

Bewertung des Makrozoobenthos – Tücken, Konsequenzen, Zukunftsoptionen



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Gliederung

- Makrozoobenthos
- Prinzipien der Bewertung mit Biokomponenten
- Missing Link: Bewertung → Maßnahmenableitung
- Werkzeuge zur Diagnose der Ursachen von Degradation

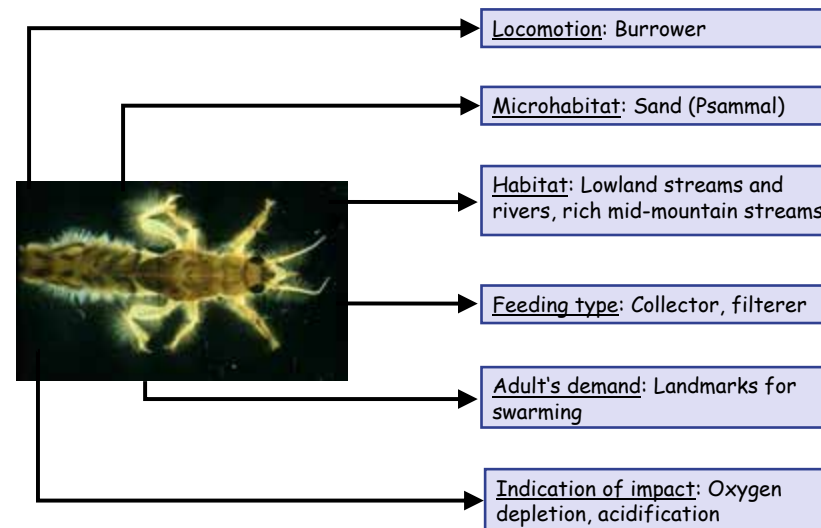
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Vorteile des Makrozoobenthos

- Mit dem bloßen Auge sichtbar (>1 mm)
- Hohe Diversität, in D ca. 4.600 Arten
- Ökologische Ansprüche (Autökologie) gut untersucht

Ephemera danica Müller, 1864



Autökologische Datenbanken



Klare Konzepte. Saubere Umwelt.

Member of the



The Taxa and Autecology Database for Freshwater Organisms

Login

Username

Password

Login

Search

- » **Fish**
- » **Macro-invertebrates**
- » **Macrophytes**
- » **Diatoms**
- » **Phytoplankton**
- » Quick search
- » Taxa Entry Tool (TET)
- » Taxa Validation Tool (TVT)

Info

- » **Terms of use (citation)**
- » About the database
- » Content overview
- » Experts
- » News archive
- » Home

Help

- » How to use the database
- » Abbreviations/explanations
- » Database management

Registration

- » Registration
- » Forgot password

Database info

Last database update: 24.10.2016
Database version: 7.0 - 10/2016

Last update: 08.01.2018

Welcome

Welcome to the **freshwaterecology.info** database. Here you can find autecological characteristics, ecological preferences and biological traits as well as distribution patterns of **more than 20,000 European freshwater organisms** belonging to **fish, macro-invertebrates, macrophytes, diatoms** and **phytoplankton**.

The ecology data feature **distributional parameters** (e.g. ecoregional distribution or endemism, etc.), **regional parameters** (e.g. stream zonation or altitudinal preference, etc.), **habitat parameters** (e.g. temperature or substrate preference, etc.) or **life related parameters** (e.g. feeding type or life duration, etc.) and others. All ecological parameters can be **individually combined and queried**.

Organism groups



Query your preferred organism group. Query more than one ecological parameter. Define special interests and features.

Tools



Find your freshwater organism and its ecological preferences (» Quick Search).
Create your standardised taxalist for each of the organism groups and enter data for up to 230 samples (» TET - Taxa Entry Tool).
Upload your taxalist, validate it and export your taxa including selected ecological parameters (» TVT - Taxa Validation Tool).

News

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- Bewertung seit über 100 Jahren: Saprobienindex
- Gute Indikatorfunktion

Indikatorfunktion

- Saprobienindex: organische Belastung
- Versauerungsindex
- Fauna-Index: Morphologische Überformung
- Rheo-Index (Banning): Strömungsverhältnisse
- Salinitätsindex
- Schadstoffakkumulation (z. B. Muscheln)
- SPEAR: Pestizide
- Verhaltensänderung: Schadstoffe

Nachteile des Makrozoobenthos

- Hohe Diversität = Artenvielfalt → Bestimmung anspruchsvoll
- Viele Gruppen nur von Spezialisten bestimmbar (z. B. Oligochaeta, Diptera, Coleoptera)
- Operationelle Taxaliste enthält daher „nur“ ca. 1.100 „allgemein“ bestimmbare Taxa (Stand: 2011)
- Interpretation der Taxaliste und Bewertungsergebnisse anspruchsvoll → sehr gute ökologische Kenntnisse erforderlich

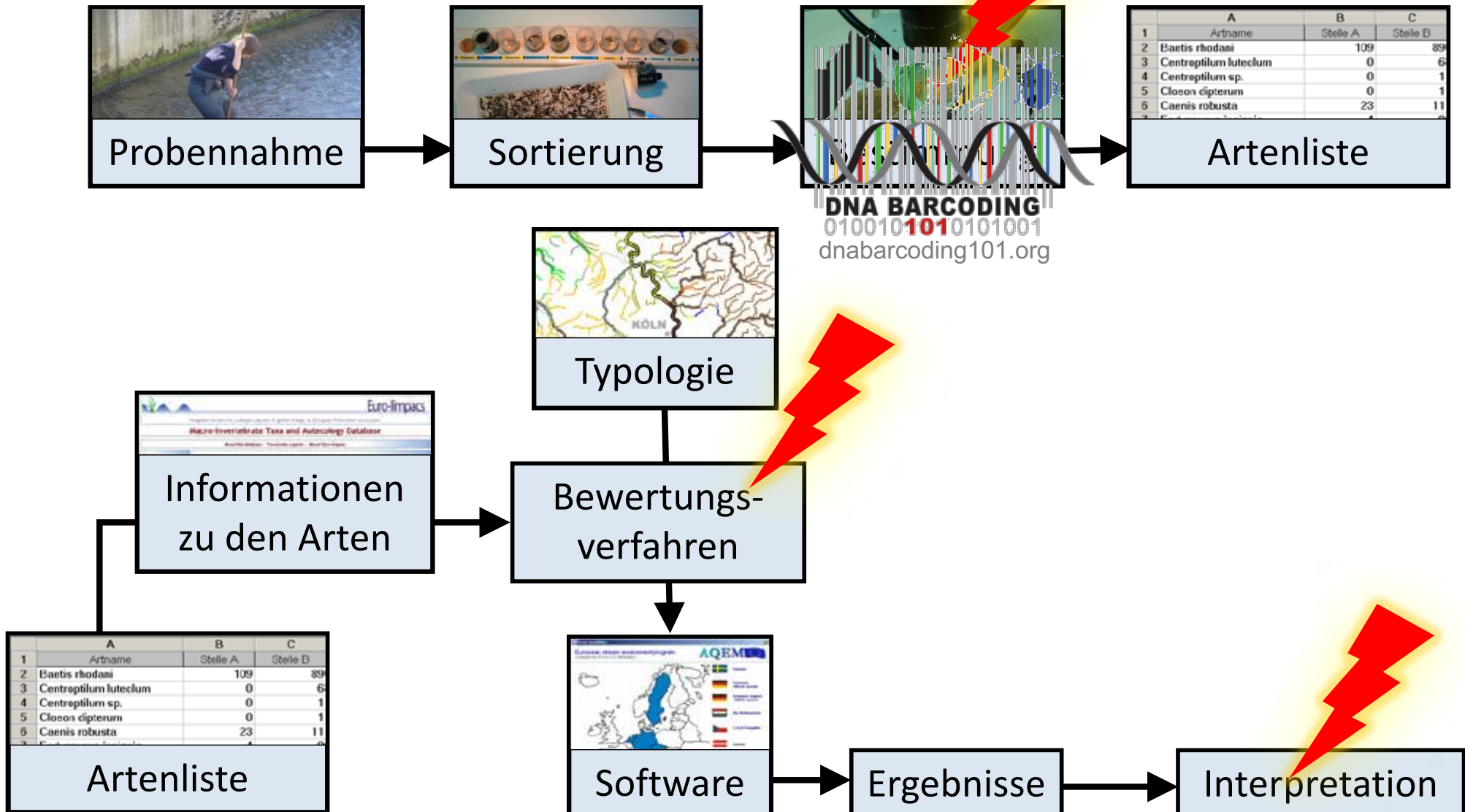
Nachteile des Makrozoobenthos

- Hohe Diversität = Artenvielfalt → Bestimmung anspruchsvoll
- Viele Gruppen nur von Experten bestimmbar (z. B. Oligochaeta, Insecta, Coleoptera)
- Zukünftig: genetische Bestimmung (Barcoding, eDNA)
- Die Taxaliste enthält daher „nur“ ca. 1.100 „allgemein“ bestimmbare Taxa (Stand: 2011)
- Interpretation der Taxaliste und Bewertungsergebnisse anspruchsvoll → sehr gute ökologische Kenntnisse erforderlich

