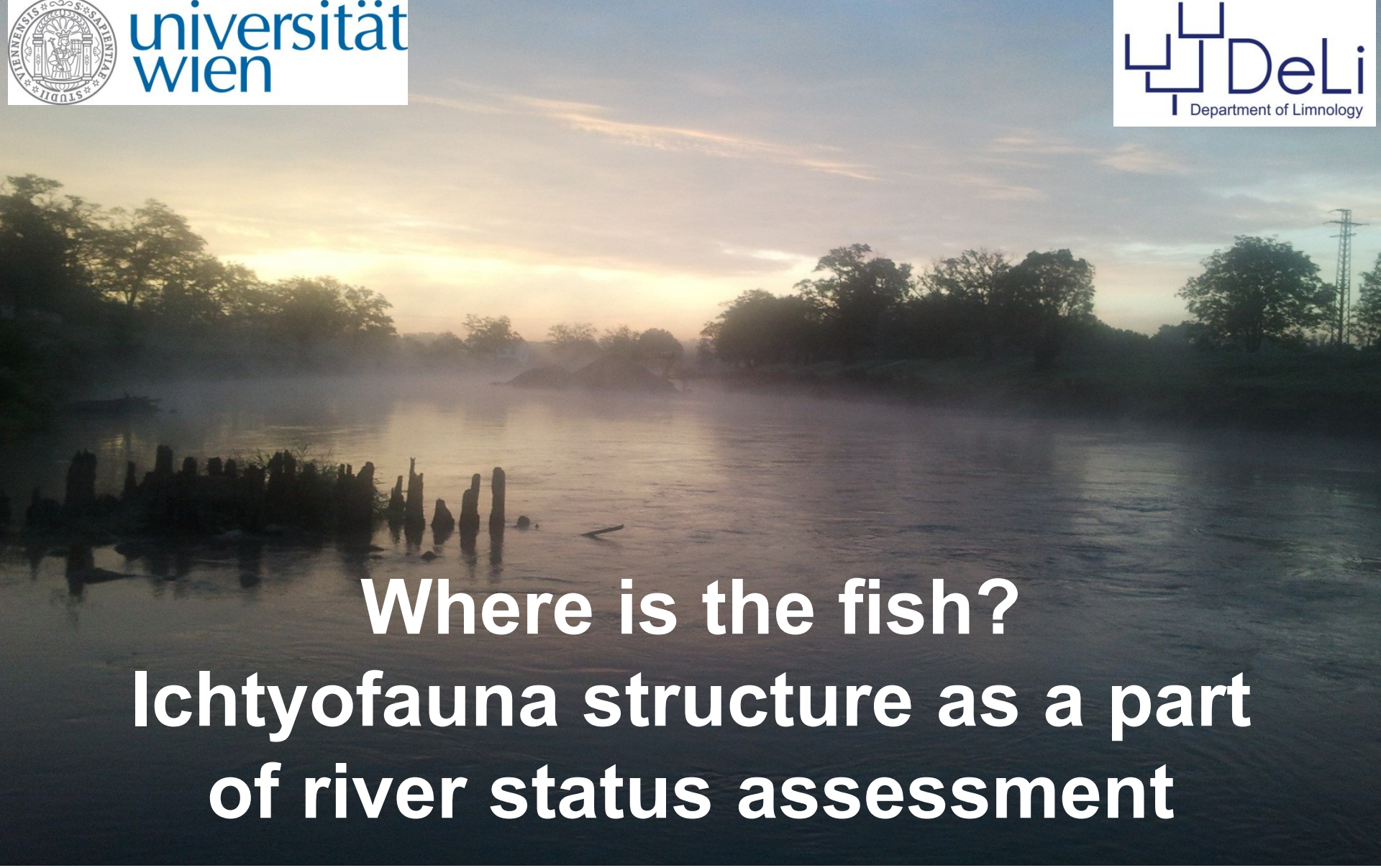


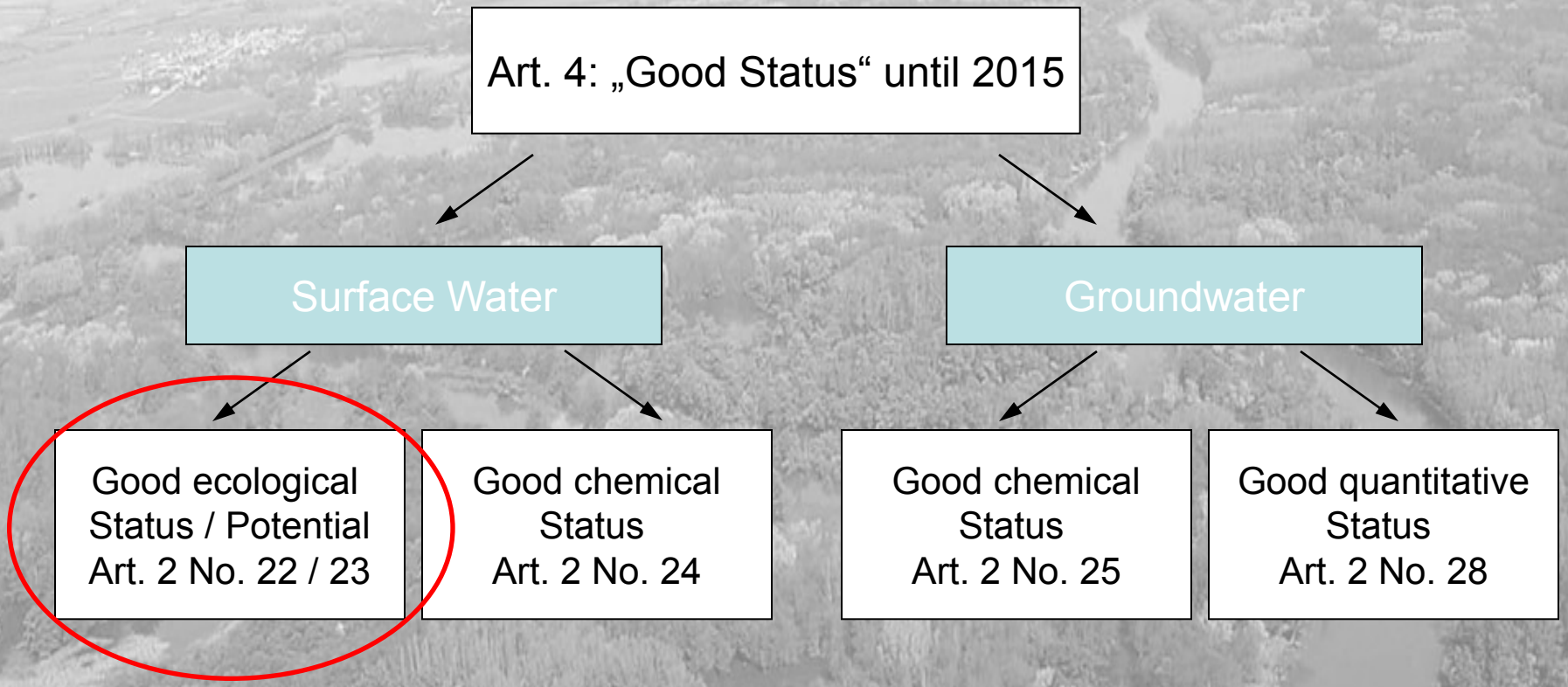
Where is the fish? Ichtyofauna structure as a part of river status assessment

Michael Schabuss 14.01.2013, Warszawa

Outline

- Introduction (WFD, Good Ecological Status)
- The Fish Index Austria (FIA) a multimetric classification index
- Examples of new river restoration projects in Austria
- Conclusions

WFD and its implementation



Exemptions:

1. Extension of the deadline
2. Less stringent objectives

Surface Water: Good Ecological Status

2. **Classification of ecological status according to water body types, Annex V No. 1.1 (5 classes of the status: high, good, moderate, poor, bad)**

- **a) Biological Elements**
  - Composition and abundance of aquatic flora (Macrophytes)
  - Composition and abundance of benthic invertebrate fauna (Macrozoobenthos)
  - Composition and abundance and age structure of **fish fauna**

- **b) Hydro-morphological Elements**
  - Hydrological
  - River continuity
  - Morphological conditions

