Integrating water management and fish conservation:

Contributions from EU-projects (FAME, EFI+) and other projects to the implementation of WFD and Habitats Directive

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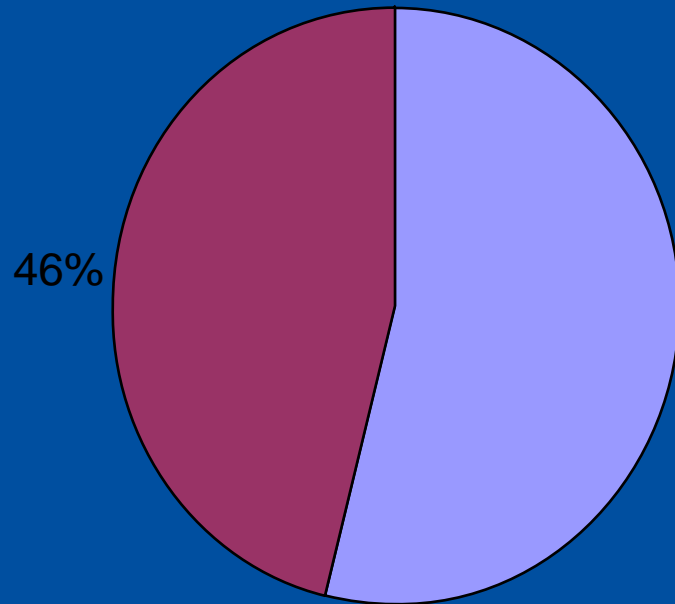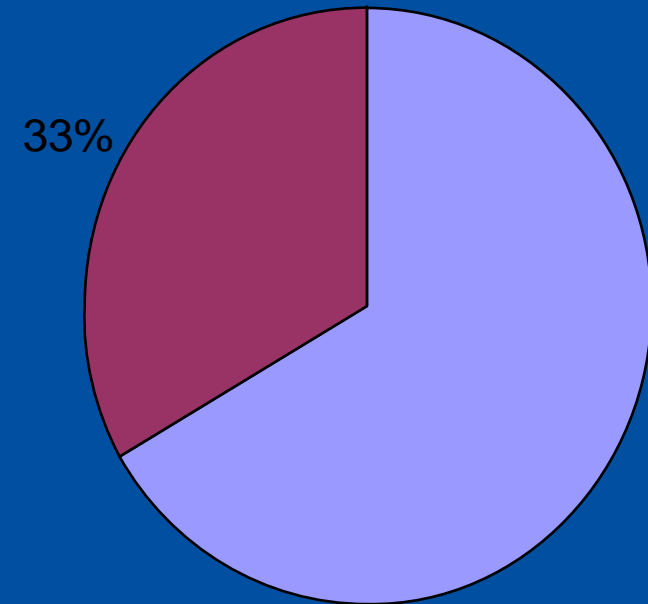*Inst. of Hydrobiology and Aquatic Ecosystem Management*

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Conservation status of fishes

Fishes belong to the most threatened species of the world

World (IUCN 2004)

Europe (Kottelat & Freyhof 2007)

46%

33%

threatened

Aims of European Directives

Habitats Directive

*"To contribute towards ensuring **biodiversity** through the **conservation** of natural habitats and of wild fauna and flora in the European territory …"*

Water Framework Directive

*To establish a framework for the **protection** of inland surface waters…which **prevents** further **deterioration** and protects and **enhances** the status of **aquatic ecosystems** …*

Biodiversity and WFD

WFD - high status classification for fish

All the type specific disturbance *sensitive species* are *present*.

Species *composition* and *abundance* correspond totally or *nearly* totally to *undisturbed conditions*.

The *age structures* of the fish communities show *little* sign of *anthropogenic disturbance* and are *not* indicative of a *failure in the reproduction* or development of any particular species.

Development, Evaluation and Implementation of a standardised Fish-based Assessment Method for the Ecological Status of European Rivers (FAME)

A Contribution to the Water Framework Directive

A research project supported by the European Commission under FP 5

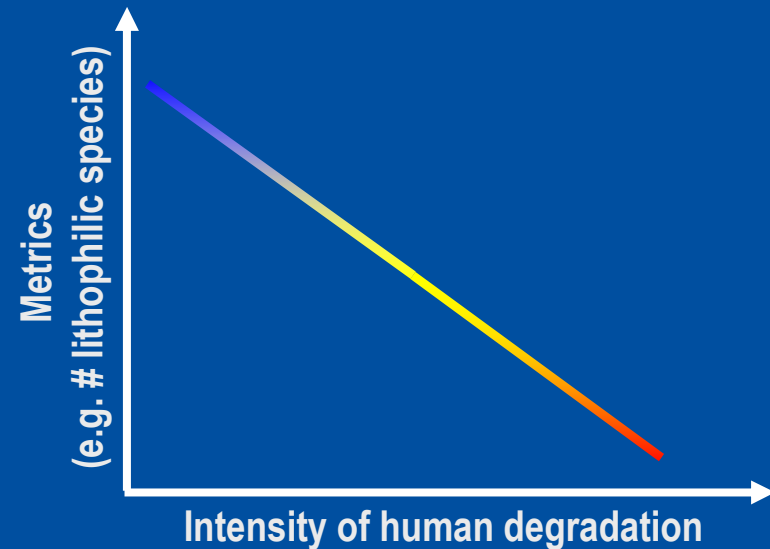*http://fame.boku.ac.at*

www.boku.ac.at/hfa

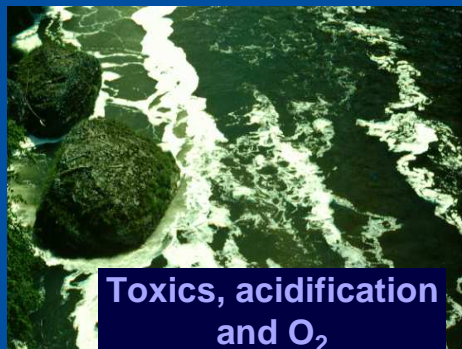# Basic concept of assessment
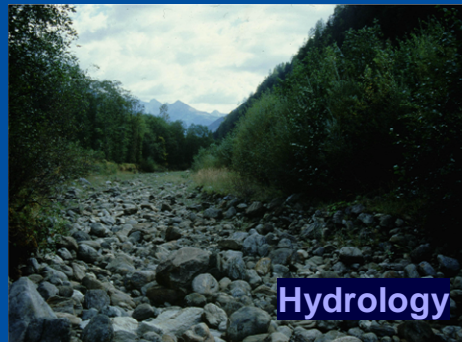
Basis = **Index of Biotic Integrity** (IBI, Karr 1981):

