XLII INTERNATIONAL MOOR EXCURSION TO NORTHERN POLAND

Combining multi-proxy palaeoecology with natural and manipulative experiments

1-7 September 2018

Excursion Guide

ORGANIZERS

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Cover photo: Foggy morning at the Linje mire, the CLIMPEAT experimental and palaeo site

Cover photo credit: Jan Barabach

Poznań 2018

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Organising committee (from the left: Mariusz Lamentowicz, Katarzyna Kajukało, Katarzyna Marcisz, Mariusz Gałka) at the Bagno Kusowo raised bog in July 2018. Photo: Kalina Lamentowicz

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Excursion programme

Saturday, 1.09.2018

	Arrival in Warsaw
ca. 14 h	Meeting at the Chopin airport and main train station
	Transfer to Suwałki (NE Poland)
20 h	Welcome dinner

Sunday, 2.09.2018 – Suwałki lake district

8 h	Departure
9:10 h	Welcoming at the Cisowa Góra (Mariusz Lamentowicz)
10 h	Jaczno laminated lake – land use changes and lake eutrophication in the last 200 years (Wojciech Tylmann)
	Jaczno mire – environmental history (Katarzyna Kajukało, Katarzyna Marcisz, Mariusz Lamentowicz)
	Kojle fen and lake – environmental history (Mariusz Gałka, Mariusz Lamentowicz)
13 h	Lunch
15:30 h	Mechacz Wielki raised bog – Baltic bog palaeohydrology, succession and climate change during the last 2000 years (Mariusz Gałka, Mariusz Lamentowicz, Katarzyna Marcisz)
17 h	Departure to the hotel (Ryn)
20 h	Dinner

Monday, 3.09.2018 – Masuria and Warmia regions

8:45 h	Departure
9:30 h	Gązwa raised bog – multi-proxy analyses of the bog development in the last 6200 years, age-depth modelling of peat sequences, calibration data set along hydrological and openness gradient (Mariusz Gałka, Mariusz Lamentowicz, Monika Karpińska-Kołaczek, Piotr Kołaczek, Katarzyna Kajukało)
11 h	Departure and lunch at the *Fagus sylvatica* range limit
15 h	The Castle of the Teutonic Order in Malbork
17 h	Departure to the hotel (Stara Kiszewa)
19 h	Dinner

Tuesday, 4.09.2018 – Kaszuby and Kociewie regions and Tuchola Pinewoods

8 h	Departure
8:30 h	Laminated lakes Głęboczek, Czechowskie and Jelonek – high resolution study covering last 140 years; Trzechowskie palaeolake – late Allerød-early Younger Dryas climatic change and tephrostratigraphy (Michał Słowiński) Głęboczek peatland – environmental change in the last 5700 years (Katarzyna Kajukało, Katarzyna Marcisz, Mariusz Lamentowicz)
12:30 h	Lunch
13:45 h	Stążki peatland complex and Jelenia Wyspa nature trail (Mariusz Lamentowicz, Mariusz Gałka)
16 h	Departure to the hotel (Tleń)
17:30 h	Visit in a local brewery and dinner

Wednesday, 5.09.2018 – Tuchola Pinewoods and Chełmińskie lake district

9 h	Departure
9:15 h	Viewing platform on the area destroyed by a tornado, Martwe lake and peatland – impact of a tornado on the forest and wetland ecosystem (Dominika Łuców, Michał Słowiński)
12:30 h	Lunch
16 h	Linje mire (*Betula nana* microrefugium), CLIMPEAT experimental site – palaeoecological changes in the last 2000 years including hydrology, vegetation, fires and human impact; long-term monitoring; warming and drought experiment focused on microbes response, vegetation change and carbon emission (Mariusz Lamentowicz, Katarzyna Marcisz, Piotr Kołaczek, Michał Słowiński, Monika Reczuga, Bogdan Chojnicki)
17:30 h	Departure to the hotel (Ostromecko)
19 h	Dinner

Thursday, 6.09.2018 – Szczecineckie lake district and Noteć Forest

8 h	Departure
11:15 h	Bagno Kusowo bog – high-resolution history of the last and 4000 years development of one of the biggest and best preserved ombrotrophic bogs in northern Poland; establishment of two new projects: *Sphagnum* translocation experiment and the Eddy covariance tower (Mariusz Gałka, Mariusz Lamentowicz, Katarzyna Marcisz)
13 h	Lunch
16:45 h	Rzecin mire, WETMAN and FLUOGPP experimental site – palaeoecological changes including vegetation changes, human impact, insects outbreaks and analysis of historical maps; warming experiments focused on gas exchange, vegetation changes and microbial response (Jan Barabach, Mariusz Lamentowicz, Radosław Juszczak, Bogdan Chojnicki, Dominika Łuców, Monika Reczuga)
19 h	Departure to the hotel (Mierzęcin)
20:30 h	Farewell dinner

Friday, 7.09.2018

9 h	Departure to Poznań
ca. 11 h	Arrival in Poznań (Ławica airport and main train station)

Addresses

1.09.2018
Hotel Loft 1898***
Pułaskiego 24K, 16-400 Suwałki
phone: +48 87 739 59 00

2.09.2018
Hotel ZAMEK RYN ****
Plac Wolności 2, 11-520 Ryn
phone: +48 87 429 70 00

3.09.2018
Hotel Wrota Kaszub
Konarzyńska 16, 83-430 Stara Kiszewa
phone: +48 58 687 64 26

4.09.2018
Hotel Przystanek Tleń
Bydgoska 2, 86-150 Tleń
phone: +48 52 333 96 00

5.09.2018
Hotel Zespół Pałacowo-Parkowy w Ostromecku
Bydgoska 9, 86-070 Ostromecko
phone: +48 52 364 64 11

6.09.2018
Hotel Pałac Mierzęcin Wellness & Wine Resort
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Invited speakers

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Introduction

The 42nd International Moor Excursion will go through the diverse relief of the young glacial landscape of N Poland (Maps 1 & 2), focusing on peatlands and lakes and their Holocene archives. We will present multi-proxy high-resolution reconstructions focused on the past: fires, insect outbreaks, hydrological dynamics, climate, land-use change, and vegetation succession. The discussions are planned to be focused on quantitative palaeoecological reconstructions, and past ecosystem functioning, as well as resilience in the context of ecological theory. We will pay attention to the radiocarbon and lead dating and problems connected with age-depth modelling of the densely dated cores.

The IME will cross several geographical areas of northern Poland – Suwałki Lake District, Masurian Lake District, Lower Vistula River, Pomerania Lakeland, and Toruń-Eberswald ice marginal valley. This area consists of various basins filled with organic sediments. In result, after different deglaciation stages many basins turned into wetlands through the paludification or terrestrialisation among various forms created by the melting Vistulian ice sheet or its fluvioglacial and aeolian activity such as outwash plains (sandur) and dune fields (Map 3). Those forms allowed accumulation of the continuous lake and peatland records. Exceptionally intriguing is the dramatic landscape of the frontal moraines of Poland. They accumulated during the last stage of Vistulian glaciation and are now filled with exceptional lake sediments (some of the are laminated) and thick peat deposits of *Sphagnum* bogs.

N Poland (like entire country) is located in the Central Europe at the interface of the continental and oceanic climates. Setting along the gradient of continentality, area of Poland experiences different temperature and precipitation amplitudes in western and eastern part of the country (Maps 5-13). The eastern part of Poland is colder and more continental where temperature amplitudes are the highest, also snow cover is usually thicker and persisting longer.

The IME 2018 will go through the peatland ecosystems of NE Poland to NW and W Poland. It is a journey through the poor-rich gradient - from extremely rich fens to ombrotrophic bogs located on the frontal moraines that were shaped during the last ice age (Map 14), in the very diverse and dramatic landscape of Suwałki Lake District, to the inland dune field of Noteć Forest. The gradients can be seen on the present surface of peatlands and in palaeoecological profiles. Most of the formerly pristine mires were impacted by drainage or peat exploitation, however, also many are still in very good conditions preserving remnants of the natural vegetation and microbial communities. In effect of water table decrease all bogs are covered with the pine forest, however, there are also relatively open areas on wetter sites.

Diversity of vegetation, main forest types and ranges of more important tree species are shown in the Maps 15-17. They are the result of climate influences and anthropogenic changes in the Holocene. Most of the N Poland forests are dominated by pine monocultures that are in fact relatively young plantations having origin in management that begun the last 300 years. The Map 18 provides a general look at the landscapes of Poland with well separated young glacial north marked by the range of the Vistulian ice sheet.

High-resolution inferences from laminated lakes located in north-western and north-eastern Poland will be demonstrated in the field. The second exceptional aspect of the IME is that those lakes are located in the same basins as peatlands (laminated lakes – peat systems) that are currently under investigations. Data (with highly robust chronologies) are expected to bring novel ideas on wetland ecosystems responses to various drivers with main focus on fires and hydroclimate.

Three exceptional peatland manipulative experiments (www.climpeat.pl, www.wetman.pl, www.mixopeat.cnrs.fr) in this part of Europe will be demonstrated where we test how warming, drought and precipitation reduction affects peatland ecosystem functioning. We will also present a natural experiment – dramatic impact of a tornado on the pine forest (plantation) surrounding wetland ecosystem. This will be the first time for the International Moor Excursion that both field experiments and palaeoecological studies will be presented.

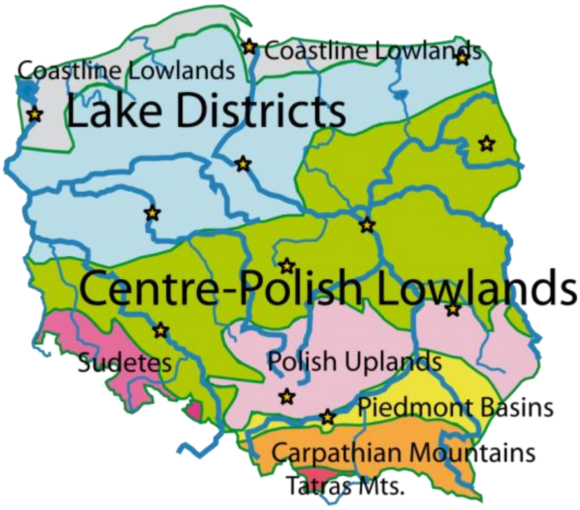
Some of the data presented are still not published and some experiments are in preparation. However, this will be a great opportunity to discuss future research designs and expected patterns in relation to long-term ecological inferences. Especially, the functional context that is now widely explored in ecology and palaeoecology in many projects and publications worldwide.

We believe that 42nd International Moor Excursion 2018 in N Poland will be rich in questions and lively discussions, as well as positive impressions from the contact with Polish biodiversity and cultural heritage.

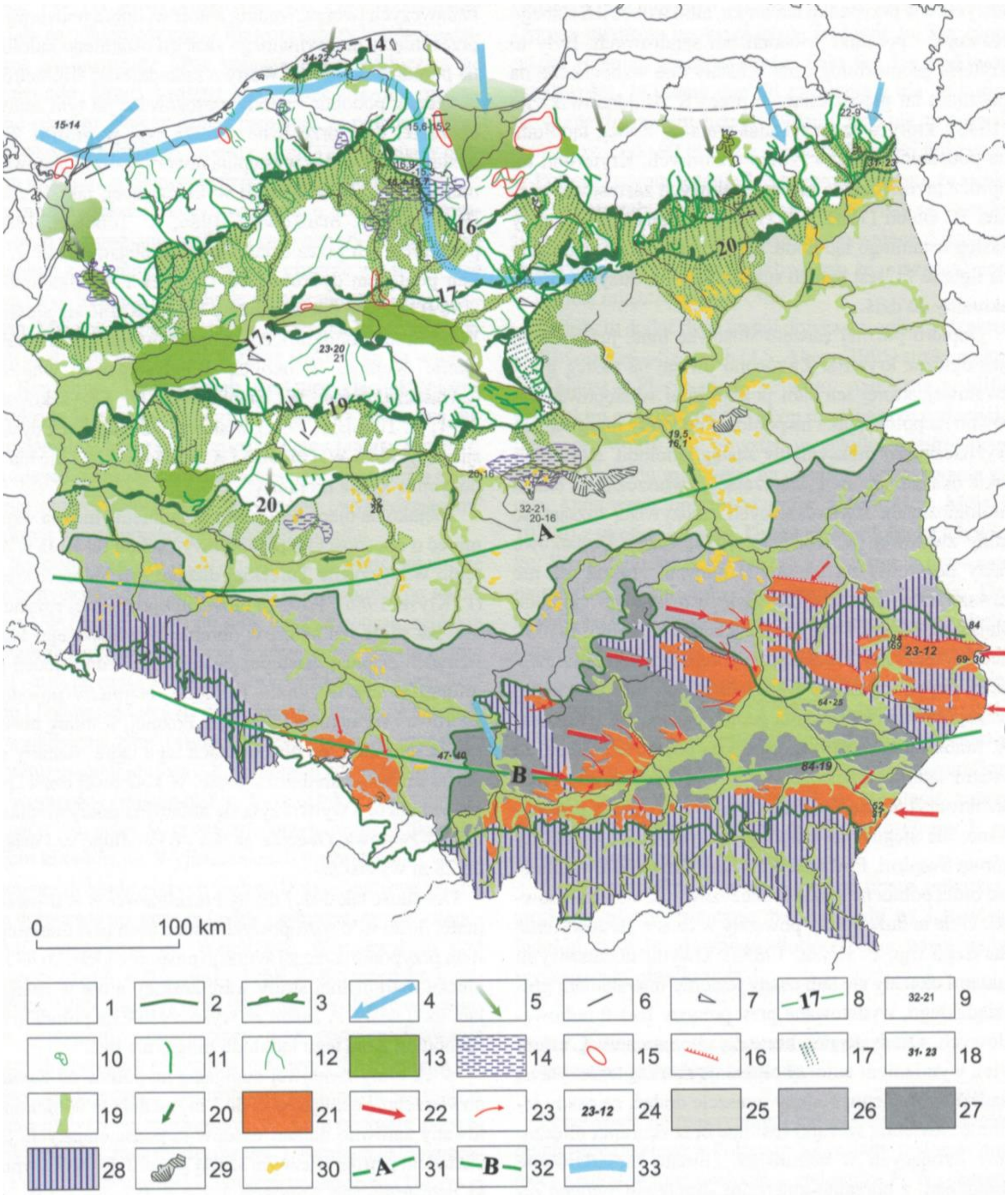
IME 2018 Organising Team

Maps

Map 1. Physical map of Poland

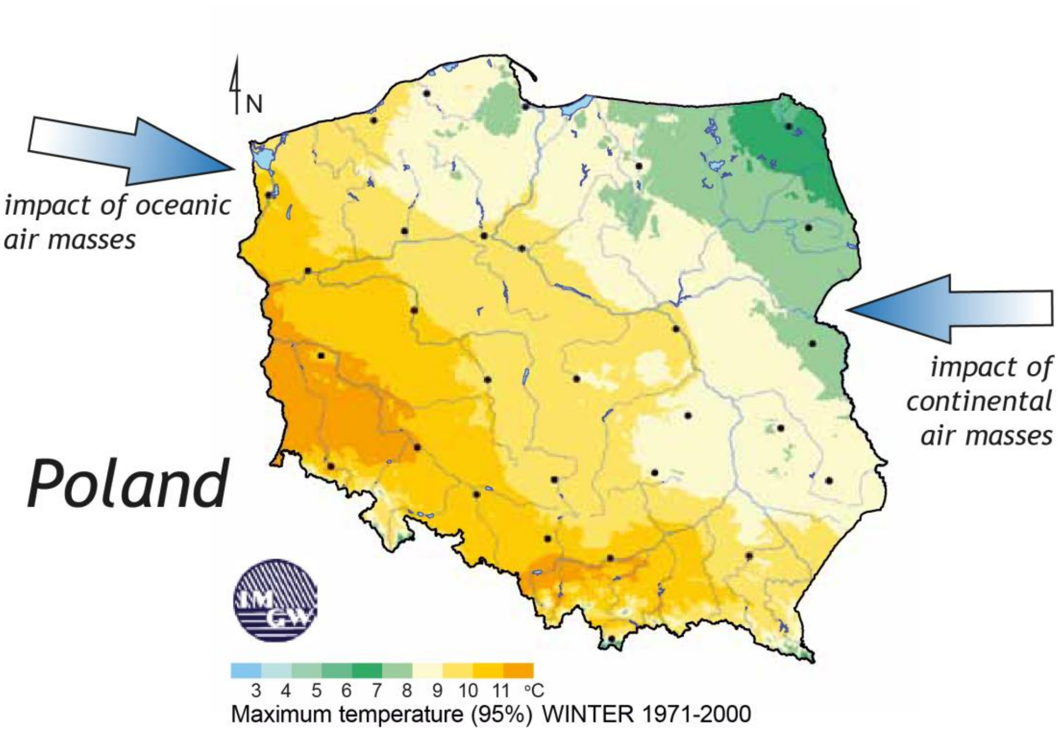


Map 2. Main geomorphological zones of Poland

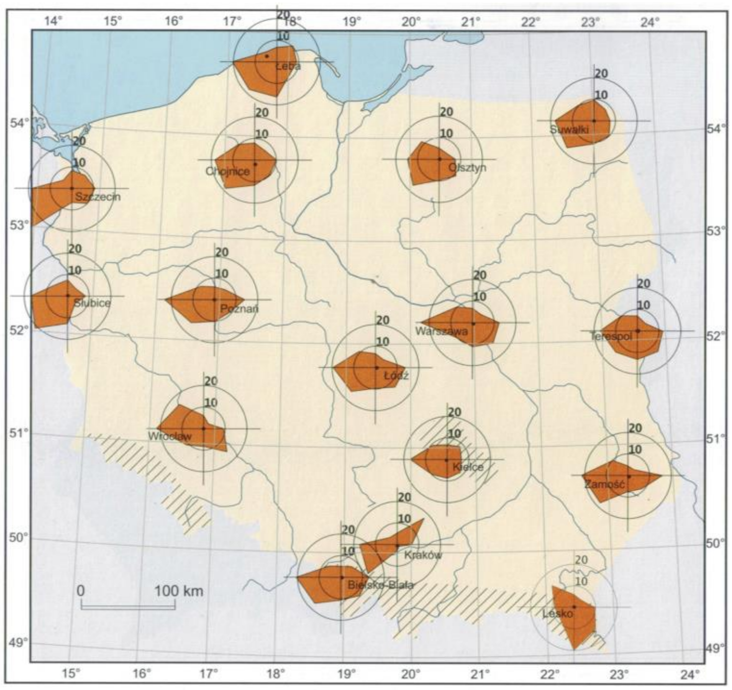


Map 3. Poland during Vistulian glaciation. 1 – area covered with the Vistulian ice sheet, 2 - the limits of the San 2, Odra and Warta ice sheets/advances, 3 – the limits of the Vistulian ice sheet and marginal zones with the frontal moraines of its earlier advances, 4 - main directions of the ice sheet advance, 5 - regional directions of ice sheet advance, 6 - local directions of ice front advance, 7 - locally variable directions of ice sheet advance, 8 – the age of the ice front standstill, 9 - selected termoluminescence ages, 10 - most pronounced melt out depression in the marginal zones, 11 - most pronounced channels crossing the marginal zones, 12 - small-scale channels, which do not cross marginal zones, 13 - extensive melt out depressions, 14 - pronounced/major sedimentation basins, 15 - pushed moraines, 16 - clear loess margins/loess sheets of proglacial domain, 17 - sandurs, 18 - selected termoluminescence ages of glacifluvial sediments in ky, 19 - river valleys and lakes, 20 - the main direction of the river and the meltout water palaeoflow, 21 - main areas of loess accumulation with thickness above 3 m, 22 - main directions of loess transport, 23 - secondary directions of loess transport, 24 - termoluminescence ages of the loess in ky, 25 – the transformation of the newly deglaciated landscape to periglacial domain, 26 - area of post-glacial landscape at least twice influenced by periglacial conditions, 27 - area of post-glacial landscape at least three times influenced by periglacial conditions, 28 - periglacially transformed upland and mountainous areas of palaeogen and neogen age, 29 - extensive glacial fans (sandur) on Polish

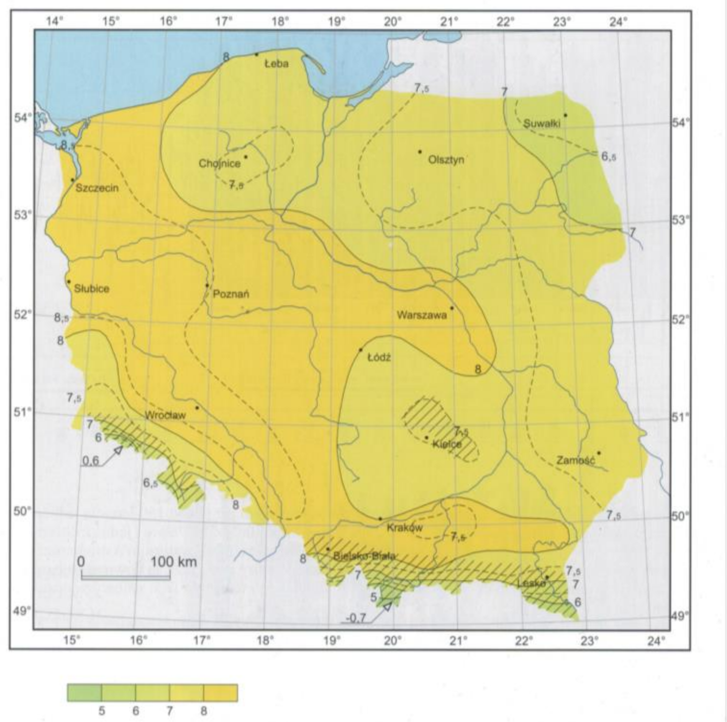
Lowland, 30 - extensive dune concentrations, 31 - southern limit of permafrost, 32 – the limit of unstable permafrost, 33 – reconstructed ice front position during the Świecie stadial (Mojski, 2005)



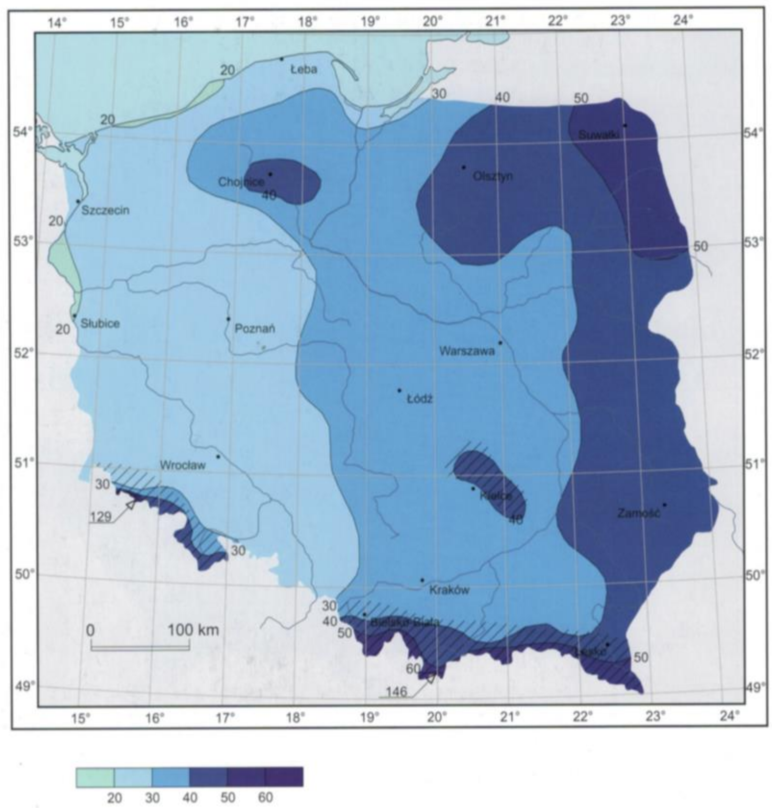
Map 4. Map revealing the continentality of the climate of Poland (modified from Marcisz *et al.* (2017))



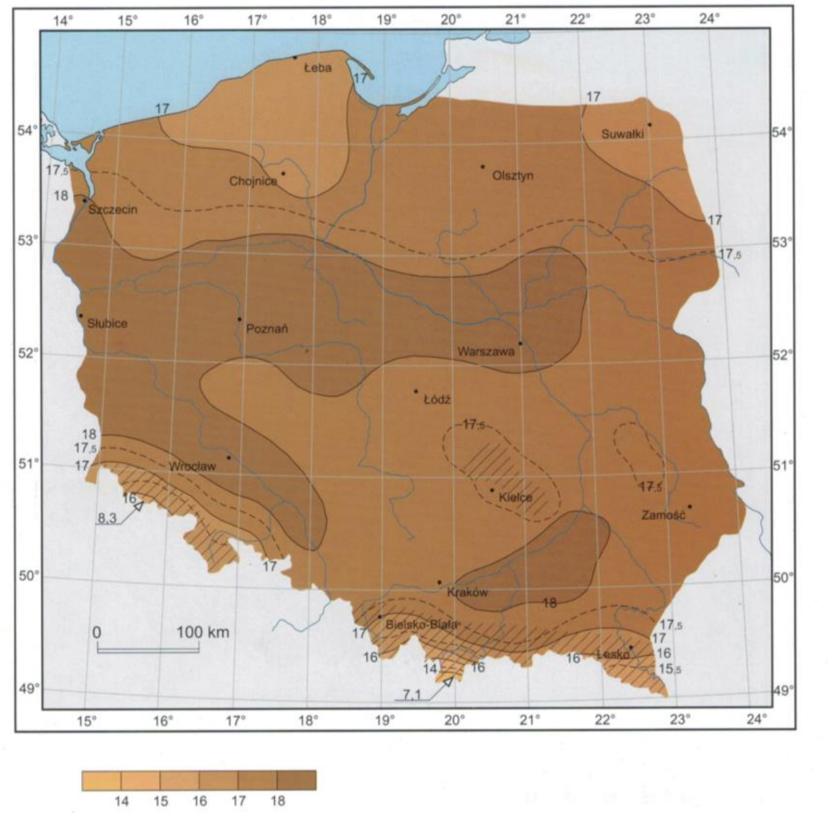
Map 5. Dominant wind directions (Lorenc, 2005)



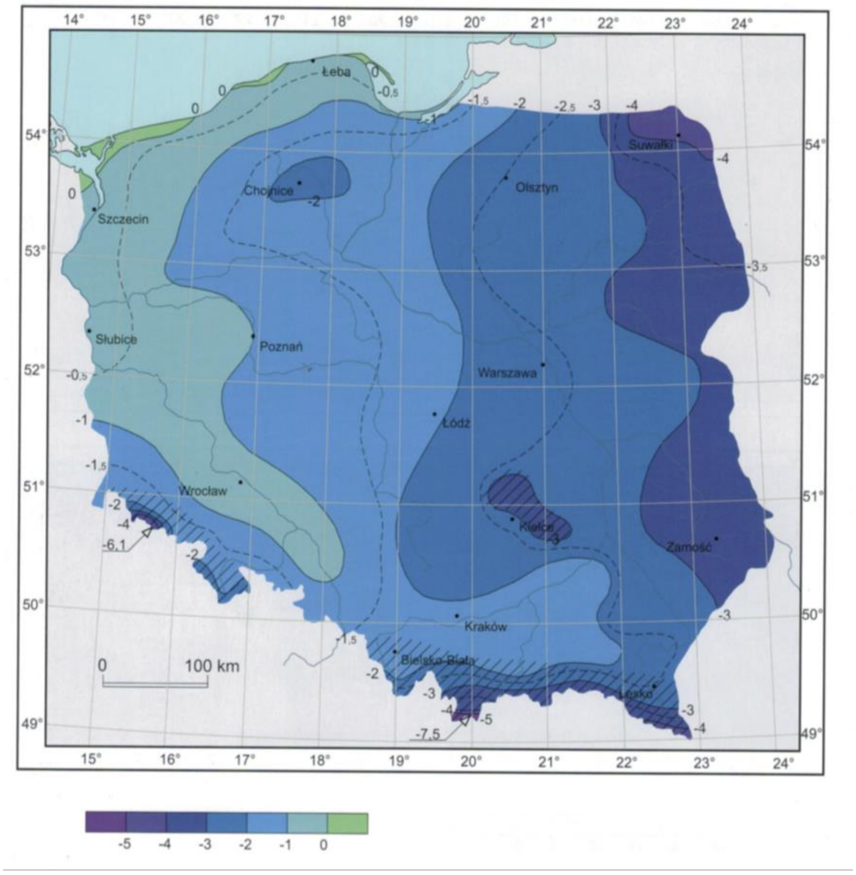
Map 6. Average annual temperature [°C] in the years 1971-2000 (Lorenc, 2005)



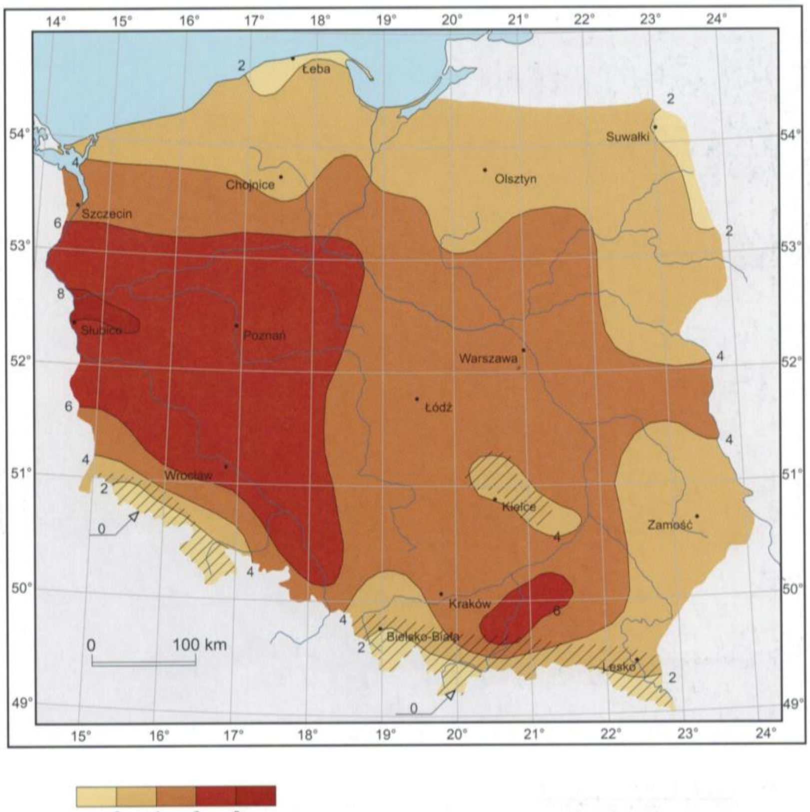
Map 7. Number of days with maximum temperature below 0°C (Lorenc, 2005)



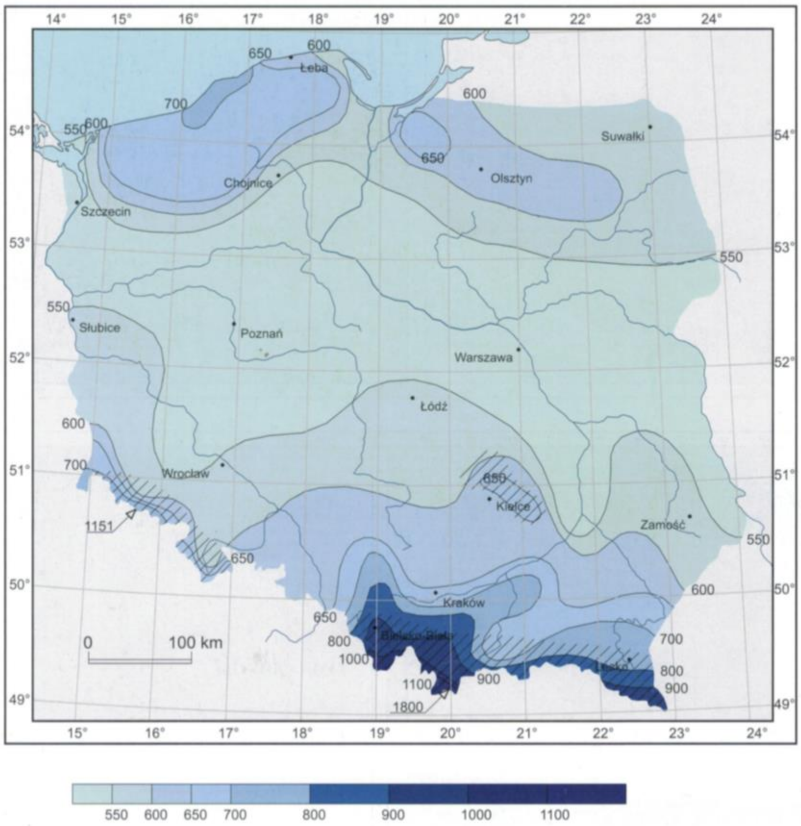
Map 8. Average temperature of July [°C] (Lorenc, 2005)



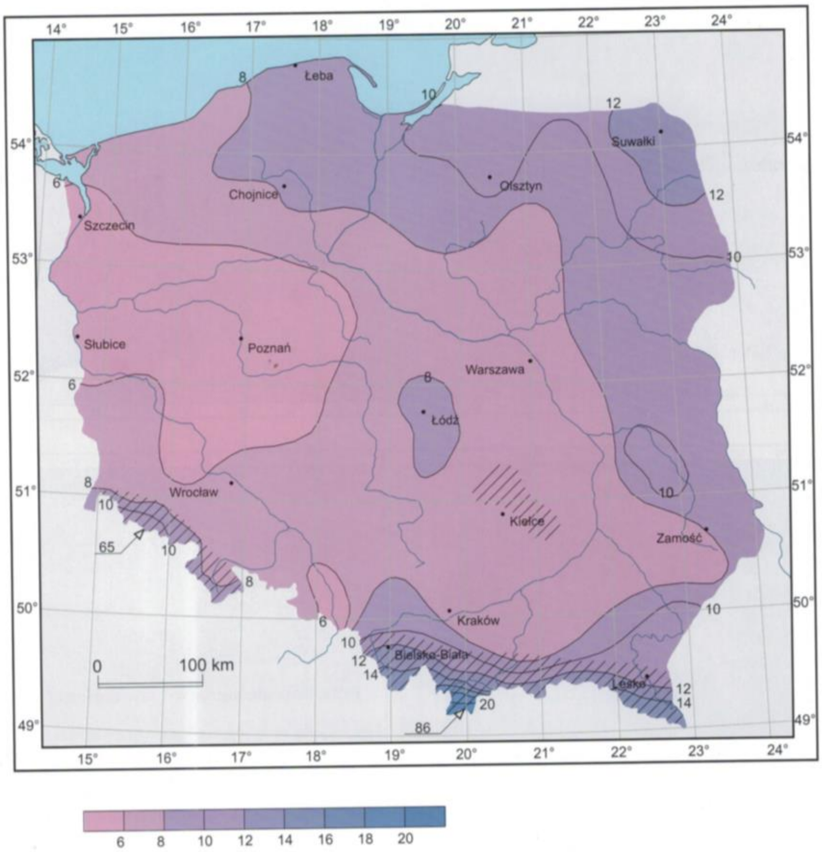
Map 9. Average temperature of January [°C] (Lorenc, 2005)



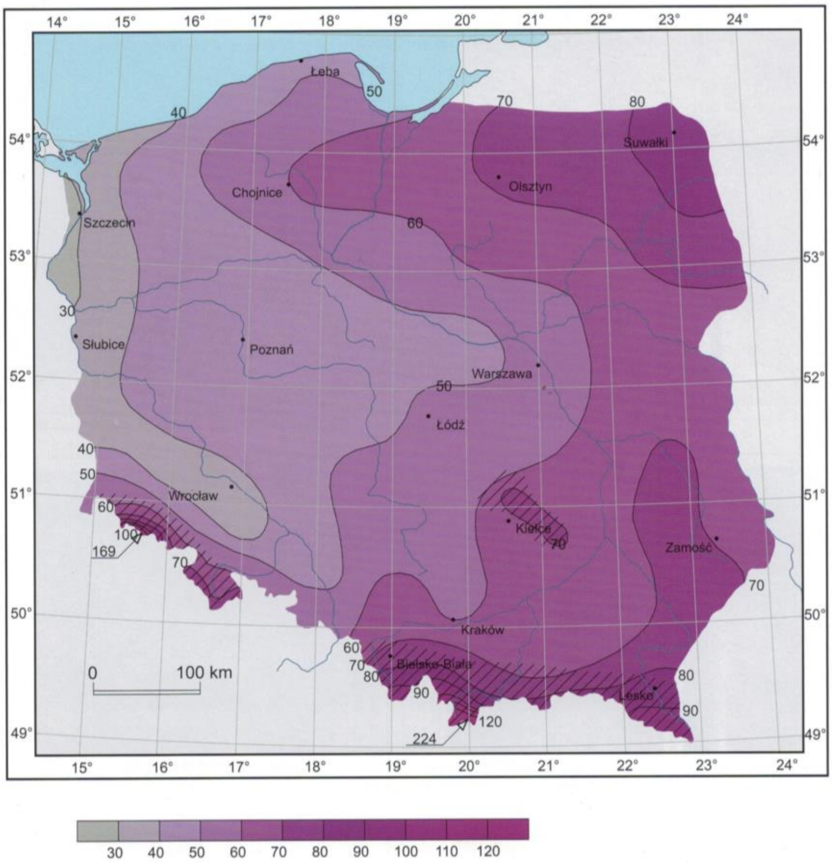
Map 10. Number of hot days with maximum temperature above 30°C (Lorenc, 2005)



