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A CHIRONOMIDAE-BASED RECONSTRUCTION OF THE SAALIAN-EEMIAN TRANSITION (MIS 6a–MIS 5e) IN A PALAEOLAKE FROM THE "PARCHLINY 2016" PROFILE, CENTRAL POLAND

MATEUSZ PŁÓCIENNIK[1], SYLWIA ŁUKAWSKA[2], EWA JANOWSKA[1], DARIUSZ KRZYSZKOWSKI[3], DARIUSZ WIECZOREK[4], LUCYNA WACHECKA-KOTKOWSKA[5]

Abstract. In the end of Saalian Glaciation (Wartanian Stadial, MIS 6a) there formed many glacial depressions, melt-out kettle holes and subglacial channels in central Poland's ice-marginal zone. In these landforms, there developed a lakeland that existed to the Early Weichselian (5d-a). Following excavation in 2016 on the eastern wall of the Szczerców field, lacustrine deposits were recognised in the Parchliny 2016 profile. A previous multi-proxy study of the Parchliny 2016 profile concerning a reconstruction of the palaeolake included analyses of pollen, plant macrofossils, wood macrofossils, diatoms, cladocerans, ostracods and molluscs. The present work presents the Chironomidae analysis for the above-mentioned section. The collected subfossils could be identified from the keys presenting modern Palaearctic fauna. The Chironomidae indicate a temperate climate in the region and favourable, meso/eutrophic conditions in the palaeolake during the Late Saalian (MIS 6a). The changes in subfossil numbers reveal that the Zeifen interstadial fells at 24.38–24.23 m core depth and the subsequent Kattegat stadial at 24.18–23.83 m, but head capsule count is too low for quantitative temperature estimations. From the Eemian (MIS 5e) transition, they decline in the sediment and are represented only by two head capsules at the 23.33 m core depth below the ground surface. The increase in summer temperature, trophic status and stratification of the lake may have caused an oxygen depletion that eliminated sensitive taxa. However, no species are observed that are resistant to eutrophication and anoxia replacing sensitive ones in the assemblages. Sediment desiccation and compaction may have caused the decomposition of Chironomidae subfossils in the deposits from the Eemian interglacial, so their apparent decline in the ecosystem may be misleading.

Key words: non-biting midges, lacustrine sediments, climate change, palaeoecological analysis, Szczerców field

Introduction

During the Quaternary period, glacial–interglacial cycles dominated the landscape, freshwater and biocenoses development. In temperate regions, changes in the environment took the most significant shift. The Penultimate Glacial Maximum (PGM) in the Odranian Glaciation (MIS 6) and the Last Glacial Maximum (LGM) in the Weichselian Glaciation (MIS 2) shaped relief in the central European Plain, Lowland Belt. These ice sheets left the glaciomarginal zone with small or large glacial depressions, melt-out kettle holes, subglacial channels, end moraines, kames, eskers and outwash plains. During the termination of the glaciations in concave landforms lakes formed. The process of lake formation, succession and terrestrialisation is well documented

[1] University of Lodz, Department of Invertebrate Zoology and Hydrobiology, Faculty of Biology and Environmental Protection, Banacha 12/16, 90-237 Lodz; e-mail: mateusz.plociennik@biol.uni.lodz.pl, ORCID: 0000-0003-1487-6698; e-mail:1ewajanowska@gmail.com, ORCID: 0009-0001-9061-6962
[2] Provincial Inspectorate of Plant Health and Seed in Lodz, Siewna 13a, 94-250 Lodz; e-mail: sylwia.lukawska99@gmail.com, ORCID: 0009-0001-9070-2940
[3] University of Wrocław, Institute of Geography and Regional Development, Plac Uniwersytecki 1, 50-137 Wrocław; e-mail: dariusz.krzyszkowski@uwr.edu.pl, ORCID: 0000-0003-4451-2051
[4] Polish Geological Institute – National Research Institute, Holy Cross Branch, Zgoda 21, 25-953 Kielce; e-mail: dwie@pgi.gov.pl, ORCID: 0000-0001-6612-5349
[5] University of Lodz, Department of Geology and Geomorphology, Narutowicza 88, 90-139 Lodz: e-mail: lucyna.wachecka@geo.uni.lodz.pl, ORCID: 0000-0002-5440-6300