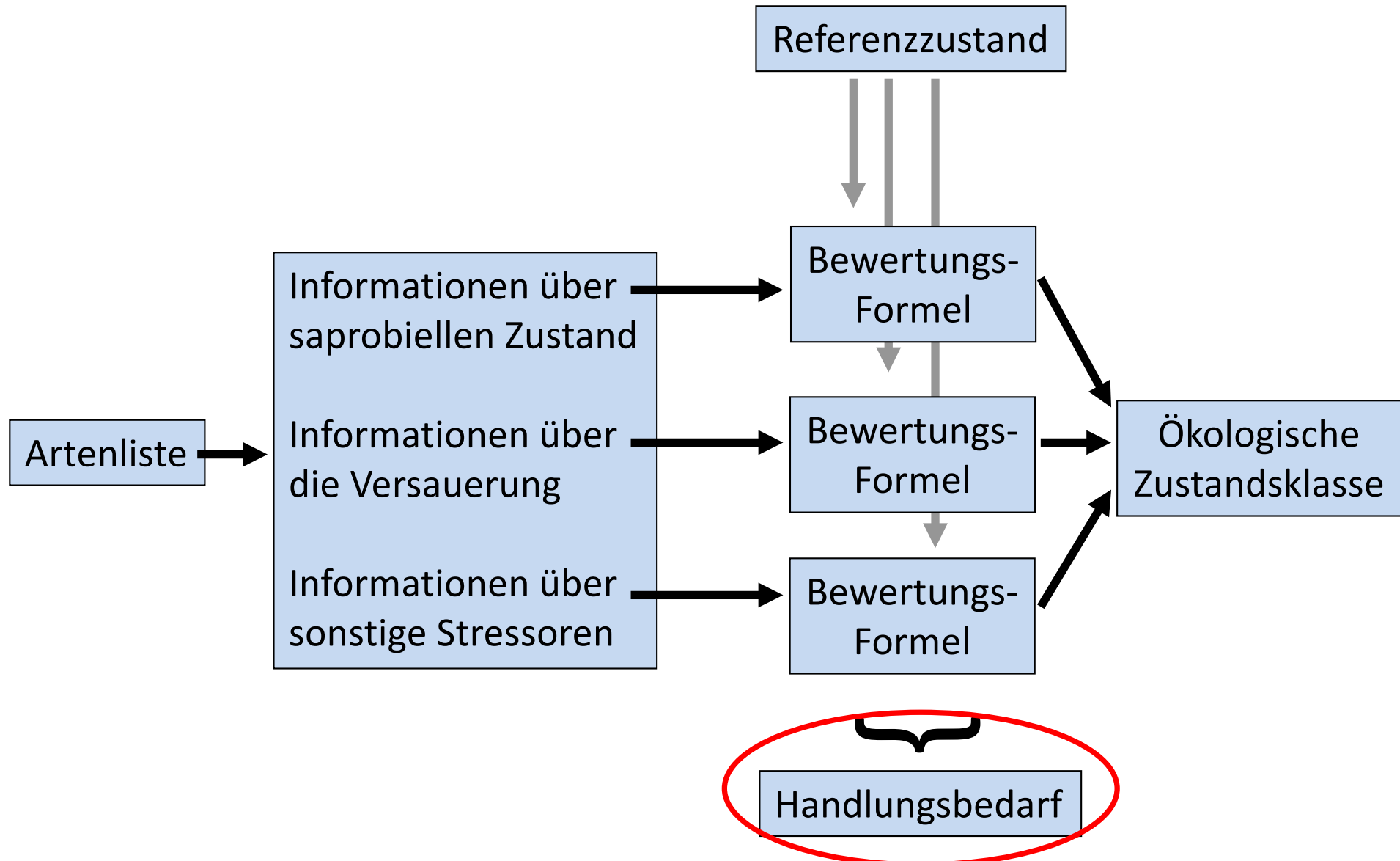
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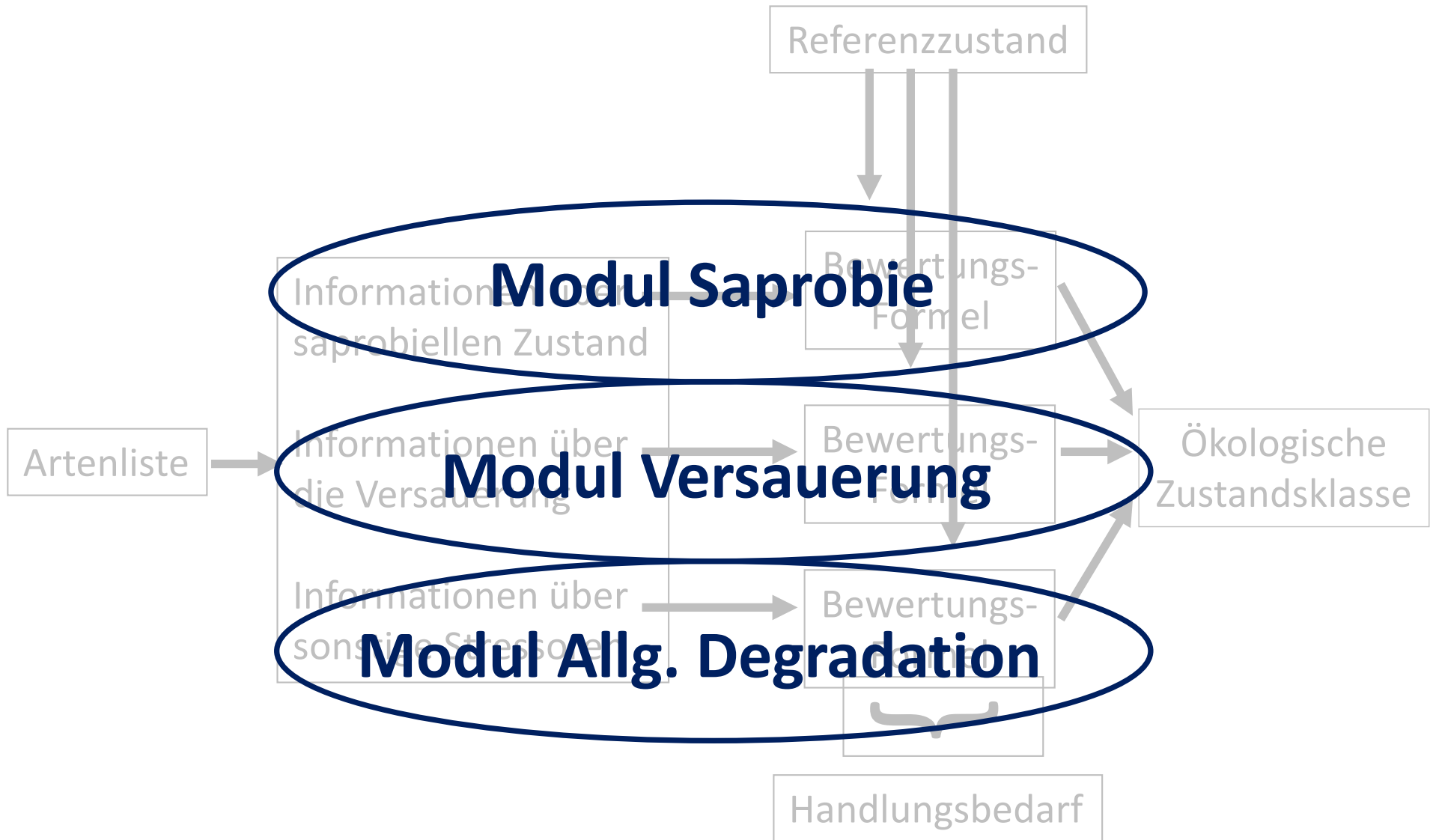
Allgemeine Bioindikation: Tücken