- **c) Chemical and Physico-Chemical Elements**
  - General (Thermal conditions, Oxygenation conditions, Salinity, Acidification status, Nutriant conditions)
  - Specific Pollutants

The actual percentage of water bodies meeting all the WFD objectives is low:

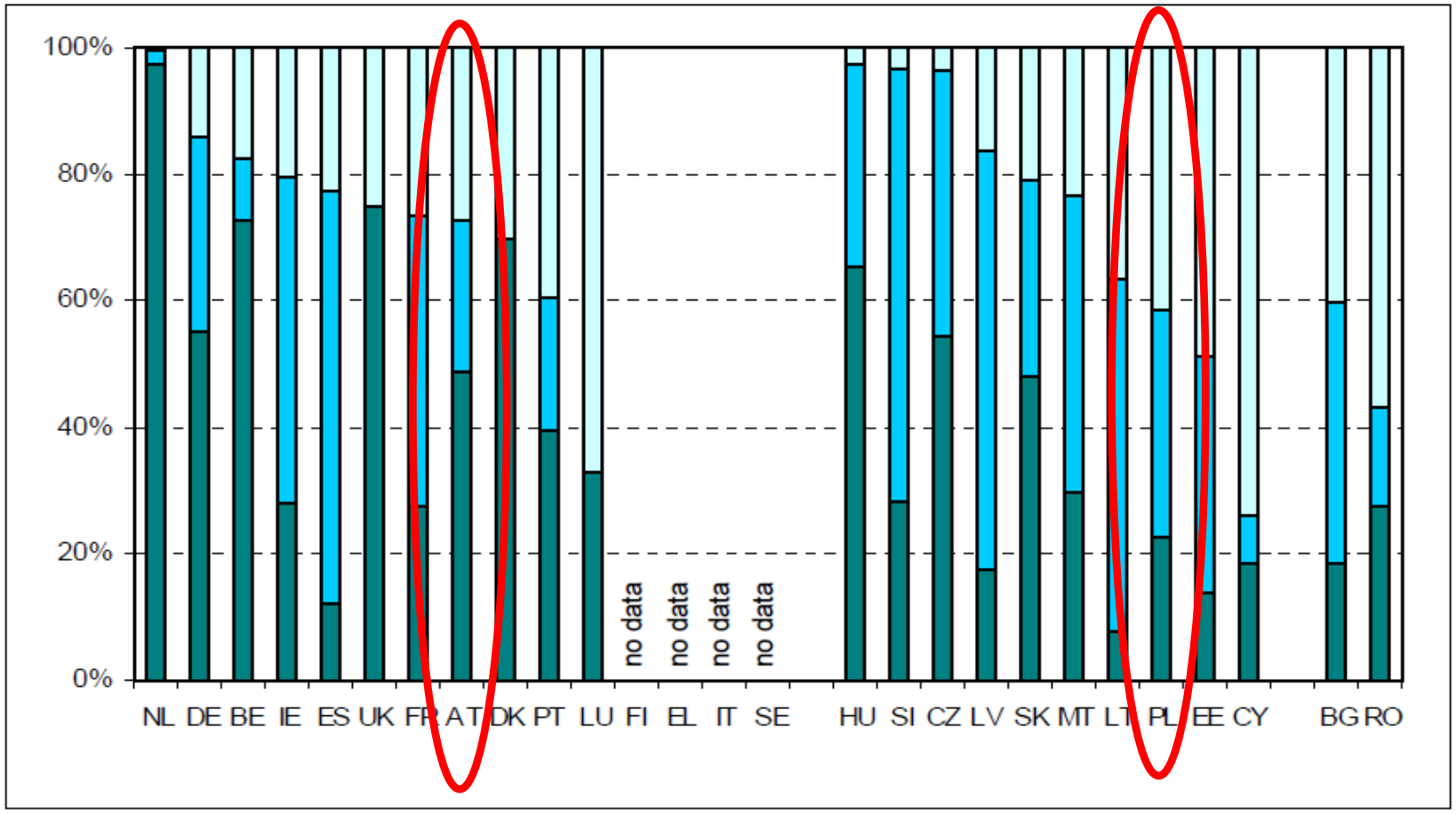


Figure 1: Percentage of surface water bodies at risk of failing WFD objectives per Member State - ■ = 'at risk', ■ = 'insufficient data', ■ = 'not at risk' (based on Member States' reports)[9]

Source: European Commission 2007

WFD - requirements

- The Water Framework Directives requires an evaluation of ecosystem quality in rivers, lakes and transitional waters, based on a variety of ‘quality elements’, including fish.
- Three key attributes of the fish community
  - ✓ species composition
  - ✓ Abundance
  - ✓ age structure
- - must be included in the schemes for freshwater fish classification in order to be WFD compliant.
- The classification must be based on an evaluation of current status of the fish community relative to the value at reference conditions for the various rivers, lakes and transitional waters.

Why Fish?

- Fish are present in most surface waters.
- The identification of fishes is relatively easy and their taxonomy, ecological requirements and life histories are generally better known than in other species groups.
- Fish have evolved complex migration patterns making them sensitive to continuum interruptions.
- The longevity of many fish species enables assessments to be sensitive to disturbance over relatively long time scales.
- The natural history and sensitivity to disturbances are well documented for many species and their responses to environmental stressors are often known.
- Fish generally occupy high trophic levels, and thus integrate conditions of lower trophic levels
- Fish occupy a variety of habitats in rivers: benthic, pelagic, rheophilic, limnophilic, etc., species have specific habitat requirements and thus exhibit predictable responses to human induced habitat alterations.
- Depressed growth and recruitment are easily assessed and reflect stress.

Significance of quality elements

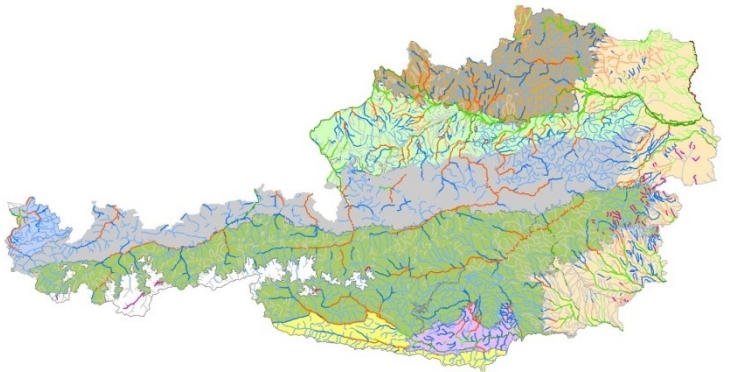
	Physic. & chem. parameters	Phytobenthos	Macrophytes	MZB	Fish
Substantial pressures					
Nutrients	**x**	**x**	(x)	(x)	
Oxygen	**x**				(x)
Temperature	**x**			(x)	**x**
Salinization	**x**	(x)		(x)	**x**
Acidification	**x**		(x)	**x**	(x)
Pollutants	**x**				
Hydromorphological pressures					
Morphological changes				(x)	**x**
Changes of river bed structure				**x**	(x)
Residual water			(x)	(x)	**x**
Flush			(x)	(x)	**x**
Impoundment			(x)	**x**	(x)
Continuum disruption				(x)	**x**

most indicative quality element

FISH INDEX AUSTRIA (FIA)

- Austrian approach to classify the ecological status of rivers according to the fish biocoenosis.
- It is a multimetric index representing the deviation of the river type-specific fish assemblage without or under low anthropogenic pressures (reference conditions) from the actual situation, taking into account species composition, abundance and age structure.
- FIA results can only be useful when calculated from fishing data which were collected with a minimum of effort, which is specified in a methodological manual (Schotko et al. 2009).

