Unveiling tipping points in long-term and experimental studies in peatlands

You can listen my talk using this LINK

Mariusz Lamentowicz
Katarzyna Marcisz, Michał Słowiński, Vincent E.J. Jassey
Laboratory of Climate Change Ecology
Adam Mickiewicz University, Poznań, Poland

Tipping point

The tipping point is the corresponding critical point in forcing and a feature of the system at which the future state of the system is qualitatively altered.

Lenton et al. 2008 PNAS

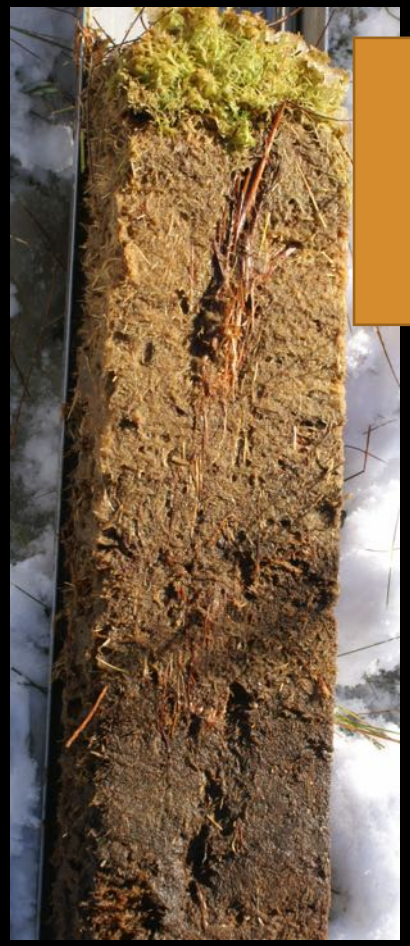
The tipping point in case of peatland ecosystems can be defined as the critical point where they lose resilience and shift into a degraded state.

Questions

- **What** the tipping point (TP) means in case of peatland ecosystem?
- **Where** was the hydrological baseline located in the last 2000 years?
- **When** the baseline was lost?
- **How** experimentally assessed TP relate to the palaeoecological inference?

Peat archive formation is a long-term process depending on water table


Fig. K. Tobolski



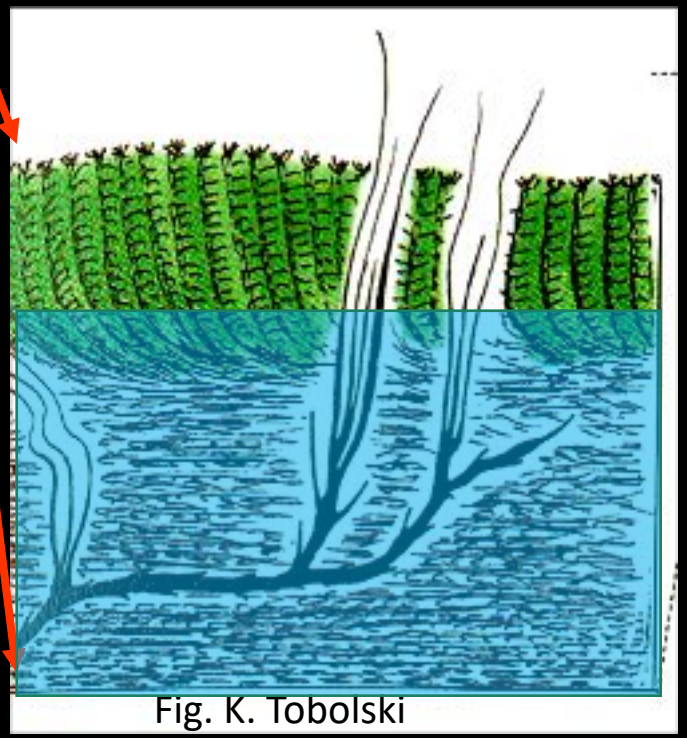
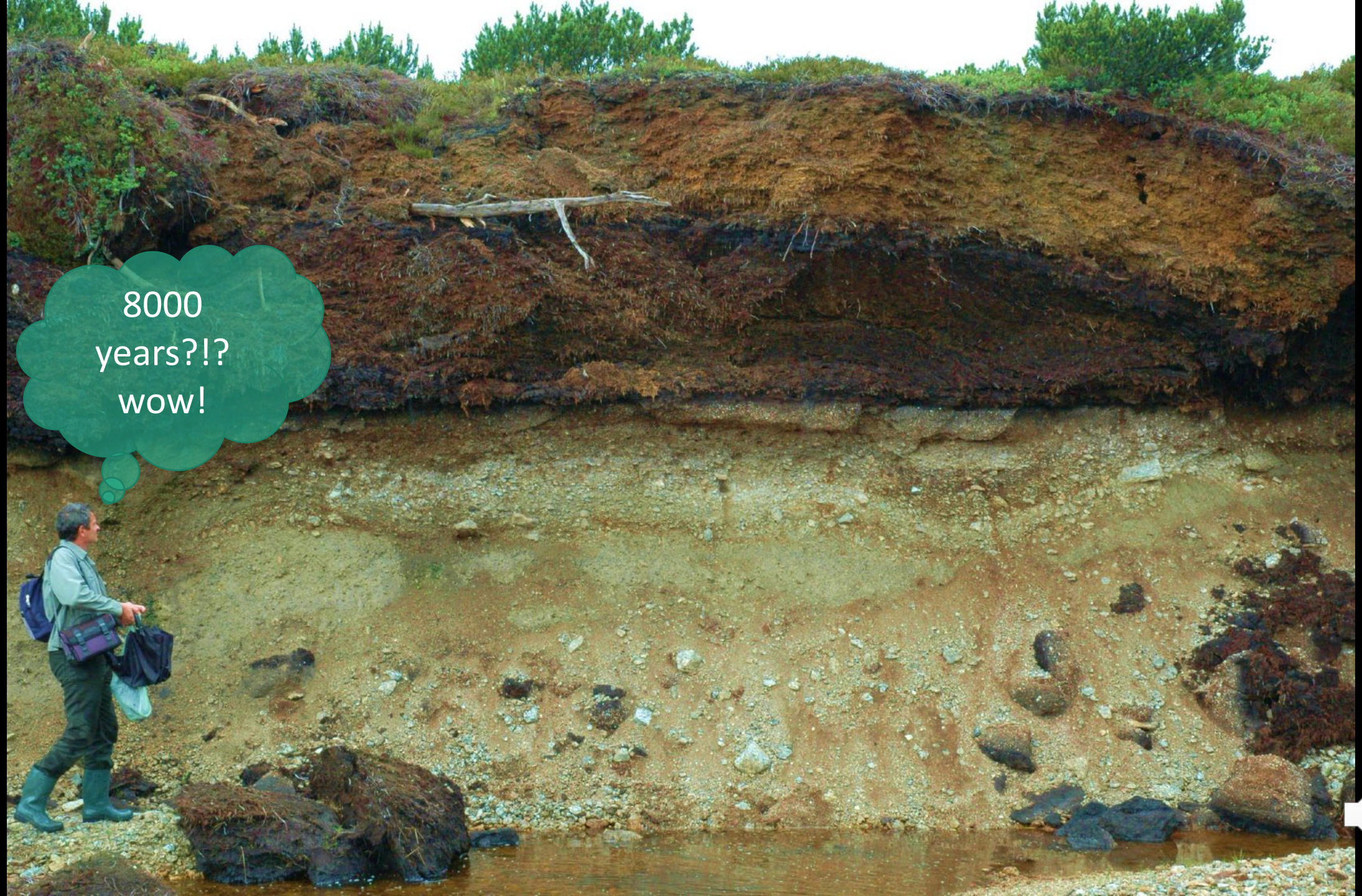
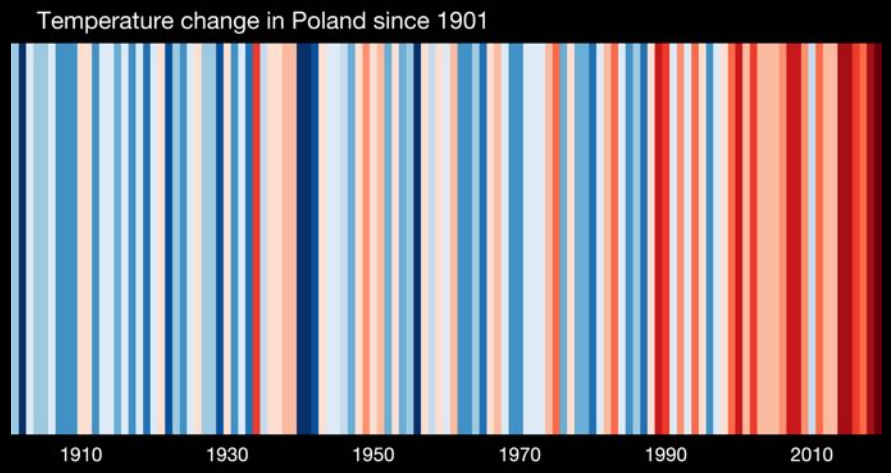