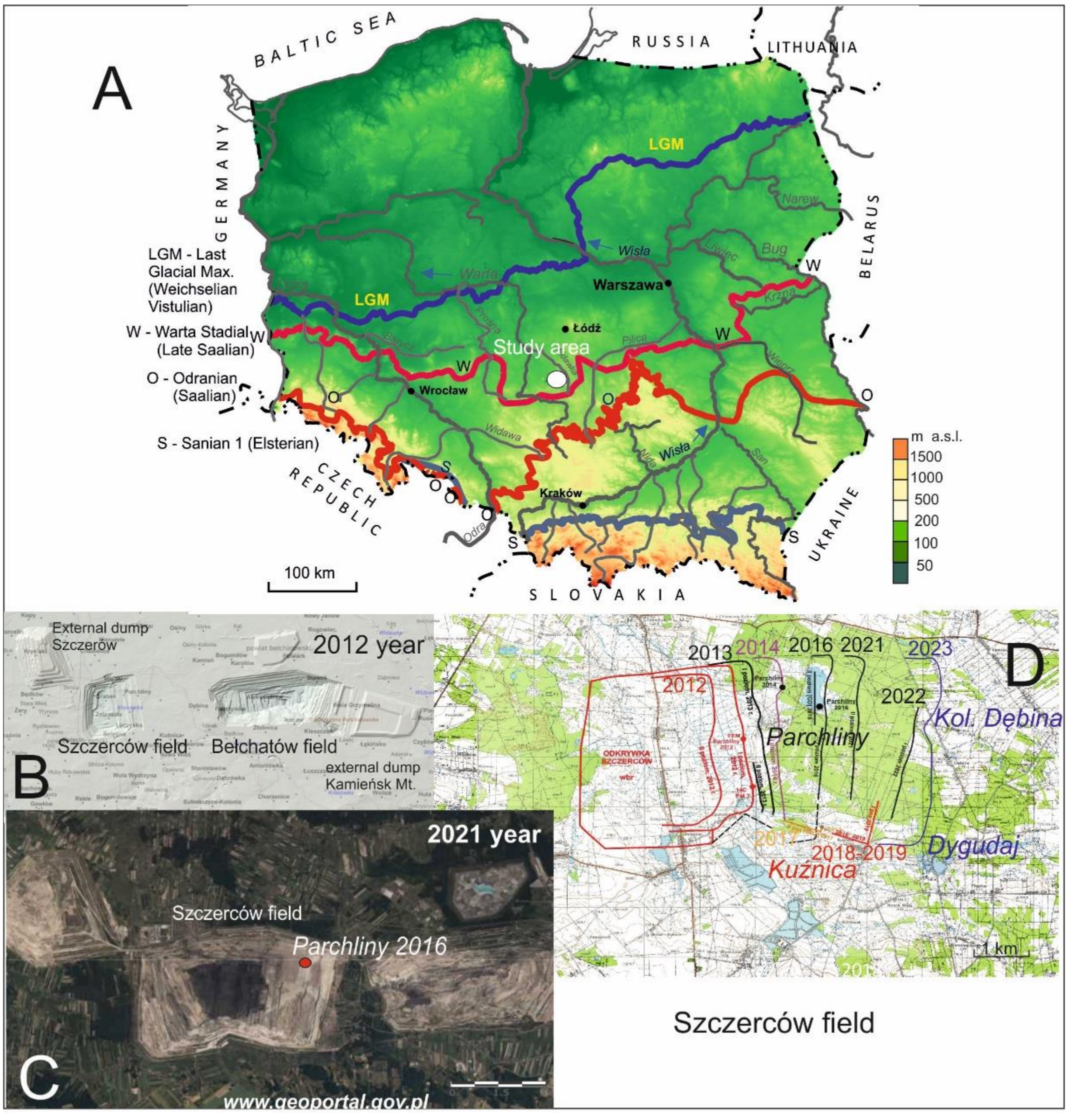

Fig. 1. A – Investigated area against the extent of the Pleistocene glaciations in Poland (after Marks 2011; Wachecka-Kotkowska 2015)
B – Szczerców field in the 2012 year
C – Szczerców field in the 2021 year and location of Parchliny 2016 profile
D – Parchliny 2016 profile against the topographical map and progress in exploitation

in the young postglacial landscape from the Late Weichselian and Holocene (Marks *et al.* 2022). The geoarchives of relatively young lakes can be easily dated, and their ecosystems are reconstructed in detail from the biota and geochemical proxies. Lake deposits from the earlier glacials and interglacials are more difficult for palaeoecological reconstructions due to less precise age modelling, sediment transformation, compaction and worse subfossil preservation (Niska 2012). Moreover, lake deposits older than the Late Weichselian or Holocene have been investigated less. Central Poland represents the type of old glacial landscape whose relief was formed during the Wartanian Stadial of the Odranian (Late Saalian, MIS 6) Glaciation. There are only a few postglacial paleolakes that thrived to the Late Pleniweichselian and Holocene. Currently, they are peatlands (e.g. Twardy *et al.* 2010; Forysiak *et al*. 2012).

The Eemian (MIS 5e) deposits indicate the presence of a large lakeland formed during the Late Odranian (Late Saalian) and existing up to the Early Weischelian in the Lodz region (Bruj, Roman 2007; Goździk, Skórzak 2011; Roman 2016; Mirosław-Grabowska *et al.* 2018; Roman *et al.* 2021).

In the Szczerców Basin (Fig. 1), during the field works into the Szczerców field of the Bełchatów Lignite Opencast Mine, deposits of Late

Saalian–Eemian lakes (MIS 6a–MIS 5e) were found.

Previous studies of the palaeolakes sediment in the Parchliny 2014 and 2016 profiles were based on the geological settings, geochemical features, palaeobotanical and palaeozoological analyses: pollen, plant macrofossils, wood macrofossils, diatoms, cladocerans, ostracods and molluscs (Wachecka-Kotkowska *et al.* 2017, 2018, 2021; Majecka *et al*. 2022). However, Chironomidae subfossils were not investigated.