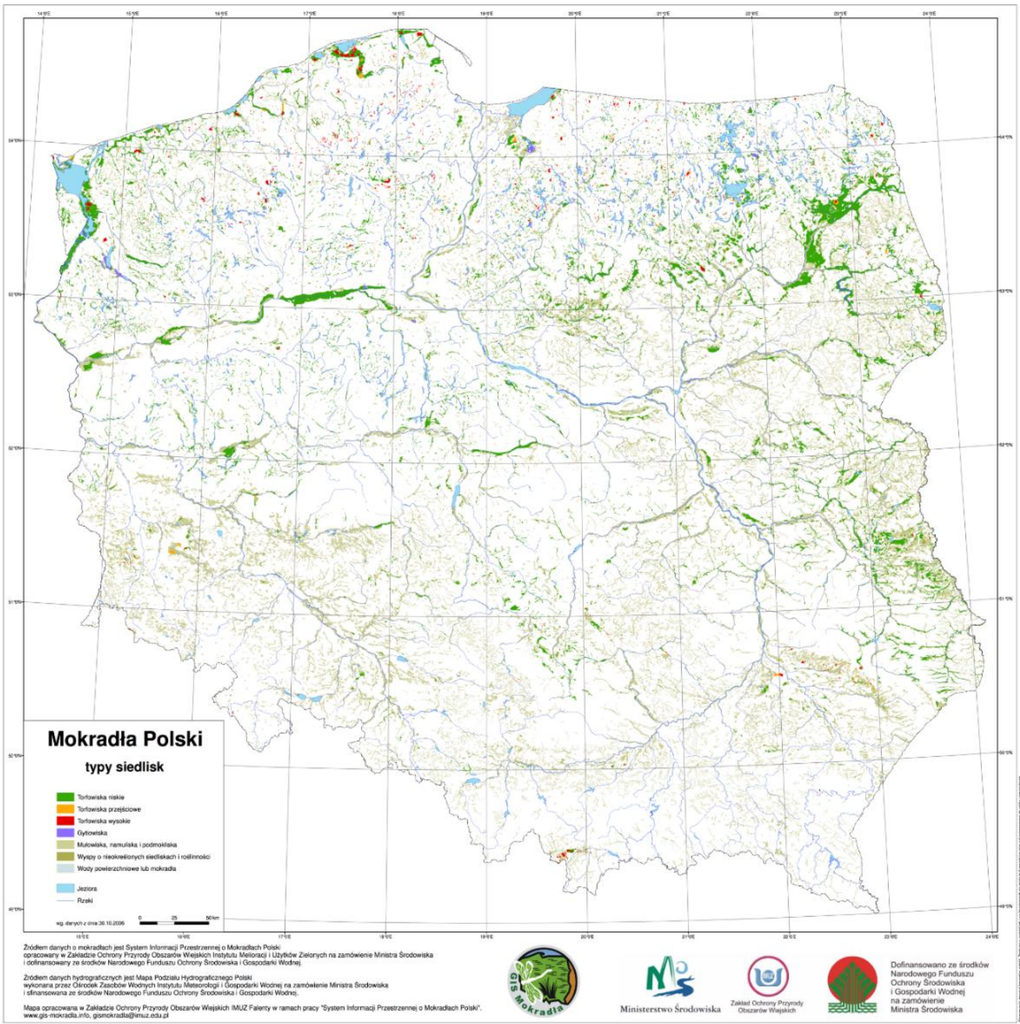
Map 11. Average annual precipitation [mm] in the years 1971-2000 (Lorenc, 2005)



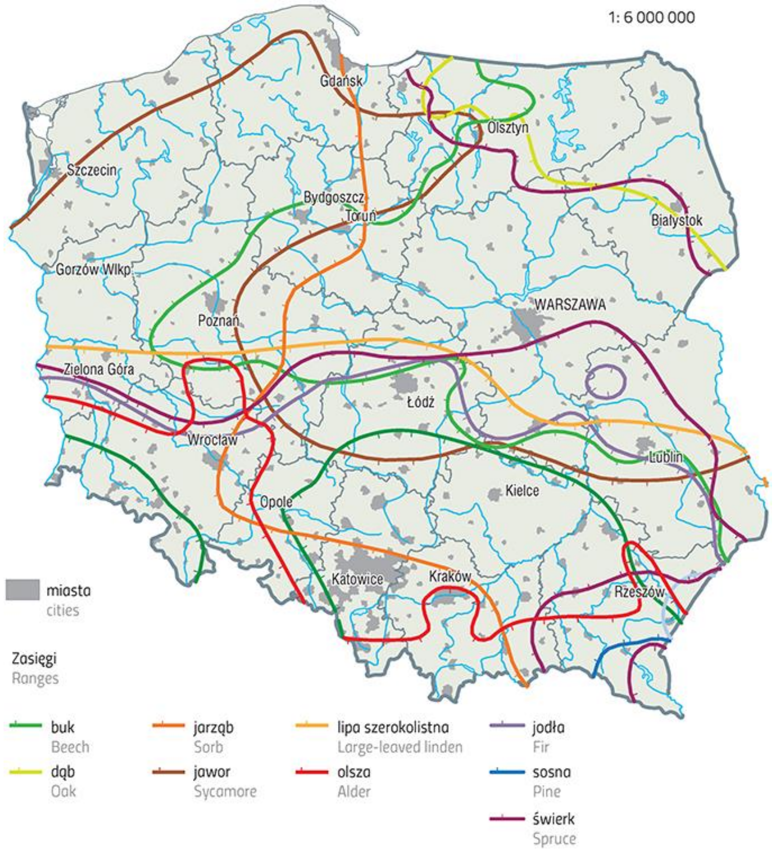
Map 12. Average thickness of the snow cover [cm] in the years 1970/1971-1999/2000 (Lorenc, 2005)



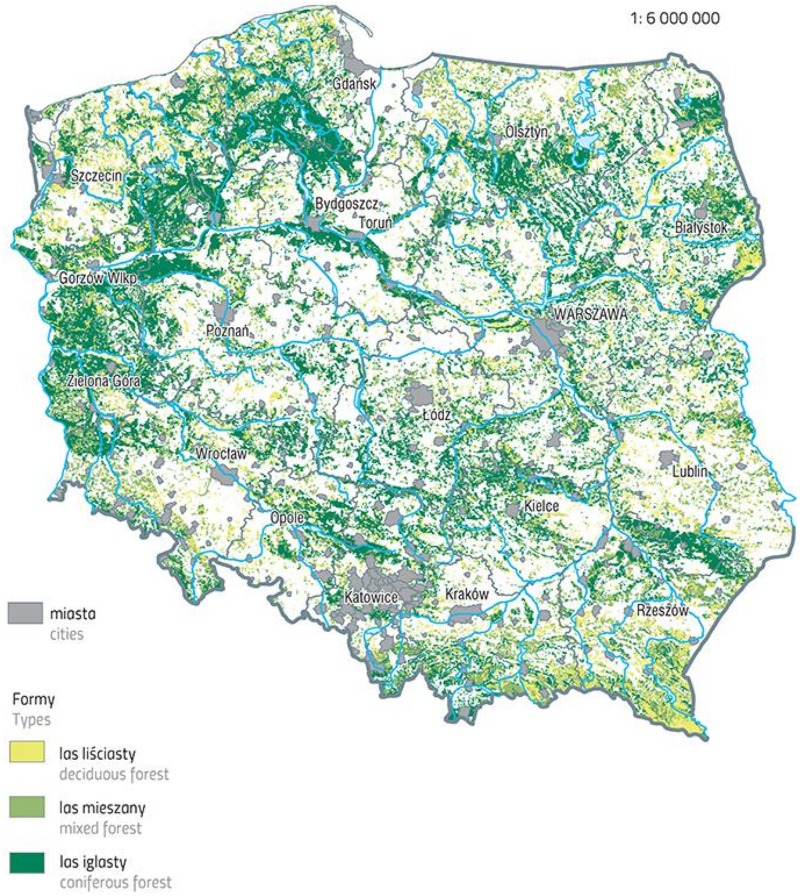
Map 13. Average number of days with the snow cover in the years 1970/1971-1999/2000 (Lorenc, 2005)



Map 14. Distribution of different wetland types in Poland. Legend: green – fens, orange – poor fens, red – bogs, violet – gyttia filled basins, light brown – swamps, brown – not identified habitats, light blue – surface waters/wetlands, dark blue – lakes, blue lines – rivers (Kotowski *et al.*, 2017)



Map 15. Limits of the distribution of the chosen tree species in Poland (Bański, 2016)



Map 16. Major forest types in Poland (Bański, 2016)

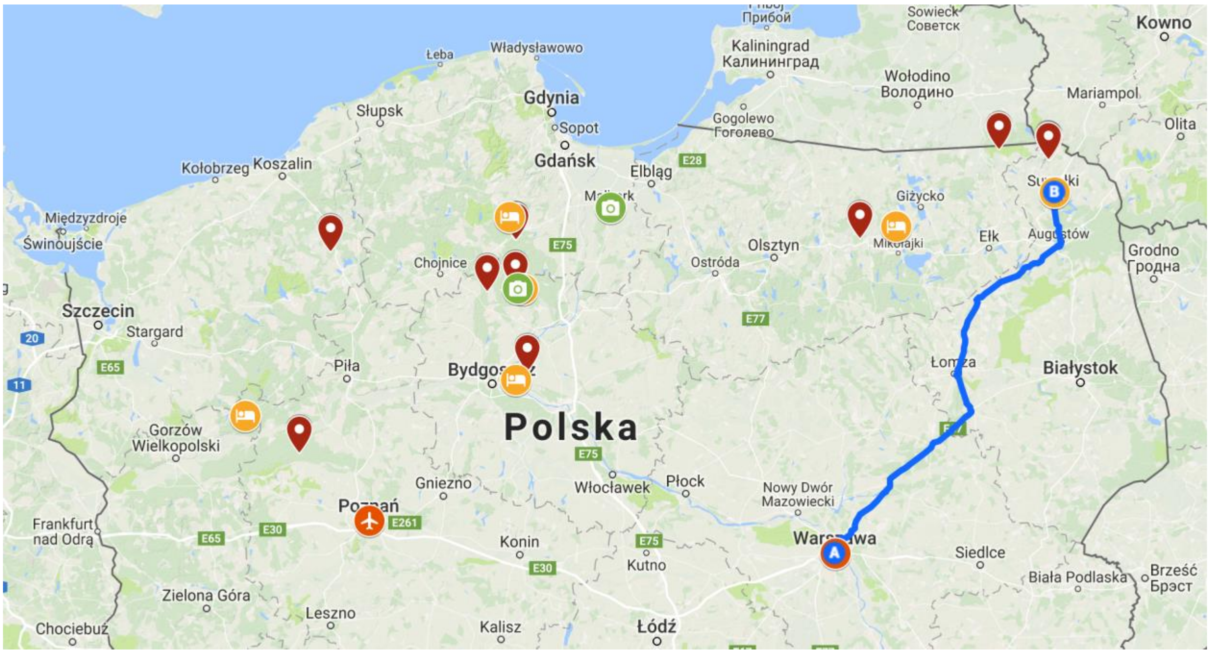
Map 17. Vegetation landscapes of Poland (Bański, 2016)

Map 18. Diversity of landscapes of Poland (Bański, 2016)

Day 1 – Saturday, 1.09.2018
Arrival

Transfer to Suwałki (NE Poland)

	Arrival in Warsaw
ca. 14 h	Meeting at the Chopin airport and main train station
	Transfer to Suwałki (NE Poland)
ca. 19 h	Arrival in Suwałki (Hotel Loft 1989***)
20 h	Welcome dinner



Day 2 – Sunday, 2.09.2018
Suwałki Lake District and Romincka Forest

Jaczno laminated lake and mire, Kojle fen and lake, Mechacz Wielki raised bog

8 h	Departure
9:10 h	Welcoming at the Cisowa Góra (Mariusz Lamentowicz)
10 h	Jaczno laminated lake – land use changes and lake eutrophication in the last 200 years (Wojciech Tylmann)
	Jaczno mire – environmental history (Katarzyna Kajukało, Katarzyna Marcisz, Mariusz Lamentowicz)
	Kojle fen and lake – environmental history (Mariusz Gałka, Mariusz Lamentowicz)
13 h	Lunch
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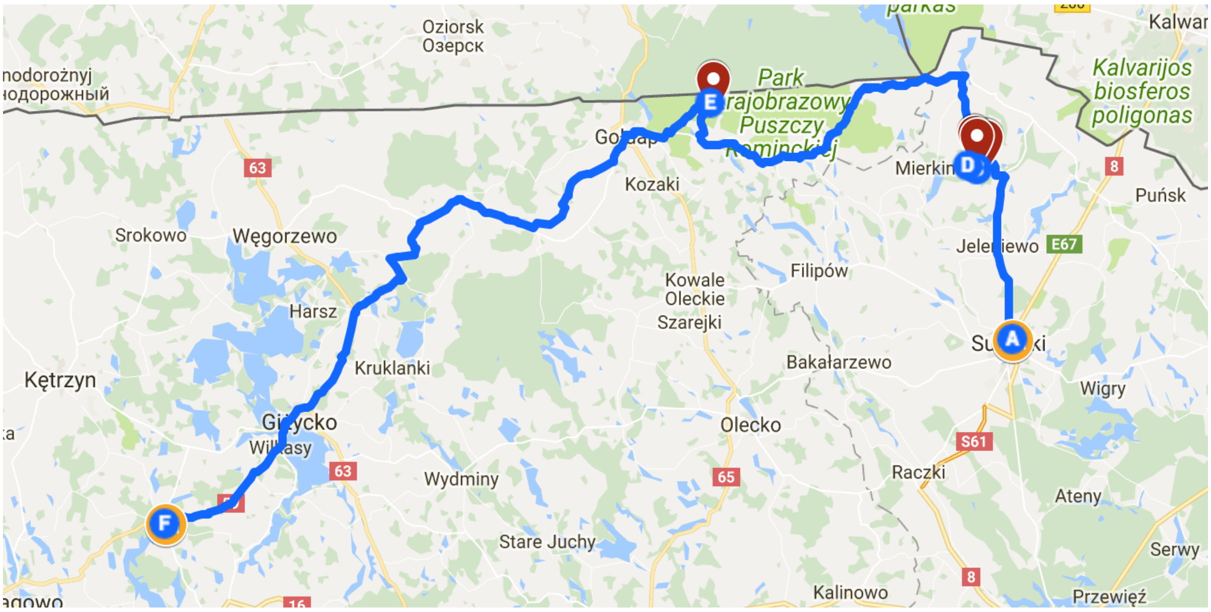
17 h	Departure to the hotel (Ryn)
20 h	Dinner



SUWAŁKI LAKE DISTRICT

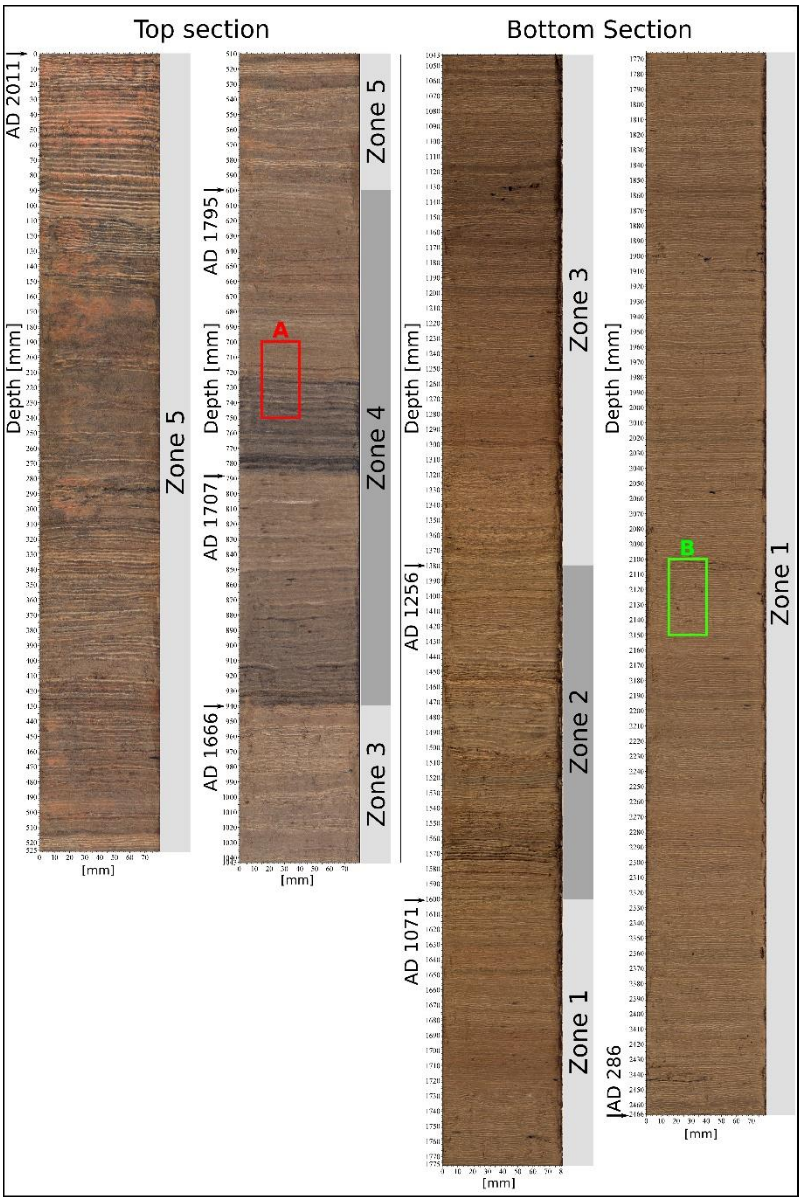
Suwałki Lake District (*Polish*: Pojezierze Suwalskie) is located in the north-eastern part of Poland, next to the border with Russia, Lithuania and Belarus. This area is characterized by a young glacial landscape with a high concentration of morainic hills. The highest peak is Rowelska Mountain reaching an elevation of 298.1 m a.s.l. There are about 250 lakes located in the Suwałki Lake District, most of them are either ribbon or moraine lakes. Even though most of the lakes are small, two deepest Polish lakes are located in this region: Lake Hańcza (maximum depth of 108.5 m) and Lake Wigry (maximum depth of 74 m). The climate of this part of Poland is highly influenced by continental air masses. The main city of the region is Suwałki (total population: ca. 69,500). Apart from lakes, most popular tourist destinations are Wigry National Park and Suwałki Landscape Park (established in 1989 and 1976, respectively).

Jaczno laminated lake

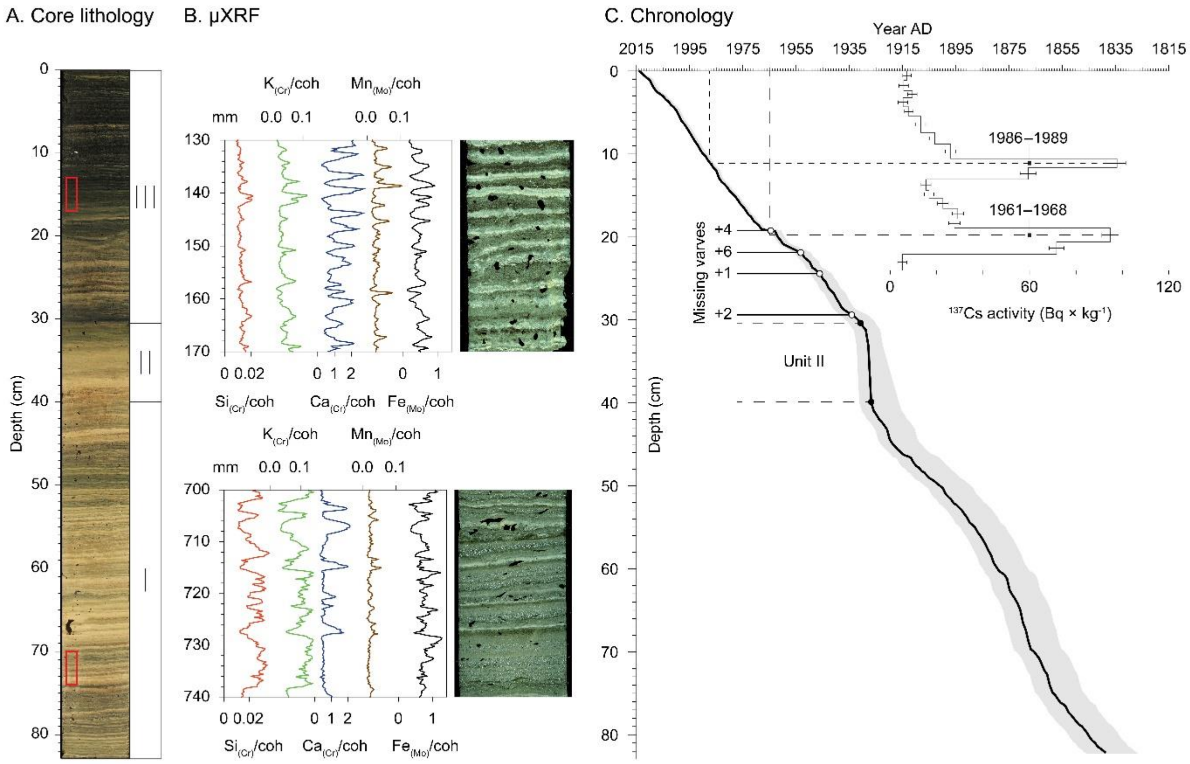
Lake Jaczno (53°51′18″ N, 21°57′07″ E, 163 m a.s.l.) is situated in the Suwałki Lakeland in north-eastern Poland. The morphology of its catchment area features a characteristic postglacial landscape, with distinct changes in elevation and diverse glacial and glaciofluvial deposits. The lake basin can be divided into five subbasins with narrow connections overgrown by aquatic plants. The northern basin is the largest with an area of 23.2 ha and a maximum depth of 21.4 m. The maximum water depth of 25.7 m occurs in the southern basin (Weisbrodt *et al.*, 2016). Seasonal field measurements of water column properties indicate a thermally stratified hardwater lake with at least seasonal anoxia in the hypolimnion. The present trophic status is described as mesotrophic.

The ongoing projects are related to:

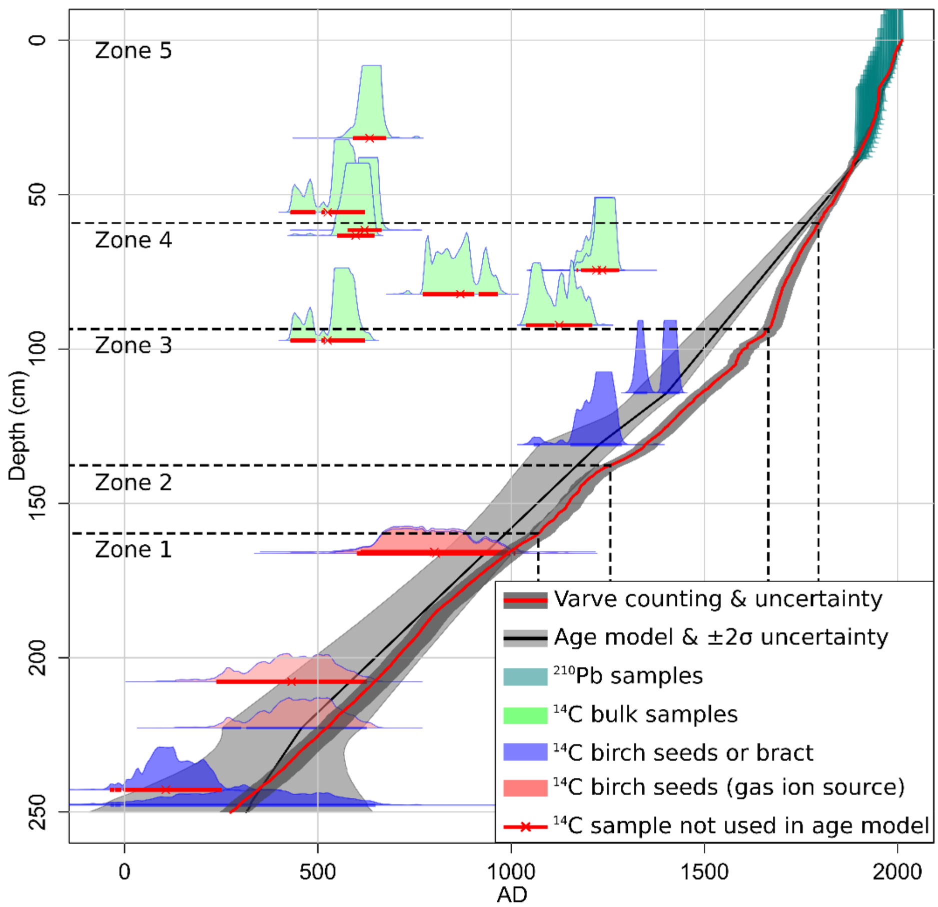
- Human-induced changes in the catchment and their record in recent sediments of the northern basin (Poraj-Górska *et al.*, 2017);
- Reconstructions of the lake mixing regimes in the southern basin using sedimentary bacterial pigments (Butz *et al.*, 2016; Butz *et al.*, 2017);
- Long-term environmental history recorded in varves of Lake Jaczno. The complete sediment profile (>12 m) was recovered from the southern basin in 2017, and is analyzed by Swiss-Polish team from Bern and Gdańsk.



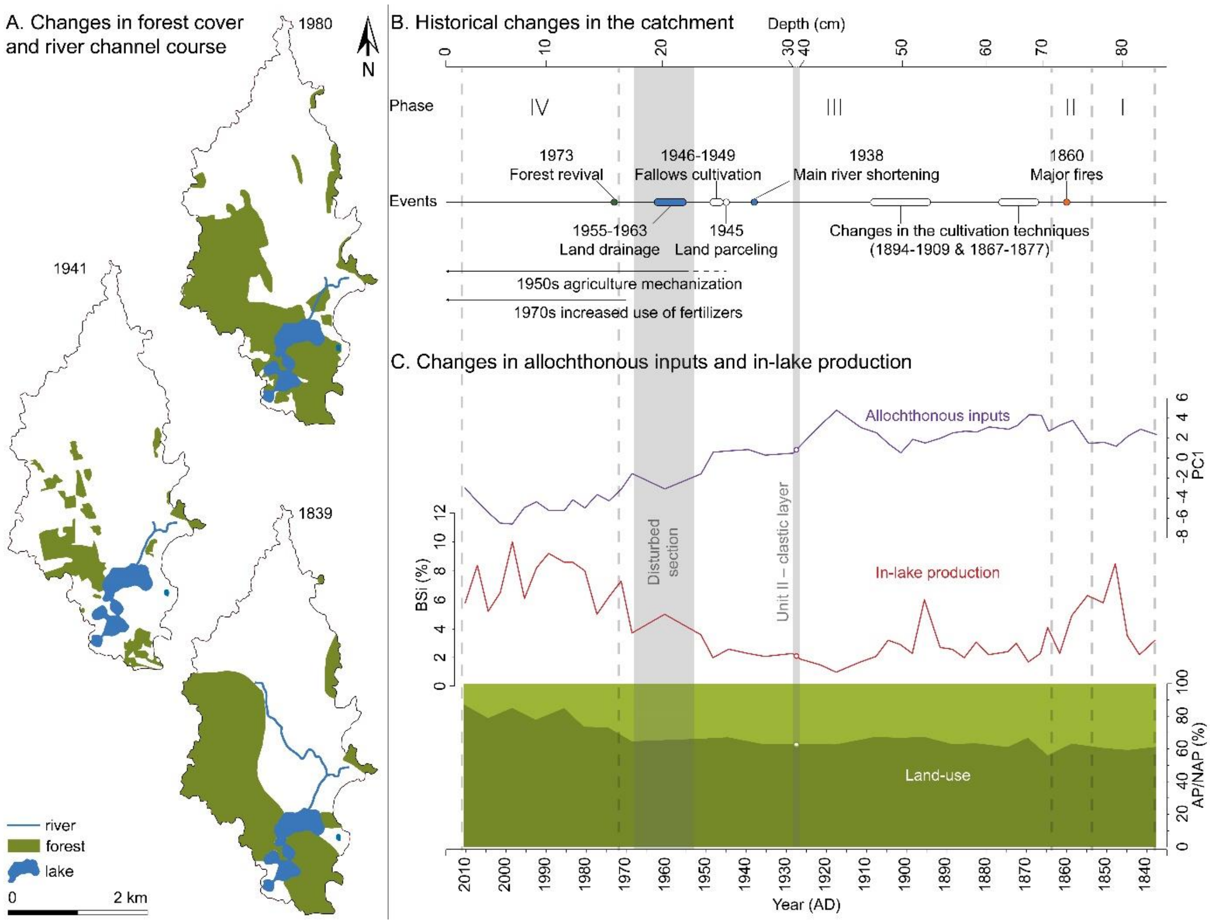
Laminated sediments from lake Jaczno



[A] sediment colour after oxidation of the split core surface; [B] microstratigraphy and chemical composition of varves; [C] varve and 137Cs chronologies of core JAC-13/1 (Poraj-Górska *et al.*, 2017)



Chronology of the core including varve counting, 14C and 210Pb methods (Butz *et al.*, 2017)



[A] Historical changes of the main inflow and of forest cover according to historical maps; [B] major events in the Lake Jaczno catchment; [C] sediment indicators (PC1 scores as an indicator of allochthonous inputs variability and BSi concentrations as a measure of in-lake (autochthonous) production) during the study period (Poraj-Górska *et al.*, 2017)

J Paleolimnol (2017) 58:57–72
DOI 10.1007/s10933-017-9955-1
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ORIGINAL PAPER

Hyperspectral imaging of sedimentary bacterial pigments: a 1700-year history of meromixis from varved Lake Jaczno, northeast Poland

Christoph Butz · Martin Grosjean · Tomasz Goslar · Wojciech Tylmann

Global and Planetary Change 144 (2016) 109–118
Contents lists available at ScienceDirect
Global and Planetary Change
journal homepage: www.elsevier.com/locate/gloplacha
ELSEVIER
CrossMark

Sedimentary Bacteriopheophytin *a* as an indicator of meromixis in varved lake sediments of Lake Jaczno, north-east Poland, CE 1891–2010

Christoph Butz [a,*], Martin Grosjean [a], Anna Poraj-Górska [b], Dirk Enters [c], Wojciech Tylmann [b]
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Limnol. Rev. (2016) 16, 4: 247–256
DOI 10.1515/limre-2016-0027

DE GRUYTER OPEN

Contribution of non-pollen palynomorphs to reconstructions of land-use changes and lake eutrophication: case study from Lake Jaczno, northeastern Poland

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Catena 153 (2017) 182–193

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CATENA

Impact of historical land use changes on lacustrine sedimentation recorded in varved sediments of Lake Jaczno, northeastern Poland

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Anna Izabela Poraj-Górska [a,*], Maurycy Jacek Żarczyński [a], Antje Ahrens [b], Dirk Enters [b,c], Dawid Weisbrodt [a], Wojciech Tylmann [a]

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Jaczno peatland

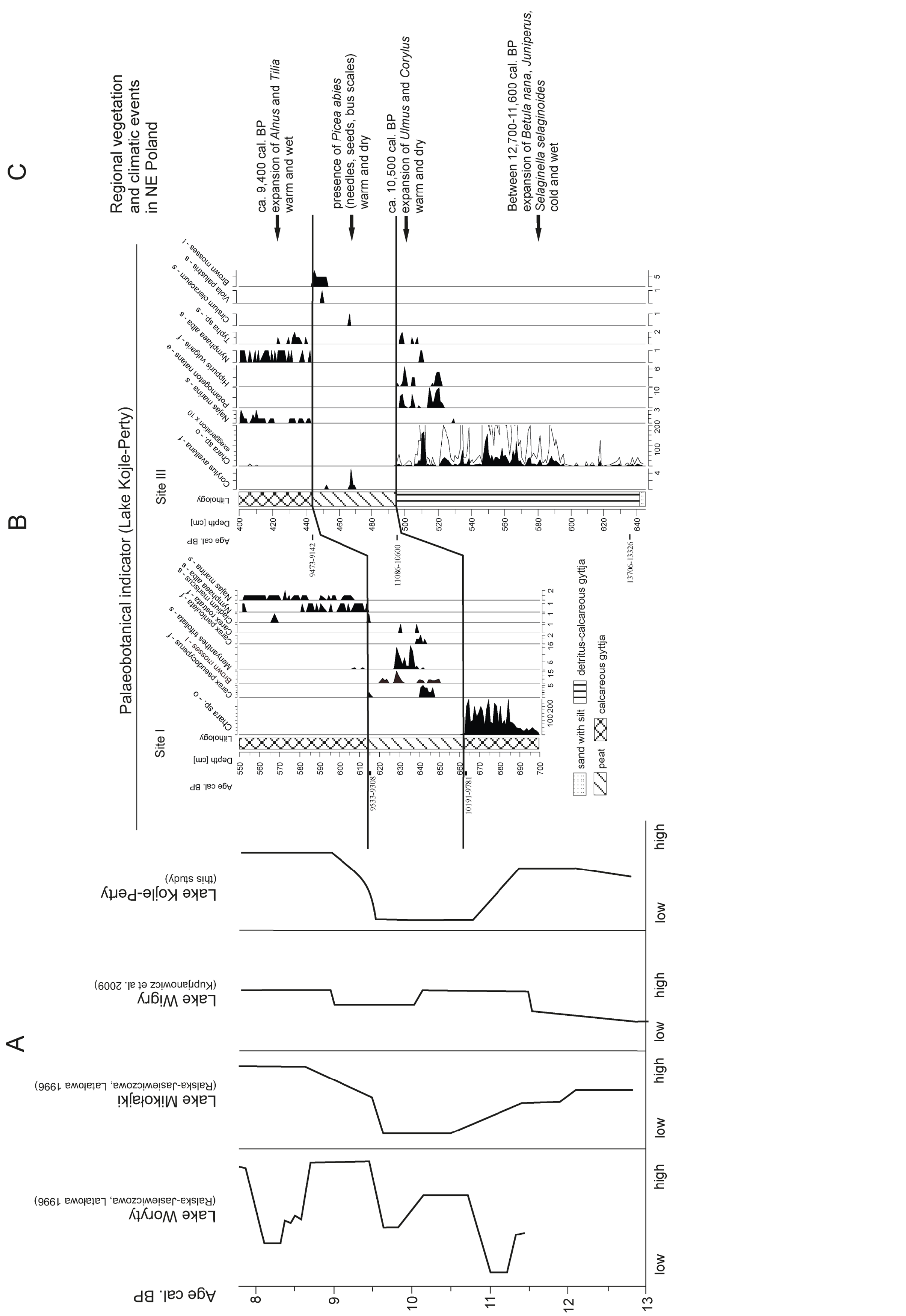
Jaczno mire is a kettle-hole *Sphagnum*-dominated bog located 100 m from the southern part of the Jaczno laminated lake. The central part is open and dominated by very wet *Sphagnum* carpet that is surrounded by a ring of dwarf *Pinus sylvestris* and then mixed forest. Central part of the peatland possesses a character of the floating mat – at least structure of the vegetation suggests that terrestrialistion process took place during the peatland formation.

The ongoing project realized at the Jaczno mire aims to reconstruct the development of the mire focusing on vegetation changes, drought detection and fire activity. Together with the investigations of Głęboczek peatland (that we will visit on day 4, 04.09.2018) and Pawski Ług peatland (located in W Poland) we want to see if oceanic-continental climatic gradient observed in Poland had an influence on peatlands development, hydrology and forest flammability. A 7.5-meter peat core have been sampled at Jaczno peatland in August 2016. The investigations of 4 meters of the sediments covering last 1500 years are on-going, therefore, we present only preliminary results.

Kojle fen and lake

Lake Kojle is located in northeast Poland in the Suwałki Landscape Park. The morphology of the study area was largely influenced by the Scandinavian ice sheet during the Weichselian glaciation, and the limit of the Pomeranian Phase ice sheet was approx. 7 km south of Lake Kojle, as estimated at ca. 16–17 ka cal. yr BP (Marks, 2012). The numerous lakes and peatlands in the area are located among morainic and kame hills with elevations up to 270 m a.s.l., and the differences in relative heights frequently exceed 50 m.

Lake Kojle has a maximum depth of 33 m and covers an area of 17.1 ha. The water level in the lake is approximately 148.3 m a.s.l. In the past, Lake Kojle was connected to the neighbouring lakes Perty and Purwin, evidenced by the continuity of the biogenic deposits between the lakes (Gałka & Apolinarska, 2014). The oldest lacustrine deposits in the area from Lake Kojle date back to ca. 14,000 cal yr BP (Gałka *et al.*, 2015a). At present, *Nymphaea alba* and *Chara* spp. occur in the lake in the areas surrounding the coring sites. *Cladium mariscus* and *Phragmites australis* grow in the rush zone, which is bordered by a belt of *Carex elata* and *Thelypteris palustris* and then by a sparse *Alnus glutinosa* swamp where *Thelypteris palustris* grows abundantly. The other common plant species in this swamp belt include *Phragmites australis*, *Carex paniculata*, and *Frangula alnus*. The moss layer is weakly developed and consists mainly of *Climacium dendroides*, *Brachythecium* sp. and *Plagiomnium ellipticum*. Testate amoebae record from the **Kojle fen** is highly unique in terms of species diversity.



