

Criteria for assessment of stream continuity

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What is "stream continuity"?

Water Framework Directive (WFD):

*" The continuity of the river is not disturbed by anthropogenic activities and allows **undisturbed migration of aquatic organisms** and sediment transport."*

Aim of this presentation

3 central criteria for assessment of "stream continuity":

1. Reference conditions.

- Historical record of all aquatic migratory organisms at a given site

2. Present conditions.

- Updated registry of migratory organisms, and potential migrational barriers.

3. Deviation between reference and present conditions.

- A thorough analysis of the potential migrational barriers to be instrumental in the difference between historical and present species range.

What do we want?

- ✓ A transparent evaluation and assessment system for stream continuity
- ✓ Possibility to divide the assessment in sub-catchments, according to watersheds and potential barriers to migrating organisms
- ✓ A measure of continuity in rivers and tributaries, enabling comparisons.
- ✓ Measureable "continuity-improving" objectives for use at restoration projects

How do we get there?

- Build on all migratory aquatic organisms
 - (rather than on hydrological characteristics or on singular, "representative" species)
- Documentation of species composition, population size and structure
- In-depth studies of migrations and biology of aquatic organisms
 - Fish migrational biology
 - Modelling of population/metapopulation structure

Documentation.....

Aquatic organisms

- Bacteria
- Algae
- Aquatic Plants
- Aquatic Invertebrates
- Vertebrates
 - Mammals
 - Reptiles and Amphibians
 - Birds
 - Fish

” The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport.”



Migrating fish

Diadromous species:

- Houting (*Coregonus oxyrinchus*)
- Atlantic Salmon (*Salmo salar*)
- Sea trout (*Salmo trutta*)
- Sea Lamprey (*Petromyzon marinus*)
- River Lamprey (*Lampetra fluviatilis*)
- Sturgeon (*Acipenser sturio*)
- European Eel (*Anguilla anguilla*)

Feeding

Breeding

Wintering

Potamodromous species:

- Grayling (*Thymallus thymallus*)
- Brook Lamprey (*Lampetra planeri*)
- Common Dace (*Leuciscus leuciscus*)
- Weatherfish (*Misgurnus fossilis*)

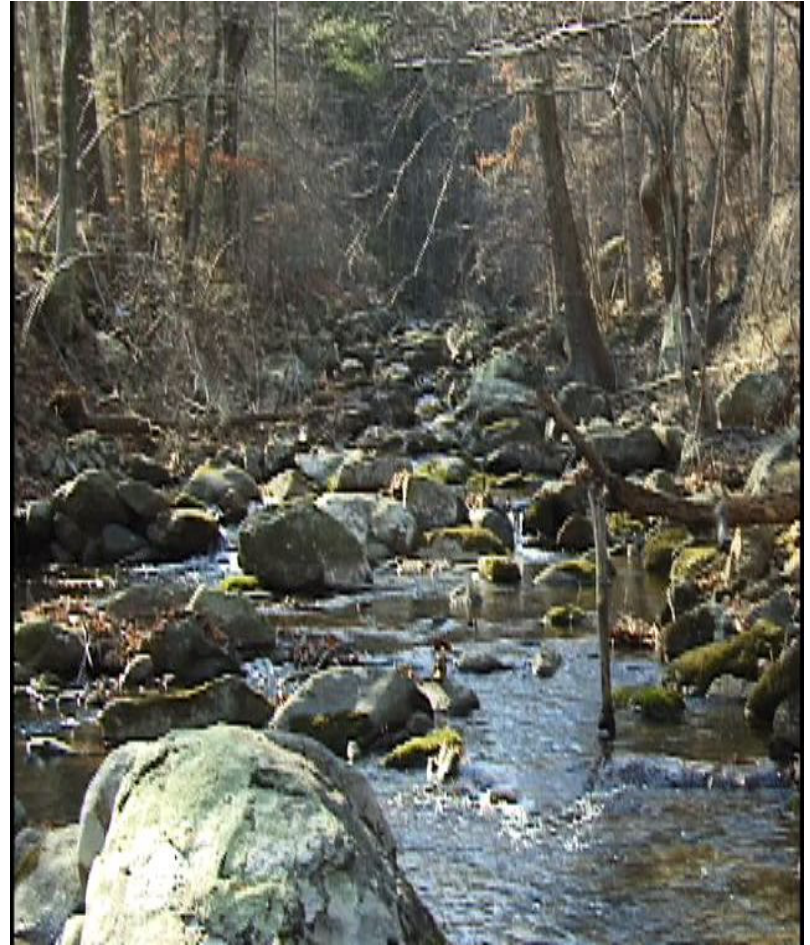
Criterion 1: Reference conditions

What to look for:

- Historical data
- Least-impacted sites
- Modelling
- Expert knowledge

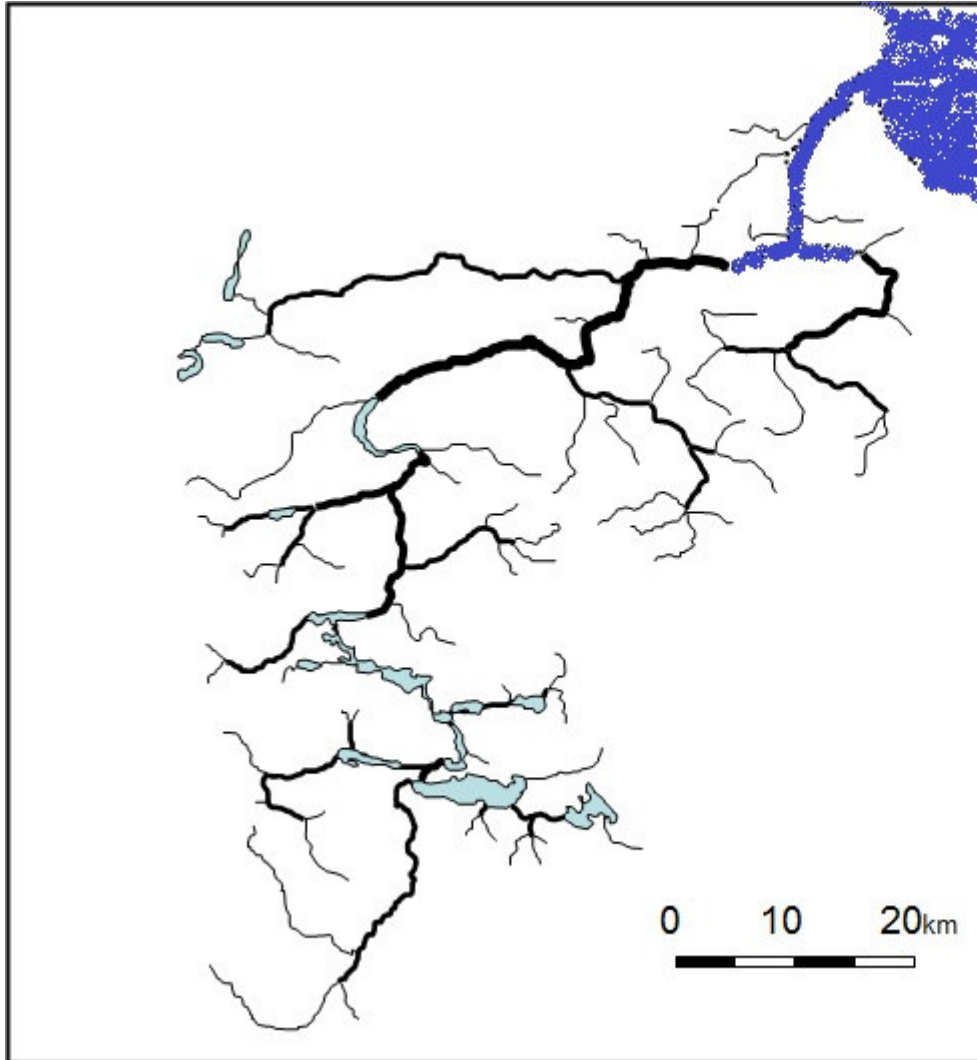
Outcome:

Report describing reference species list and population structure under pristine (unimpacted) conditions



Least impacted sites

= sites with most migratory species



Criterion 2: Present conditions

- Registry of:
 - Species presence/absence, density, age-structure
 - Listing of all potential migrational barriers
 - Longitudinal AND lateral barriers



