudiksvall



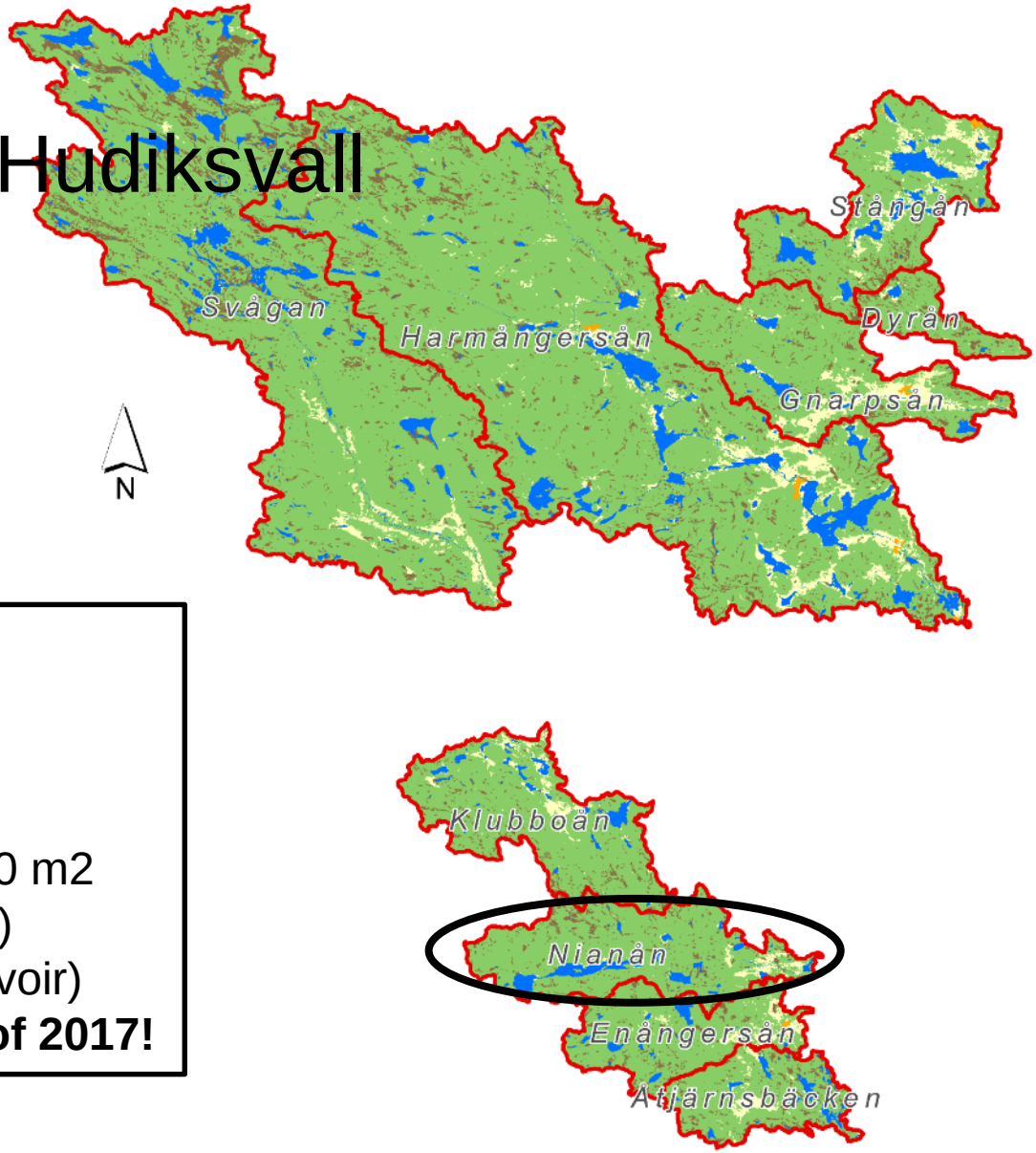
Dam Removals of Hudiksvall



River Gnarpsån

Catchment: 229 km^2
MQ: 2,84 m^3/s
Length: 120 km (w. tribs)
Lotic habitat: 25 Ha
Lakes: 28 (total area: 7,3 km^2)
Dams: 4 (2 HEPs + 2 barrages)
→ **All to be removed in 2018!**

Dam Removals of Hudiksvall



River Nianån

Catchment area: 200 km2
MQ: 1,9 m3/s
Length incl. tributaries: 90 km
Rep. area Brown trout: 181 400 m2
Lakes: 41 (total area:14,1 km2)
Dams: 2 (hydroelectric + reservoir)
→ **Removed in the summer of 2017!**

Hudiksvall municipality incentives:

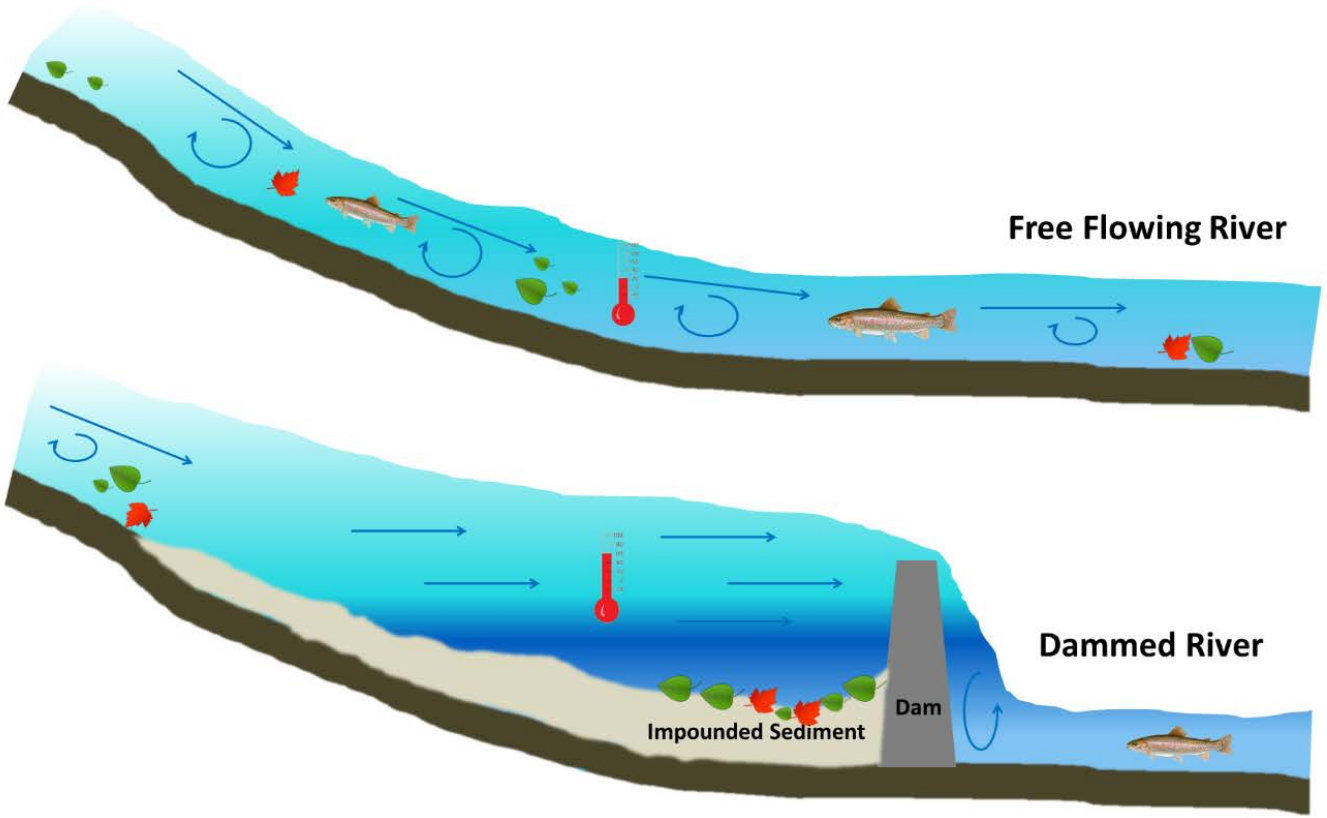
- Increased biodiversity
- Swedish environmental objectives:
  - Flourishing lakes and streams
  - A balanced marine environment, flourishing coastal areas and archipelagos
- Local growth and jobs
- Improved quality of life