The only studies using Chironomidae as a palaeoclimate proxy earlier than MIS 2 from Poland are related to the discovery of rhino *Stephanorhinus kirchbergensis* (Jäger 1839) remains in palaeolake sediments near Gorzów Wielkopolski (NW Poland) (Hrynowiecka *et al*. in press). There is also research being conducted on Mazovian (MIS 11c) and Eemian (MIS 5e) Chironomidae stratigraphy in Poland, but the results are yet to be published (Polkowski *et al*., in preparation). Currently, midges are being analysed from old deposits more widely, *i.e.* in Greenland (McFarlin *et al.* 2016), Finland (Plikk *et al.* 2019) and Germany (Bolland *et al.* 2022). Chironomidae constitute one of the leading groups of palaeoclimate, palaeohydrology and habitat change indicators in lake sediments (Brooks *et al.* 2007) and have been used widely for hydroclimatic reconstructions in the Lodz region (*i.e.*, Płóciennik *et al.* 2015, 2016, 2021; Antczak-Orlewska *et al.* 2023). They are valuable summertime air temperature indicators (Medeiros *et al.* 2022), but the resolution of Chironomidae-inferred temperature reconstructions is limited, and climate signals often interfere with other factors like trophic, pH and water-level changes (Telford 2019; Płóciennik *et al.* 2020).

Chironomidae are mostly used as a tool for Late Weichselian and Holocene palaeolimnological reconstructions, though the Eemian interglacial is important in understanding present shifts in lake ecosystems caused by climate warming. Here is presented one of Poland's first Chironomidae stratigraphy reconstructions of the transition from the Late Saalian (Wartanian) to Eemian in lake sediments.

The first aim of this study is to analyse subfossils' perseverance and morphotype convergence in the Parchliny 2016 profile (MIS 6––MIS 5e transition) with taxonomy based on Late Weichselian–Holocene fauna (Brooks *et al.* 2007). The second aim is to reconstruct hydrological and habitat conditions in the palaeolake from the Parchliny 2016 profile:

- it is hypothesised that Chironomidae from the Late Saalian (Wartanian) to Eemian transition represent the same morphotypes that existed in central Poland since the Late Weichselian and their subfossils are well preserved in the Eemian lake sediments;
- the investigated palaeolake underwent a severe hydrological and trophic state change from glacial to interglacial periods that was caused by climate warming and territorialisation processes.

Methods

The material includes 18 sediment samples collected from the Parchliny 2016 section described below. The sample resolution was at most 5 cm (see Fig. 3). The samples were passed through a 90 μm sieve and processed following Brooks *et al.* (2007). Subfossil identification follows mainly the keys of Brooks *et al.* (2007) and Andersen *et al.* (2013). Ecological interpretation of the morphospecies habitat preferences is based mainly on Brooks *et al.* (2007), Vallenduuk and Moller Pillot (2007), Moller Pillot (2009, 2013) and the authors' personal experience. The reference collection is deposited at the Department of Invertebrate Zoology and Hydrobiology (University of Lodz). The stratigraphic diagram was constructed using C2 software (Juggins 2007) version 1.8.0.

Geological settings and study area

At the end of the Wartanian Stadial, MIS 6a was formed an ice-marginal zone with several strings of end moraines, glacial depressions, melt-out kettle holes, kames, eskers, subglacial channels and tunnel valleys (Baraniecka, Sarnacka 1971; Wieczorek, Stoiński 2019; Majecka *et al.* 2022).

Following excavation in 2016 on levels I and II on the eastern wall of the Szczerców field (the Bełchatów Lignite Opencast Mine), lacustrine deposits were documented in the Parchliny 2016 site (Fig. 2). The Parchliny 2016 profile (51°14'38.2"N; 19°09'46.5"E) is from the lower part of a former lake that formed within a subglacial channel, a melt-out kettle hole (Majecka *et al.* 2022) (Fig. 2). The basement of the profile is com-

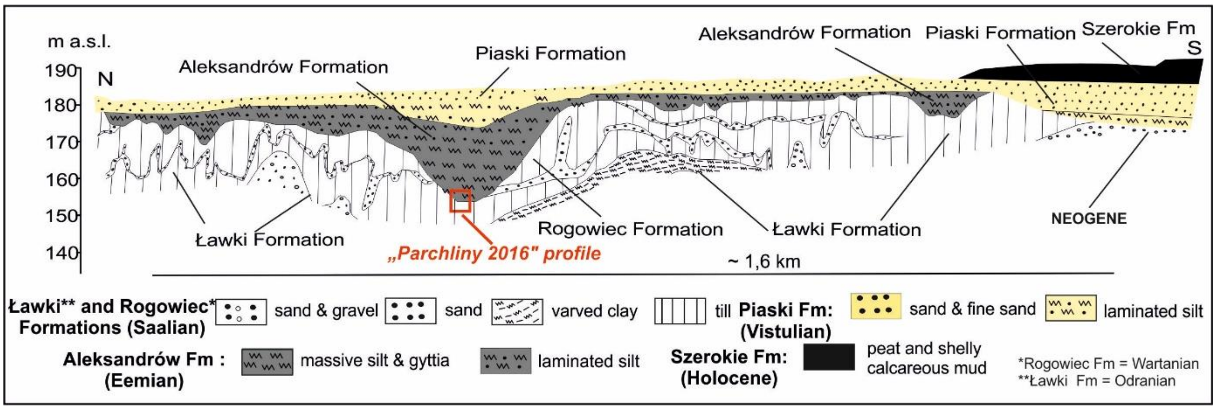

Fig. 2. Location of the Parchliny 2016 profile on the eastern wall of the Szczerców field

