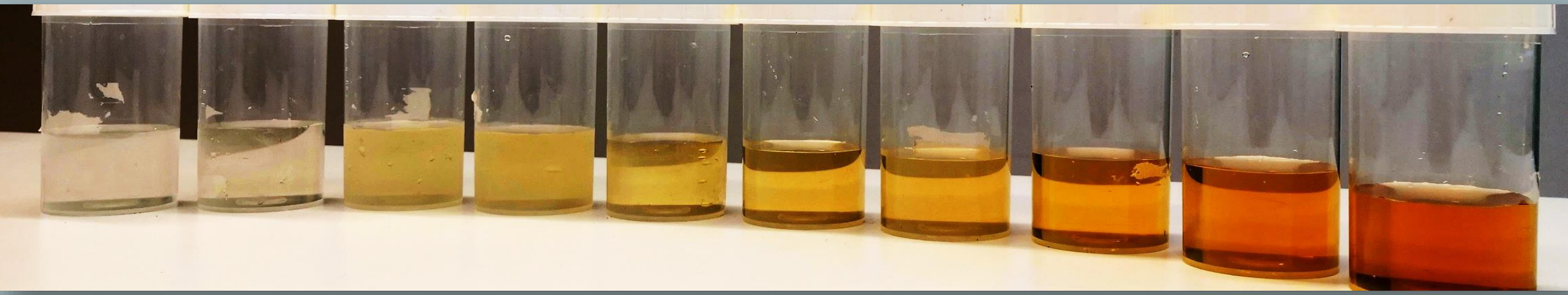
BROWNING ALTERS FOOD-WEBS AND LEADS TO BIODIVERSITY LOSS IN RIVERINE ECOSYSTEMS



Jussi Jyväsjärvi

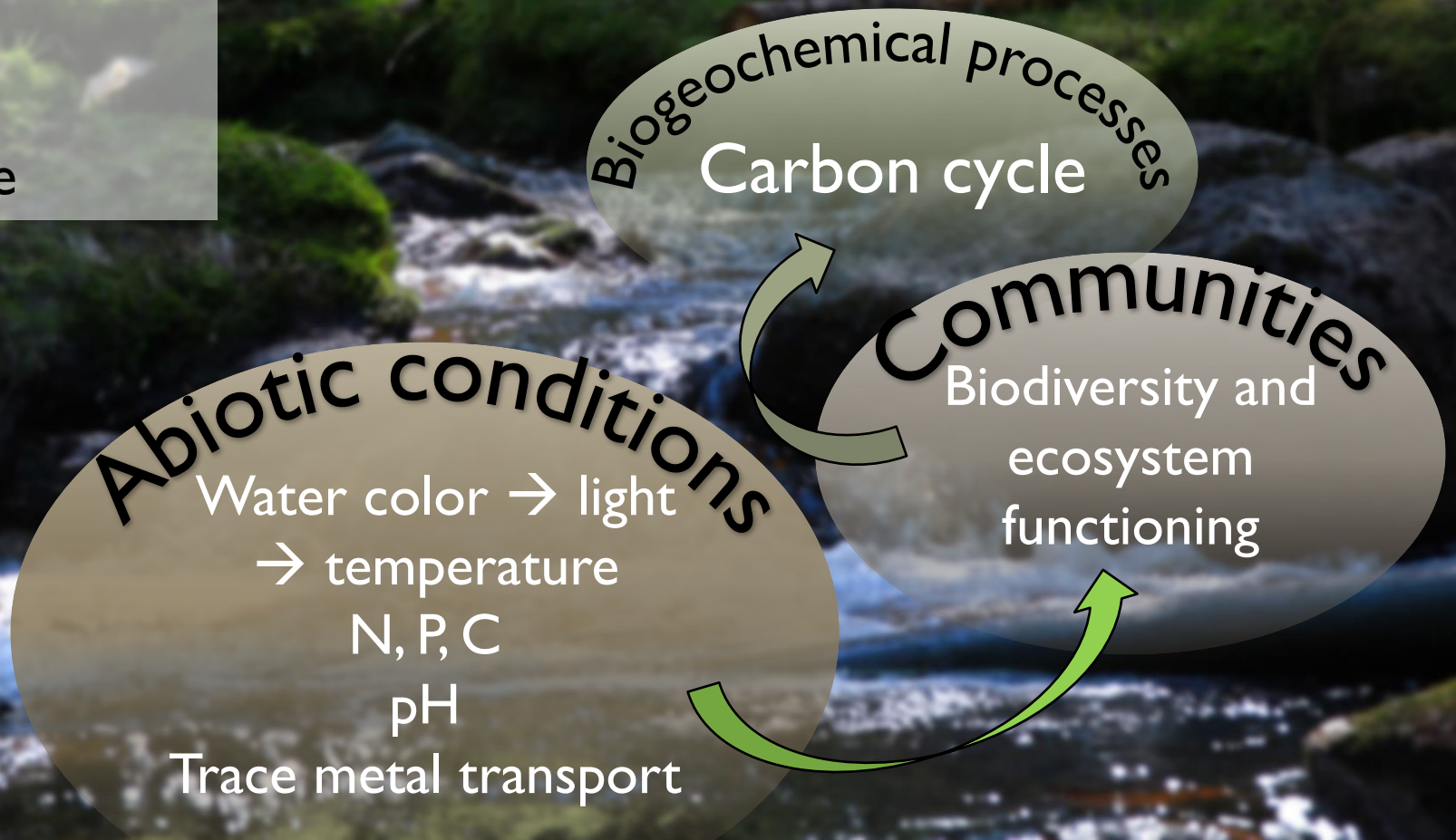
2nd International Conference for Sustainable Resource Society
Kuopio, Finland
3 November 2022