- description of fish assemblage by metrics

- metrics response to human pressures

Identification of reference conditions & pressure classification

4 pressure variables

Hydrology

Morphology

Toxics, acidification and O_2

Nutrients and organic input

FIDES – Fish Database of European Streams

Data of

- **12 countries**
- **17 ecoregions**
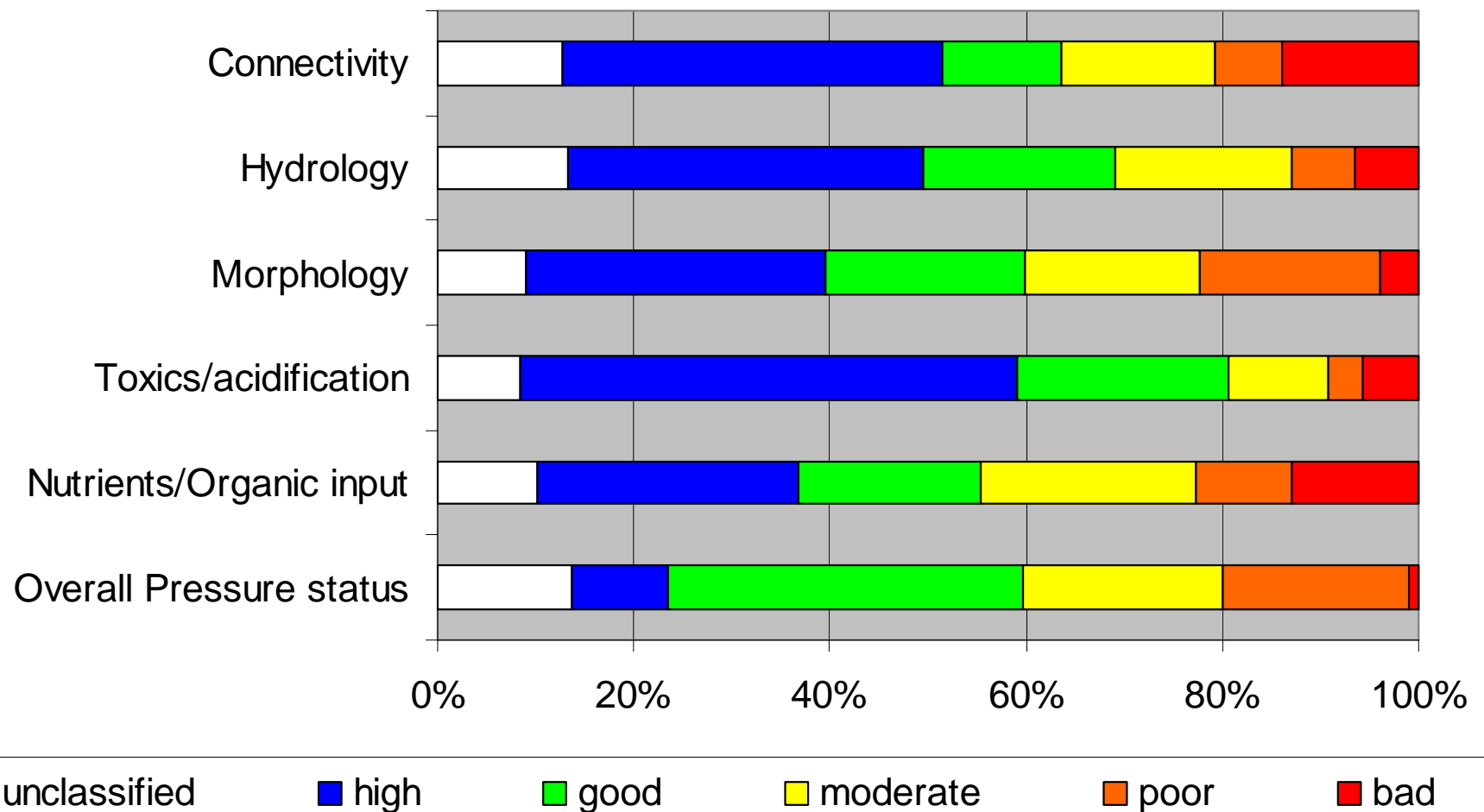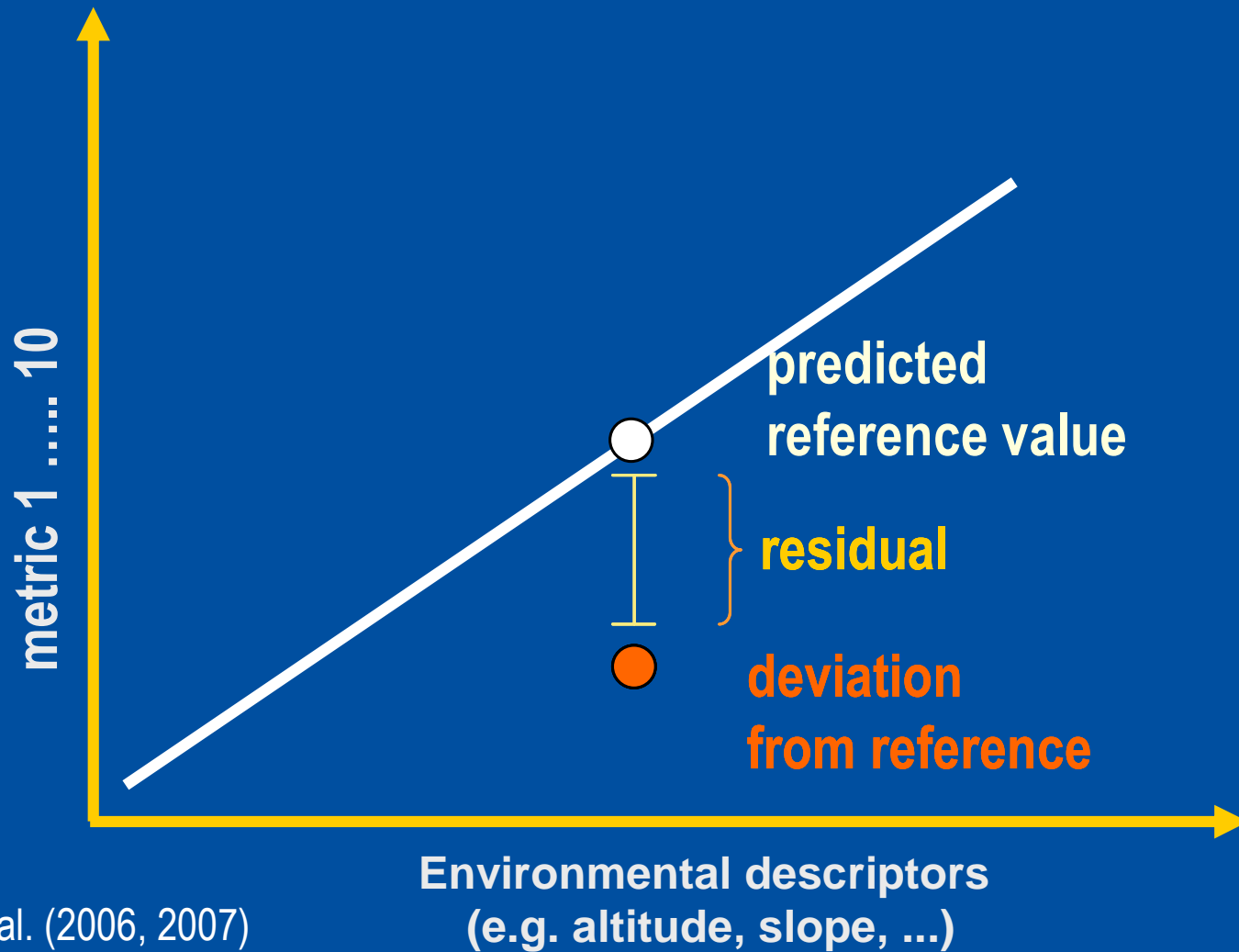- **2 651 rivers**
- **8 228 sites, ca. 15 000 samples**

Main pressures in European rivers

European Fish Index methodology

Pont et al. (2006, 2007)

European Fish Index – metrics list

Trophic structure

    1. Density of insectivorous species

    2. Density of omnivorous species

Reproduction guilds

    3. Density of phytophilic species

    4. Relative abundance of lithophilic species

Physical habitat

    5. Number of benthic species

    6. Number of rheophilic species

Tolerance to disturbance in general

    7. Relative number of intolerant species

    8. Relative number of tolerant species

Migratory species richness

    9. Number of species migrating over long distances

    10. Number of potamodromous species

Trend of reaction to pressures

Metric	Trend
1. Density of insectivorous species	↓
2. Density of omnivorous species	↑
3. Density of phytophilic species	↑
4. Relative abundance of lithophilic species	↓
5. Number of benthic species	↓
6. Number of rheophilic species	↓
7. Relative number of intolerant species	↓
8. Relative number of tolerant species	↑
9. Number of species migrating over long distances	↓
10. Number of potamodromous species	↓