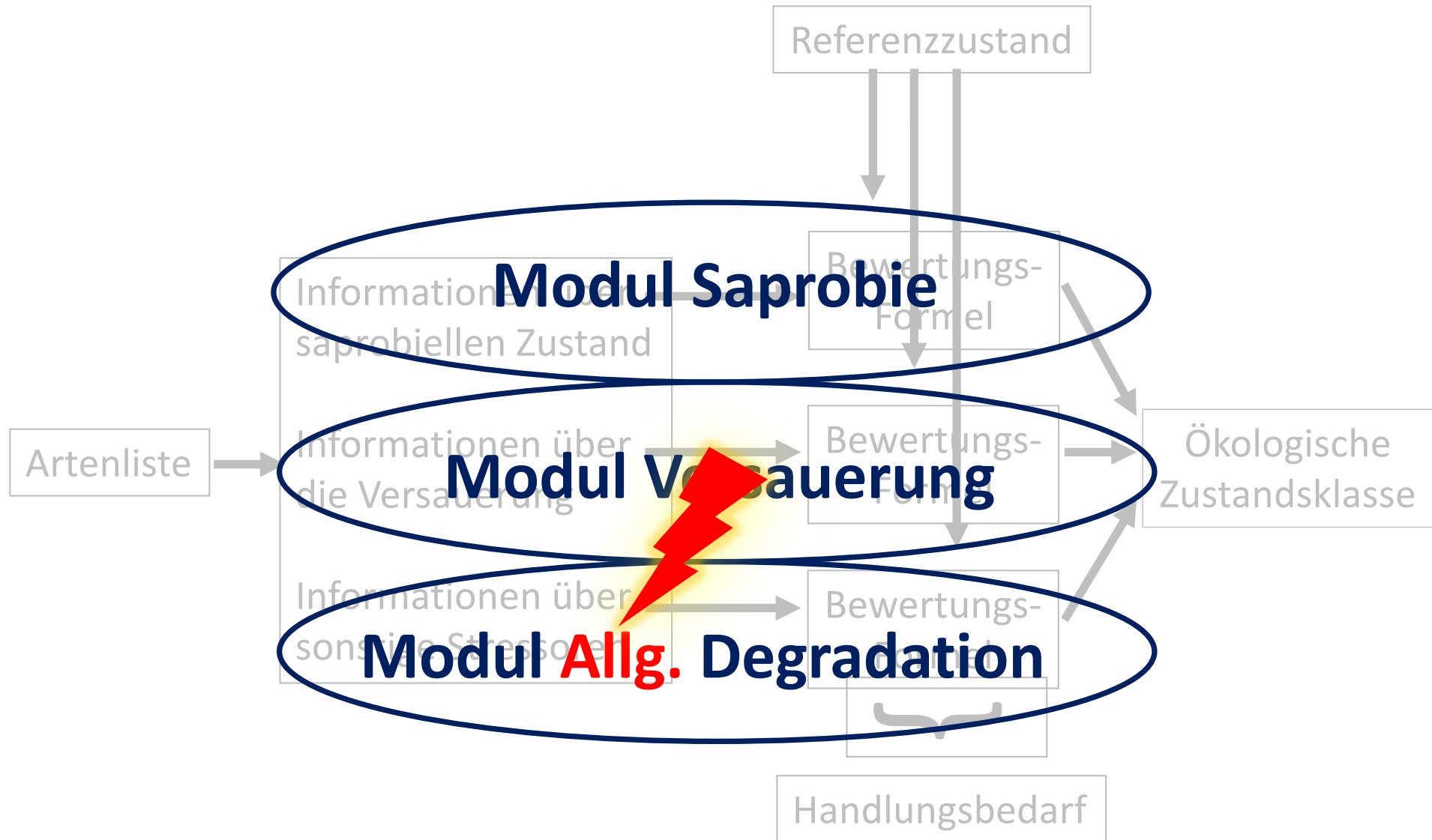
Modulare Bewertung



Drei Module

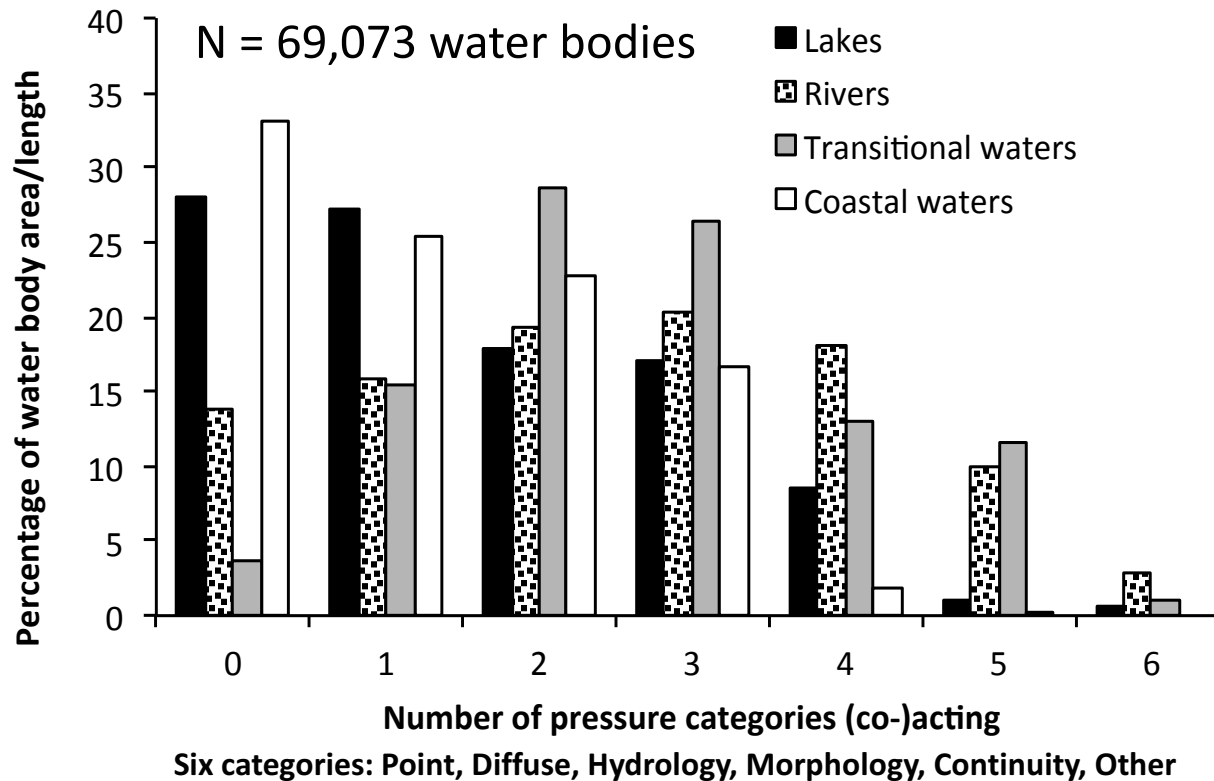
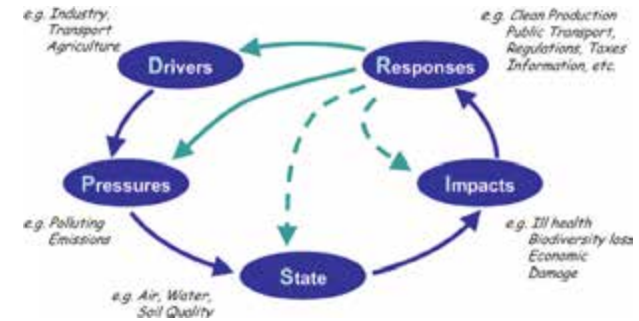


Drei Makrozoobenthos-Module



Multiple “Stressoren“

- Stressoren = Pressures + States



63% multipel belastet

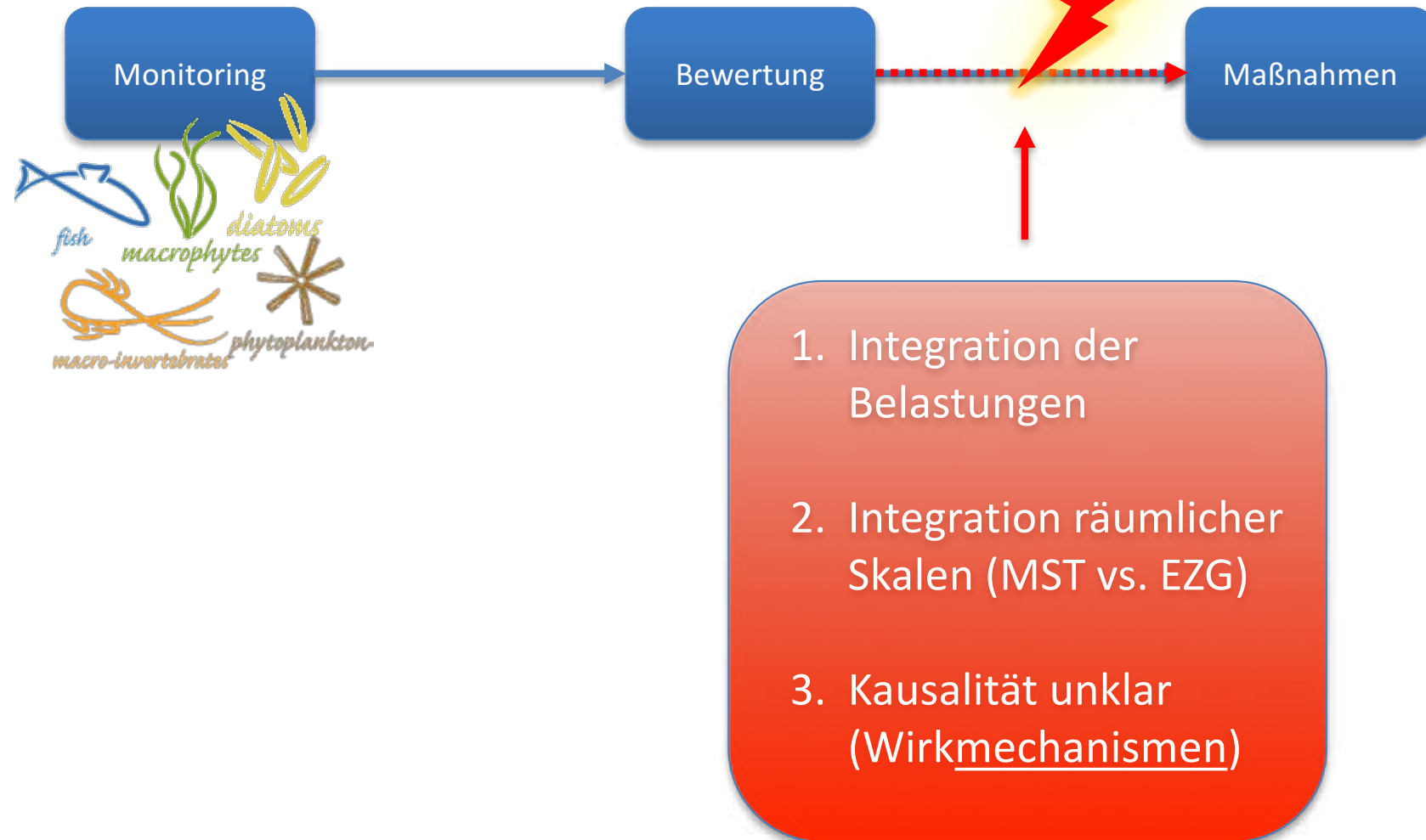
- Seen = 45%
- Flüsse = 70%
- Übergangsgew. = 81%
- Küstengew. = 42%