RESEARCH GROUP Stream Ecology

UNIVERSITY OF OULU

CAUSES AND CONSEQUENCES OF BROWNING

- Recovery from acid deposition
- Precipitation changes
- Global warming
- Intensification of land use



BROWNING OF BOREAL FRESHWATER ECOSYSTEMS – NOTABLE ROLE OF FORESTRY

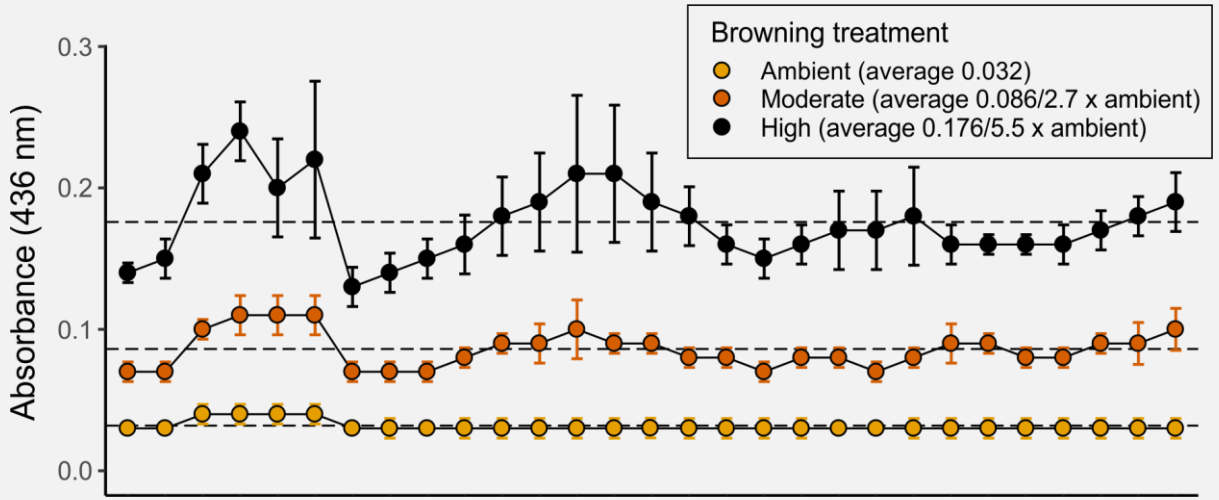
DOUBLE TROUBLE – EFFECTS OF BROWNING AND CLEAR CUTS ON STREAM ECOSYSTEMS?