Summary diagram of the lake level changes in NE Poland. A: Comparison with other sites, B: Palaeobotanical indications of lake-level changes from Lake Kolje-Perty, C: Regional vegetation and climatic events (Gałka *et al.*, 2015a)

Quaternary International 328-329 (2014) 213–225

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Climate change, vegetation development, and lake level fluctuations in Lake Purwin (NE Poland) during the last 8600 cal. BP based on a high-resolution plant macrofossil record and stable isotope data ($\delta^{13}C$ and $\delta^{18}O$)

Mariusz Gałka [a,*], Karina Apolinarska [b]

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Late Glacial and Early Holocene lake level fluctuations in NE Poland tracked by macro-fossil, pollen and diatom records

Mariusz Gałka [a,*], Kazimierz Tobolski [a], Iwona Bubak [b]

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ROMINCKA FOREST

Romincka Forest (*Polish*: Puszcza Romincka) is an extensive forest and heath landscape stretching from the south-eastern Russia to north-eastern Poland. The forest covers an area of ca. 35,500 ha, including about 15,500 ha on the Polish side. The highest point in the forest is 295.4 m a.s.l., the lowest: 150 m a.s.l. The forest is dominated by pine and spruce stands with an admixture of oak, linden, birch, alder and hornbeam. The climate is quite severe (average temperatures are -5°C in January and 16-17°C in July). The closest city is Gołdap where, during the last winter (February 2018) the lowest temperatures in Poland were noted, reaching -26°C. Part of the forest is protected by law within a Puszcza Romincka Landscape Park.

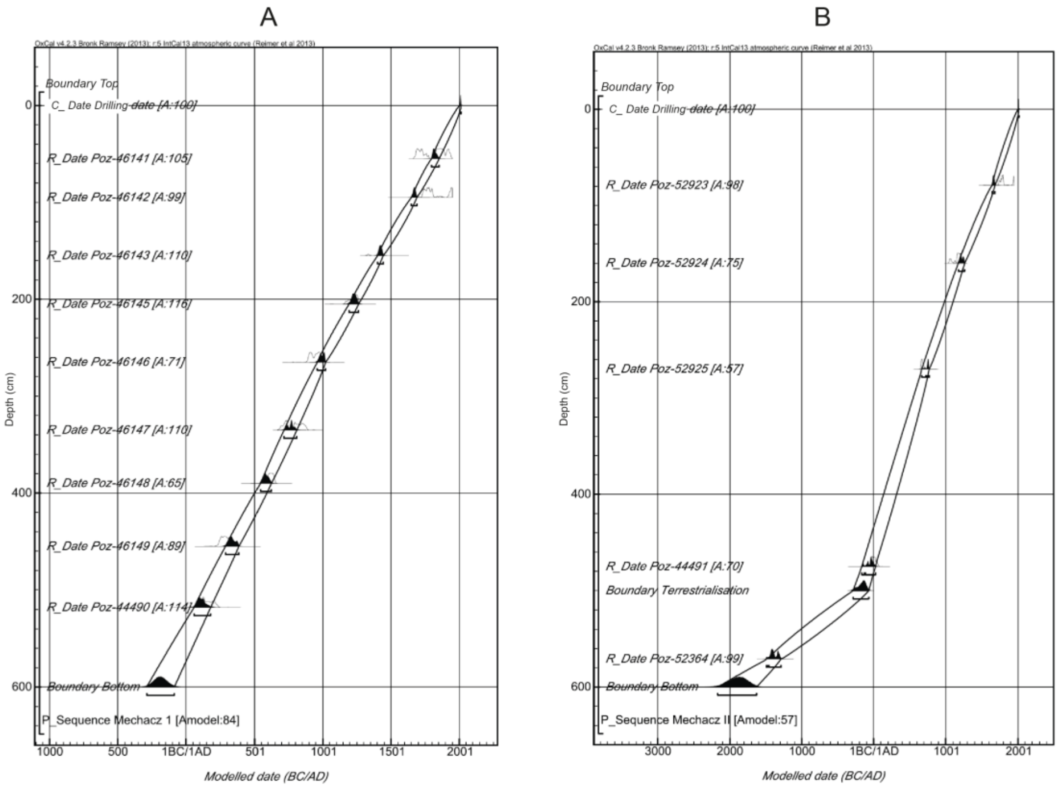
Mechacz Wielki raised bog

Mechacz Wielki bog covers an area of 146.72 ha and is located within the Romincka Forest. This area was formed by the Vistulian glaciation and the relief is characterised by numerous morainic and kame hills (composed of silty clays, glacial sands and erratic boulders), with a height of approximately 200 m a.s.l. Human activity in this region was very low due to low and increased only ca. 1700 CE (Gałka *et al.*, 2014a). The peatland was drained in the 1960s, but was later restored by a system of dams on ditches. The vegetation of the peatland has a highly mosaic character. Mechacz Wielki is protected by law because the remains of the pristine and rare ombrotrophic plant communities with *Sphagnum fuscum*, *S. cuspidatum* or *Rubus chamaemorus* (typical for the Baltic bog vegetation) can still be found there.

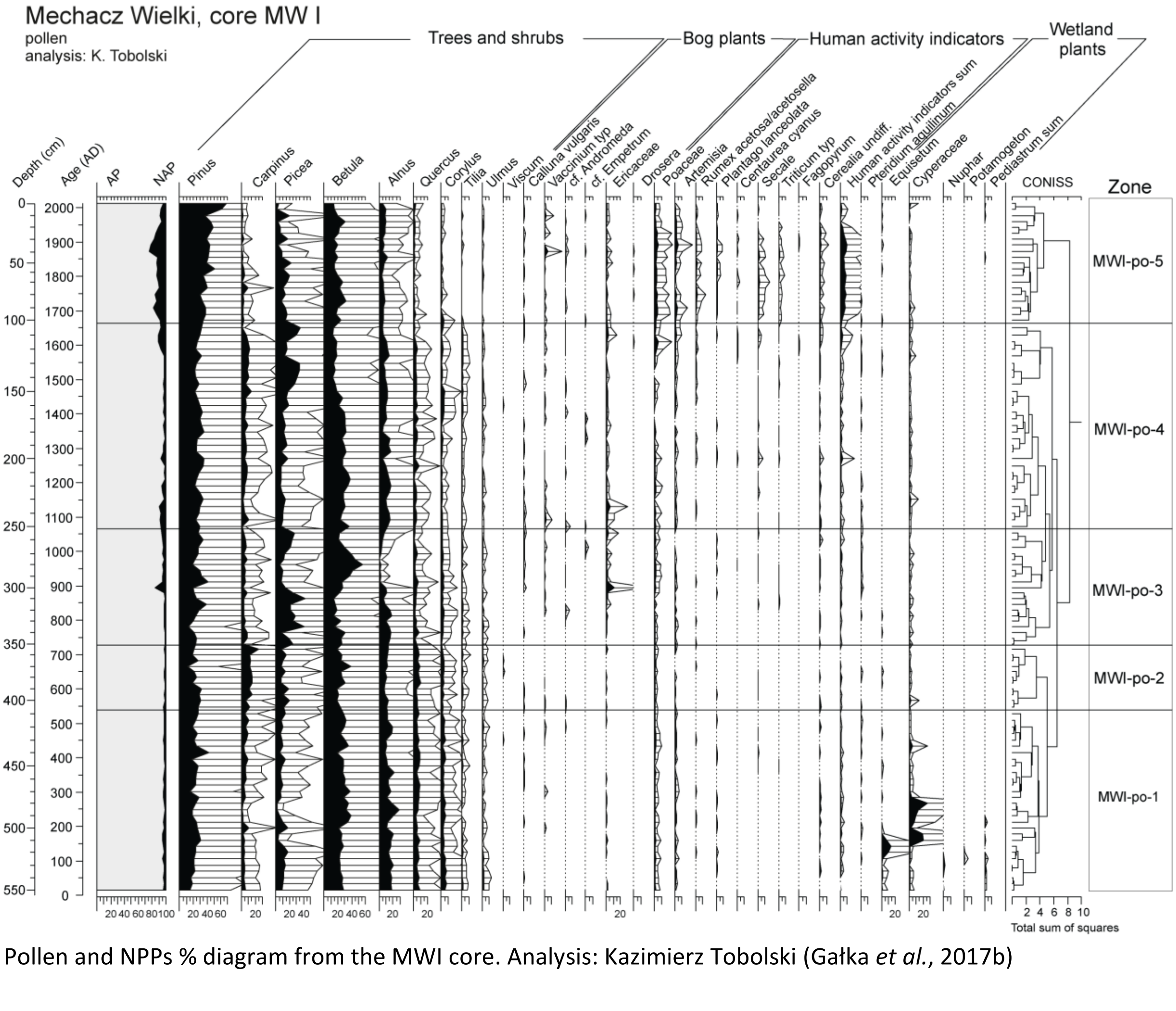
Two cores were sampled from Mechacz Wielki in August 2011 for **multi-proxy investigations**. Surprisingly, both 6-meter long peat core covered only the last 2000 years and peat accumulation rated were very high: 2.75 mm/year (Gałka *et al.*, 2017b). In both cores a partly synchronous changes in *Sphagnum* communities are observed, suggesting that extrinsic factors (climate) has driven Mechacz Wielki development. Moreover, strong correlation between testate amoeba traits (community-weighted mean) and pH suggest that other variables than water-table depth influenced microbial properties under stable hydrological conditions. Additional analyses of microscopic charcoal showed that fires were commonly occurring in the region during the last 2000 years with a distinct rise in charcoal influx in the 1st part of the 20th century (Marcisz *et al.*, 2017).

Palaeoecological investigation of *Sphagnum obtusum* showed that this species was occurring in a moderately wet habitat (mean depth to the water table or DWT=9.5 cm, SD=0.5) and under slightly acid conditions (mean pH=5, SD=.1) and its disappearance is assumed to have been caused by a trophic shift and succession of a more acidophilic species: *Sphagnum angustifolium* (Gałka *et al.*, 2013).

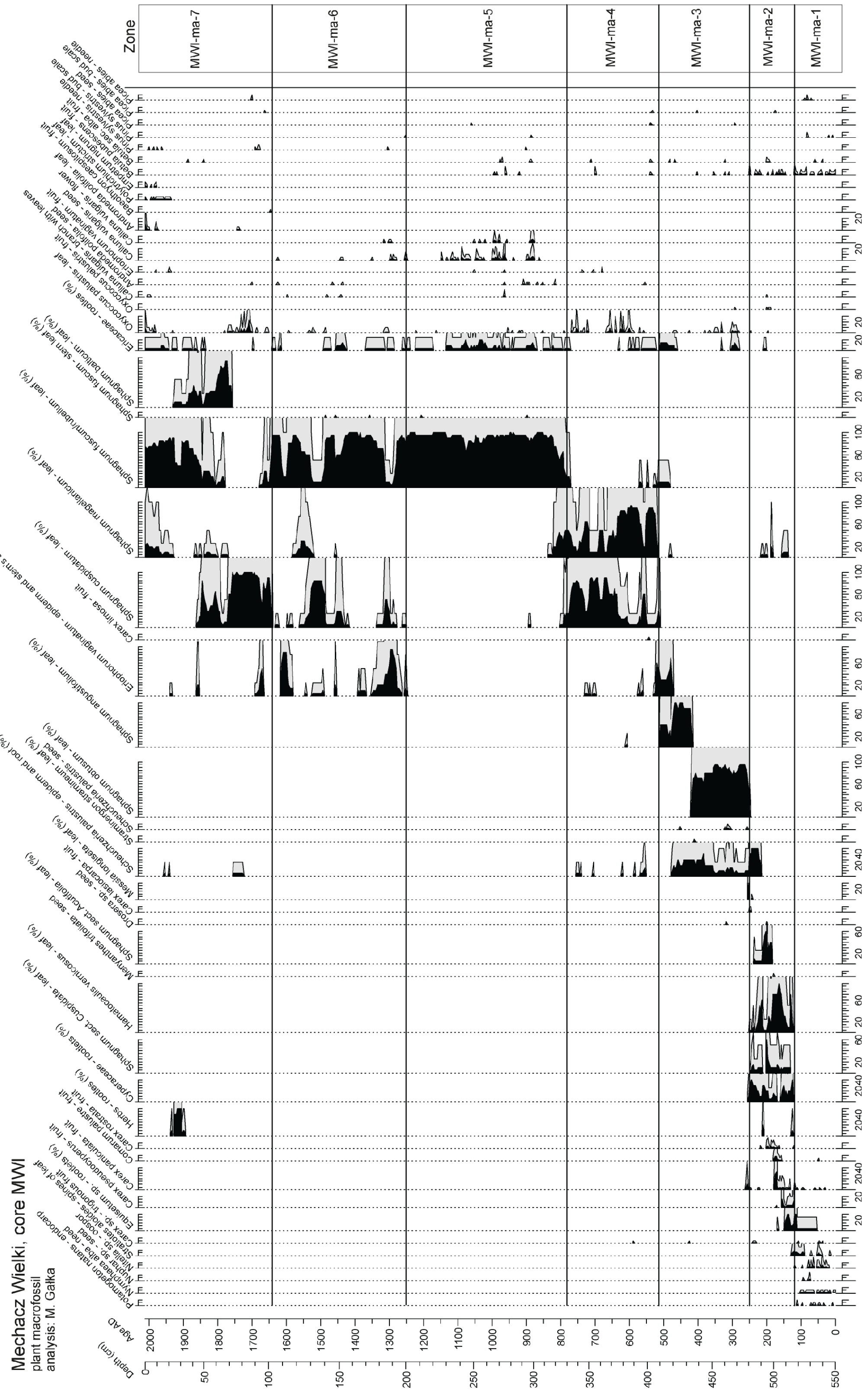
Currently, another project is being realised on the Mechacz Wielki, Gązwa and Bagno Kusowo peatlands, focusing on the **non-pollen palynomorphs record** (based on the archived cores) and surface samples (sampling in August 2015) (PI: Monika Karpińska-Kołaczek).



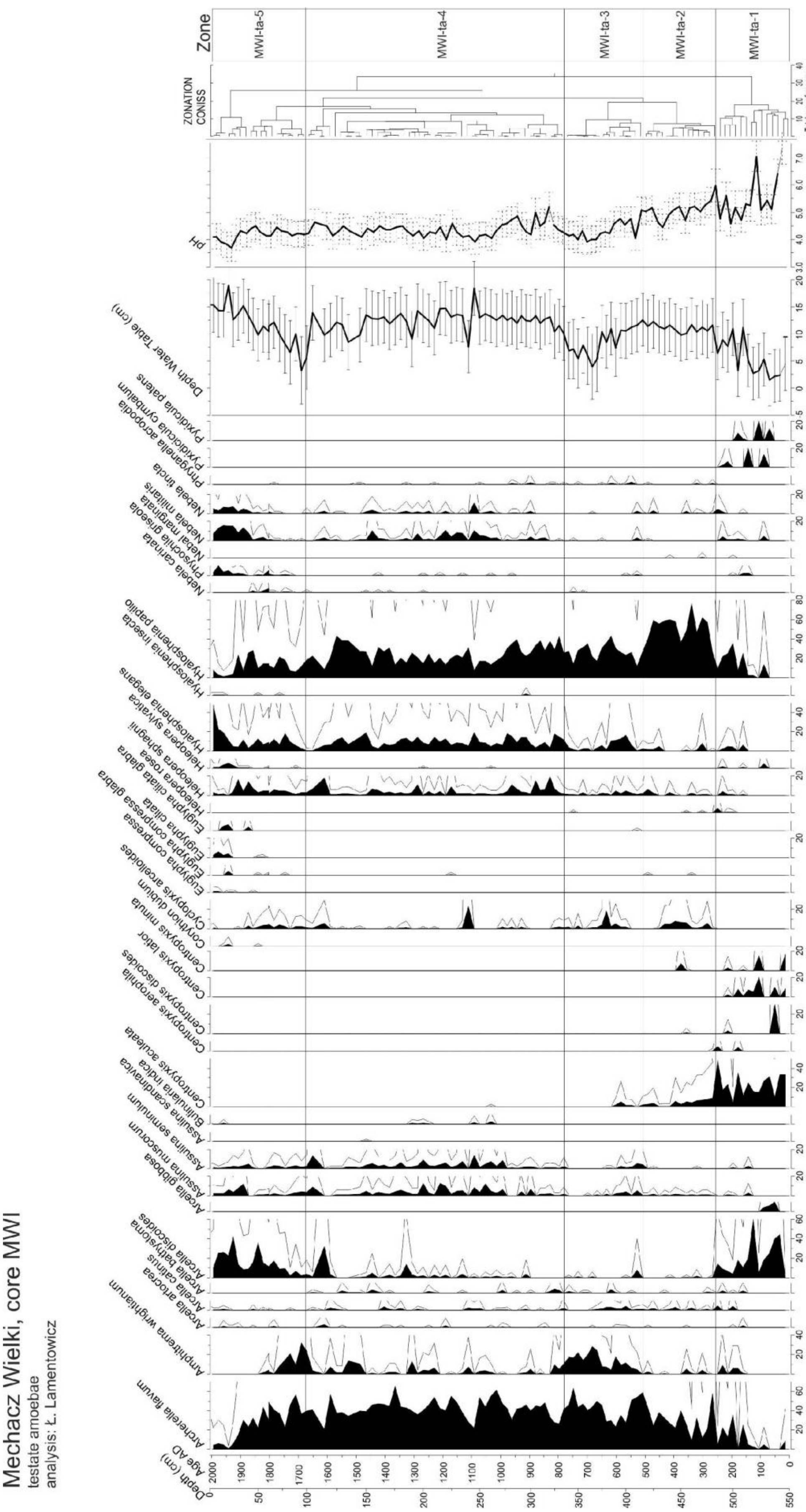
Age-depth models of (A) MWI and (B) MWII peat cores (Gałka *et al.*, 2017b)



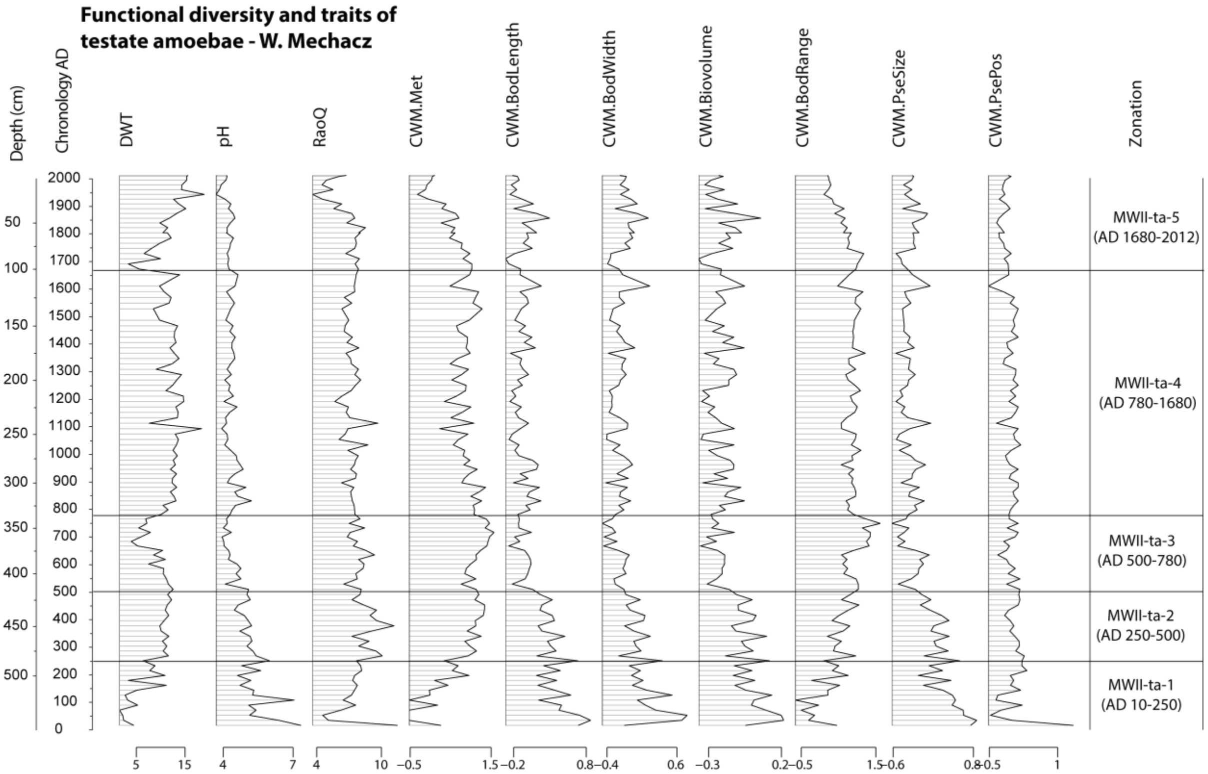
Pollen and NPPs % diagram from the MWI core. Analysis: Kazimierz Tobolski (Gałka *et al.*, 2017b)



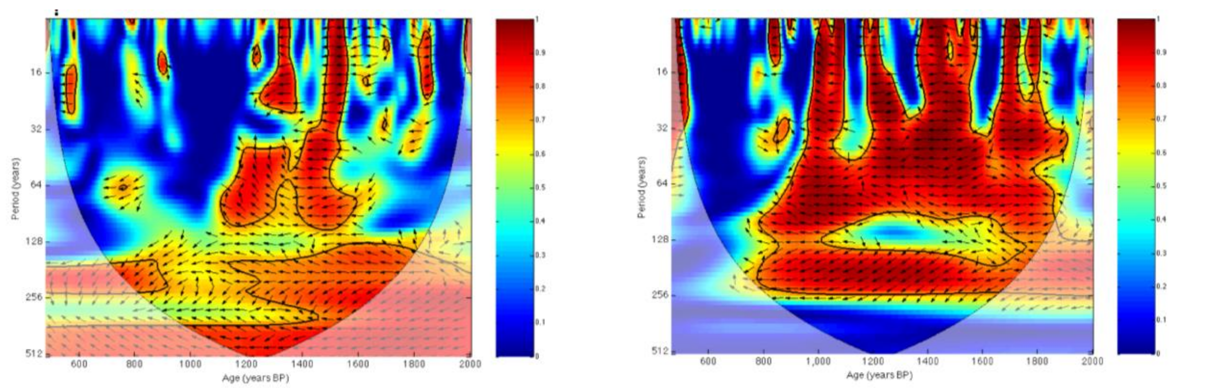
Plant macrofossils diagram from the MWI core. Analysis: Mariusz Gałka (Gałka *et al.*, 2017b)



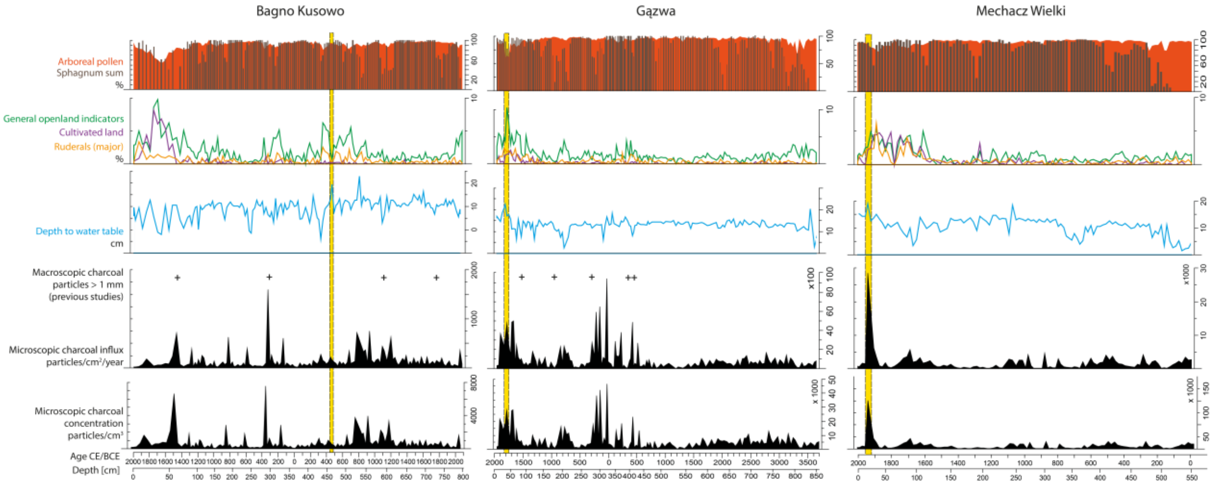
Testate amoebae % diagram Analysis: Mariusz Lamentowicz (Gałka *et al.*, 2017b)



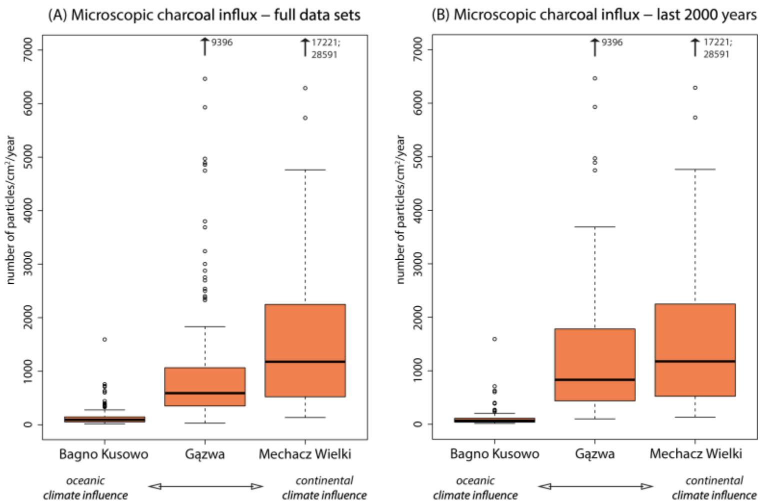
Functional diversity and traits of testate amoebae. Analysis: Mariusz Lamentowicz (Gałka *et al.*, 2017b)



Wavelength analysis - squared wavelet coherence between *Sphagnum fuscum/rubellum* and *Sphagnum cuspidatum* in (A) core WMI and (B) core WMII. The phase between the two time series in each core is shown by arrows (with in-phase relationship represented by arrows pointing to the right, anti-phase pointing to the left and *S. fuscum* leading *S. cuspidatum* by 90° pointing down). The statistical significance of wavelet coherence was estimated using Monte Carlo methods and the thick black contour line in each panel indicates the 5% significance level against red noise. The coherence strength is indicated by the colour scale with warm colours showing high coherency and cool colours highlighting periods of low coherence. The lighter shade represents the cone of influence below which the analysis could be distorted due to edge effects. Analysis: Vasile Ersek (Gałka *et al.*, 2017b)



Summary results for three studied sites: microscopic charcoal concentrations and influx (black), testate amoebae-based depth to water table (DWT) reconstruction (blue), pollen types pointing to anthropogenic presence (ruderals (major) in orange, cultivated land in violet), pollen open land indicators (green), arboreal pollen sum (red), and *Sphagnum* sum (brown). Macroscopic charcoal particles found during plant macrofossil analyses from Bagno Kusowo (Gałka *et al.*, 2014b; Lamentowicz *et al.*, 2015a) (Gałka et al., 2014a; Lamentowicz et al., 2015a) and Gązwa (Gałka & Lamentowicz, 2014; Gałka *et al.*, 2015b) are marked with "+". Charcoal influx (CHAR) peaks recorded during low water tables were marked in yellow. Charcoal analysis and data summary: Katarzyna Marcisz (Marcisz *et al.*, 2017)



Boxplots showing charcoal influx in three studied sites computed for (A) all studied samples in each peatland and (B) only for the samples covering the past 2000 years. Outliers are marked next to the arrow on the top of the boxplots. Analysis: Katarzyna Marcisz (Marcisz *et al.*, 2017)

Palaeoecology of *Sphagnum obtusum* in NE Poland

Mariusz Gałka[1,2], Łukasz Lamentowicz[3] and Mariusz Lamentowicz[2,4]

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Quaternary Science Reviews 156 (2017) 90–106

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Unveiling exceptional Baltic bog ecohydrology, autogenic succession and climate change during the last 2000 years in CE Europe using replicate cores, multi-proxy data and functional traits of testate amoebae

Mariusz Gałka [a, *], Kazimierz Tobolski [a], Łukasz Lamentowicz [b], Vasile Ersek [c], Vincent E.J. Jassey [d, e], Willem O. van der Knaap [f], Mariusz Lamentowicz [a, g]

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[e] École Polytechnique Fédérale de Lausanne (EPFL), School of Architecture, Civil and Environmental, Engineering (ENAC), Laboratory of Ecological Systems (ECOS), Station 2, CH-1015 Lausanne, Switzerland
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Quaternary Science Reviews 177 (2017) 145–157

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Fire activity and hydrological dynamics in the past 5700 years reconstructed from *Sphagnum* peatlands along the oceanic–continental climatic gradient in northern Poland

Katarzyna Marcisz [a, b, c, *], Mariusz Gałka [b], Patryk Pietrala [a], Grażyna Miotk-Szpiganowicz [d], Milena Obremska [e], Kazimierz Tobolski [b], Mariusz Lamentowicz [a, b]

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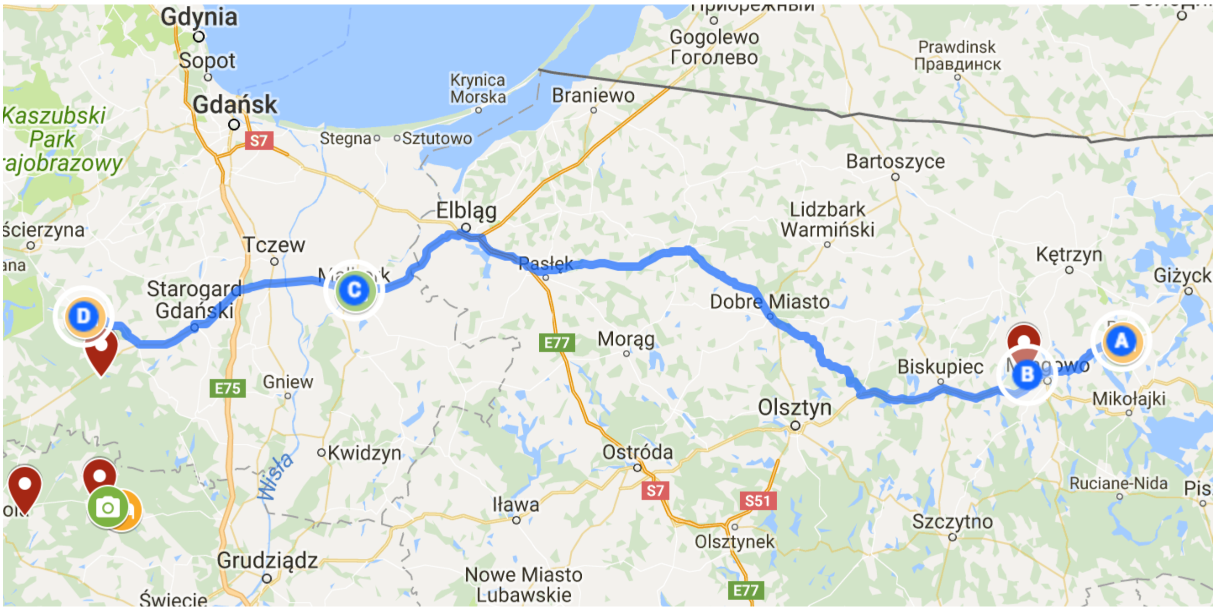
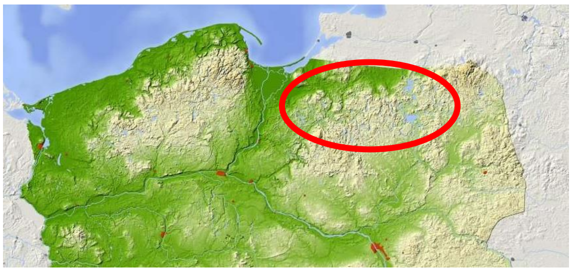
Day 3 – Monday, 3.09.2018
Masuria and Warmia regions

Gązwa raised bog, *Fagus sylvatica* range limit, The Castle of the Teutonic Order in Malbork

8:45 h	Departure
9:30 h	Gązwa raised bog – multi-proxy analyses of the bog development in the last 6200 years, age-depth modelling of peat sequences, calibration data set along hydrological and openness gradient (Mariusz Gałka, Mariusz Lamentowicz, Monika Karpińska-Kołaczek, Piotr Kołaczek, Katarzyna Kajukało)
11 h	Departure and lunch at the *Fagus sylvatica* range limit
15 h	The Castle of the Teutonic Order in Malbork
17 h	Departure to the hotel (Stara Kiszewa)
19 h	Dinner



MASURIA AND WARMIA REGIONS



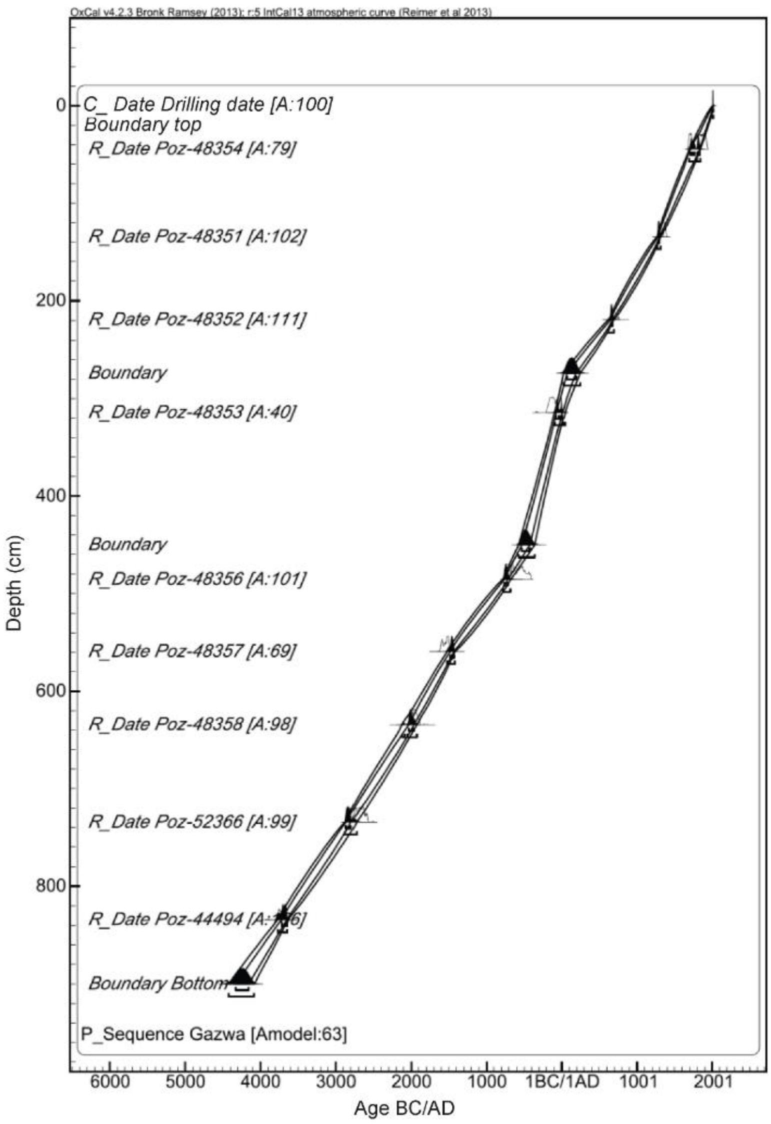
Masuria and Warmia regions (*Polish*: Mazury i Warmia) are two geographical and cultural regions that were belonging to historical region of Prussia. The history of this region is very complicated because the land was changing its affiliation between Poland, Prussia and the Teutonic Order. Masuria and Warmia region is a young glacial landscape with plenty of morainic hills (the highest is Dylewska Mountain, 312 m a.s.l.). This region has many lakes – big and small ones, including the biggest Polish lake: Lake Śniardwy (covering an area of 113.5 km^2). A central part of the Mazury region is regarded as the Masurian Lake District (*Polish*: Kraina Wielkich Jezior Mazurskich) that is a popular holiday destination for swimming and various water sports. The capital of this region is Olsztyn (total population: ca. 173,000).

