



Understanding cross-habitat linkages between **blue** and **green** infrastructure to optimize management of biodiversity, ecosystem services and multiple human uses



Brendan G. McKie, Senior Lecturer in Freshwater Ecology
Swedish University of Agricultural Sciences



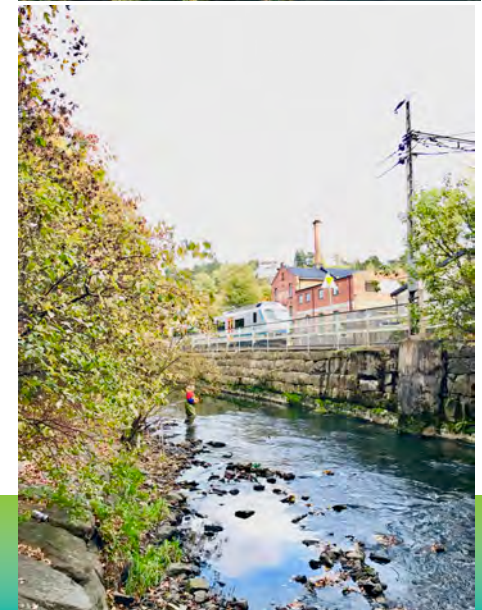


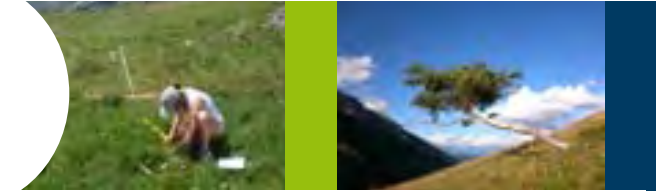
What are woody riparian buffers good for?

Brendan G. McKie



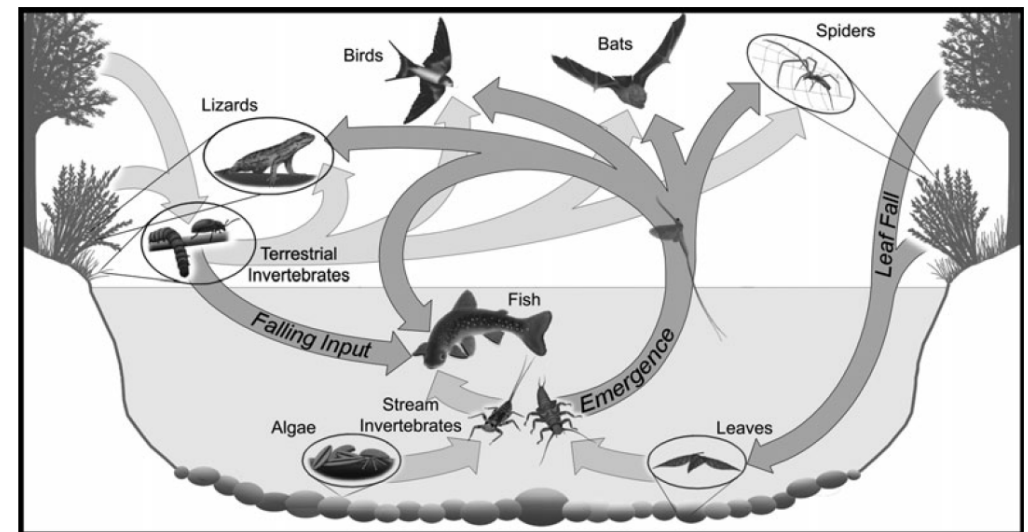
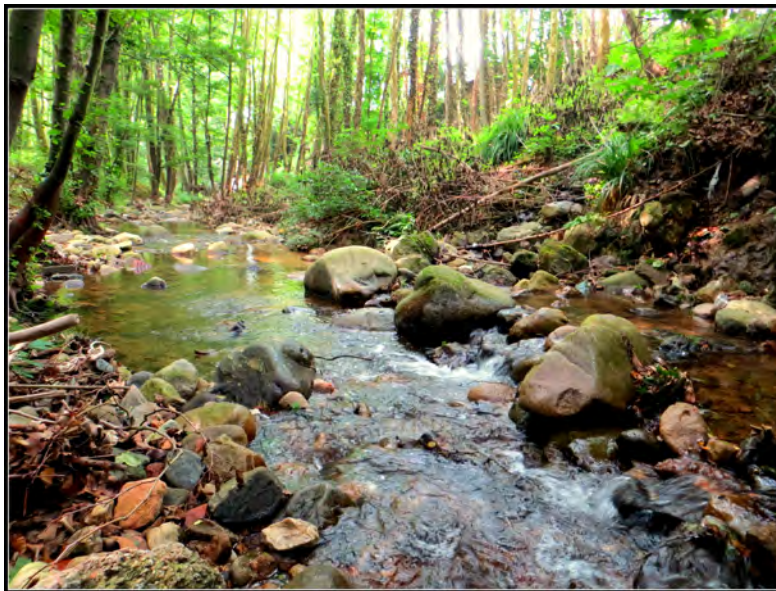
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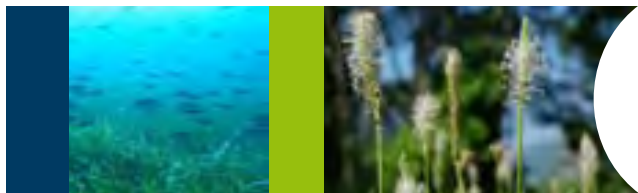