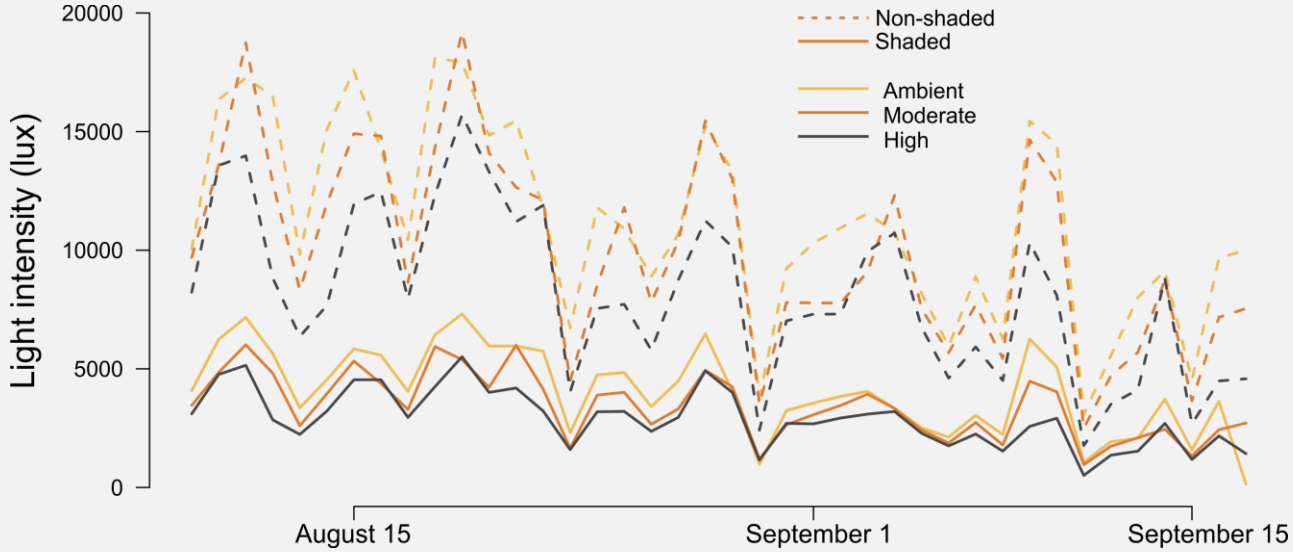
	No drainage (low DOC)	Sparse drainage (moderate DOC)	Intense drainage (high DOC)
No clearcut	1. 		

EXPERIMENTAL MANIPULATION OF BROWNING AND RIPARIAN SHADING LOSS

Luke
NATURAL RESOURCES INSTITUTE FINLAND

EXPERIMENTAL SETUP
-
BROWNING & SHADING TREATMENT





EXPERIMENTAL SETUP
-
RESPONSE VARIABLES

Responses measured:

- **Ecosystem processes**
  - Primary production
  - Bacterial production
  - Bacterial respiration
  - Organic matter decomposition

- **Biofilm nutritional quality**
  - C:N:P stoichiometry
  - Fatty acid composition

- **Community composition & diversity**
  - Biofilm bacteria (16s rRNA, rDNA)
  - Leaf-decomposing fungi (ITS rDNA)
  - Benthic macroinvertebrates
  - Periphytic diatoms