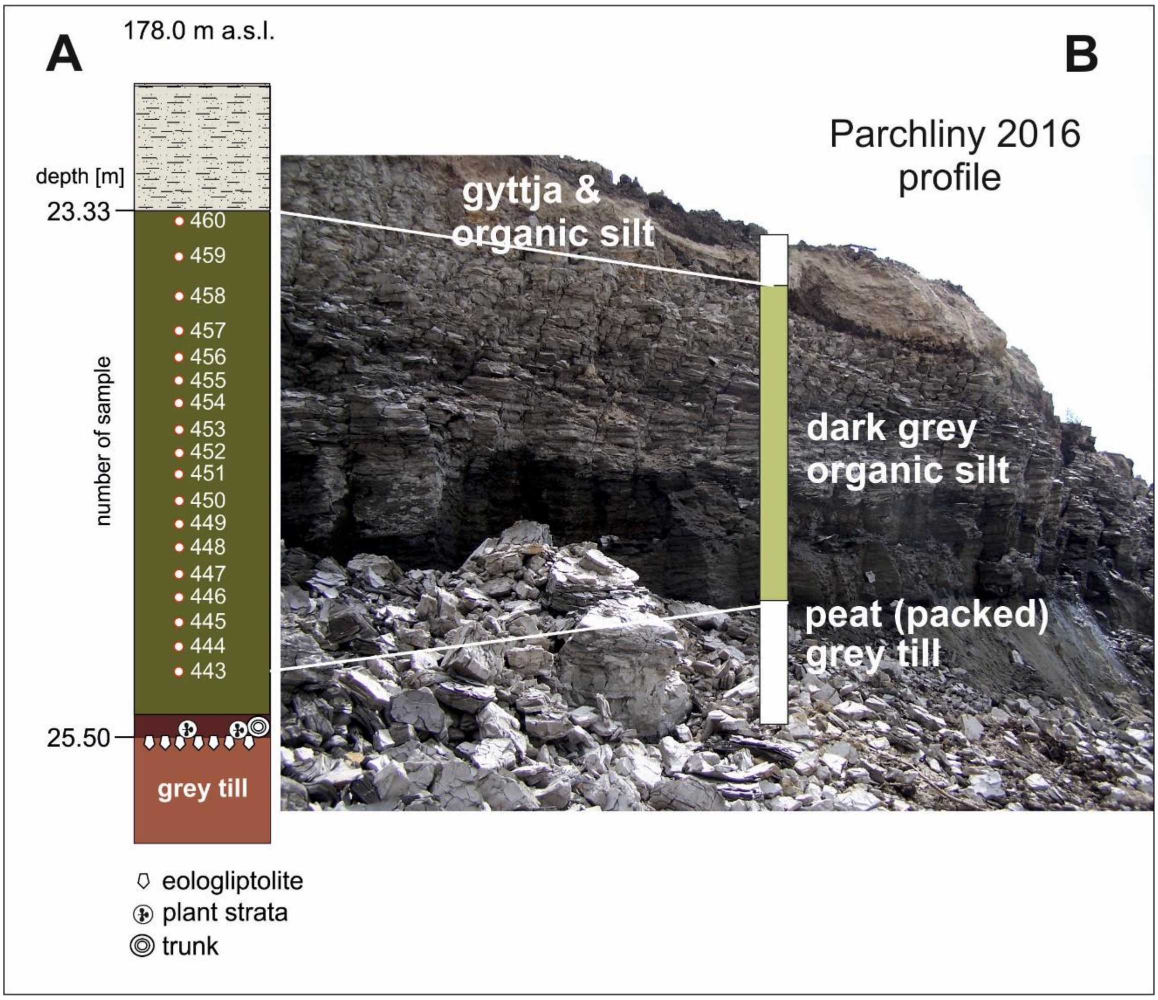

Fig. 3. A – Lithological profile with the location of samplings
B – Parchliny 2016 profile on the background of the outcrop

posed of glaciotectonically disturbed glacial tills with sand interlayers. The elevation of the ground surface in this area before excavation commenced, was ~178.0–181.5 m a.s.l. At the base of the profile, there were the Saalian glacial till layers from Rogowiec and/or Ławki formations (Allen, Krzyszkowski 2008; Wachecka-Kotkowska *et al*. 2021). It is typical basal till with a large amount of gravel. Lithological studies of the gravel indicate the prevalence of fragments Scandinavian rocks (58.5%) over local ones (41.5%) (Majecka *et al*. 2022). The boundary between the till and the overlying deposits is clearly defined. Above the till, there are biogenic deposits that include a fragment of a tree bough. At a depth of 24.48 m, there is a dense layer of peat with organic debris at the surface. The majority of the analysed profile consists of layered organic clayey gyttja and dark grey organic silt, located within the depth range of 24.44–23.33 m. Just before the top of the Parchliny 2016 profile, there is a noticeable change in the lithology of the lacustrine deposits, with the appearance of sandy silt and silty sand deposits of ~5–20 m thick.

