What are the consequences of river fragmentation?

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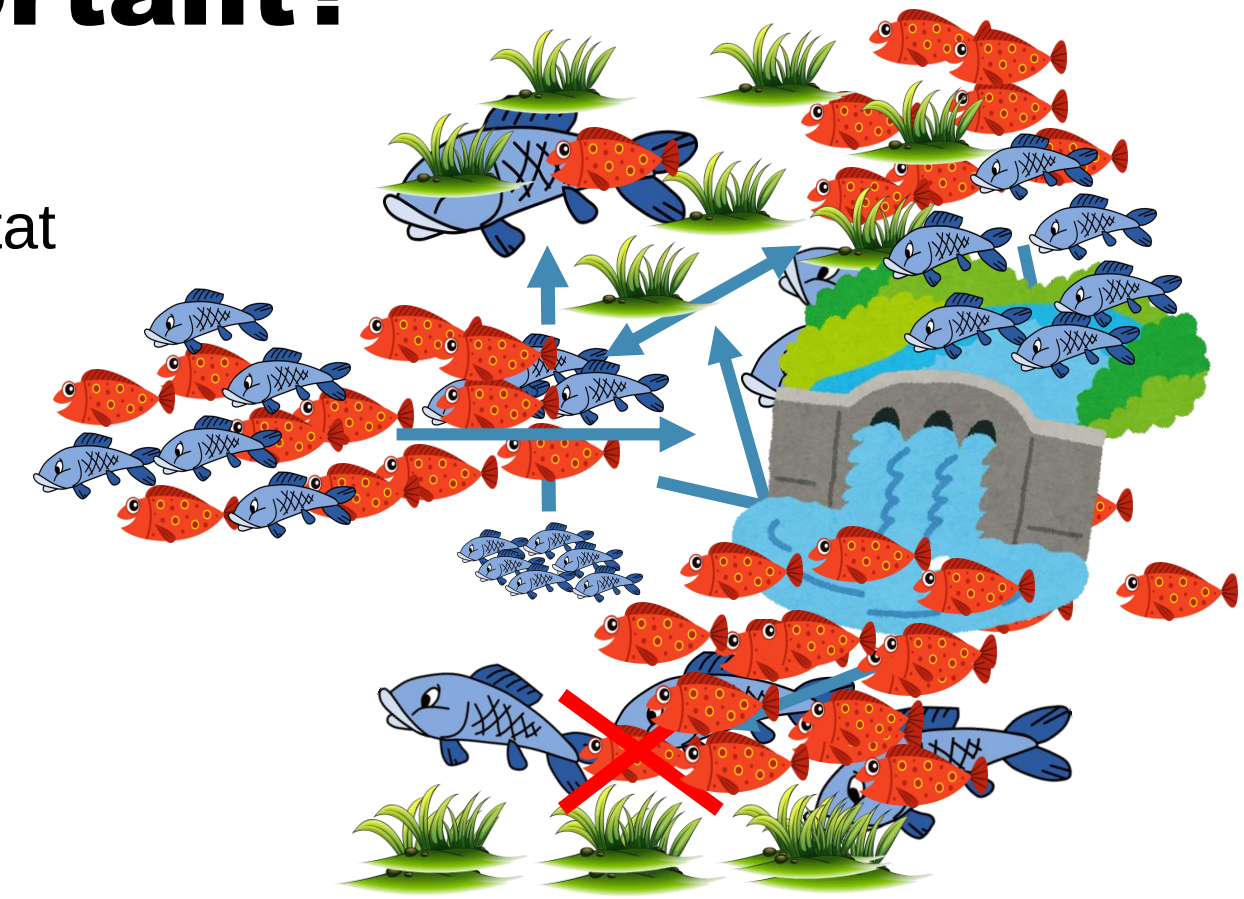
Why is longitudinal connectivity important?

- Access to lifecycle essential habitat
- Metapopulation dynamics
- Resource management
- Gene flow



