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Reconstruction of the Genesis of Faunal Assemblages of Insects (Insecta, Ectognatha) of the Raised Bogs of the Belarusian Lakeland

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Abstract—A putative scenario for the formation of insect assemblages of raised bogs of the Belarusian Lakeland is proposed. Early Holocene, when groups of chortobiont species trophically associated with cotton grass, as well as sphagnicoles and species associated with pine, were formed, is proposed as the time when insect assemblage formation began. The next stage occurred in the Atlantic period, when the relics of periglacial fauna and flora, including phytophages of ericaceous shrubs, apparently moved to the bogs. The formation of the core of insect assemblages with a set of characteristic stenobiont species probably ended in the subboreal period, since the main spectrum of ecological niches for the extant insect complex was present by this time.

Keywords: raised bog, insects, reconstruction, genesis story, Holocene, botanical composition of peat, glacier, Belarus, Lakeland

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INTRODUCTION

The raised bogs of Central Europe are island ecosystems with specific environmental conditions that are not characteristic of the temperate zone of the Northern Hemisphere as such. A scanty vegetation complex dominated by psychrophilic sphagnum moss species, ericaceous shrubs, and sedge, the wide range of fluctuations in daily temperatures, and low mineralization and high acidity of the soil (peat) confer distinct tundra-like features to the bogs (Spitzer and Danks, 2006). The territory of the Republic of Belarus is located at the boundary of the two largest natural areas (the boreal and nemoral zones); it includes vast peat bog areas located on the border of their continuous distribution. The four well-pronounced geomorphological zonal belts of Belarus are the Belarusian Lakeland, uplands and plains of Central Belarus, the plains and lowlands of pre-Polesye, and the Belarusian Polesye (Gel'tman, 1982; Matveev et al., 1988). The largest area occupied by raised bogs is located in the Belarusian Lakeland, the region affected by the most recent glaciation. These ecosystems occupy 314.5 thousand hectares (Zelenkevich et al., 2016).

Virtually no attempts to reconstruct the dynamics of the extant insect assemblages of raised bogs have been made to date. Two of the studies published by now merit a special mention. The first one is a very brief general overview of the proposed pathways of insect fauna formation at the Estonian bogs (Maavara, 1955), and the second one substantiated the stages of bog (Göldenitzer Hochmoor) insect assemblage formation in north-west Germany (Rabeler, 1931).

As we turn to the studies of insect fauna dynamics during the Holocene in Belarus, it is necessary to mention that the number of these studies is limited. The works of V.I. Nazarov (1984, 1988), O.R. Alexandrovich (1995), S.V. Buga (2002), and O.I. Borodin (2014) deserve a particular mention. The materials concerning the dynamics of insect assemblages and the insect faunogenesis in the Holocene in Belarus are limited to those listed above. The paleozoological studies of avifauna formation in Belarus performed by M.E. Nikiforov (2008) should also be mentioned.

A considerable number of studies that address various aspects of extant flora and vegetation formation at the raised bogs in Belarus are currently available (Pidoplichko, 1961; Makhnach et al., 1981; Gel'tman, 1982; Kukharchik, 1993; Elovicheva, 2001; Elovicheva et al., 2008). Peat deposit formation is an important feature of wetland ecosystems: peat contains plant debris of different ages decomposed to varying degrees and thus reflects the dynamics of phytocenoses and enables the reconstruction of the floristic composition of phytocenoses. Floristic reconstructions, in turn, lay the foundations for assumptions concerning the dynamics of complexes formed by phytophagous and zoophagous insects that inhabited the sphagnum cover throughout the Holocene. On the other hand, extensive material on the insect species composition of the Pleistocene orictocenoses of the