Quelle: WFD WISE Reporting Data 2016 – Preliminary results, 25 Member States, August 2017

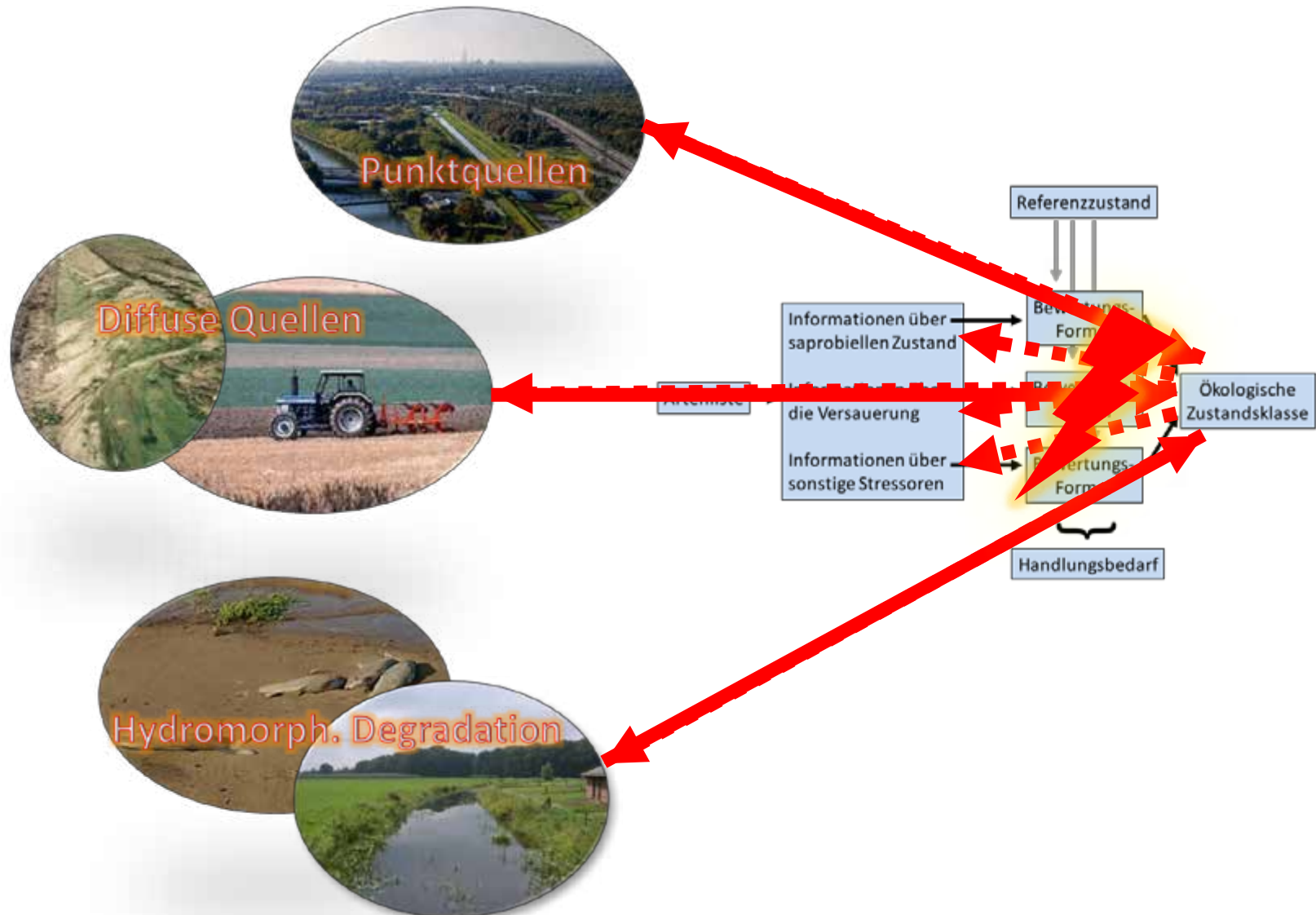
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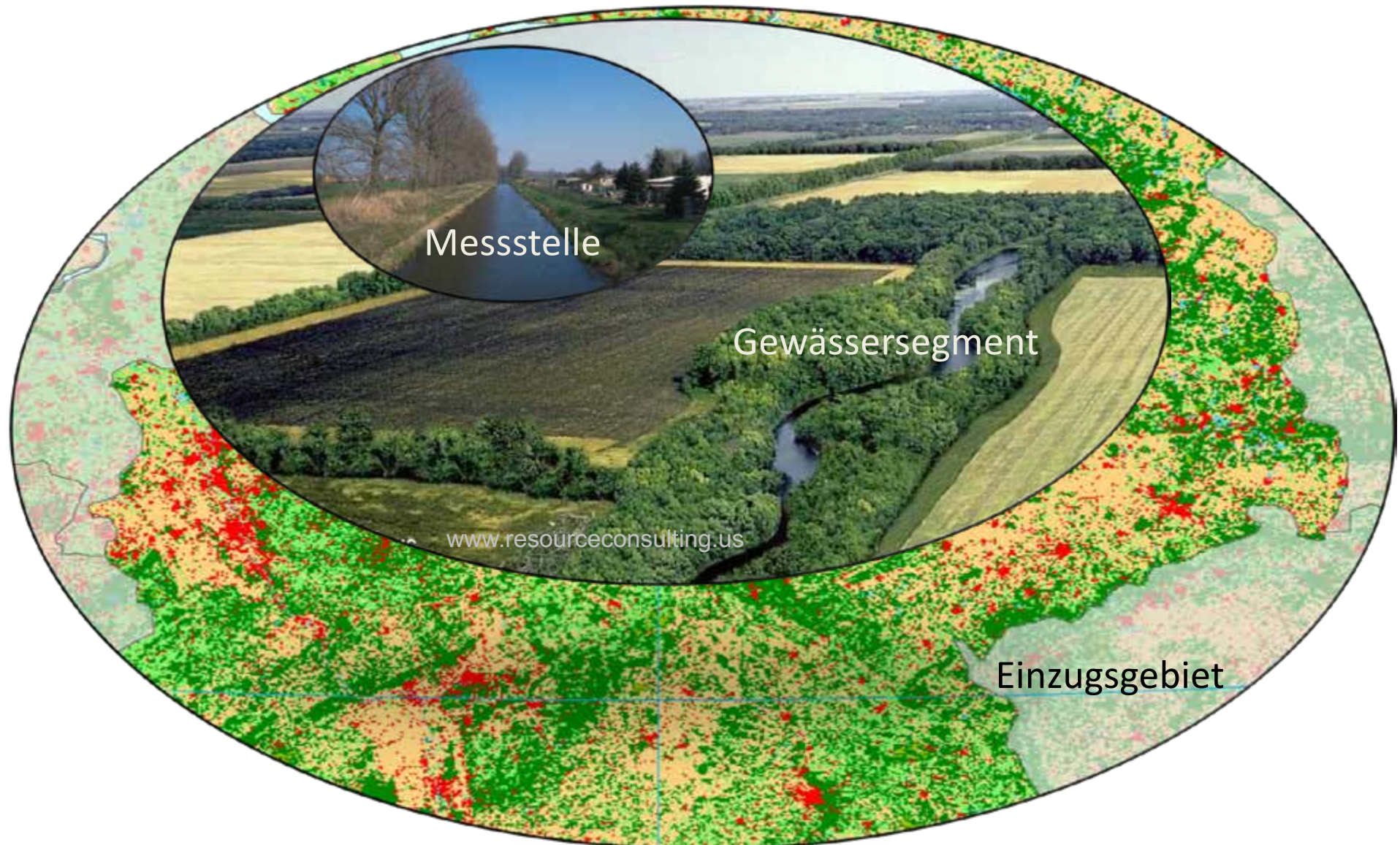
Missing Link