21 Million SEK (2.1M Euro) to remove 6 dams funded by:

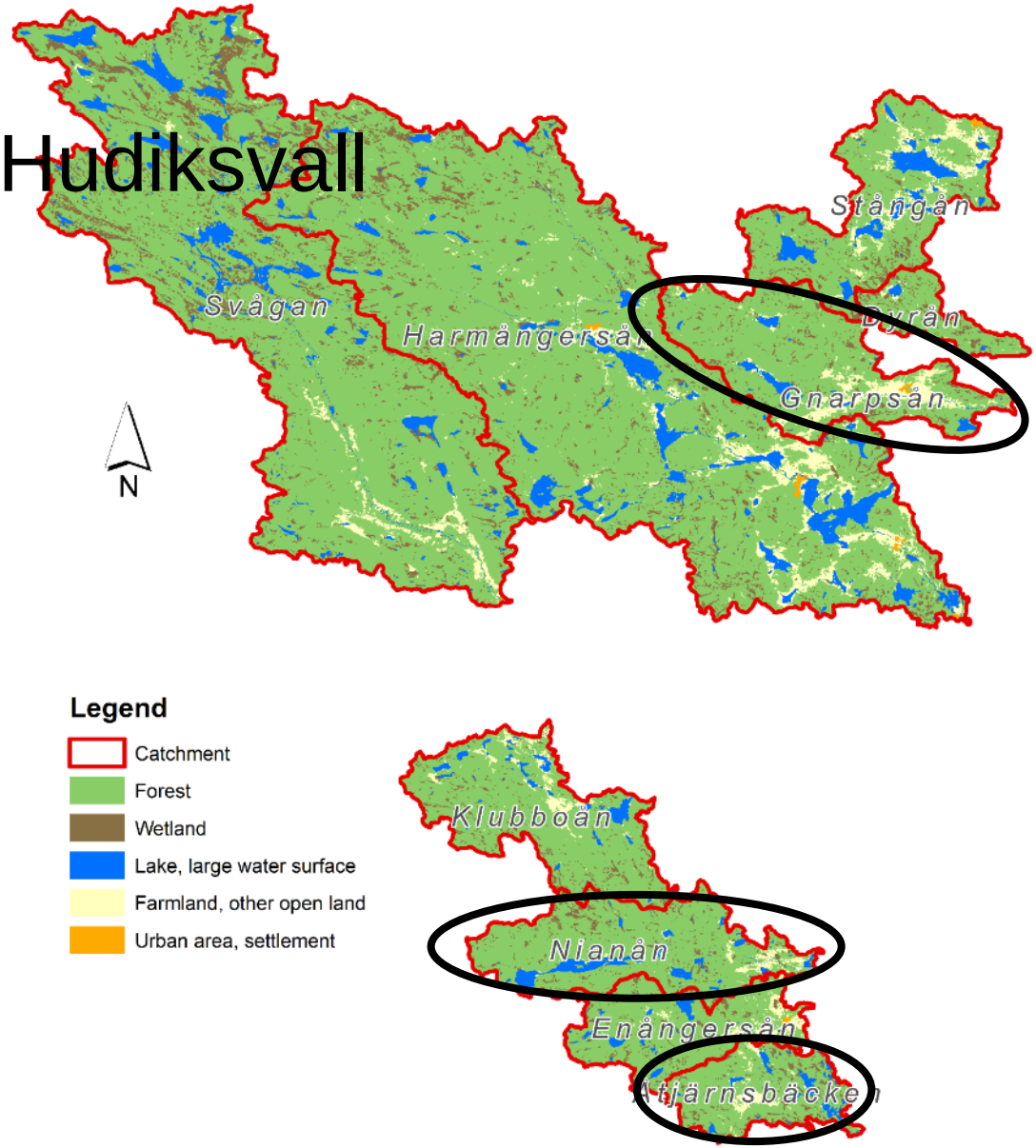
- Hudiksvall Municipality
- Nordanstig Municipality
- Swedish Environmental Protection Agency
- Swedish Agency for Marine and Water Management
- The Environmental Fund (Green electricity)
- Swedish Anglers Association (Ge fan i våra vatten)
- European Maritime and Fisheries Fund (EMFF)

Holistic Ecological Evaluation of Dam Removal

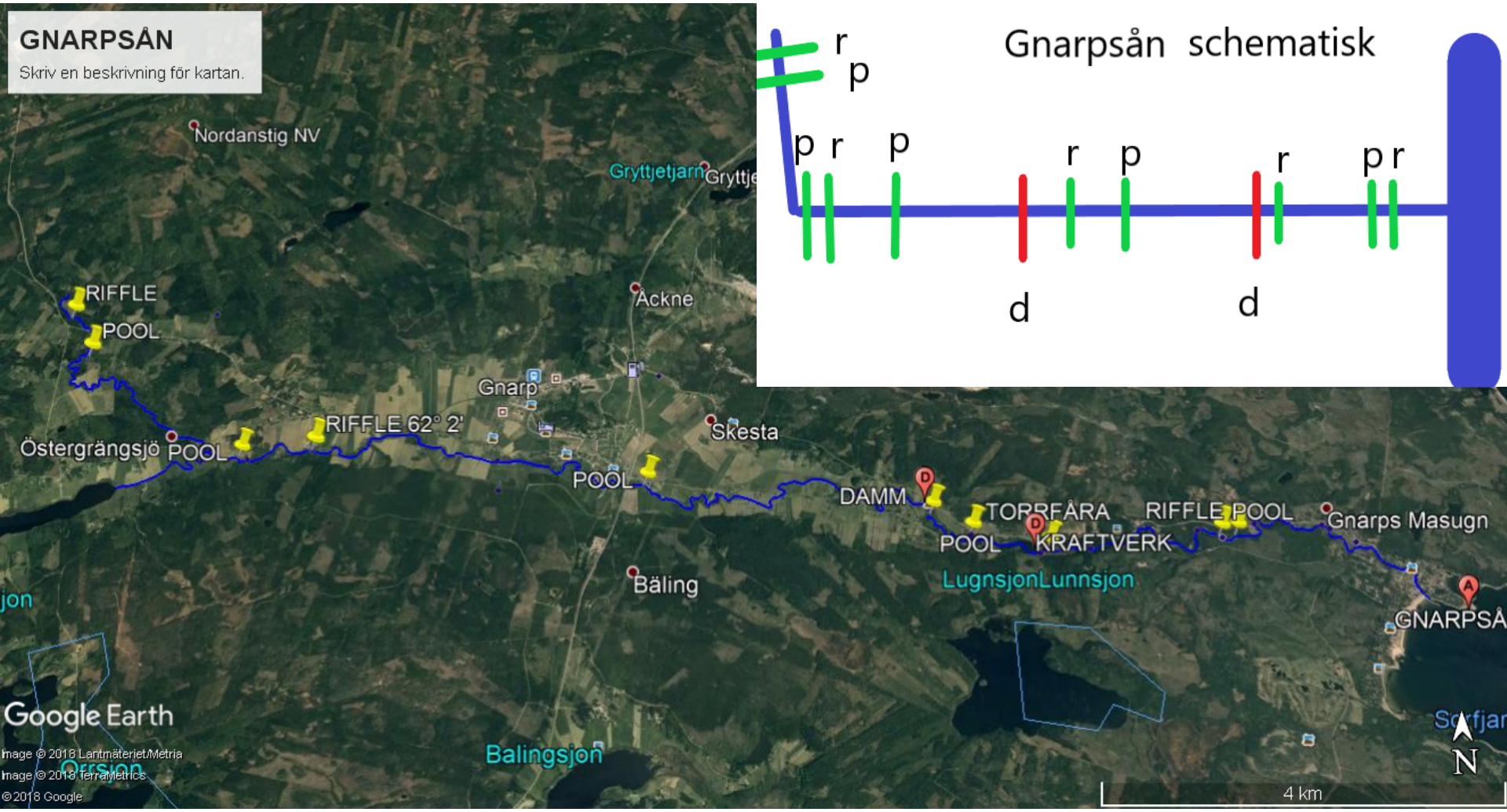
The environmental consequences of dams are numerous and varied, and have direct impacts to the biological, chemical, and physical properties of rivers and riparian environments.