Reduced longitudinal connectivity

- Height

Reduced longitudinal connectivity

- Height
- Depth

Reduced longitudinal connectivity

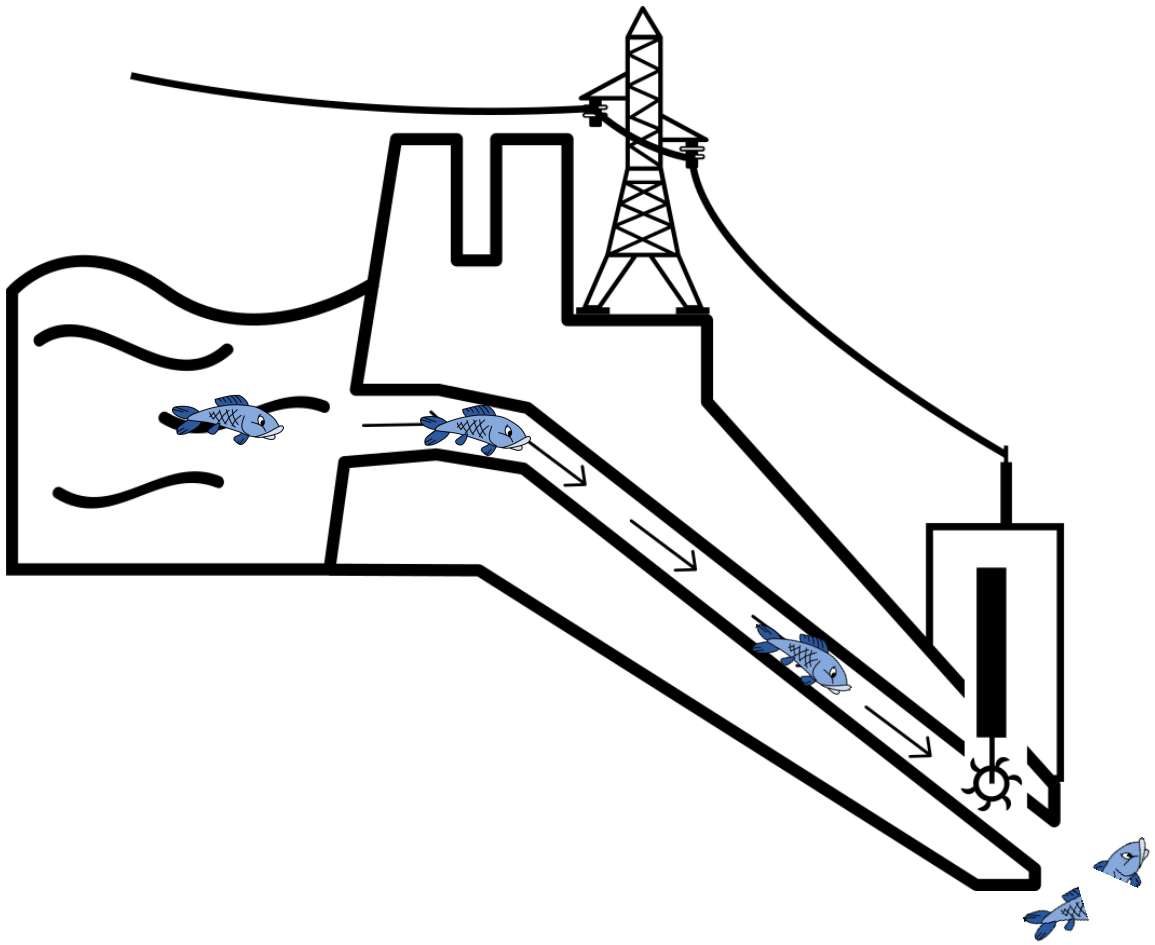
- Height
- Depth
- High flow velocity

Reduced longitudinal connectivity

- Height
- Depth
- High flow velocity
- Turbulence

Reduced longitudinal connectivity

- Height
- Depth
- High flow velocity
- Turbulence
- Loss of navigational cues
- Turbine passage mortality