Gązwa raised bog

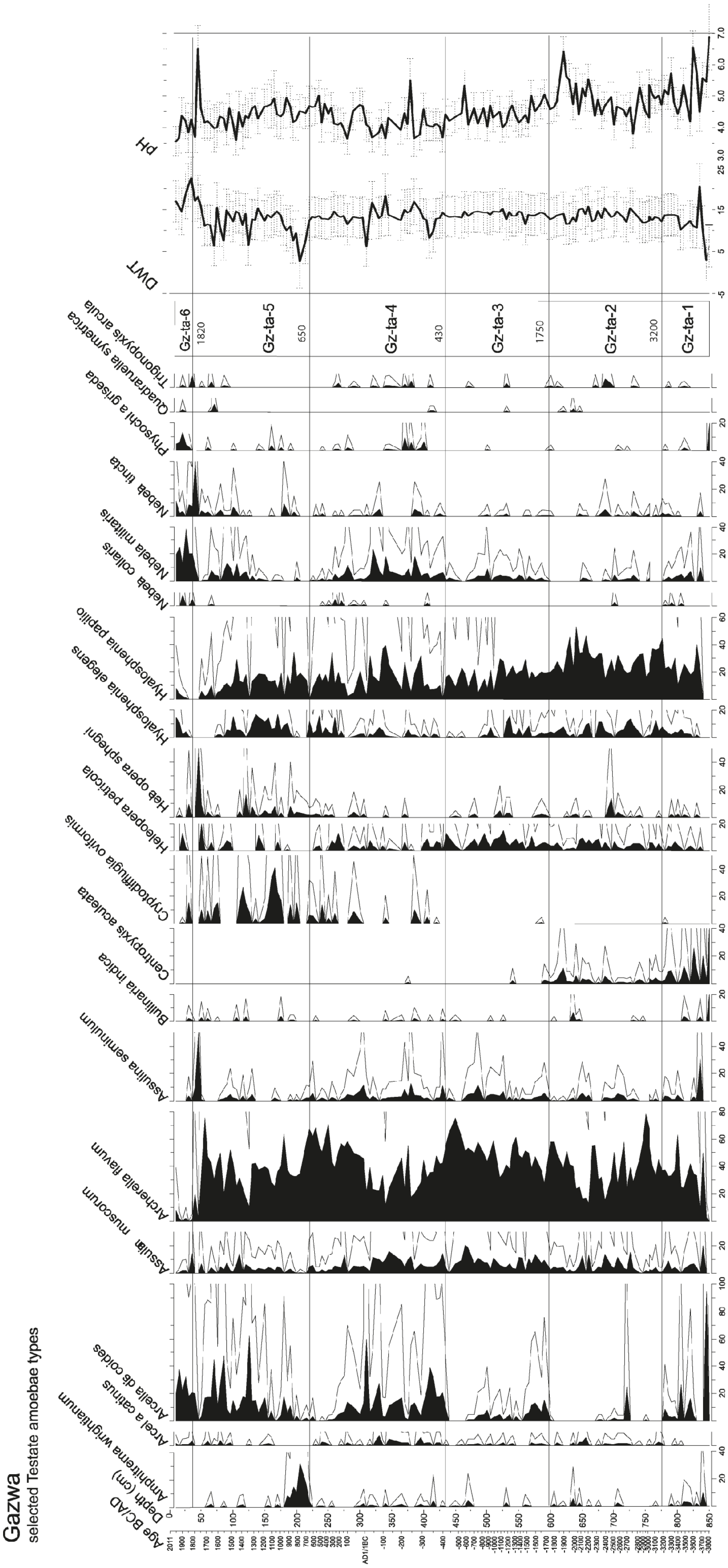
Gązwa bog covers an area of 204 ha and developed in a depression between the moraine hills. The mean annual temperature is 6.5°C (mean July: 17.5°C, mean January: -4.5°C), annual precipitation reaches 670 mm. The bog is protected by law as a nature reserve. Gązwa bog is located under the transitional climate, what is reflected in the tree ranges: *Picea abies* reaches its western limit, whereas *Fagus sylvatica* and *Acer pseudoplatanus* reach their eastern limits in Poland. The bog was drained in the early 20th century and is presently undergoing a natural restoration process.

A peat core (735 cm-long) have been sampled from the bog in August 2011. The sequence covers the last 6200 years (model based on nine ^{14}C dates). First study focused on the ***Sphagnum* succession and palaeoecology of *Sphagnum contortum*** (Gałka & Lamentowicz, 2014). *S. contortum* occurred during two periods, 3700–3300 BC and 2850–2000 BC, corresponding with its modern ecological requirements in the northern hemisphere. *S. contortum* occurred in the rich fen phase with *Carex lasiocarpa, Comarum palustre, Menyanthes trifoliata* and *Meesia triquetra*. Its disappearance is assumed to have been caused by a trophic shift and the succession of a more acidophilic species, *Sphagnum obtusum*. **The multi-proxy study** revealed that, except for terrestrialisation and the fen-to-bog transition phase, the development of the bog vegetation was mainly dependent on the climate until ca. AD 1700 (Gałka *et al.*, 2015b). Since ca. AD 1350 the impact of Teutonic settlement is apparent, and after ca. AD 1700 human impact largely intensified, what is also visible in the fire record (Marcisz *et al.*, 2017).

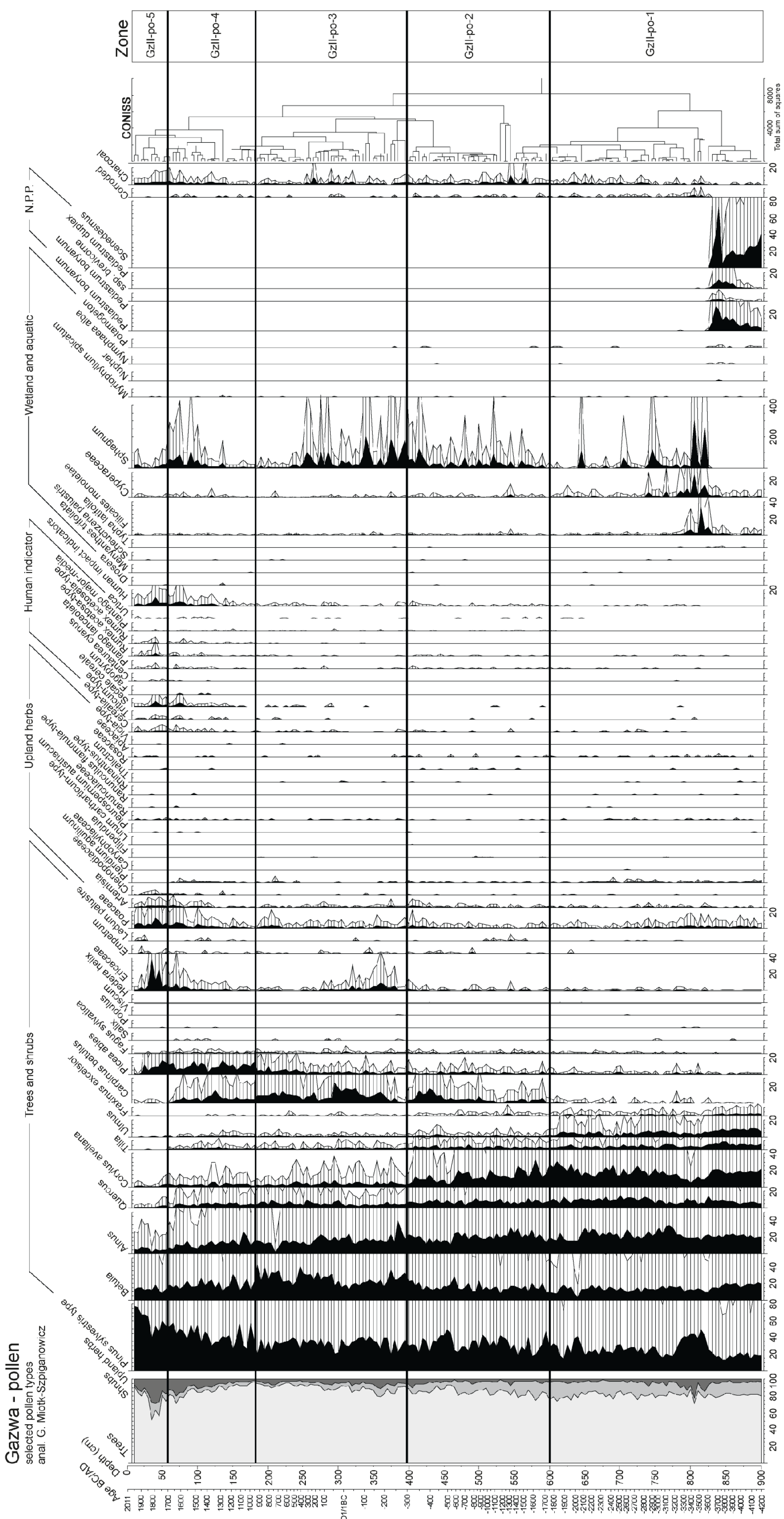
Currently, another project is being realised on the Gązwa, Mechacz Wielki and Bagno Kusowo peatlands, focusing on the **non-pollen palynomorphs record** (based on the archived cores) and surface samples (sampling in August 2015) (PI: Monika Karpińska-Kołaczek). Within the project, *Sphagnum* surface samples have also been sampled for the testate amoebae investigations.



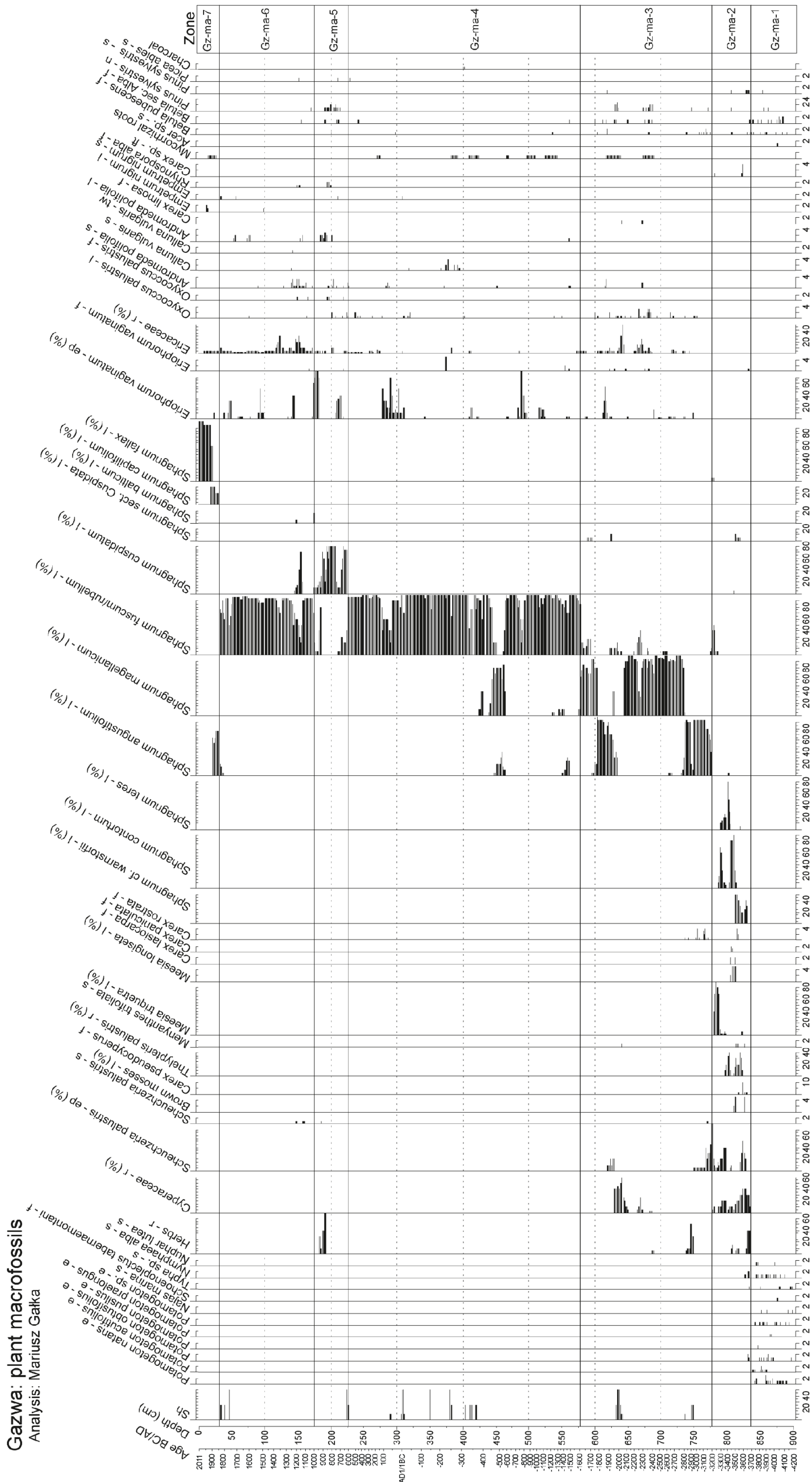
Age-depth model of the Gązwa core (Gałka *et al.*, 2015b)



Testate amoebae % diagram including reconstructions of water table depth and pH. Analysis: Miriam Marczewska, Mariusz Lamentowicz (Gałka *et al.*, 2015b)



Pollen % diagram from Gązwa bog. Analysis: Grażyna Miotk-Szpiganowicz (Gałka *et al.*, 2015b)



Plant macrofossils diagram from Gązwa bog. Analysis: Mariusz Gałka (Gałka *et al.*, 2015b)

Sphagnum succession in a Baltic bog in central-eastern Europe over the last 6200 years and paleoecology of *Sphagnum contortum*

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Research paper

The Holocene
2015, Vol. 25(3) 421–434

DOI: 10.1177/0959683614561887
hol.sagepub.com
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Palaeoenvironmental changes in Central Europe (NE Poland) during the last 6200 years reconstructed from a high-resolution multi-proxy peat archive

Mariusz Gałka,[1] Grażyna Miotk-Szpiganowicz,[2] Miriam Marczewska,[1] Jan Barabach,[1] Willem O van der Knaap[3] and Mariusz Lamentowicz[1,4]

Quaternary Science Reviews 177 (2017) 145–157

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

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Fire activity and hydrological dynamics in the past 5700 years reconstructed from *Sphagnum* peatlands along the oceanic–continental climatic gradient in northern Poland

Katarzyna Marcisz [a, b, c, *], Mariusz Gałka [b], Patryk Pietrala [a], Grażyna Miotk-Szpiganowicz [d], Milena Obremska [e], Kazimierz Tobolski [b], Mariusz Lamentowicz [a, b]

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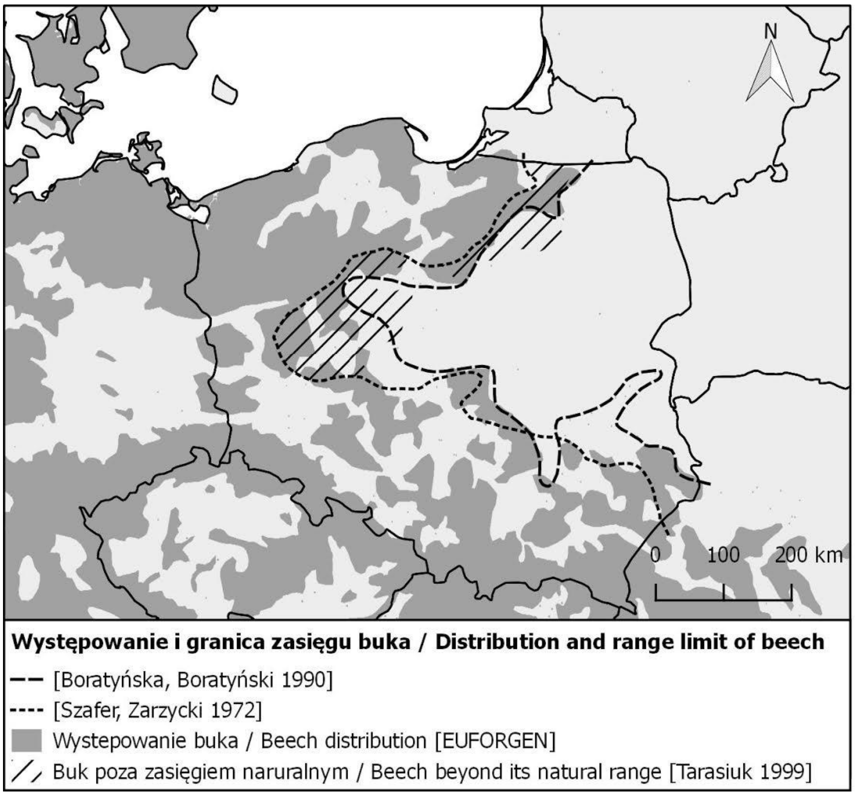
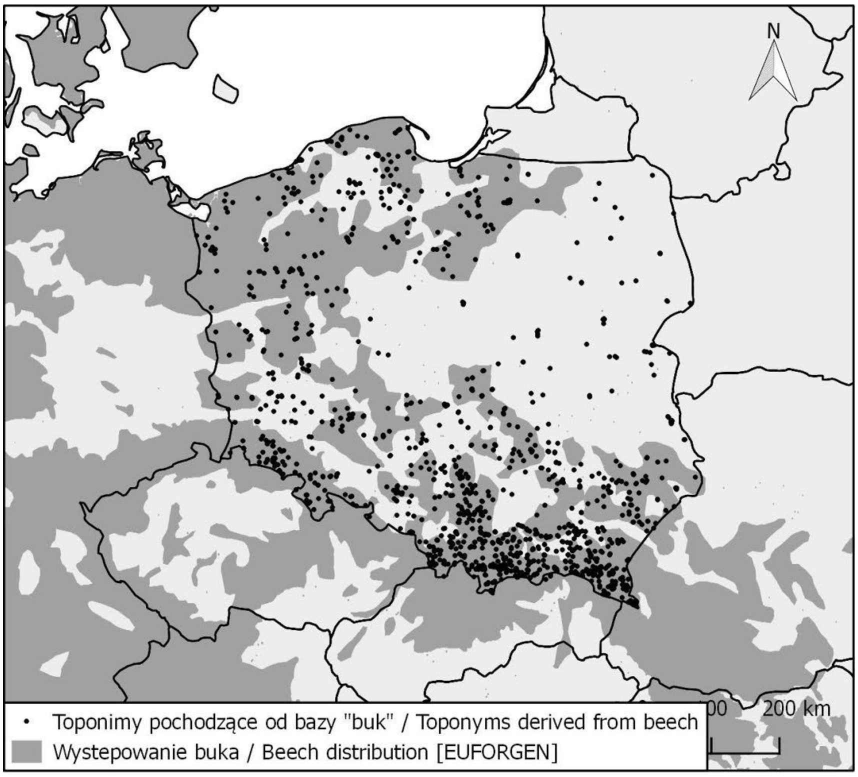
Fagus sylvatica range limit





Distribution and range limit of beech and typonyms derived from the name “beech”. Analysis: Jan Barabach (Barabach, in press)

The Castle of the Teutonic Order in Malbork

The Castle of the Teutonic Order in Malbork (*Polish*: zamek krzyżacki w Malborku; *German*: Ordensburg Marienburg) was built in the 13th century in Prussia. Currently, it is located in the town of Malbork in northern Poland. It is the largest castle in the world measured by land area.

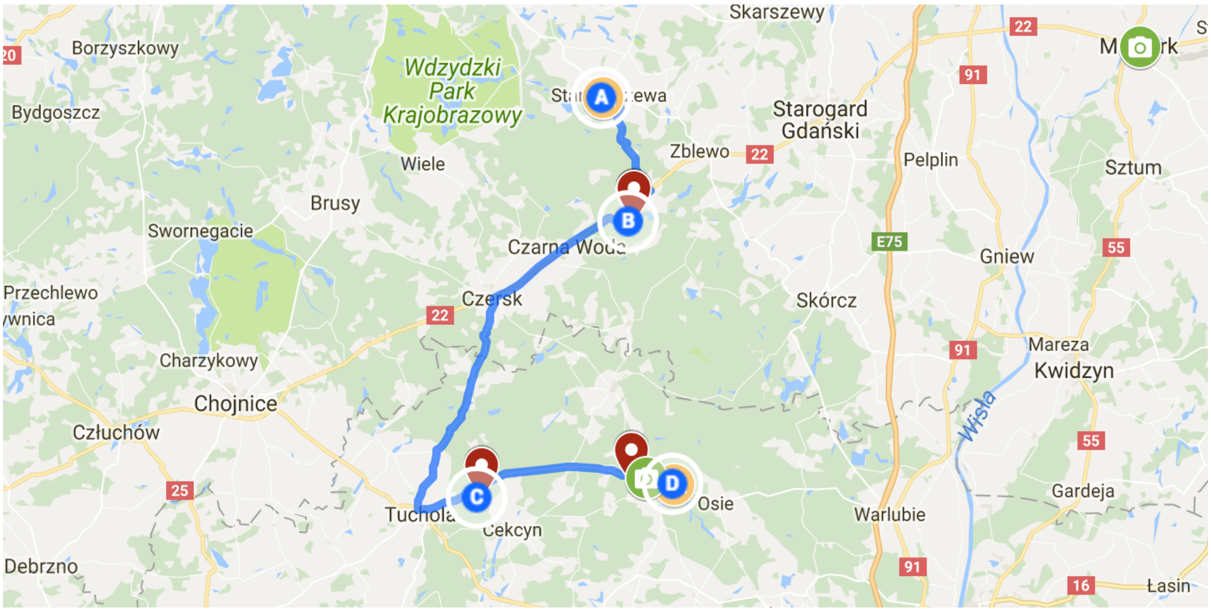
The castle is a classic example of a medieval fortress. On its completion in 1406 it was the world's largest brick castle. Since September 1994 Malbork Castle is one of Poland's official national Historic Monuments (Pomnik historii). In December 1997, UNESCO designated the "Castle of the Teutonic Order in Malbork" and the Malbork Castle Museum a World Heritage Site (ID: 847).


Source: https://pl.wikipedia.org/wiki/Zamek_w_Malborku

Day 4 – Tuesday, 4.09.2018
Kaszuby and Kociewie regions and Tuchola Pinewoods

Głęboczek peatland and laminated lake, Trzechowskie paleolake, Stążki peatland complex and Jelenia Wyspa nature trail

8 h	Departure
8:30 h	Laminated lakes Głęboczek, Czechowskie and Jelonek – high resolution study covering last 140 years; Trzechowskie palaeolake – late Allerød-early Younger Dryas climatic change and tephrostratigraphy (Michał Słowiński) Głęboczek peatland – environmental change in the last 5700 years (Katarzyna Kajukało, Katarzyna Marcisz, Mariusz Lamentowicz)
12:30 h	Lunch
13:45 h	Stążki peatland complex and Jelenia Wyspa nature trail (Mariusz Lamentowicz, Mariusz Gałka)
16 h	Departure to the hotel (Tleń)
17:30 h	Visit in a local brewery and dinner



KASZUBY AND KOCIEWIE REGIONS AND TUCHOLA PINEWOODS

The Tuchola Pinewoods/Tuchola Forest (*Polish*: Bory Tucholskie; *German*: Tuchler/Tucheler Heide) is the largest forest complex in Poland formed on a flat and sandy outwash plains (sandur) surrounded by the morainic islands and plateaus. Two main rivers are Wda and Brda. Relatively young *Pinus sylvestris* monoculture (plantations having origin in Prussian forestry in the 2nd half of the 18th century) are covering the landscape where peatlands and lakes shine like diamonds in the green shade of coniferous forests. There are deep ribbon lakes (reaching 68 m) located in glacial channels and numerous kettle mires and lakes that were formed from the melting dead ice – now with evidence of the basal peat in the bottom of the lake sediments. Now some of them are closed by the *Sphagnum* carpets and filled with the peat, but some consist characteristic floating islands that travel on the surface of oligotrophic or dystrophic lakes. Many of the kettle holes possess a floating *Sphagnum* mat ring that is gradually encroaching the surface of the water. The forest is protected within the Tuchola Forest National Park and the UNESCO Tuchola Forest Biosphere Reserve (designated in 2010).

The Kaszuby and Kociewie regions are cultural areas or an ethno-cultural regions in the northern part of the Tuchola Pinewoods – Kociewie is located in the north-eastern part (light green on the map), Kaszuby in the north-western part (dark green on the map). Both regions possess their own local language ("język kaszubski" & "gwara kociewska") and a special culture that we will get to know when visiting this region.

Source: pl.kaszubia.com

Głęboczek peatland

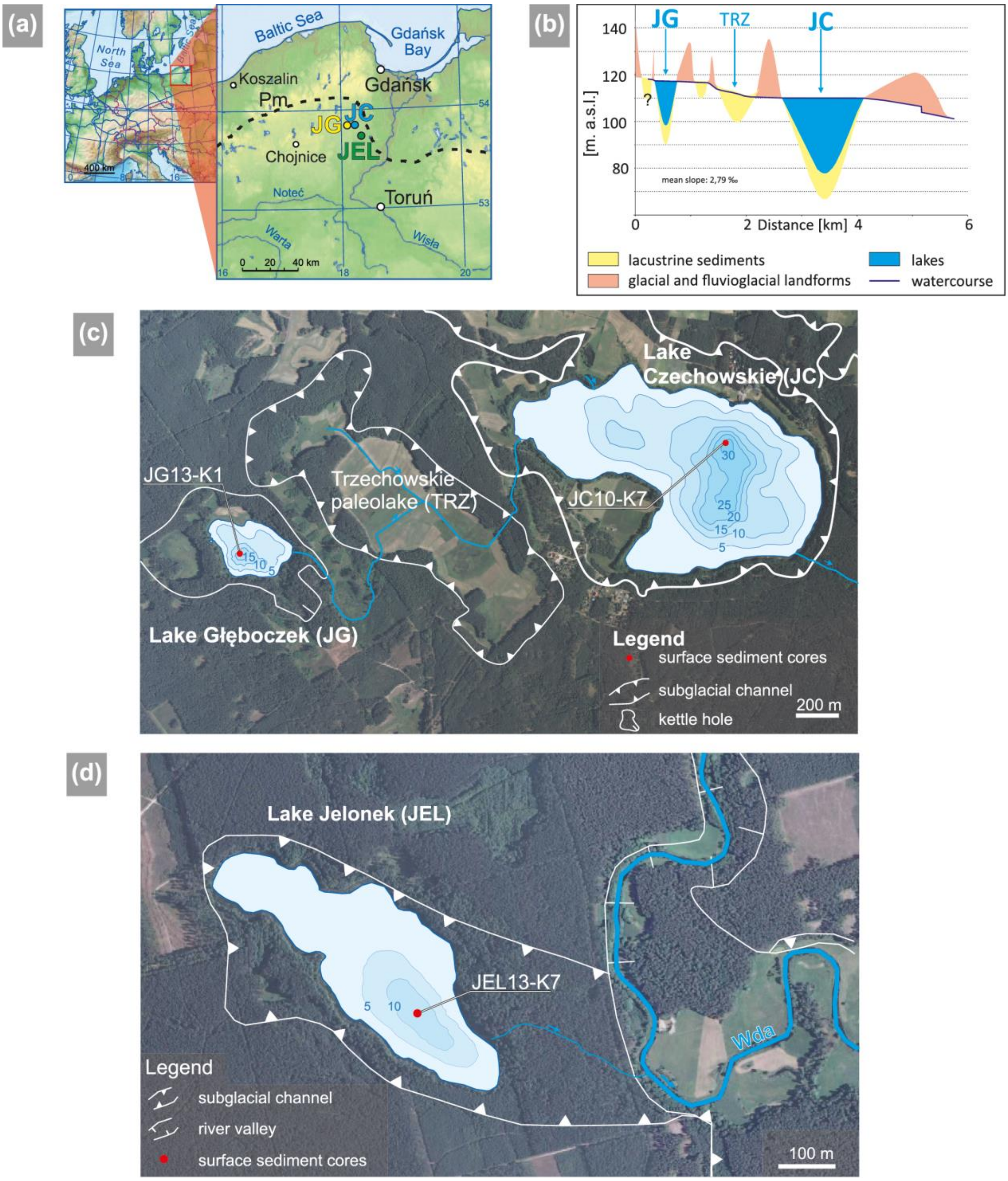
Głęboczek is a very small (less than 1 ha) kettle hole adjacent to the Głęboczek lake that possesses laminated sediments and in the vicinity of Trzechowskie Palaeolake, close to the Pomeranian ice margin dated between 17,000 and 16,000 cal. BP. The sediments are composed of glacial till and outwash plain deposits. Lake basins formed after the melting of dead ice blocks in subglacial channels or in a kettle hole. Climatic conditions in this area are characterized by a warm summer continental climate. Monthly temperatures range from −2.5°C in January to 17°C in July. Total annual precipitation reaches 590 mm with distinct summer maxima (82 mm in July and 70 mm in August).

The ongoing project realized at the Głęboczek peatland aims to reconstruct the development of the mire focusing on vegetation changes, drought detection and fire activity. Together with the investigations of Jaczno mire (that we visited on day 2, 02.09.2018) and Pawski Ług peatland (located in W Poland) we want to see if oceanic-continental climatic gradient observed in Poland had an influence on peatlands development, hydrology and forest flammability. A 4-meter peat core have been sampled from Głęboczek peatland in March 2016. The sequence covers the last 6000 years of peatland development. The investigations of the sediments are on-going, therefore, we present only preliminary results.

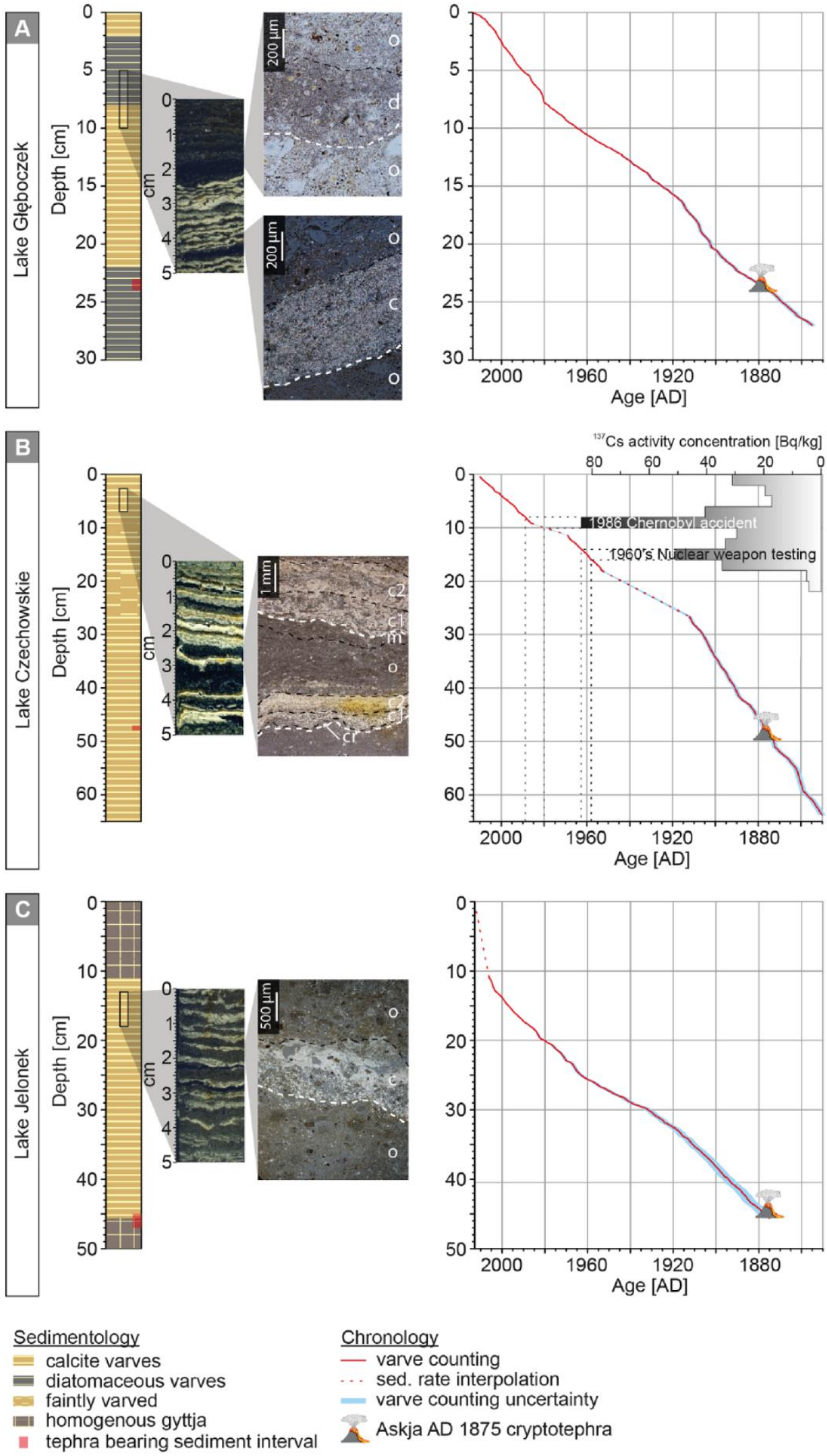
We generated multi-proxy material including: testate amoebae, plant macrofossils, pollen, NPPs, bulk density, micro- and macrocharcoal, and geochemistry including XRF and neodyme. First results reveal a very unstable history of development of this site that shifted between different alternative stable states from a fen to inundated wetland and then to a *Sphagnum* mire. Huge numbers of macro- and micro-charcoal suggest that the surrounding forest was burning frequently, what was connected with climatic change and presence of the settlement of different cultures. The age-depth model will be also compared to the existing varve chronology that expected to support the age-depth modelling with additional precision.

Laminated lakes Głęboczek, Czechowskie and Jelonek

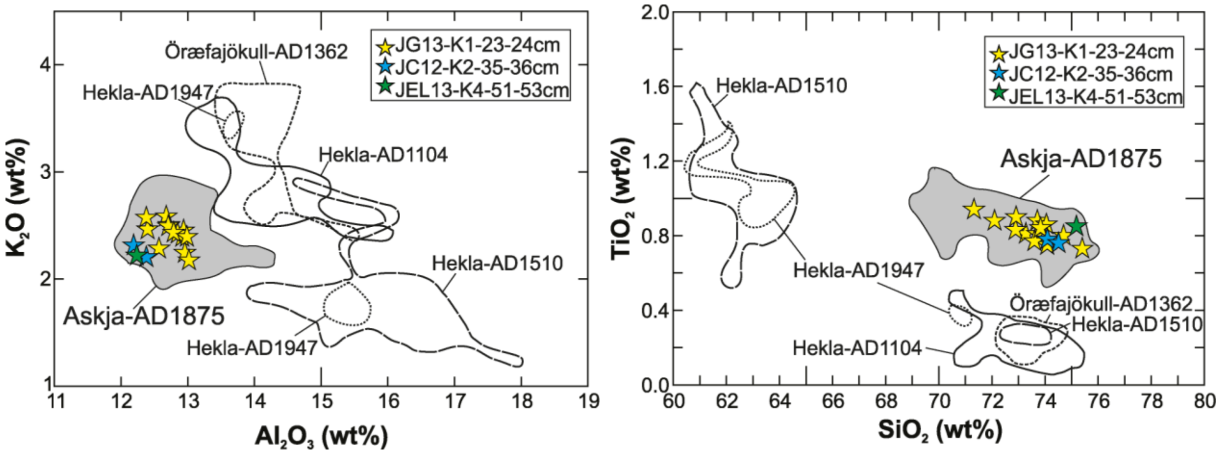
The aim of the study was to compare the varved sediment records from **three lakes: Głęboczek, Czechowskie and Jelonek** (Ott *et al.*, 2017). The analyses covered last 140 years focusing on micro-facies analyses and µ-XRF element scanning at seasonal resolution, as well as bulk elemental analyses (organic matter, carbonate) at sub-decadal to decadal resolution.