The top of the profile was determined at a depth of 23.33 m, while its base was 24.50 m below the ground surface (Fig. 3).

Above the analysed profile, the thickness of the lake deposits (Aleksandrów Formation connected with Eemian interglacial, MIS 5e and Early Weichselian, MIS 5d-a) was ~4–6 m. The higher position was occupied by fluvial and slopes sands and silts of the Piaski Formation (connected with Middle and Late Weichselian = Vistulian Glaciation, MIS 4-2) (Fig. 2).

The Parchliny 2016 profile and previous Parchliny 2012 and Parchliny 2014 profiles document the existence of the so-called "Eemian Lakeland" in the Szczerców region (Goździk, Skórzak 2011; Wachecka-Kotkowska *et al.* 2018; Wieczorek, Stoiński 2019). For the 2016 Parchliny profile (20 samples from a depth of 24.48–23.33 m), a series of multi-proxy analyses (diatoms, pollen, Cladocera, plant macrofossils, woody macrofossils, mollusc and ostracods; elemental and isotope values) was conducted that allowed the succession to be subdivided into six local pollen zones (L PAZ–PI-PVI), four local diatom zones (DPAZ, P1a,b,c and P2) and six local Cladoceran zones (I-A, I-B, I-C; II-A, II-B, II-C). All zones were correlated stratigraphically from below as Stadial 1, Zeifen and Kattegat representing the decline of the Warta Stadial (MIS 6a) and then transitioning upwards into the beginning of the Eemian interglacial (Procratic and Mesocratic phase with two local levels) (Majecka *et al.* 2022). The whole local profile was compared with sites from central Poland: Parchliny 2012, Parchliny 2014 (Wachecka *et al.* 2018), Kuców IIc (Niska 2008), Zgierz-Rudunki (Jastrzębska-Mamełka 1985), Żabieniec Południowy (Majecka 2014), Warszawa Warwrzyszew XV (Krupiński, Morawski 1993), Babin (Żarski *et al.* 2018) and Wola Sarogrodzka G-122s (Kupryjanowicz *et al.* 2021).

Results

Chironomidae stratigraphy

In the sequence of Chironomidae assemblages, two zones have been identified: the Wartanian Stadial of the Odranian Glaciation (Late Saalian) and the Early Eemian. These zones differ in subfossils concentration and species composition (Fig. 4).

The Late Saalian zone ranges from 24.38 m to 23.83 m depth. The total number of subfossils in this zone is 104. The assemblages in this zone are relatively abundant and diverse. The highest number of head capsules was found at 23.98 m (31 head capsules), whereas no head capsules were collected at 24.03 m. One of the dominant species for this zone is *Corynocera ambigua*, which reaches a maximum of 50% at the lowest sample. Its presence is consistently high, but it temporarily disappears at depths of 24.28––24.18 m. Another noticeable species is *Microtendipes pedellus*-type, which usually accounts for up to 33%, reaching 100% at the 24.28 m sample. *Chironomus plumosus*-type reaches up to 12.5%, with a maximum of 50% at 23.93 m. Subdominant species in this zone are *Cladopelma lateralis*-type, which reaches a maximum of 22%, *Sergentia coracina*-type reaching 13%, and *Propsilocerus lacustris*-type reaching up to 12.5%. A noteworthy morphospecies is *Paratanytarsus penicillatus*-type, with two peaks of occurrence at depths of 24.23 m and 23.98-23.93 m.

The next Early Eemian zone ranges from 23.83 m to 23.33 m, in which there are nearly no Chironomidae subfossils. Only singular head capsules of *Paratanytarsus austriacus*-type and *Psectrocladius limbatellus*-type were found at the topmost 23.33 m.