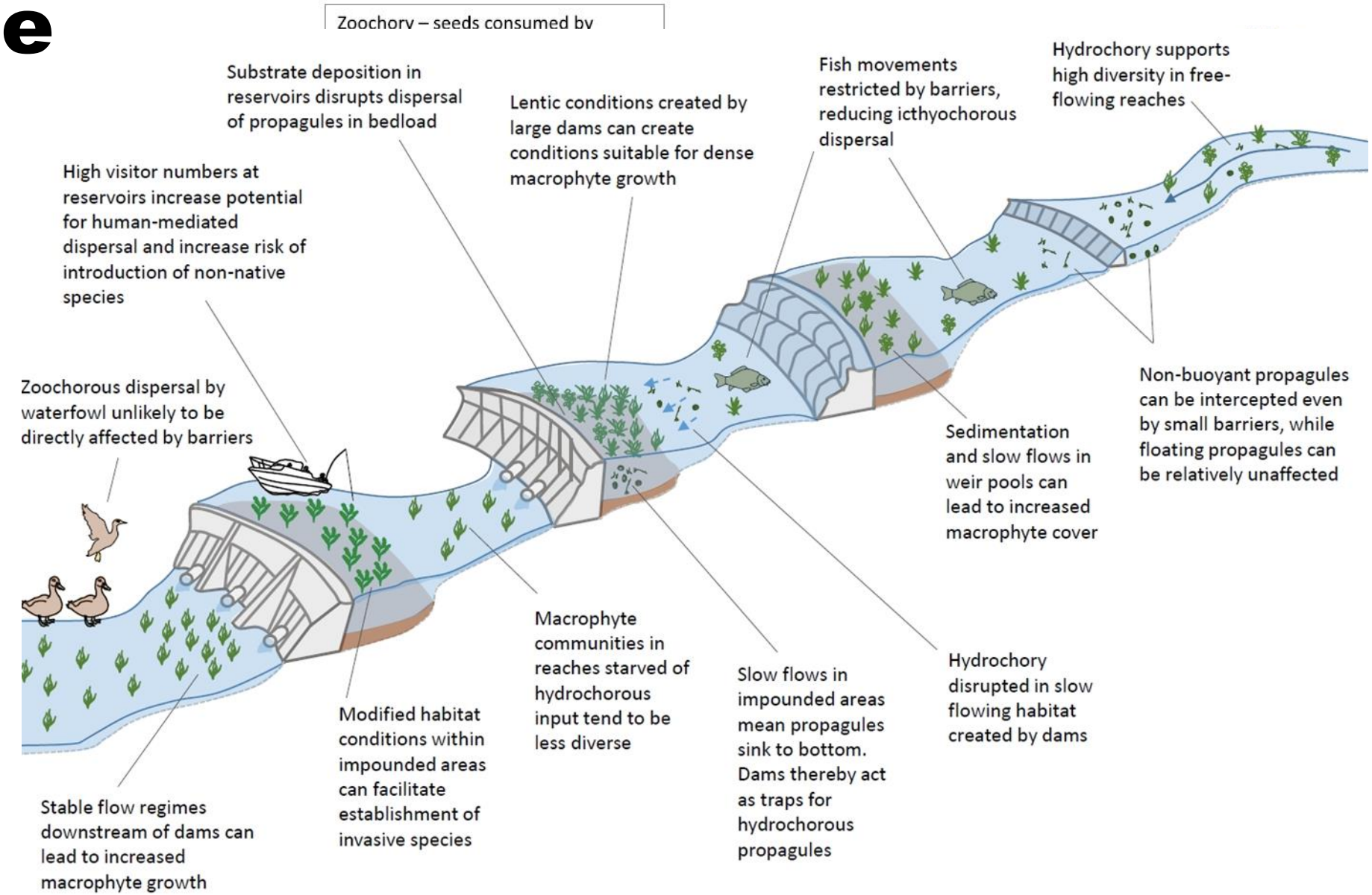


Consequence of reduced longitudinal connectivity for fish

- **Worldwide, freshwater fish are in decline[1,2,3,4,5,6].**
  - Human modification/development of rivers[7,8].
- **Barriers a key limiting factor to a self-sustaining population of:**
  - European eel[3,9].
  - Chinese paddlefish[10].
- **In extreme cases populations have already become extirpated[4,11].**
- **Further losses are predicted to occur within the next century[12,13].**

Macrophyte dispersal

Jones et al., 2019. Impacts of artificial barriers on the connectivity and dispersal of vascular macrophytes in rivers: A critical review. Freshwater Biology, 65(6), 1165-1180.



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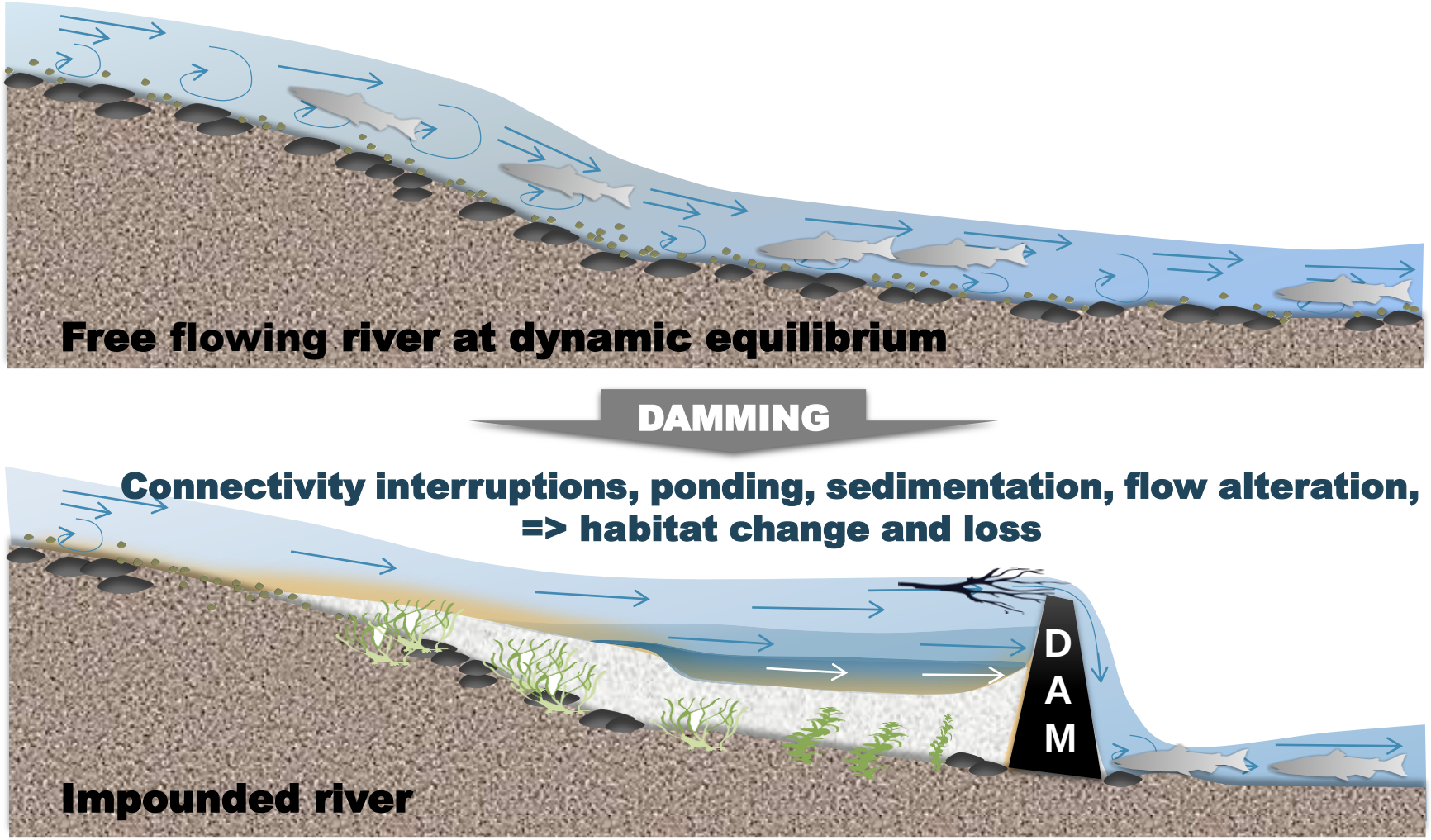
Benefits of fragmentation:
Containing the spread of non-native species