Fig. K. Tobolski


8000
years?!?
wow!

Drivers of peatlands hydrological disturbances

- Climate
- Drainage
- Mining
- Afforestation



BIOLOGY LETTERS

royalsocietypublishing.org/journal/rsbl

Research

Cite this article: Lamentowicz M, Gałka M, Marcisz K, Słowiński M, Kajukało-Drygalska K, Dayras MD, Jassey VEJ. 2019 Unveiling tipping points in long-term ecological records from *Sphagnum*-dominated peatlands. *Biol. Lett.* **15**: 20190043.
http://dx.doi.org/10.1098/rsbl.2019.0043

Received: 18 January 2019
Accepted: 6 March 2019

Community ecology

Unveiling tipping points in long-term ecological records from *Sphagnum*-dominated peatlands

Mariusz Lamentowicz[1,2,†], Mariusz Gałka[3], Katarzyna Marcisz[1,2], Michał Słowiński[4], Katarzyna Kajukało-Drygalska[1,2], Milva Druguet Dayras[5] and Vincent E. J. Jassey[5,†]

[1]Laboratory of Wetland Ecology and Monitoring, and [2]Department of Biogeography and Palaeoecology, Adam Mickiewicz University, 61-680 Poznań, Poland
[3]Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Łódź, 90-237 Łódź, Poland
[4]Department of Environmental Resources and Geohazards, Institute of Geography and Spatial Organisation, Polish Academy of Sciences, 00-818 Warsaw, Poland
[5]Laboratoire d'Ecologie Fonctionnelle et Environnement, Université de Toulouse, CNRS-INPT, 31062 Toulouse, France

ML, 0000-0003-0429-1530; MG, 0000-0001-8906-944X; KM, 0000-0003-2655-9729; MS, 0000-0002-3011-2682; VEJJ, 0000-0002-1450-2437

Study sites

Kusowo

Mechacz

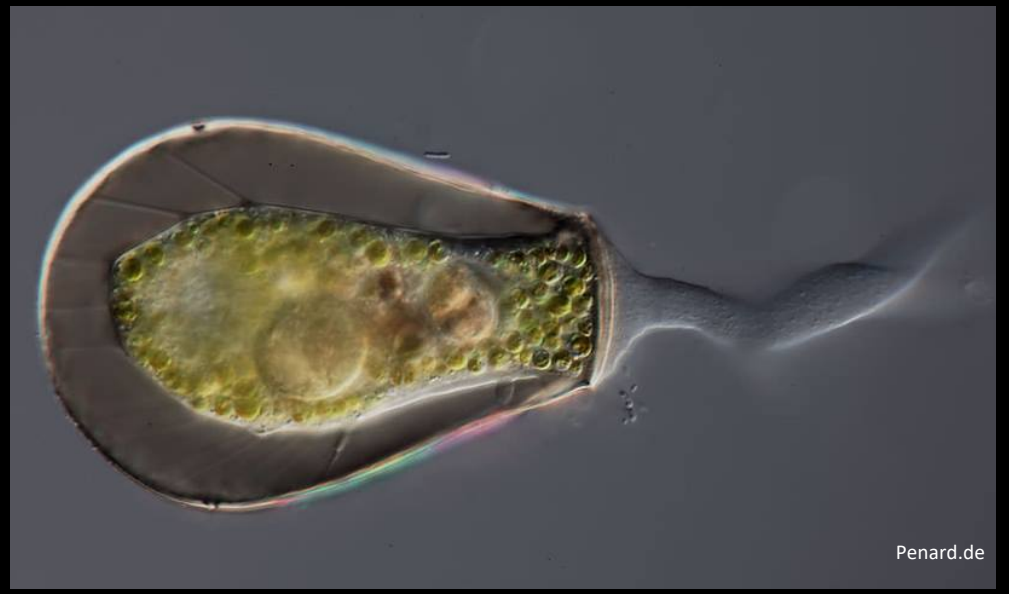
Lamentowicz i in. 2019. Biol Lett.

Last 2000 years in high-resolution

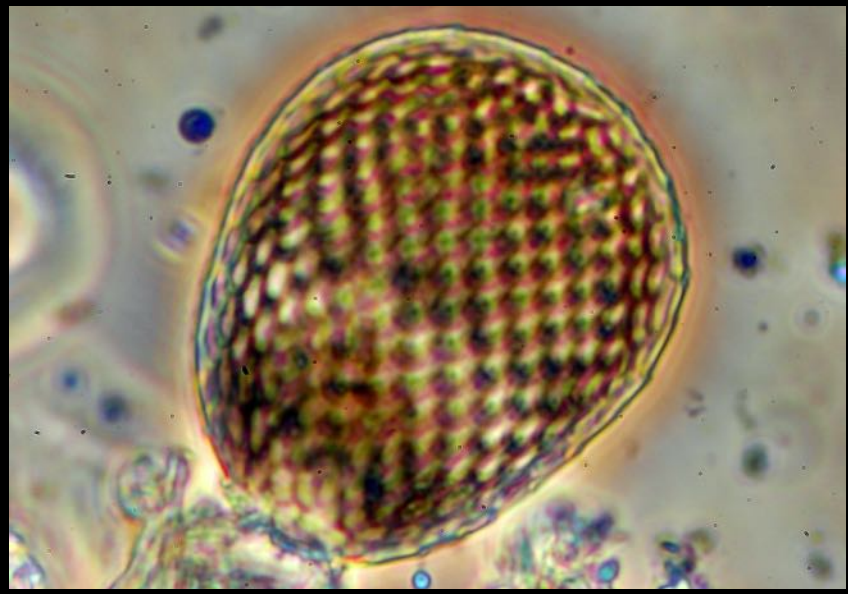
Proxies

- Testate amoebae-based water table reconstruction,
- Plant remains – macrofossils