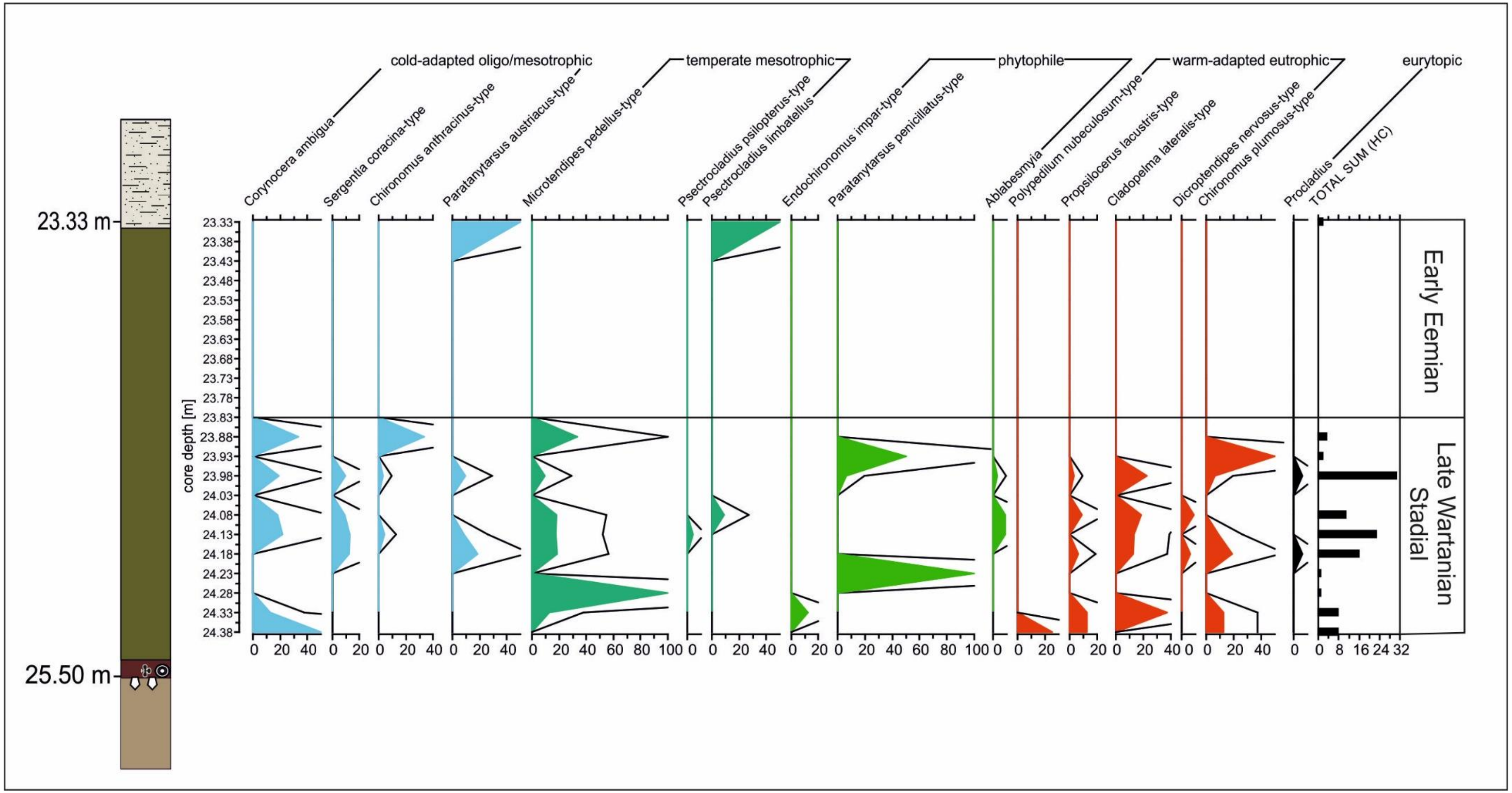

Fig. 4 Chironomidae percentage stratigraphic diagram from the Parchliny 2016 profile

HC – head capsule count

Ecological interpretation

C. ambigua is a species that prefers cool and temperate summer temperatures and that resides in shallow lakes in Arctic and sub-Arctic regions but is also recorded in central-European lakelands (Kotrys *et al.* 2020). In the discussed stratigraphic section, it is abundant throughout the Late Saalian sequence. The domination of *C. amigua* during the glaciations but also in warm interstadials during periods of flux in the environment is characteristic of this species (Brodersen *et al*. 1999).

Besides *C. ambigua* and three other cold--adapted oligotrophic species, there appear mesotrophic *M. pedellus*-type and, sporadically, taxa from the *Psectrocladius* genus. *Mictrotendipes* and *Psectrocladius* are ubiquistic genera and occur in variant conditions from mesotrophic through meso/eutrophic to dystrophic lakes, but they usually avoid hypertrophic states and high summer temperatures. The abovementioned oligotrophic and mesotrophic taxa prove cool-temperate summers typical of boreal and glacial climates, though these species coexisted with taxa preferring higher trophic states and warmer climates, like *C. plumosus*-type, *Dicrotendipes nervosus*-type, *P. lacustris*-type and *C. laterais*-type. *P. lacustris*-type and *C. lateralis*-type are present in lower trophic states and are frequent in Late Glacial sequences through the Palaearctic boreal zone (Self *et al.* 2011; van Asch *et al.* 2012; Engels *et al.* 2022) but they can be found even in heavily polluted and hypertrophic lakes (Kornijów, Halkiewicz 2007; Moller Pillot 2009). Generally, the species composition of the Late Saalian zone with *C. ambigua*, *M. pedellus*-type, *P. lacustris*-type and *C. lateralis*-type suggests moderate eutrophic conditions and temperate climate. The phytophile taxa are rare compared to bottom dwellers, which indicates rather weak macrophyte vegetation in the lake in the Late Saalian. The Chironomidae assemblages from the Late Saalian (Fig. 4) seem to correspond with the pollen, diatom and Cladocera zonation distinguished earlier for this profile (Majecka *et al*. 2022), but the pollen-based intervals of the Zeifen interstadial (24.43–24.28 m) and subsequent Kattegat stadial (24.23–23.83 m) fall in chironomid assemblages at 24.38–24.23 m and 24.18–23.83 m, respectively. Lower head capsule counts in the Zeifen interstadial indicate less favourable conditions for non-biting midges than in the following Kattegat stadial, but it should not been interpreted in term of temperature variation, as midges can also be abundant in cold climates. Species composition does not change significantly, and the above interstadial and stadial can be distinguished mainly on subfossil concentrations.