- **Barriers can block or hinder the spread of invasive species**
  - Red swamp crayfish
  - Signal crayfish
  - Chinese mitten crab[15]

- **Using exclusion barriers to limit the spread of aquatic invasive species**[16]
  - Moderate success:
    - XX.X% partially successful
    - XX.X% successful

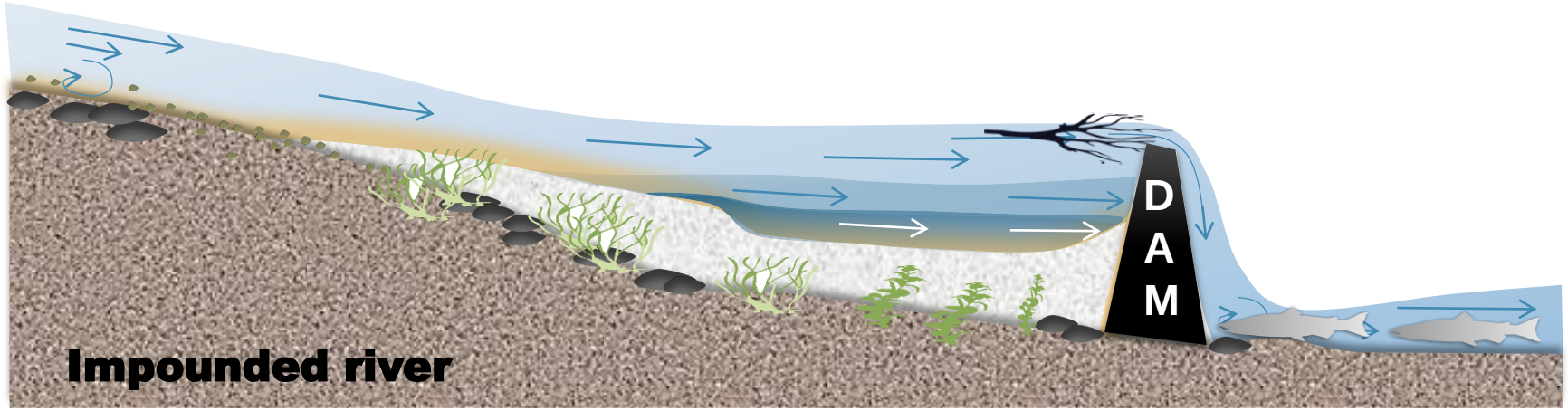
- **Integrated pest management protocols**

Dam impact on free flowing river habitats



What are the consequences of river fragmentation?

Dam impact on upstream habitat



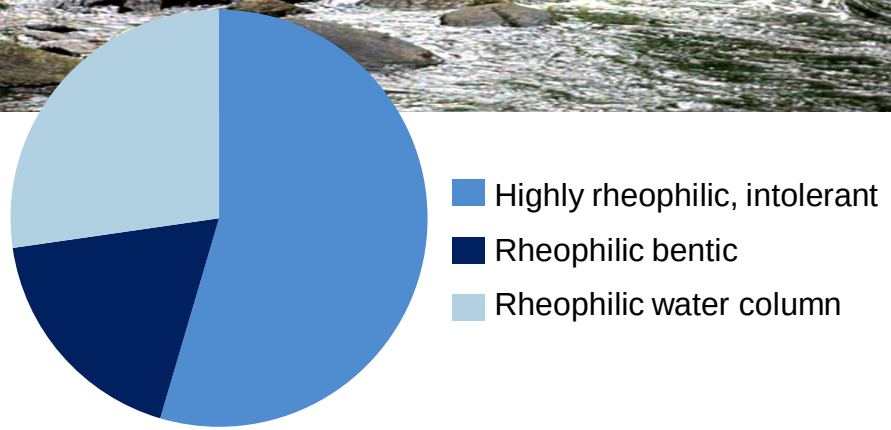
- higher depth
- low velocity
- substrate siltation
- high temperature
- low oxygen
- eutrophication
- vegetation shift
- benthos alteration

What are the consequences of river fragmentation?