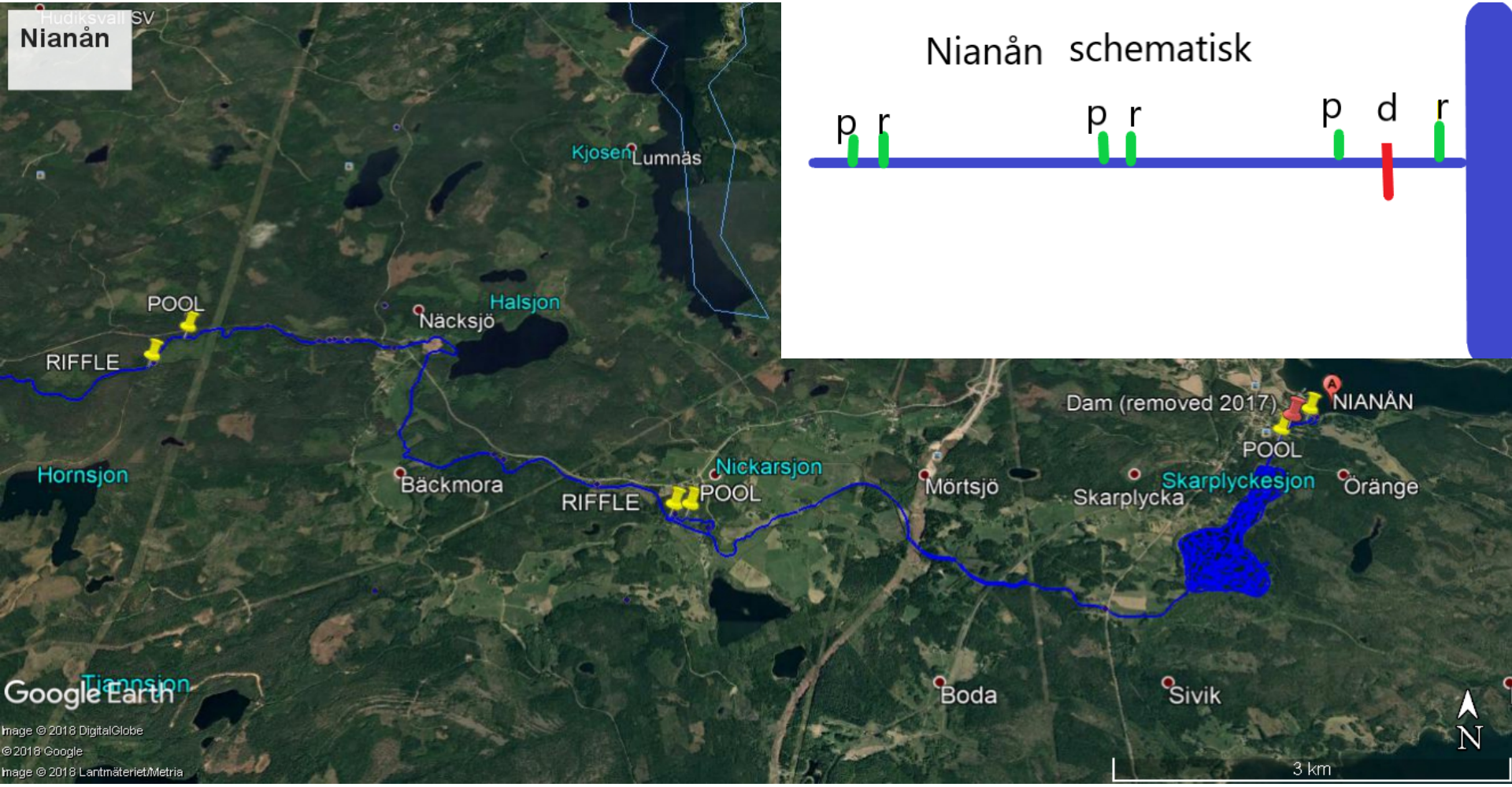
Dam Removals of Hudiksvall



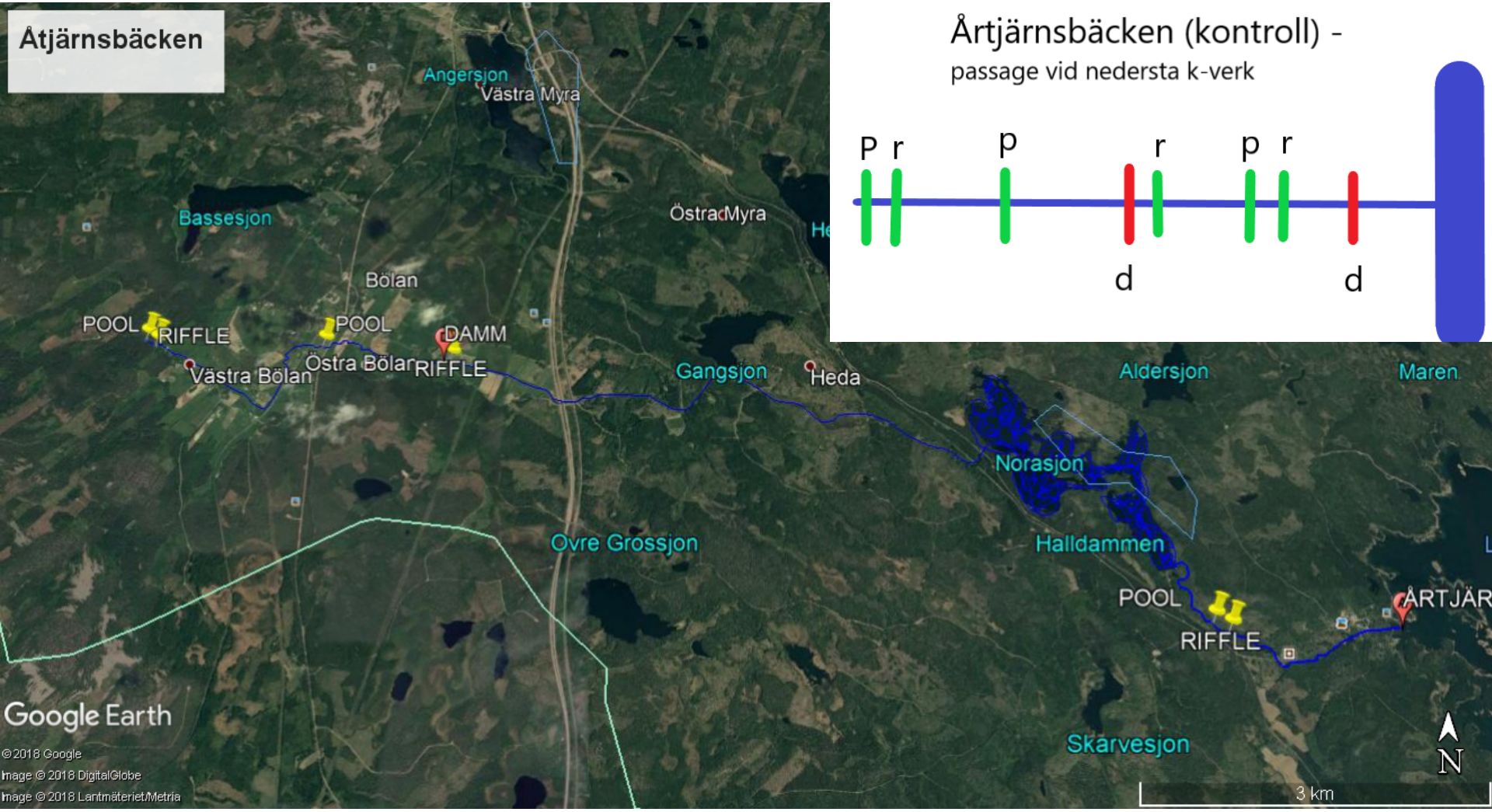
River Gnarpsån



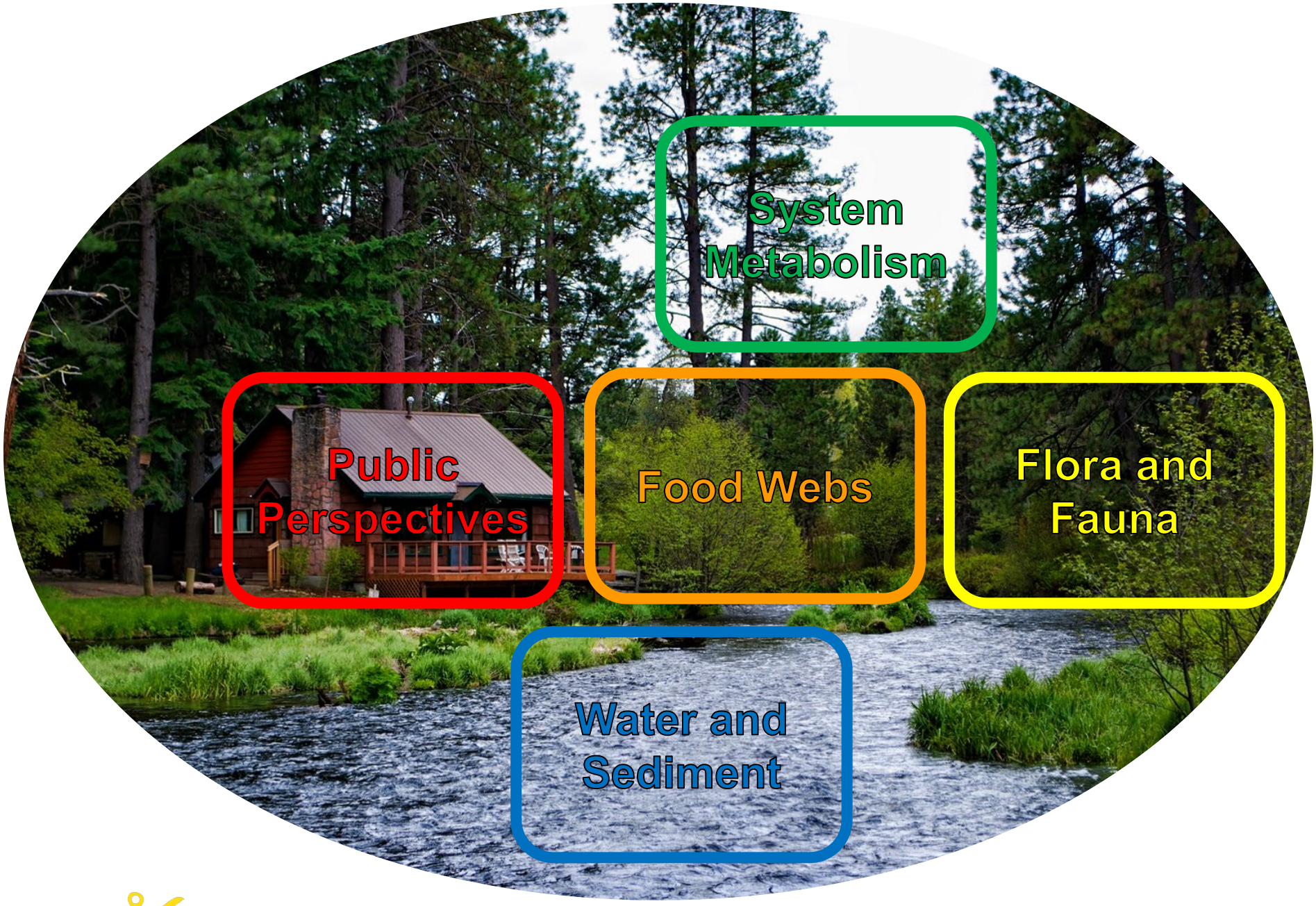
River Nianån



River Åtjärnsbäcken



Holistic Ecological Evaluation of Dam Removal


System Metabolism
Public Perspectives