Fishecological status class		Boundaries Fisch Index Austria
1	High	1 - <1,5
2	Good	1,5 - < 2,5
3	Moderate	2,5 - < 3,5
4	Poor	3,5 - < 4,5
5	Bad	4,5 – 5



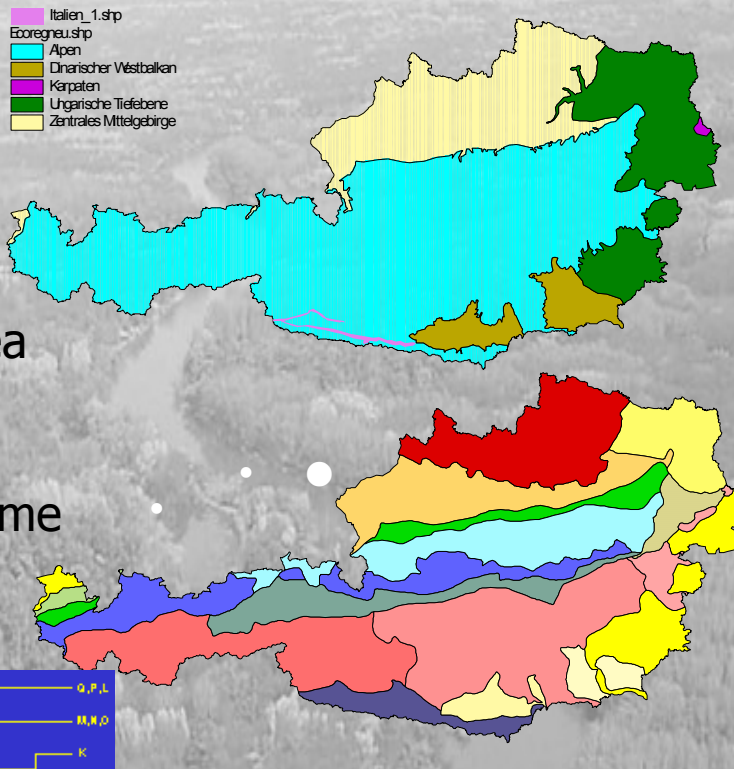
FISH INDEX AUSTRIA

River typology

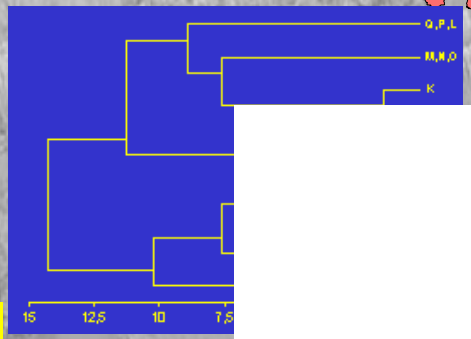
6 (4) Ecoregions

abiotic classification
17 types + 9 big rivers

+catchment area
+altitude
+geology
+discharge regime

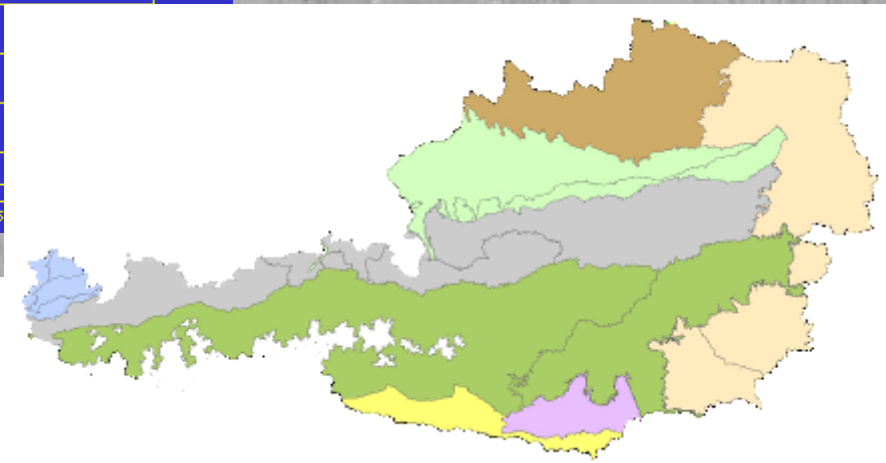


Expert judgement to find fish types & biological verfication

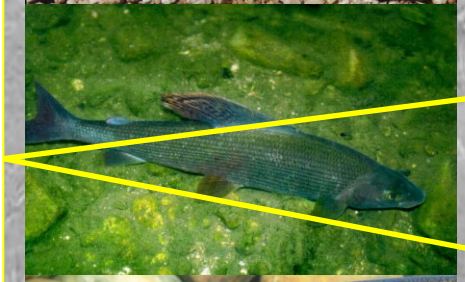
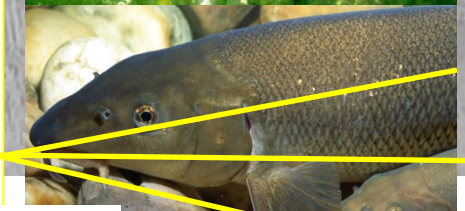


9 fish-bioregions

+ 9 big rivers (Danube, March, Rhine, Inn, Enns, Traun, Salzach, Mur, Drau)

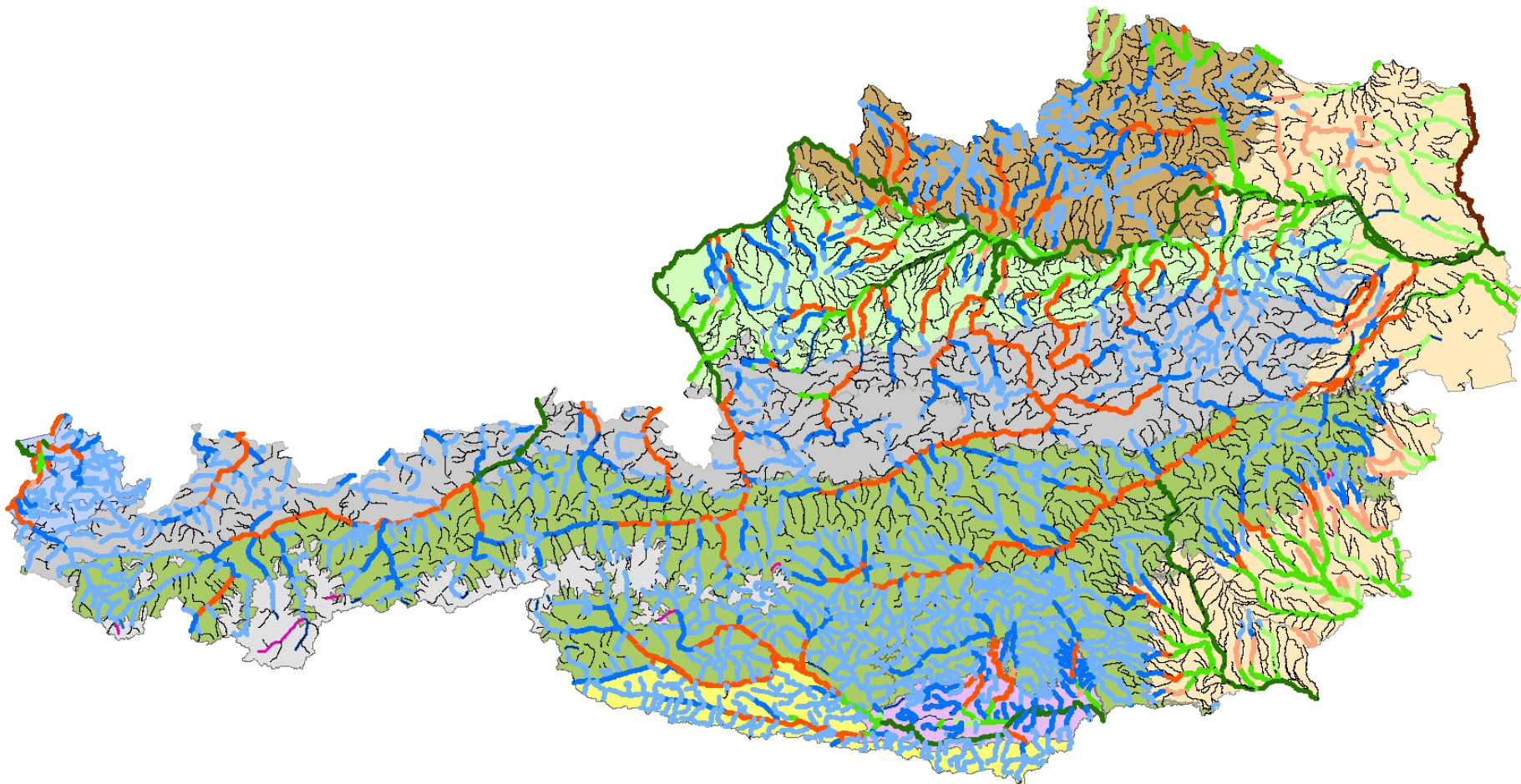


Longitudinal river zonation concept adapted to Austrian conditions

Biocoenotic region		*Fish zone*
Epirhithron		Upper trout zone
Metarhithron		Lower trout zone
Hyporhithron		Small grayling zone (<5m width; <2m³ MQ)
		Large grayling zone (>5m width; >2m³ MQ)
Epipotamon		Small barbel zone (<3m width; <1m³ MQ)
		Middle barbel zone (<25m width; <20m³ MQ)
		Large barbel zone (>25m width; >20m³ MQ)