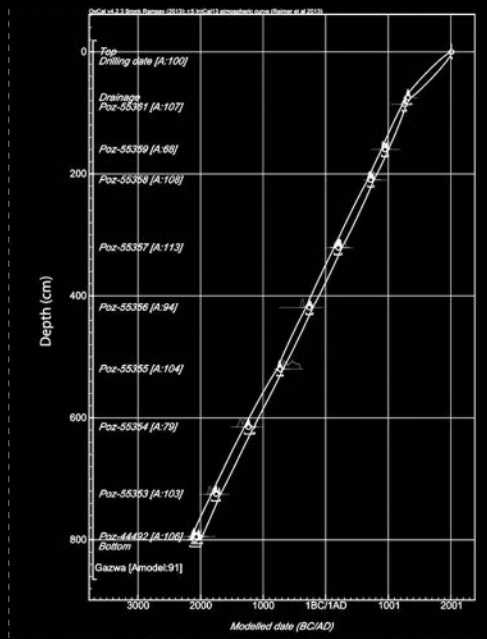
Hyalosphenia papilio



Assulina muscorum

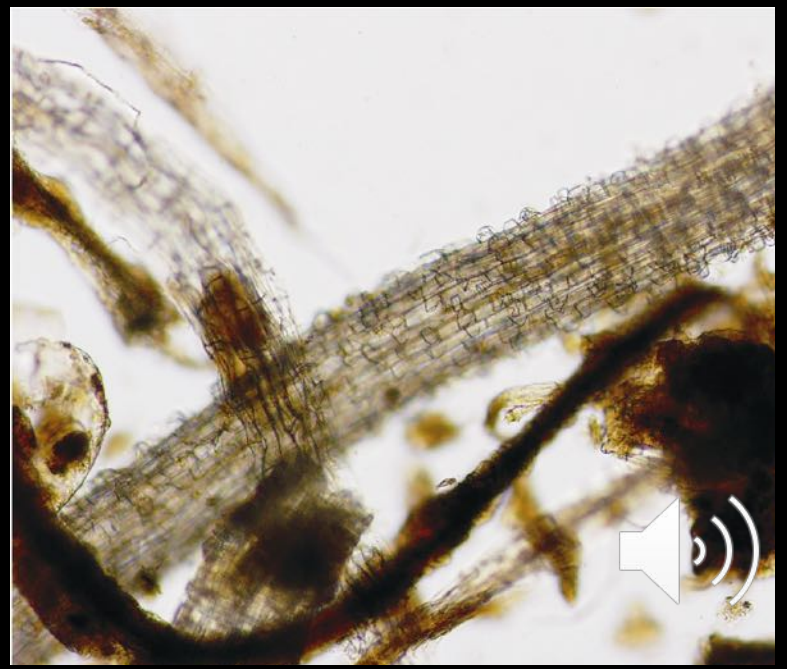


Time scales

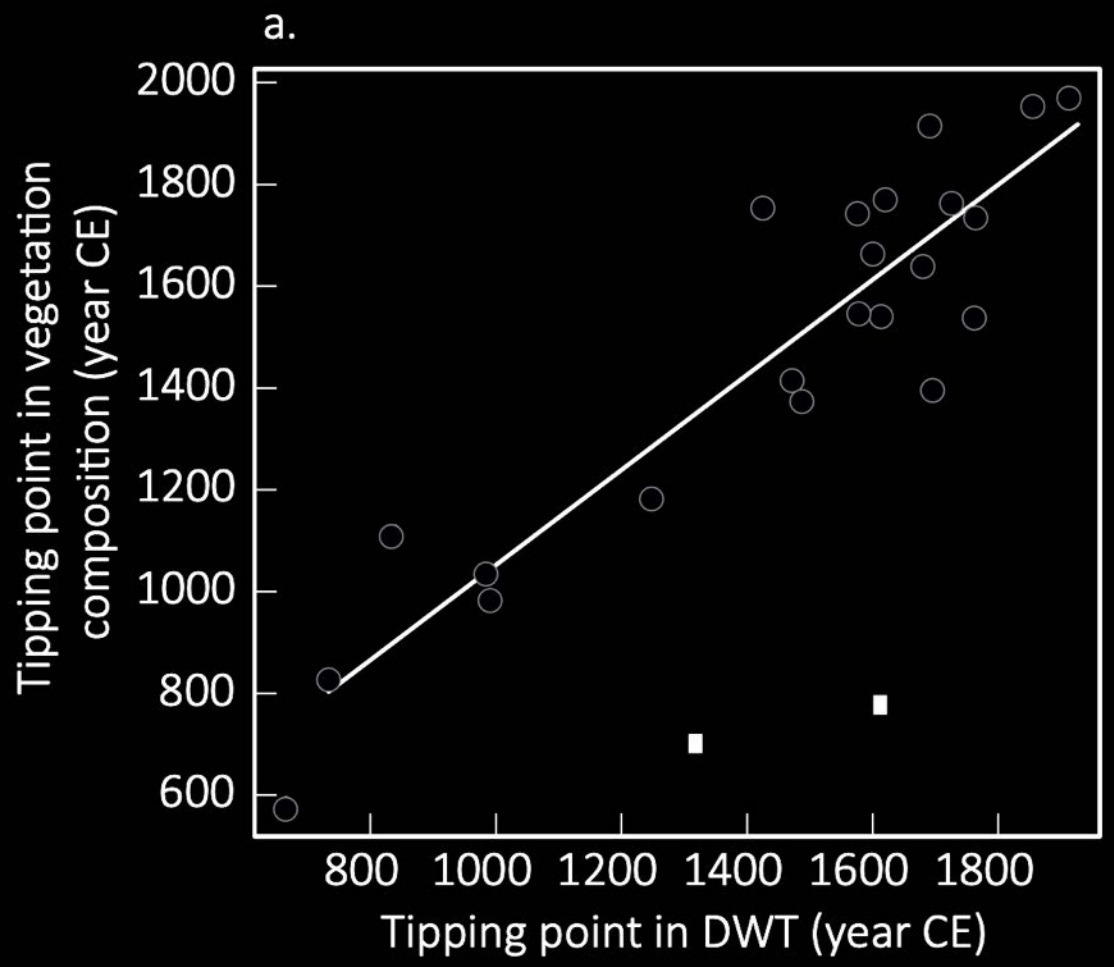


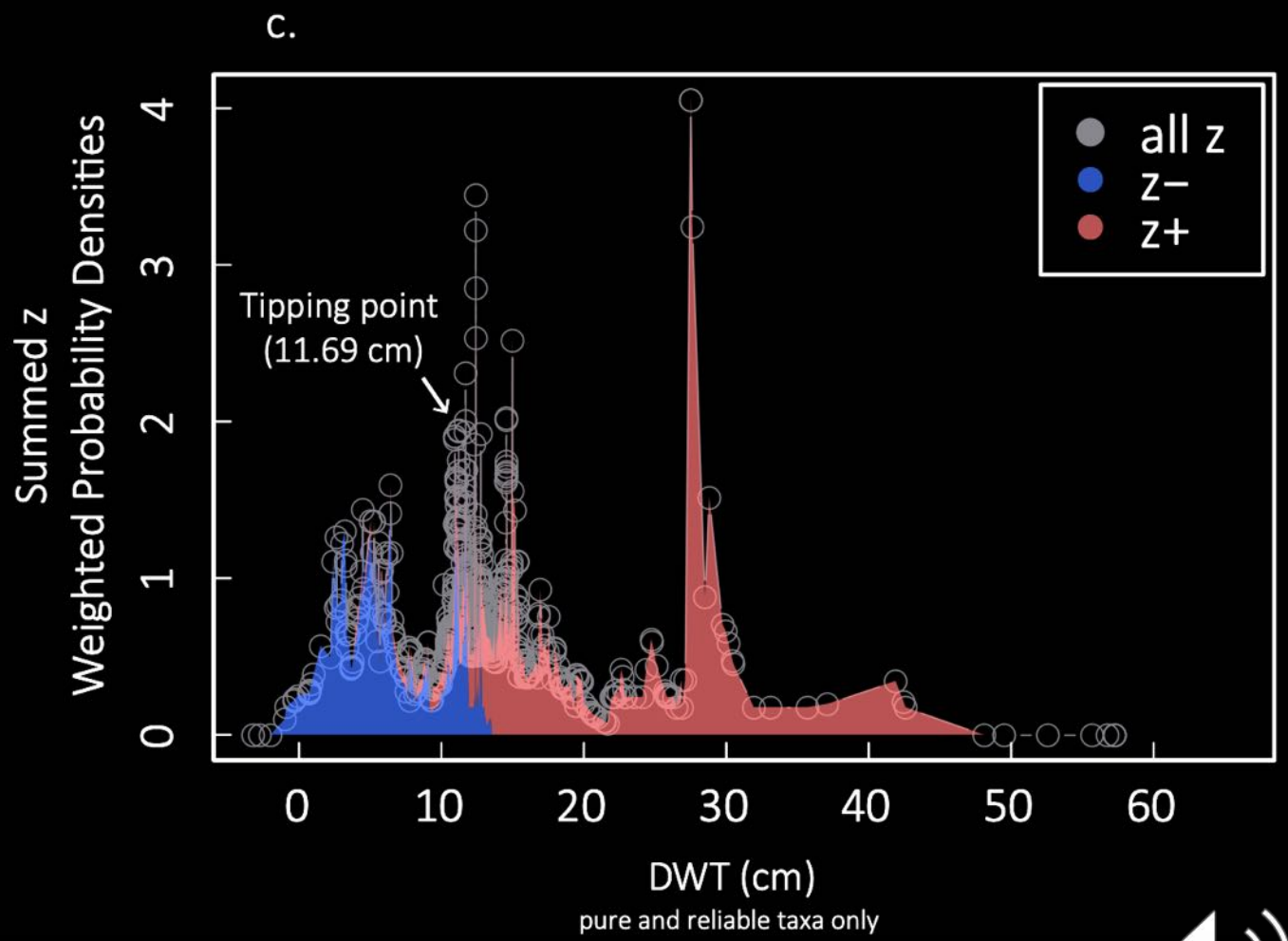
Sphagnum

Sphagnum, Shrubs and sedges