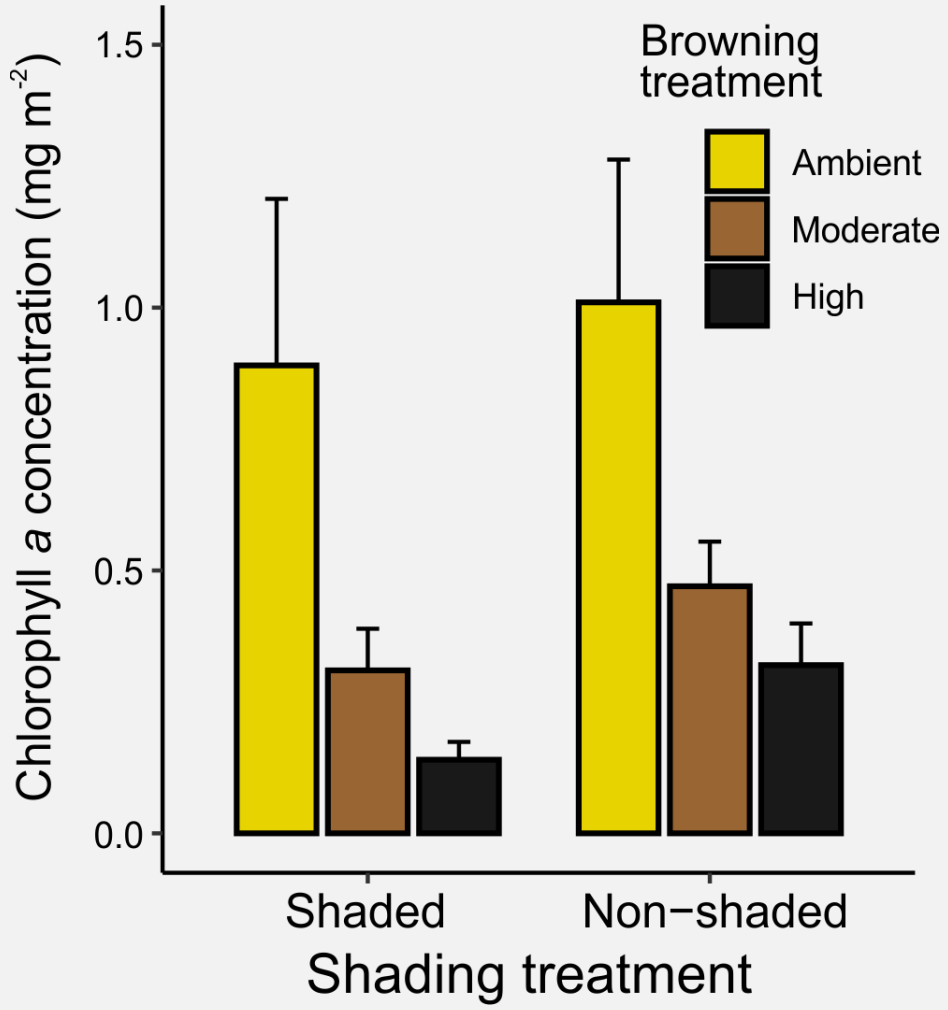





RESULTS - ALGAL PRODUCTIVITY

- Periphytic algal productivity was strongly reduced by both moderate browning (63%; P<0.001) and high browning (81%; P<0.001) treatments

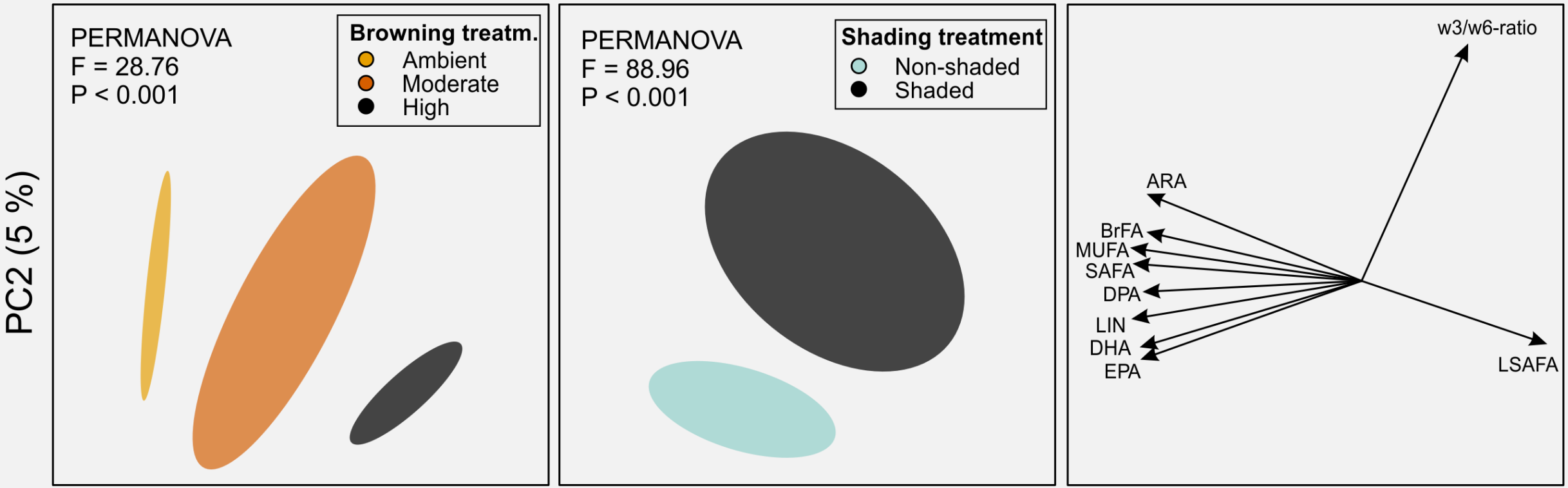
- In contrast, algal productivity was enhanced by shading loss (16 %; P = 0.002)



Jyväsjärvi et al. 2022 Glob. Change Biol.