Longitudinal and lateral continuity



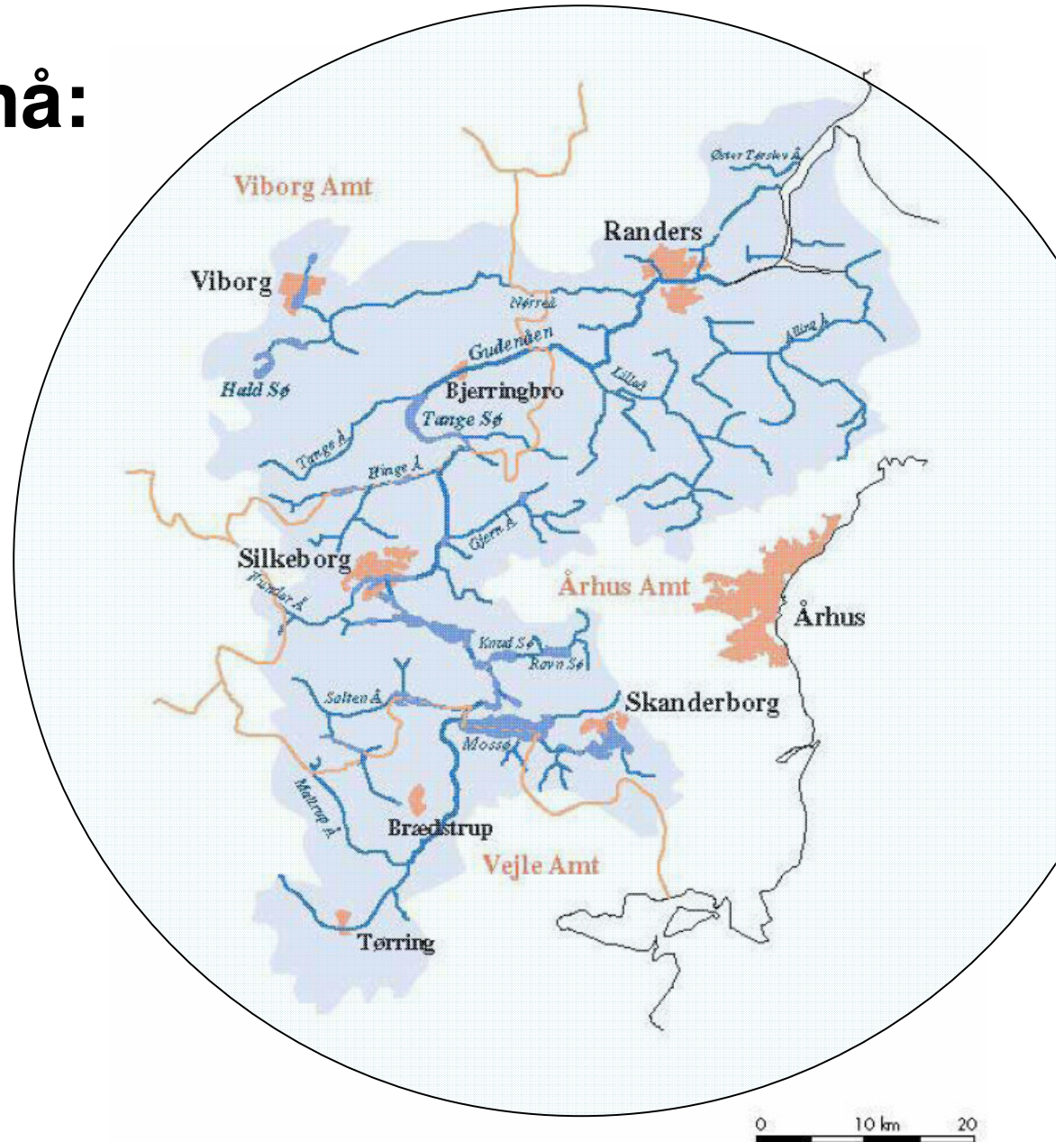
Agents of discontinuity

- Weirs
- Dams
- Abstraction systems
- Hydrological alterations
- Embankments
- Drainage pipes
- Closure of stream segments
- Road culverts
- Aquatic weed cutting
- Fishing activities