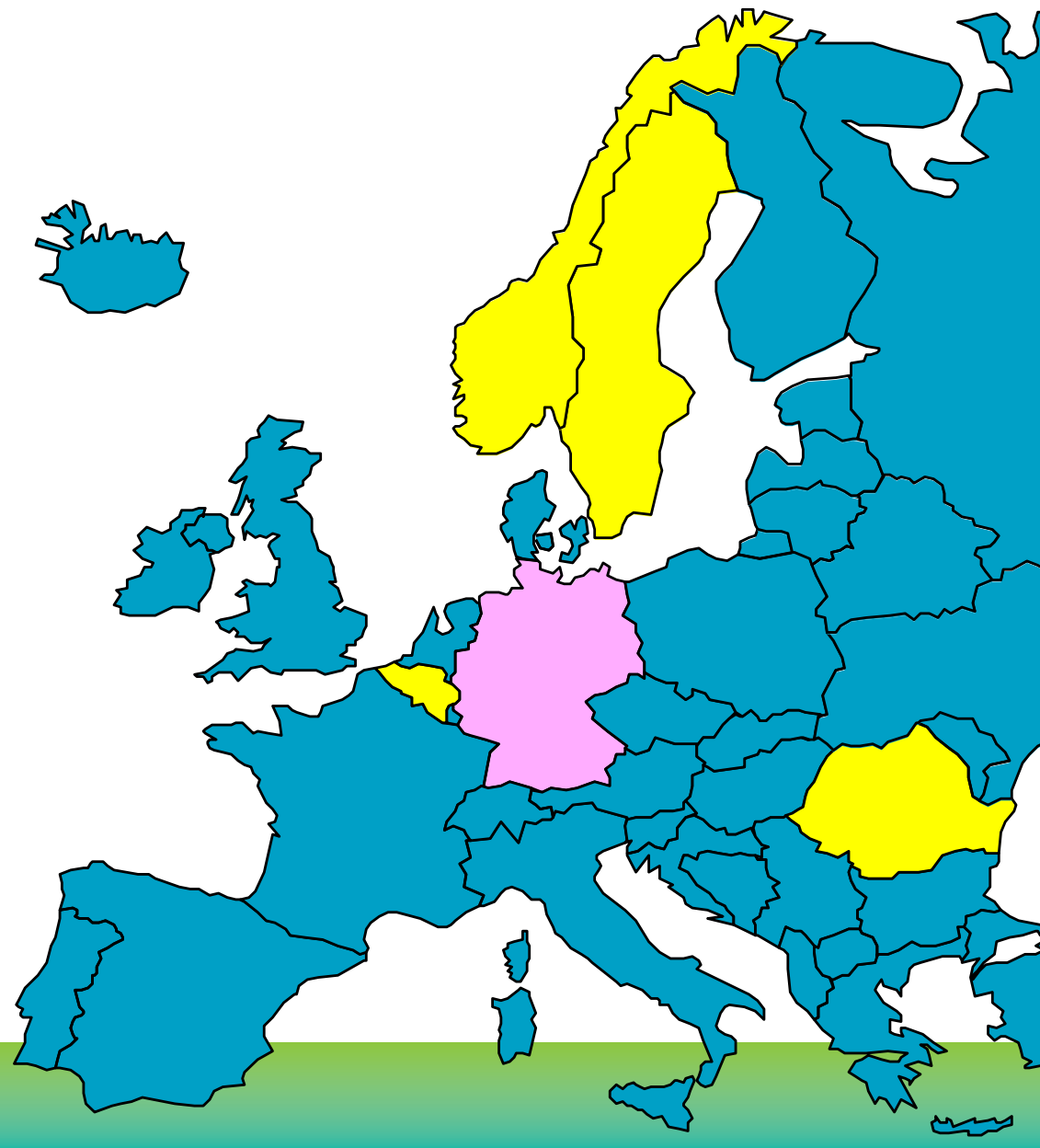
Two broad research areas

1. The utility of riparian buffers as a management tool for mitigating anthropogenic impacts, protecting biodiversity, and enhancing ecosystem function and services
2. The ecological and anthropogenic factors that regulate ecological connectivity between stream ecosystems and terrestrial consumers





- Brendan McKie (SLU, Coordinator)
- Nikolai Friberg (NIVA Norway)
- Geta Risnoveneu (UBUC, Romania)
- Peter Goethals (U. Ghent, Belgium)
- Martin Volk (UFZ, Germany)*

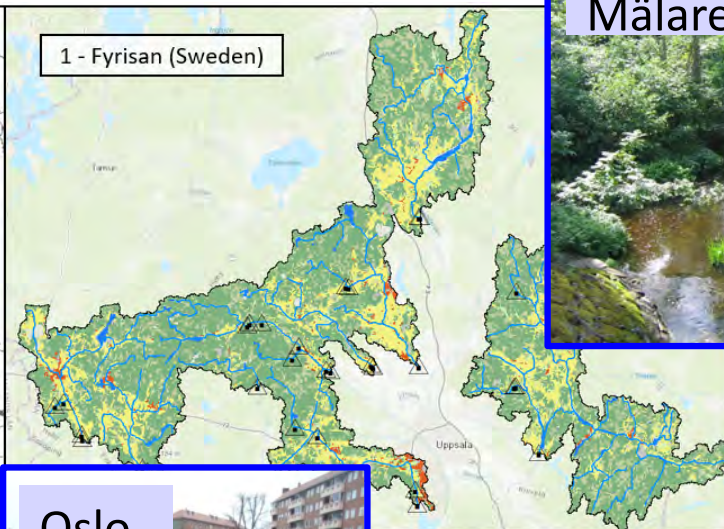


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Mälaren/Fyrisån



1 - Fyrisån (Sweden)