RESULTS
-
COMPOSITION OF BIOFILM FATTY ACIDS

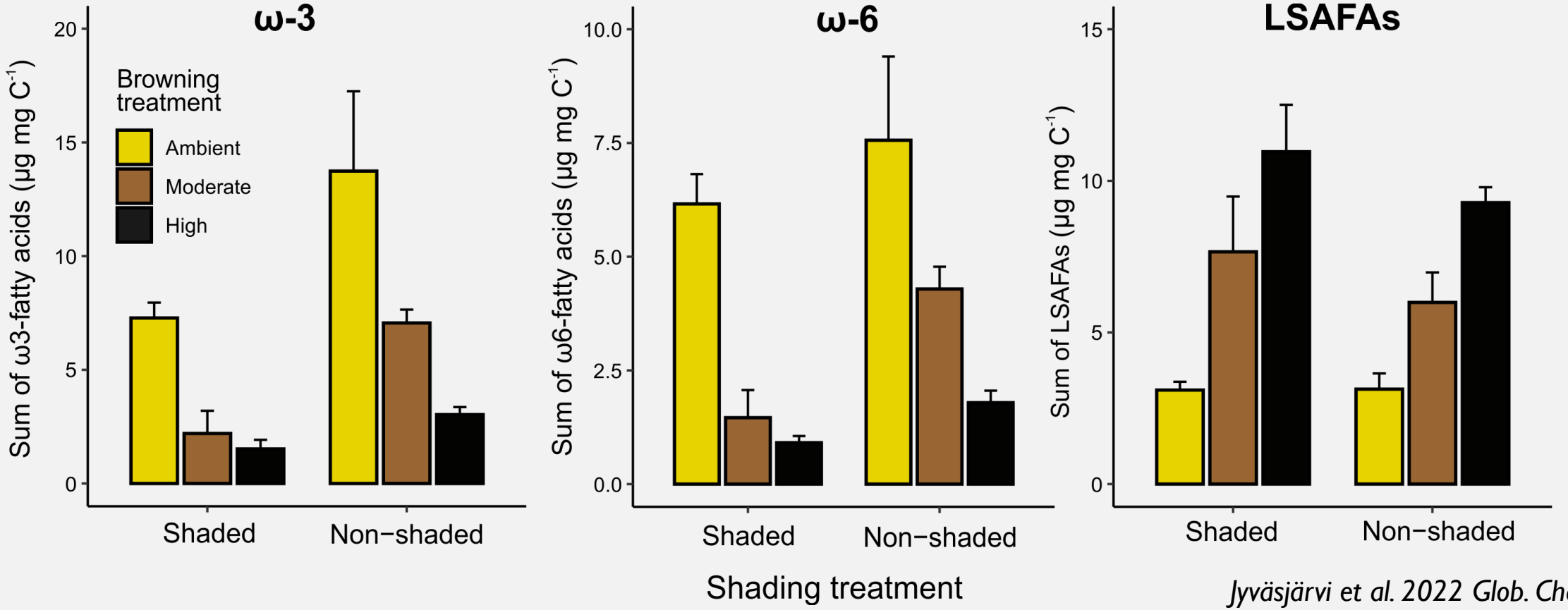
- Biofilm fatty acid composition was markedly altered by both browning ($P < 0.001$) and shading loss ($P < 0.001$).



Jyväsjärvi et al. 2022 Glob. Change Biol.

RESULTS
-
QUANTITIES OF BIOFILM FATTY ACIDS

- The quantities of long-chain ω-3 and ω-6 fatty acids were reduced by browning.
- Instead, the quantities of low-quality (terrestrial-originating) long-chain saturated fatty acids (LSAFA) were increased.



Jyväsjärvi et al. 2022 Glob. Change Biol.