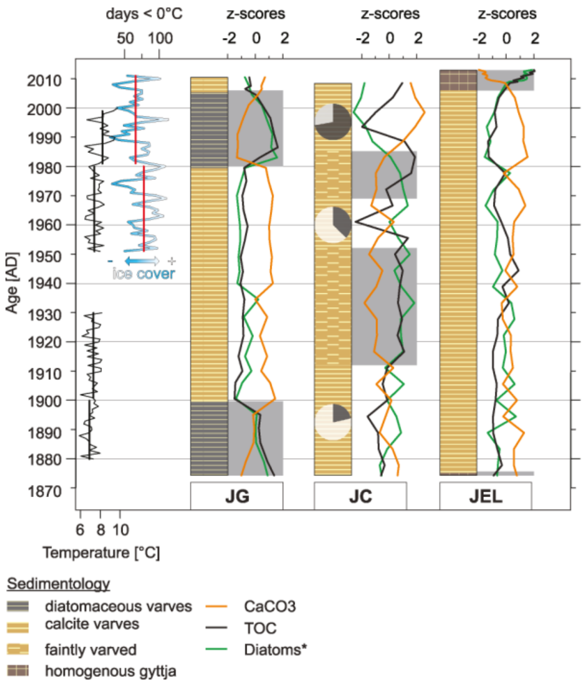
Overview about study sites. (a) Map of Europe and north-central Poland. The investigated lakes are marked by JG (Lake Głęboczek), JC (Lake Czechowskie) and JEL (Lake Jelonek). (b) Cross section through the lake-palaeolake cascade system with JG, palaeolake Trzechowskie and JC. Total height difference between JG and JC is 10 m. (c and d) (Ott *et al.*, 2017)

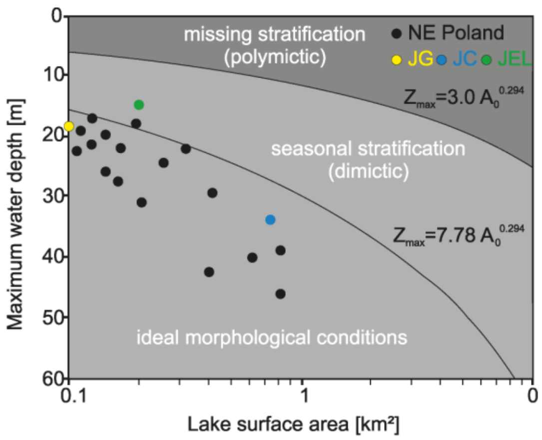


Lithology and age models for Lake Głęboczek (top), Lake Czechowskie (middle) and Lake Jelonek (bottom). Thin section scans and microphotographs display typical varve micro-facies for each lake (c/c1/c2 = calcite sublayer, cr = chrysophyte cysts sublayer, d = diatom sublayer, m = mixed sublayer and o = organic sublayer). Each sediment record was independently dated by a combination of varve counting (red line) and tephrochronology (Askja AD 1875 tephra). JC has been additionally dated by 137Cs activity concentration measurements. Varve counting uncertainty estimates are derived by multiple counting by two different investigators (Ott *et al.*, 2017)



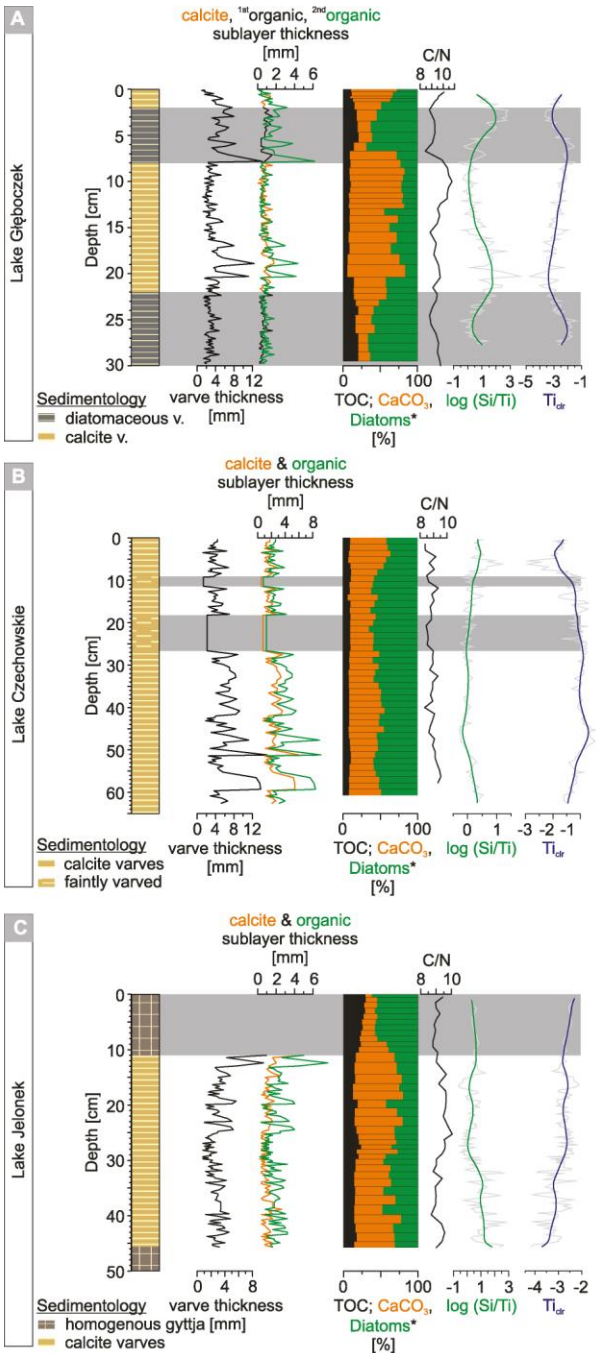
Geochemical biplots of normalized (volatile-free) single glass data of the Askja AD 1875 tephra in Lake Głęboczek (yellow star), Lake Czechowskie (blue star) and Lake Jelonek (green star) (Ott *et al.*, 2017)





Proxy data compilation for the last 140 years. Temperature data display annual mean temperature from the Koszalin station. The number of frost days is based on temperature data from Chojnice. TOC, CaCO3 and residuals are displayed as normalized z-scores (Ott *et al.*, 2017)

Biplot showing the relation between maximum water depth and lake surface area to lake stratification and the occurrence of varved lake sediments (using the equations by Larsen and MacDonald, 1993; modified after Tylmann et al., 2013). The dots indicate varved lake sediments in north-eastern Poland (black; Tylmann *et al.* (2013)), north-central Poland with Lake Głęboczek (JG, dark blue), Lake Czechowskie (JC, blue) and Lake Jelonek (JEL, green) (all this study) (Ott *et al.*, 2017)



Micro-facies (varve and sublayer thicknesses), bulk geochemical (TOC, CaCO3, diatom contents and C/N ratio) and µ-XRF element data (log(Si/Ti) and Ticlr date displayed as annual and 30-year running mean) for the three lakes. Grey bars indicate sedimentological changes (Ott *et al.*, 2017)

Research paper

Site-specific sediment responses to climate change during the last 140 years in three varved lakes in Northern Poland

The Holocene
1–14
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DOI: 10.1177/0959683617729448
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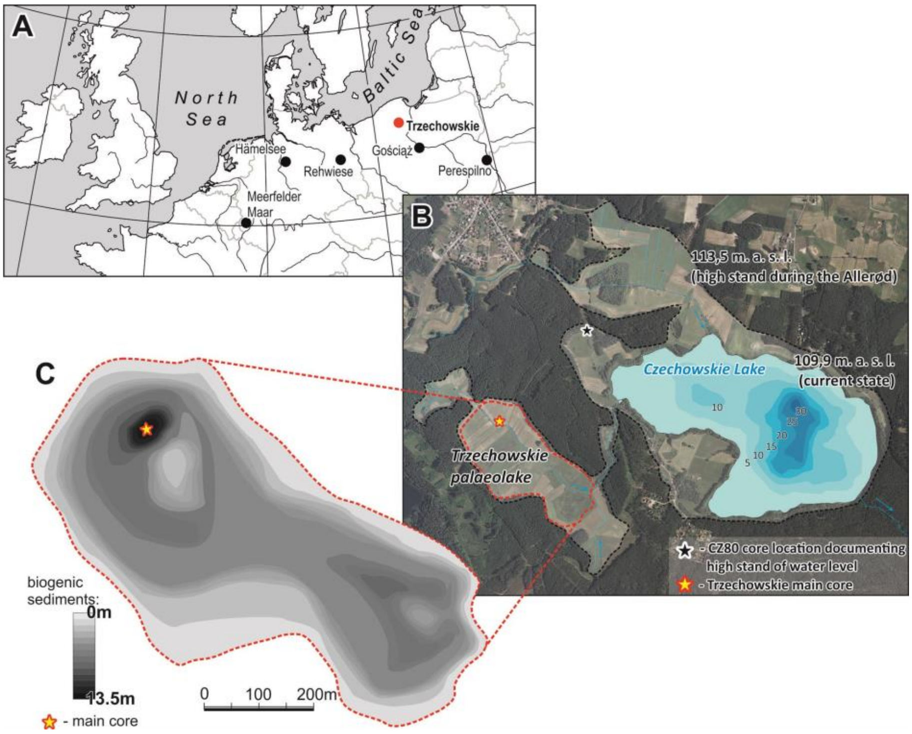
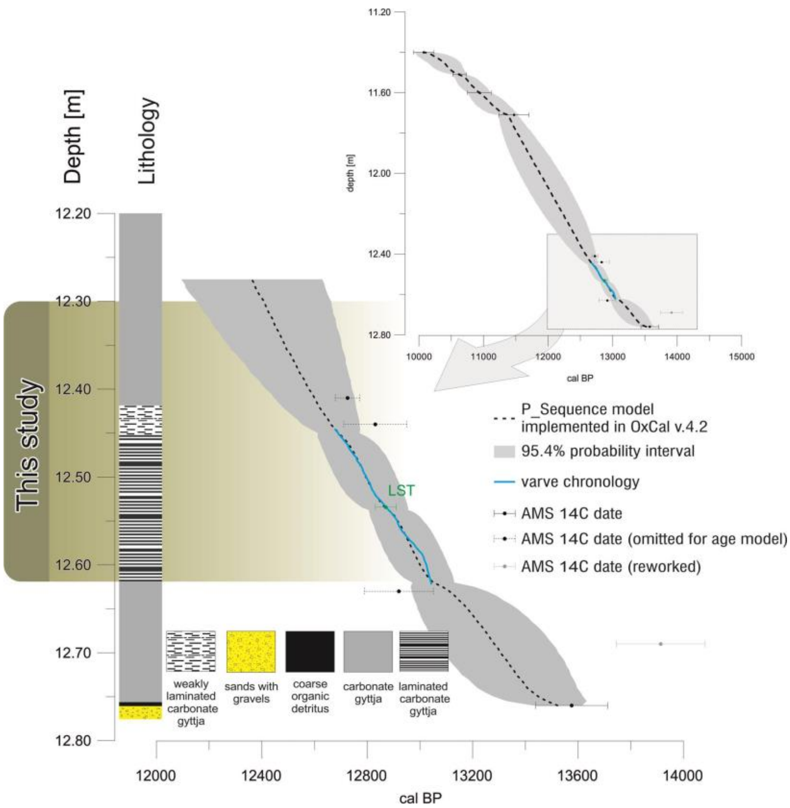
Trzechowskie paleolake

Trzechowskie paleolake (53°52’22’’N, 18°12’58’’E; reconstructed surface area: 19.7 km^2) is located within the catchment of the nearby modern Lake Czechowskie, which formed together one larger lake during the Late Glacial. The lake is situated in the outwash plain of the Wda River, which developed during the Pomeranian phase of the Vistulian glaciation. The formation of the TRZ depression was associated with the melting of a buried ice block (Słowiński *et al.*, 2015).

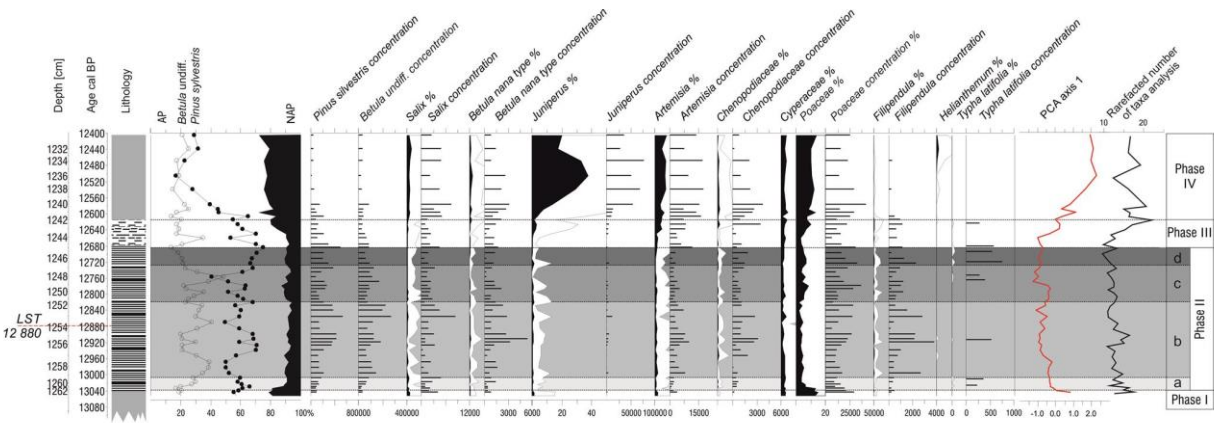
High-resolution biological proxies, geochemical data and a robust chronology were applied to **reconstruct lake system responses to rapid climatic and environmental changes of the Trzechowskie palaeolake during the late Allerød - Younger Dryas (YD) transition** at 5-15 years temporal resolution (Słowiński *et al.*, 2017). Our results indicate (1) a water level decrease and an increase in wind activities during the late Allerød and the Allerød-YD transition, which caused intensified erosion in the catchment, (2) a two decades delayed vegetation response in comparison to the lake depositional system. Comparison with the Lake Meerfelder Maar record revealed slightly different vegetation responses of the Trzechowskie palaeolake at the YD onset.



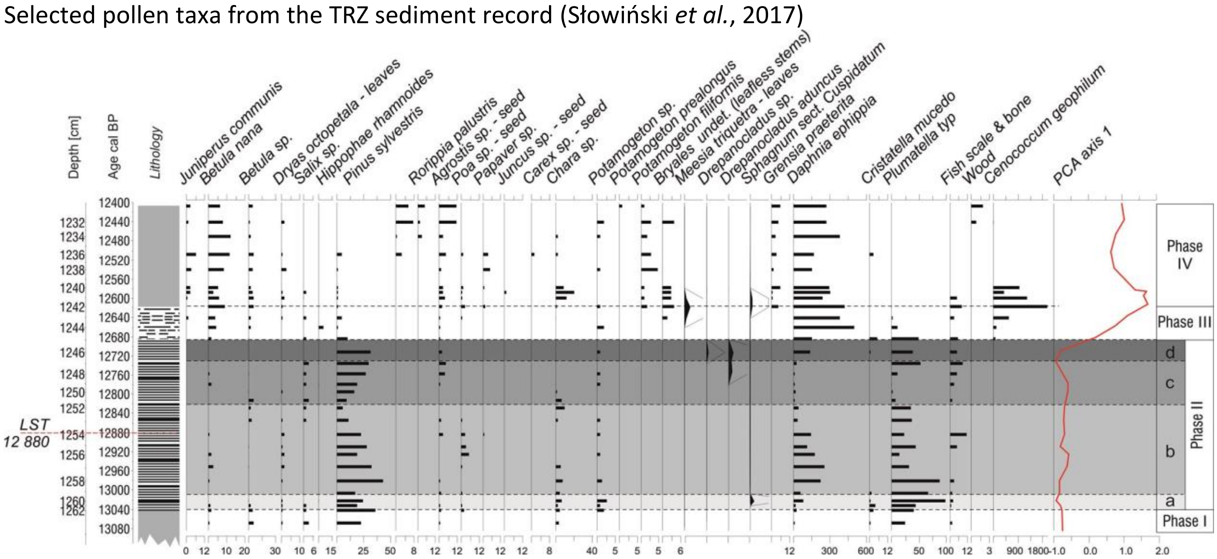
Location of the Trzechowskie palaeolake (Słowiński *et al.*, 2017)



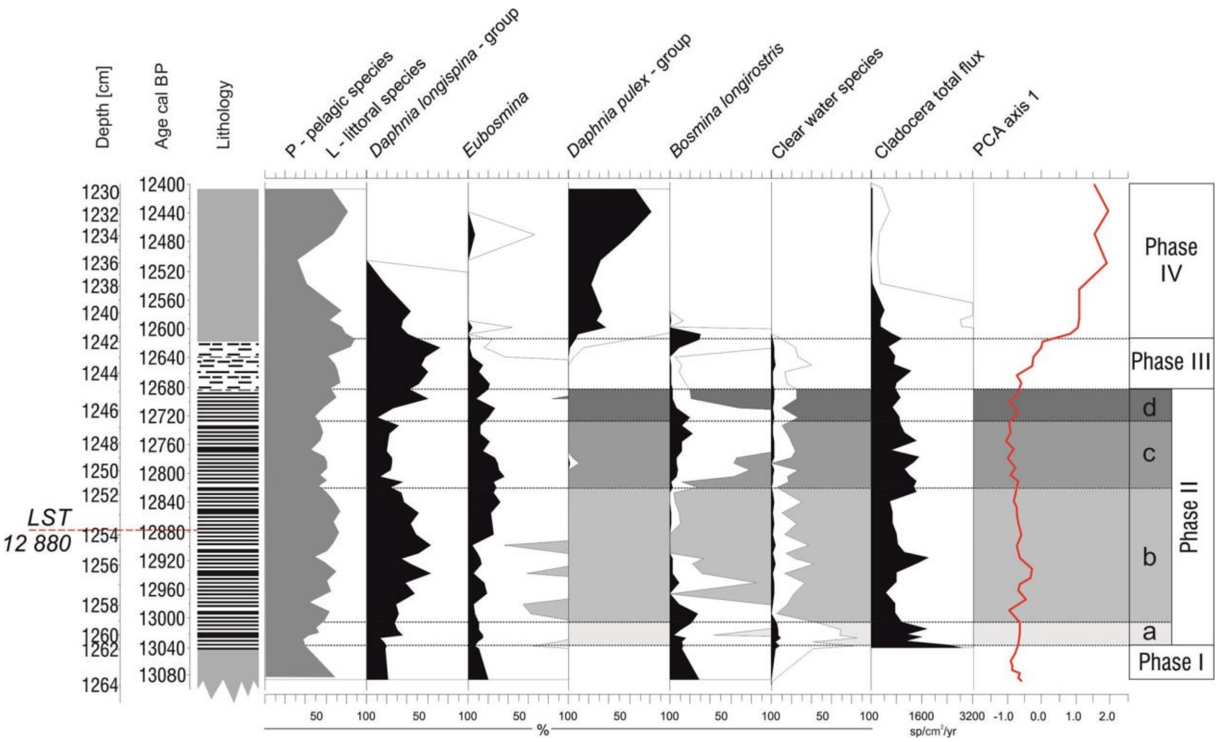
Age-depth model of the TRZ Late Glacial sediment record (Słowiński *et al.*, 2017)



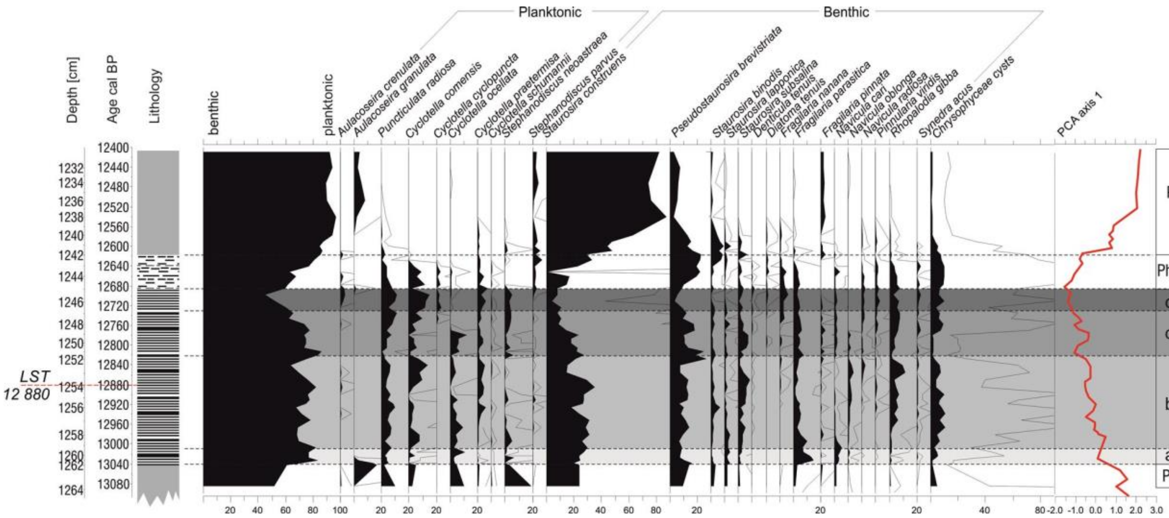
Selected pollen taxa from the TRZ sediment record (Słowiński *et al.*, 2017)



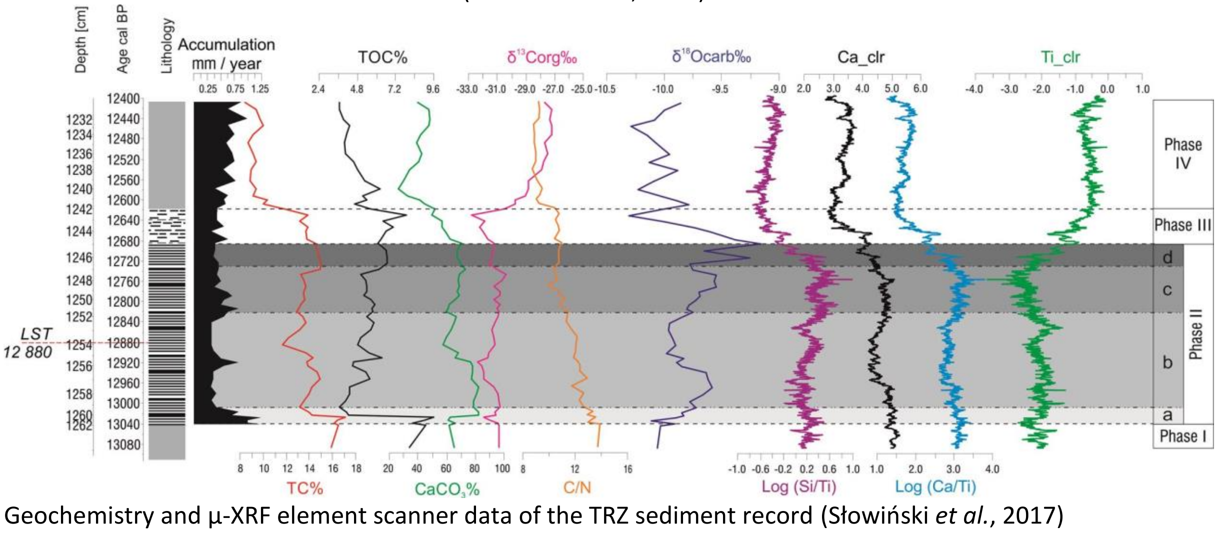
Macrofossils diagram showing the most abundant taxa (concentrations in 50 ml sediment) (Słowiński *et al.*, 2017)



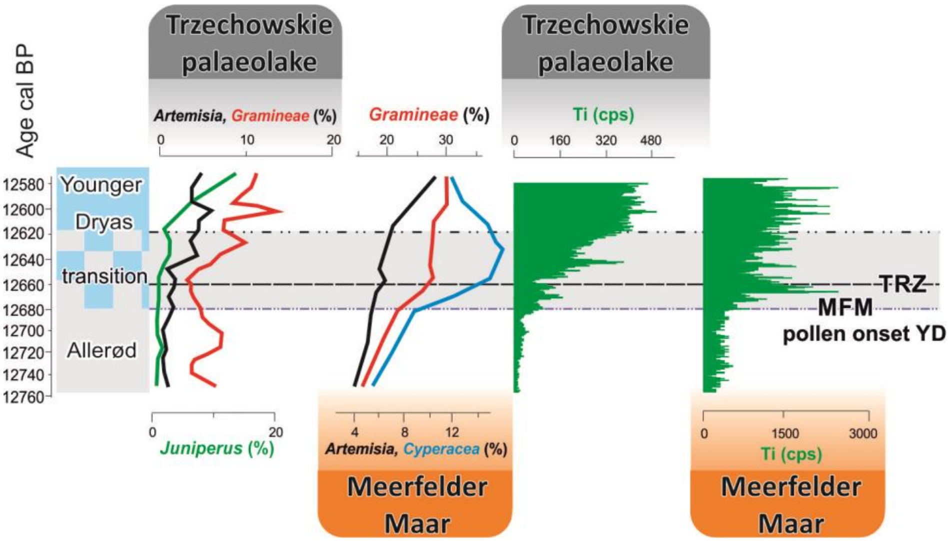
Selected subfossil Cladocera taxa from the TRZ sediment record (Słowiński *et al.*, 2017)



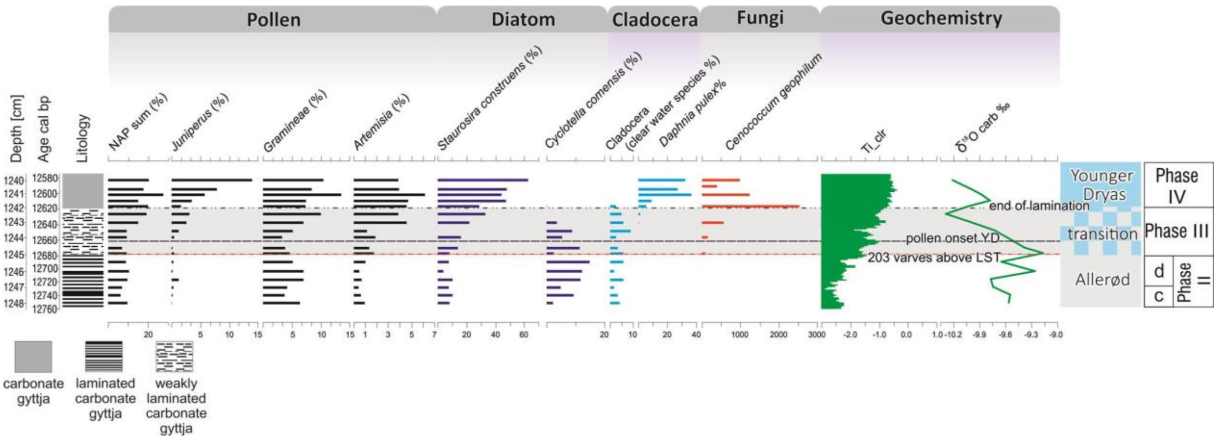
Selected diatom taxa from the TRZ record (Słowiński *et al.*, 2017)



Geochemistry and μ-XRF element scanner data of the TRZ sediment record (Słowiński *et al.*, 2017)



Palaeoclimate proxy data from TRZ and MFM (Brauer et al. 1999). The onset of the YD in detail vegetation from pollen counting and curves of titanium (Ti) (Słowiński *et al.*, 2017)



Summary of TRZ proxy data (Słowiński *et al.*, 2017)

Quaternary Science Reviews 158 (2017) 94–106

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Differential proxy responses to late Allerød and early Younger Dryas climatic change recorded in varved sediments of the Trzechowskie palaeolake in Northern Poland

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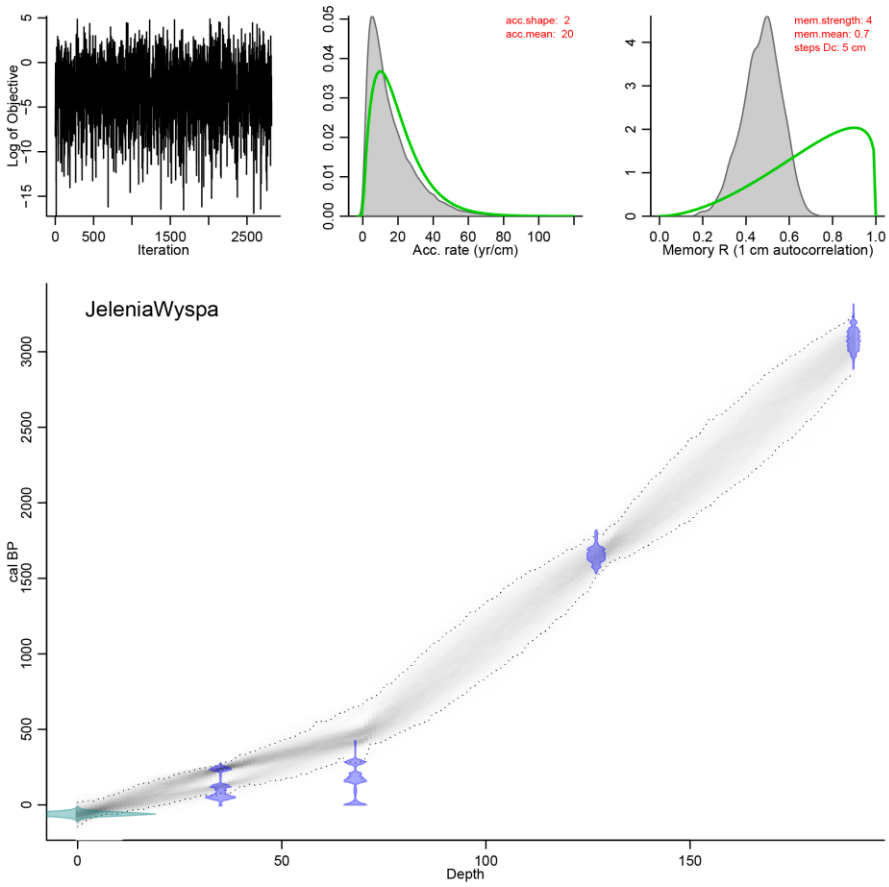
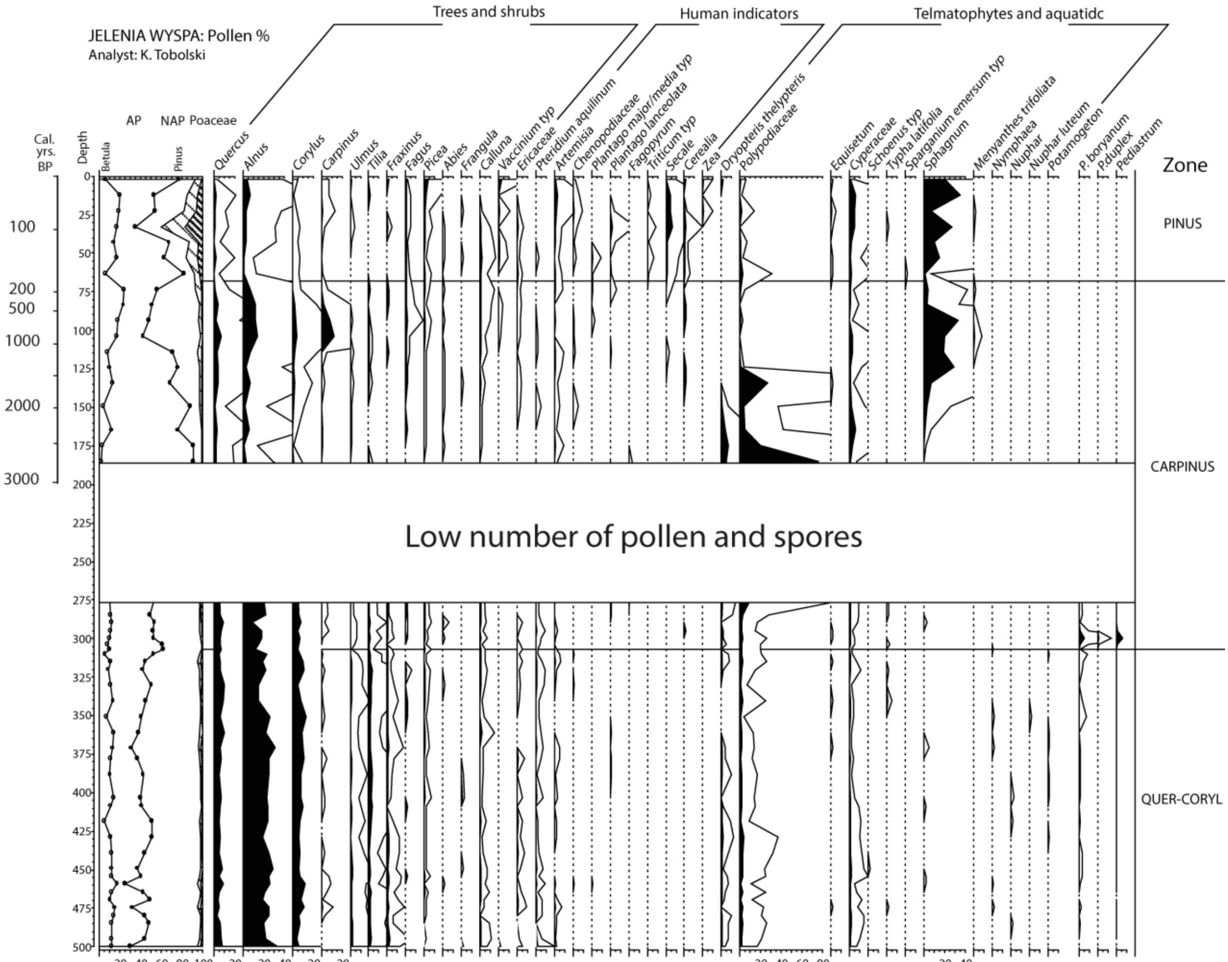
Stążki peatland complex and Jelenia Wyspa nature trail

The Stążka fen and Jelenia Wyspa bog are located in in the region of the Tuchola Pinewoods on the sandy outwash plain of the Brda River, which formed during the Pomeranian phase of the Vistulian glaciation (ca 16 kcal BP). This site is located within the administration limits of the Tuchola Forest management area and the southern part of the Tuchola Landscape Park. Both fen and bog are a part of the Bagna nad Stążką Nature Reserve (covering an area of 478.45 ha), where this complex of natural peatlands is under protection. The Stążka fen is part of the complex of mires that developed in a fluvio-glacial channel of the Stążka River. There are also spring mires at the margins of the channel, as well as kettle-hole bogs scattered near the river (Lamentowicz, 2005).

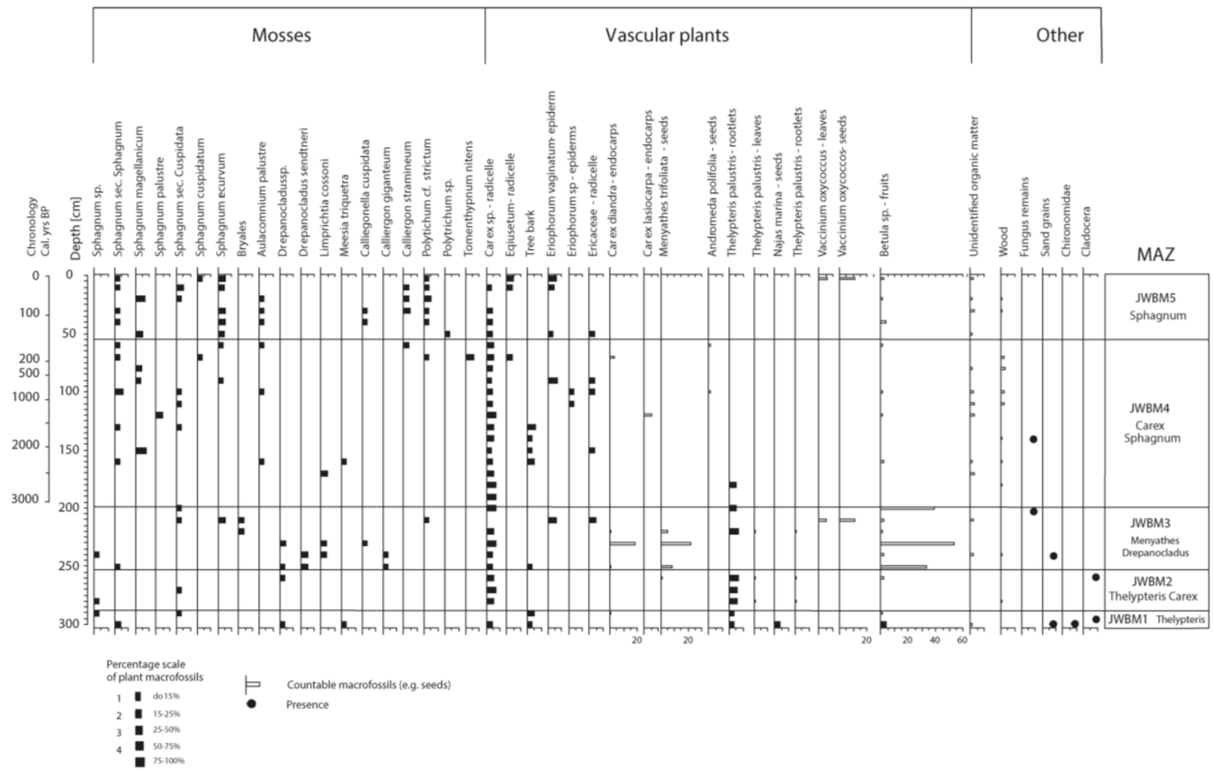
The results from **the Jelenia Wyspa mire** suggest that this peatland followed the classical succession from lake to a *Sphagnum*-dominated peatland, but peat accumulation only started about 3000 cal. BP (Lamentowicz *et al.*, 2007). A rapid shift to wetter conditions, lower pH and higher peat accumulation rate took place about 110–150 years before present, when the vegetation shifted to a *Sphagnum*-dominated poor fen with some bog plants. While the first shift to a peat-accumulating system was most likely driven by climate, the second one was probably caused by forest clearance around the mire. The process of deforestation and planting monoculture of Pine probably also leaded to floating mats development in other areas of Tuchola Pinewoods.



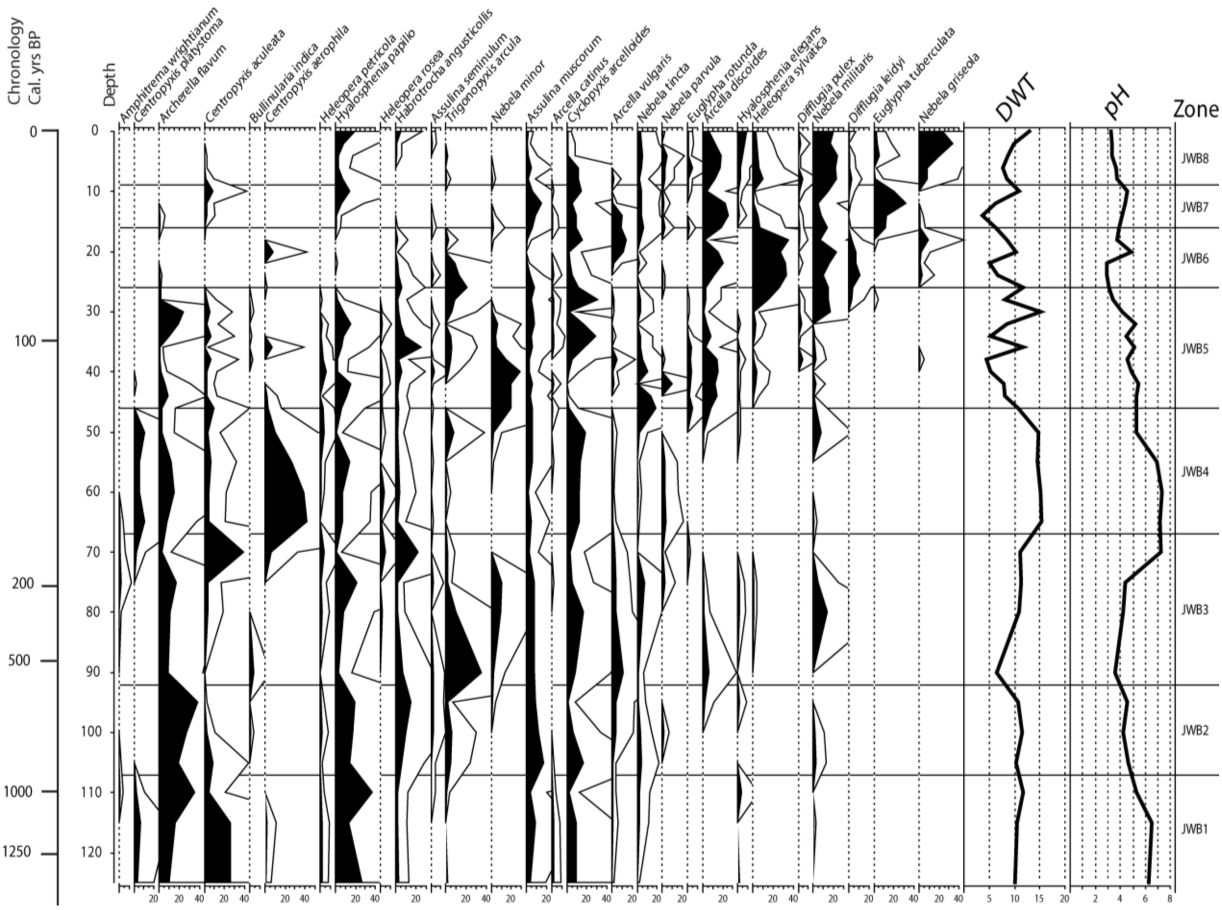
Depth age model of the Jelenia Wyspa sequence (Lamentowicz *et al.*, 2007) – new model constructed in *bacon*.