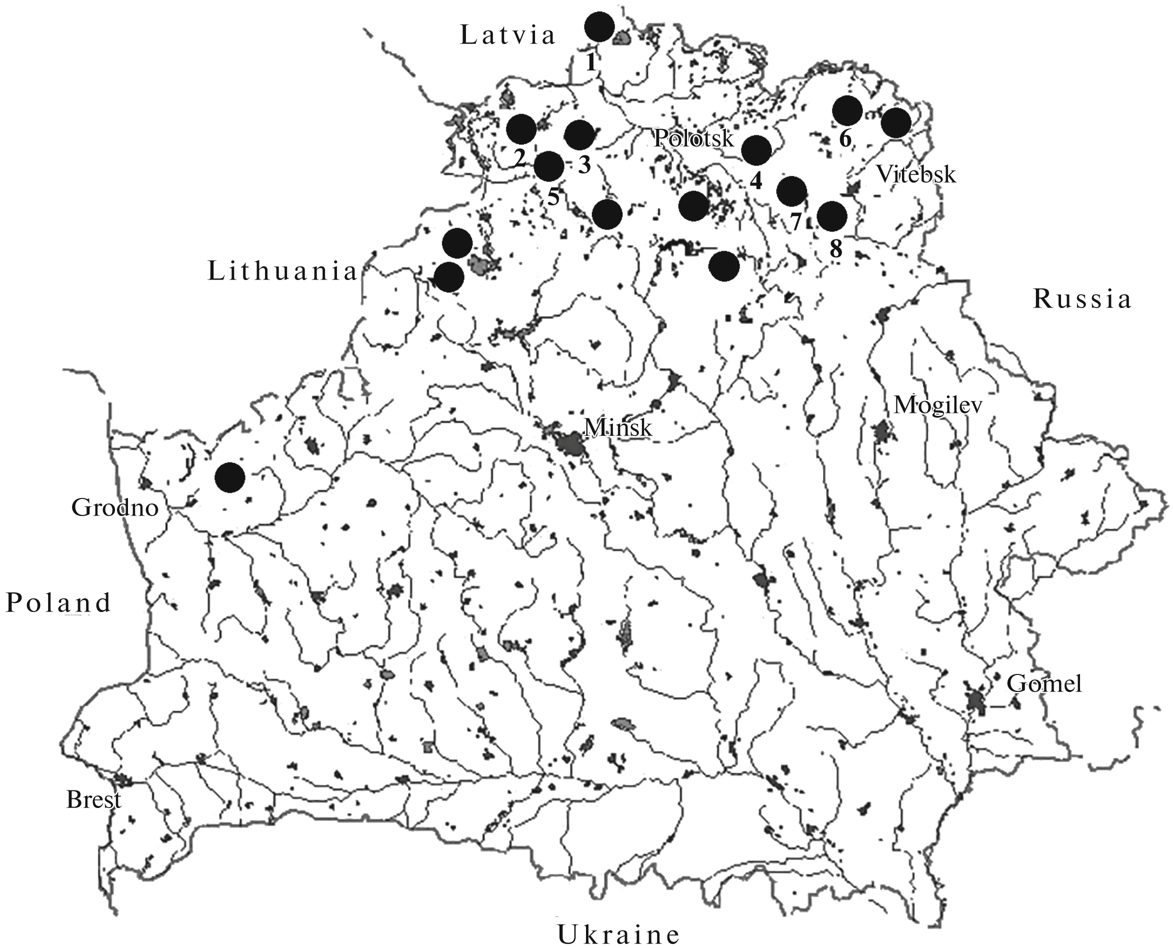

Fig. 1. Study sites. The bogs, for which the relative age was determined (after Belen'kii and Kurzo, 1988), are numbered.

modern territory of Belarus has been accumulated (Nazarov, 1981, 1984, 1985, 1988), and these materials indicate that the ecological preferences of insects had already been formed by mid-Pleistocene (Nazarov, 1981), so that the insect associations found in the Holocene sediments of the Zapadnaya Dvina valley included insect fauna representatives common for this region (Nazarov, 1985). Consequently, the regularities of the modern distribution of insects are strongly connected to their recent history and can serve as the basis for reconstructions of Holocene rearrangements of insect assemblages. The modern appearance of the Belarusian insect fauna was formed in the Holocene, as evident from the absence of cryophilic tundra and Asian steppe and forest insect species characteristic of the Mikulinskii interglacial period (Nazarov, 1981). Moreover, the morphological and ecological stability of insects during the Pleistocene was demonstrated quite reliably and shown to be sufficient for reconstructions of the conditions of the past (Nazarov, 1985). It is necessary to note that insects are very sensitive to environmental changes and are able to respond to them with extremely rapid migrations. The insect fauna reacts to changes much faster than the flora does (Nazarov, 1988; Coope, 1994).

This paper presents an attempt of reconstruction of the genesis of raised bog insect assemblages of the Belarusian Lakeland. The reconstruction is based on the analysis of publications devoted to the history of landscape formation in Belarus, the structure of the peat deposit, and the geographical distribution and trophic and topical preferences of specialized bog insects identified during the long-term studies performed by the author.