It is difficult to deliberate about July air temperature variation from the Zeifen to the Kattegat. Quantitative temperature may be inferred from chironomids only with head capsule counts of above 50. The temperatures of the warmest month in the Late Saalian presented in Majecka *et al*. (2022) seem to be too low comparing to chironomid assemblages. Taxonomic composition indicates rather temperate conditions, as even morphospecies classified here as cold-adapted (Fig. 4) represent a cool temperate climate rather than a cold one. They are i.e. abundant in warm interstadial conditions during the Late Weichselian and even occur currently at Polish Lakelands where the mean July air temperature is above 17°C (Kotrys *et al*. 2020). Taxa limited to very low temperatures, like *Tanytarsus lugens*--type or *Corynocera oliveri*-type, are absent from the profile. At the Eemian onset, non-biting midges nearly disappear in the Parchliny 2016 profile, but singular head capsules of *P. austriacus*-type and *P. limbatellus*-type at 23.33 cm reveal aquatic conditions.

Discussion

Chironomidae subfossil concentration and taxonomic issues

The subfossil concentration was too low (even in the Late Saalian zone) for a palaeotemperature reconstruction. In none of the samples did the head capsule number reach the 50 required for reliable quantitative reconstruction (Quinlan, Smol 2001). Nevertheless, the results allowed for qualitative habitat ecological interpretation (see Results section). This raises the question of the preservation of subfossils in the investigated lake sequence. Head capsules were often in a poor state, but identification was usually possible. It cannot be excluded that, in the Early Eemian zone, there were non-biting midge larvae in the lake, as deposits indicate an aquatic environment (Majecka *et al.* 2022) but that sediment desiccation and compaction caused subfossils to decompose. The collected species are common in the Weichselian and Holocene lake sequences of the region (*i.e.* Płóciennik *et al.* 2011, 2015) and could be easily associated with morphotypes described by Brooks *et al.* (2007). The small differences in collected material from the types presented by Brooks *et al.* (2007) and Larocque-Tobler (2014) previously reported from the region may be explained by the differences in populations that settled in the two periods. The subfossils from MIS 6a-5e transition represented earlier ones than those living in the region in MIS 2-1 transition. The morphological differences are insignificant and do not require taxonomic discussion.

The palaeolake development and local palaeoclimate issues

The analysed sequence of assemblages indicates relatively favourable conditions for Chironomidae in the Late Saalian. It is symptomatic that, also during the Late Weichselian in many palaeolakes in central Poland, there were more abundant and diverse midge communities than in the later Holocene epoch. Glaciations manifested in lower temperatures, lake productivity and dynamic geological processes that caused higher sedimentation in lake basins. However, hydrological conditions during glacial terminations can be more favourable for chironomids (Płóciennik *et al.* 2020). That phenomenon is typical for oxbows or other shallow palaeolakes in valley terraces (Pawłowski *et al*. 2016; Forysiak *et al.* 2023), but also some postglacial lakes (Płóciennik *et al.* 2015). Chironomidae communities transformation is often associated with lake succession, shallowing, acidification and oxygen depletion caused by paludification (Słowiński *et al.* 2016). Sometimes it is difficult to explain Chironomidae disappearance during interglacials that are warmer and reveal higher production in lakes. In deeper lakes, rising summer temperatures may induce stratification, which is unfavourable for benthic organisms in the profundal zone (Jyväsjärvi, Hämäläinen 2014; Płóciennik *et al*. 2022). Eemian sequences often evince low midge head capsule counts (Plikk *et al.* 2019; Bolland *et al.* 2021; Polkowski *et al.* in preparation). In the Parchliny 2016 case study, there were relatively diverse and moderately abundant midge communities during the Late Saalian, but from the onset of the Eemian onwards, chironomid subfossils nearly completely vanish from the lake.

Majecka *et al.* (2022) seem to give an ambiguous picture of the lake's history from the Parchliny 2016 profile. Cladocera had lower abundance and diversity during the Late Saalian, with the domination of mesotrophic taxa and an increase of the populations at the Eemian interglacial. In the Eemian there developed shallow-water, phytophile and eutrophic water flea species. Diatoms indicate oligotrophication of the lake in the Eemian and the development of a thick, stratified pelagic zone.