Palynological % diagram of Jelenia Wyspa mire. Analysis: Kazimierz Tobolski (Lamentowicz *et al.*, 2007).



Plant macrofossils diagram of Jelenia Wyspa mire. Analysis: Mariusz Lamentowicz (Lamentowicz *et al.*, 2007).



Testate amoebae % diagram of Jelenia Wyspa mire. Analysis: Mariusz Lamentowicz (Lamentowicz *et al.*, 2007).

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Palaeoecological evidence for anthropogenic acidification of a kettle-hole peatland in northern Poland

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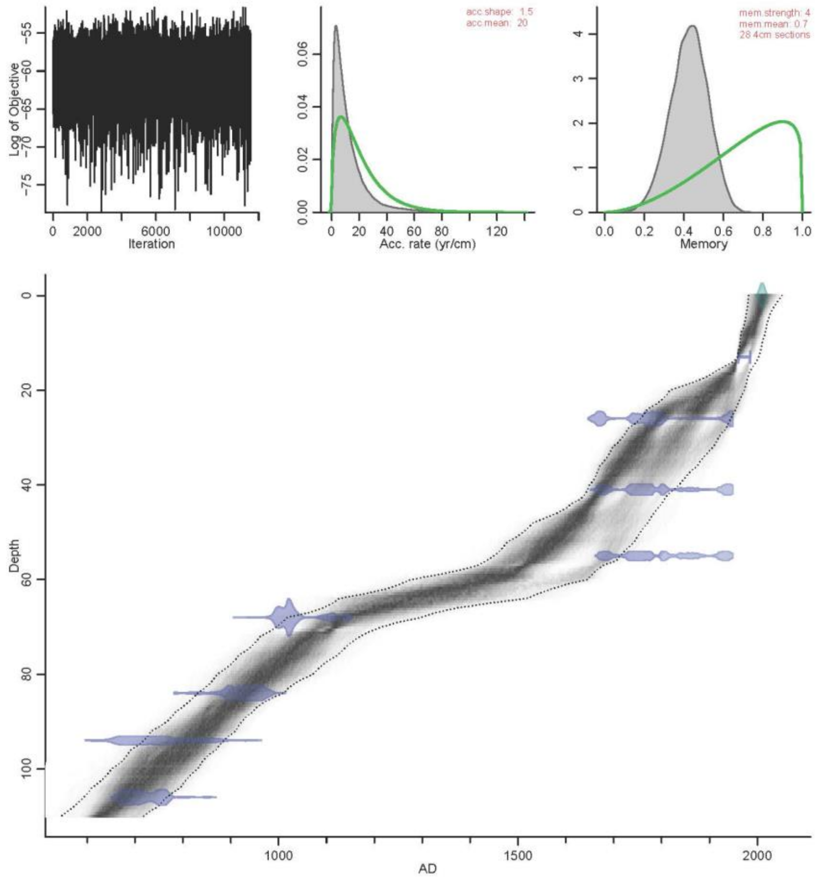
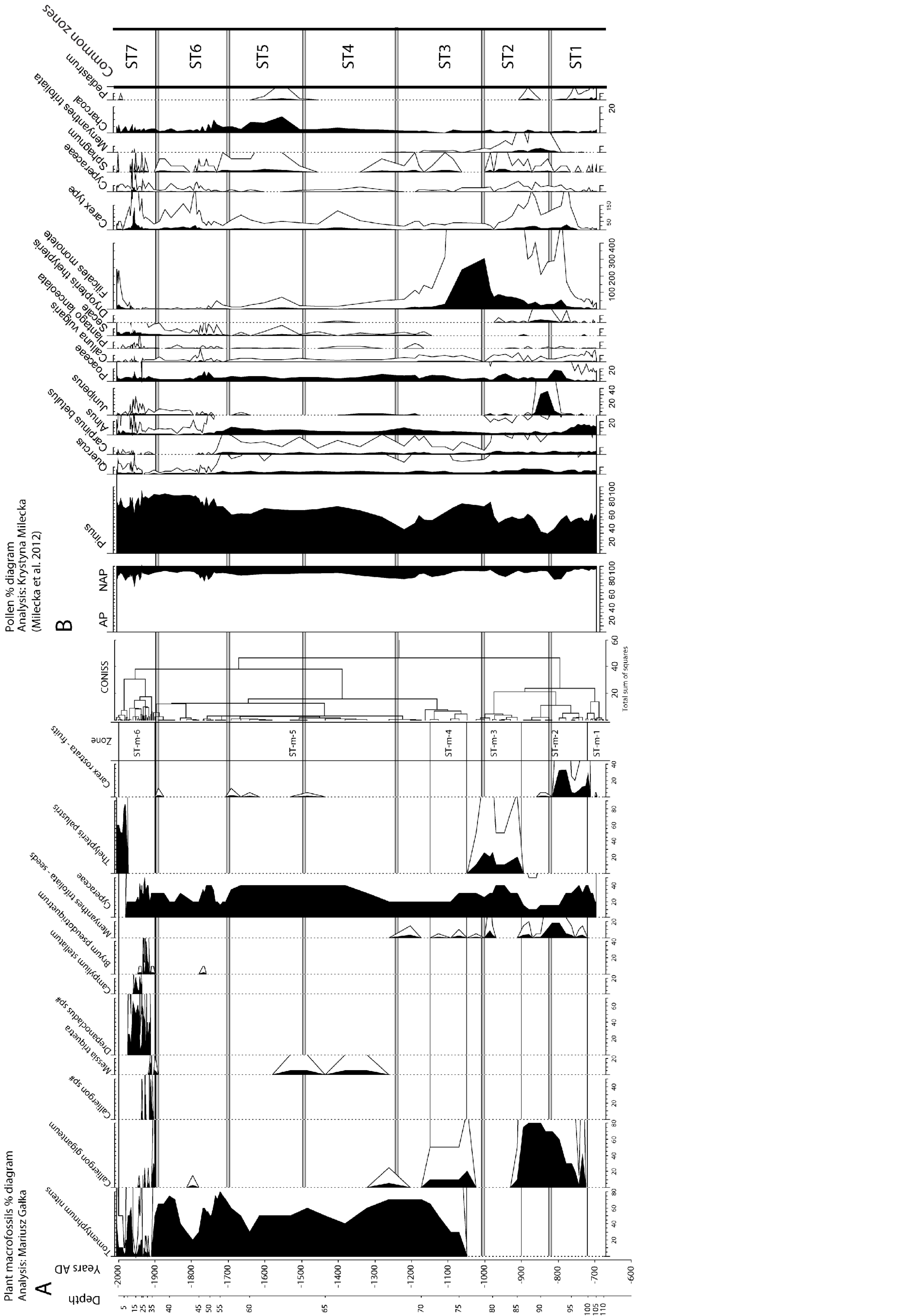
Bagna nad Stążką fen

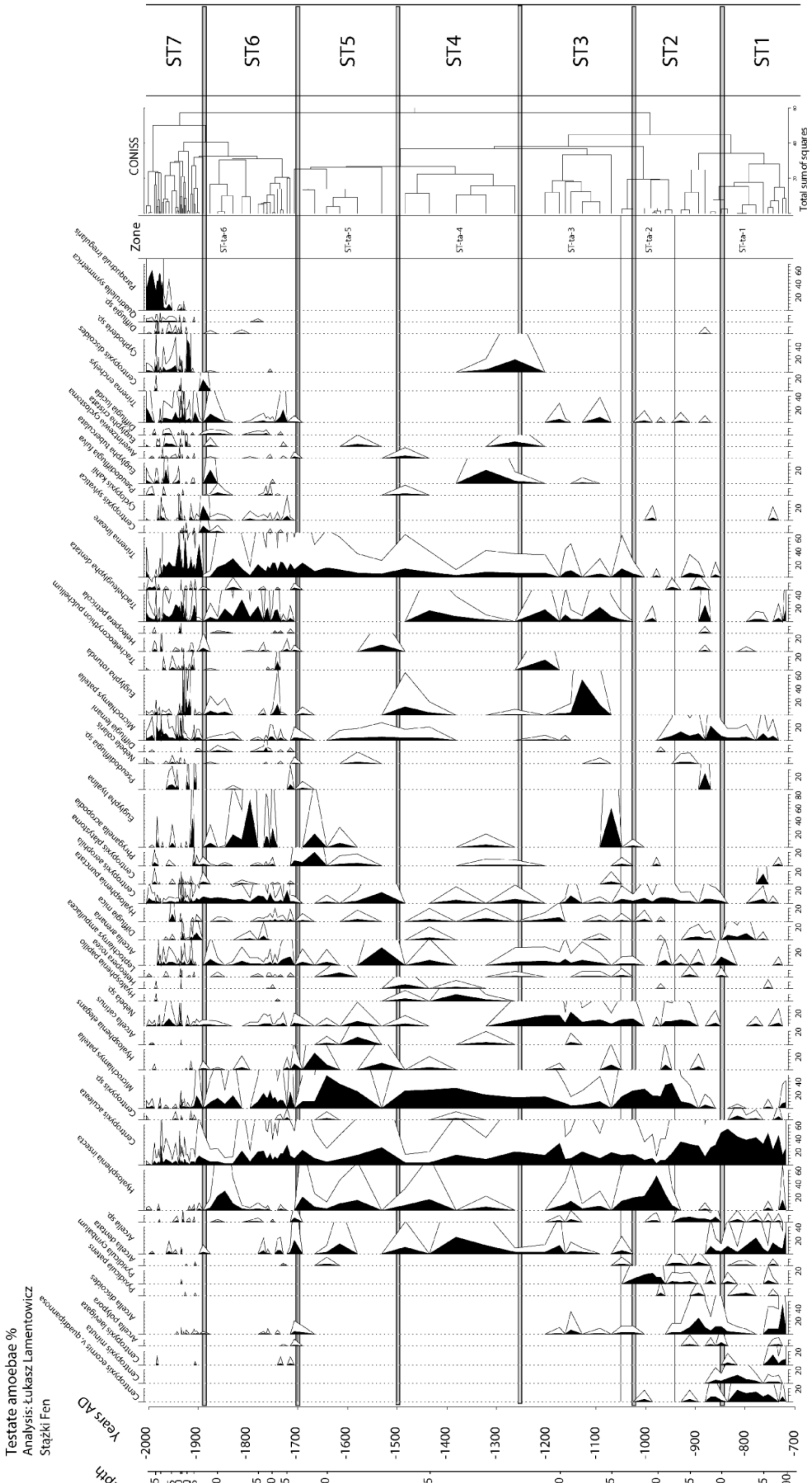
Several stages of **the Bagna nad Stążką fen** history were determined, beginning with the lake-to-fen transition ca. AD 700 (Lamentowicz *et al.*, 2013). Brown mosses dominated the sampling site from this period to the present. No human impact was found to have occurred until ca. AD 1700, when the first forest cutting began. Around AD 1890 a more significant disturbance took place – this date marks the clear cutting of forests and dramatic landscape openness. Deforestation changed the hydrology and chemistry of the mire, which was revealed by a shift in local plant and testate amoebae communities.



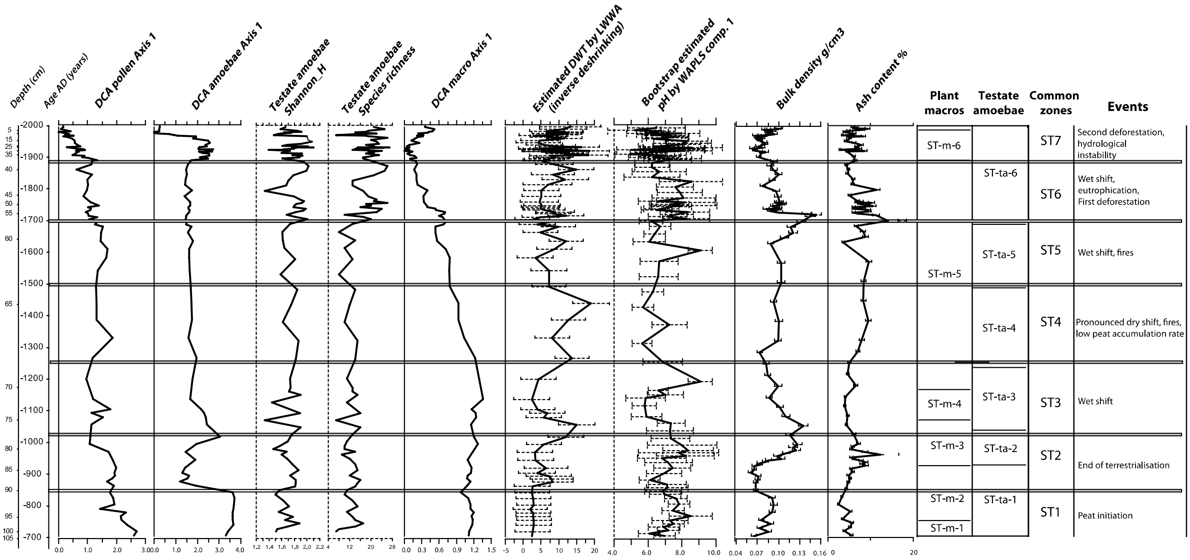
Depth age model of the Bagna nad Stążką sequence (Lamentowicz *et al.*, 2013).



Plant macrofossils and pollen % diagram from Bagna nad Stążką fen. Analysis: Mariusz Gałka (Lamentowicz *et al.*, 2013)



Testate amoeba % diagram from Bagna nad Stążką fen. Analysis: Łukasz Lamentowicz (Lamentowicz *et al.*, 2013)



Synthesis of proxies from Bagna nad Stążką fen (Lamentowicz *et al.*, 2013)

JOURNAL OF QUATERNARY SCIENCE (2013) **28**(6) 582–594 ISSN 0267-8179. DOI: 10.1002/jqs.2650

A 1300-year multi-proxy, high-resolution record from a rich fen in northern Poland: reconstructing hydrology, land use and climate change

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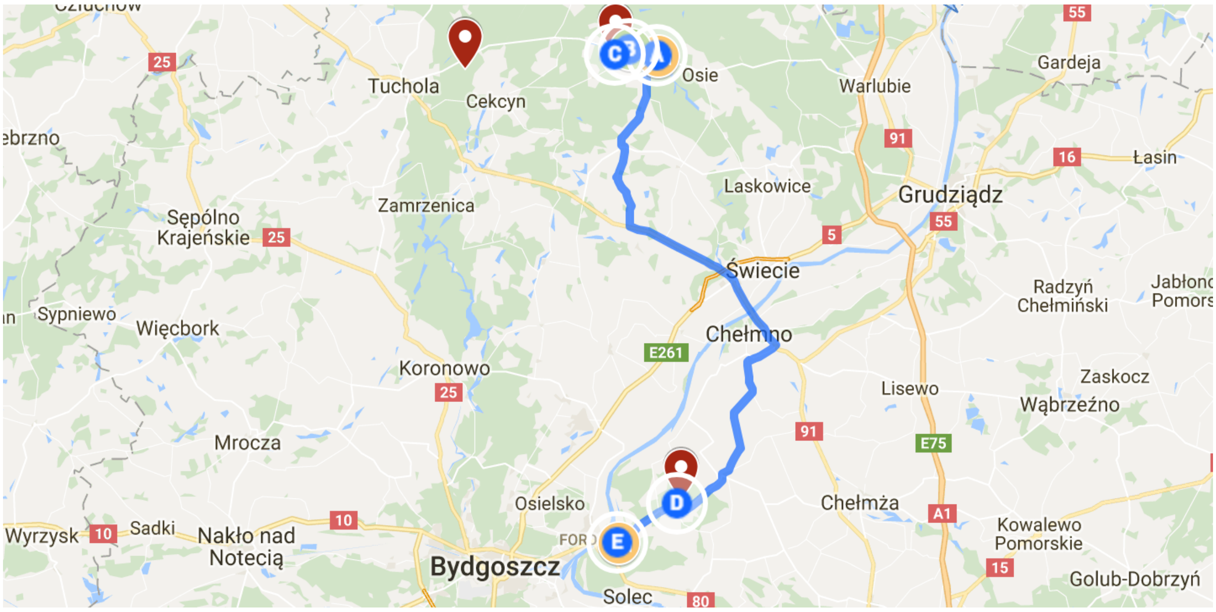
Day 5 – Wednesday, 5.09.2018
Tuchola Pinewoods and Chełmińskie Lake District

Viewing platform on the area destroyed by a tornado, Martwe lake and peatland, Linje mire, CLIMPEAT experimental site

9 h	Departure
9:15 h	Viewing platform on the area destroyed by a tornado, Martwe lake and peatland – impact of a tornado on the forest and wetland ecosystem (Dominika Łuców, Michał Słowiński)
12:30 h	Lunch
16 h	Linje mire (*Betula nana* microrefugium), CLIMPEAT experimental site – palaeoecological changes in the last 2000 years including hydrology, vegetation, fires and human impact; long-term monitoring; warming and drought experiment focused on microbes response, vegetation change and carbon emission (Mariusz Lamentowicz, Katarzyna Marcisz, Piotr Kołaczek, Michał Słowiński, Monika Reczuga, Bogdan Chojnicki)
17:30 h	Departure to the hotel (Ostromecko)
19 h	Dinner



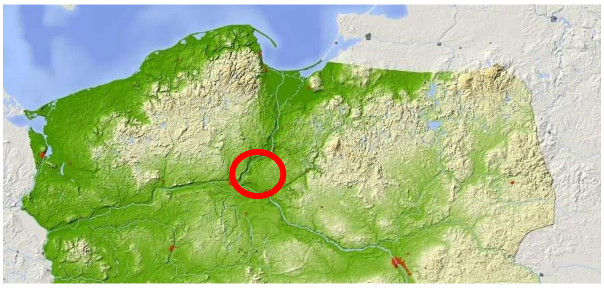
The influence of the tornado on the Tuchola Pinewoods and Martwe lake and peatland

Martwe lake and peatland are located in the Tuchola Pinewoods (53°37’07,28’’N, 18°12’09,33’’E) and are protected by law as nature reserve. This area have been covered by forest since hundreds of years, and ca. 300 years ago the forest was turned into a pine (*Pinus sylvestris*) monoculture. In July 14^{th} 2012 the tornado occurred in this part of the Tuchola Pinewoods and destroyed ca. 550 ha of the forest. Six people were hurt during those events. Because of the tornado south-eastern part of the Martwe lake and peatland was deforested. In an on-going project (PI: Michał Słowiński) we are trying to see how a sudden deforestation impacted peatland and lake. Within the project, three peat cores and one lake core were sampled. So far the analysis are focused on two peat cores (MAR1 and MAR4), where we performed high resolution analyses of plant macrofossil, pollen, testate amoebae, chemical analyses (XRF scanning) as well as Chironomidae and tephra. We also look at historical data (old documents and historical maps).

A photo by Daniel Pach (source: gazetaprawna.pl)

Polish media were talking about this tragic tornado for a long time. Here, screen from the TVN24 TV info channel, a live material from a helicopter (source: tvnmeteo.tvn24.pl)

CHEŁMIŃSKIE LAKE DISTRICT



Chełmińskie Lake District (*Polish*: Pojezierze Chełmińskie), located in central-northern Poland, is a moraine plateau situated between the valleys of three rivers: Drwęca, Osa and Wisła. The region was formed during the Weichselian glaciation. The highest moraine hill located close to Wąbrzeźno reaches 134 m a.s.l., but the elevation of the moraine hills usually does not exceed 120 m a.s.l. There are about 100 lakes in the Chełmińskie Lake District, but all are not very large. The region is poorly forested, dominated by vast areas of farmlands. The main city of the region is Chełmno – a historical capital of the Chełmno Land (*Polish*: ziemia chełmińska, *German*: Kulmerland, *Old Prussian*: Kulma).

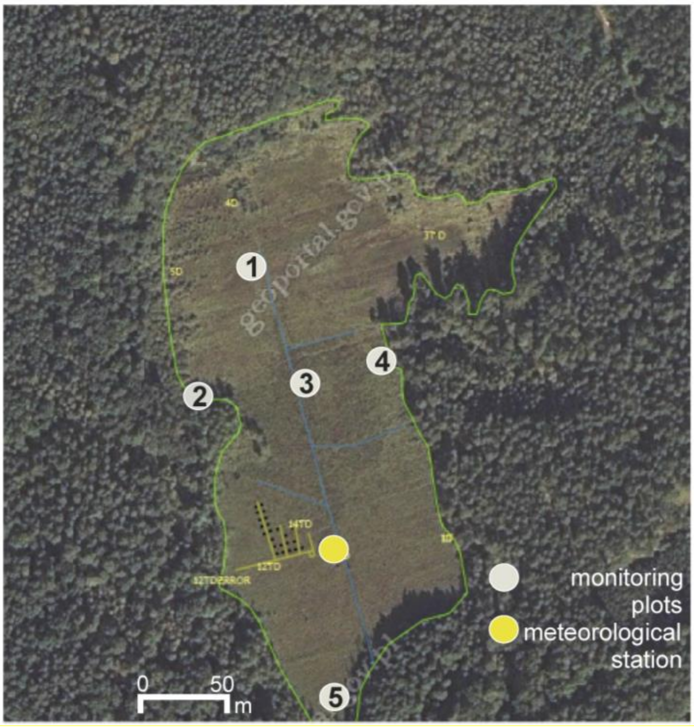
Linje mire, CLIMPEAT experimental site

Linje mire is a small (5.95 ha) peatland located at 91 m a.s.l. under transitional climate conditions, at the contact zone between oceanic and continental air masses. Mean annual air temperature is 7.5-8.0°C, mean annual precipitation sum is 500-550 mm (Hałas *et al.*, 2008; Słowińska *et al.*, 2010). Linje mire is classified as a poor fen, while in the centre of the mire ombrotrophic vegetation is present (Marcisz *et al.*, 2015). This site is the only lowland area in Poland with glacial relict species *Betula nana*, and is a part of the protected area and the Nature 2000 habitat area.

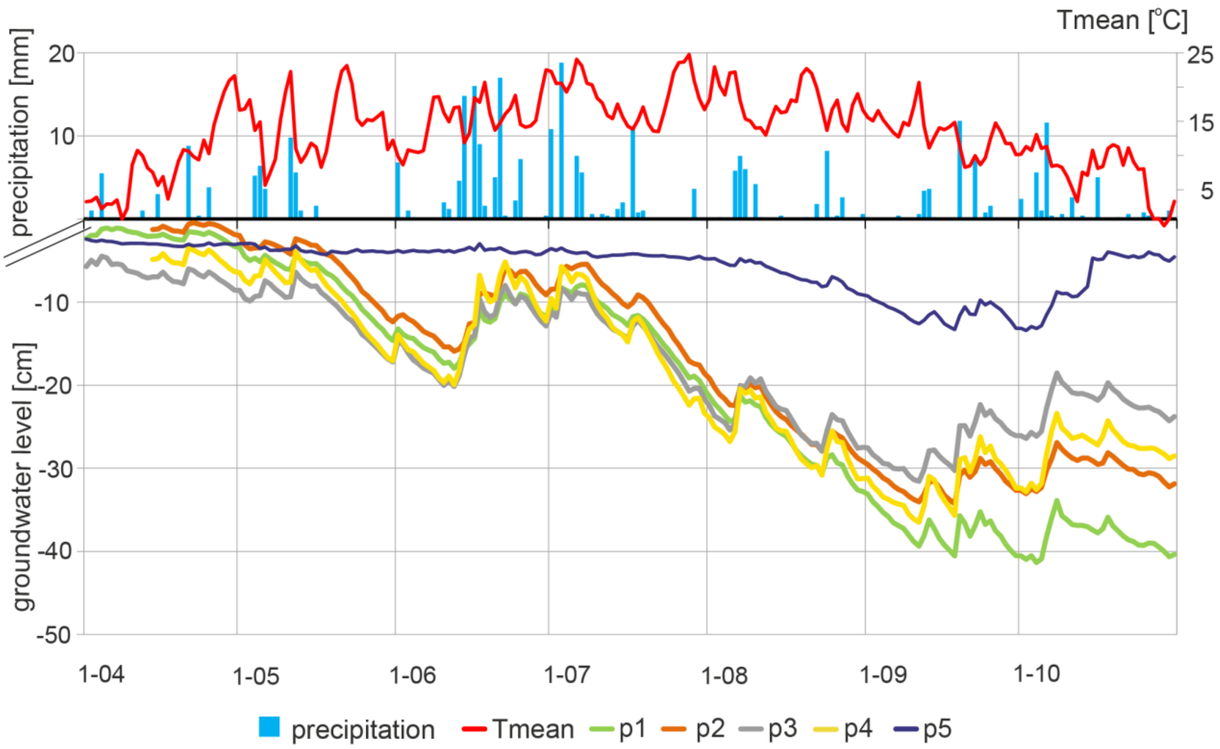
The mire has been continuously monitored since the year 2006. The monitoring includes: (1) measurements at the meteorological station located in the centre of the mire (i.e. air temperature, air pressure, rainfall); (2) monitoring of water table depth in 11 piezometers located around the mire; (3) detailed monitoring of meteorological parameters by micro-meteorological stations at five selected piezometers (Słowińska *et al.*, 2010; Słowińska, 2016). Monitoring of water table fluctuations have been supplemented by the seasonal analyses of testate amoebae (Marcisz *et al.*, 2014).

In 2012 we sampled a 2.5 m peat core and carried out a **high-resolution palaeoecological investigation covering the last 2000 years of peatland development**. The study showed that human-induced disturbances (fires, drainage) led to peatland drying and change of *Sphagnum* cover from primeval *S. magellanicum* to *S. fallax* (Marcisz *et al.*, 2015). Disturbances triggered a change in trait composition of testate amoebae that seem to be a new bioindicators of peatland disturbances (Marcisz *et al.*, 2016). Moreover, tephra from the Askja 1875 eruption have been found in Linje peat core, extending the spatial distribution and regional importance of this Icelandic tephra in Central and Eastern Europe (Watson *et al.*, 2017).

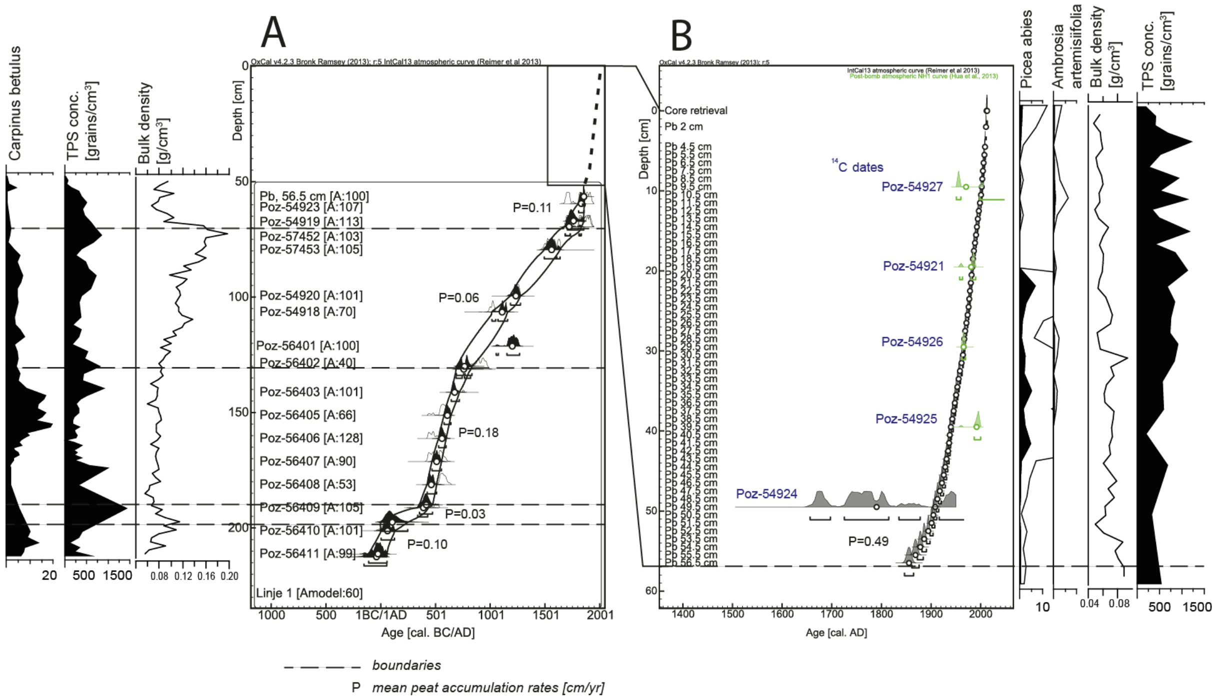
In the years 2012-2016, **CLIMPEAT field experiment** (Polish-Swiss cooperation through the Swiss Contribution to the enlarged European Union, www.climpeat.pl) have been performed on the Linje mire (Lamentowicz *et al.*, 2016). In the experiment, **global change conditions have been simulated by field manipulations: passive warming using Open Top Chambers (OTCs) and creation of hummock macroforms**. The application of OTC increased the mean values of daily maximum air temperature by approx. 1.1–1.8 °C. Measurements of gas fluxes showed that carbon emission (ecosystem respiration, R_{ECO}) increased as an effect of manipulations (Samson *et al.*, 2018). Substantial changes in ecosystem respiration, plant and soil fungal communities occurred when the water level fell below a tipping point of -24 cm (Jassey *et al.*, 2018). The investigation of microbial communities confirmed the importance of large microbial consumers on the functioning of peatlands (Reczuga *et al.*, 2018).



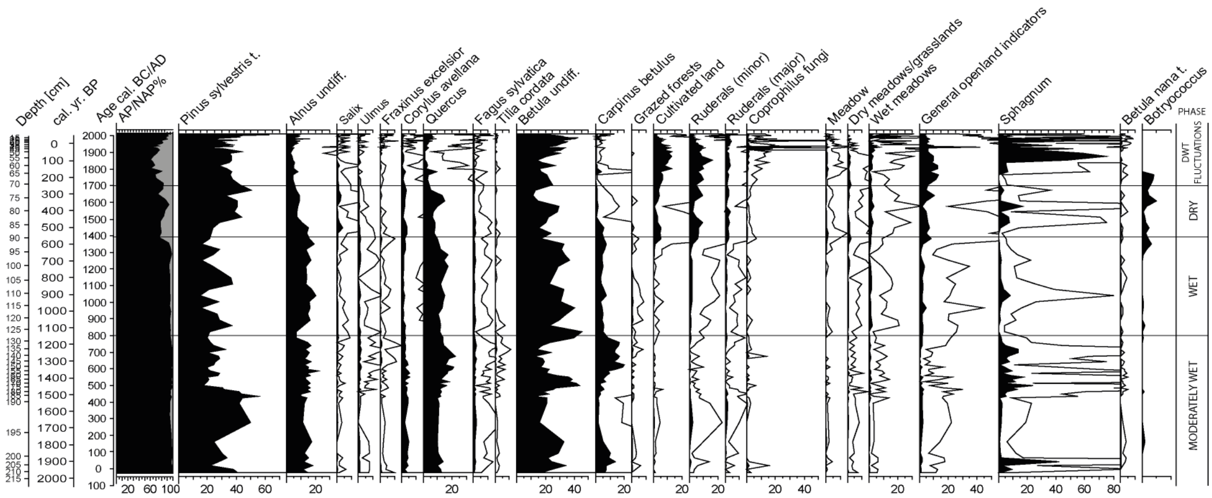
The location of monitoring plots at the Linje mire. Figure: Sandra Słowińska



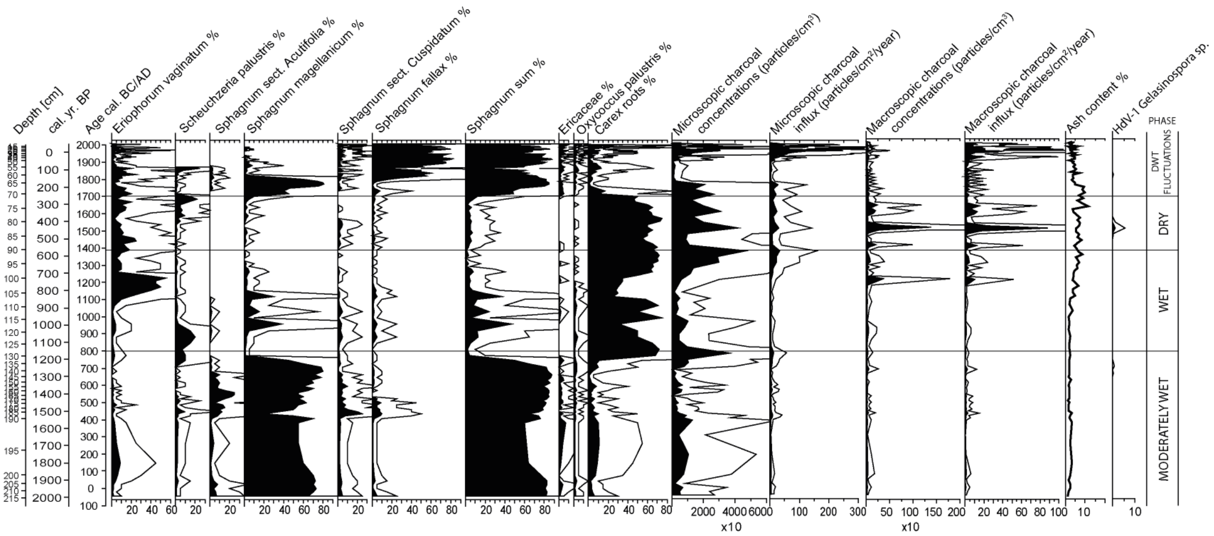
The results of the hydrometeorological monitoring in the year 2012. Analysis: Sandra Słowińska (Lamentowicz *et al.*, 2017)



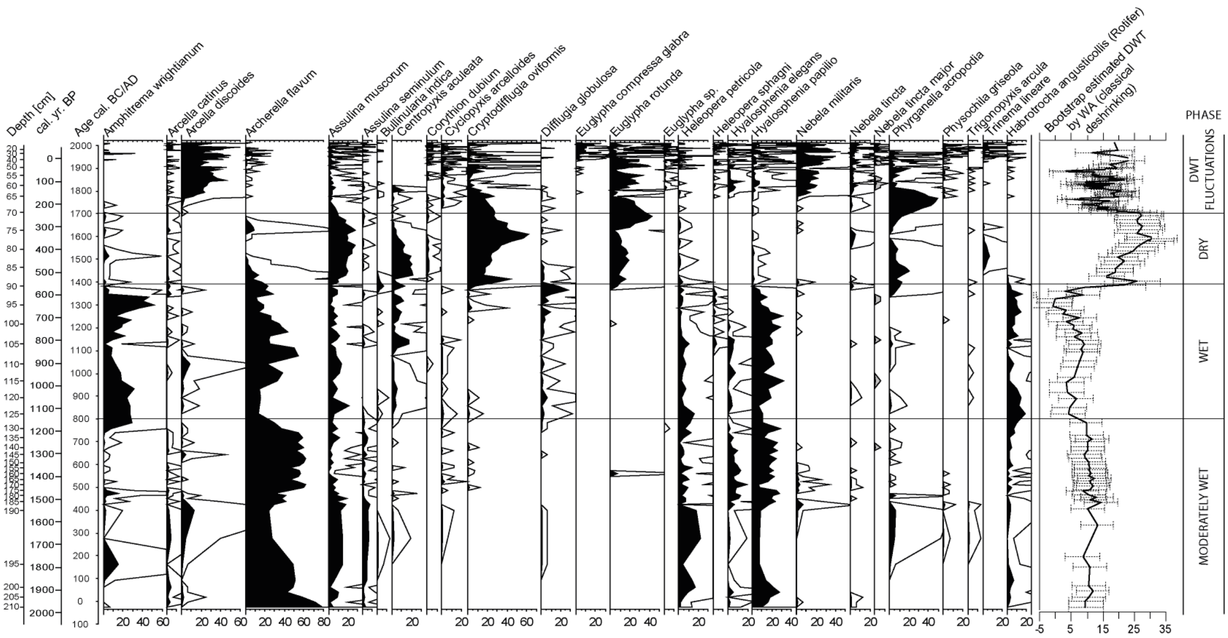
Age-depth model of the peat profile in Linje. Model A is based on ^{14}C datings, model B is based on ^{210}Pb datings. Model boundaries, mean peat accumulation rates [P] and agreement index values for each date are marked. Diagrams are showing the abundance of proxies used to validate the model (bulk density, *Picea abies*, *Ambrosia artemisiifolia* t., *Carpinus betulus*) (Marcisz *et al.*, 2015)