Food Webs
Flora and Fauna
Water and Sediment

Holistic Ecological Evaluation of Dam Removal

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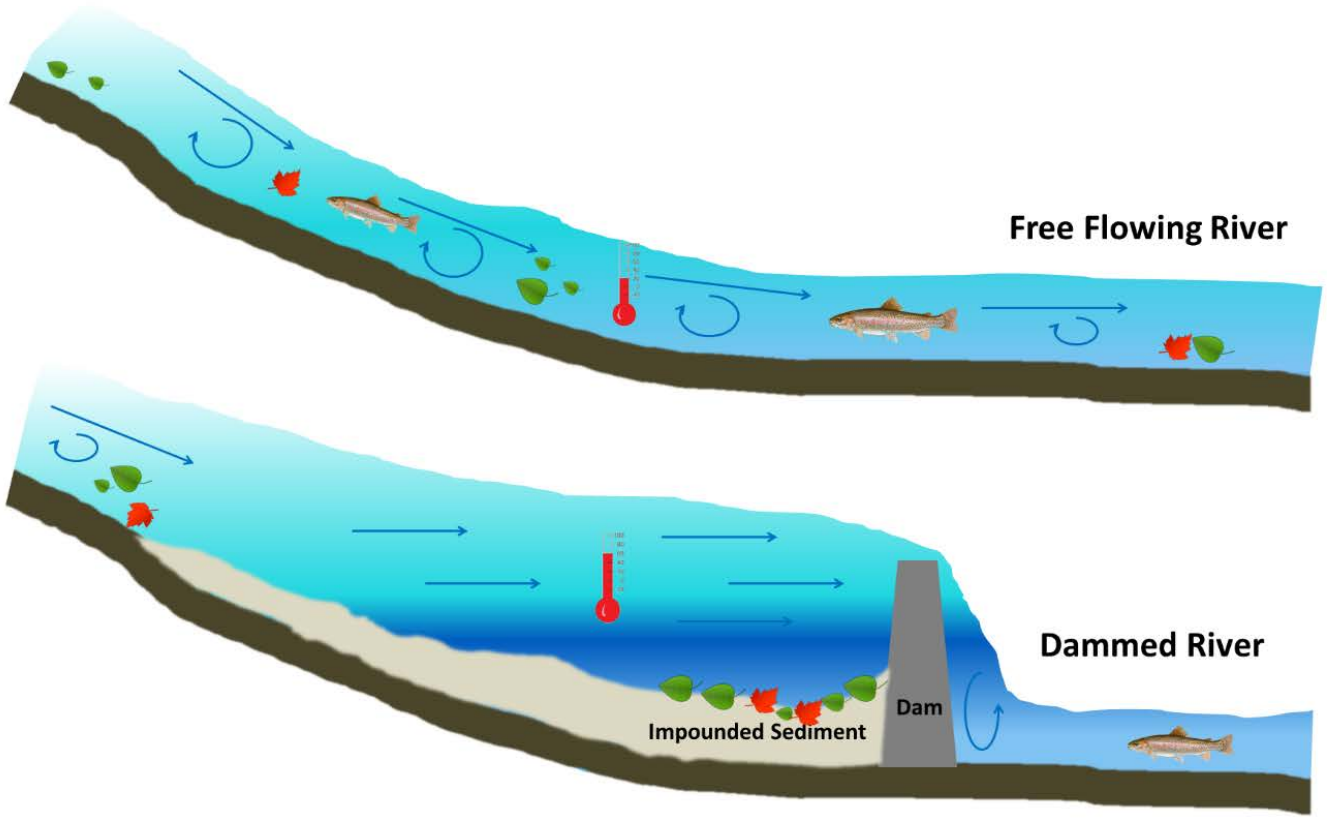
Dam Removal:
Water and sediment

Dams have a huge impact on water chemistry, flow, and sediment.