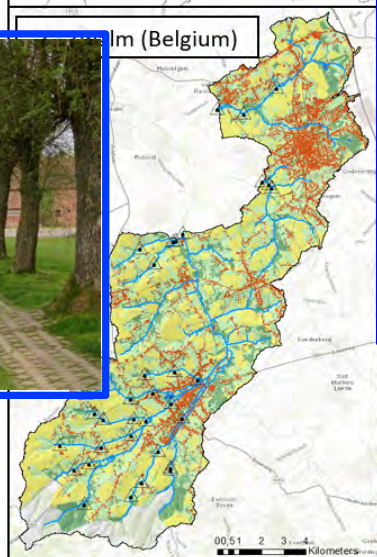


Oslo



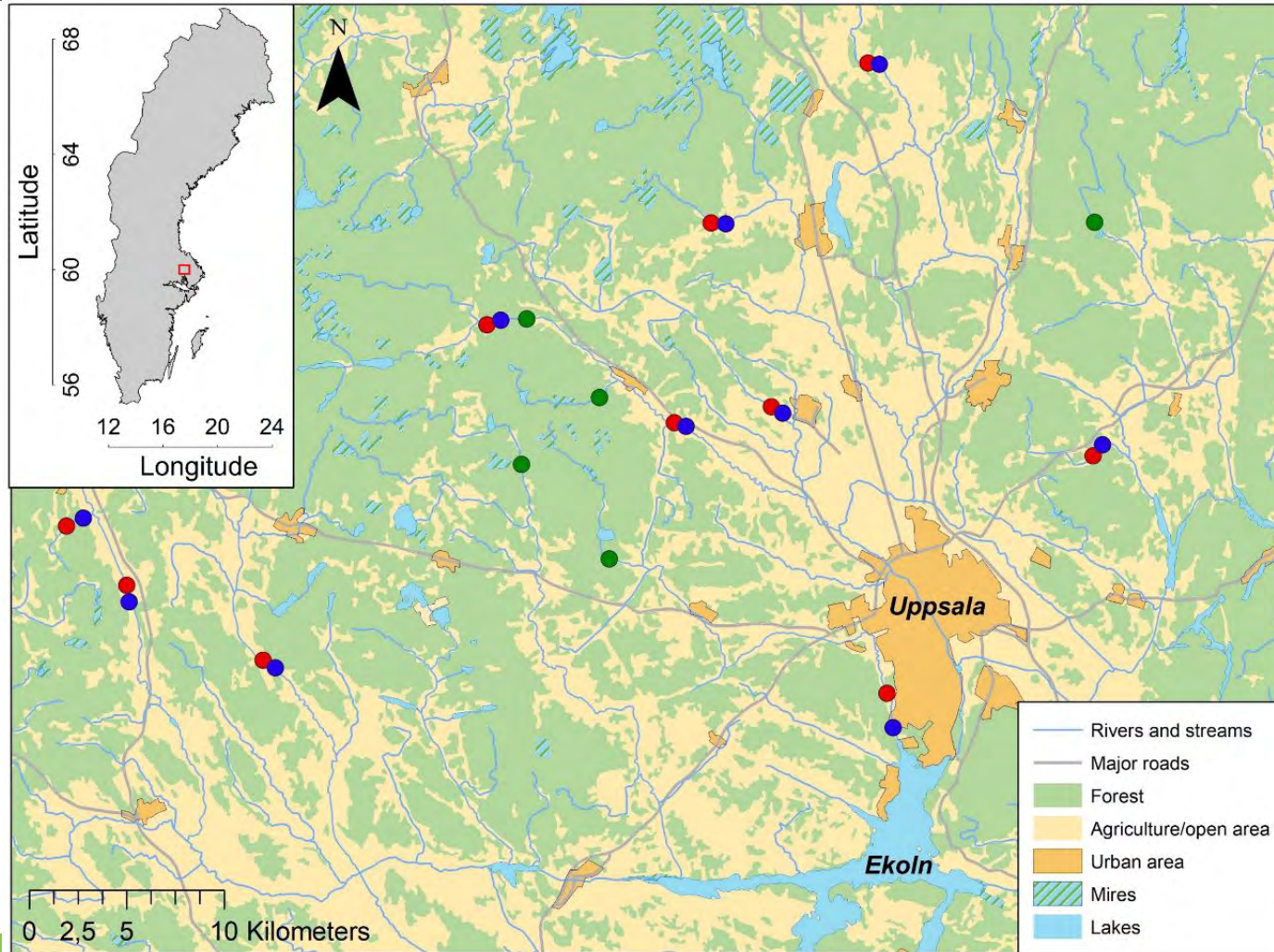
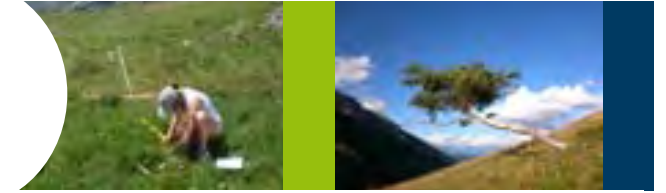
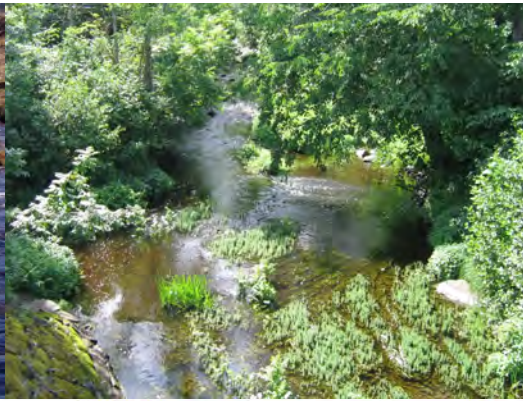
4 - Arges

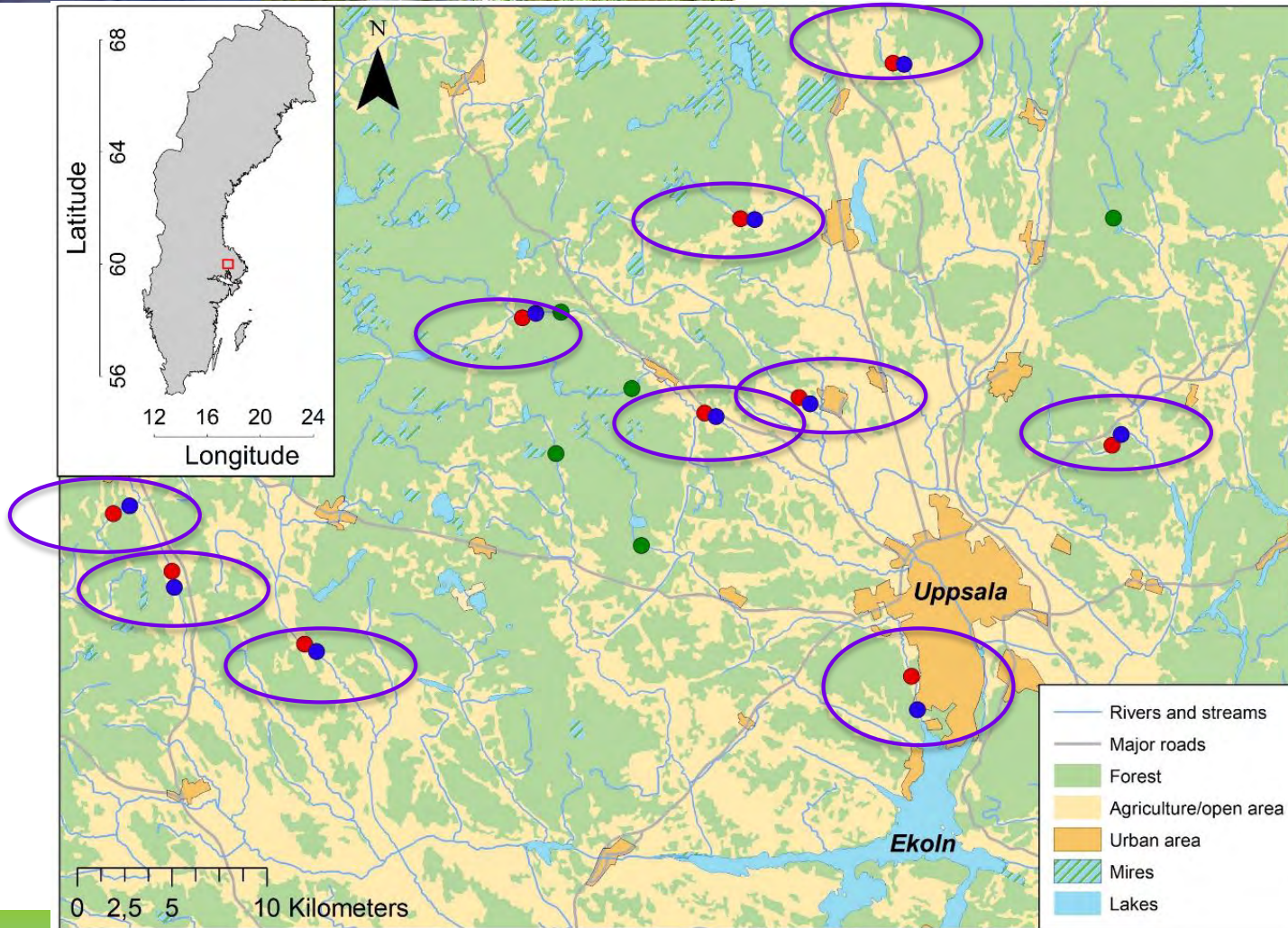
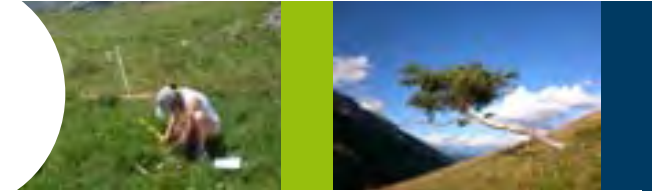
Arges