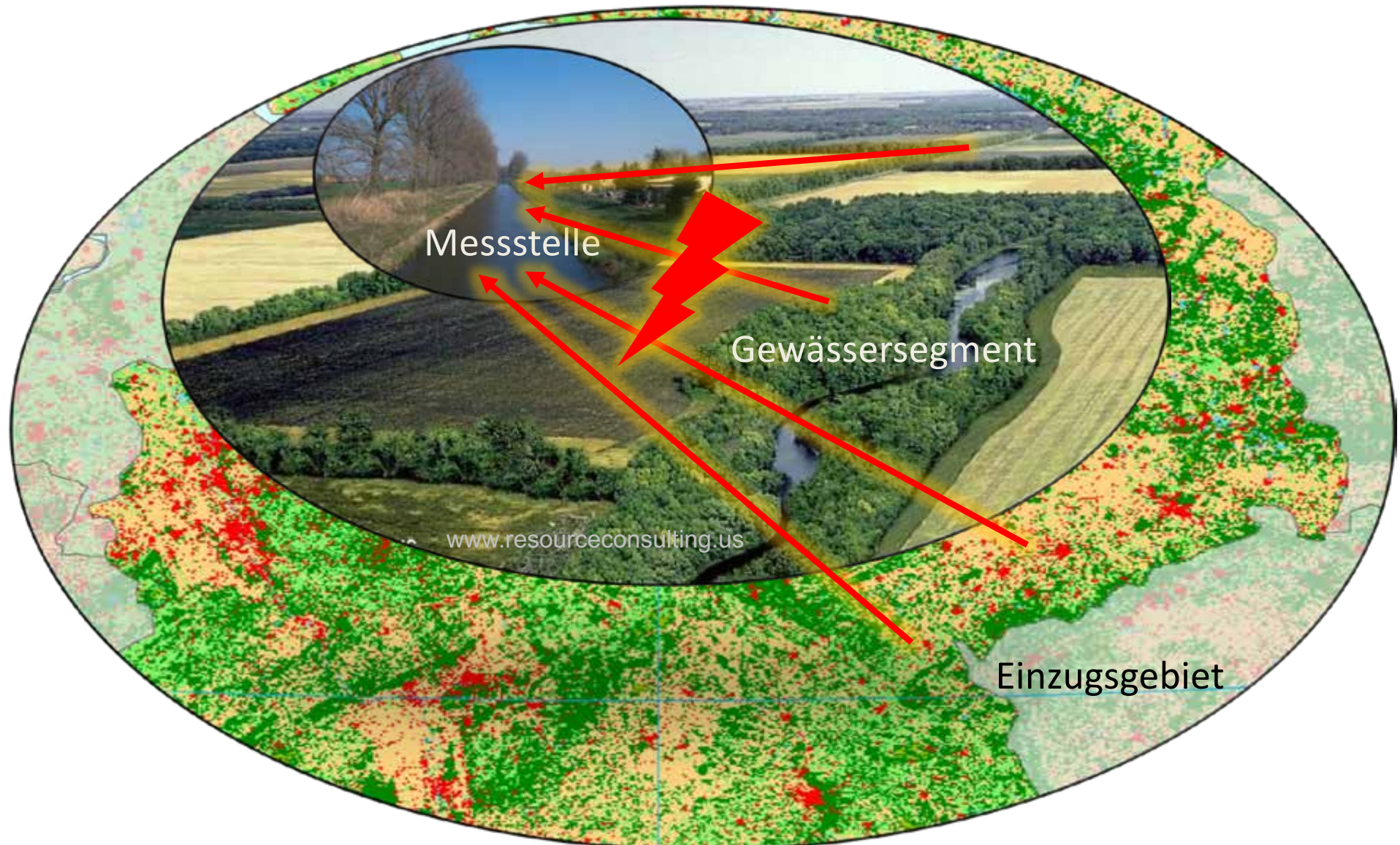
Integration der Belastungen



Integration räumlicher Skalen

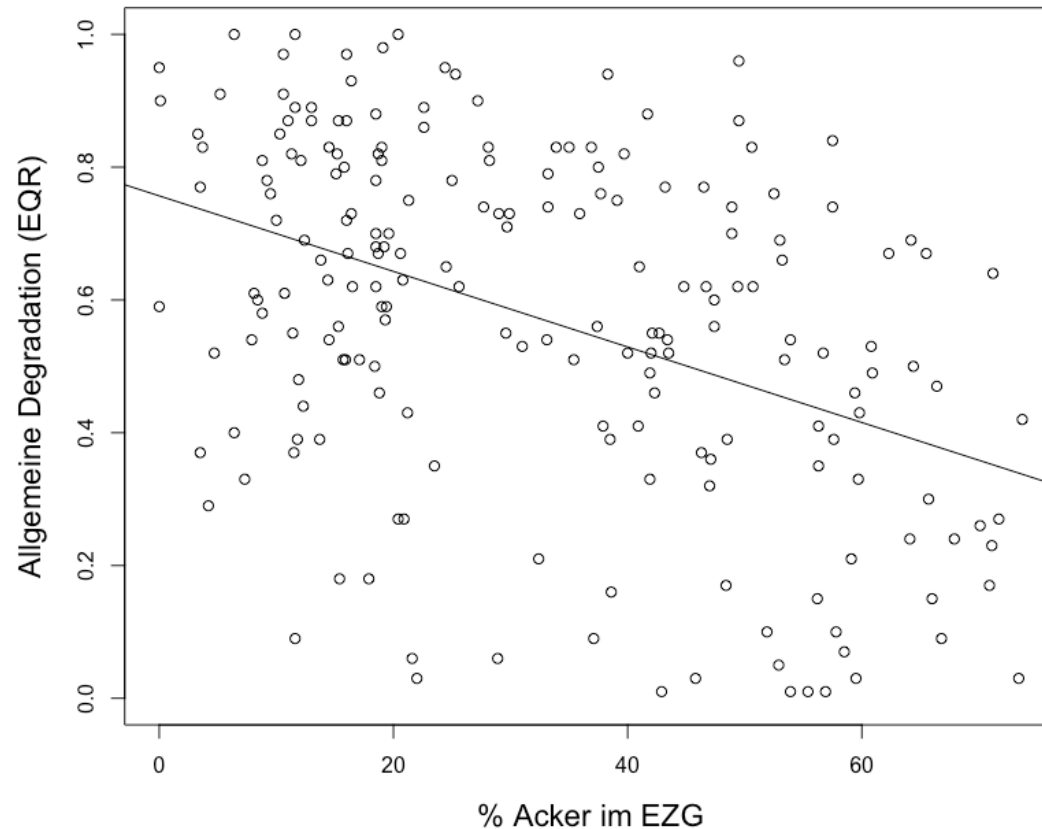


Integration räumlicher Skalen



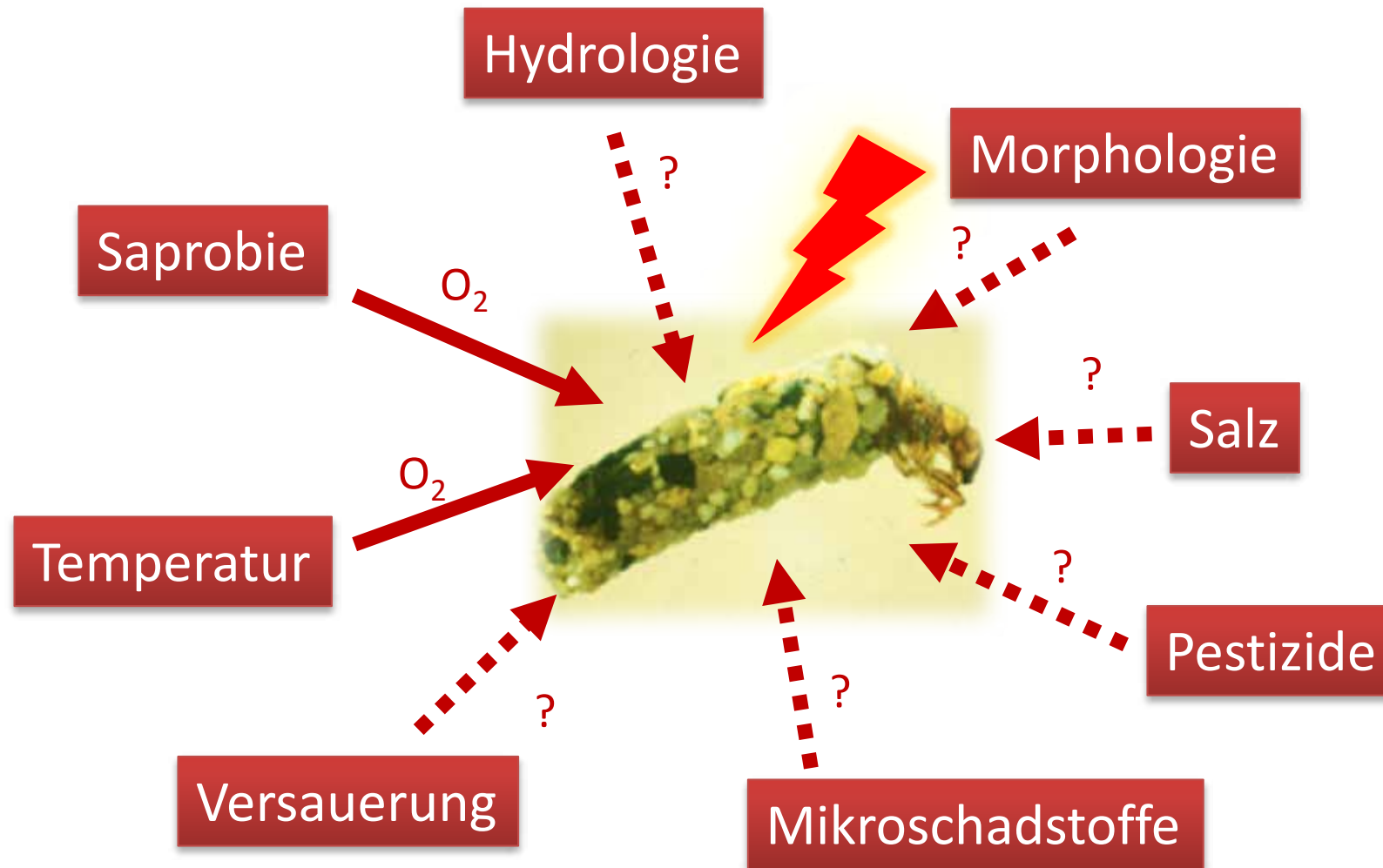
Unklare Kausalität

N = 269, R² = 0,18



- Nährstoffe?
(Sekundärsaprobie)
- Pestizide?
- Feinsedimente?
- Wasserentnahme?
- Stauhaltung?

Unklare Wirkmechanismen



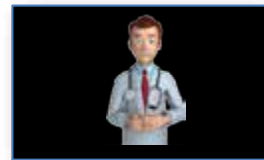
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- **Werkzeuge zur Diagnose der Ursachen von Degradation**

Diagnosewerkzeuge



Metrics



Diagnose

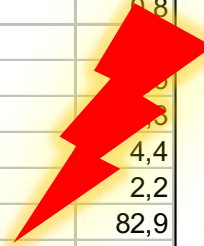


Maßnahmen

Diagnosewerkzeuge

- Expertenwissen

ID_ART	TAXON_NAME	Sieg
4335	Aphelocheirus aestivalis	0,8
4380	Baetidae Gen. sp.	0,3
4397	Baetis fuscatus	0,3
4419	Baetis sp.	0,3
4521	Caenis luctuosa	4,4
4584	Ceraclea sp.	2,2
4639	Cheumatopsyche lepida	82,9
4642	Chironomidae Gen. sp.	24,0
5059	Ecdyonurus venosus-Gr.	29,4