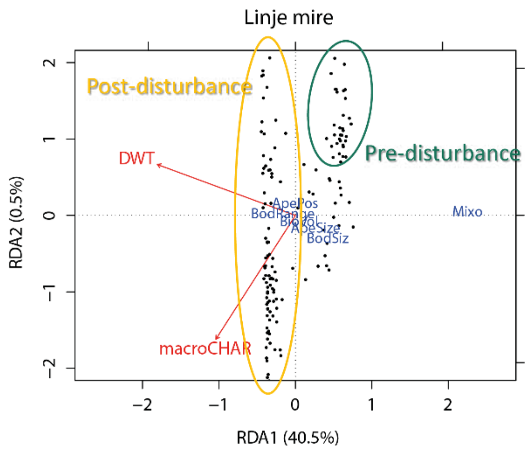
Pollen % diagram with selected taxa. Analysis: Piotr Kołaczek (Marcisz *et al.*, 2015)



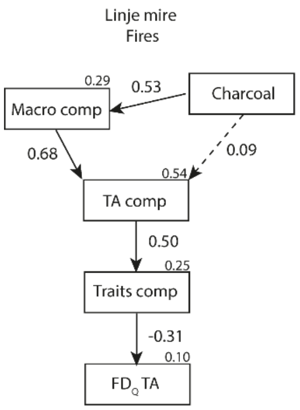
Macrofossil diagram, and fire proxies: micro- and macroscopic charcoal concentrations and influx, ash content and *Gelasinospora* sp. curve. 5 times exaggeration is marked. Analysis: Michał Słowiński (plant macrofossils) and Katarzyna Marcisz (charcoal) (Marcisz *et al.*, 2015)



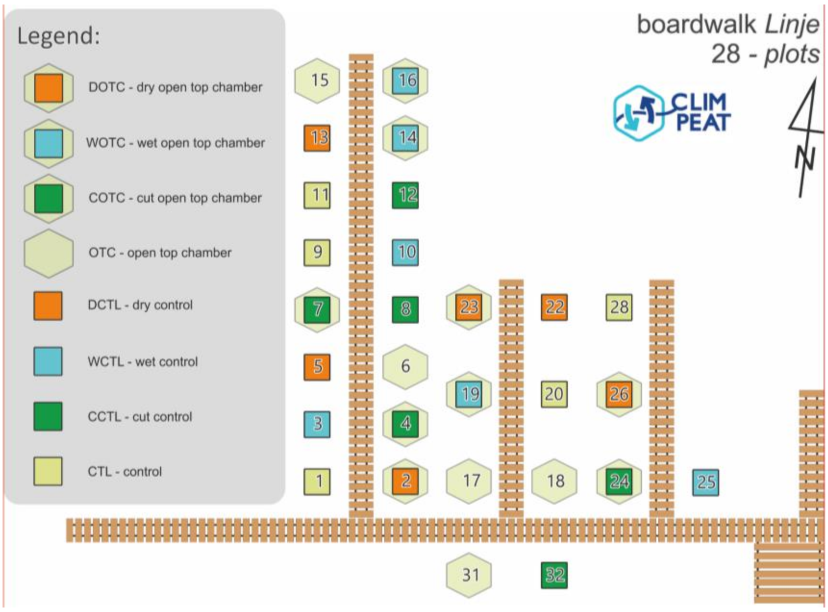
Testate amoebae % diagram (percentages shown in black and 5 times exaggeration is marked), including testate amoebae based depth to water table (DWT) reconstruction. Analysis: Katarzyna Marcisz (Marcisz *et al.*, 2015)



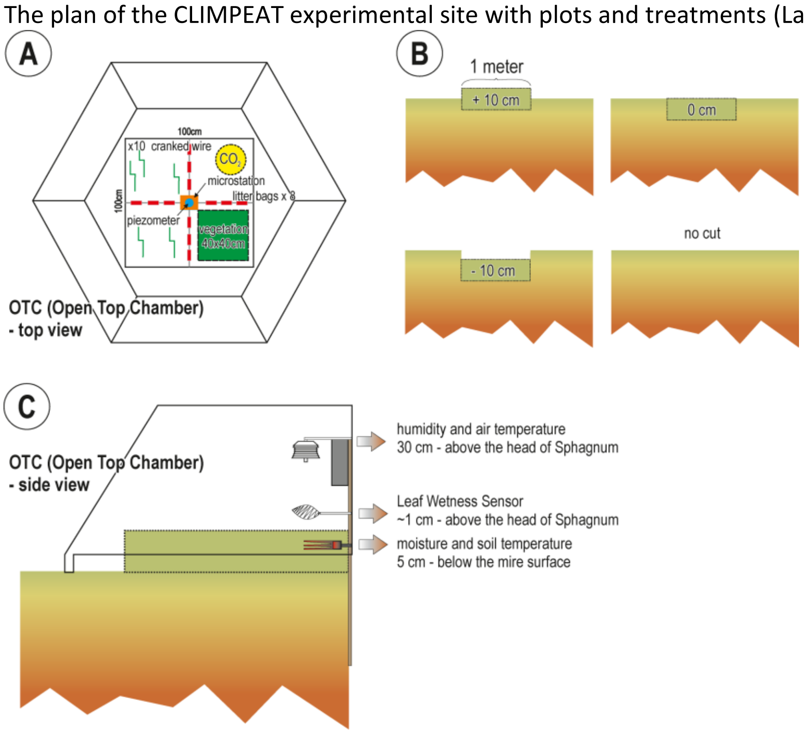
Redundancy analysis showing the relationships between testate amoeba functional traits and environmental variables: macroscopic charcoal influx (proxy for local fire) and reconstructed depth to water table (DWT) (model significant, P=0.001). Black points represent individual samples. Green circles indicate samples from pre-disturbance communities; yellow circles indicate samples from post-disturbance communities. Abbreviations used in the figure: Mixo – mixotrophs; BodSiz – body size; BioVol – biovolume; ApeSize – diameter of the shell aperture; ApePos – shell aperture position; BodRange – body range; DWT – reconstructed depth to water table; macroCHAR – macroscopic charcoal influx/accumulation rate. Analysis: Katarzyna Marcisz (Marcisz *et al.*, 2016)



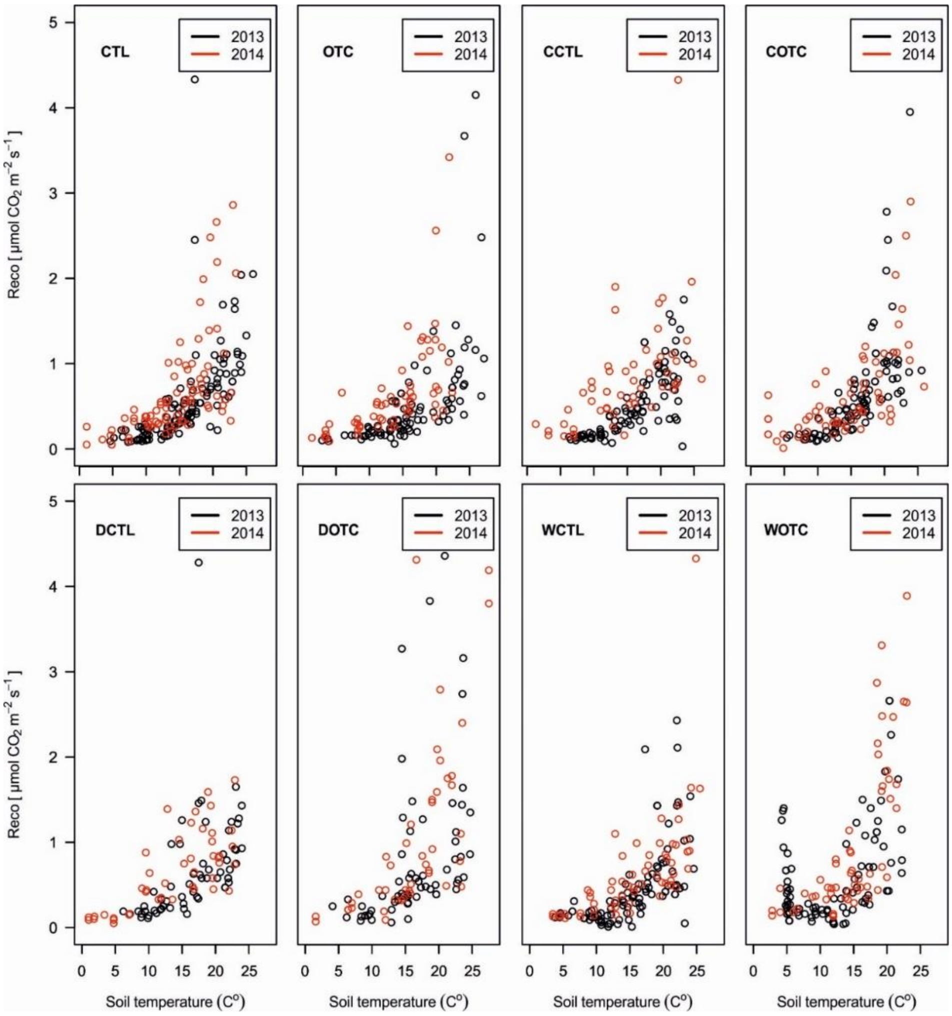
Structural equation model showing the effect of environmental disturbances on testate amoeba functional diversity (FDQ). Solid lines are significant paths ($P<0.05$), while dashed lines represent non-significant paths ($P>0.05$). Squared multiple correlations (R^2) for the predicted/dependent factors are given on the top of the box of the dependent variable. TA comp=testate amoebae species composition (PCA axis 1); Macro comp=plant macro-remains composition (PCA axis 1); Traits comp=testate amoebae trait composition (PCoA axis 1). Model includes macroscopic charcoal influx used as disturbance indicator for fire. Analysis: Vincent E. J. Jassey (Marcisz *et al.*, 2016)



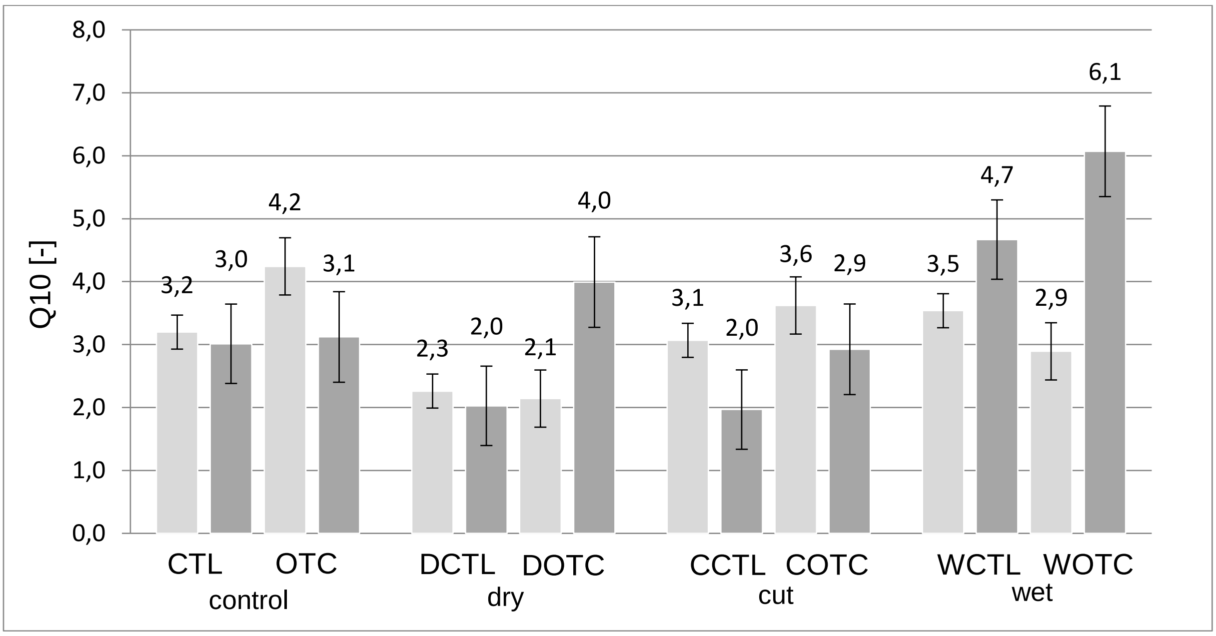
The plan of the CLIMPEAT experimental site with plots and treatments (Lamentowicz *et al.*, 2016)



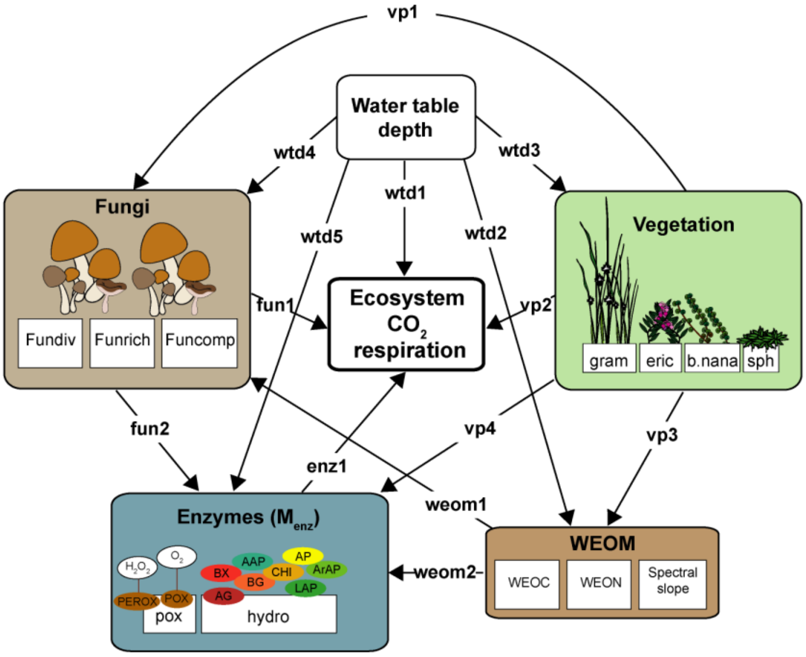
Experimental design with descriptions of: (A) within-plot space subdivision for the various measurements and sampling; (B) water level manipulation treatments; and (C) environmental monitoring within each plot (Lamentowicz *et al.*, 2016)



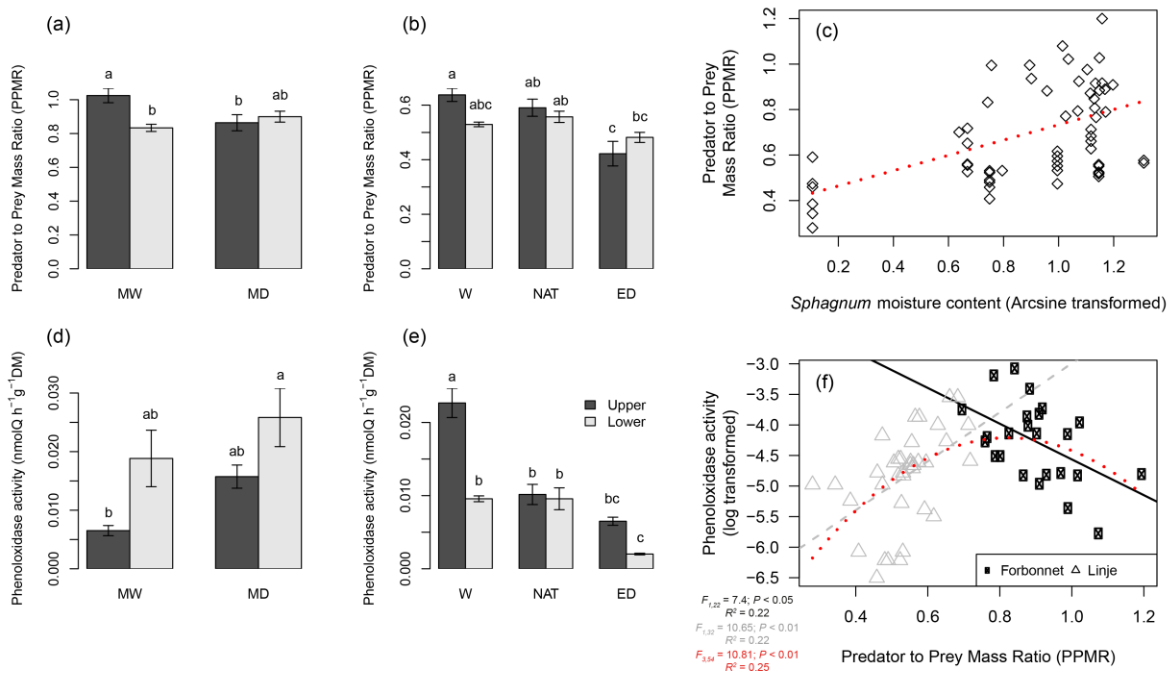
The ecosystem respiration (RECO) in relation to soil temperature (2013: black dots, 2014: red dots). Analysis: Mateusz Samson (Samson *et al.*, 2018)



Mean Q10 values for each combination of treatments in 2013 (grey) and 2014 (dark grey). Error bars represent standard deviation (Control uncut plots: N=5, dry, cut and wet plots: N=3). Analysis: Mateusz Samson (Samson *et al.*, 2018)



A priori conceptual structural equation model (SEM) depicting pathways by which water table depth, dissolved organic matter (WEOM), vegetation, fungi and enzymes may influence ecosystem CO_2 respiration. For simplicity, we only show global pathways by variable category (e.g. fungi). Letters correspond to hypothetical pathways. Fundiv = fungal diversity; Funrich = fungal richness; Funcomp = fungal community composition (NMDS axis 1); gram = graminoid cover; eric = ericoid cover; b.nana = *Betula nana* cover; sph = *Sphagnum* cover; weoc = water-extractable organic carbon; weon = water-extractable organic nitrogen; Spectral slope = spectral slope of the WEOM; pox = phenoloxidases (POX + PEROX); hydro = hydrolases (PCA axis 1 computed on BX, AG, BG, CHI, LAP, ArAP, AAP, AP). Analysis: Vincent E. J. Jassey (Jassey *et al.*, 2018)



Response of phenoloxidase activity (a, b) and predator-to-prey mass ratio (PPMR) (d, e) to moisture in upper and lower *Sphagnum* segments in the two peatlands. MW, moderately wet plots; MD, moderately dry; W, wet (Linje); NAT, natural condition (Linje); ED, extreme drought (Linje). (c) Relationship between PPMR and *Sphagnum* moisture content (e) Relationship between PPMR and phenoloxidase activity (log-transformed). Both upper and lower *Sphagnum* segments were combined. Triangles represent the drought experiment (Linje peatland) while circles the observational study (Forbonnet peatland). The red line in (f) represents the relationship between PPMR and phenoloxidases when both sites are combined. Analysis: Monika Reczuga (Reczuga *et al.*, 2018)

Polish J. of Environ. Stud. Vol. 19, No. 4 (2010), 779-787

Original Research

Relationships between Local Climate and Hydrology in *Sphagnum* Mire: Implications for Palaeohydrological Studies and Ecosystem Management

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European Journal of Protistology 50 (2014) 445–455

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Seasonal changes in *Sphagnum* peatland testate amoeba communities along a hydrological gradient

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Quaternary Science Reviews 112 (2015) 138–152

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QUATERNARY SCIENCE REVIEWS

Long-term hydrological dynamics and fire history over the last 2000 years in CE Europe reconstructed from a high-resolution peat archive

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Katarzyna Marcisz[a,b,c,*], Willy Tinner[c], Daniele Colombaroli[c], Piotr Kołaczek[b], Michał Słowiński[d,e], Barbara Fiałkiewicz-Kozieł[b], Edyta Łokas[f], Mariusz Lamentowicz[a,b]

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SCIENTIFIC REPORTS

OPEN

A novel testate amoebae trait-based approach to infer environmental disturbance in *Sphagnum* peatlands

Received: 27 June 2016
Accepted: 02 September 2016
Published: 23 September 2016

Katarzyna Marcisz[1,2,3], Daniele Colombaroli[3], Vincent E. J. Jassey[4,5], Willy Tinner[3], Piotr Kołaczek[2], Mariusz Gałka[2], Monika Karpińska-Kołaczek[1,2], Michał Słowiński[6] & Mariusz Lamentowicz[1,2]

JOURNAL OF QUATERNARY SCIENCE (2017) 32(4) 457–462 ISSN 0267-8179. DOI: 10.1002/jqs.2945

JQS Journal of Quaternary Science QRA

Rapid Communication

First discovery of Holocene Alaskan and Icelandic tephra in Polish peatlands

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Combining short-term manipulative experiments with long-term palaeoecological investigations at high resolution to assess the response of *Sphagnum* peatlands to drought, fire and warming

M. Lamentowicz[1,2], S. Słowińska[3], M. Słowiński[4], V.E.J. Jassey[5,6], B.H. Chojnicki[7], M.K. Reczuga[1,2], M. Zielińska[1,2], K. Marcisz[1,2], Ł. Lamentowicz[1], J. Barabach[1], M. Samson[7], P. Kołaczek[2] and A. Buttler[5,6]

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Wetlands
https://doi.org/10.1007/s13157-018-0999-4

ORIGINAL RESEARCH

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The Impact of Experimental Temperature and Water Level Manipulation on Carbon Dioxide Release in a Poor Fen in Northern Poland

Mateusz Samson[1] · Sandra Słowińska[2,3] · Michał Słowiński[4] · Mariusz Lamentowicz[5,6] · Jan Barabach[5] · Kamila Harenda[1] · Małgorzata Zielińska[5] · Bjorn J. M. Robroek[7,8,9] · Vincent E. J. Jassey[7] · Alexandre Buttler[5,7,9,10] · Bogdan H. Chojnicki[1]

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]

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DOI: 10.1002/ece3.4114

ORIGINAL RESEARCH

WILEY Ecology and Evolution

Predator–prey mass ratio drives microbial activity under dry conditions in *Sphagnum* peatlands

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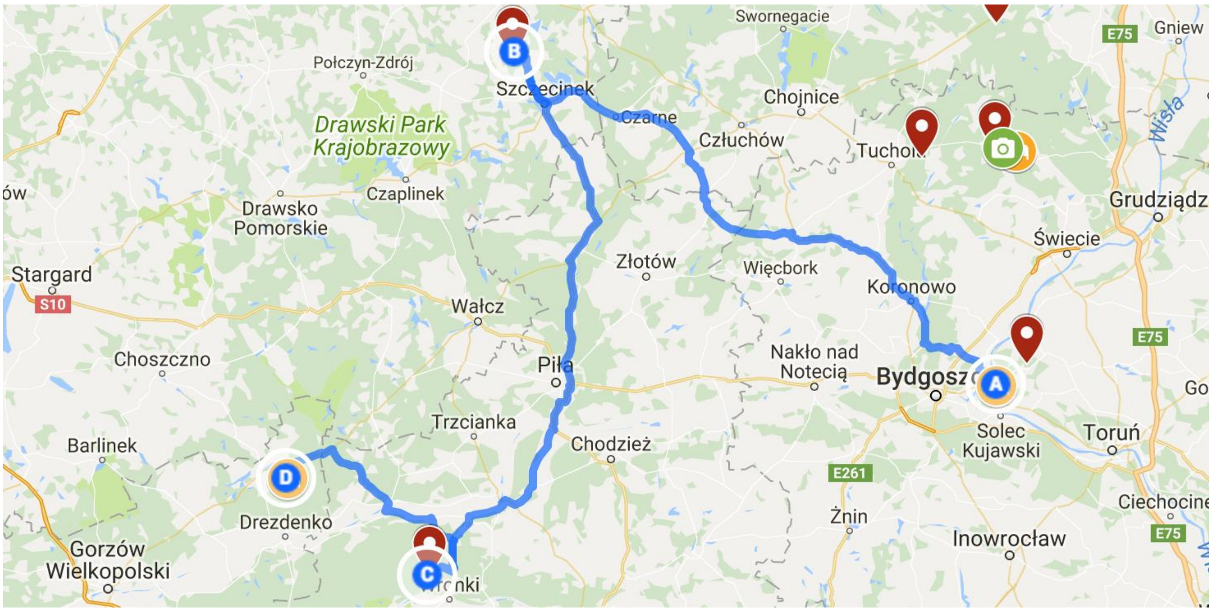
Day 6 – Thursday, 6.09.2018
Szczecineckie Lake District and Noteć Forest

Bagno Kusowo bog, Rzecin mire, WETMAN and FLUOGPP experimental site

8 h	Departure
11:15 h	Bagno Kusowo bog – high-resolution history of the last and 4000 years development of one of the biggest and best preserved ombrotrophic bogs in northern Poland; establishment of two new projects: *Sphagnum* translocation experiment and the Eddy covariance tower (Mariusz Gałka, Mariusz Lamentowicz, Katarzyna Marcisz)
13 h	Lunch
16:45 h	Rzecin mire, WETMAN and FLUOGPP experimental site – palaeoecological changes including vegetation changes, human impact, insects outbreaks and analysis of historical maps; warming experiments focused on gas exchange, vegetation changes and microbial response (Jan Barabach, Mariusz Lamentowicz, Radosław Juszczak, Bogdan Chojnicki, Dominika Łuców, Monika Reczuga)
19 h	Departure to the hotel (Mierzęcin)
20:30 h	Farewell dinner



SZCZECINECKIE LAKE DISTRICT

Szczecineckie Lake Distict (*Polish*: Pojezierze Szczecineckie) is a small area in NW Poland, Central Pomerania. The landscape of the region is dominated by moraine hills covered with many lakes and numerous wetlands including well-preserved Baltic raised bogs. Land management is dominated by forests and agriculture. In the past part of the region was an extensive military area. The main city is Szczecinek (total population: over 40,000).

Bagno Kusowo bog

Bagno Kusowo bog (53°48′ 28″ N, 16°35′ 14″ E) is located in the glacial area formed by the activity of the last Scandinavian ice sheet, which retreated from this area approximately 15,000 cal. BP. The bog covers an area of 318.82 ha and is one of the biggest raised bogs in Poland. The bog is a nature reserve and is a part of the Special Area of Conservation Natura 2000 site "Lake Szczecineckie" (PLH 320009).

Several studies have been performed at Bagno Kusowo and three peat cores were sampled: an 8 m-long sequence (covering the last 4000 years) and two 1 m-monoliths (covering the last 650 years).

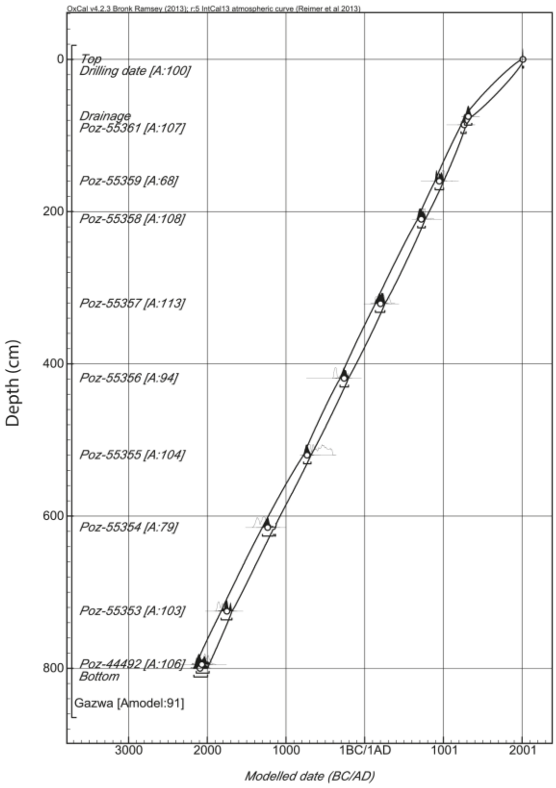
The multi-proxy study spanning the last 4000 years showed very high and stable peat accumulation rates over time (Lamentowicz *et al.*, 2015a). Few wet shifts have been recorded: AD 250, 550, 850, 1250 and 1700. The results provided statistically validated evidence that interactions between plant and microbe need to be more considered further to reconstruct past hydrological. This is the first study of past hydro-climatic changes in peatlands based upon a trait-based approach. Moreover, we identify the most easterly occurrence of the AD 860 B tephra, recently correlated to the White River Ash (WRAe) derived from Mount Churchill, Alaska (Watson *et al.*, 2017).

Studies based on two 1-m monoliths covering the last 650 years showed a decrease in water table in the years AD 1450-1500, AD 1640-1720 and AD 1810-1840, which correlate with the periods of lower solar activity and the periods of lower temperatures in Europe. Between AD 1640-1720 we noted a drop in abundance of *Sphagnum* sec. Cuspidata and *S. magellanicum* and a spread of *Eriophorum vaginatum*, *Baeothryon caespitosum* and *Pinus sylvestris*, followed by a regeneration of *Sphagnum* communities (*S. fuscum/capillifolium*) since ca. AD 1720 (Gałka *et al.*, 2014b). It was also underlined that (1) testate amoebae reflect similar hydrological trends in two peat cores despite considerable microhabitat variability, (2) average long-term water level 10 cm below the surface should be a target for active bog conservation and (3) sites like Bagno Kusowo are extremely important to preserve the remains of pristine biodiversity (including genetic diversity of plants and protists) that was completely removed from most of the raised bogs in Europe due to human activities, for example, drainage (Gałka *et al.*, 2017a).

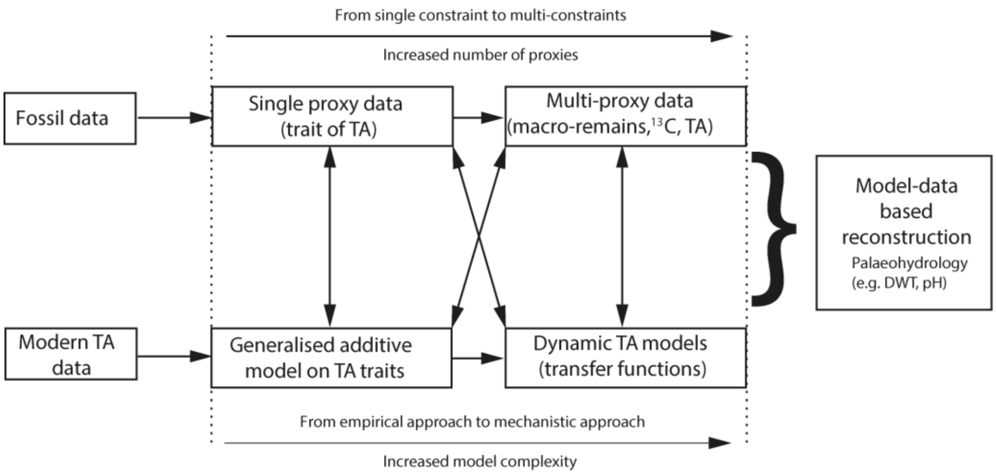
Fire activity in Bagno Kusowo located under the influence of the oceanic air masses was much lower than in Mechacz Wielki and Gązwa that are influenced mostly by continental air masses (Marcisz *et al.*, 2017). However, contiguous macroscopic charcoal investigation spanning the last 650 years showed that few fire events were present in Bagno Kusowo between 1620-1720 CE, influencing local vegetation and microbial communities (Marcisz et al., unpublished data).

Currently, another two projects are being realised on Bagno Kusowo. The first one focuses on the **non-pollen palynomorphs record** (based on the archived cores) and surface samples (sampling in August

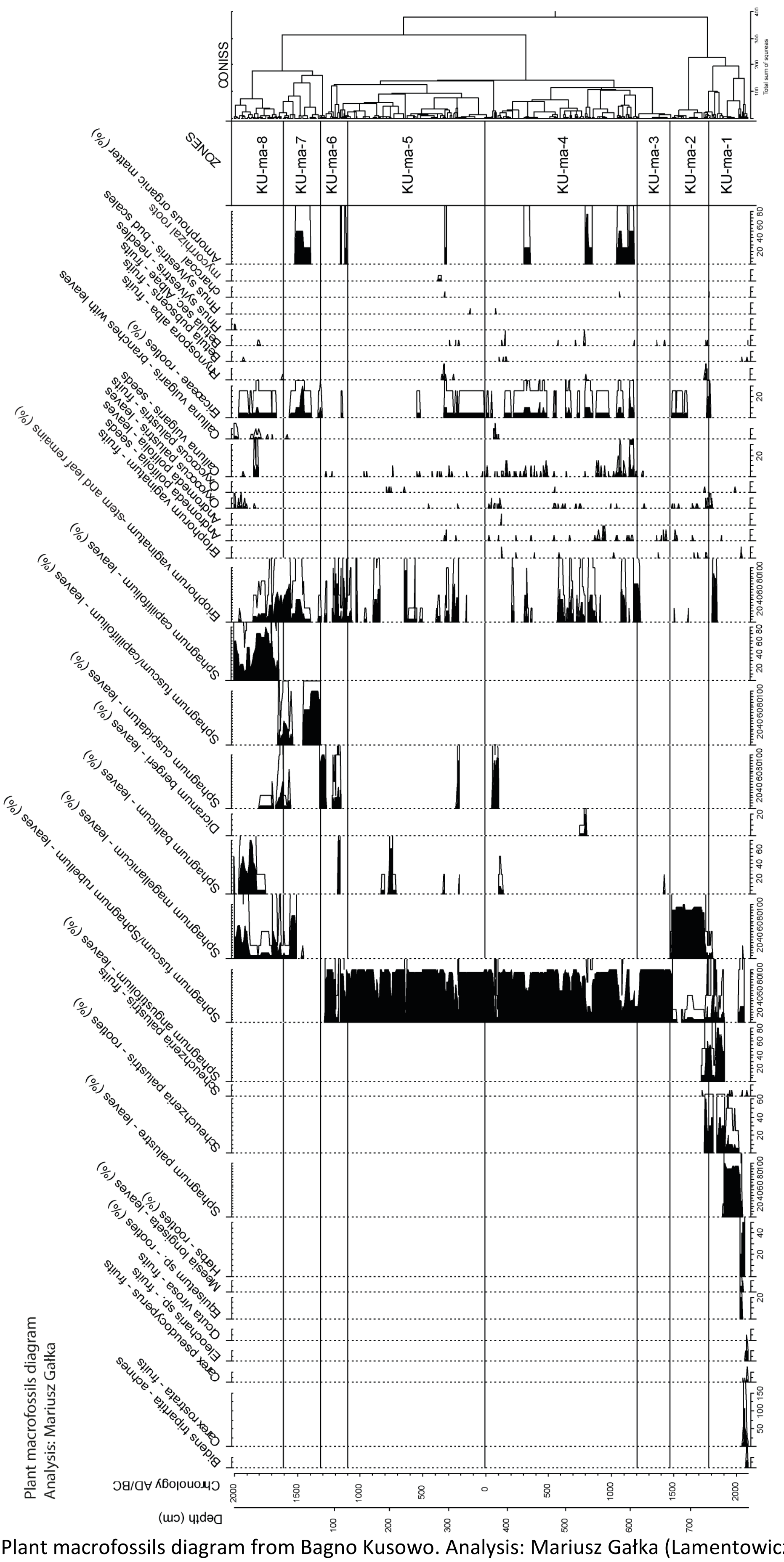
2015) from Bagno Kusowo, Gązwa and Mechacz Wielki peatlands (PI: Monika Karpińska-Kołaczek). The second one is the **MIXOPEAT translocation experiment** (http://www.mixopeat.cnrs.fr/) focusing on the role of mixotrophic microbes on peatland functioning, and is based on four raised bogs located in Europe (France, Poland, Estonia, Finland) and a mesocosm experiment in CNRS Tolouse, France (PI: Vincent Jassey).