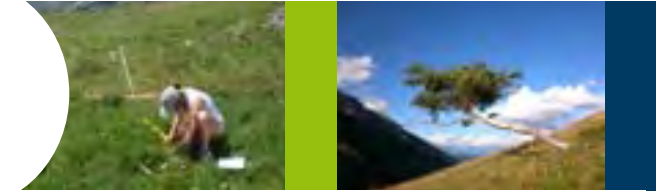


Zwalm





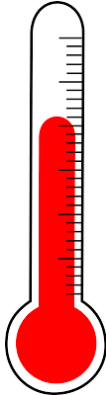




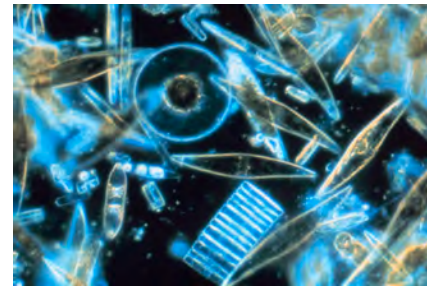
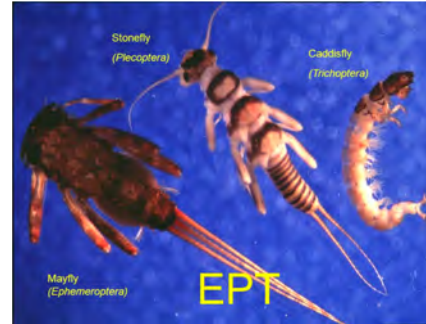
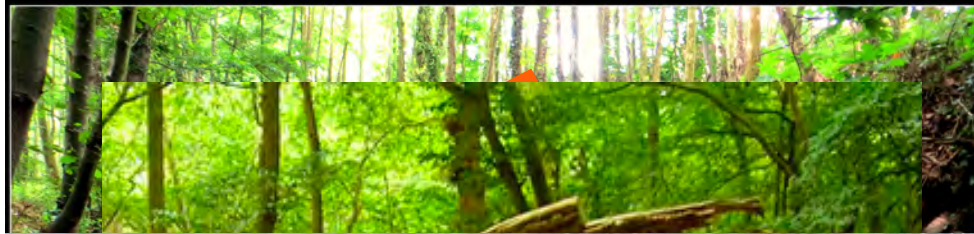
GBI asset portfolio

- **Habitat:** Local and catchment scale riparian vegetation properties, shading, coarse woody debris (terrestrial and aquatic), macrophyte density
- **Biodiversity:** microbial diversity in soils and streams, stream diatoms, stream macroinvertebrates, terrestrial invertebrates, trees, fish*
- **Supporting ecosystem services:** C and N cycling (C & N isotopes, detritus decomposition, primary production, organic particle dynamics)
- **Regulating ecosystem services:** Thermal buffering, nutrient reduction, sediment reduction, filtration
- **Connectivity & Resilience attributes:** Connectivity biomarkers (Polyunsaturated Fatty Acids, isotopes), Dispersal traits, Functional diversity
- **Water Framework Directive ecological status:** macroinvertebrate- & diatom-based bioassessment metrics

Buffering & C-cycling



Biodiversity, WFD, habitat

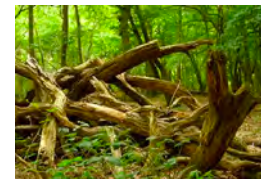
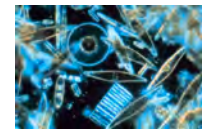
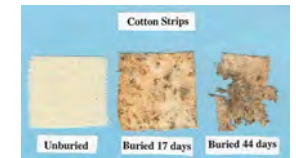
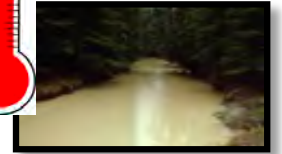
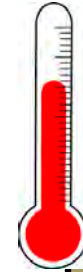
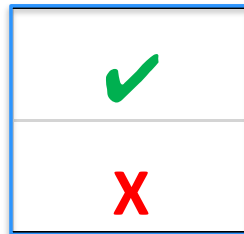


Ecological Status

- High
- Good
- Moderate
- Poor
- Bad

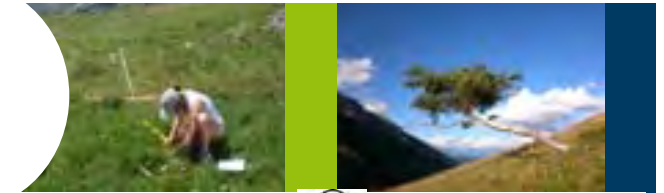


Buffer effect: Yes or No?