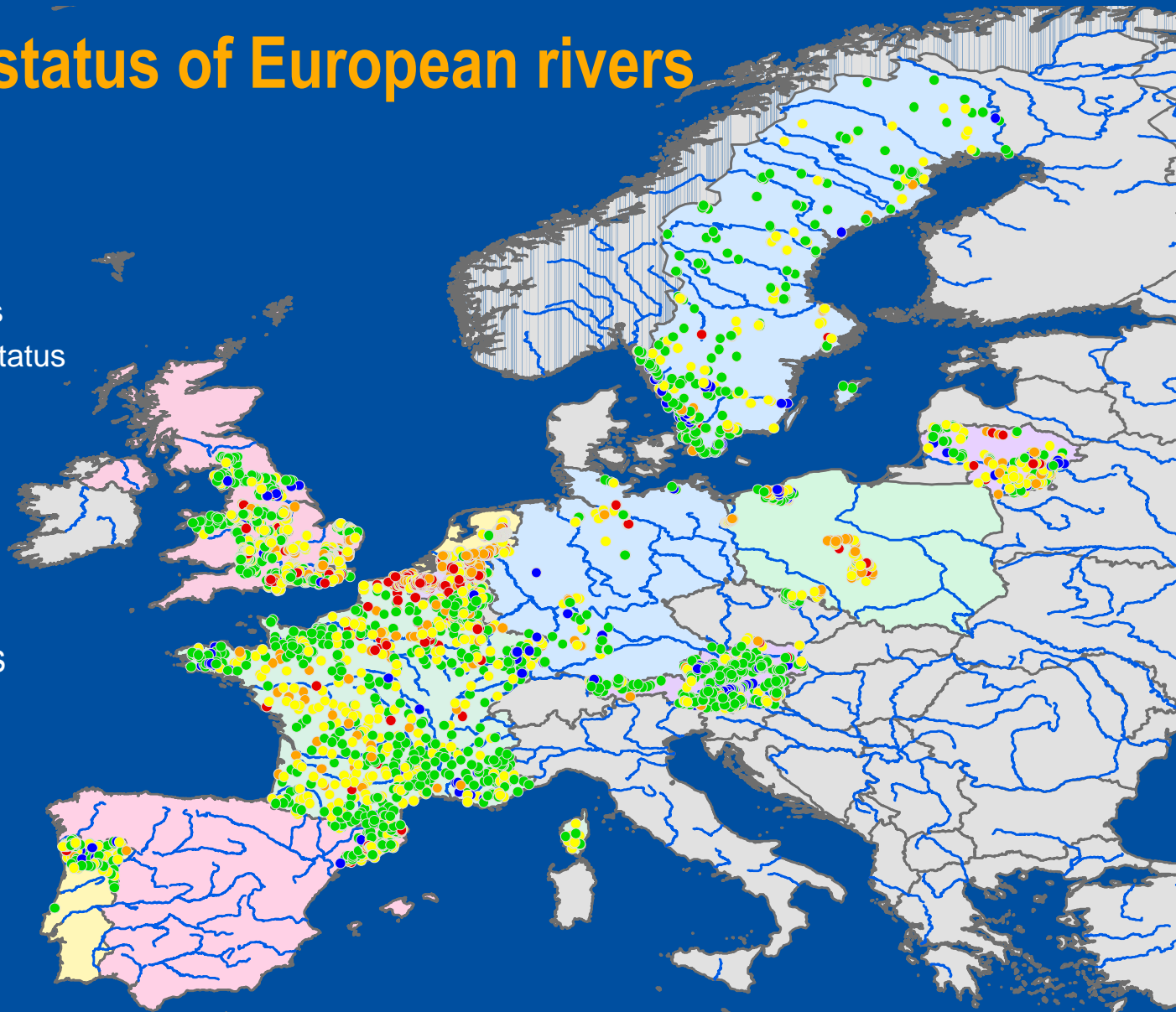*http://fame.boku.ac.at*

www.boku.ac.at/hfa
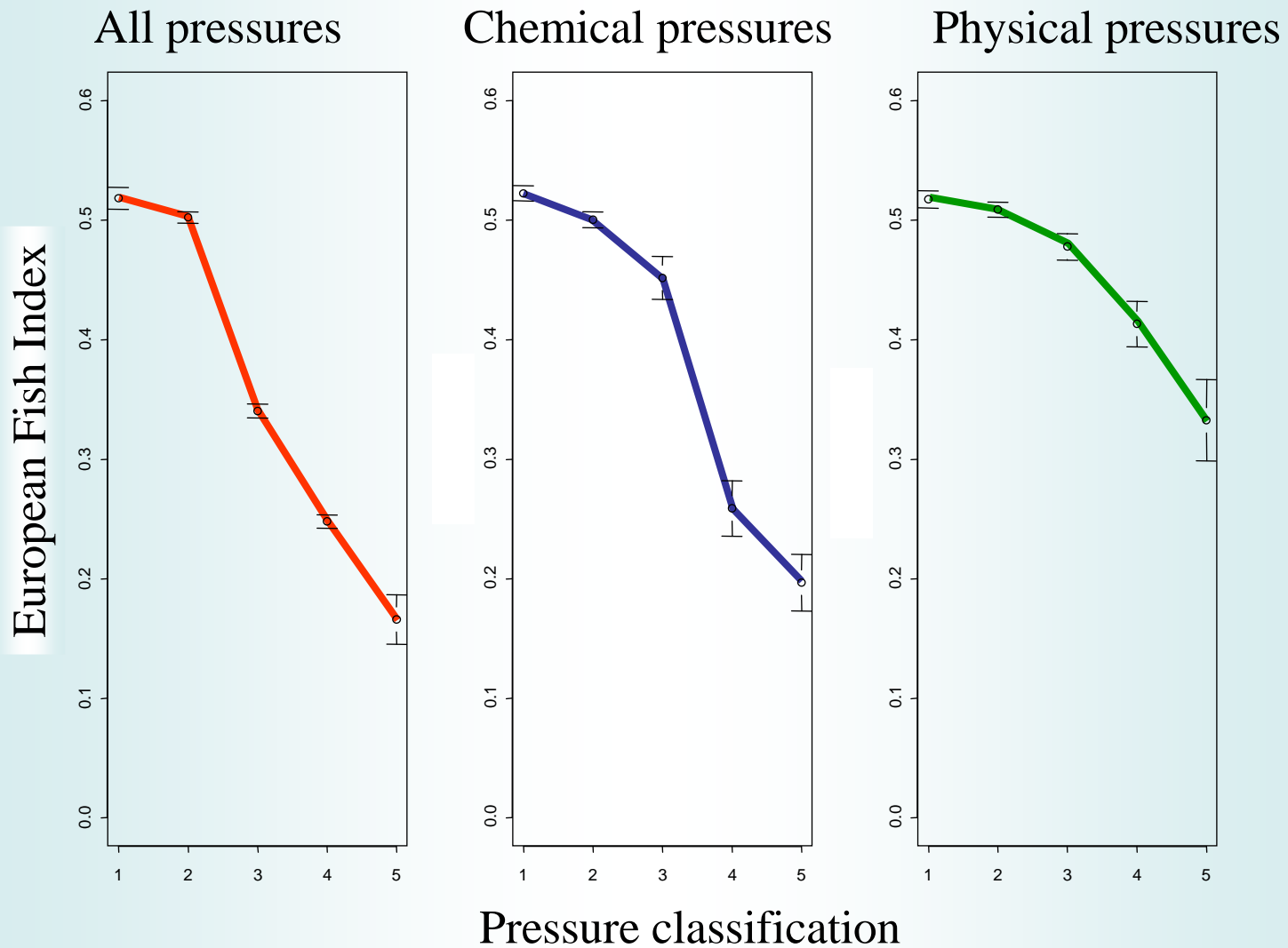
Ecological status of European rivers

Index classes

- ⬭ 1 – high status
- ⬬ 2 – good status
- ⬬ 3 – moderate status
- ⬬ 4 – poor status
- ⬬ 5 – bad status

81 % of reference and impacted sites correctly classified when comparing with human pressures

Index response to different types of human pressures

Conclusions of FAME and EFI

- **With EFI it is possible to incorporate natural variability of fish in Europe in a single index.**

- **Regional differences can be overcome by using functional metrics.**

- **EFI is calibrated against pressures and degradation is assessed as statistically proven deviation from reference conditions.**

- **EFI software and manual can be downloaded from the internet.**

- **FAME and EFI enables the first time a standardised assessment accross Europe**

Objectives of EFI +

- The overall goal of the project is to develop a new, **more accurate and wider applicable EFI.**

- The existing EFI will be evaluated in **Eastern, Mediterranean** and **Large Rivers** and necessary adaptations will be identified.

- Relationships between **hydromorphological pressures** (incl. continuity) and fish assemblages will be analysed.

# Contributions of FAME, EFI+ to fish diversity conservation

Conservation efforts for European fishes

- 72 fish species are listed in the Habitats Directive (annex II)

- Fishes are protected in 2703 Natura 2000 sites (16 % of all Natura 2000 sites, EUNIS database)

- For nearly all annex II species (66 species, 92 %) Natura 2000 sites have been established (EUNIS database)