Dam impact on upstream habitat

RHEOPHILIC
fish guilds
in undisturbed river

Mountain river free flowing



What are the consequences of river fragmentation?

Dam impact on upstream habitat

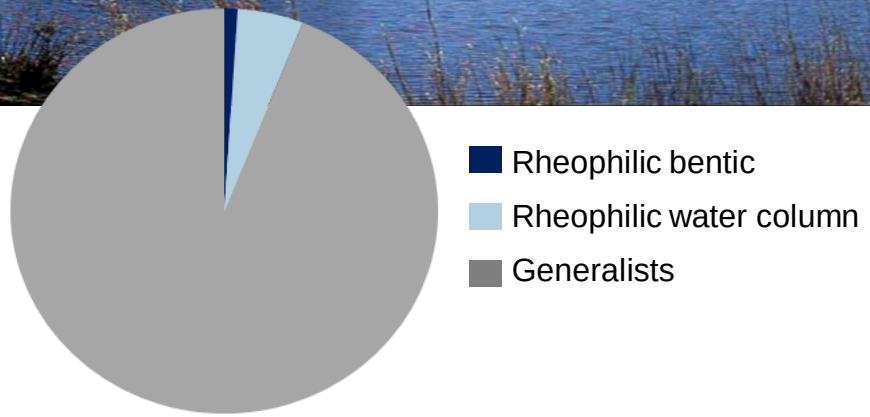
RHEOPHILIC
fish guilds
in undisturbed river

DAMMING

change of lotic into
lentic habitats
= altered fish community

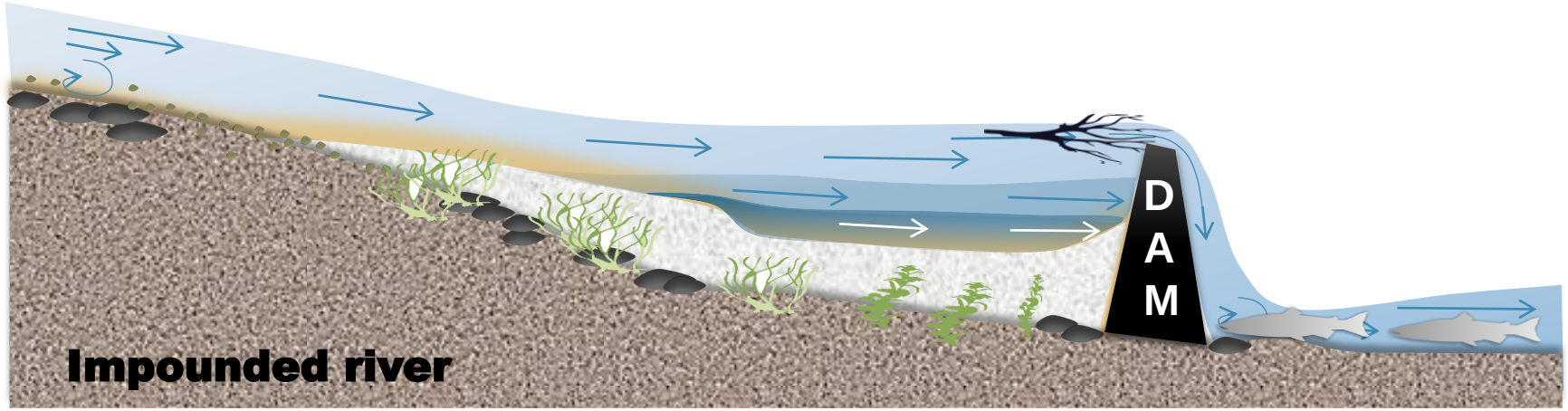
GENERALISTS –
tolerant fish guilds
in impounded river

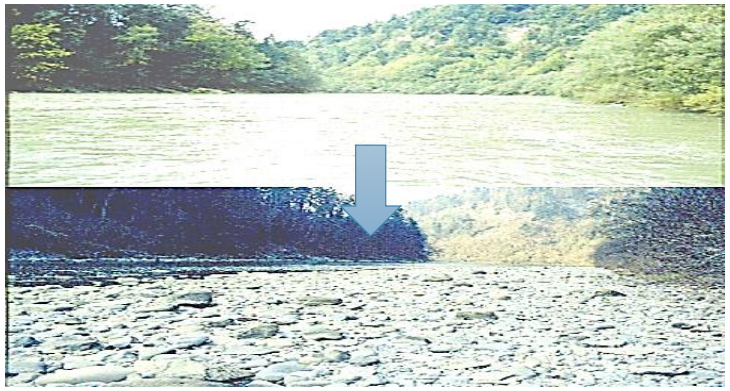
Mountain impounded river



What are the consequences of river fragmentation?