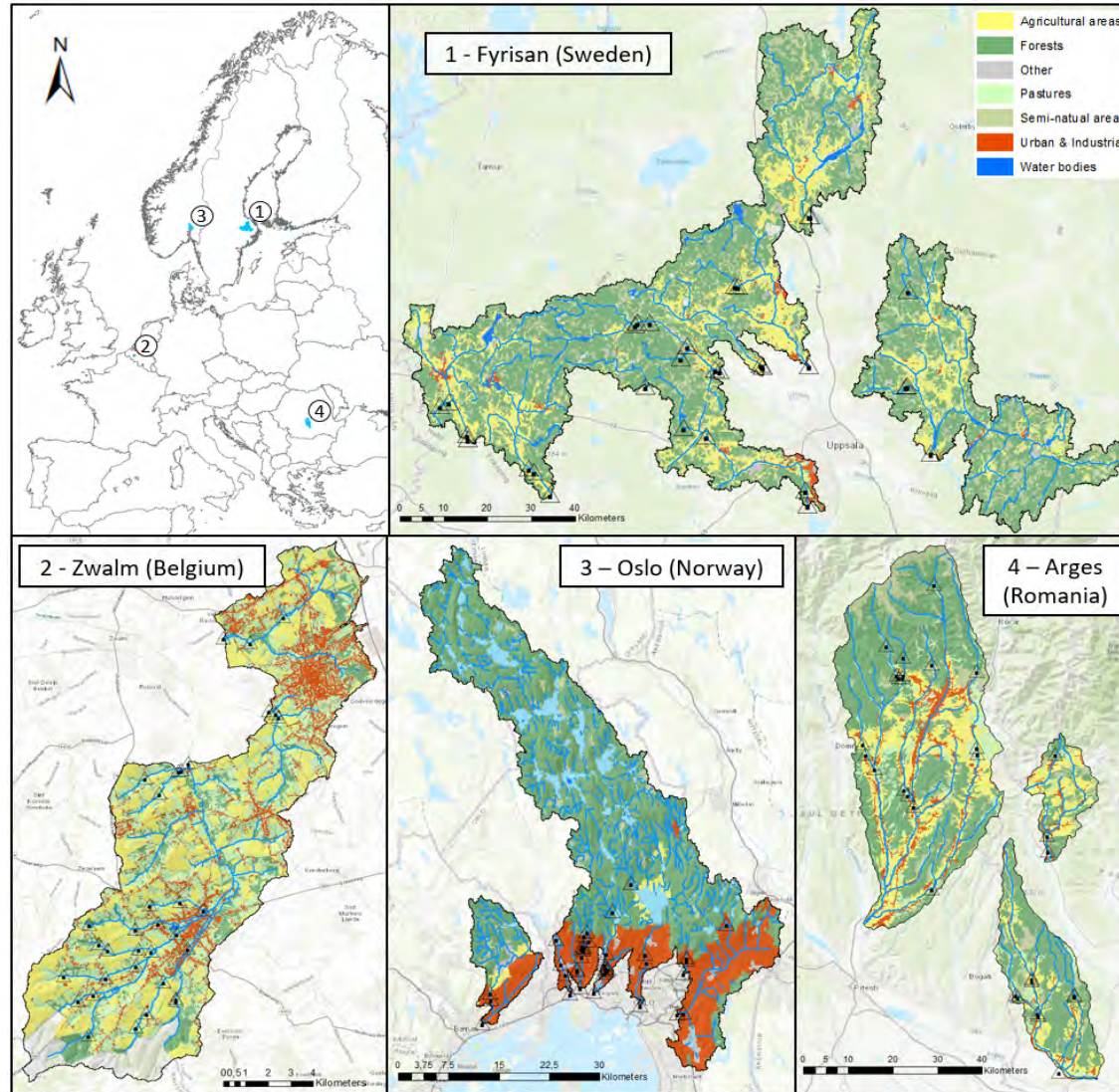


Summary: Benefits of Riparian buffers

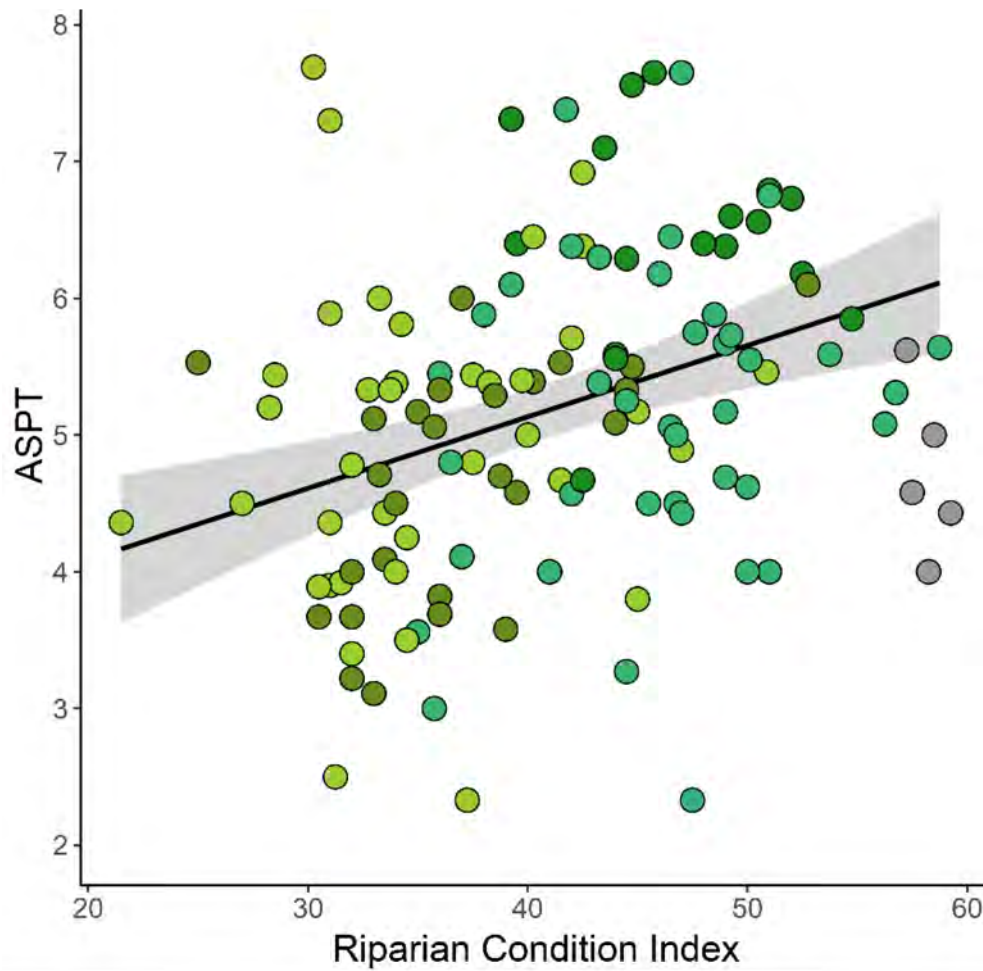
Unpublished results: showing a range of positive outcomes from riparian buffers
-More positive outcomes detected in Sweden and Romania which have an overall lower level of human impact than Belgium and Oslo