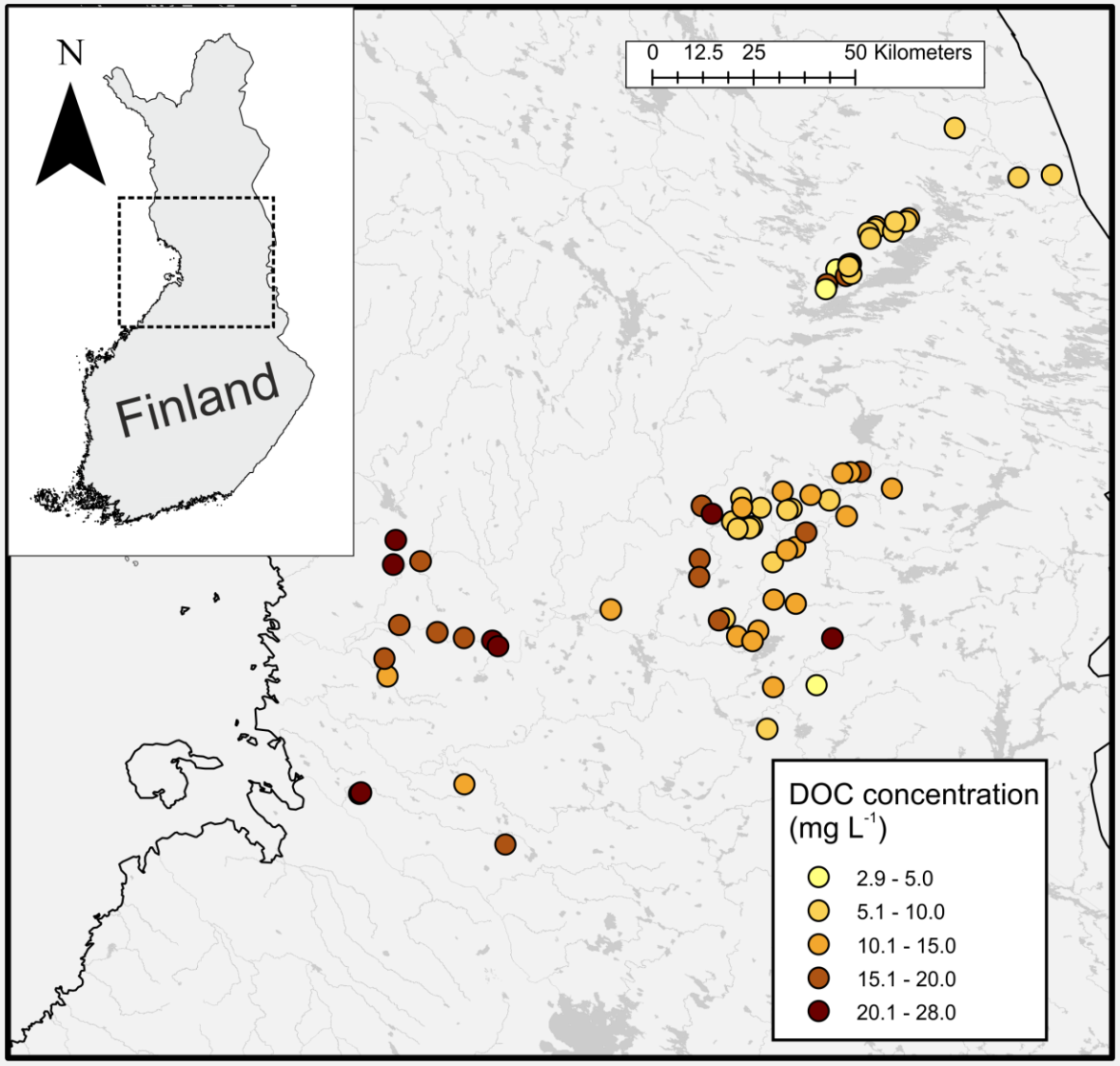
THE EFFECTS OF BROWNING ON STREAM BIOTA?

FIELD DATA FROM BOREAL STREAMS

- Biological and environmental data from 63 boreal headwater streams.
- An extensive 'browning' gradient (2.9 – 27.0 DOC mg L^{-1})