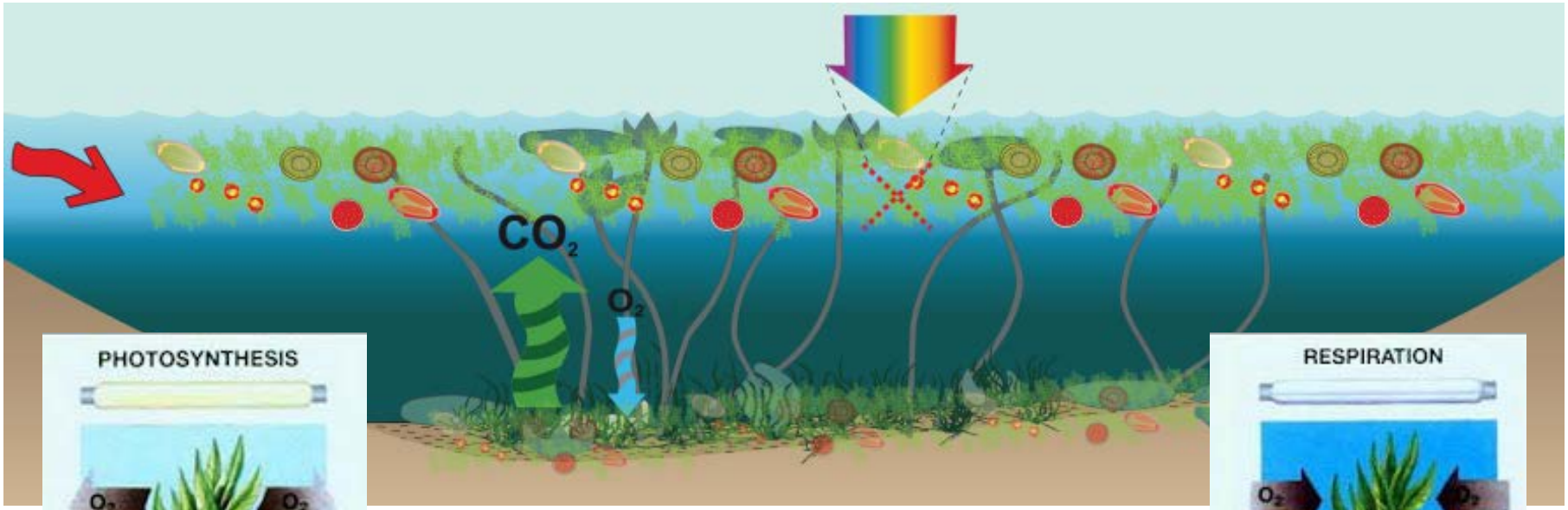


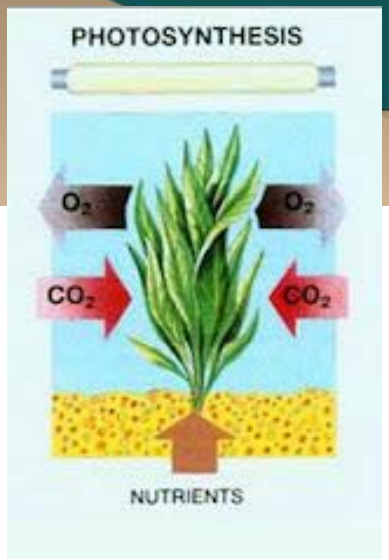
We are measuring water velocity and depth, and classifying substrate size class at each transect.

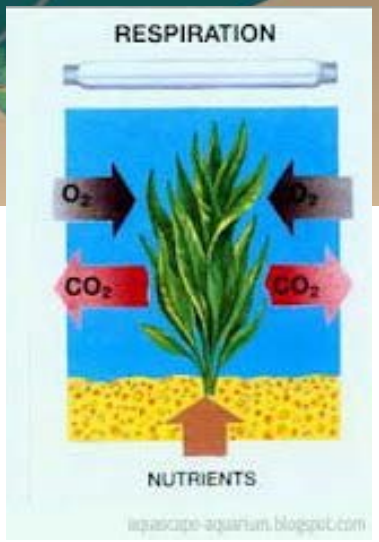
Holistic Ecological Evaluation of Dam Removal

Dam Removal:
System Metabolism

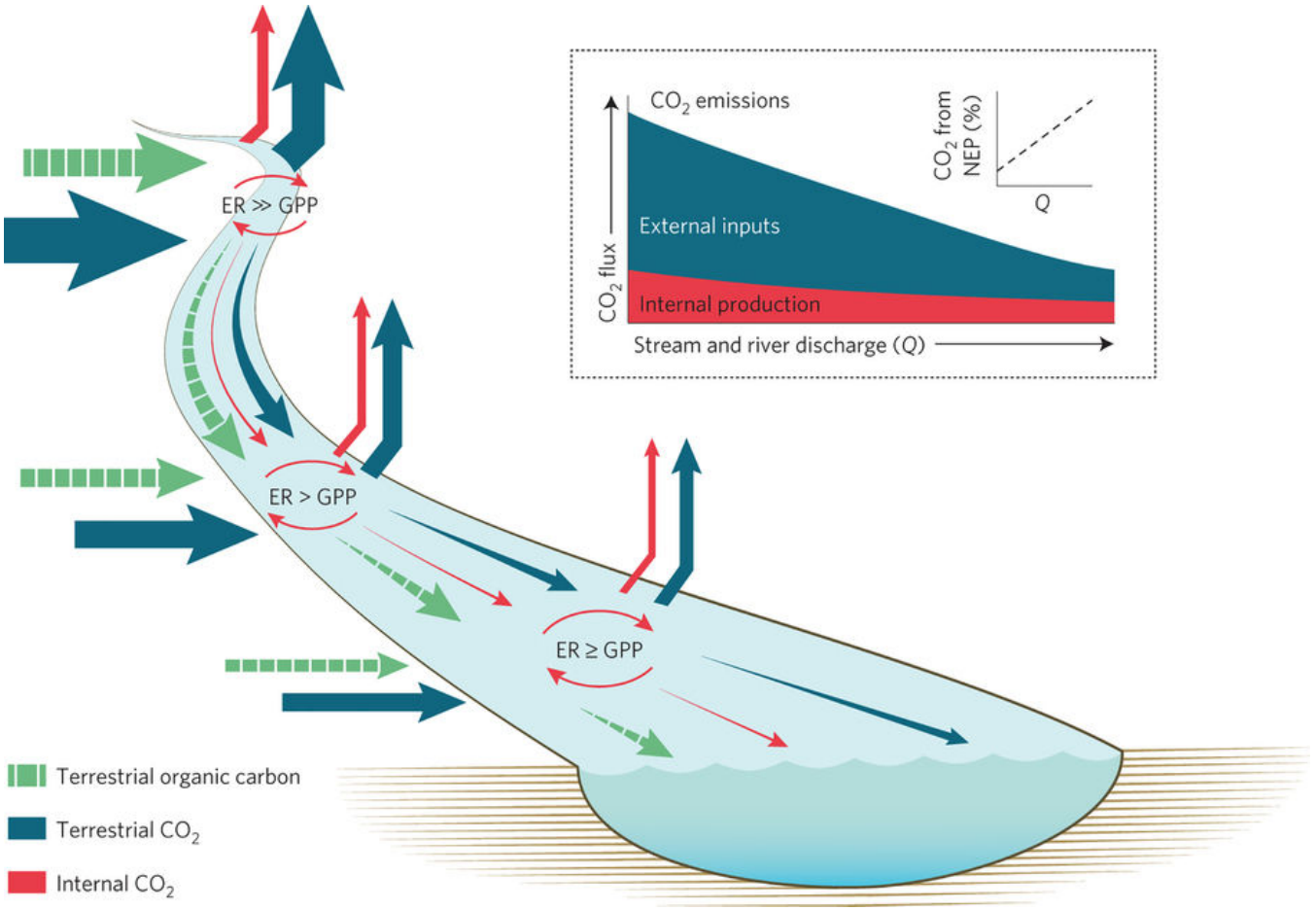
Gross Primary productivity (GPP) and Community Respiration (CR) provide a measure of the amounts of organic carbon produced and consumed within the system, respectively.







River metabolism is an aggregated measure of photosynthesis and respiration. We can use system metabolism to determine the temporal variation in heterotrophic to autotrophic character of the river.



For system metabolism we will sample using the Open Stream Diel O_2 Method, where we collect two-station O_2, temperature, Photosynthetic active radiation (PAR), water velocity and water level.