8 fish zones in 9 biogeographical regions

	discharge	width
Epirhithron	no limit	no limit
Metarhithron	no limit	no limit
Hyporhithron – small	≤2 m³/s	≤ 5m
Hyp		
Epi		
Epi		
Epi		
Met		

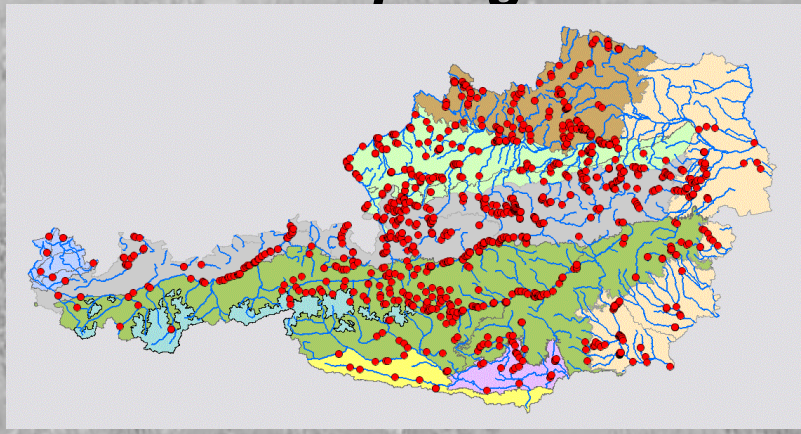


Defining reference conditions for each type and fish zonation concerning species composition

Historical data

Abiotic conditions *(dam, weir residual water, morphology, hydrology, etc.)*

Actual sampling data



Expert judgement on data quality

Reference conditions native fish fauna

Reference fish assemblages for each fish zone in all 9 bioregions (A-K)

I	dominant species
b	subdominant species
s	rare species

Epirhithron	A	B	C	D	E	J	M	P	K
brown trout	I	I	I	I	I	I	I	I	I
bullhead	b	b	b	b	b	b	b	b	b

Metarhithron	A	B	C	D	E	J	M	P	K
burbot						s	s		s
chub		s	s	s				s	s
grayling	s	b	b	s		s	s	s	s
brown trout	I	I	I	I	I	I	I	I	I
stone loach			s	s	s	s		s	b
minnow	s	s			s	s		s	s
gudgeon				s	s	s		s	s
bullhead	b	b	b	b	b	b	I	b	I
brook lamprey		b	s	b	s				s
lake trout								s	

Hyporhithron large	A	B	C	D	E	J	M	P	K
burbot	s	b	b	b	s	l	b	s	b
chub	s	b	b	b	b	b	b	b	b
grayling	l	l	l	l	l	l	l	l	l
brown trout	l	l	l	l	l	l	l	l	l
stone loach	s	s	s	b	b	l	s	l	l
barbel	s	b	s	b	b	b	b	b	b
minnow	b	s	s	s	b	l	b	b	b
perch	s	s	s	s	s	s	s	s	s
gudgeon	s	b	b	b	b	b	s	s	b
dace	s		s	s	s	b	s	s	b
pike	s	s	s	s	s	s	s	s	s
danube salmon	l	l	l	l	s	b	b		b
bullhead	l	l	l	l	l	l	l	l	l
nose	s	b	s	s	s	b	b	s	b
brook lamprey	s	b	b	b	b	s			b
spirlin	s	s	s	b	b	b	s	s	s
lake trout								s	
danube barbel		s		s	s				
spined loach					s				s
streber				s	s				
blageon	b	s	b	s	s	b	s	b	

Procedure for the construction of an assessment scheme

- Selection of candidate metrics
- Testing of candidate metrics
- Selection of sensitive core metrics
- Determination of borders for each selected metric regarding deviation to reference conditions
- Assembling of all metrics and development of an algorithm to determine the ecological status (WFD)

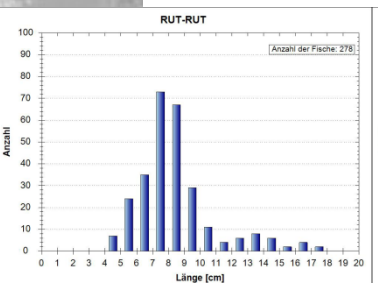
Metrics used by FIA

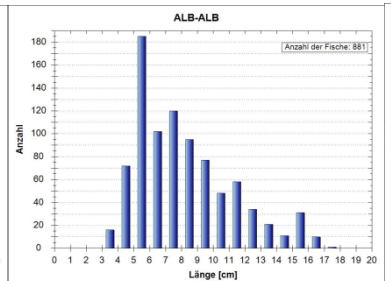
Species composition	% dominant species % subdominant species % rare species number of reproduction guilds number of habitat guilds fish region index (ko criterion)
Abundance	biomass (ko criterion)
Age structure	Length-frequency distribution of dominant species Length-frequency distribution of subdominant sp.

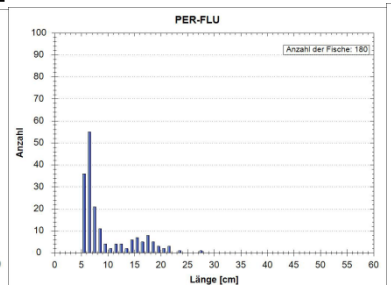
=> significant deviation of Fish Region Index & low biomass act as a ko-criterion!

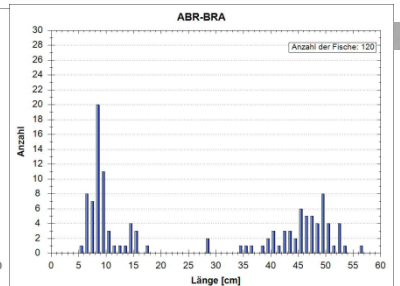
Expert judgement of length frequency/ age structure

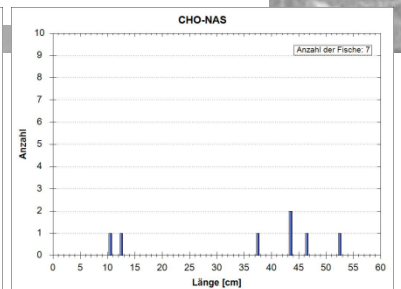
- Class 1: all age classes present and shows a high percentage of young fish, natural population structure
- Class 2: all age classes present but 0+ fish clearly under-represented or adults over- represented
- Class 3: lack of certain age classes, disturbed distribution of age classes
- Class 4: heavily disturbed age distribution, very low individual numbers, single individuals in various age classes
- Class 5: no fish present