Chironomidae are benthic organisms, and only the first larval stages are thought to be planktonic, but they do not preserve in the sediments. The 3rd and 4th larval stages that are used as palaeoindicators reveal conditions in the benthic zone. They confirm the meso/eutrophic state of the Late Saalian zone, as oligo/mesotrophic, mesotrophic and eutrophic species coexisted. Temperate temperatures inferred from the pollen assemblages (Majecka *et al.* 2022) and moderate trophic state might imply good water mixing and oxygen conditions near the bottom, which gave favourable conditions for chironomid larvae. The disappearance of non-biting midges in the Eemian period might have been caused by oxygen depletion near the lake bottom which indicates an eutrophic or even hypertrophic state in the profundal zone (inferred from Cladocera) and lake stratification (inferred from diatoms). The development of phytoplankton in the pelagic zone without ample zooplankton populations clearly comes from the results of the study by Majecka *et al.* (2022). Oligotrophic diatoms that grow in spring and autumn do not exclude green algae blooms in summer that could eliminate water fleas from the pelagic zone due to oxygen depletion. Cladocera lived mainly in the littoral zone, where oxygen conditions were better, organic matter accumulated and macrophytes grew, but conditions for chironomids may have been too difficult. Oxygen saturation is important for Chironomidae, and many species are sensitive to oxygen depletion (Moller Pillot 2009, 2013); however, there are taxa like *C. plumosus*-type present in the Late Saalian zone that are resistant to low saturation (Armitage *et al*. 1995) and whose subfossils should be present in a high number in the investigated Eemian eutrophic lake. The lack of midge head capsules in the Eemian section may also be associated with sediment deposition conditions. In the analysed sequence, molluscs and Ostracoda were also not recorded. Very few plant macrofossils were found (Majecka *et al.* 2022). It is possible that midge subfossils decomposed due to sediment desiccation or compaction.

Palynological studies indicate that the Eemian was warmer than the Holocene interglacial (Bova *et al.* 2021; Kupryjanowicz *et al.* 2021; Kasse *et al.* 2022). In parallel to the associated terrestrial biome changes (Allen *et al.* 2020) freshwaters transformed to a different state than in the Saalian. Similar processes as in the Parchliny 2016 profile are observed at variant scales at the other palaeolakes on the Polish Plain (Roman *et al.* 2021; Suchora *et al.* 2022). There is currently wide knowledge about the lithology, geochemistry, palynology and Cladocera communities of the Polish Eemian Lakeland, but the stratigraphy of Chironomidae assemblages remains unknown. This, one of the first case studies from the region older than MIS 2 (see also Hrynowiecka *et al*. in press; Polkowski *et al*. in preparation) indicates that there is no need to construct a new taxonomy of Chironomidae morphospecies for MIS 6a–MIS 5 but that some common morphotypes from MIS 6a reveal small morphological differences to the current one (Brooks *et al.* 2007). Midge subfossils are usually in low concentrations in MIS 6-5 sections (Plikk *et al.* 2019; Bolland *et al.* 2021) which may be only partly related to the factual absence of larvae from the lakes and may depend on the decomposition of macrofossils from desiccation or compaction of the sediment. The Chironomidae analysis presented here completes the previous multi-proxy study (Majecka *et al.* 2022), shedding new light on the trophic and habitat conditions in the palaeolake of the Parchliny 2016 section. However, the concentration of subfossils was too low for a quantitative palaeotemperature reconstruction (Quinlan, Smol 2001). This is because Chironomidae analysis cannot confirm the statement by Majecka *et al*. (2022) that the transition from the Zeifen to the Kattegat caused a slight climate cooling. Regarding midge species composition falling on P2–P3 L PAZ, *Juniperus*-based July temperature estimations of *ca* 8–10°C are underestimated. Chironomidae reveal a cool–temperate rather than a cold climate in the Late Wartanian Stadial. Chironomidae analysis in such old sediments requires larger samples than for Late Weichselian or Holocene reconstructions – – of at least 20–50 cm^3 for palaeoclimatic studies.

Conclusions

Here is presented a Chironomidae analysis for the Parchliny 2016 section. The Chironomidae indicate a temperate climate in the region and favourable, meso/eutrophic conditions in the palaeolake during the Late Saalian (MIS 6a). From the Eemian (MIS 5e) transition, they decline in the sediment and are represented by only two head capsules at the 23.33 m core depth below the ground surface. The increase in summer temperature, trophic status and stratification of the lake may have caused an oxygen depletion that eliminated sensitive taxa. However, there are no species resistant to eutrophication and anoxia that, in such a scenario, should have replaced sensitive ones in the assemblages. Moreover, previous studies reveal that Cladocera and diatom communities were abundant in Eemian. Sediment desiccation and compaction may have caused the decomposition of Chironomidae subfossils in the deposits from the Eemian interglacial, which is why their apparent decline in the ecosystem may be misleading.

Concluding, Chironomidae from the stadial of the Odranian Glaciation, MIS6a to Eemian interglacial (MIS 5e) transition represent the same morphotypes that existed later in central Poland, and there is no need to construct a new taxonomy of their subfossils in central Poland. Also, the palaeolake underwent a hydrological and trophic change from the glacial to interglacial period, that was caused by climate warming, but the absence of midges from the Eemian sediments may derive from the decomposition of subfossils, not from the decline of Chironomidae populations in the lake during MIS 5e.

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