Tipping point in vegetation community composition

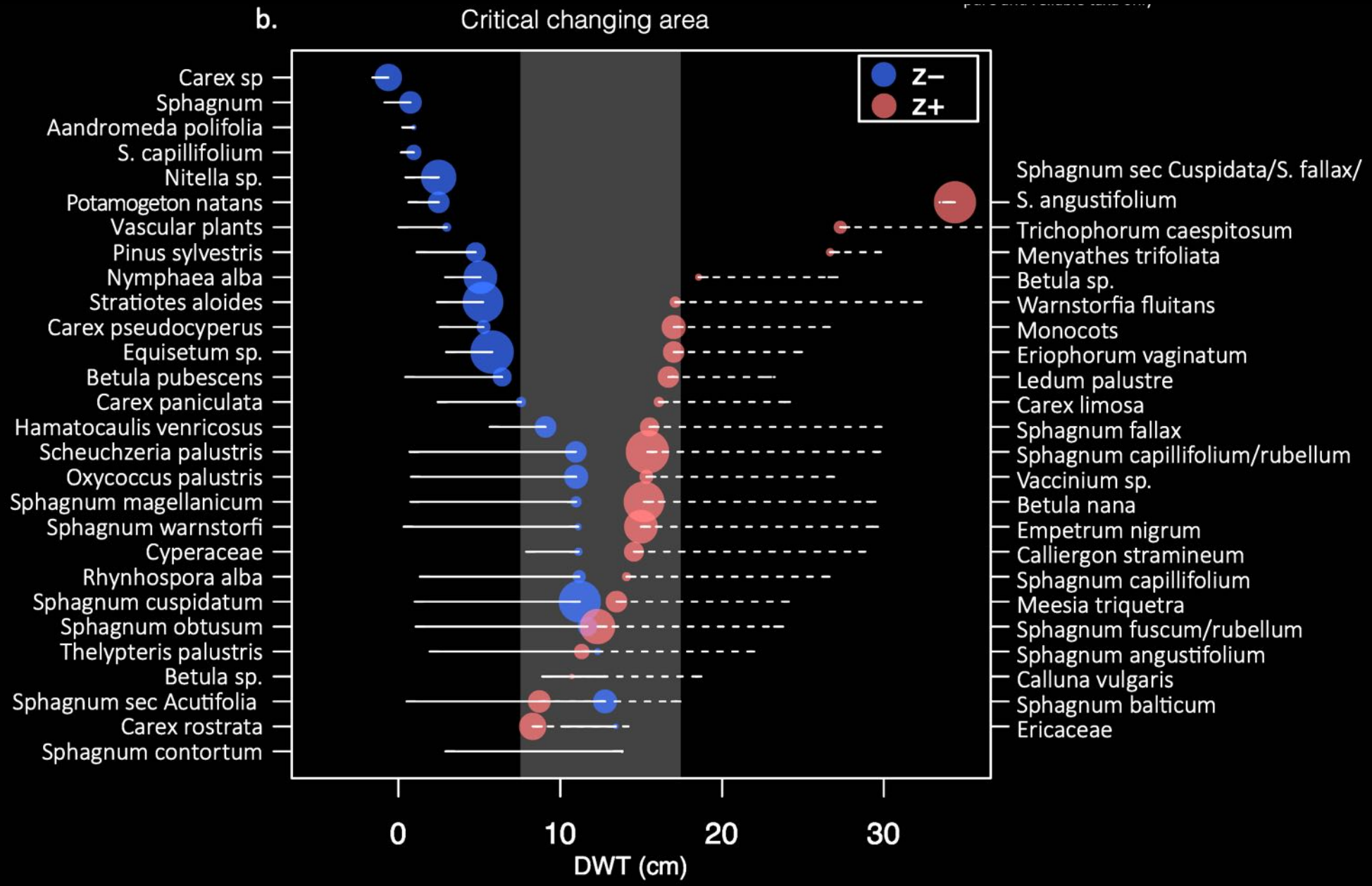




Baker, M., S. King, R., 2010. A new method for detecting and interpreting biodiversity and ecological community thresholds. Methods in Ecology and Evolution. 1, 25–37.

Lamentowicz i in. 2019 Biol Lett.