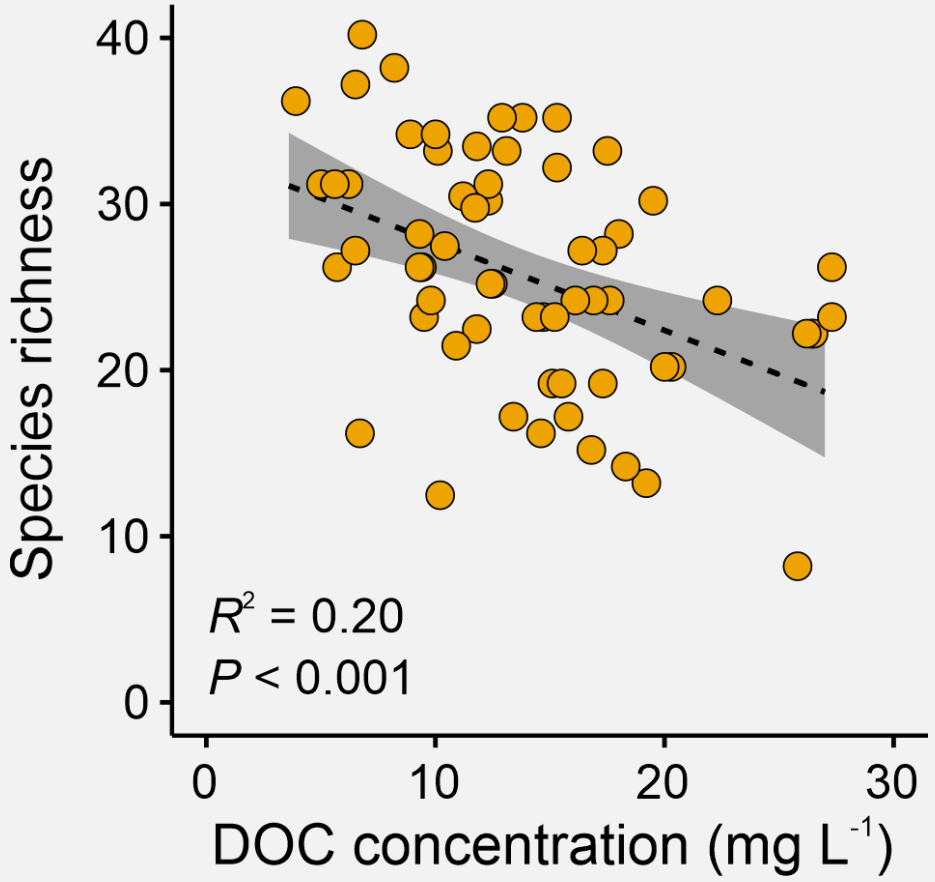
Response variables measured:

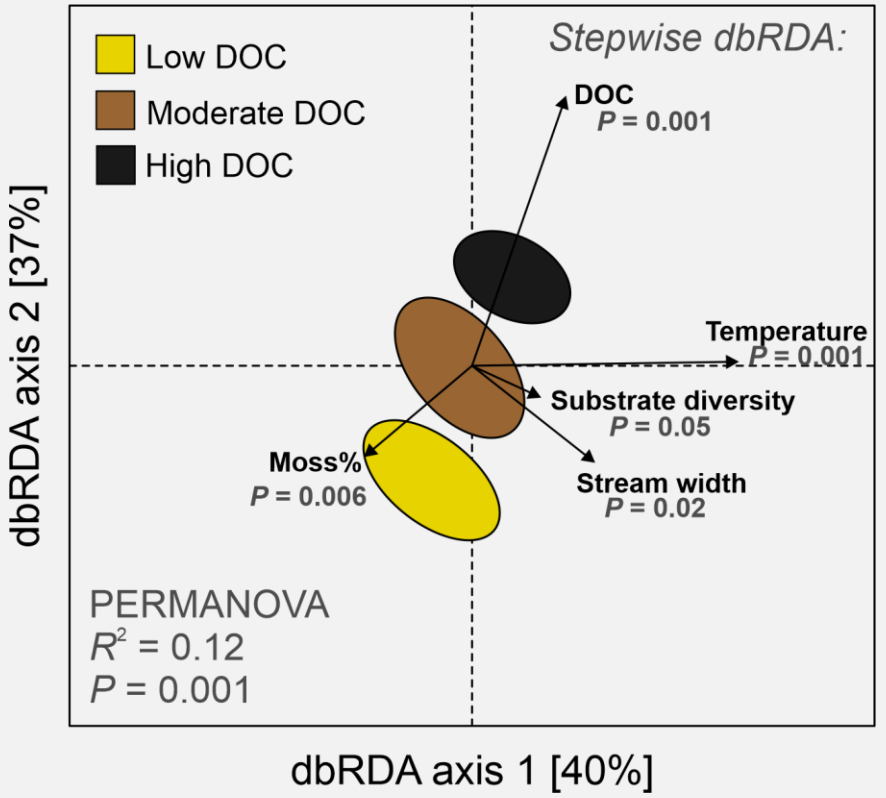
- Fatty acid composition
- Primary production
- Organic matter decomposition rates
- Benthic macroinvertebrates
- Biofilm bacteria (16s rRNA, rDNA)
- Leaf-decomposing fungi (ITS rDNA)
- Fish biomass
- Riparian predators (spiders)