5075	Eiseniella tetraedra	13,1
5131	Serratella ignita	30,0
5237	Leuctra geniculata	2,2
5601	Hydropsyche pellucidula	15,3
5605	Hydropsyche sp.	35,7
5790	Leuctra sp.	10,9
5851	Limnius opacus Lv.	102,5
5854	Limnius volckmari Lv.	2,2
6468	Polycentropus flavomaculatus	6,5
6510	Potamanthus luteus	16,3
6780	Rhyacophila sp.	15,3
6853	Simulium sp.	268,4
6886	Sphaerium sp.	2,2
6909	Stenelmis canaliculata Lv.	48,0
6972	Tanypodinae Gen. sp.	39,3
6977	Tanytarsini Gen. sp.	19,6
8142	Hydropsyche incognita	10,3
8691	Asellus aquaticus	24,0
8736	Oligochaeta Gen. sp.	8,7
8831	Turbellaria Gen. sp.	2,2
12091	Limnius opacus Ad.	9,5
12121	Stenelmis canaliculata Ad.	2,2
19110	Rhyacophila dorsalis/nubila	13,9



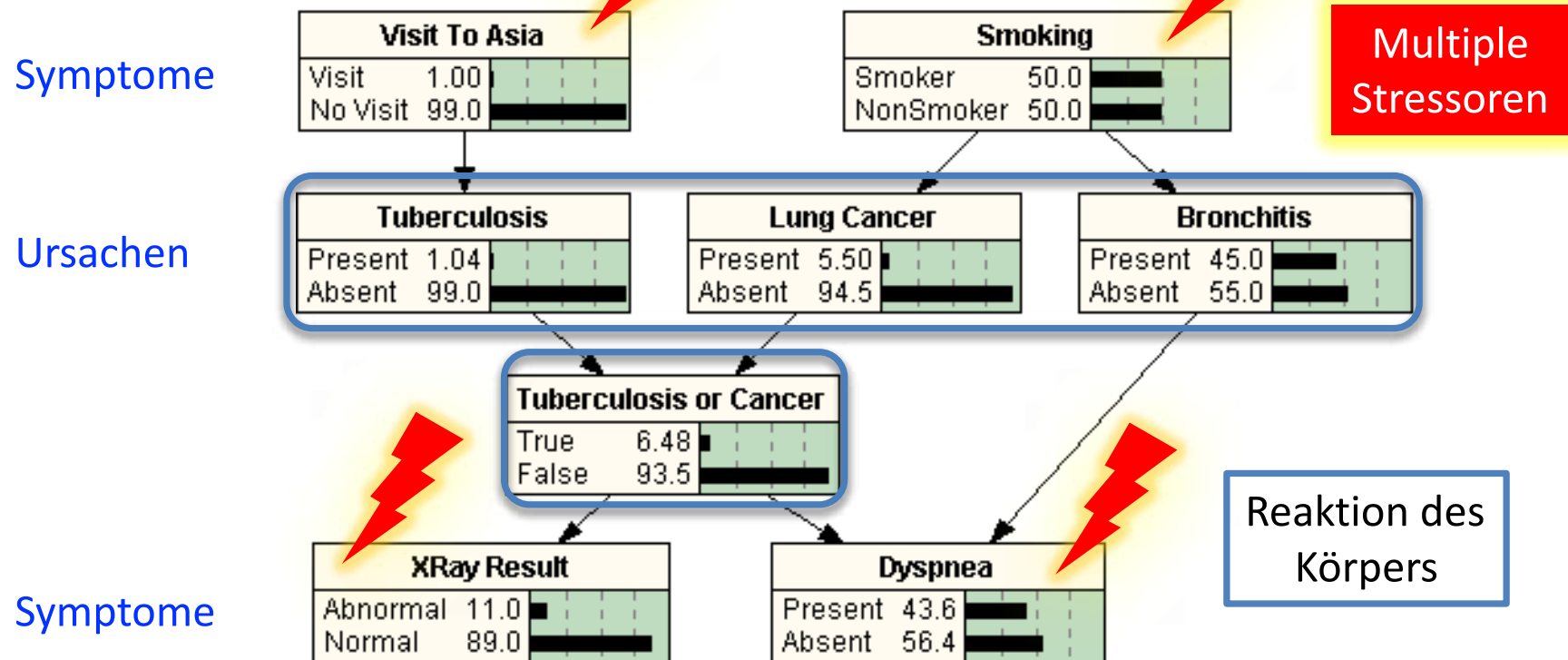
Diagnosewerkzeuge

- Expertenwissen
- Stressor-spezifische biologische Reaktionen
 - selten
 - Kenntnisse spezifischer Reaktionen der Biologie derzeit noch lückenhaft → Wirkmechanismen?