Contingencies in buffer benefits



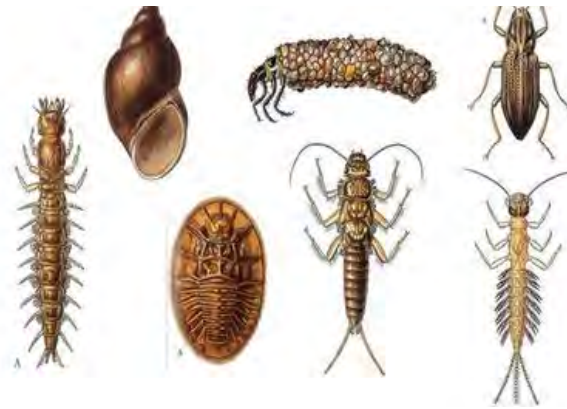
Context dependant change



Average score per taxon:
Standard macroinvertebrate
biotic index

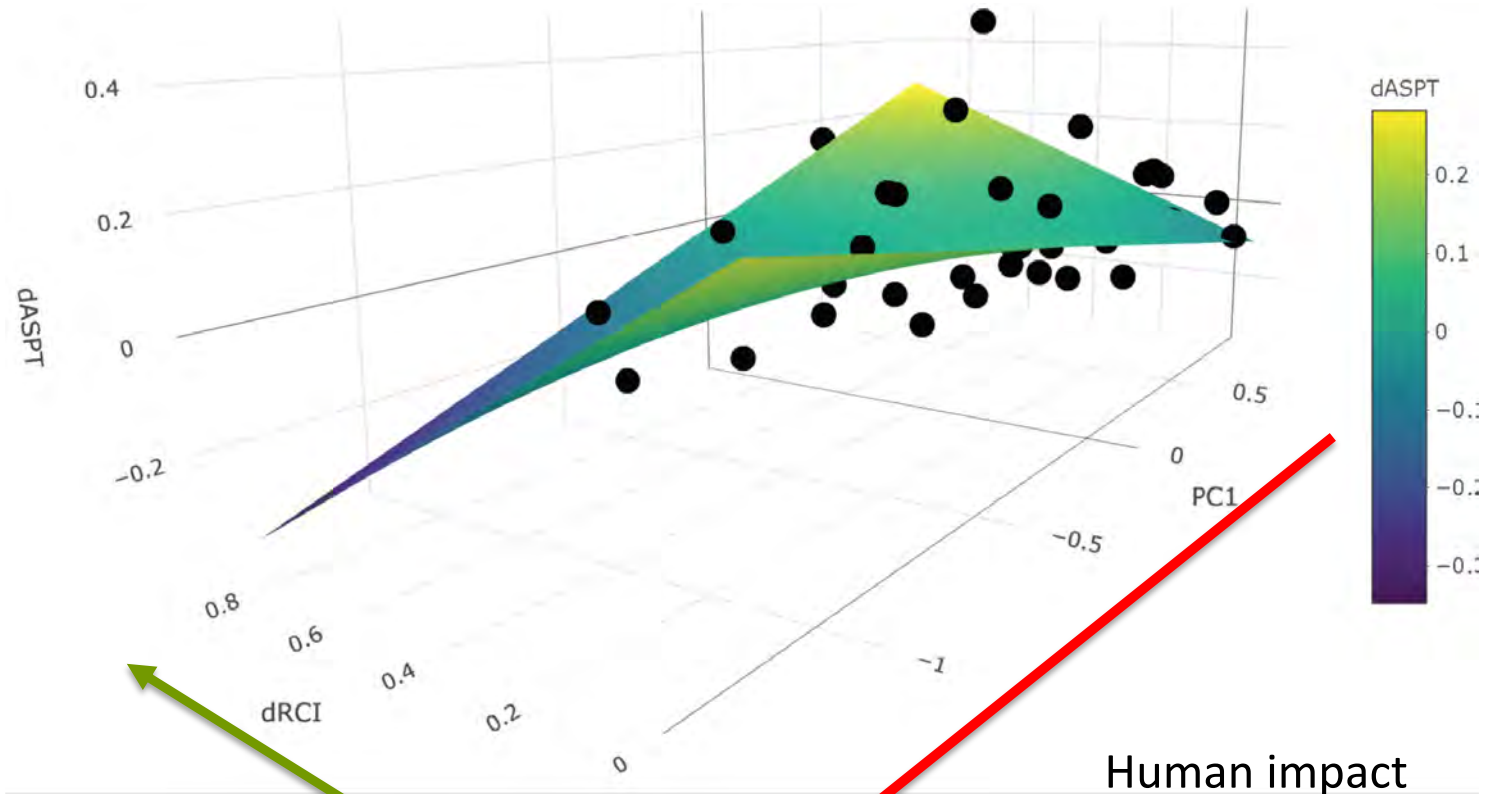


Burdon et al. (2020)

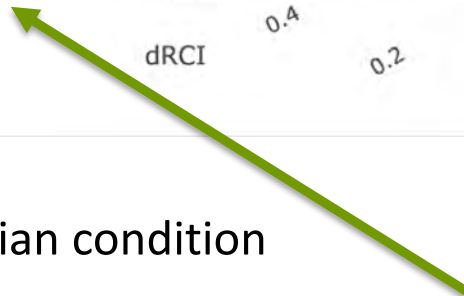


Burdon et al.
(2020)

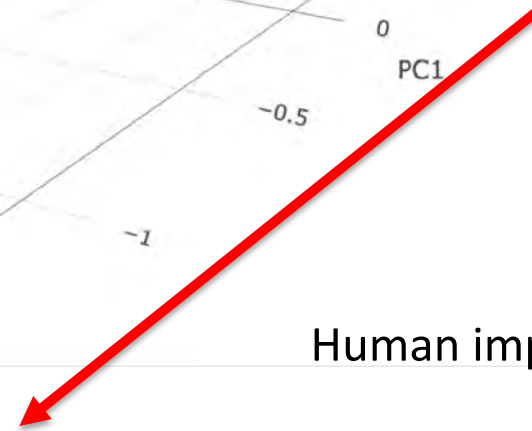
Change in
ASPT



Change in Riparian condition



Human impact



The role of specific buffer properties

Decomposition rate (k day⁻¹)

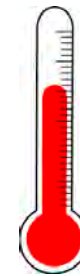
Unpublished results removed



Increasing buffer width

Mean summer maximum
Temperature. (°C)