Dam impact on downstream habitat





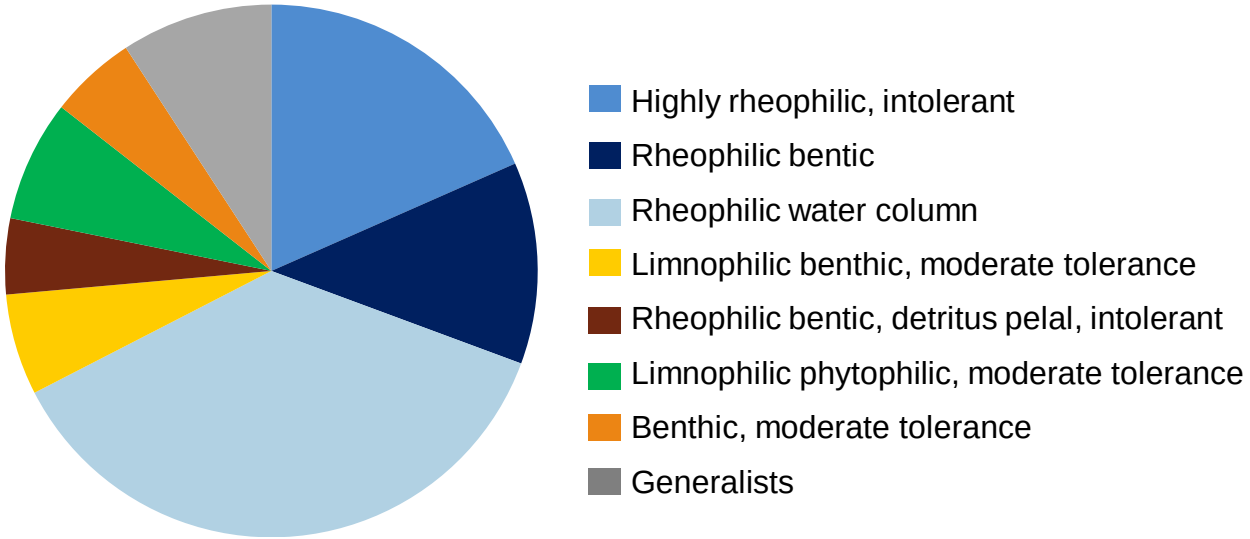
- **flow regime**
  - fluctuations:
    - depth
    - velocity
    - temperature
- **blocked sediment**
  - riverbed erosion
- **migration blocked**
- **fish mortality**

What are the consequences of river fragmentation?

Dam impact on downstream habitat

RHEOPHILIC
fish guilds dominate
in undisturbed river

Lowland river free flowing



What are the consequences of river fragmentation?

Dam impact on downstream habitat

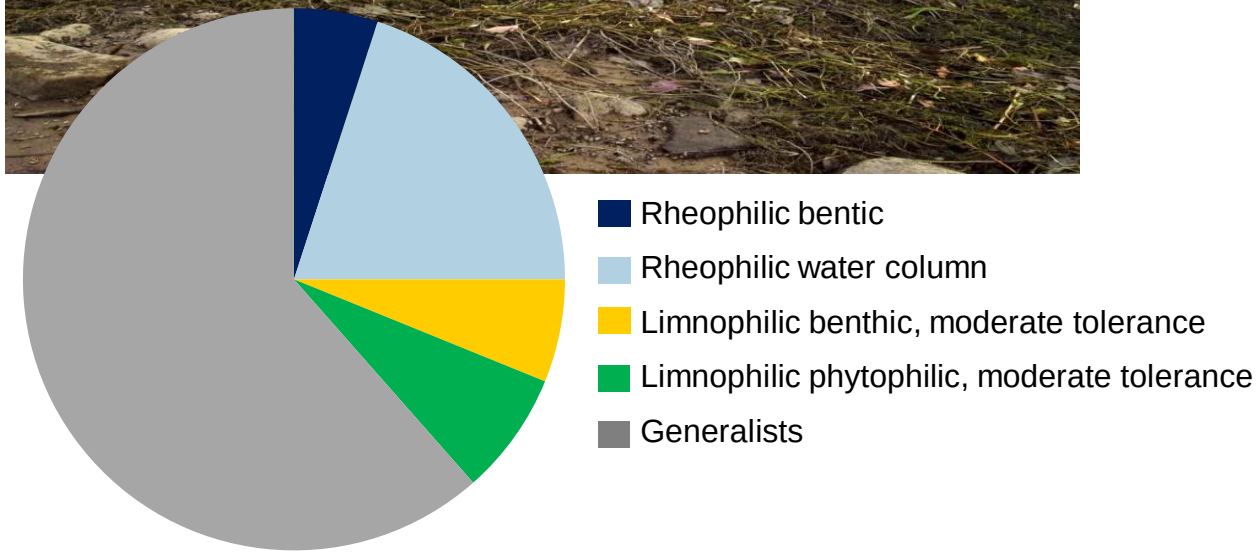
RHEOPHILIC
fish guilds dominate
in undisturbed river

DAMMING

change of habitat quality and stability, rapid bottom erosion
= altered fish community