Diagnosewerkzeuge

- Expertenwissen
- Stressor-spezifische biologische Reaktionen
 - selten
 - Kenntnisse spezifischer Reaktionen der Biologie derzeit noch lückenhaft
- Diagnose über Bayesische Netzwerke (BNs)
 - probabilistische statistische Modelle als Ursache-Wirkungs-Netzwerke (Einbeziehung von Expertenwissen)
 - bislang kaum in der Gewässerökologie angewandt

BNs in der klinischen Diagnose



The "Chest Clinic" (Lauritzen and Spiegelhalter 1988, J. Royal Statistics Society B, 50/2, 157–194)

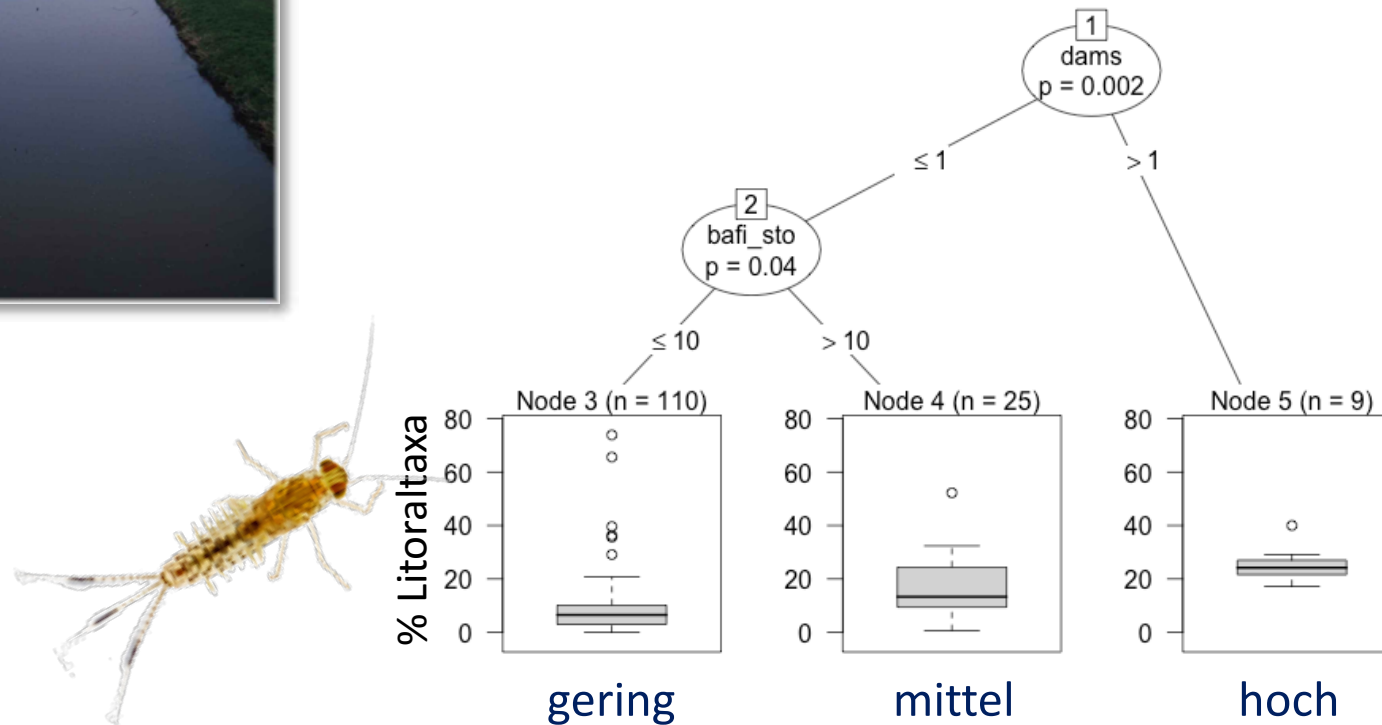
Wie groß ist die Wahrscheinlichkeit, unter einer der Ursachen zu leiden, wenn er/sie raucht, kurzatmig ist, im letzten Jahr in Asien war und einen positiven Röntgenbefund hat?

Ökologische Diagnose



Wie groß ist die Wahrscheinlichkeit eines Wasserkörpers, aufgestaut und/oder mit Steinschüttungen versehen zu sein?

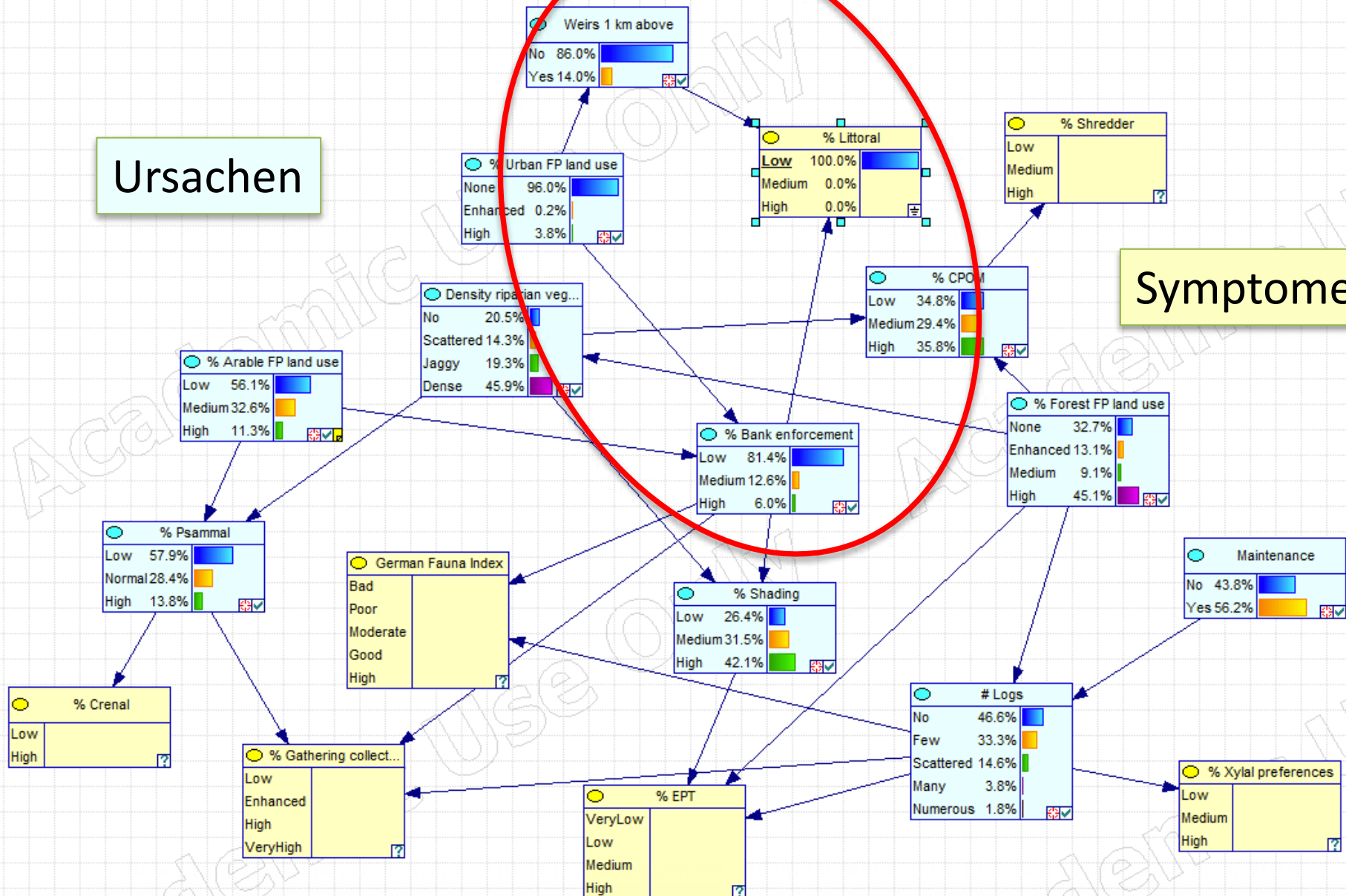
CART-Analyse



BN zur ökologischen Diagnose

Ursachen

Symptome



Online-Werkzeug

https://simplyshiny.shinyapps.io/REACH_model/

Apps Dia_CATCH Dia_REACH Dia_SITE Dia_PP

Reach-scale Diagnosis Reach-scale Prognosis

Please indicate the appropriate status of the following biological metrics/indices:

What is the proportion of EPT specimens in the community (%)

Unknown

What is the proportion of gathering collectors (%)

Unknown

What is the proportion of shredders (%)

Unknown

What is the proportion of crenal specimens (%)

Unknown

What is the proportion of littoral specimens (%)

High (>20)

Low (<10)

Medium (10-20)

High (>20)

Unknown

What is the German Fauna Index (EQR value)

Unknown

Change the %-scale of the radar plot here

10% 40%

Diagnostic plot Causal hierarchy Read more

Benthic invertebrates in mid-sized sand-bottom lowland rivers of Central Europe

By choosing the appropriate metric states of your water body, you can diagnose potential causes of deterioration. Chose "Unknown", if a particular metric status is not available.

Based on your selection, the radar plot to the right displays the probabilities of the seven candidate causes, of being causal for your metric states. Klick on each cause to get more details of the probability distribution. To increase viability, you can change the plot's scaling by sliding the scale bar to the right or left.

The index card "Causal hierarchy" provides you with a tabular output of the causes, in decreasing order of their probability. Select the index card "Read more" for more information and useful links.