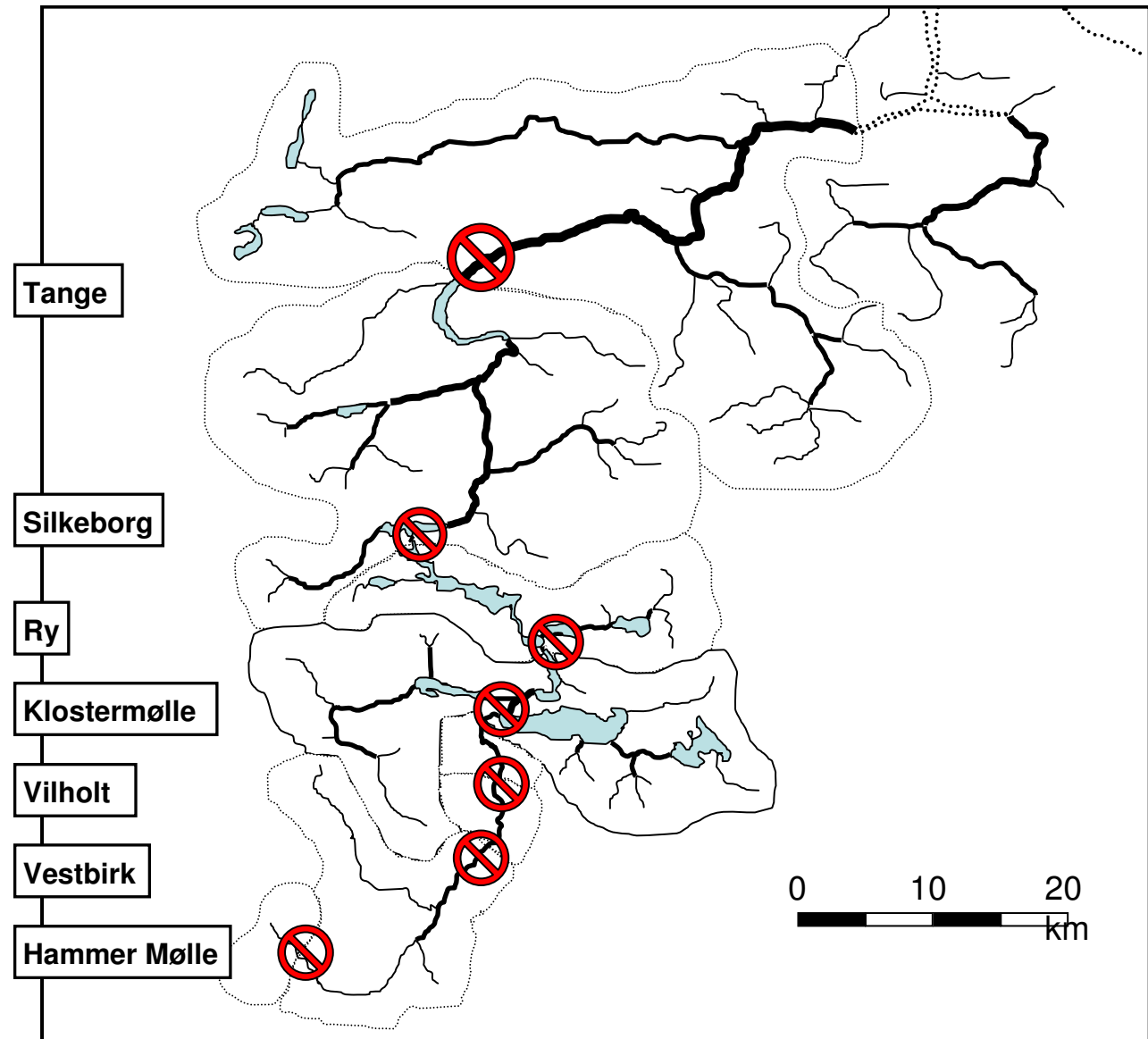


The River Gudenå:

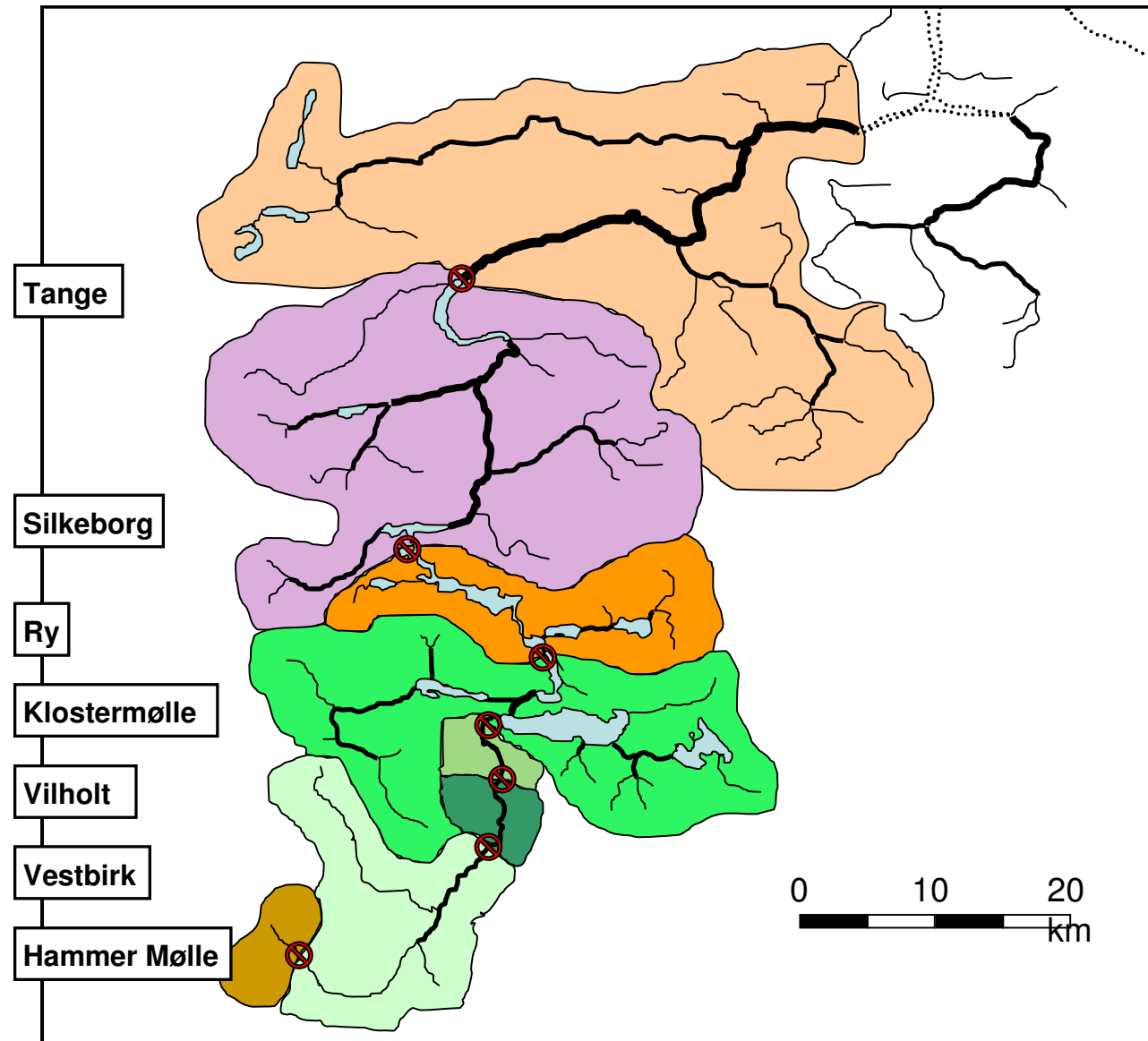
- 150 km long
- Median discharge $25 \text{ m}^3\text{s}^{-1}$
- 28 native fish species
- 9 introduced species