GENERALISTS –
tolerant fish guilds dominate
in impounded river

Lowland river below the dam

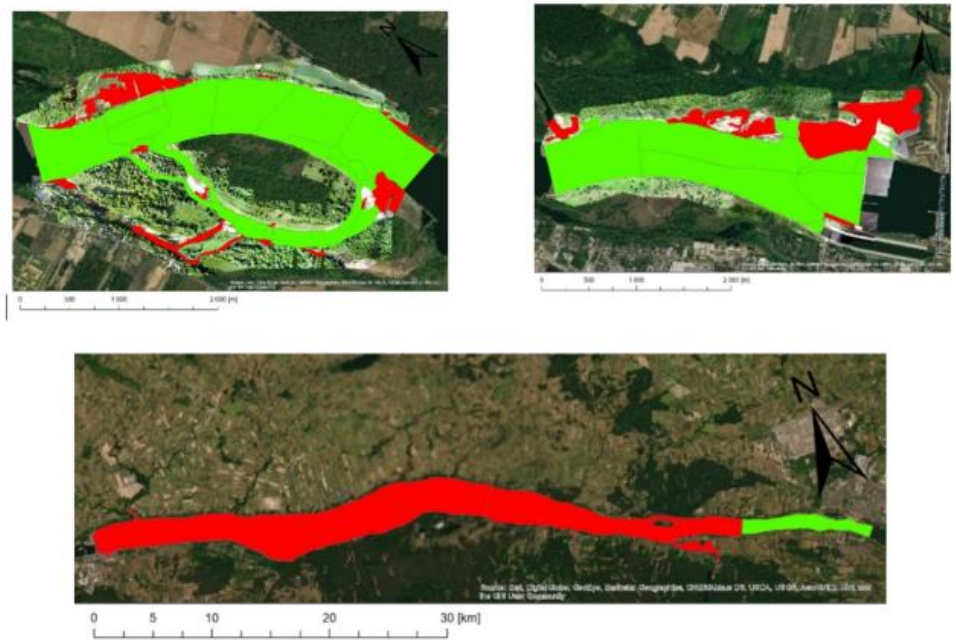


What are the consequences of river fragmentation?