Tipping point in vegetation community composition



Received: 7 July 2017 | Revised: 22 September 2017 | Accepted: 27 September 2017

DOI: 10.1111/gcb.13928

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Tipping point in plant–fungal interactions under severe drought causes abrupt rise in peatland ecosystem respiration

Vincent E. J. Jassey[1,2,3] | Monika K. Reczuga[4] | Małgorzata Zielińska[4] | Sandra Słowińska[5] | Bjorn J. M. Robroek[6] | Pierre Mariotte[2,3] | Christophe V. W. Seppey[7,8] | Enrique Lara[9] | Jan Barabach[4] | Michał Słowiński[10] | Luca Bragazza[2,3,11] | Bogdan H. Chojnicki[12] | Mariusz Lamentowicz[4] | Edward A. D. Mitchell[7,13] | Alexandre Buttler[2,3]

[1]Functional Ecology and Environment laboratory, University of Toulouse, CNRS, INP, UPS, Toulouse Cedex, France

[2]Ecological Systems Laboratory (ECOS), School of Architecture, Civil and Environmental Engineering (ENAC), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

[3]WSL—Swiss Federal Institute for Forest, Snow and Landscape Research, Site Lausanne, Lausanne, Switzerland

[4]Laboratory of Wetland Ecology and Monitoring & Department of Biogeography and Palaeoecology, Adam Mickiewicz University, Poznań, Poland

[5]Department of Geoecology and Climatology, Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warsaw, Poland

[6]Biological Sciences, University of Southampton, Southampton, UK

[7]Laboratory of Soil Biodiversity, University of Neuchâtel, Neuchâtel, Switzerland

[8]Arctic and Marine Biology Department, University of Tromsø, Tromsø, Norway

[9]Real Jardín Botánico, CSIC, Madrid, Spain

[10]Department of Environmental Resources and Geohazards, Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warszawa, Poland

[11]Department of Life Science and Biotechnologies, University of Ferrara, Ferrara, Italy

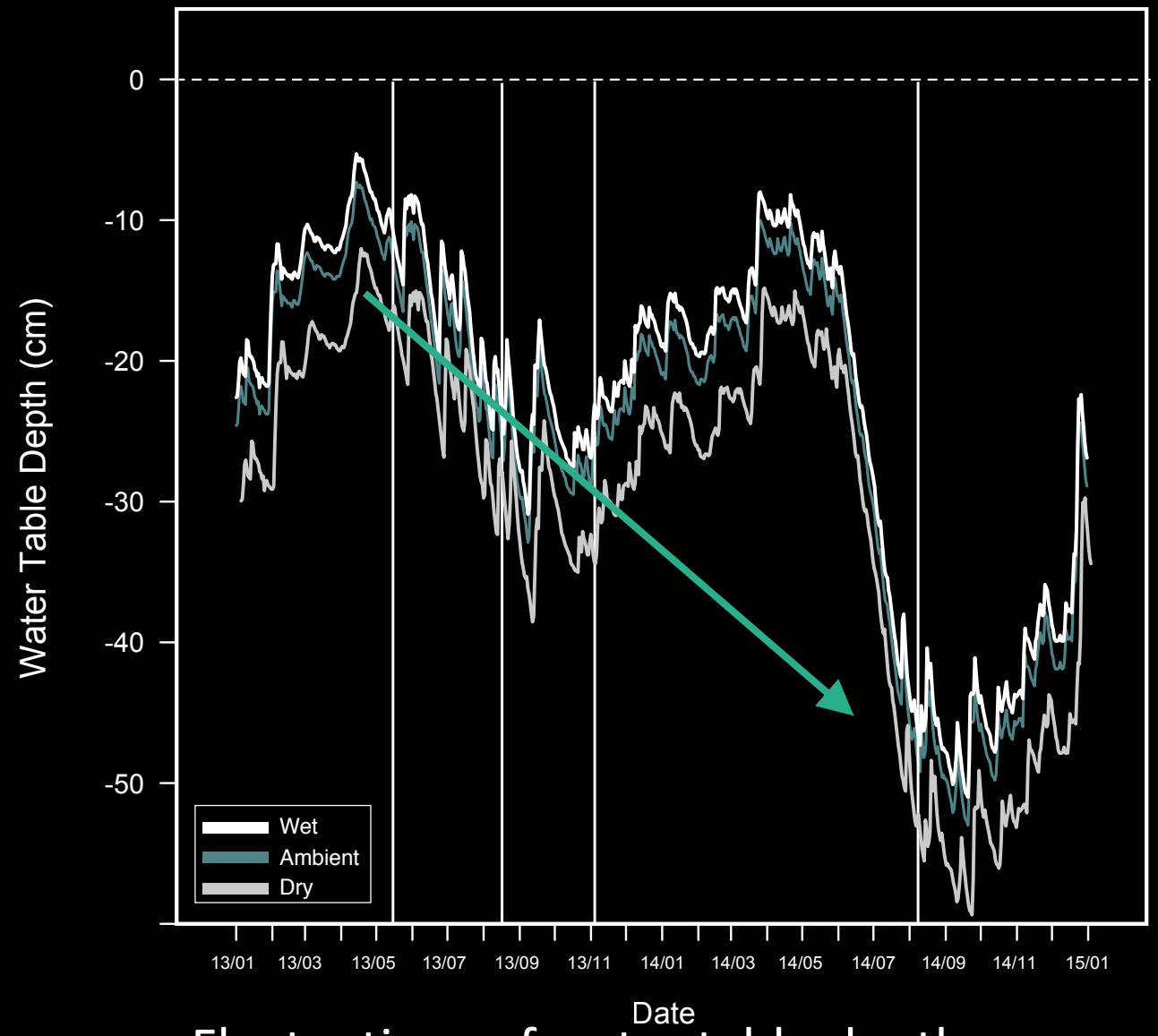
[12]Meteorology Department, Poznan University of Life Sciences, Poznań, Poland

[13]Botanical Garden of Neuchâtel, Neuchâtel, Switzerland

Manipulation of the water table in a N Poland

We monitored ecosystem CO_2 respiration and its potential drivers such as plant and fungal communities and enzyme activities.

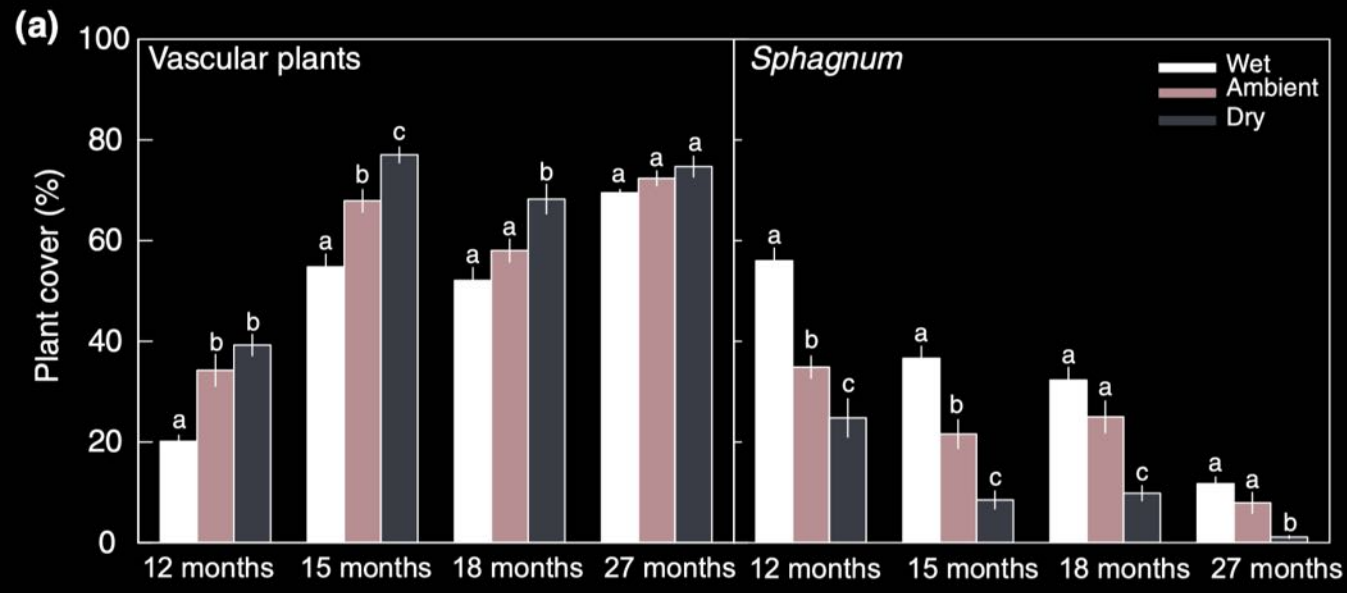
From water level manipulation to water level gradient