Unpublished results removed



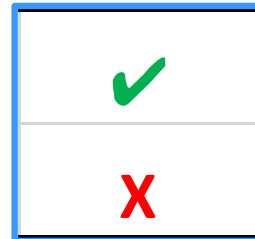
Increasing upstream tree cover

Country

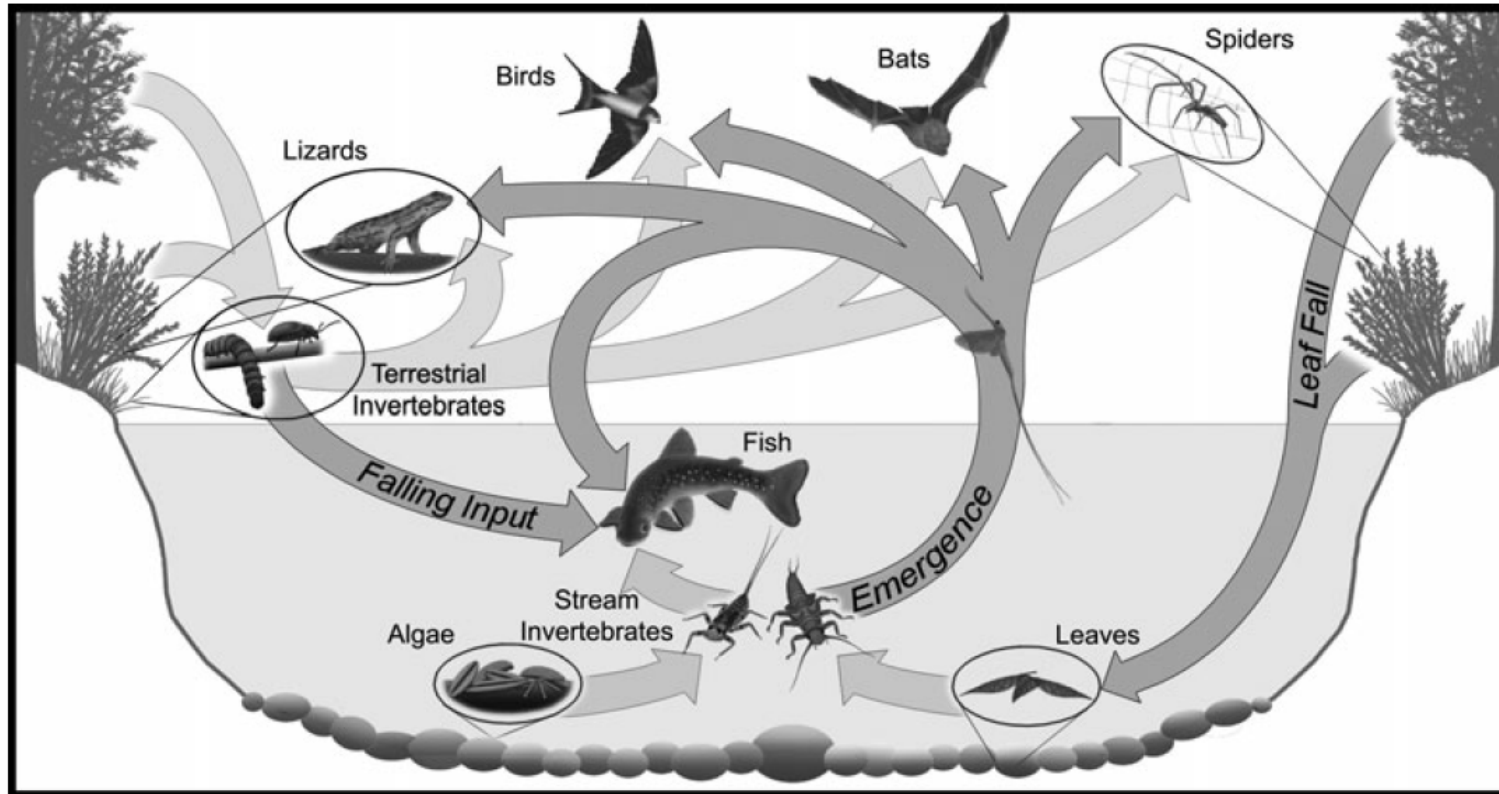
- BE
- NO
- RO
- SE

Lessons being learnt...

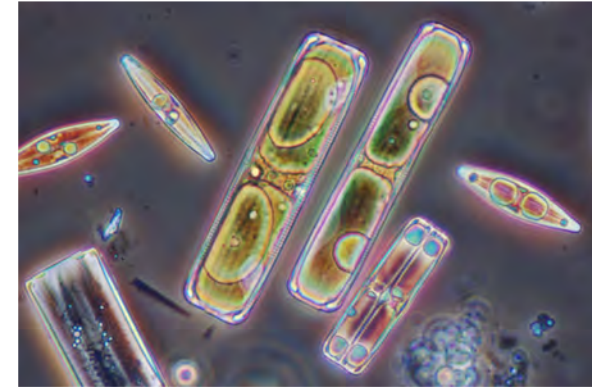
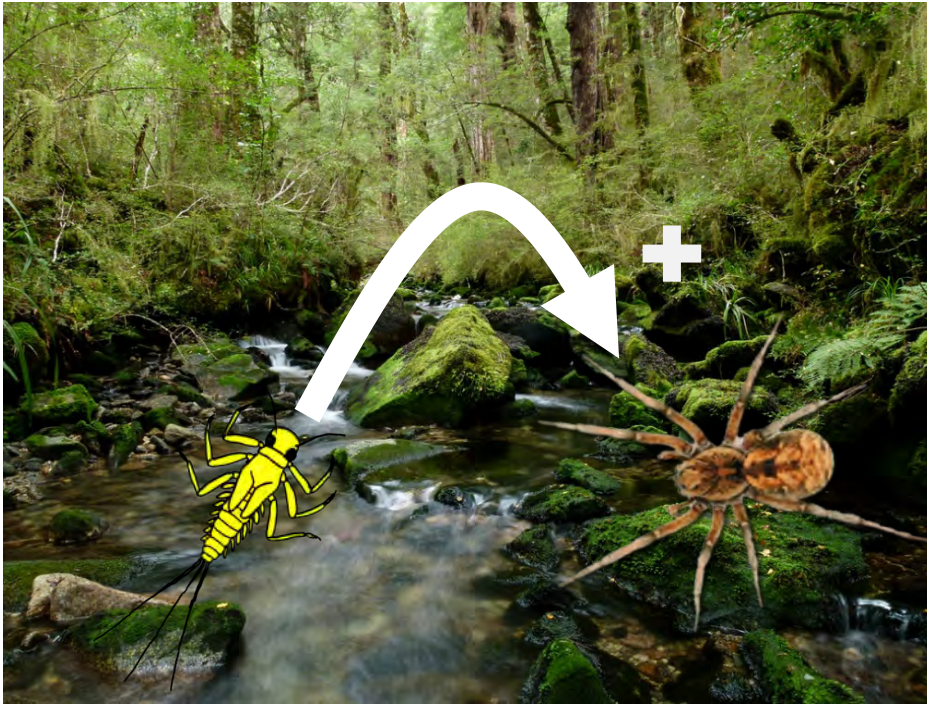
- Which environmental and biodiversity attributes respond to the presence of woody riparian buffers?
- Where is it worth rehabilitating riparian buffers?
 - Level of human impact
 - Catchment position
- How much buffer is needed?
 - Length, width
 - Elsewhere in the catchment?



Connectivity...