Natura 2000 sites

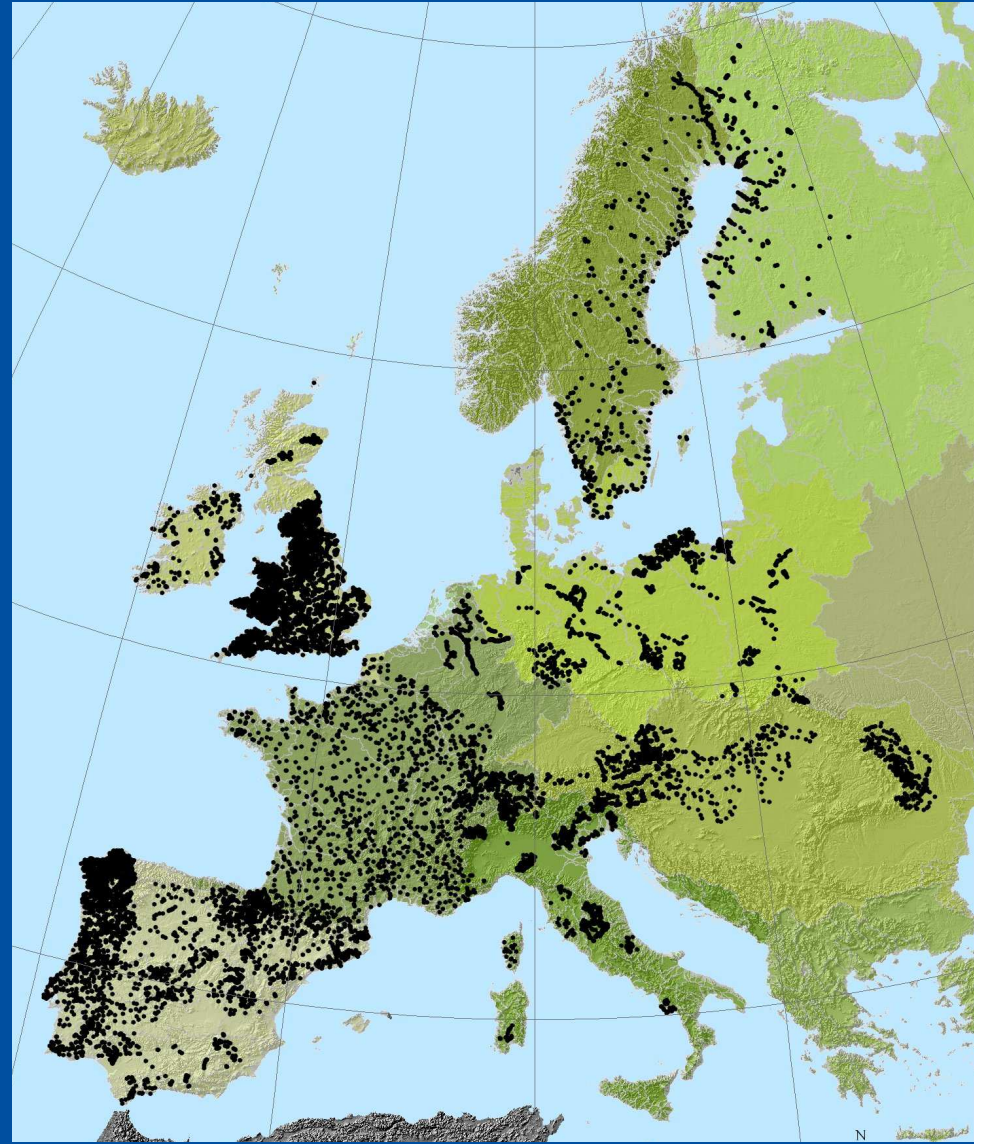Life projects

Annex II species
(FAME)
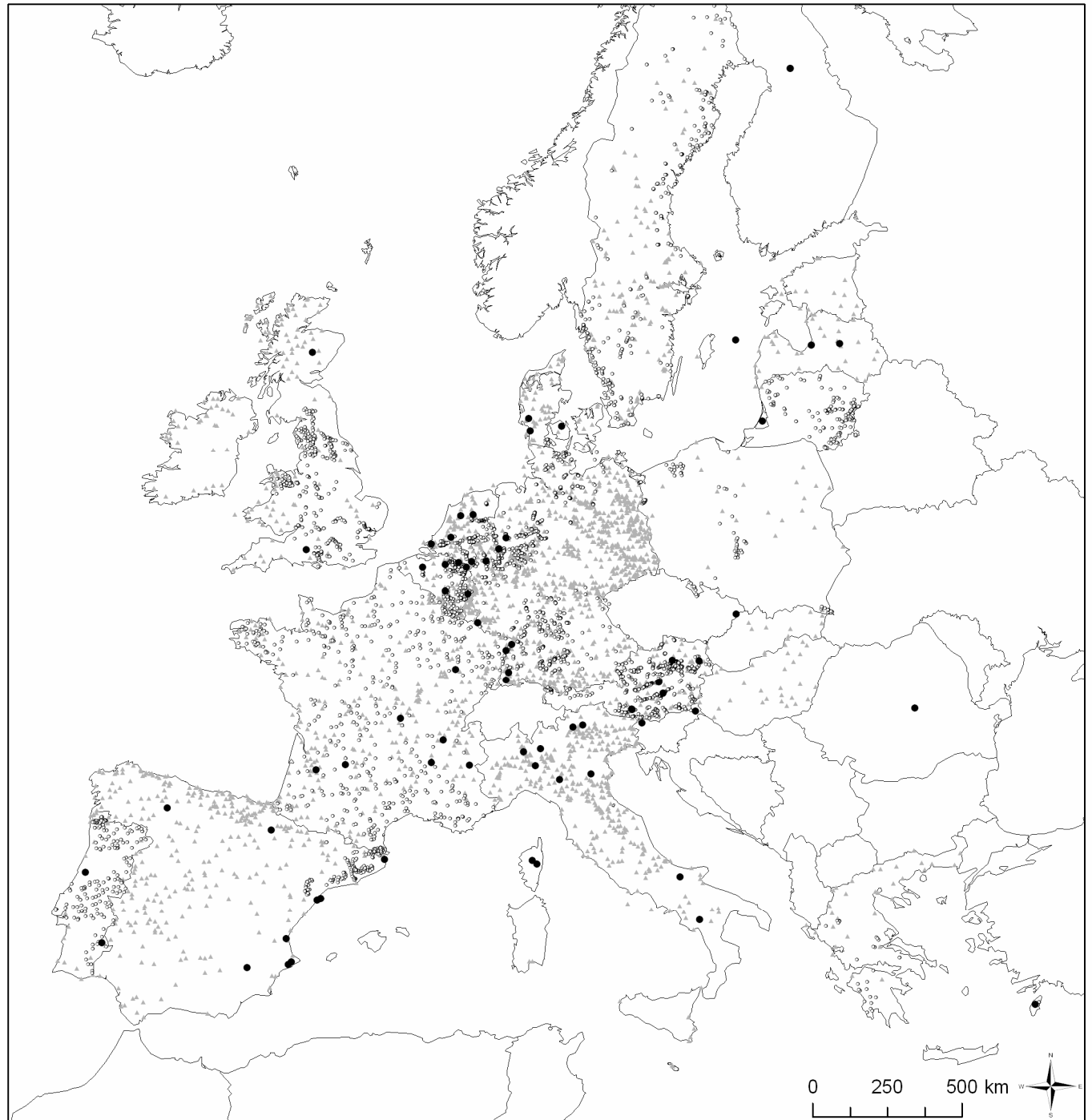
Contribution of FAME to Habitats Directive

- For 3 species NATURA 2000 sites have not been designated although existing populations have been documented in FAME-database:
  - *Chondrostoma willkommii, Ladigesocypris ghigii* and *Scardinius graecu*.

- *Species with questionable conservation status:*
  - *Cottus gobio* is the forth most common species in FAME-database and found in nearly every second site of FIDES (44 %).
  - *Aspius aspius, Cobitis taenia, Lampetra planeri, Salmo salar and Rhodeus sericeus* are also frequent species

Current status of EFI+ database

> 16 000 sites

Current status of EFI+ database

Research opportunity

Merging FAME and EFI+ databases with other EU databases will give new insights in fish diversity patterns, threads and management options.

LIFE-Nature projects

- Between 1992 and 2006 70 LIFE projects designated to fish (154 mio. €)

- 37 fish species targeted by LIFE projects (51 % of annex II)

No need for further improvement
of European fish protection?

Reviewing LIFE-Nature projects

- Weak documentation
  - reports only in national languages
  - lack of scientific publications

- Almost half of the 29 finalised projects (13 projects) failed to clearly demonstrate project success (quantifiable criteria)

How to quantify biodiversity loss/recovery

- Biodiversity metrics
  - Species richness, endangered species, endemic species, invasive species, etc.

  Versus

- Functional metrics
  - Trophic status, migratory behaviour, etc.