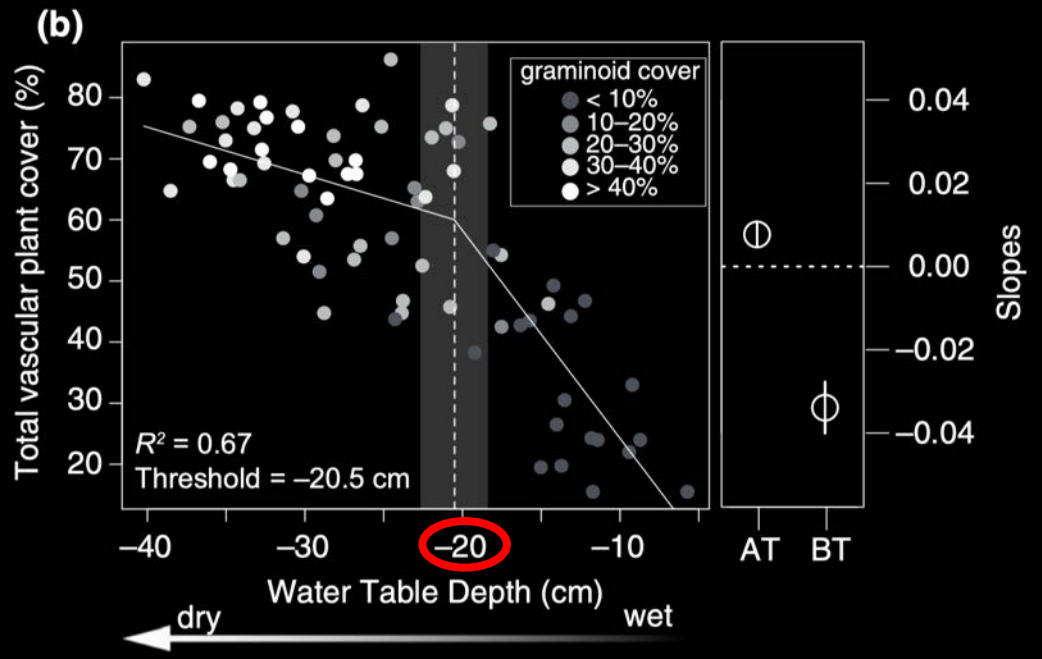


Jassey et al. 2018. GCB

Fluctuations of water table depth spanned over gradient from -40 cm to -5 cm

Response of vegetation to water level gradient

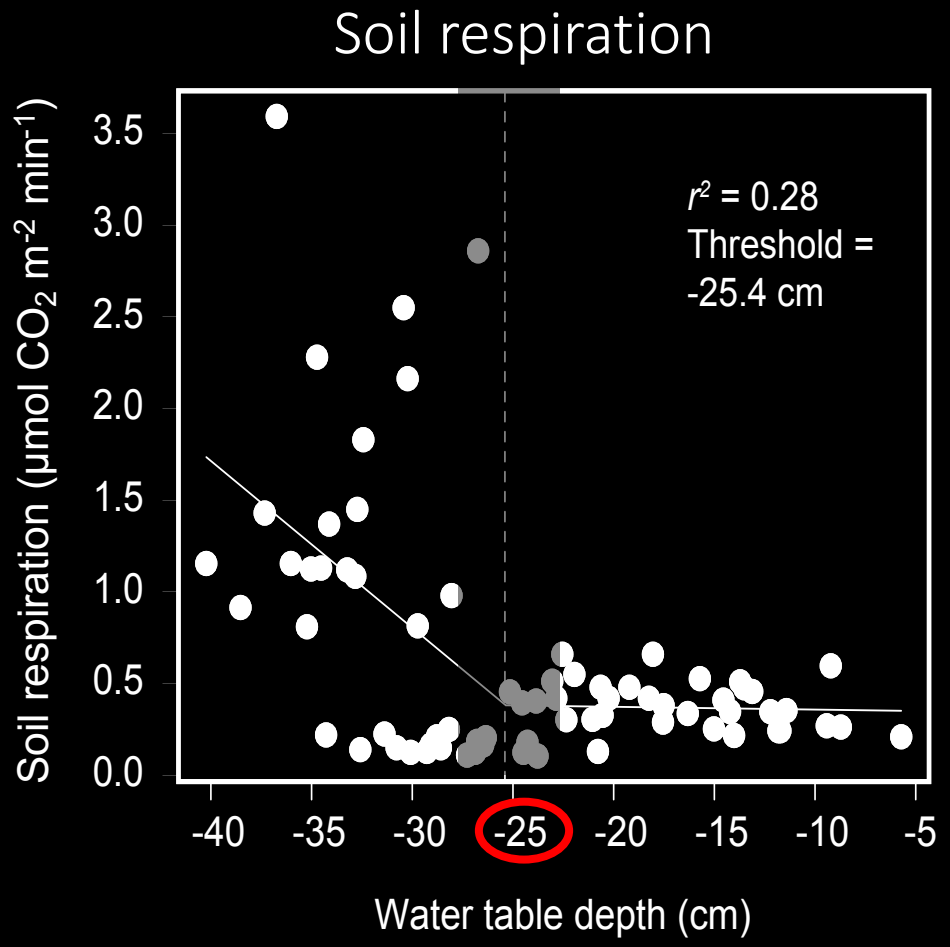


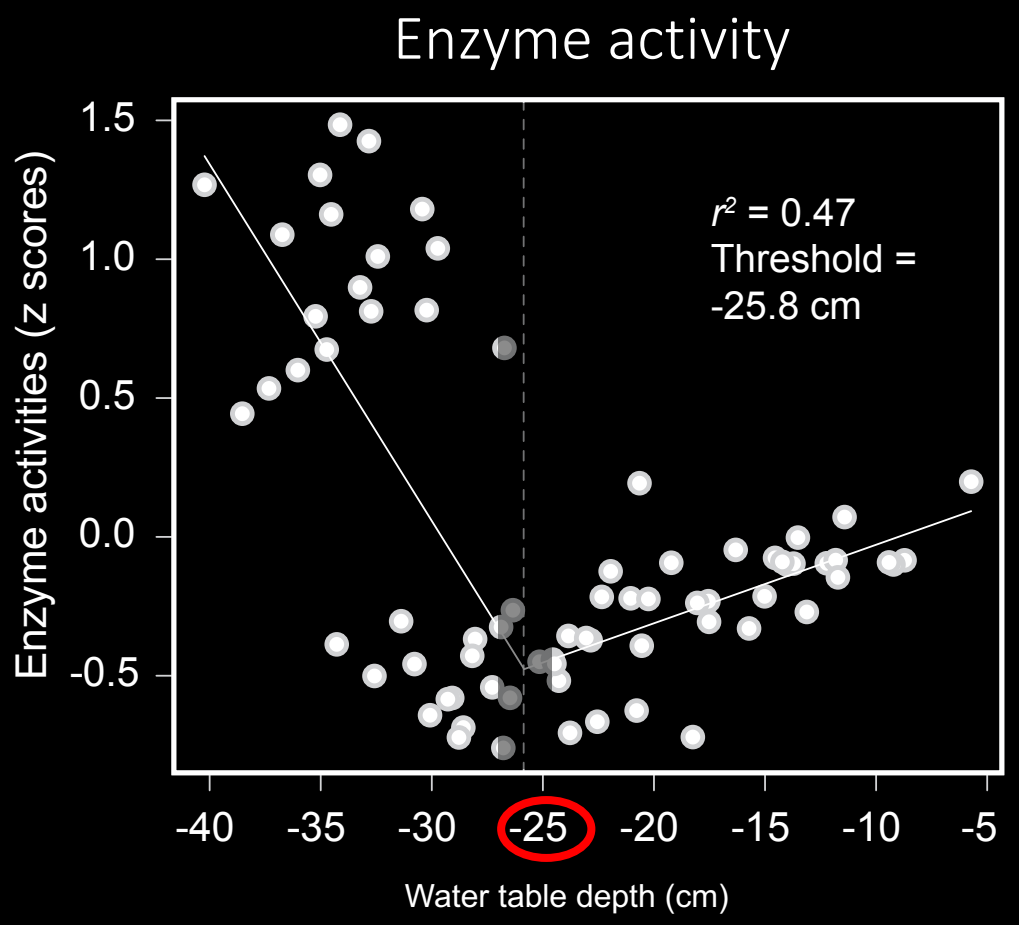


Jassey et al. 2018. GCB

Response of peatland functions to water level gradient