Anthropogenic Allochthony: potential sources of elevated respiration in human-influenced rivers, storage behind impoundments

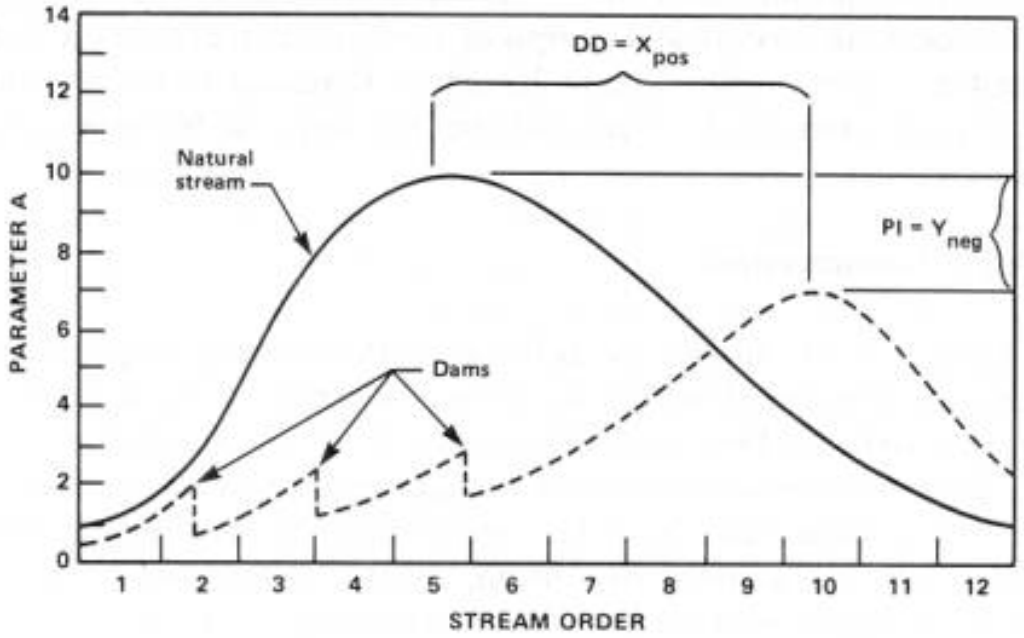
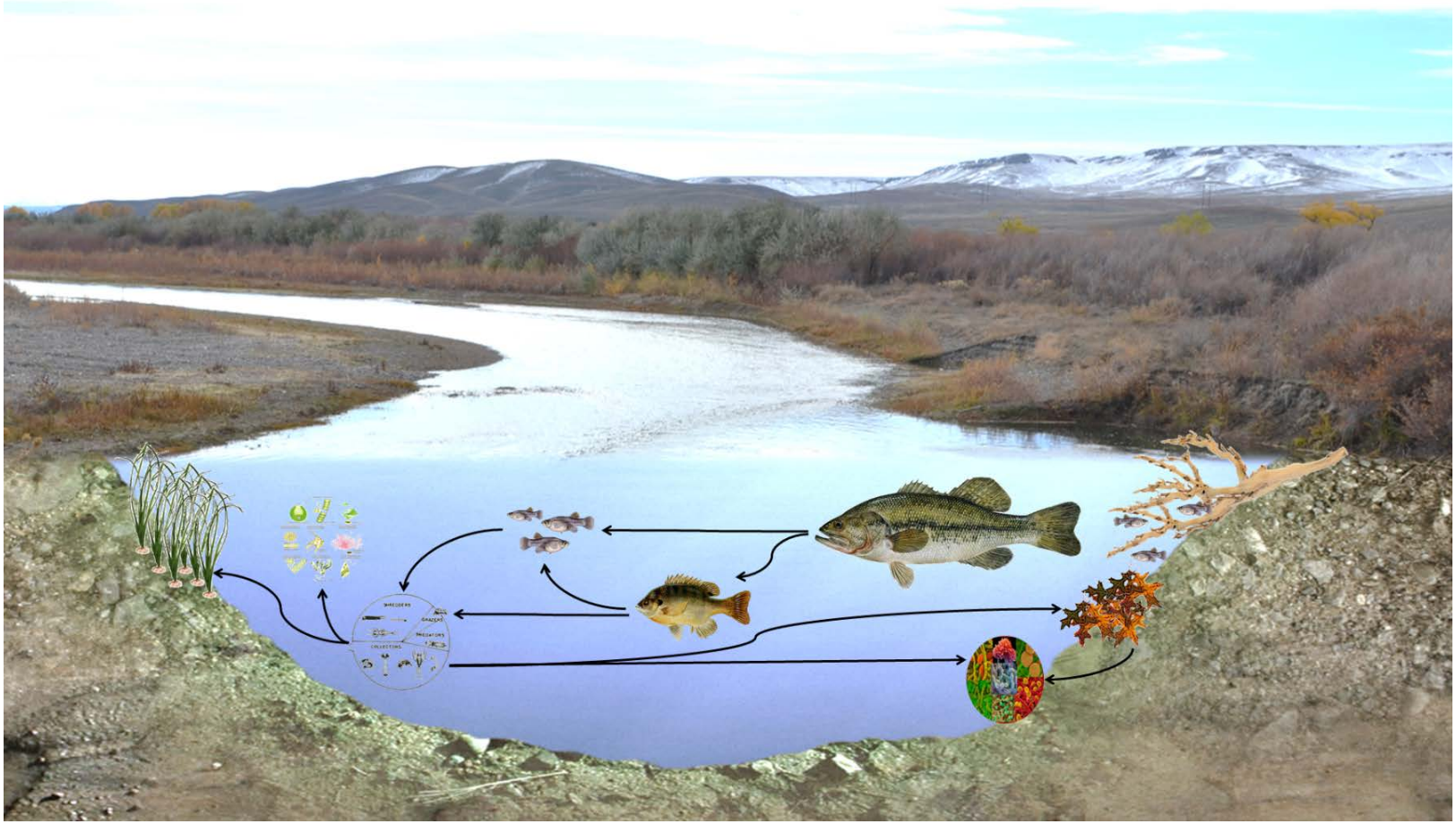


Figure 3. Theoretical framework for conceptualizing the influence of impoundment on ecological parameters in a river system. Discontinuity distance (DD) is the downstream (positive) or upstream (negative) shift of a parameter a given distance (X) due to stream regulation. PI is a measure of the difference in the parameter intensity attributed to stream regulation. See text for further explanation.

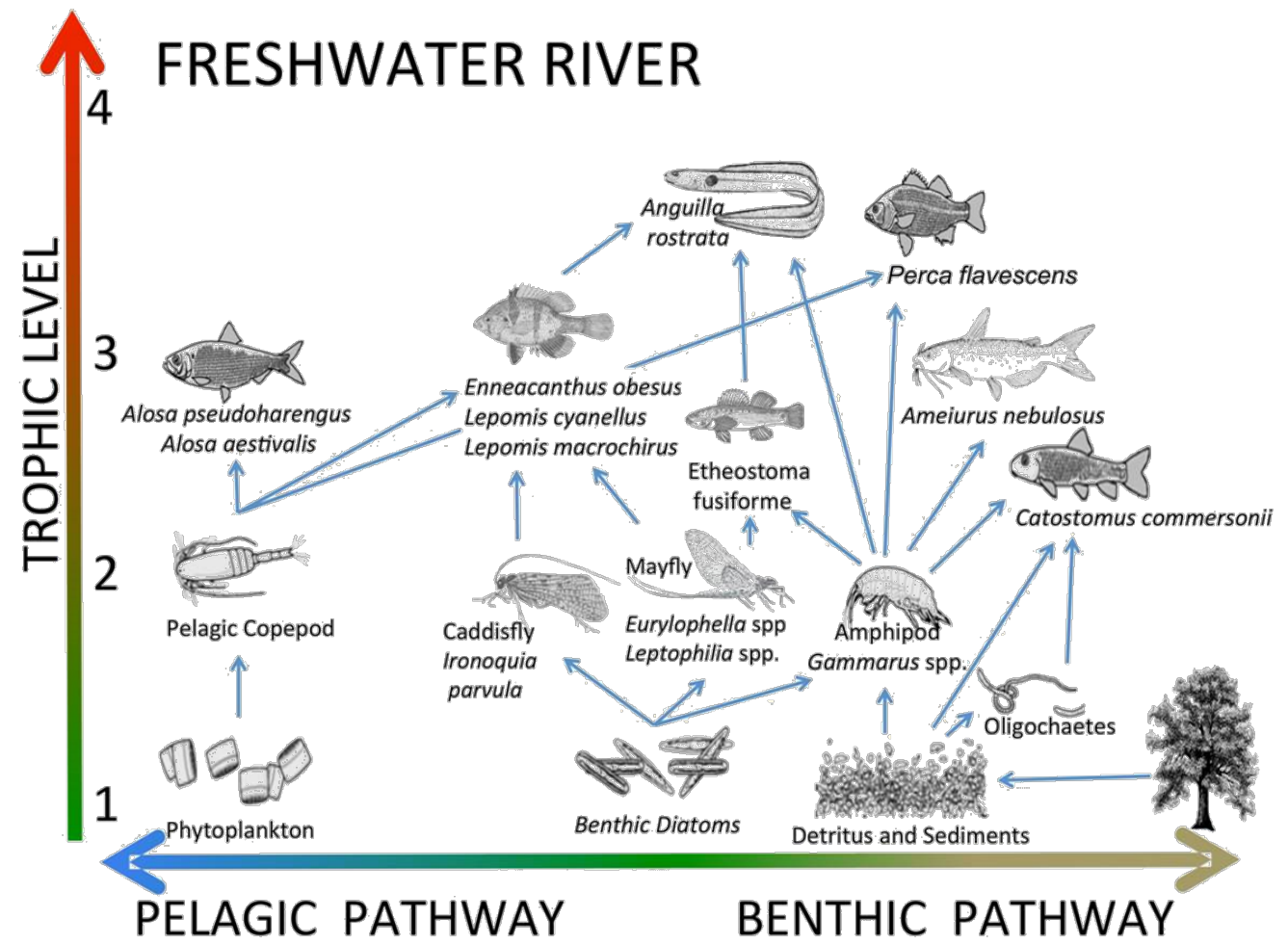
Holistic Ecological Evaluation of Dam Removal