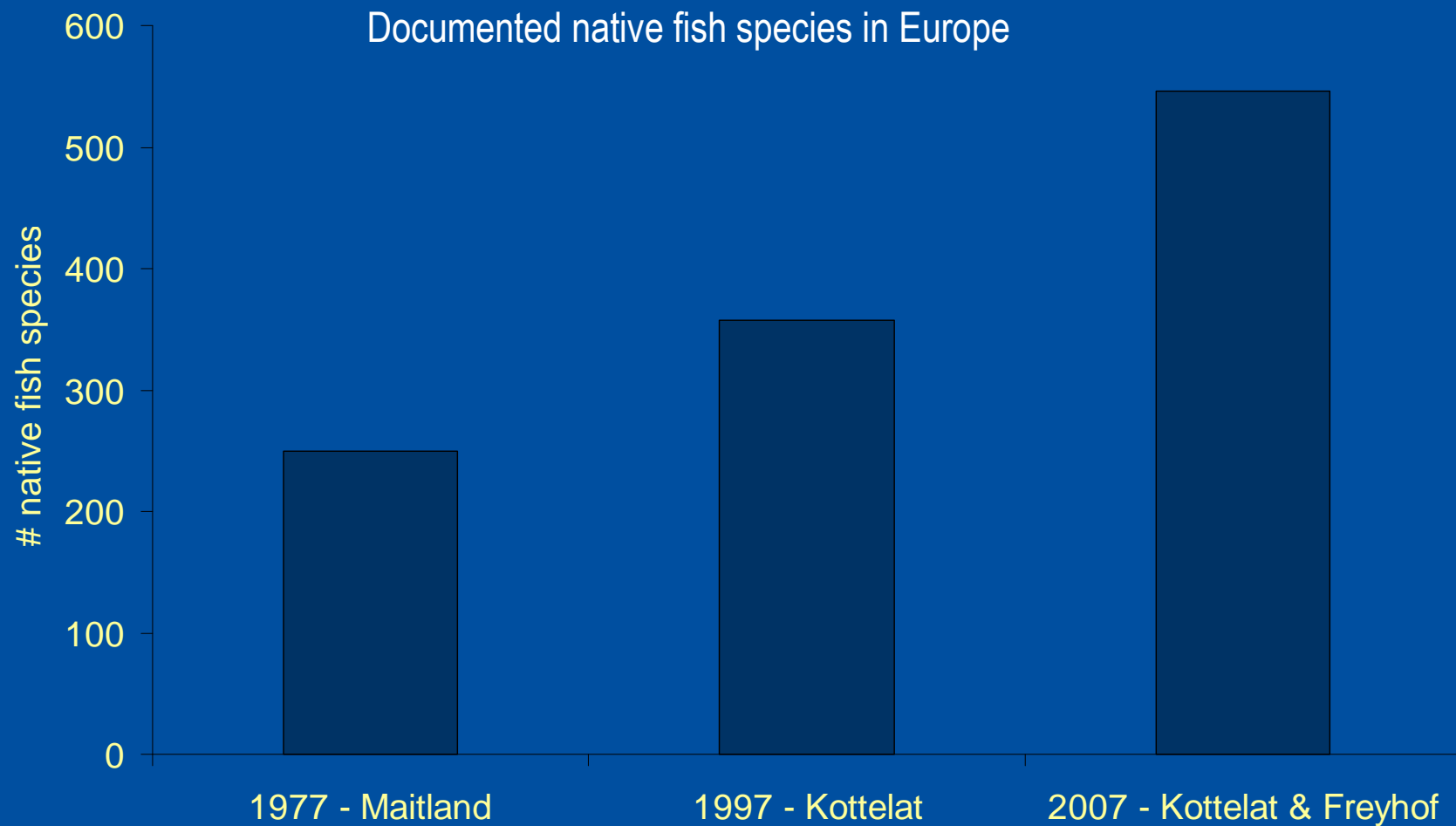# How to quantify biodiversity loss/recovery

- Biodiversity metrics

Research needs

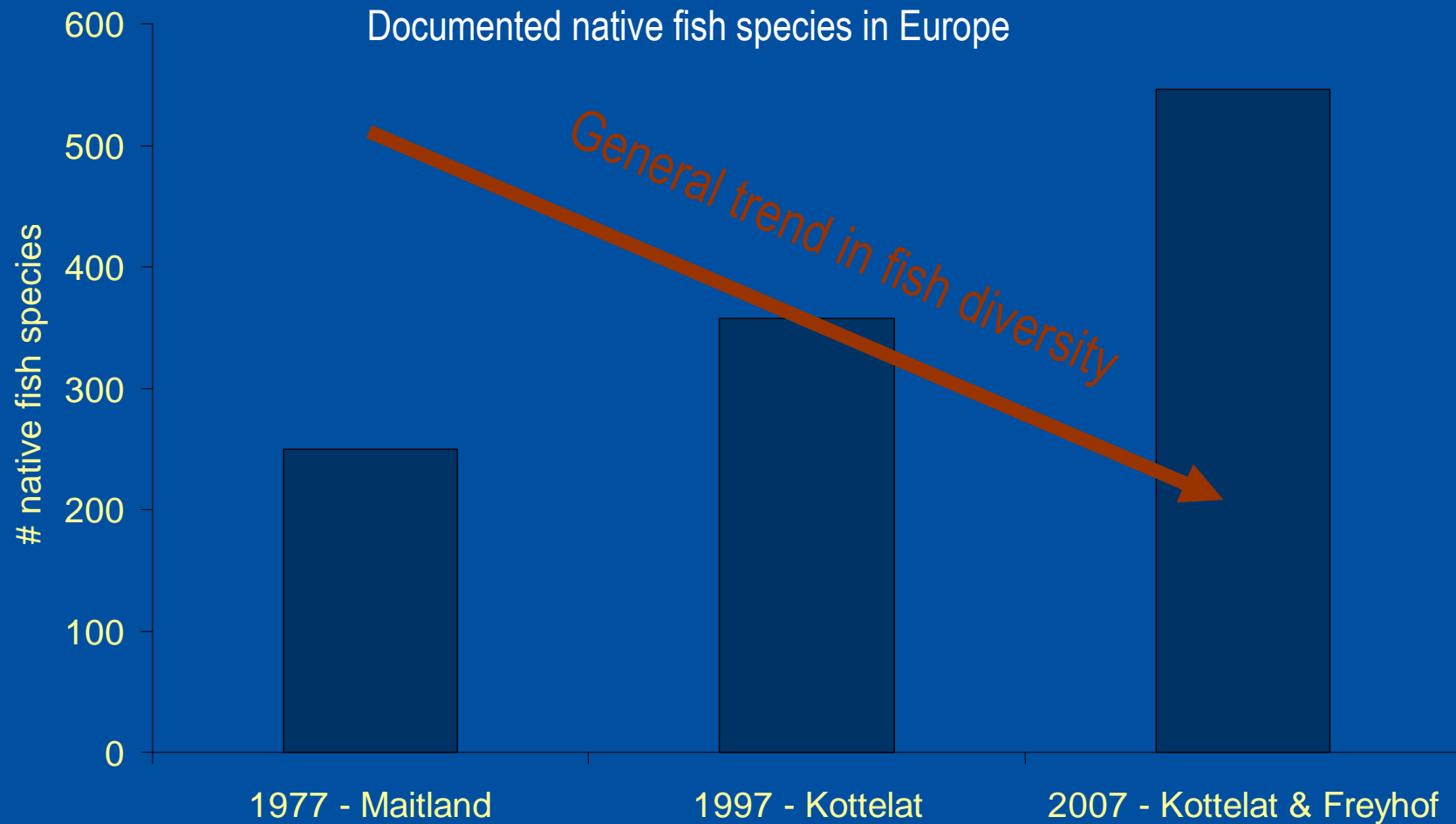Comparative analyses of biodiversity-related and functional metrics at European scale

Development of standardised biodiversity assessment methods

How to measure biodiversity?

Documented native fish species in Europe

How to measure biodiversity?

Documented native fish species in Europe

General trend in fish diversity

native fish species

600
500
400
300
200
100
0

1977 - Maitland   1997 - Kottelat   2007 - Kottelat & Freyhof

How to measure biodiversity?