RESULTS
-
MACROINVERTEBRATE SPECIES DIVERSITY & COMPOSITION

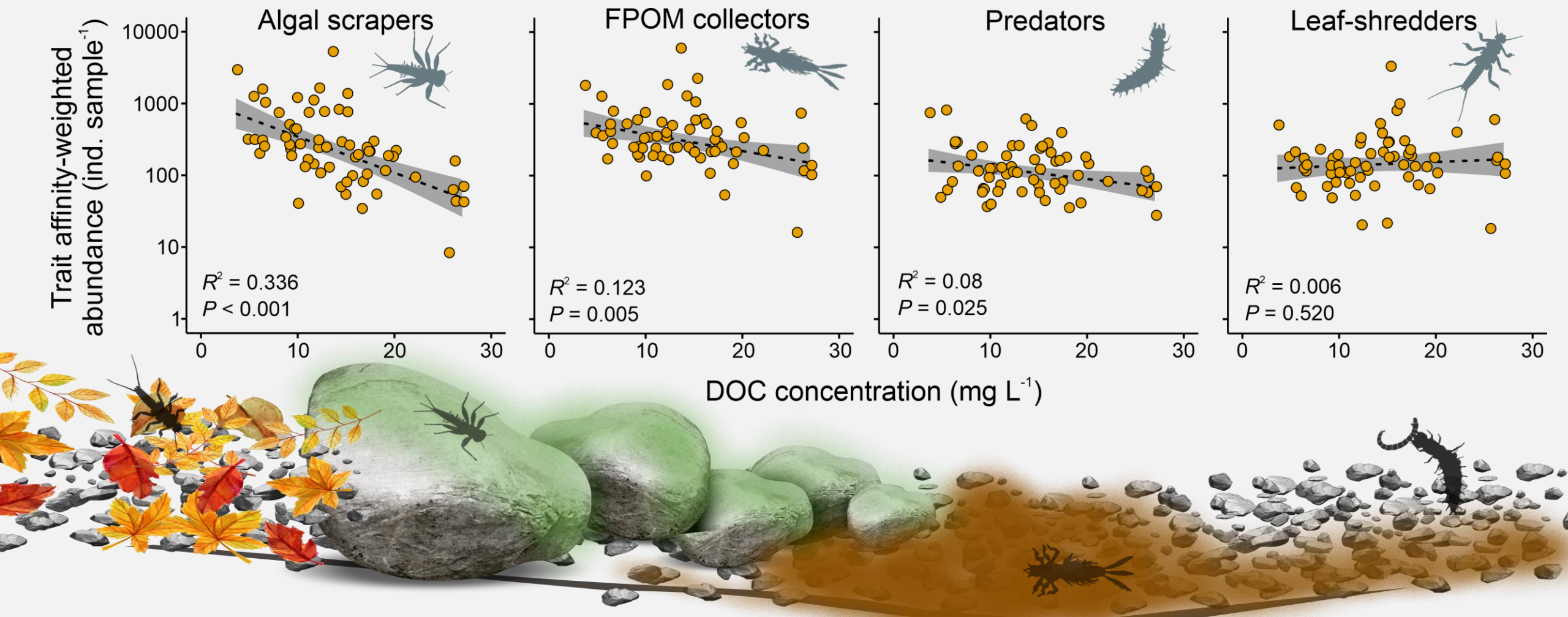
- Species diversity negatively related to the DOC content.
- Community composition was primarily moderated by the DOC content.





Brüsecke et al. L&O Letters (in revision)

RESULTS
-
FUNCTIONAL FEEDING GROUPS



CONCLUSIONS

Our experimental and field data showed that **browning strongly reduces the quantity and quality of stream biofilms.**

Browning reduces the diversity and controls species composition of stream invertebrate communities. Algal-feeding species most responsive.

Comprehensive management of catchments is a top priority for safeguarding freshwater biodiversity. In Finland, this means large-scale restoration of intensively drained peatlands.

THANK YOU!

Luke
NATURAL RESOURCES
INSTITUTE FINLAND

UBC

Water 2015 Works

ACADEMY OF FINLAND

European Commission

BIOWATER