Dam Removal:
Food Webs

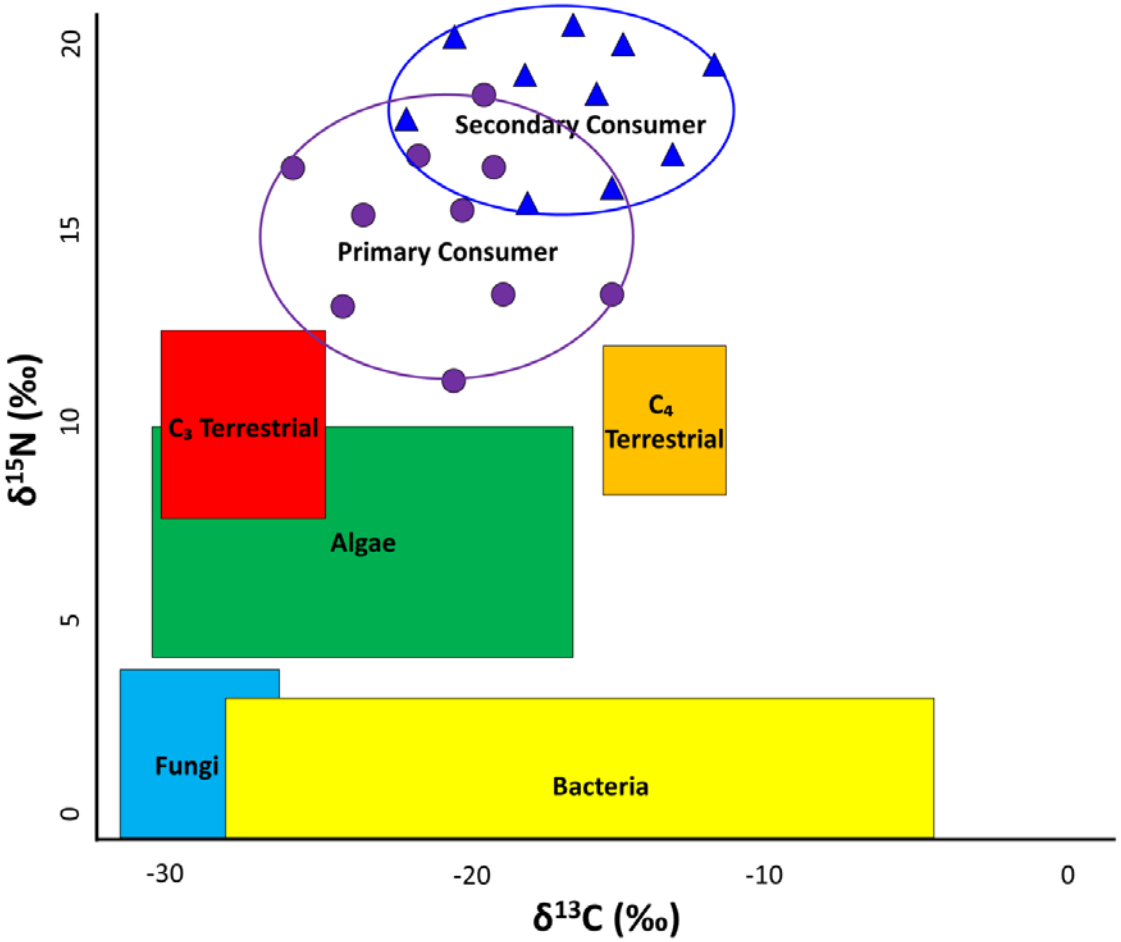
Food webs are special descriptions of biological communities focused on trophic interactions between consumers and resources, and incorporate population to ecosystem level dynamics.



There are two different aspects of food webs that aquatic ecologists focus on, food chain length/trophic position and basal carbon sources.



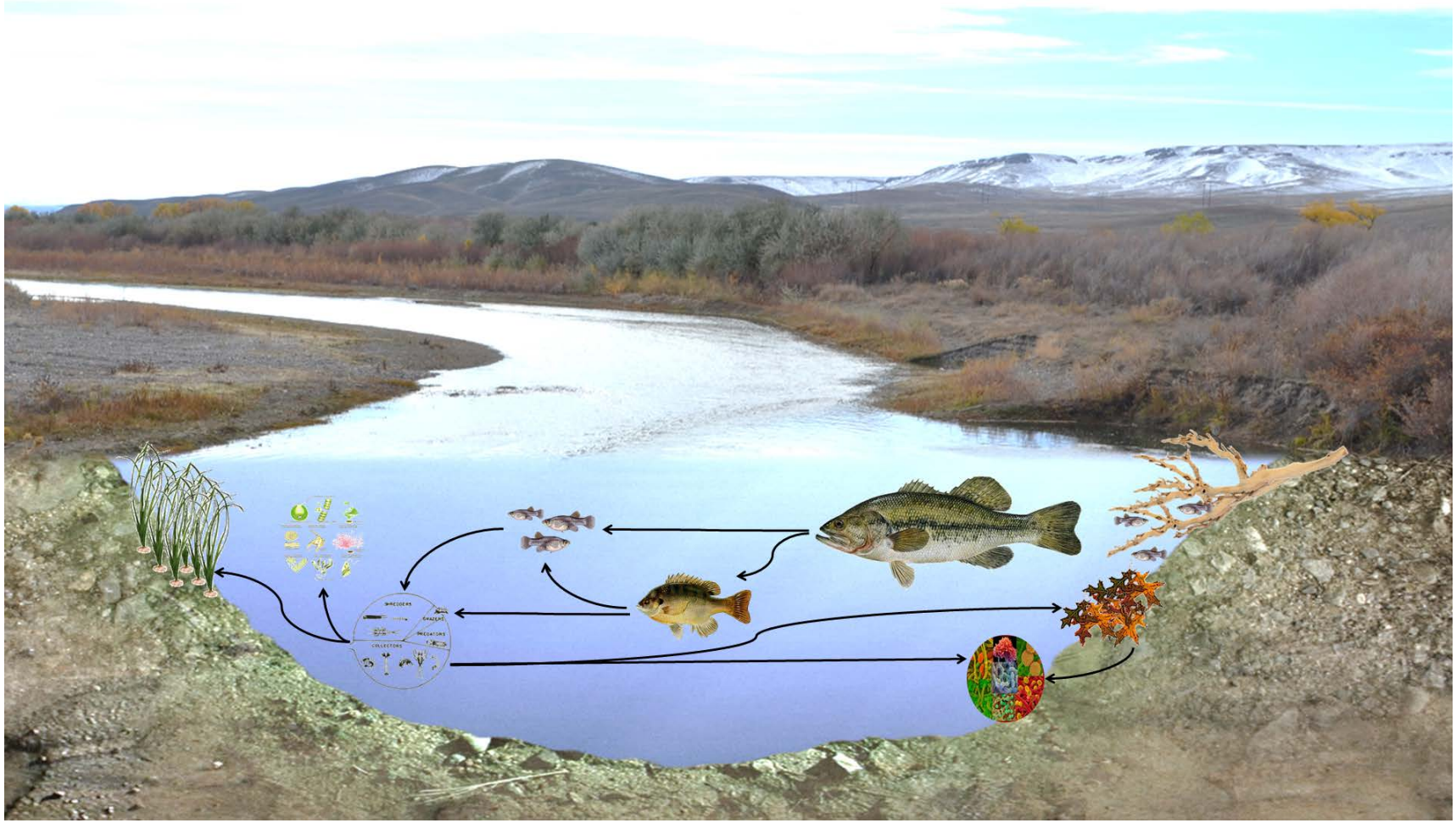
The application of Stable Isotope measurements can be used to integrate, indicate, record and trace fundamental ecological processes.