Documented native fish species in Europe

600

Research needs

Fundamental research for understanding European fish diversity and spatial patterns

200

100

0

| 1977 - Maitland | 1997 - Kottelat | 2007 - Kottelat & Freyhof |
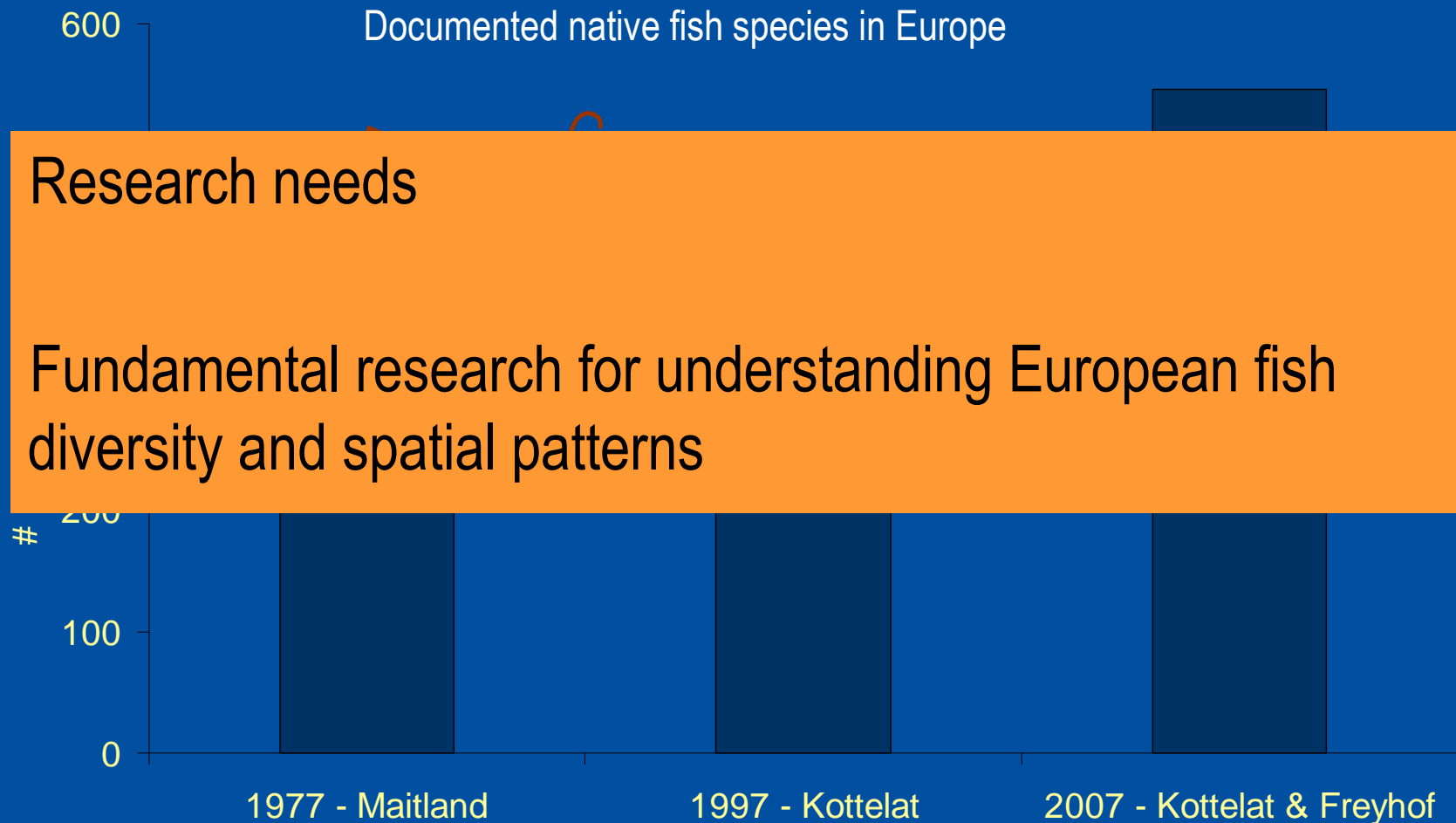
Aquatic habitat deterroriation continues

Non-passable migration barriers in Austria

(rivers >100km^2, 3.148 ≡ *one per 3.6 km*)

Not all barriers were reported!
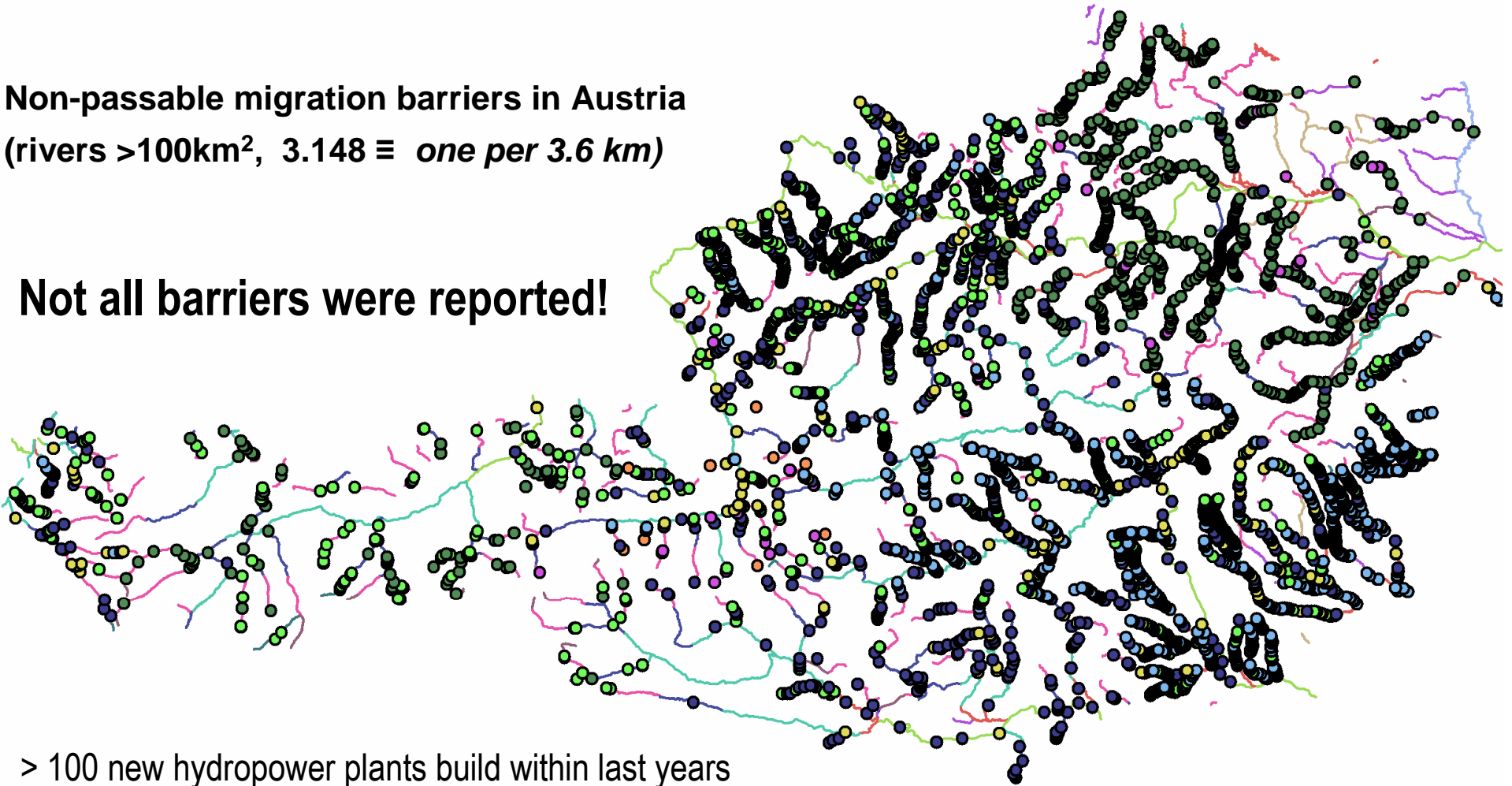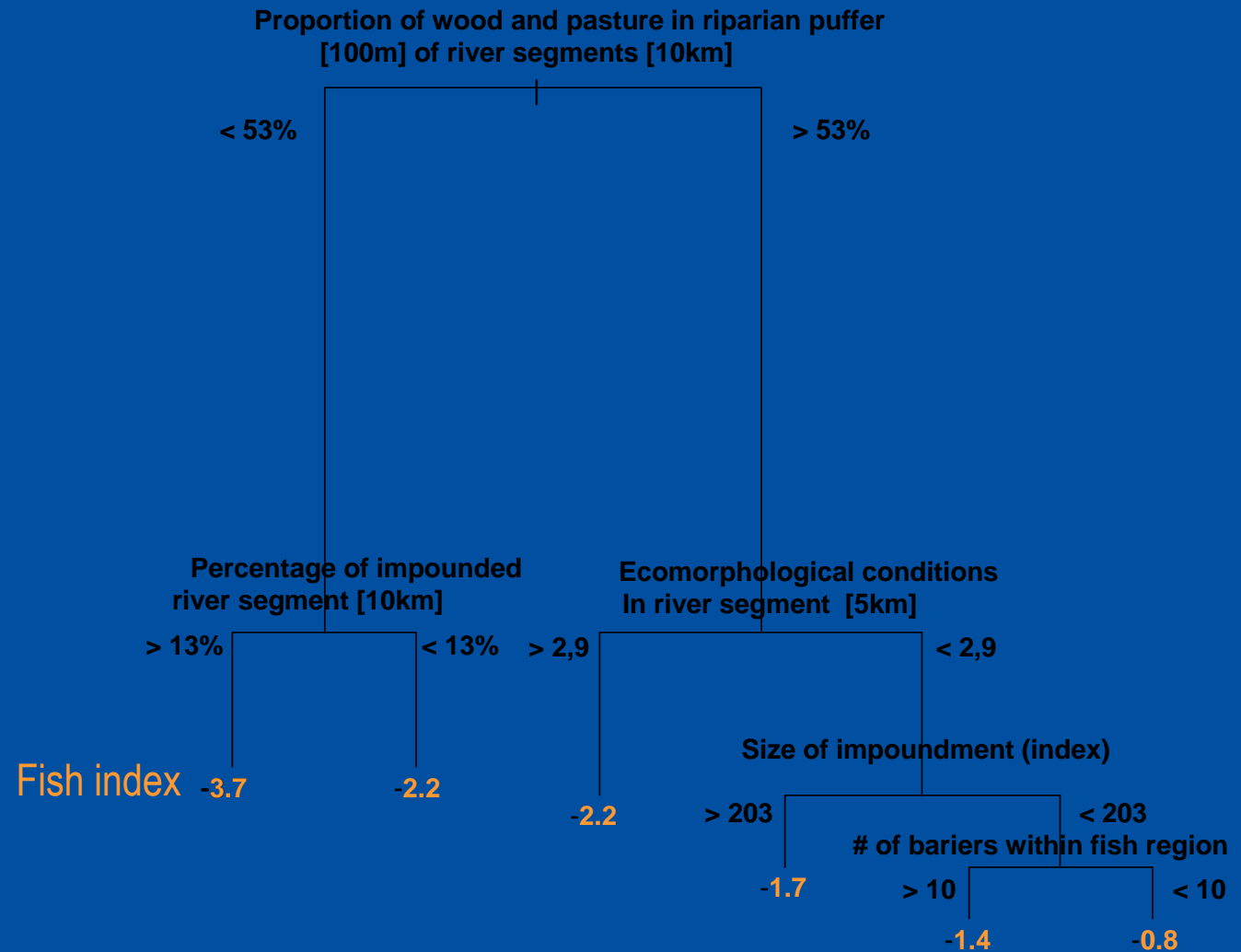
> 100 new hydropower plants build within last years