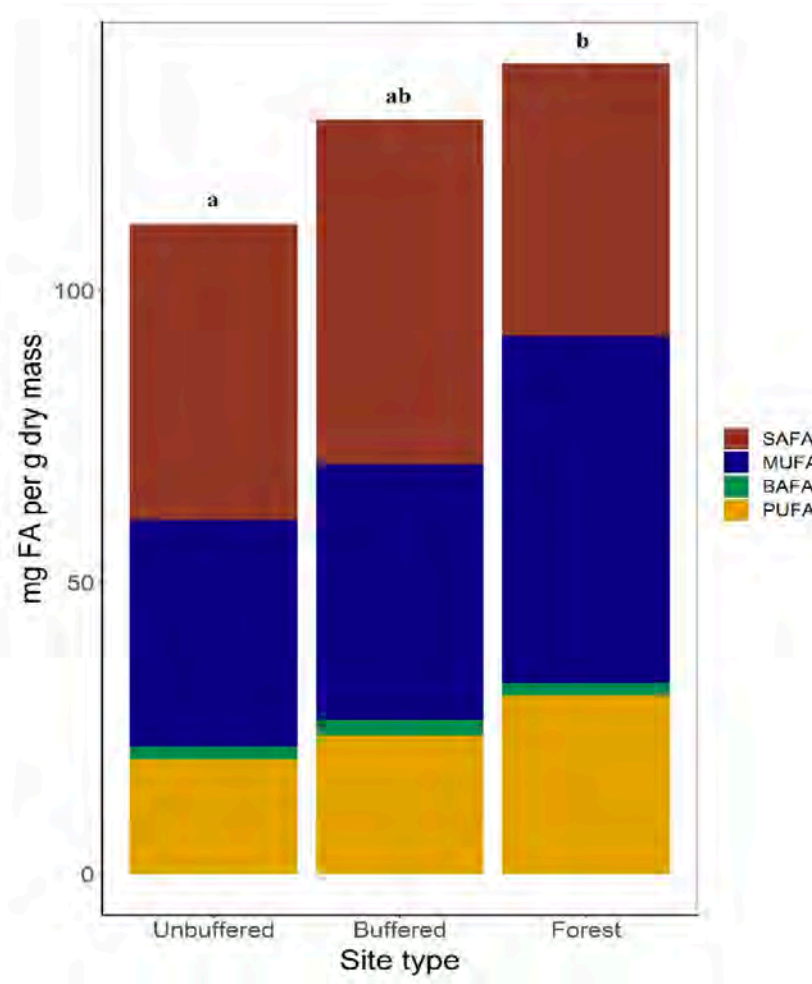
Polyunsaturated fatty acids...



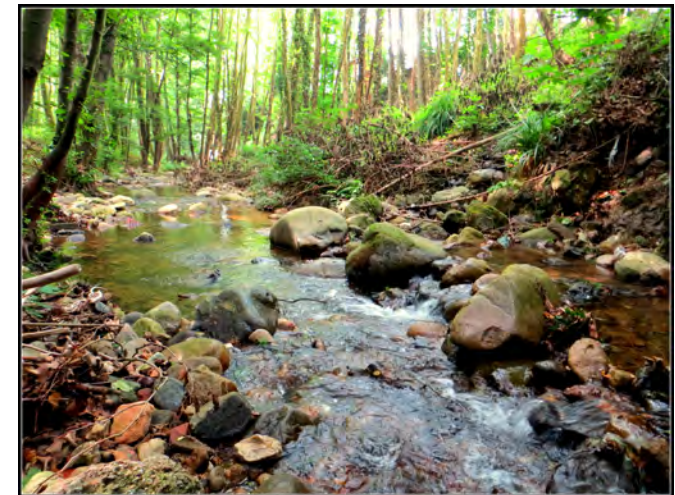
- E.g. Omega 3 fatty acids
- Highest quality fatty acids synthesised in aquatic environments ...
- ... by algae
- Essential for metabolism and development

Connectivity is a complex interplay between . . .

Intream productivity – aquatic insect dispersal – terrestrial consumer responses



(Ramberg et al, 2020)



Dispersal traits ...



- Adult dispersal and life history traits



Insect trait clusters

FOREST

Large Dipterans

Medium size
Short adult lifespan



Elmidae

Long adult lifespan



Trichoptera, Odonata

Long adult lifespan
Large size
Strong adult flying strength



AGRICULTURAL

*Chironomidae,
Simuliidae,
small Trichoptera*

Small size
Very short adult life span
Weak flying strength
High female dispersal



(McKie et al. 2018)


CROSSLINK

Traits associated with greater dispersal
also associated with higher spider PUFA
content

The header features a white central circle containing the text. To the left of the circle are two images: an underwater scene with blue water and green plants, and a close-up of white flowers. To the right are two images: a person kneeling in a grassy field and a landscape with a tree and a blue sky.

And aquatic insect dispersal

Unpublished results removed:
Relationship between dispersal traits
and PUFAs

A horizontal bar at the bottom of the slide with a green-to-blue gradient.



COMING SOON 2021



CROSSLINK

www.riparianbuffers.com

Already here! Nine publications including:

- Burdon, F. J., *et al* (2020). "Assessing the benefits of forested riparian zones: A qualitative index of riparian integrity is positively associated with ecological status in european streams." **Water** 12(4): doi.org/10.3390/w12041178.
- Forio, M. A., N. *et al.* (2020). "Small Patches of Riparian Woody Vegetation Enhance Biodiversity of Invertebrates." **Water** 12(11).
- Mutinova, P. T., M. Kahlert, *et al.* (2020). "Benthic Diatom Communities in Urban Streams and the Role of Riparian Buffers." **Water** 12(10).
- Ramberg, E., *et al.* (2020). "The Structure of Riparian Vegetation in Agricultural Landscapes Influences Spider Communities and Aquatic-Terrestrial Linkages." **Water** 12(10).
- McKie, B. G., *et al.* (2018). "Species traits reveal effects of land use, season and habitat on the potential subsidy of stream invertebrates to terrestrial food webs." **Aquatic sciences** 80(2): 15.

https://www.slu.se/Biodiversa_Crosslink



And this...

<https://www.youtube.com/watch?v=goC7hzaXqeM>

(in Swedish, version with English subtitles coming soon)



LÄNSSTYRELSEN
UPPSALA LÄN

FYRISÅNS
VATTENFÖRBUND

ACKNOWLEDGEMENTS



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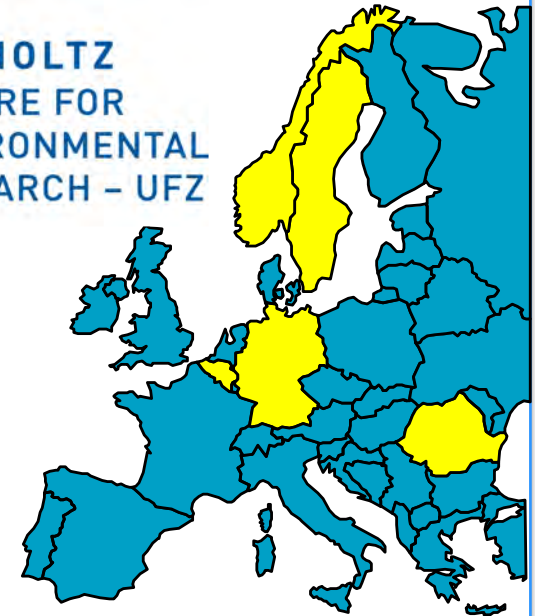
Norwegian Institute for Water Research



HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

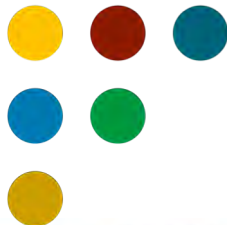


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SWEDISH ENVIRONMENTAL
PROTECTION AGENCY

FORMAS



*The Swedish Research Council for Environment,
Agricultural Sciences and Spatial Planning*



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AND INNOVATION FUNDING



Opening
new
horizons



The Research Council
of Norway



Federal Ministry of
Education
and Research