You are in the diagnostic analysis

Potential causes of deterioration

Anstieg der Wahrscheinlichkeit

Weitere Hinweise zur Diagnose

https://simplyshiny.shinyapps.io/REACH_model/

Apps Dia_CATCH Dia_REACH Dia_SITE Dia_PP

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You are in the diagnostic analysis

Potential causes of deterioration

Cause	Probability (approximate)
Urban land use	10%
Arable land use	10%
Riparian degradation	10%
Flow reduction/impounding	10%
Bank reinforcement	40%
Lack of large wood (logs)	10%
Fine sediment pollution	10%

https://simplyshiny.shinyapps.io/REACH_model/

Apps Dia_CATCH Dia_REACH Dia_SITE Dia_PP

Reach-scale Diagnosis Reach-scale Processes

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Unknown

What is the proportion of littoral specimens (%)

High (>20)

What is the proportion of xylo-pretarring specimens (%)

Unknown

What is the German Fauna Index (EQR value)

Unknown


Change the %-scale of the radar plot here

10 40%

Bank reinforcement

What does it mean?

Bank reinforcement refers to (mainly) artificial structures, to stabilise stream banks and thus to reduce or inhibit bank erosion. Bank reinforcement may consist of ('hard engineering') rip-rap, gabions, concrete or sheet piling (steel walls), or of more soft materials such as woody fascines. Yet, even trees can be found to enforce stream banks, as they can enhance bank stability through their dense root system.



Bank (side) erosion is a natural process and a key mechanism behind meandering. Eroding banks constantly re-locate the stream course, enhance its dynamics and provide (natural) sediment to the stream system, to form habitats and balance the sediment dynamics (i.e., the dynamics between erosion and deposition). Bank reinforcement shifts sediment dynamics towards bed (bottom) erosion, thus leading to the long-term incision of the stream course. At the same time, bank habitat diversity is largely degraded and dominated by artificial (hard) substrates. This can cause dramatic changes in the composition of the aquatic fauna and flora (e.g., Schmetterling et al. 2001). Reinforced stream sections often resemble artificial navigation canals, and so does its fauna and flora.

What can be done?

The answer to this question is conditional on another question: Is the reinforcement really necessary? Often, bank reinforcement can be found that is no longer maintained. Because of its (very) slow decay, the reinforcement then continues to adversely impact a stream course over years or even decades, although not required anymore. Wherever bank reinforcement has become obsolete, it should be removed. Where cobbles and blocks belong to the natural substrate composition of streams, rip-rap may be dislocated from the stream banks to the stream bottom (provided that the geological origin of the material matches that one of the river substrates). If bank reinforcement is still required (and thus maintained), alternative options should be checked. For example, 'hard engineering' might be replaced by rather 'soft engineering' methods such as woody fascines or trees. Woody reinforcement structures provide habitat and even food to the river biota and hence should be preferred over stones, concrete and steel. Trees (and riparian vegetation in general) not only can help stabilise stream banks (Abernethy & Rutherford 1999), but also provide shade and organic matter to the system.

References:

Abernethy, B. & Rutherford, I.D. (1999) Guidelines for Stabilising Streambanks with Riparian Vegetation. Technical Report 99/10, Cooperative Research Centre for Catchment Hydrology, University of Melbourne, Parkville, Victoria, Australia, 30 pp. (available at <http://www.ewater.org.au/archive/crcc/h/archive/pubs/pdfs/technical199910.pdf>; checked on 17 Oct. 2017)

Schmetterling, D.A., Clancy, C.G. & Brandt, T.M. (2001) Effects of Riprap Bank Reinforcement on Stream Salmonids in the Western United States. *Fisheries*, 26, 5-13.

How to interpret the probabilities

The bar plot shows a more detailed picture of the probabilities of impact through no, present and dense bank reinforcement (e.g., no-ripap)

Diagnose- und Informationsportal



https://simplyshiny.shinyapps.io/REACH_model/

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High (>20)

What is the proportion of xylic-pollarding specimens (%)

Unknown

What is the German Fauna Index (EQR value)

Unknown

Change the 10-scale of the radar plot here

10 40%

Bank reinforcement

What does it mean?

Bank reinforcement refers to (mainly) artificial structures, to stabilise stream banks and thus to reduce or inhibit bank erosion. Bank reinforcement may consist ('hard engineering') rip-rap, gabions, concrete or sheet piling (steel walls), or more soft materials such as woody fascines. Yet, even trees can be found to reinforce stream banks, as they can enhance bank stability through their dense root system.

Bank (side) erosion is a natural process and a key mechanism behind mean stream dynamics. Eroding banks constantly re-locate the stream course, enhance its dynamic and provide (natural) sediment to the stream system, to form habitat and balance sediment dynamics (i.e., the dynamics between erosion and deposition). Bank reinforcement shifts sediment dynamics towards bed (bottom) erosion, thus leading to the long-term incision of the stream course. At the same time, its habitat diversity is largely degraded and dominated by artificial (hard) substrate. This can cause dramatic changes in the composition of the aquatic fauna as sections often resemble artificial navigation canals, and so does its fauna.

What can be done?

The answer to this question is conditional on another question: Is the reinforcement found that is no longer maintained. Because of its (very) slow decay, the reinforcement over years or even decades, although not required anymore. Wherever bank reinforcement is found, the natural substrate composition of stream bottom (provided that the geological origin of the material matches) is required (and thus maintained), alternative options should be checked. For 'hard engineering' methods such as woody fascines or trees. Woody reinforcement and hence should be preferred over stones, concrete and steel. Trees (and shrubs) on stream banks (Abernethy & Rutherford 1999), but also provide shade and organic matter to the stream.

References:

Abernethy, B. & Rutherford, I.D. (1999) Guidelines for Stabilising Streambanks. Cooperative Research Centre for Catchment Hydrology, University of Melbourne. [http://www.ewater.org.au/archive/crccch/archive/pubs/pdfs/technical199910/Schmutterling_D.A., Clancy_C.G. & Brandt_T.M. \(2001\) Effects of Riprap in the United States. Fisheries, 26, 5-13.](http://www.ewater.org.au/archive/crccch/archive/pubs/pdfs/technical199910/Schmutterling_D.A., Clancy_C.G. & Brandt_T.M. (2001) Effects of Riprap in the United States. Fisheries, 26, 5-13.)

How to interpret the probabilities

The bar plot shows a more detailed picture of the probabilities of impact to the system.

http://www.freshwaterplatform.eu/

Freshwater Information Platform

The Network for freshwater research
Data, tools and resources for science and policy support

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TOOLS OVERVIEW

Our tools section includes a variety of tools covering different areas within freshwater science.

We start with tools for collecting and publishing metadata (Freshwater Metadata Journal), publishing occurrence data (Freshwater Biodiversity Data Portal) and publishing spatial data in map format (Global Freshwater Biodiversity Atlas).

We link to the freshwaterecology.info database as a valuable tool to gain information on ecological preferences and biological characteristics of species.

Further you will find three tools that were developed within the MARS project: FIS - Freshwater Information System, diagnostic tools and scenario tool (online release planned for autumn 2017).

Our last box summarises a collection of other tools that might be helpful for your research, including modelling tools, assessment tools or GIS and R tools.

<p>FRESHWATER METADATA JOURNAL & METADATABASE</p> <p>Collect and save information about your freshwater dataset, then make it visible to the world by publishing it</p>	<p>FRESHWATER BIODIVERSITY DATA PORTAL</p> <p>Find freshwater data and publish your own research data on the web</p>	<p>GLOBAL FRESHWATER BIODIVERSITY ATLAS</p> <p>Publish your scientific results as a map in the atlas and make it visible to a wide audience</p>	<p>FRESHWATER SPECIES TRAITS DATABASE</p> <p>Unified, standardised and codified information about ecological preferences of more than 20.000 European freshwater organisms</p>
<p>MARS FRESHWATER INFORMATION SYSTEM - FIS</p> <p>Find background information on the effects of multiple stressors and options to mitigate them as well as example case studies in all kinds of freshwater ecosystems (will be online end of September 2017)</p>	<p>MARS DIAGNOSTIC TOOLS</p> <p>Identify and diagnose multiple stressors and their effects on waterbodies with an interactive tool, which also suggests potential management measures</p>	<p>MARS SCENARIO TOOL</p> <p>Provide a catchment-scale perspective of the multiple stressor situation and estimate the effects of changing multiple stressor combinations due to changes (MARS project product, going online end of 2017)</p>	<p>COLLECTION OF OTHER USEFUL TOOLS</p> <p>Find here a variety of other useful tools for your research, including modelling tools or GIS and R tools</p>

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Fazit

- Bewertung mit Makrozoobenthos ist anspruchsvoll
- Interpretation der Bewertung erfordert Spezialwissen
 - Ökologie der Arten
 - Belastungen
 - Situation im Einzugsgebiet
- Kenntnisstand der Mechanismen der ökologischen Wirkung von Belastungen ist noch lückenhaft
- Diagnosewerkzeuge können die Interpretation unterstützen, das Expertenwissen jedoch nicht ersetzen
- Genetische Methoden werden die Bestimmung unterstützen, nicht aber die Interpretation



Diagnosetool



Der nächste bitte...

MARS (Managing Aquatic ecosystems and water resources under multiple stress) wird gefördert von der Europäischen Union im 7. Rahmenprogramm, Theme ENV.2013.6.2-1 (Water resources management under complex, multi-stressor conditions), Contract No. 603378.