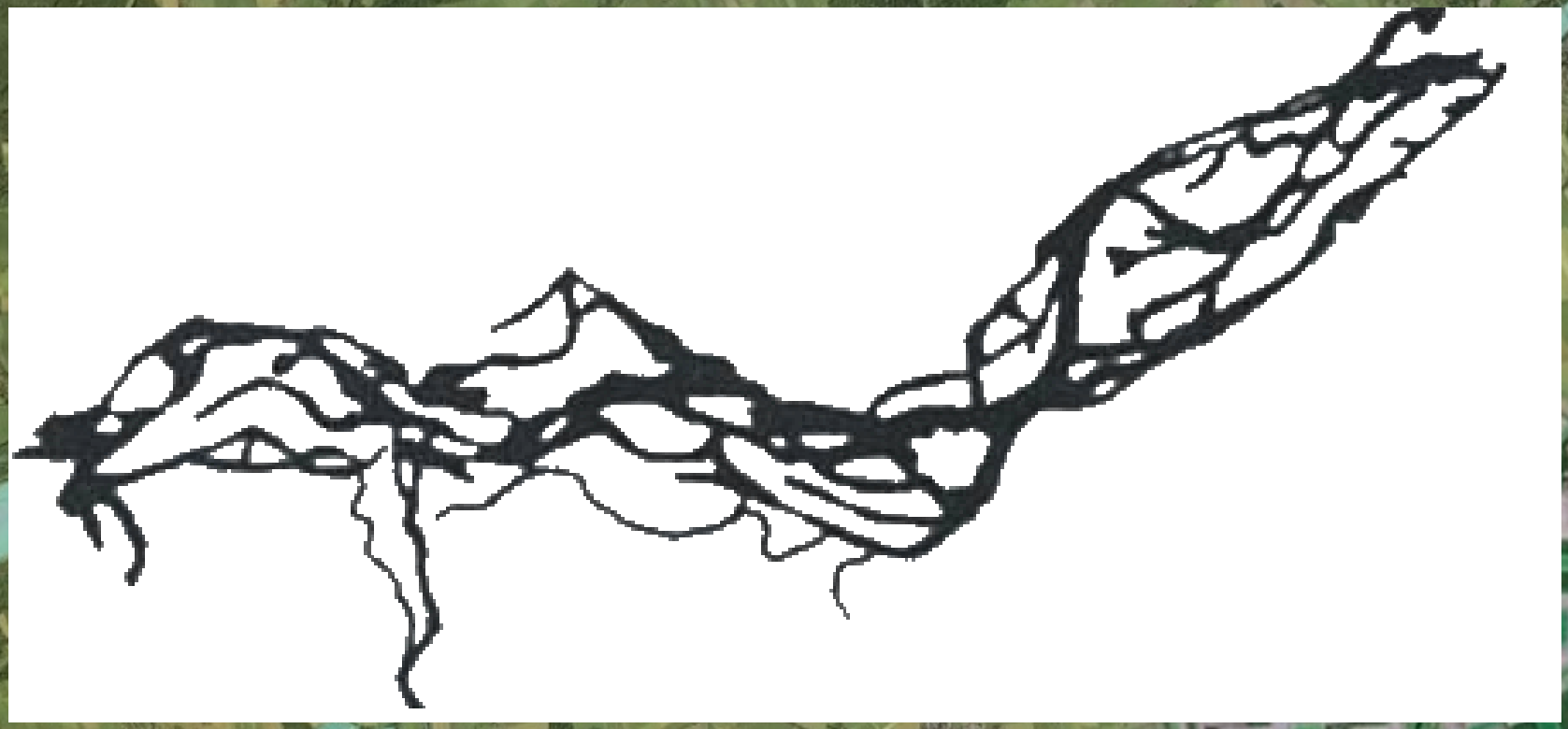


Used metrics and boundaries of class 1 - 5

Fishecological status class		Boundaries Fisch Index Austria
1	High	1 - <1,5
2	Good	1,5 - < 2,5
3	Moderate	2,5 - < 3,5
4	Poor	3,5 - < 4,5
5	Bad	4,5 – 5

	1	2	3	4	5
Biomass	-	-	-	25-50 kg/ha	<25 kg/ha
% dominant species	100%	90-99%	70%-89%	50%-69%	< 50 %
%subdominant species	100%-75%	74%-50%	49%-25%	< 25%	0
% rare species	>49%	49%-20%	19%-10%	< 10%	0
habitat guilds	All represented	1 absent	2 absent	>2 absent	none
reproduction guilds	All represented	1 absent	2 absent	>2 absent	none
fishregion index	+-0,3	+->0,3 - 0,6	+->0,6 - 0,9	+->0,9 - 1,2	+->1,2
Length-frequency distribution of dominant species	1	2	3	4	5
Length-frequency distribution of subdominant species	1	2	3	4	5

Main pressures in Austria =Hydromorphology



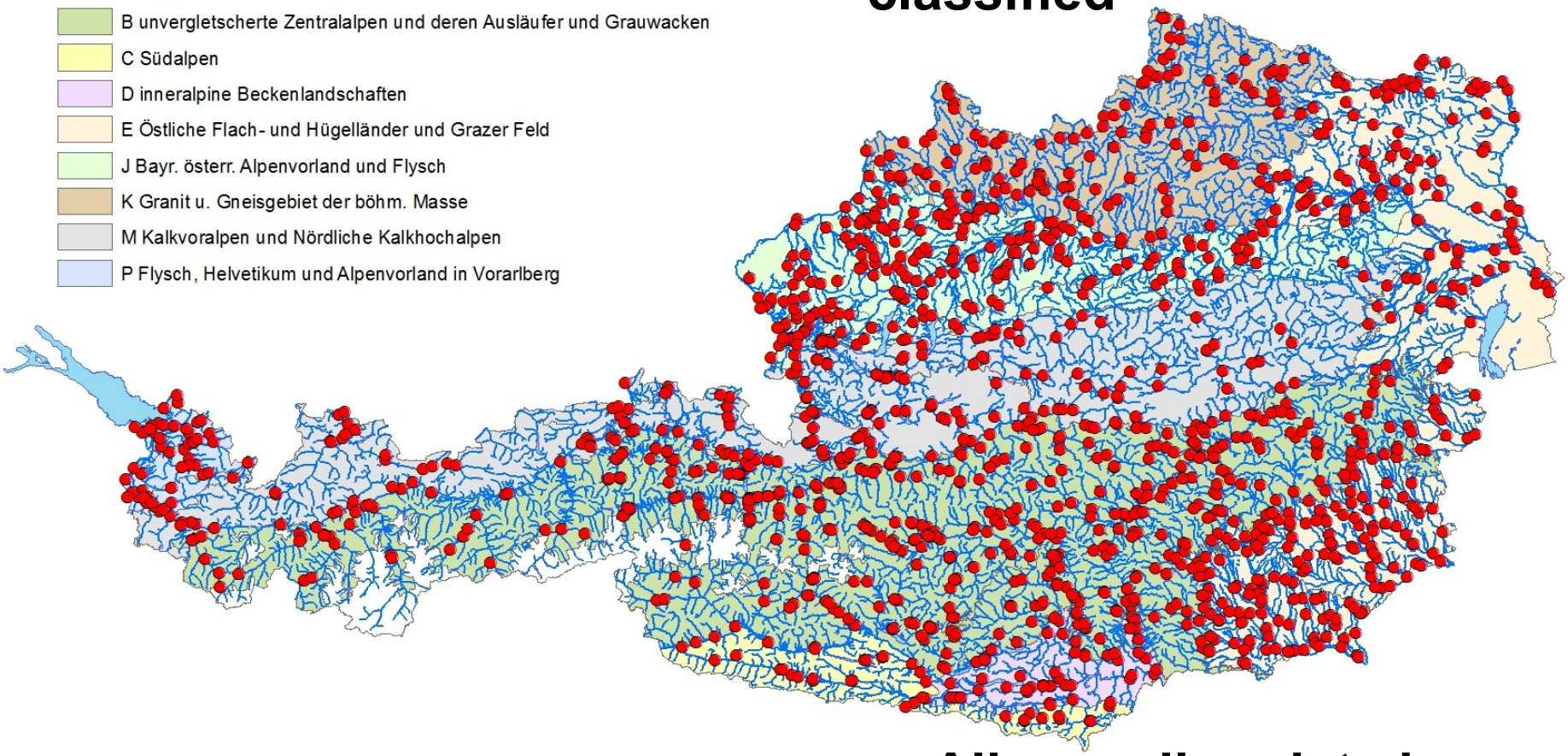
Typical hydromorphological disturbances on which metrics have been tested

pressure
impoundment
flush and sink (discharge regime)
river fragmentation
straightening
impoundment x fragmentation
fragmentation x channalization
fragmentation x interstitial closure
river regulation x interstitial closure