Lower Sava hydropower schema

Response of fishes to multiple pressures and scales

Proportion of wood and pasture in riparian puffer [100m] of river segments [10km]

433 sites of Lower Austria

< 53%   **> 53%**

Percentage of impounded river segment [10km]

Ecomorphological conditions In river segment [5km]

> 13%   **< 13%**   **> 2,9**   **< 2,9**

Size of impoundment (index)

Fish index   **-3.7**   **-2.2**   **-2.2**   **> 203**   **< 203**

# of bariers within fish region

-1.7   **> 10**   **< 10**

-1.4   **-0.8**

Model-based Instrument for River Restoration

www.boku.ac.at/hfa

Response of fishes to multiple pressures and scales

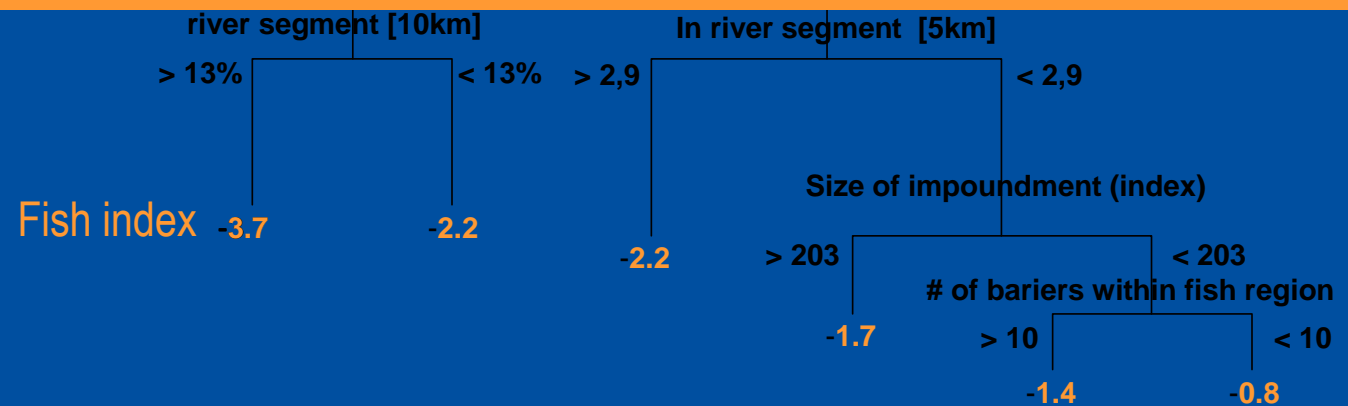**Proportion of wood and pasture in riparian puffer [100m] of river segments [10km]**

< 53%   > 53%

433
Aus

Research needs

Identifying key pressures and scales acting on fishes

river segment [10km]   In river segment [5km]

> 13%   < 13%   > 2,9   < 2,9

Size of impoundment (index)

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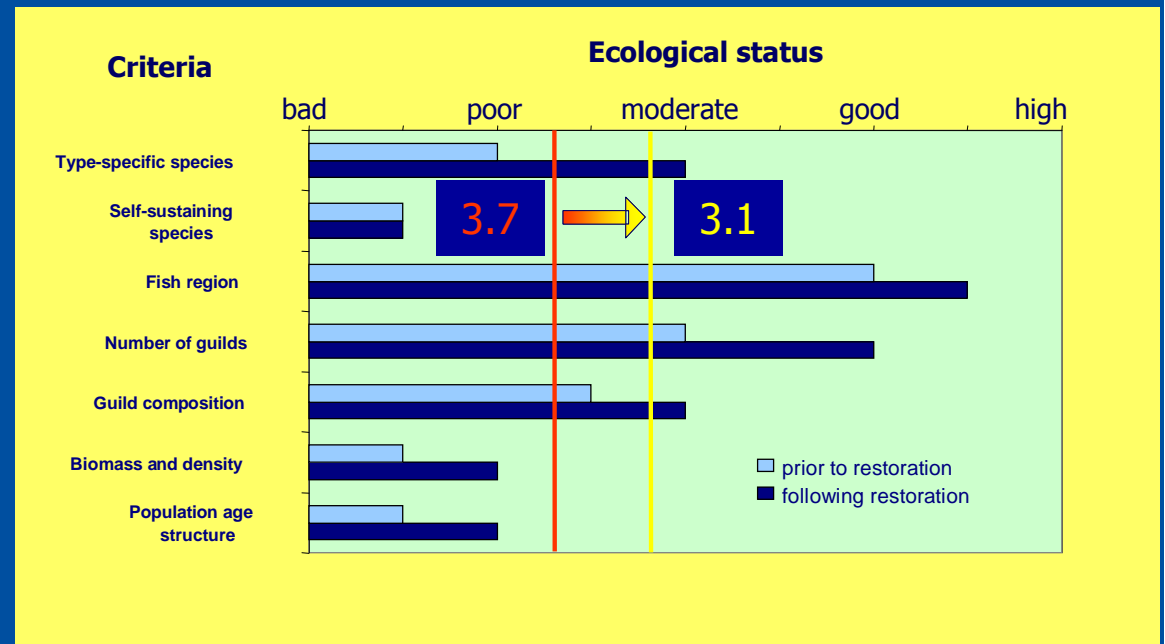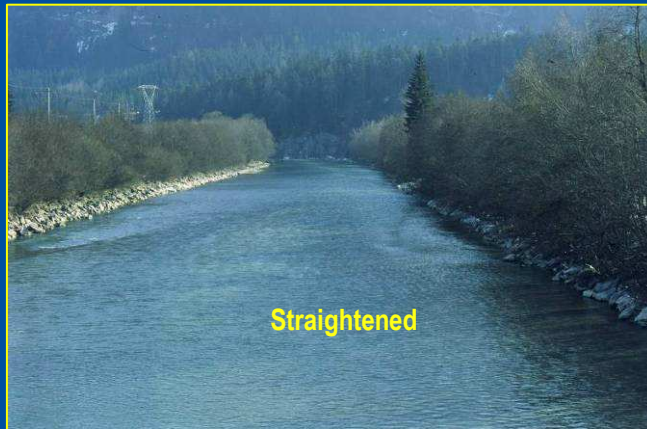
-1.4   -0.8

Is there any hope for biodiversity recovery?