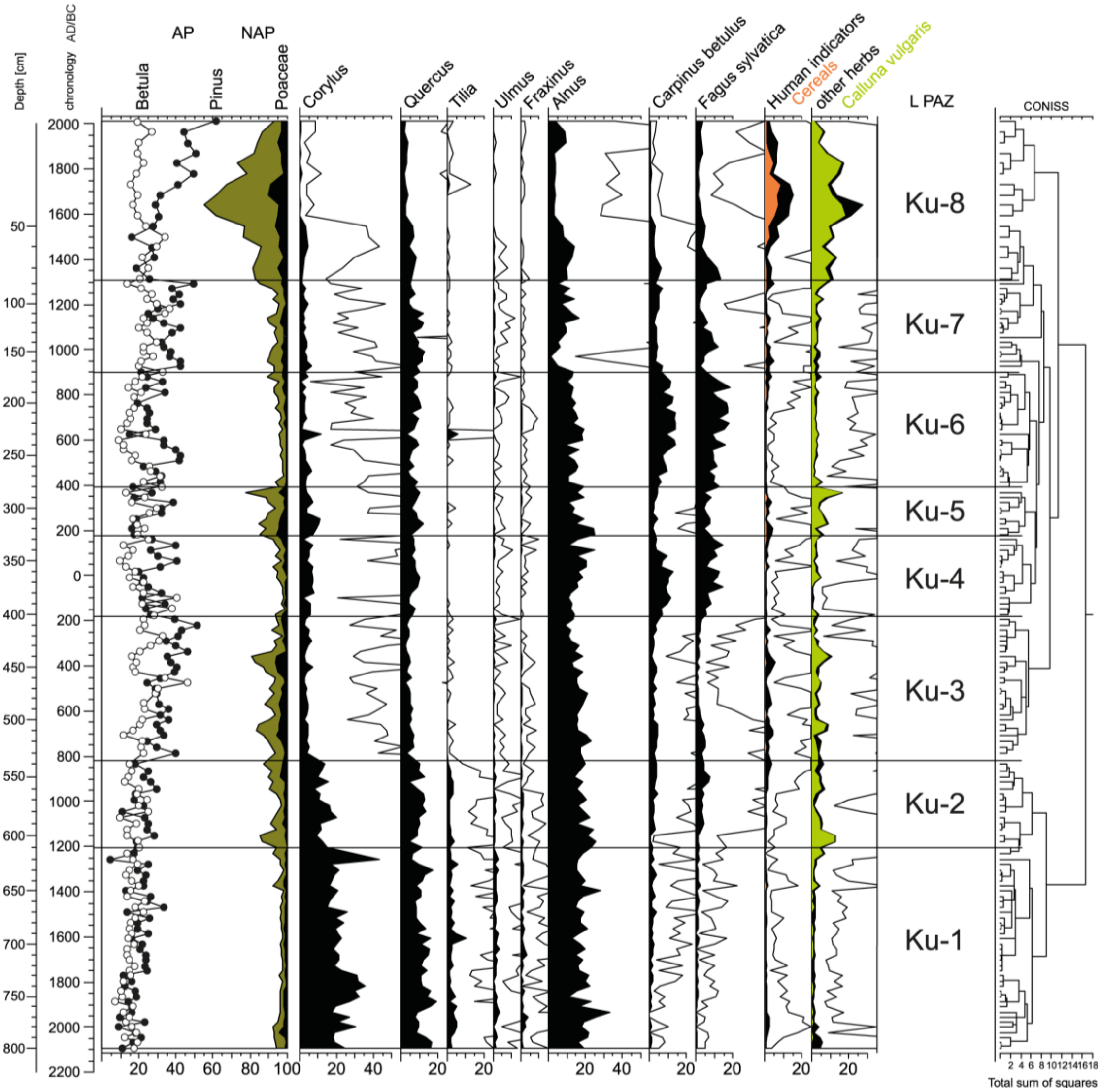
Age depth model of the longer Bagno Kusowo sequence (Lamentowicz *et al.*, 2015a)



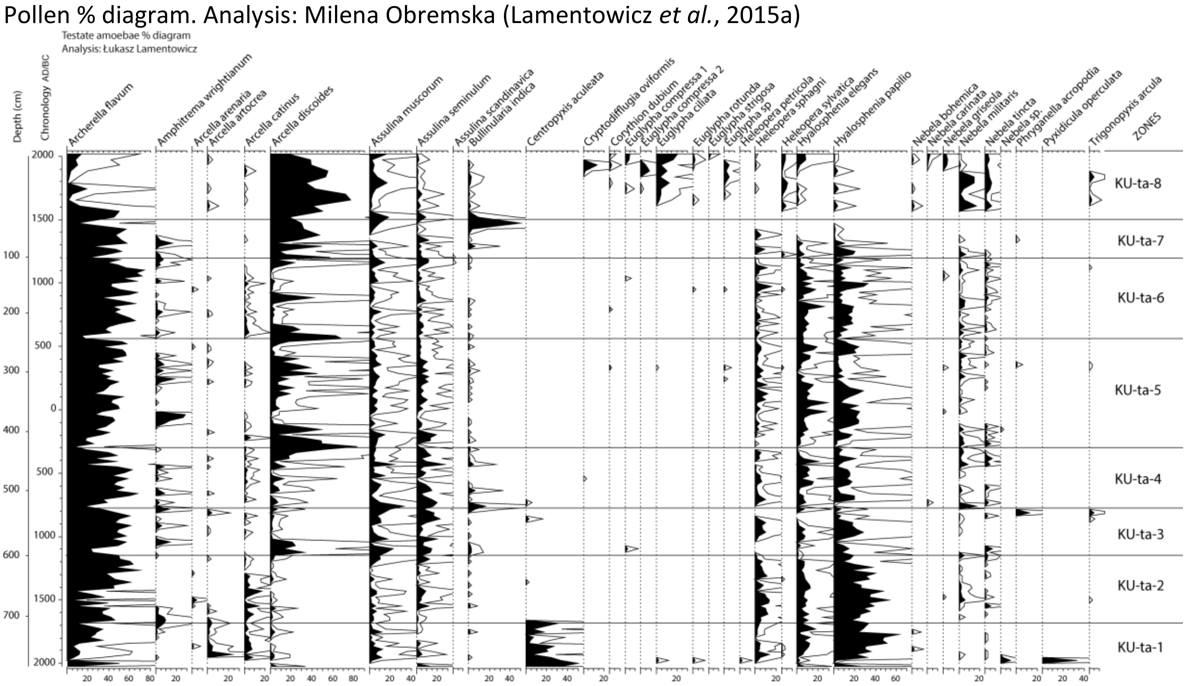
Causal network approach developed on Bagno Kusowo palaeodata-sets (Lamentowicz *et al.*, 2015a)



Plant macrofossils diagram from Bagno Kusowo. Analysis: Mariusz Gałka (Lamentowicz *et al.*, 2015a)

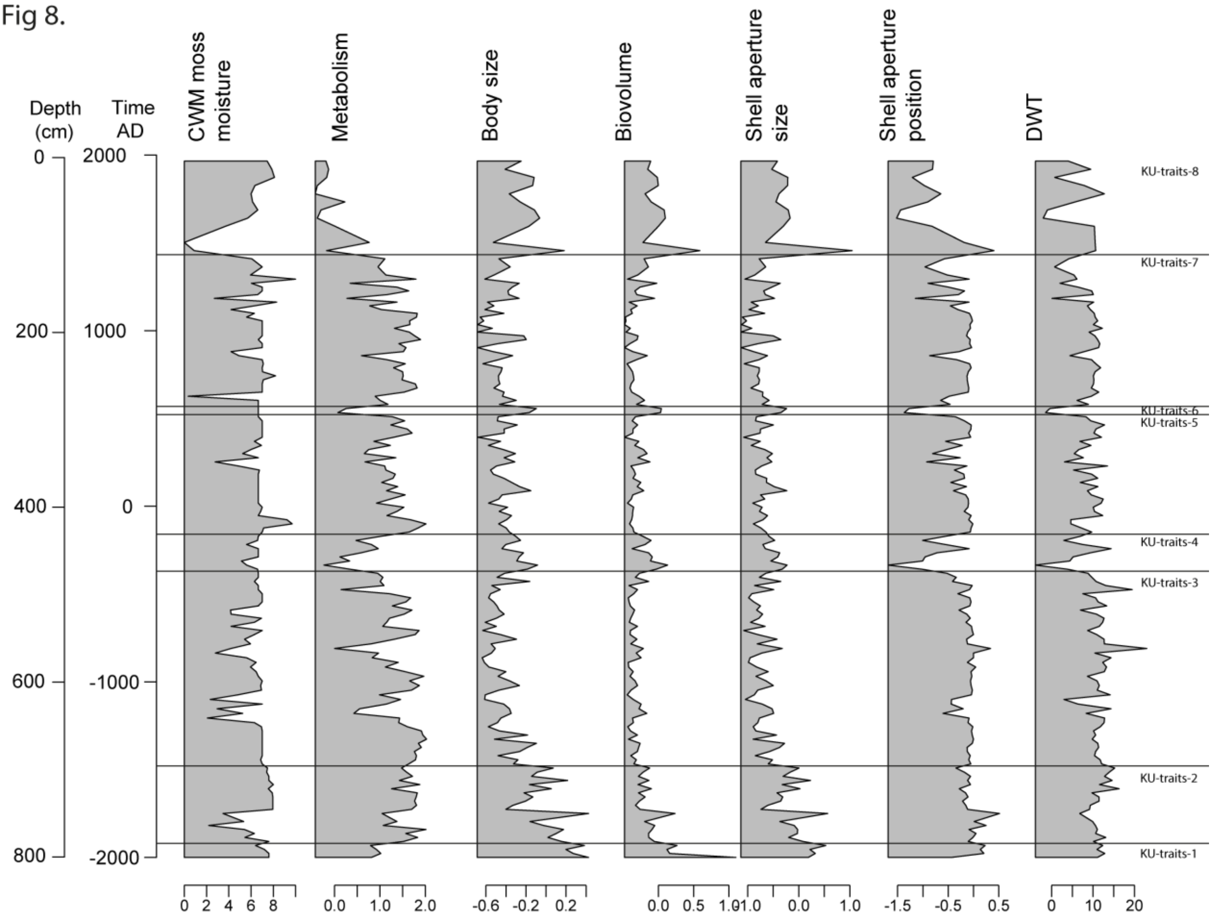


Pollen % diagram. Analysis: Milena Obremska (Lamentowicz *et al.*, 2015a)

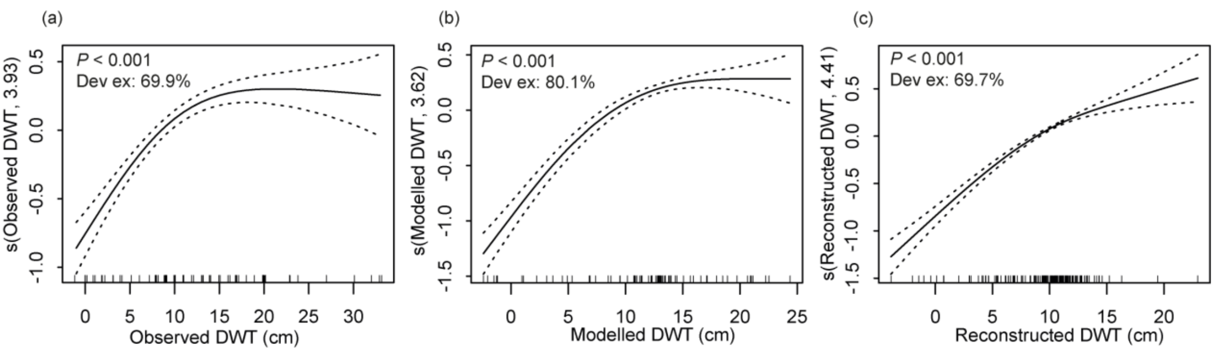


Testate amoebae from Bagno Kusowo. Analysis: Łukasz Lamentowicz (Lamentowicz *et al.*, 2015a)

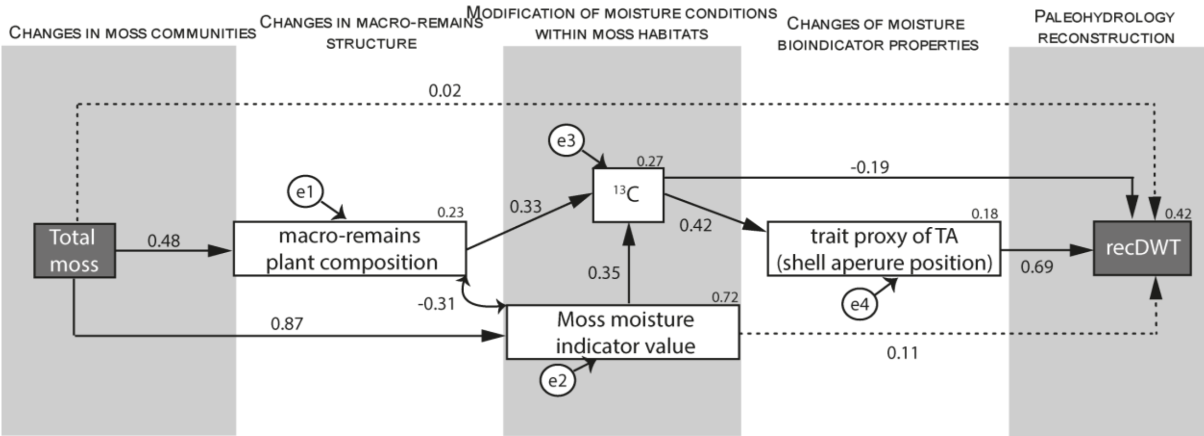
Fig 8.



Community-weighted-means (CWMs) of standardized traits of testate amoebae and mosses from Bagno Kusowo and reconstructed testate amoeba-based depth to water table (DWT). Analysis: Mariusz Lamentowicz (Lamentowicz *et al.*, 2015a)



Response curve of Community-Weighted-Mean shell aperture position of testate amoebae to observed DWT (a), modelled DWT from modern testate amoebae data-set (b), and reconstructed DWT from palaeo-data (c). The vertical axis indicates the relative influence of the explanatory variable on the prediction on the basis of partial residuals. Dashed lines show 95% confidence intervals, Dev ex = deviance explained in the GAM model. Statistics: Vincent E. J. Jassey (Lamentowicz *et al.*, 2015a)



Structural equation modelling of the relationships among the macro-remains, moss-trait, testate amoeba-trait and water-table depths (X^2 = 5.81, P = 0.33, CFI = 0.99, RMESA = 0.03, SRMR = 0.03). Solid arrows show significant relationships (pathways) between variables, dotted arrows indicate a non-significant relationship, and numbers next to arrows show standardised parameter estimates (i.e. standardised regression weights). Circles (e1–e4) indicate error terms, and double-headed arrows indicate significant correlations between the error terms. Squared multiple correlations (R^2) for the predicted/dependent factors are given in the box of the dependent variable. Abbreviations are: recDWT: reconstructed water table depths; TA: testate amoebae; CWM: community-weighted mean; Total moss: total abundance of mosses in plant macrofossils. Statistics: Vincent E. J. Jassey (Lamentowicz *et al.*, 2015a)

Quaternary International 328-329 (2014) 323–337

Contents lists available at SciVerse ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

ELSEVIER

Disentangling the drivers for the development of a Baltic bog during the Little Ice Age in northern Poland

CrossMark

Mariusz Gałka*, Kazimierz Tobolski, Aleksandra Górska, Krystyna Milecka, Barbara Fiałkiewicz-Kozieł, Mariusz Lamentowicz

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Resilience of plant and testate amoeba communities after climatic and anthropogenic disturbances in a Baltic bog in Northern Poland: Implications for ecological restoration

The Holocene
1–12
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DOI: 10.1177/0959683616652704
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Palaeogeography, Palaeoclimatology, Palaeoecology 418 (2015) 261–277

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Reconstructing climate change and ombrotrophic bog development during the last 4000 years in northern Poland using biotic proxies, stable isotopes and trait-based approach

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Quaternary Science Reviews 177 (2017) 145–157

Contents lists available at ScienceDirect

Quaternary Science Reviews

journal homepage: www.elsevier.com/locate/quascirev

Fire activity and hydrological dynamics in the past 5700 years reconstructed from *Sphagnum* peatlands along the oceanic–continental climatic gradient in northern Poland

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JOURNAL OF QUATERNARY SCIENCE (2017) **32**(4) 457–462 ISSN 0267-8179. DOI: 10.1002/jqs.2945

JQS Journal of Quaternary Science QRA

Rapid Communication

First discovery of Holocene Alaskan and Icelandic tephra in Polish peatlands

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NOTEĆ FOREST

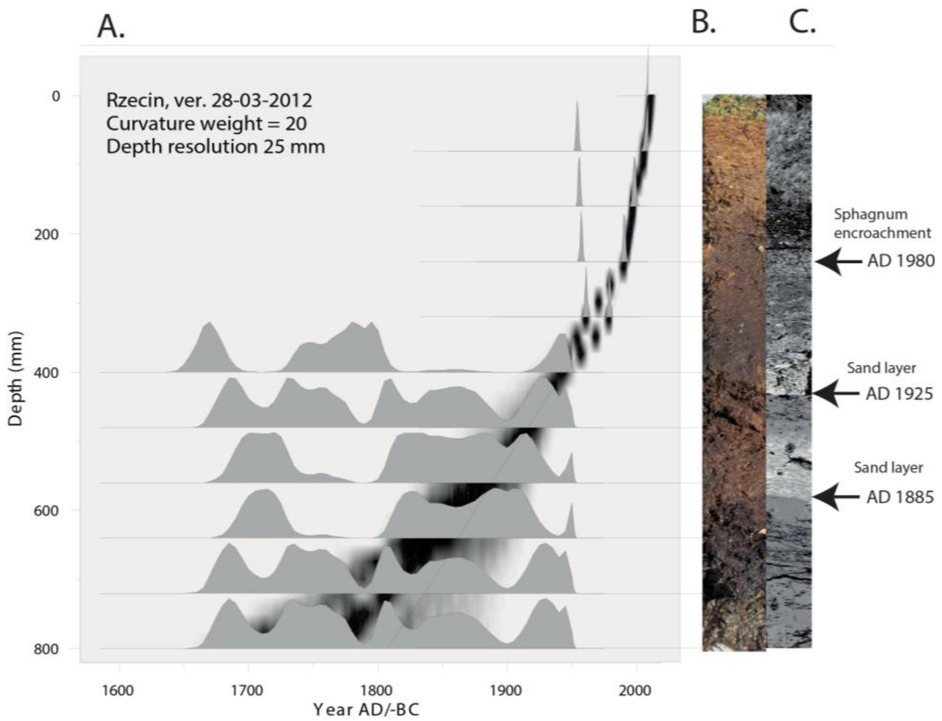
The Noteć Forest (*Polish*: Puszcza Notecka) is located between Warta and Noteć rivers in the Toruń-Eberswalde ice marginal valley. Modern young glacial relief of the Noteć Forest was shaped during the post-glacial erosional activity of the ice sheet and then aeolian activity that shaped inland dunes. Huge water volumes were flowing west from the front of the melting ice sheet bringing immense quantities of the mineral matter. They were gradually transformed into the dunes from the end of Pleistocene to the Atlantic period. As an effect, the sandy dunes now reach the height of 35 m. Located in the ice marginal valley, the Noteć Forest is not only the largest dune area in Poland, but also one of the largest forest areas. Dune fields are covered with poor *Pinus sylvestris*-dominated forests (Pine forms up to 93% of the forest stands).

Rzecin mire, WETMAN experimental site

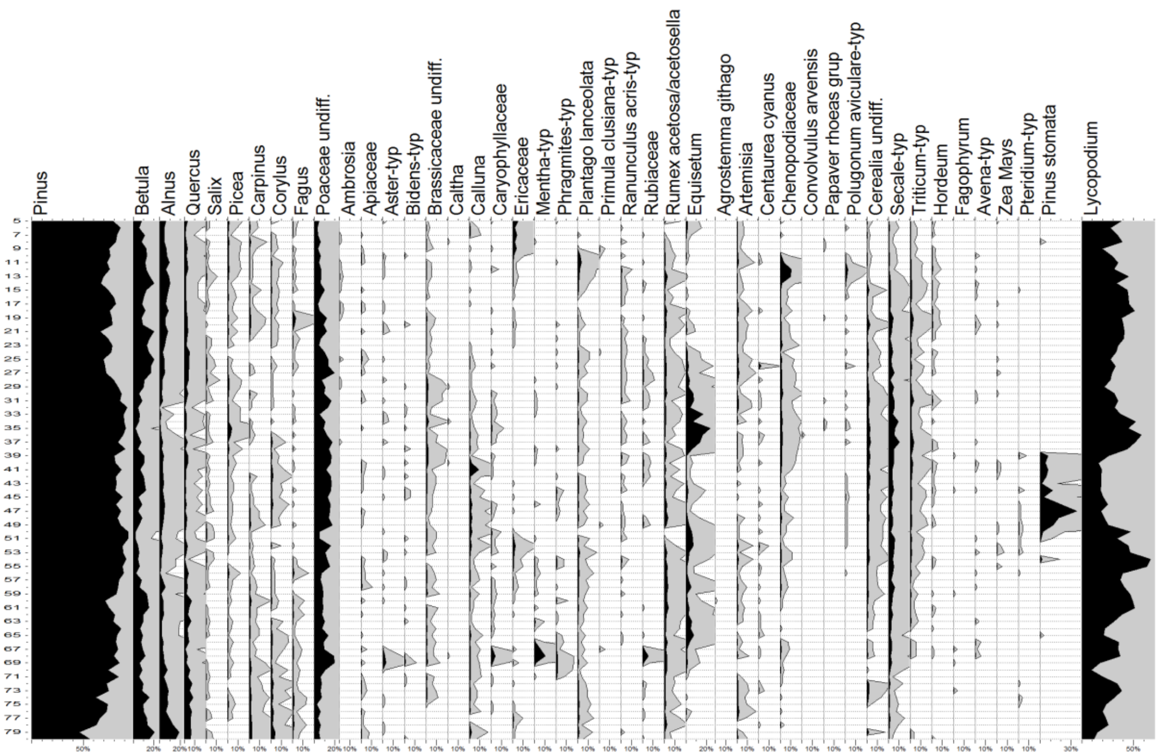
Rzecin mire and Rzecin lake (52°45'0'' N, 16°18'0'' E, 54 m a.s.l.) are located between dune areas of the Noteć Forest within the drainage basin of the Warta and Noteć Rivers. Both peatland and lake are protected within the Natura 2000 network and cover an area of 236.4 ha. Farms with meadows and pastures, are located on the edge of the peatland close to the forest, but the anthropogenic pressure on the mire ecosystem is now rather small. In the middle of the peatland, there is a 70-cm thick floating carpet of peat-substrate overgrown mostly by mosses underlain by saturated sediment (Barabach, 2012).

Two peat monoliths have been sampled from Rzecin mire in October 2011 for **multi-proxy investigations**. Core R1 was 80 cm-long and the bottom was dated to AD 1810; core R2 was 55 cm-long and the bottom was dated to AD 1880 (Lamentowicz *et al.*, 2015b; Milecka *et al.*, 2017). Plant macrofossils, testate amoebae, peat microtomography and radiocarbon dating were used in high-resolution to reconstruct the recent human impact on the peatland. Deforestation and the digging of the Rzecin drainage canal between AD 1880 and 1890 marked the beginning of major changes in the wetland ecosystem and caused habitat acidification and floating mat development. Based on our quantitative reconstruction, the water table decreased during the years preceding *Panolis flammea* outbreak in AD 1923. After the outbreak, the water table increased and this event have been shown on the historical maps of the region (ephemeral lakes in the Noteć Forest) (Barabach, 2012). The next acidification event, connected with *Sphagnum* appearance, began ca. AD 1990.

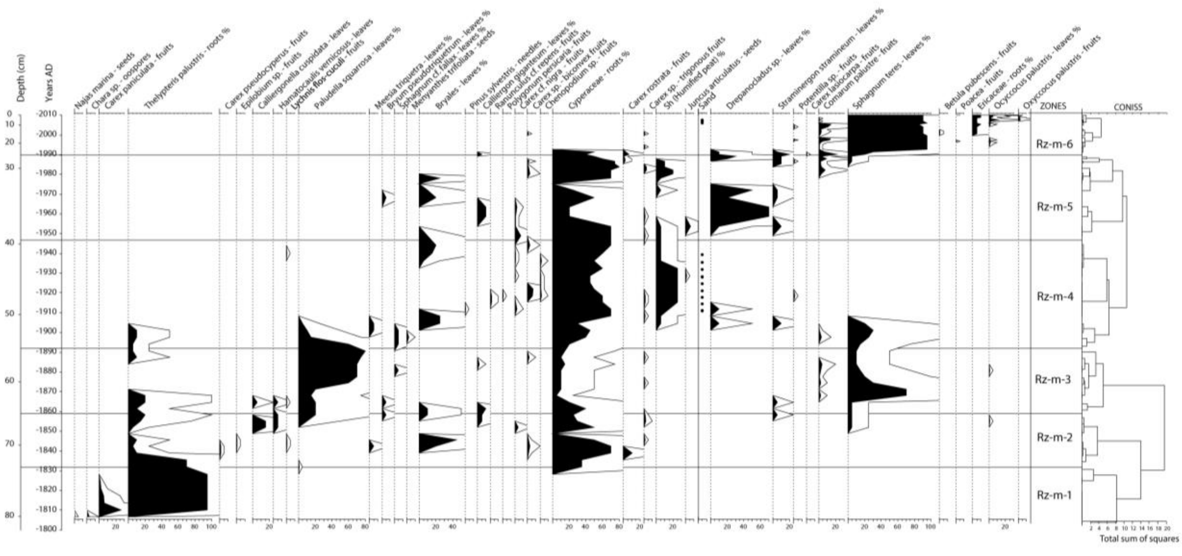
Rzecin mire is under investigation and constant monitoring since almost 15 years by scientist from Poznań University of Life Sciences, who established **Measuring Station Rzecin POLWET** (Chojnicki *et al.*, 2010; Juszczak *et al.*, 2013). The station is equipped with the Eddy covariance tower that provides a key atmospheric measurement technique to measure and calculate vertical turbulent fluxes within atmospheric boundary layers. Two manipulative experiments are now performed at the mire: **WETMAN** since 2014 (through Polish-Norwegian Research Programme, www.wetman.pl) and **FLUOGPP** since 2017. Both experiments focus on the response of peatland ecosystem (carbon and methane fluxes, vegetation, microbes) to warming and reduced precipitation. In the WETMAN experiment active warming have been applied (Juszczak *et al.*, 2016) whereas in FLUOGPP passive warming (Open Top Chambers) is applied.



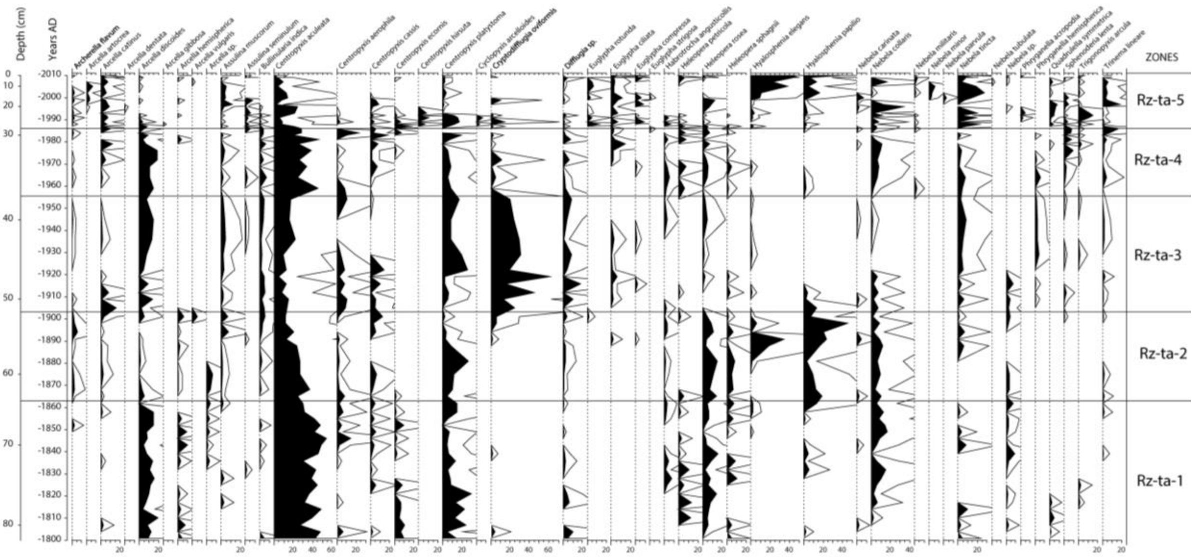
Age-depth model of the Rzecin 1 core (A); picture of the monolith (B); output of the peat X-ray tomography revealing main events in the history of Rzecin wetland (Lamentowicz *et al.*, 2015b)



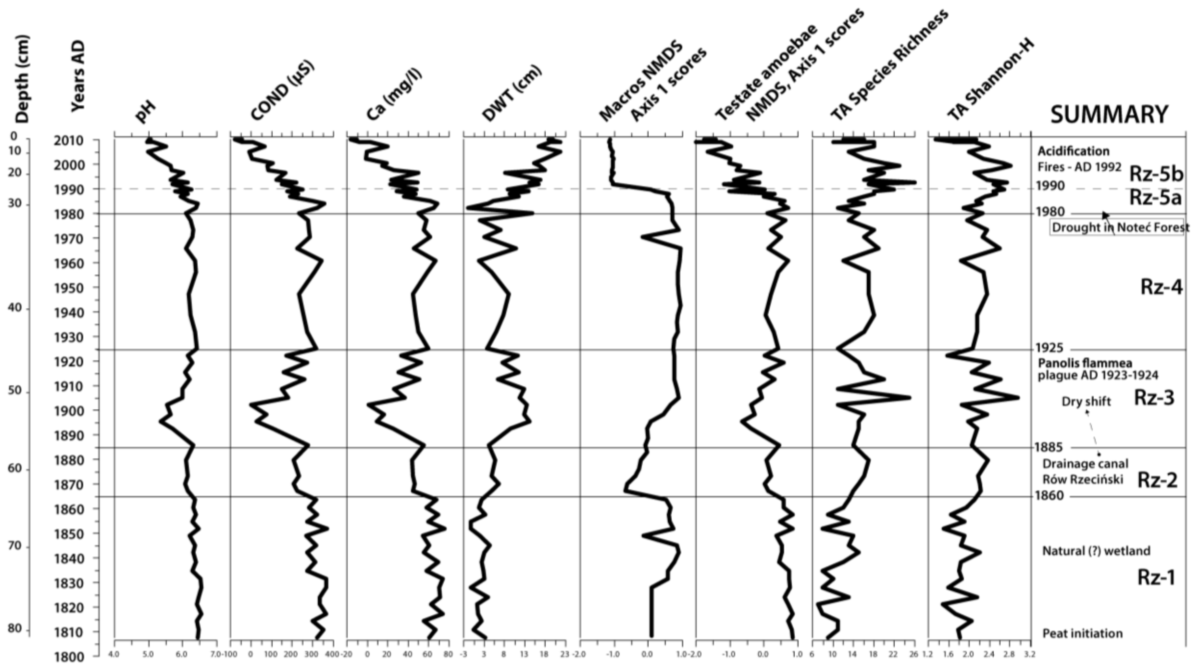
Palynological % diagram. Analysis: Jan Barabach (Milecka *et al.*, 2017)



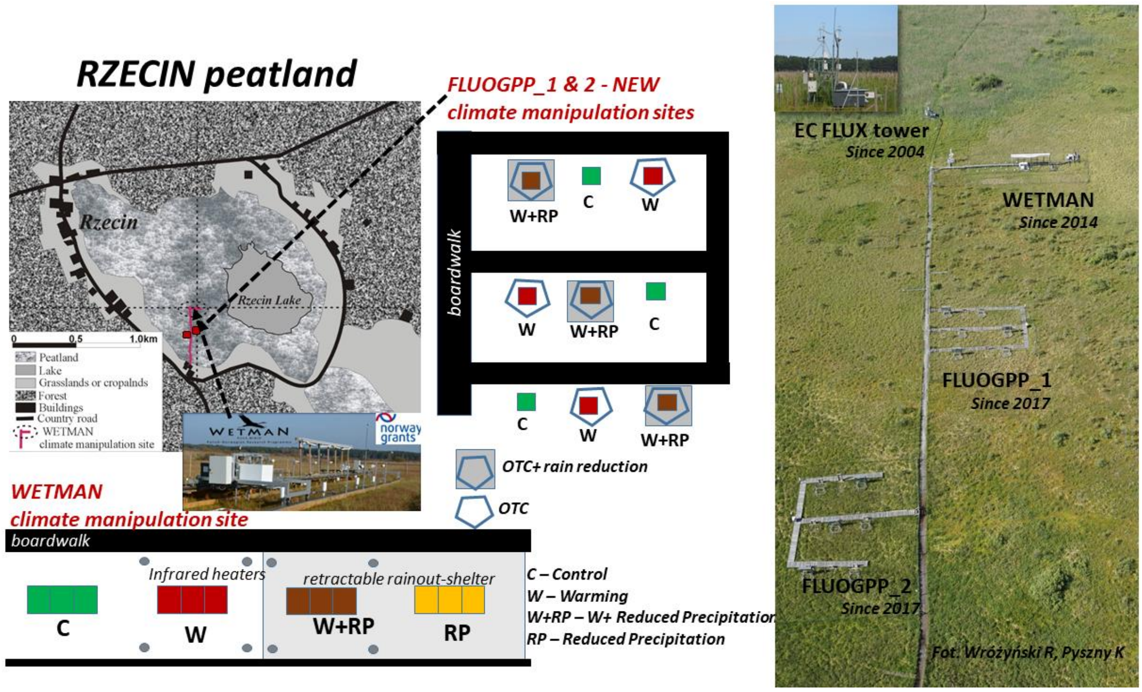
Plant macrofossils diagram. Analysis: Mariusz Gałka (Lamentowicz *et al.*, 2015b)



Testate amoebae % diagram. Analysis: Magdalena Mueller, Mariusz Lamentowicz (Lamentowicz *et al.*, 2015b)



Comparison of the quantitative reconstruction of calcium content, conductivity and pH based on the analysis of testate amoebae, with main gradients of change and diversity. Analysis: Mariusz Lamentowicz (Lamentowicz *et al.*, 2015b)



The design of WETMAN and FLUOGPP experimental sites

Limnological Review (2012) 12, 3: 103-114
DOI 10.2478/v10194-011-0050-0

The history of Lake Rzecin and its surroundings drawn on maps as a background to palaeoecological reconstruction

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Quaternary International 357 (2015) 282–294

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Reconstructing human impact on peatland development during the past 200 years in CE Europe through biotic proxies and X-ray tomography

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Research paper

The Holocene
1–14

DOI: 10.1177/0959683616670468
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Hydrological changes in the Rzecin peatland (Puszcza Notecka, Poland) induced by anthropogenic factors: Implications for mire development and carbon sequestration

Krystyna Milecka,[1] Grzegorz Kowalewski,[1] Barbara Fiałkiewicz-Kozieł,[1] Mariusz Gałka,[1] Mariusz Lamentowicz,[1] Bogdan H Chojnicki,[2] Tomasz Goslar[3,4] and Jan Barabach[1]

Polish J. of Environ. Stud. Vol. 19, No. 2 (2010), 283-291

Original Research

Measurements of Carbon Dioxide Fluxes by Chamber Method at the Rzecin Wetland Ecosystem, Poland

Bogdan H. Chojnicki[1]*, Maria Michalak[1], Manuel Acosta[1], Radosław Juszczak[1], Jürgen Augustin[2], Matthias Drösler[3], Janusz Olejnik[1]

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Plant Soil (2013) 366:505–520
DOI 10.1007/s11104-012-1441-y

REGULAR ARTICLE

Ecosystem respiration in a heterogeneous temperate peatland and its sensitivity to peat temperature and water table depth

Radosław Juszczak · Elyn Humphreys · Manuel Acosta · Maria Michalak-Galczewska · Dariusz Kayzer · Janusz Olejnik

Geophysical Research Abstracts
Vol. 18, EGU2016-14558-2, 2016
EGU General Assembly 2016

Short term response of a peatland to warming and drought – climate manipulation experiment in W Poland

Radosław Juszczak (1), Bogdan Chojnicki (1), Marek Urbaniak (1), Jacek Leśny (1), Hanna Silvennoinen (2), Mariusz Lamentowicz (3), Anna Basińska (1,4), Maciej Gąbka (5), Marcin Stróżecki (1), Mateusz Samson (1), Dominika Łuców (3), Damian Józefczyk (1), Mathias Hoffmann (6), and Janusz Olejnik (1)

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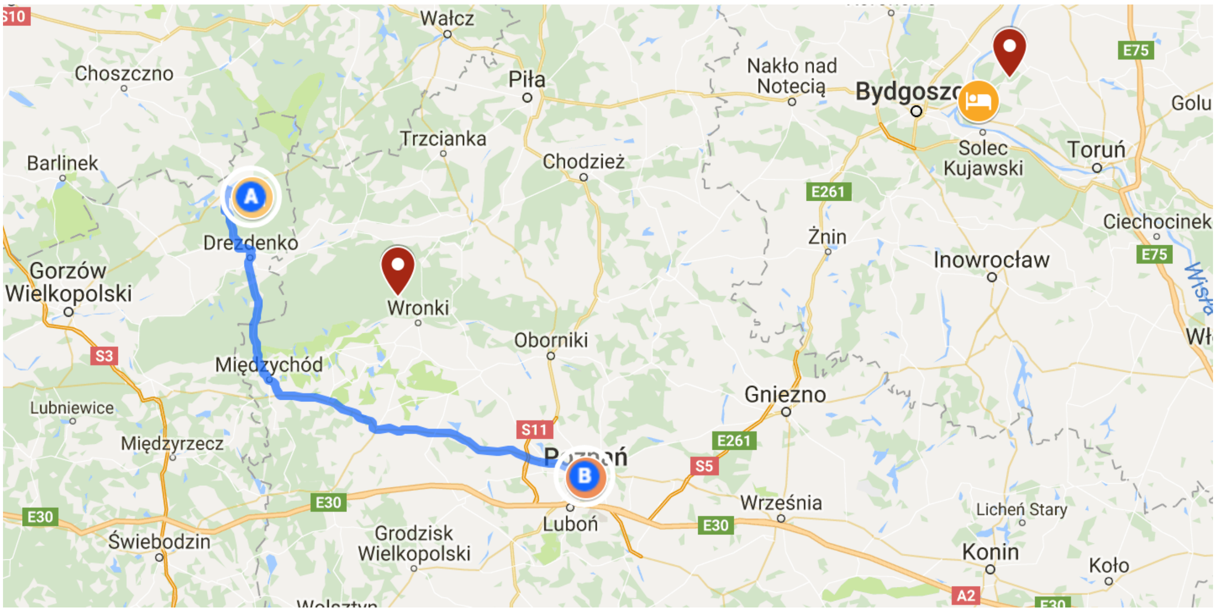
Day 7 – Friday, 7.09.2018
Departure

Transfer to Poznań

9 h	Departure to Poznań
ca. 11 h	Arrival in Poznań (Ławica airport and main train station)



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All the presented papers can be found on the memory sticks as pdf files.

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