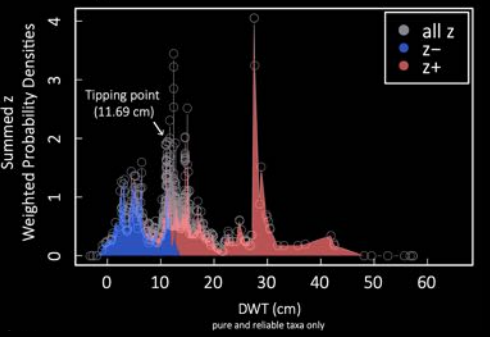
✓ Important shifts in soil respiration and soil activity when the water level crossed -25 cm





Jassey et al. 2018. GCB

Where is the tipping point located?



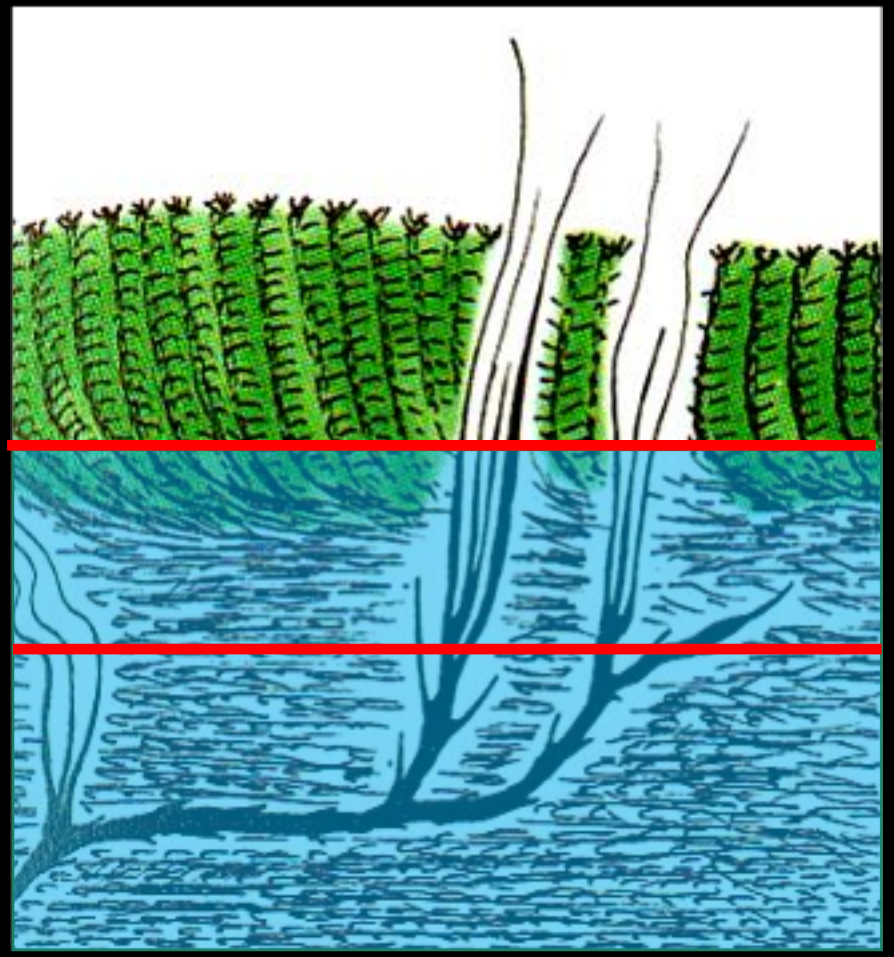
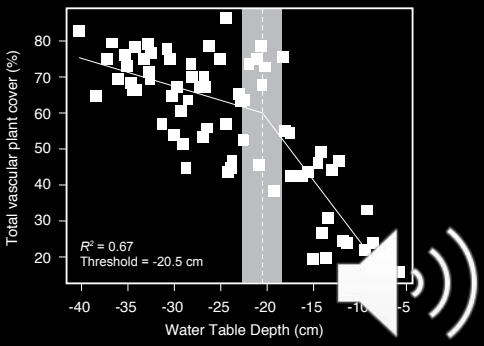
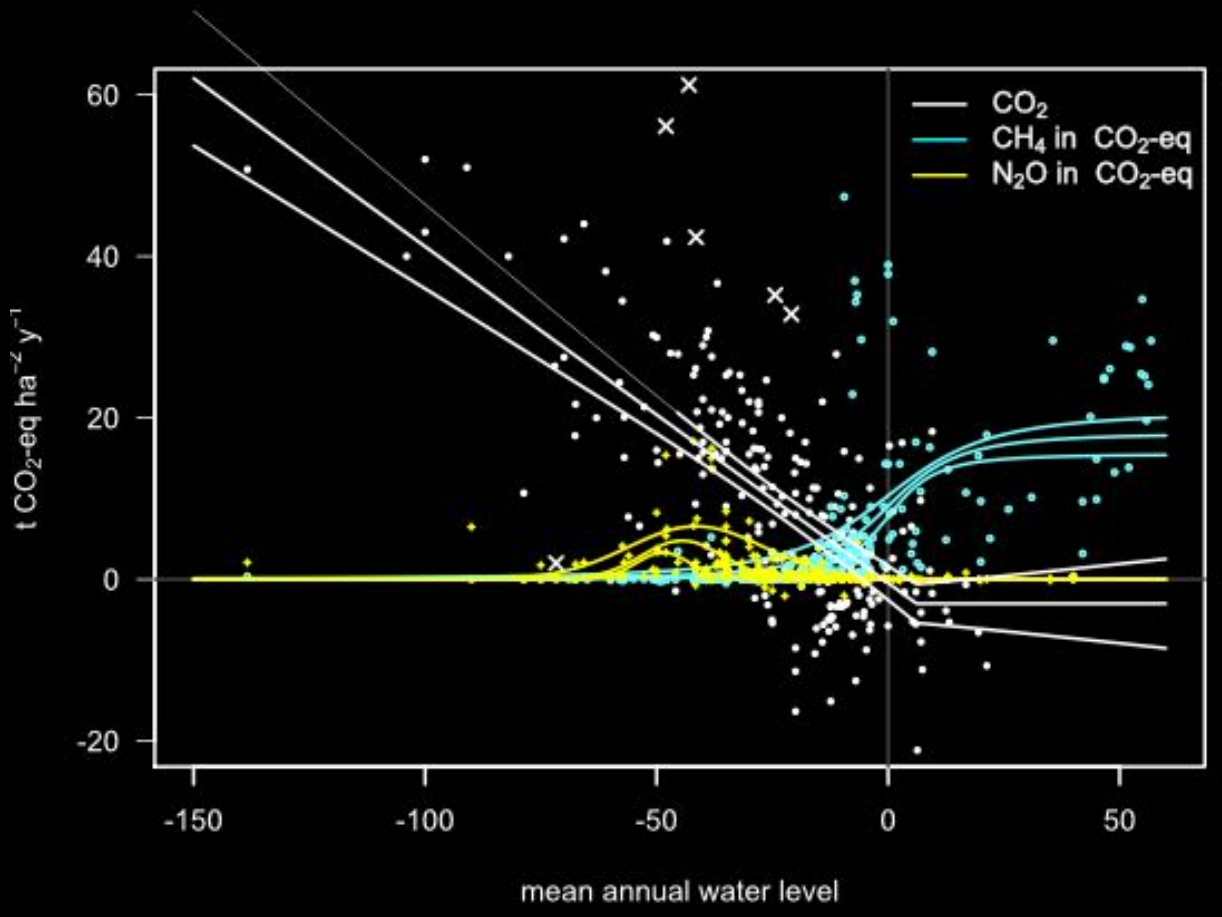