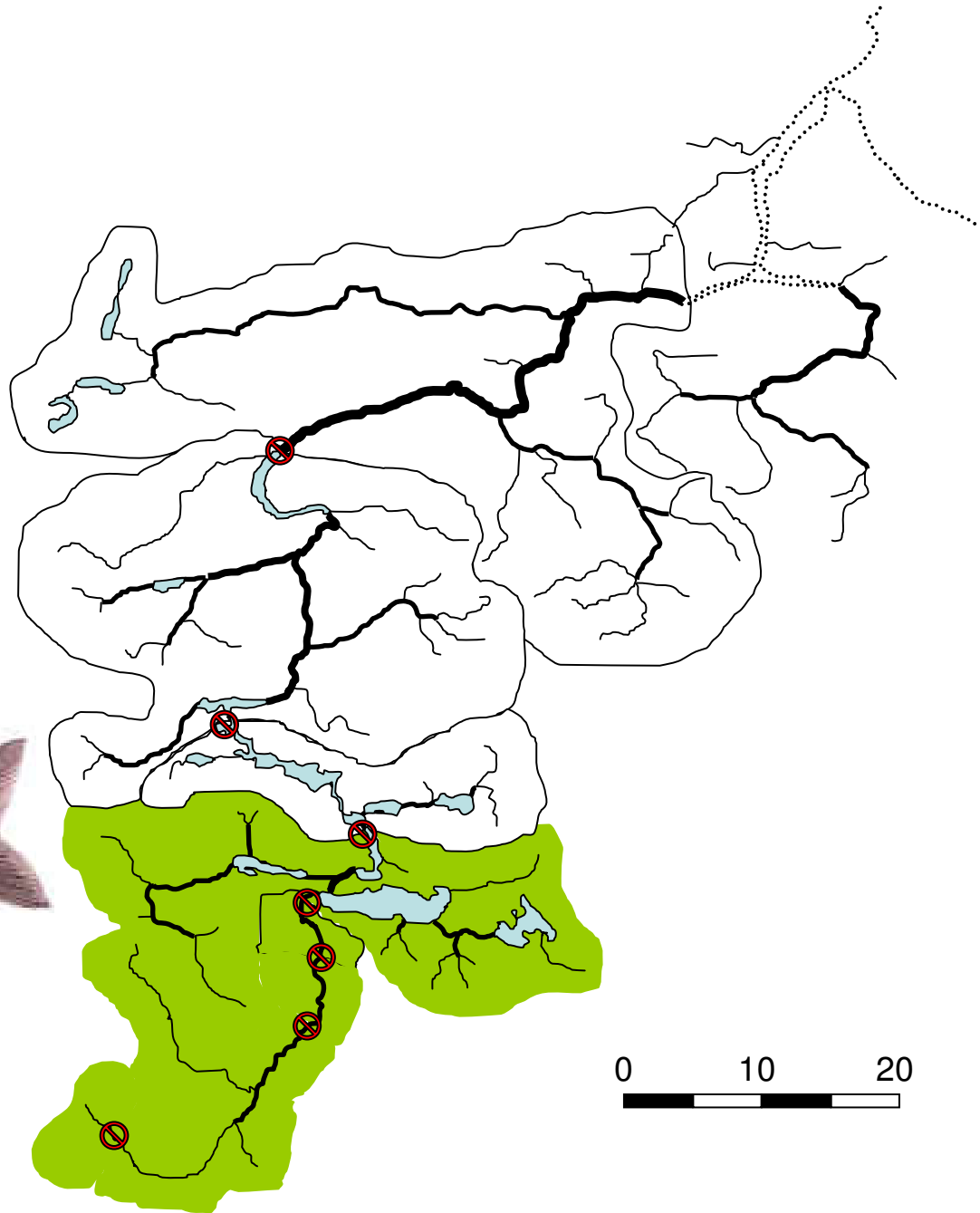
Sub-catchments and migrational barriers



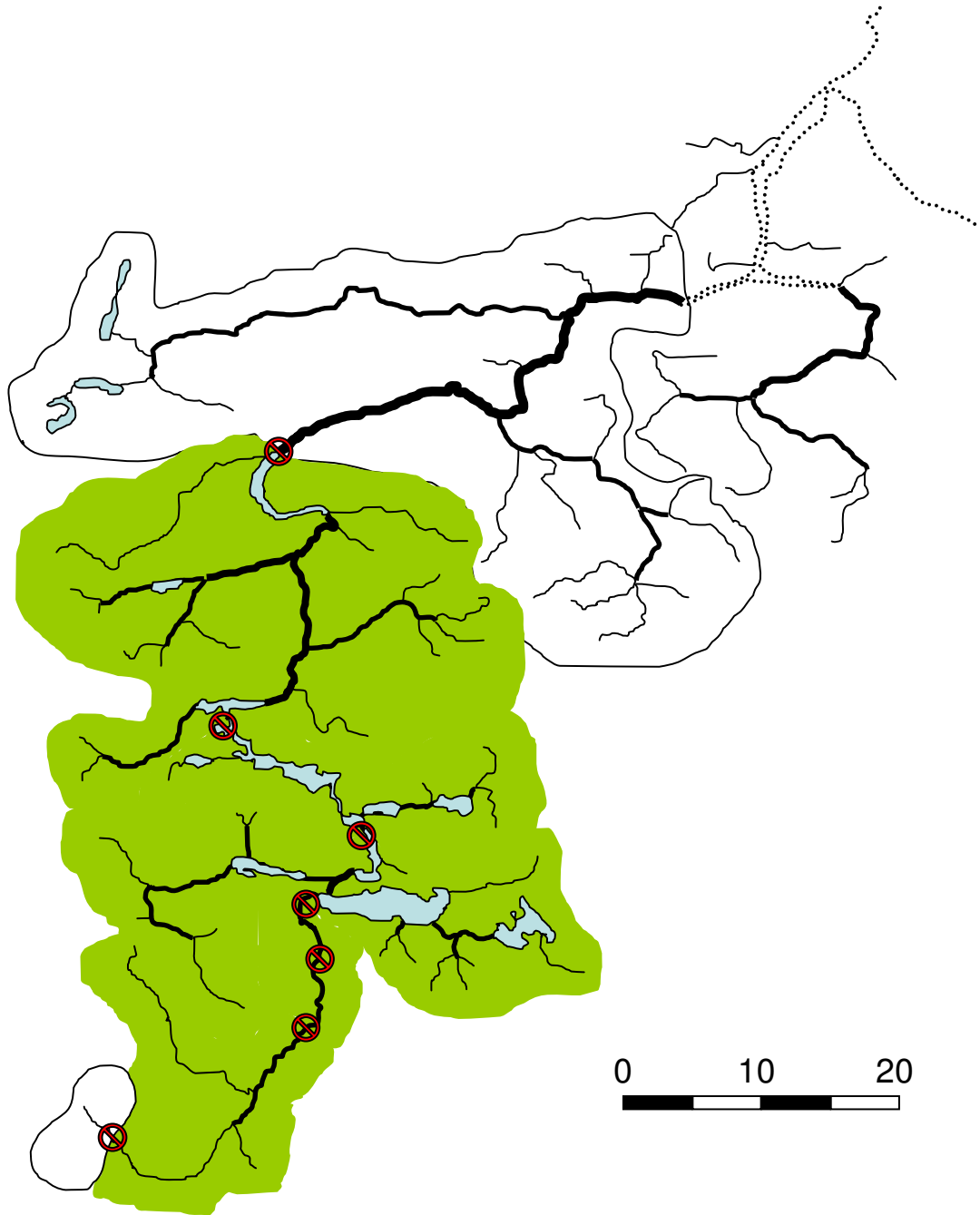
Sub-catchments and migrational barriers



Grayling



Gudgeon



Criterion 3: Historical-present comparison

- Explaining most possible reasons for changes in diversity of migratory fish
- Linking changes to registry of potential migrational barriers

Scaling of the assessment

- Stretch
- Sub-catchments
- Catchment
- Regional level



Scaling of monitoring effort

- Most simple:
Species
presence/absence
- Elaborate:
Population size
- More elaborate:
Lifehistory analysis



Conclusion

- An organism-based continuity assessment system must rest upon several reporting stages:
 1. Description of pristine conditions
 2. Survey of present conditions
 3. Comparison coupled with potential discontinuity vectors.
 4. A post-project evaluation of effects obtained

The houting project

- ... has already used the three criteria: Historic record, present distribution, analysis of the difference.
- ... has established a convincing linkage between the numerous weirs at rainbow trout hatcheries and the lack of upstream passage for spawning houting.
- ...has utilised basic research on the osmoregulatory capabilities of young houting as a cornerstone in the river restoration strategy.
- ...has demonstrated the importance of lateral continuity, causing increasing hydraulic retension, presumably very important for survival of houting fry.