For stable isotope analysis, we are collecting small tissue samples from organisms (marine, freshwater, terrestrial) to analyze at each site.

We are sampling before and after removal of the dams. We are also sampling museum specimens collected before dams were built.

We expect the food web of the river to change, in particular in regards to the amount of marine derived nutrients entering the food web (expected to increase with removal of dam).



Holistic Ecological Evaluation of Dam Removal

Dam Removal:
Flora and Fauna

Flora and Fauna

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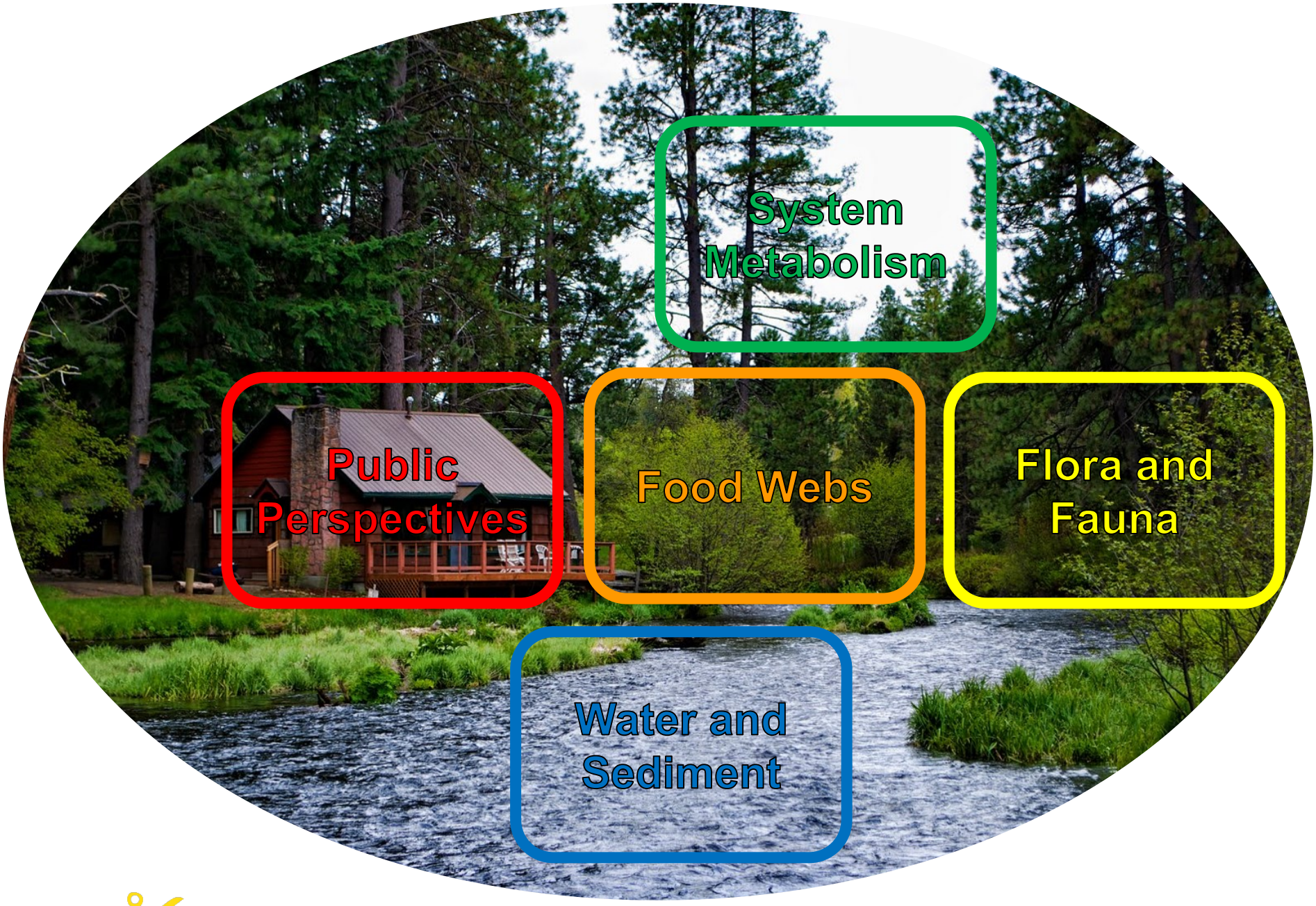
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Tack så mycket!

Olle Calles, Larry Greenberg

Martin Österling, Anders Nilsson

Denis Lafage, Lutz Eckstein

Eva Bergman, Svante Karlsson, Beatrice Hedelin

Derek Sellens, Jessica Dolk, Philip Ericsson

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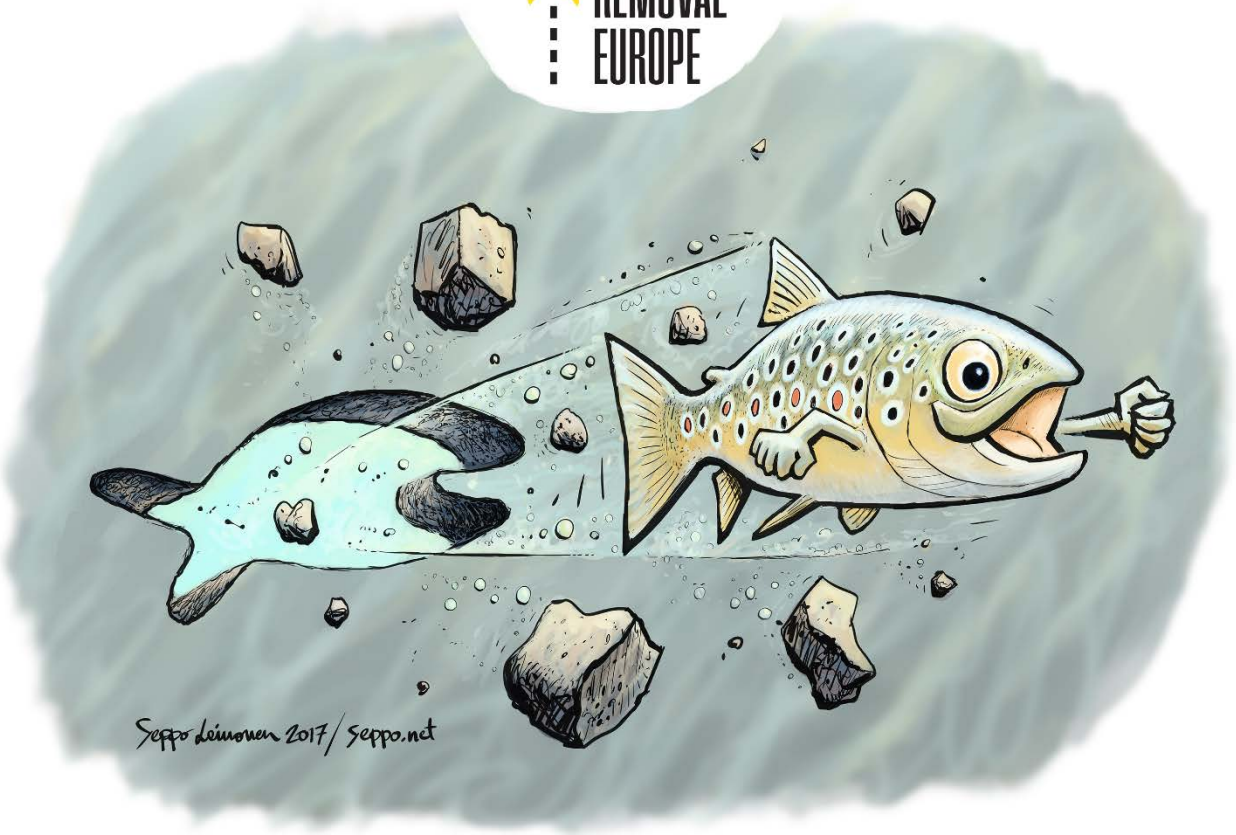

'To be or not not be...removed'

Workshop Dam Removal | 24-26 september | Hudiksvall (Sweden)

Hudiksvalls kommun

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Contact: john.piccolo@kau.se

FWWG

The Freshwater Working Group of the Society for Conservation Biology