Habitat availability for two fish types downstream and upstream of the dam

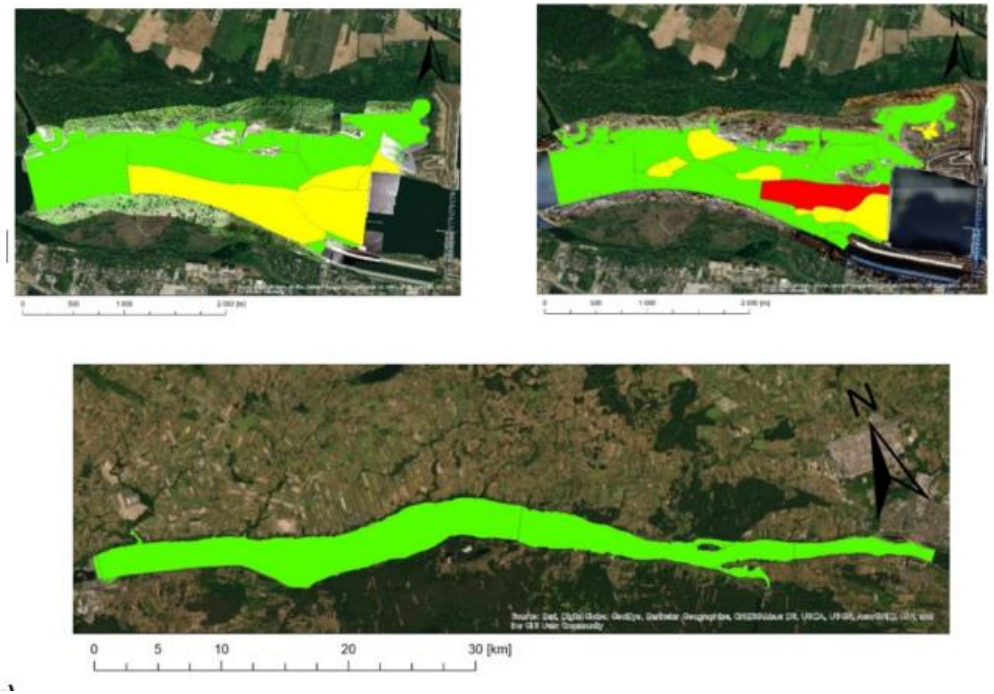
River Fish

Highly rheophylic intolerant species



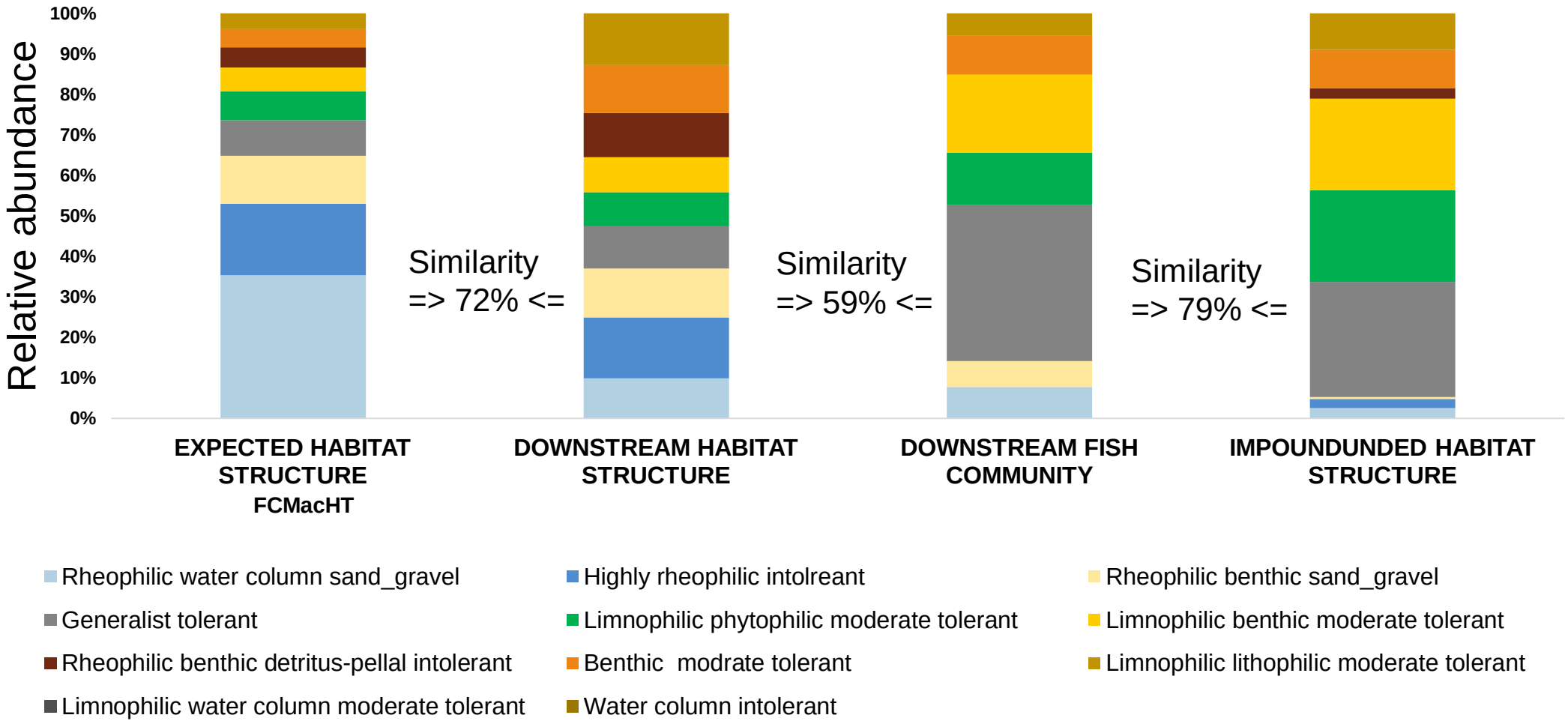
Pond Fish

Generalist species



What are the consequences of river fragmentation?

Downstream fish community affected by impounded habitat structure



What are the consequences of river fragmentation?

Take home message

Barriers do:

1. Alter habitats up- and downstream
2. Reduce longitudinal connectivity
3. Alter aquatic communities for long distances

There are tools allowing to address and mitigate the impacts

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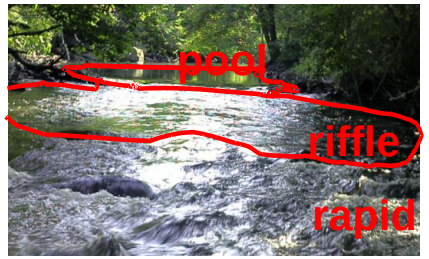

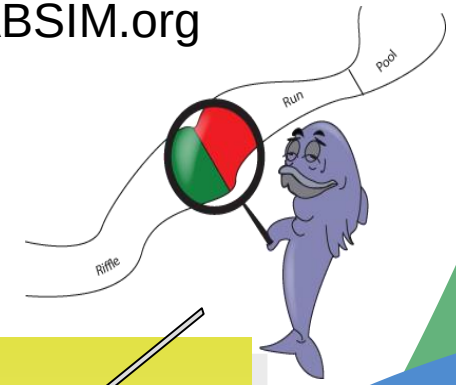

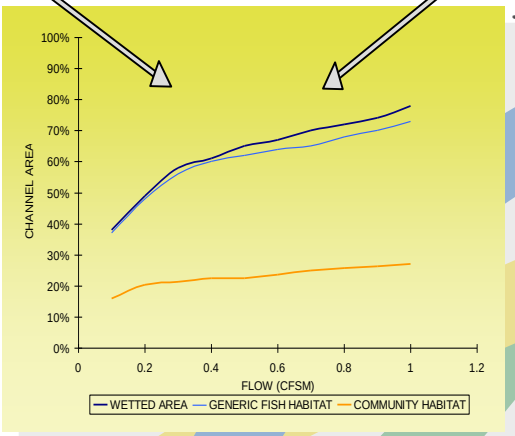

THANK YOU LET IT FLOW

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