GZÜV Fisch-Messstellen 2007 - 2012

- GZÜV Messstelle
- A vergletscherte Zentralalpen "Gletscherbäche"
- B unvergletscherte Zentralalpen und deren Ausläufer und Grauwacken
- C Südalpen
- D inneralpine Beckenlandschaften
- E Östliche Flach- und Hügelländer und Grazer Feld
- J Bayr. österr. Alpenvorland und Flysch
- K Granit u. Gneisgebiet der böhm. Masse
- M Kalkvoralpen und Nördliche Kalkhochalpen
- P Flysch, Helvetikum und Alpenvorland in Vorarlberg

Since 2007 a total of 1597 sampling sites classified



All sampling data in one common data base

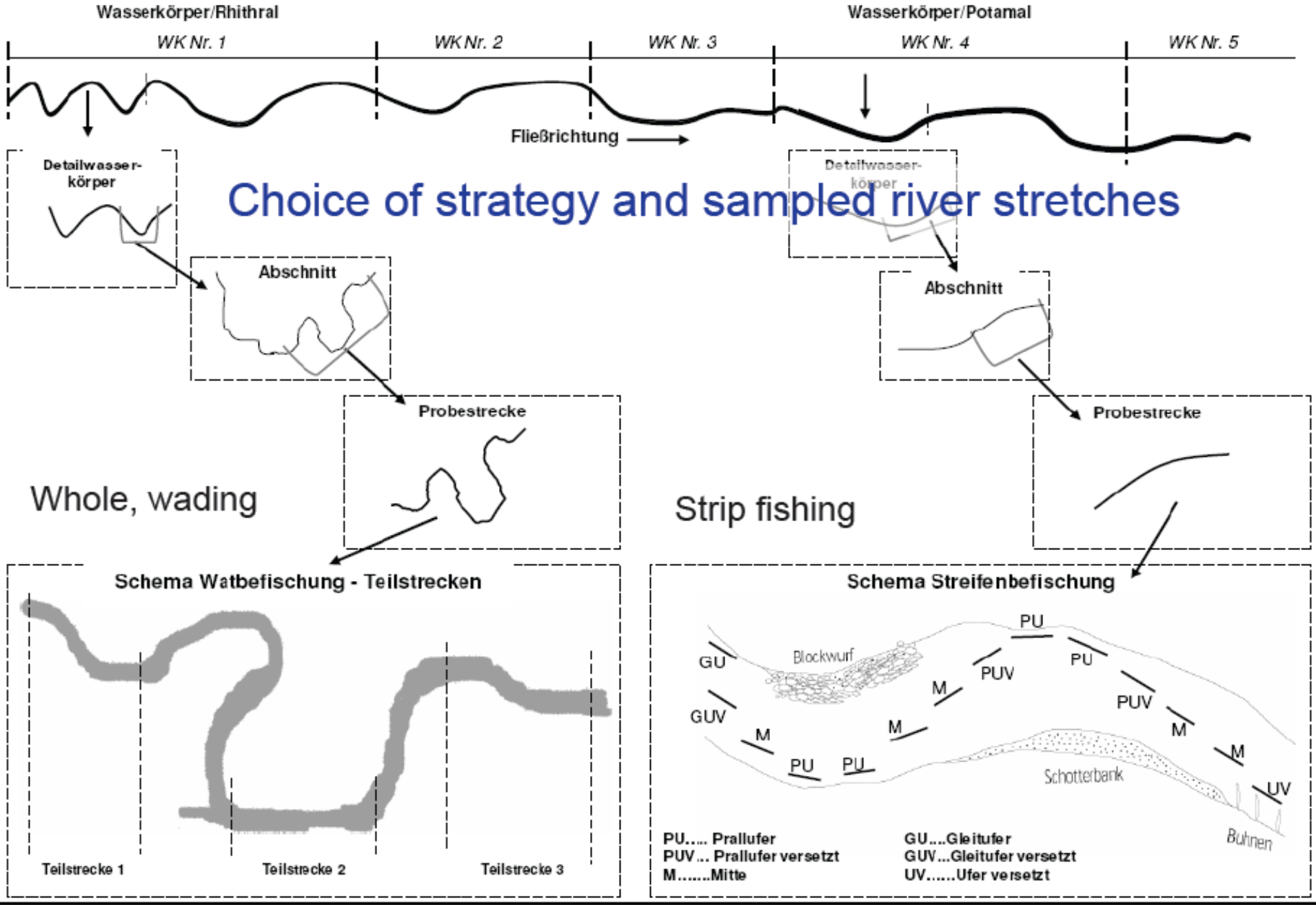
BUNDESAMT FÜR WASSERWIRTSCHAFT

Quelle: Fischdatenbank Austria (FDA), Datenstand Jänner 2013
Bundesamt für Wasserwirtschaft, Institut für Gewässerökologie, Fischereibiologie und Seenkunde

Conclusions FIA

- 9 metrics considering species composition, abundance and age structure
- Age structure metrics require expert judgement
- One assessment scheme for all rivers in Austria
- Quick assessment procedure
- FIA more sensitive to hymo pressures than EFI
- Intercalibrated with other Fish indices (DE, SL, FR)

Choice of strategy and sampled river stretches



Fish sampling methods

EN 14962 Water quality – guidance on the scope and selection of fish sampling methods.
EN 14011 Water quality – sampling of fish with electricity.
EN 14757 Water quality – sampling of fish with multi-mesh gillnets.

National manual on fish sampling procedure

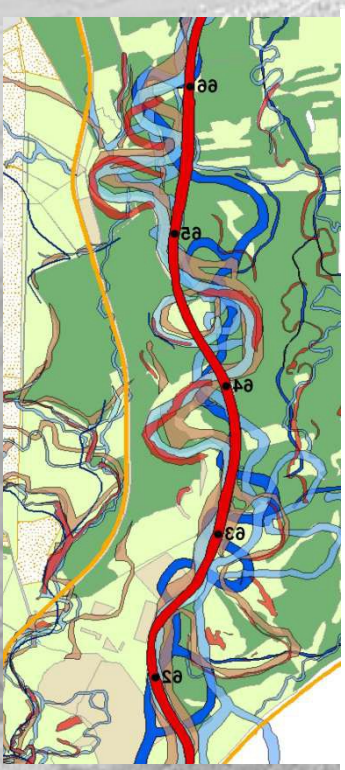
Erstellung einer fischbasierten Typologie österreichischer Fließgewässer sowie einer Bewertungsmethode des Fischökologischen Zustandes gemäß EU-Wasserrahmenrichtlinie

Haunschmid R., Wolfram G., Spindler T., Honsig-Erlenburg W., Wimmer R., Jagsch A., Kainz E., Hehenwarter K., Wagner B., Konecny R., Riedmüller R., Ibel G., Sasano B. & Schotzko N. 2006.

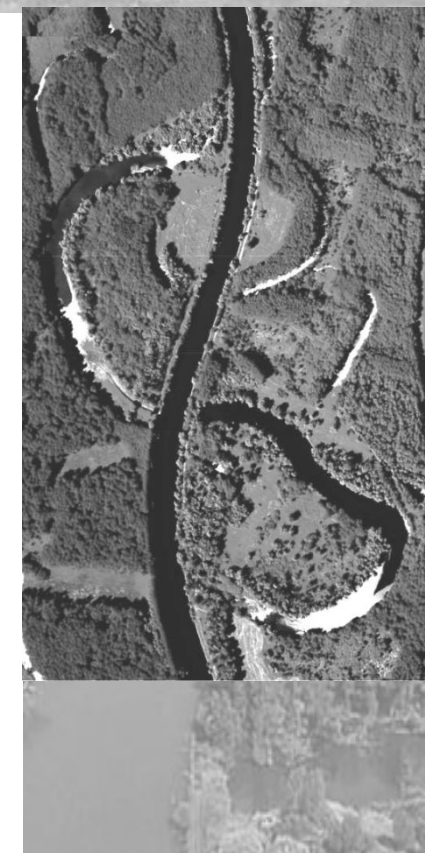
BAW Band 23, Wien; 104 pp, ISBN: 3-901605-23-1.