MATERIALS AND METHODS

The insects were collected by the author in 1998–2017 on 15 raised bogs in 10 raions (administrative districts) of the Vitebsk, Grodno, and Minsk oblasts (Fig. 1); standard entomological techniques (Fasulati, 1971) were used for specimen collection. The surface area of the bogs examined ranged from ten hectares to several tens of thousands of hectares. The vast majority of these bogs were protected areas characterized by a low degree of anthropogenic impact. More than

Table 1. Characteristics of higher vascular plant consortia in the extant flora of the Belarusian Lakeland raised bogs

Plant species	Strength of site association	Biotopic group	Geographical element of the flora	Major phytophagous insects
Andromeda polifolia (L.)	5	Bog	Hol, Bor	*Aulacorthum flavum, Athrips pruinosella, Macaria carbonaria, Teia antiquiodes*
Betula nana L.	5	Bog	Hol, Arc-Bor	*Ortholepis vacciniella, Coenophila subrosea*
Calluna vulgaris (L.) Hull.	3	For-Bog	Hol, Bor-Nem	*Altica longicollis,Lochmaea suturalis, Ulopa reticulata,*
Chamaedaphne calyculata (L.) Moench.	5	Bog	Hol, Bor	*Stephanitis oberti*
Empetrum nigrum L.	4	For-Bog	EuSib, Bor	*Fimbriaphis latifrons, Altica longicollis, Altenia perspersella,*
Eriophorum vaginatum L.	4	Bog	Hol, Bor	*Kelisia vittipennis, Sorhoanus xanthoneurus, Ommatidiotus dissimilis, Plateumaris discolor, Aphthona erichsoni Celaena haworthi, Oeneis jutta*
Ledum palustre (L.)	5	Bog	Hol, Arc-Bor	*Cixius similis, Lyonetia ledi, Argyroploce lediana, Eupithecia gelidata, Cacopsylla ledi, Neoamphorophora ledi, Stephanitis oberti, Arichanna melanaria*
Oxycoccus palustris L.	4	Bog	Hol, Bor	*Ophiola russeola, Stephanitis oberti, Aspilates gilvaria, Arichanna melanaria, Anarta myrtilli, Carsia sororiata, Vacciniina optilete, Clossiana frigga, Boloria aquilonaris*
Pinus sylvestris L.	3	For-Bog	EurAs, Bor-Nem	*Schizolachnus pineti, Brachonyx pineti, Hylobius abietis*
Rhynchospora alba (L.) Vahl.	4	Bog	Hol, Bor-Nem	*Stroggylocephalus livens, Coenonympha tullia*
Rubus chamaemorus L.	5	Bog	Hol, Arc-Bor	*Aspilates gilvaria, Clossiana frigga*
Scheuchzeria palustris L.	4	Bog	EurAs, Bor-Nem	*Acronycta menyanthidis*
Vaccinium uliginosum L.	4	Bog	Hol, Bor	*Aulacorthum flavum, Cixius similis, Aspilates gilvaria, Arichanna melanaria, Macaria brunneata, Carsia sororiata, Colias palaeno*

80 thousand insects of 1348 species were processed. The collections are preserved in the Zoological Museum of Masherov University (Vitebsk, Belarus).

The studies were carried out in the main types of habitats, including open ones and those with pine tree stands, with shrub-cotton grass-sphagnum and cotton grass-sphagnum associations and ridge-hollow and ridge-pool vegetation complexes. The typical plant species of these areas are the higher plant species *Eriophorum vaginatum* L., *Scheuchzeria palustris* L., *Rhynchospora alba* L., *Drosera anglica* Huds., *D. obovata* Mert. et W.D.J. Koch, *D. rotundifolia* L., *Calluna vulgaris* (L.) Hull, *Ledum palustre* L., *Andromeda polyfolia* L., *Oxycoccus palustris* Pers., *O. microcarpus* Turcz. ex Rupr., *Chamaedaphne calyculata* (L.) Moench, *Vaccinium uliginosum* L., *Empetrum nigrum* L., bog forms of pine (*Pinus sylvestris* f. uliginosa, *P. sylvestris* f. litwinowii, and *P. sylvestris* f. willkommii), *Betula pubescens* Ehrh., and *B. nana* L. *Sphagnum magellanicum* Brid., S. *angustifolium* (C. Jens. ex Russ.) C. Jens, *S. fuscum* (Schimp.) Klinggr., *S. rubellum* Wils., and *S. cuspidatum* Ehrh. ex Hoffm dominate among the mosses. *Polytrichum strictum* Brid. is common (Gel'tman, 1982; Zelenkevich et al., 2016) (Table 1).

Notes. The degree of plant "attachment" to raised bogs: (3) found in various habitats, but develop normally at raised bogs, (4) prefer raised bogs, (5) almost exclusively at raised bogs; ecological and phytocenotic valence: (Bog) bog, (For) forest; geographical element of the flora: (Hol) Holarctic, (EurAs) Eurasian, (EuSib) Euro-Siberian (longitudinal element), (ArcBor) arctic-boreal, (Bor) boreal, (Bor-Nem) borealnemoral (latitudinal element) (Zelenkevich et al., 2015).