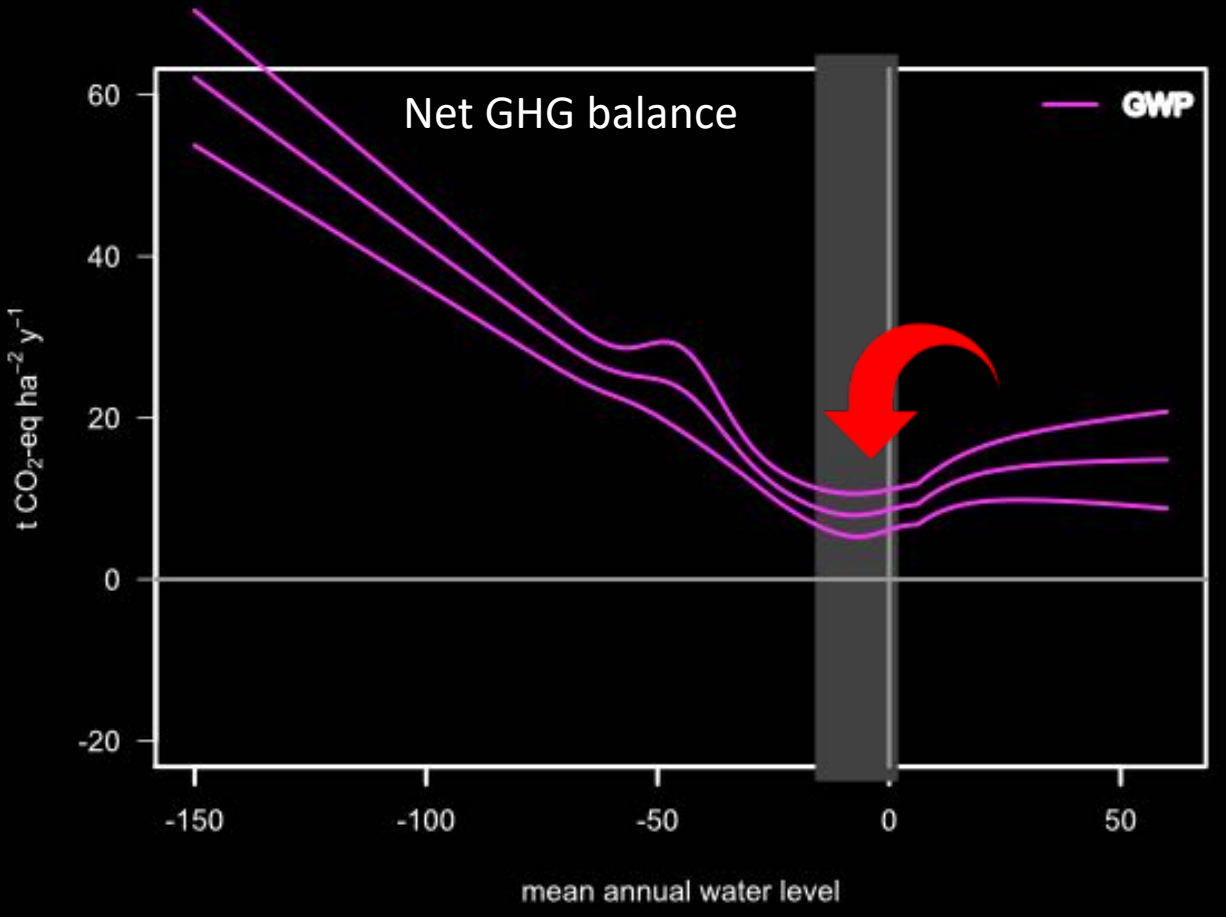
Fig. Kazimierz Tobolski

- 11,7 cm (2ky - palaeoecology)
- 20-25 cm (2-years experiment)



Carbon emission and water table





GLOBAL WARMING POTENTIAL IS THE LOWEST ca 10 cm DWT!

Jurasinski, 20

Summary

- The inferred hydrological tipping point was WTD=12 cm for peat archives covering the last 2000 years (Lamentowicz et al. 2019),
- Experimental study provided value WTD=20-25 cm when substantial changes in ecosystem respiration, vegetation and soil fungal communities occurred in 2-years of manipulation (Jassey et al. 2018),
- Many of European peatlands **crossed the long-term tipping point ca 200 years ago and lost resilience** in response to drainage and climate change (Swindles et al. 2019).
- We conclude that the water table ca 12 cm indicates *Sphagnum* peatland **resilience** in the **long-term** ecological context and it is an important value in terms of **greenhouse gasses balance** and **global warming potential.**

Thank you for your attention

mariuszl@amu.edu.pl

@utriculator

Polish-Swiss Research Programme

NATIONAL SCIENCE CENTRE POLAND