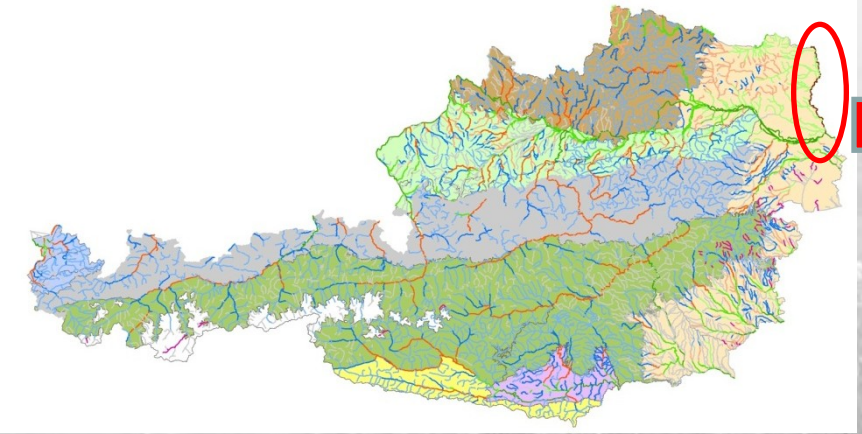
http://wasser.lebensministerium.at/article/archive/5659

Future River Restoration Projects in Austria

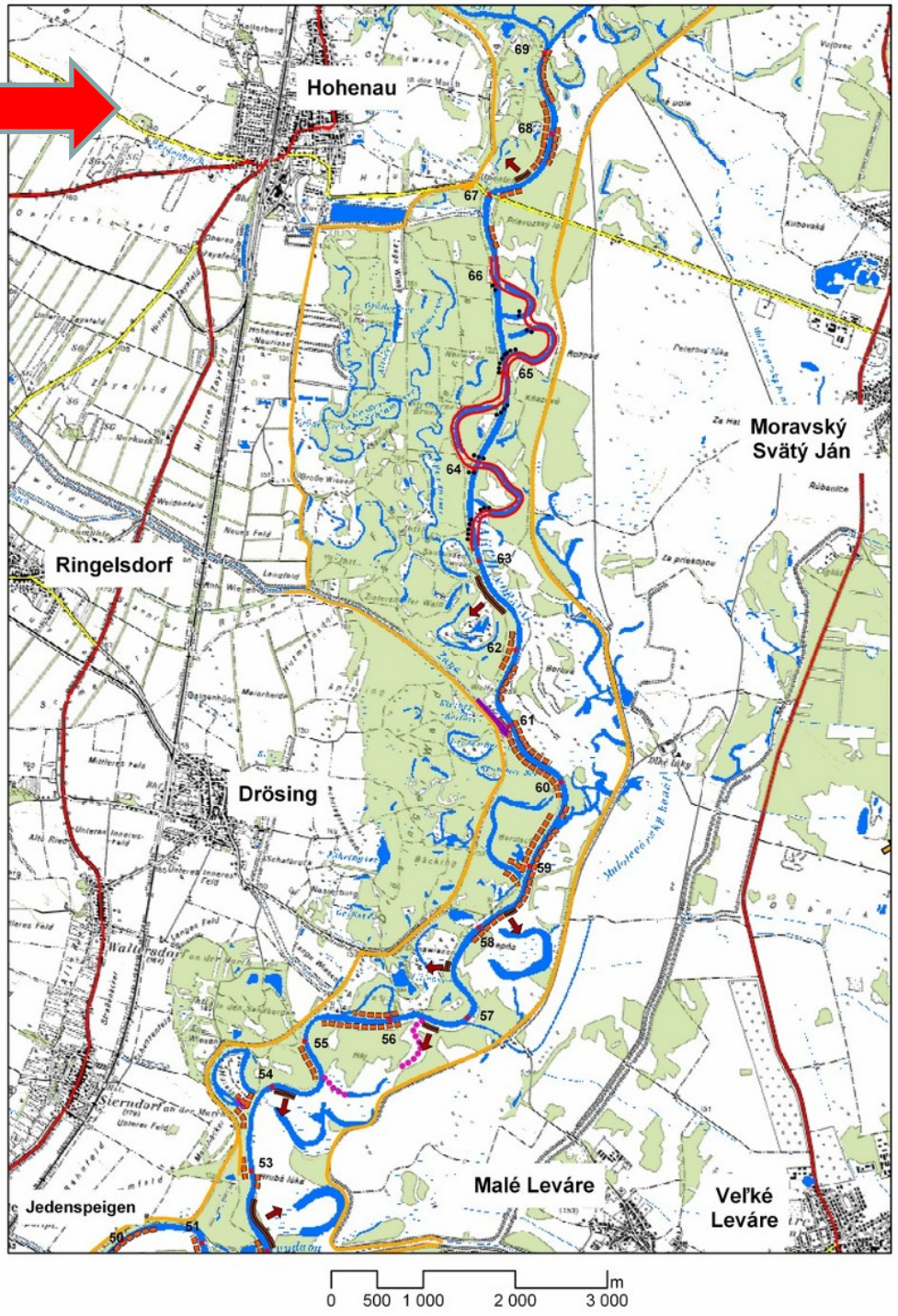


- Main focus on restoration of hydromorphological processes
- Over the last decades growing experience in river restoration and predictive models
- Step by step more ambitious & transboundary projects
- Common basin wide approaches still missing
- Stakeholder dialogues must be improved





Restoration of the Morava and Thaya/Dije River between Austrian Czech and Slovak Territory



Renaturierungsmaßnahmen - Hlavné revitalizačné opatrenia

- Hochwasser Deiche / Protipovodňová hrádza
- Mäanderanbindung / Sprietočnenie odrezaných meandr
- Laterale Vernetzung / Laterálne prepojenie
- Uferrückbau / Rekonštrukcia brehov
- Verbesserung der Durchgängigkeit zu Zubringern/ Zlepše