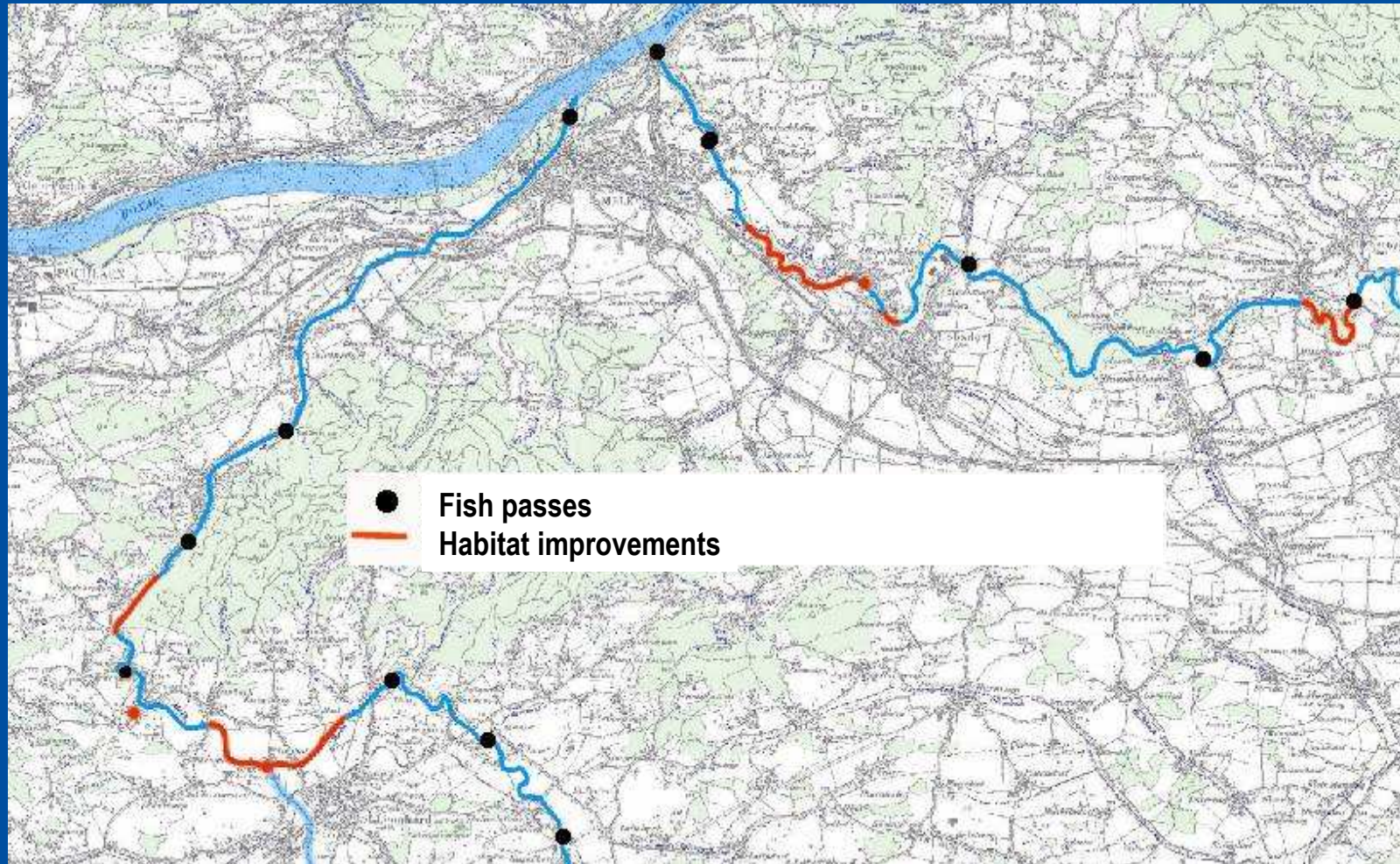LIFE-Nature project

Restoration of the River Drau

Muhar et al. (2007)

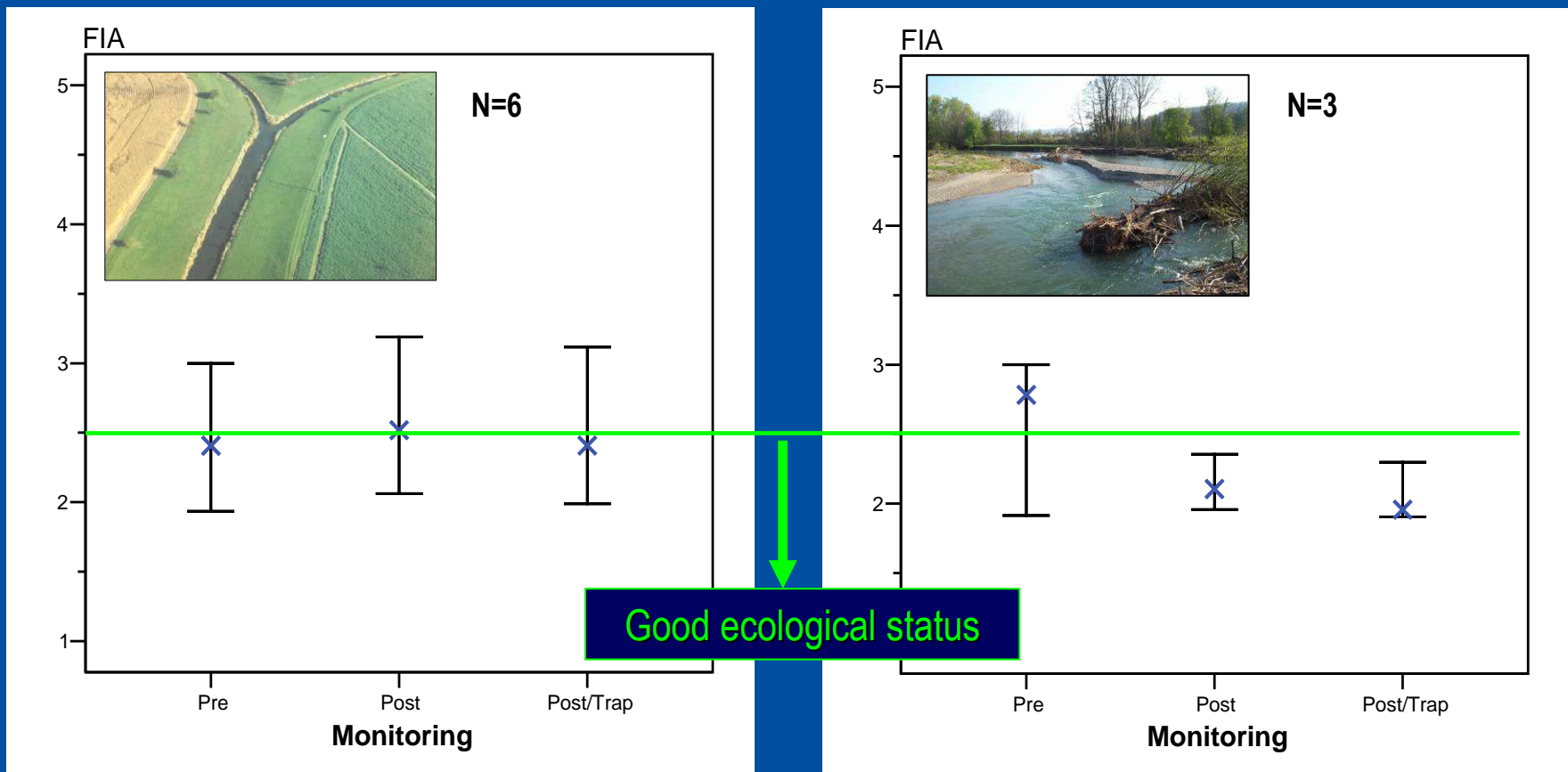# The EU-LIFE project „Living space of Danube salmon (*Hucho hucho* L.)"

Re-connecting fragmented
sub-populations and enabling fish migration

Fish passes
Habitat improvements

Improvement of the ecological status

River Melk

Zitek et al, Hydrobiologia, accepted

River Pielach

Good ecological status

Lessons learned from LIFE-Nature projects

- LIFE-Nature projects have been crucial in gaining first experiences in river restoration.

- WFD river basin management plans and programme of measures will considerably benefit from these experiences.

Lessons learned from LIFE-Nature projects

- LIFE-Nature projects have been crucial in gaining first experiences in river restoration in Austria

Research needs

Comparative pre- and post monitoring of restoration measures focusing on different river types, pressures and scales.

www.boku.ac.at/hfa

Final remarks

Fishes are becoming crucial indicators within freshwater biodiversity management in Europe as

- European-wide data are available,

- we are increasingly able to understand pressure-response-recovery pathways,

- Habitats Directive and WFD are targeting fishes and complementary support recovery of fish diversity,

- fishes are able draw public attention below water surface.