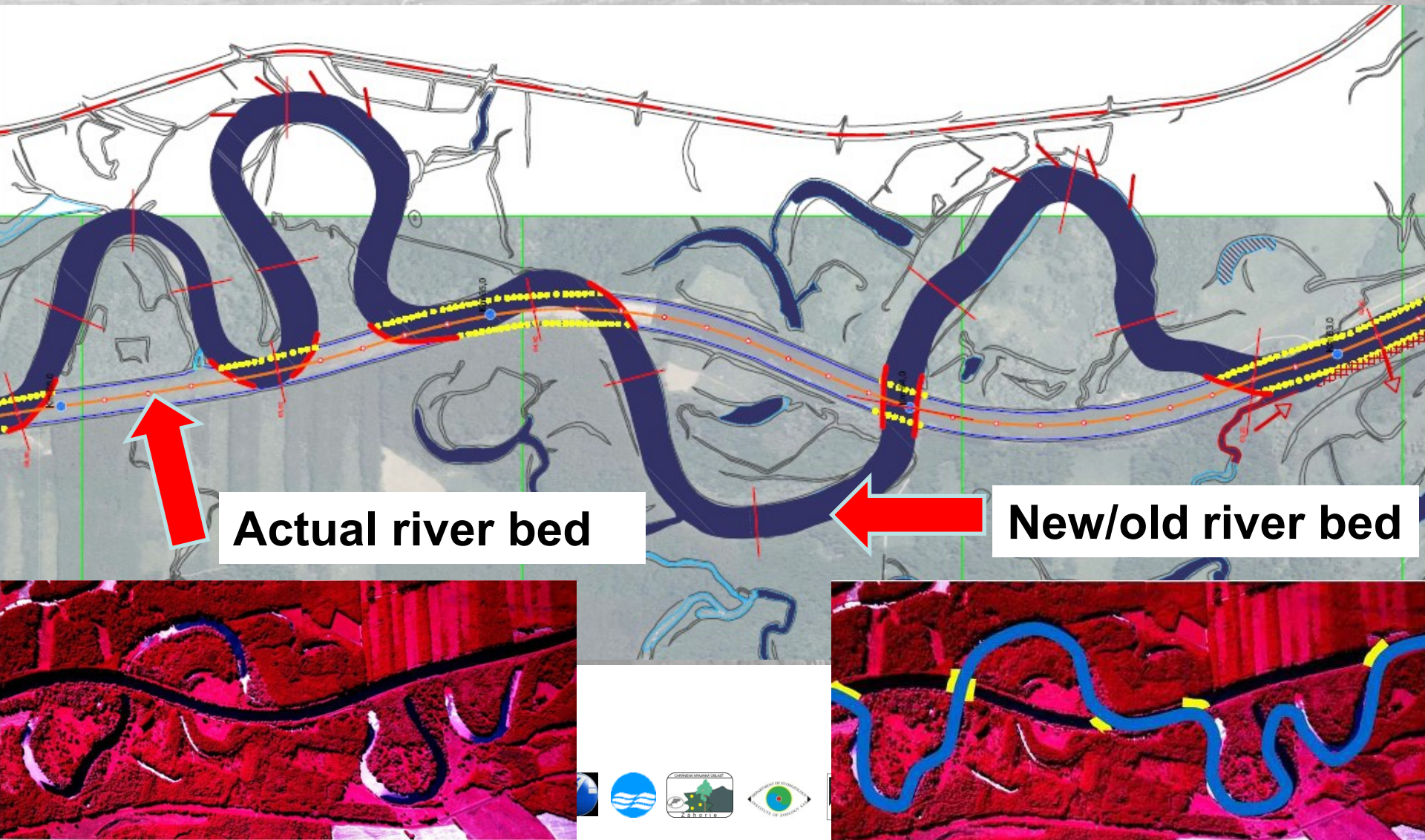
Project Aims MoRe

- Maintain and restore the original character of the meandering river
- Reduce river bed degradation
- Increase hydrological connectivity; surface and groundwater
- Reconnect cut-off meanders and integrate them into the river system
- Increase the physical habitat diversity of the river channel
- Enhance biodiversity and preserve wetland ecosystems
- Improve the ecological status and conservation status of the water body
- Increase flood protection

Measures

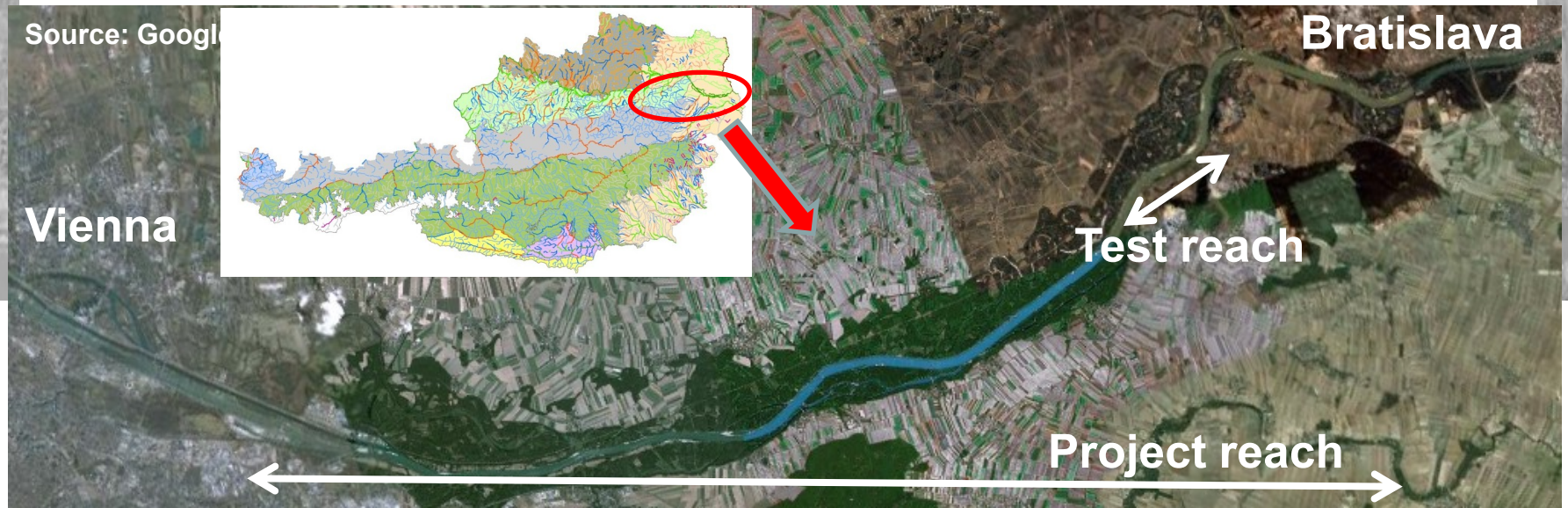
- Riverbank restoration: restoration of the existing embankment
- Meander integration: full meander integration and connection of selected meanders with the Morava River
- Lateral connectivity: To improve the connectivity of the floodplain with the river-flow dynamics
- Tributaries: Elimination of migration barriers and restoration of estuaries of tributaries (Zaya)
- Local measures to improve the flow capacity: a measure for local flood protection in the area between the existing flood control dams

Full integration of cut off meanders



The “Integrated River Engineering Project” Danube east of Vienna

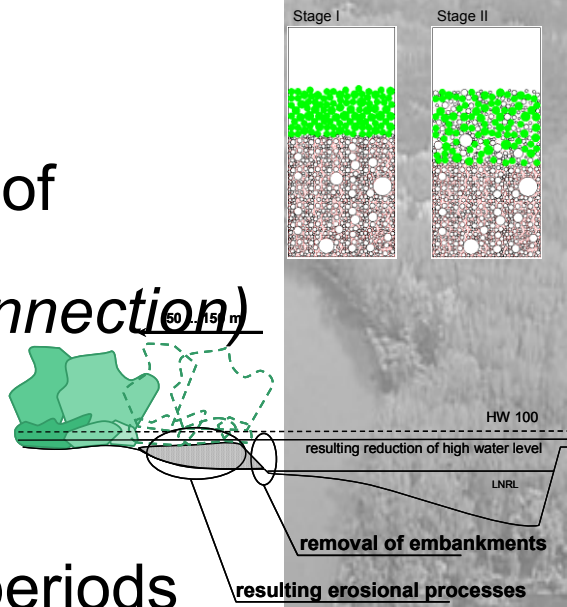
- The Danube between Vienna and the Austrian – Slovak border (approx. 50 km)
- The reach is heavily regulated, a critical spot for navigation with a steady riverbed erosion and an unbalanced sediment budget
- The fluvial dynamics are drastically reduced
- Most of the region is part of the Alluvial Zone National Park

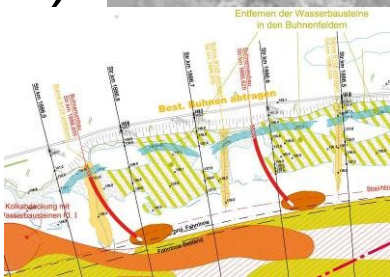


The “Integrated River Engineering Project”

Main aims:

- A stop of the ongoing degradation and incision of the river bed
  (by granulometric bed improvement)
- An improvement of the ecological quality of riverine and riparian habitats
  (river bank restoration and side arm reconnection)
- An improvement of navigation
  (low flow river regulation)
- A reduction of high water levels at flood periods
  (river bank restoration and side arm reconnection)





Morphological effects of restoration measures- Side erosion

Conclusions

- The practical experience with floodplain restoration (especially sidearm reconnection) is growing – prognostic tools (models) available
- River bank restoration and sidearm reconnections have highly positive effects on typical river-floodplain species
- The measures in the main channel to improve navigation (dredging, groynes) impact rheophilic biota (fish, macro-invertebrates), but knowledge is limited
- Optimisation of groynes and river bank restoration will decrease their impact

Lessons learned from previous restoration projects

- Strict project management is of great importance
- Authorities are rather sceptical towards scientific approaches in monitoring schemes
- Ongoing dispute between conservational and dynamic nature protection (species vs. process)
- Interdisciplinary approaches strongly depend on personal interests/motivation of researchers
- Many investigation & modelling methods have to be adapted to large river systems
- Current guidelines for assessing the ecological status with biological elements are sometimes not adequate for large rivers with floodplains
- Political/public issues must not be underestimated


universität wien
DeLi
Department of Limnology
Thanx for your attention
michael.schabuss@univie.ac.at
PRO·FISCH
European Centre for River Restoration
ECRR