The descriptive nomenclature proposed by K.B. Gorodkov (1984) was used to characterize the living ranges of insects. This nomenclature is based on the toponymy related to physical geography; it describes all components of the range (the latitude, longitude, and altitude components). Information about the geographical distribution of insects was retrieved from the works of B.F. Belyshev (1963), S. Mielewczyk (1969), Aleksandrovich (1991), H. Nickel (2003), P. Ivinskis (2004), and the Coleoptera Poloniae Internet resource (www.coleoptera.ksib.pl). Data on the trophic and biotopic association of the species were derived from the author's own observations, published studies (Merzheevskaya et al., 1976; Koch, 1984; Nickel, 2003; Ivinskis, 2004; Lopatin and Nesterova, 2005) and Internet resources (www.kielo.luomus.fi; www.coleoptera.ksib.pl; www.brc.ac.uk). Specialized inhabitants of raised bogs (Spitzer and Danks 2006), such as tyrphobionts and tyrphophiles, were considered the most promising species for analysis. The former are stenobionts of the ecosystems studied, and the latter are found in some other habitats with similar ecological conditions.

Terminology and chronology are given according to the Blitt–Sernander scheme (Novenko, 2016).

The accumulation of various types of peat in differing climatic conditions allows for the reconstruction of the floristic composition of bog phytocenoses (Pidoplichko, 1961; Elovicheva et al., 2008), which lays the foundation for the assumptions concerning the formation of phytophagous insect complexes during different periods of bog ecosystem formation. Analysis of materials from published works showed that the peat deposits of raised bogs in the north of Belarus were quite homogeneous, with the oligotrophic stage starting with the deposition of peat with abundant cotton grass and pine stumps, subsequent deposition of layers rich in ericaceous shrub remains, and the deposition of fuscum peat in the topmost layer. A scheuchzeria–sphagnum layer (Fig. 2) can constitute the first oligotrophic peat layer if the bog is formed under the conditions of excessive moisture supply (Pidoplichko, 1961; Belen'kii and Kurzo, 1988; Zelenkevich et al., 2016).

RESULTS AND DISCUSSION

The process of formation of the extant fauna of Belarus began with the retreat of the Pripyat glacier, which covered the entire territory of the modern Republic of Belarus at the Dnieper stage of glacier development. The subsequent Lakeland glaciation covered the northern part of the country (Belorussian Lakeland) only. The glacier advanced approximately to the Vilnius–Orsha–Smolensk line. Its retreat began approximately 14–13 thousand years ago, and it disappeared from Scandinavia 3–4 thousand years later (Gel'tman, 1982; Aleksandrovich, 1995). Therefore, the fauna of the Belarusian Lakeland is younger than the faunas of other regions of the country. This is indicated by the absence of relics of the Neogene period. At the same time, the fauna does not include endemic species, and therefore it can be considered migratory, that is, formed due to migration flows from several sites (Alexandrovich and Lopatin, 1994; Lopatin and Nesterova, 2005).

The formation of raised bog insect assemblages of the Belarusian Lakeland probably started in Early Holocene (preboreal, 10.3–9.3 thousand years ago), when climate warming occurred and the amount of precipitation increased. As a result, the deposition of the oldest raised-bog peat layers preserved by now started at most isolated individual bogs in the northern and central parts of the territory of present-day Belarus. More intensive development of the sphagnum cover and the transition of many bogs to the oligotrophic stage of development was characteristic of the boreal period (Belen'kii and Kurzo, 1988). Layers of pine-cotton grass, cotton grass, and cotton grass-sphagnum peat were deposited initially (Pidoplichko, 1961; Belen'kii and Kurzo, 1988; Elovicheva et al., 2008) (Fig. 2). As a rule, these peat deposits are currently the thickest at bog margins and somewhat thinner in the middle of the bog (Pidoplichko, 1961). Consequently, cotton grass phytocenoses predominated at the early stages of bog formation. The appearance of the phytocenosis at the pioneer stages of succession was similar to the modern cotton grass-sphagnum phytocenoses (which often occur as narrow strips bordering on the bog areas). In addition, pine-cotton grass-sphagnum phytocenoses were formed due to the spreading of pine seeds. The colonization of bogs by insects probably began with chortobiont species, which formed trophic associations with cotton grass. This group of species is represented by sedge monophages *Kelisia vittipennis* (Sahlberg 1868), *Sorhoanus xanthoneurus* (Fieber, 1869) (Auchenorryncha), and oligophages *Plateumaris discolor* (Panzer, 1795), *Aphthona erichsoni* (Zetterstedt, 1838, Coleoptera), and *Celaena haworthi* (Curtis, 1829) (Lepidoptera) in the extant insect assemblages (Table 1).

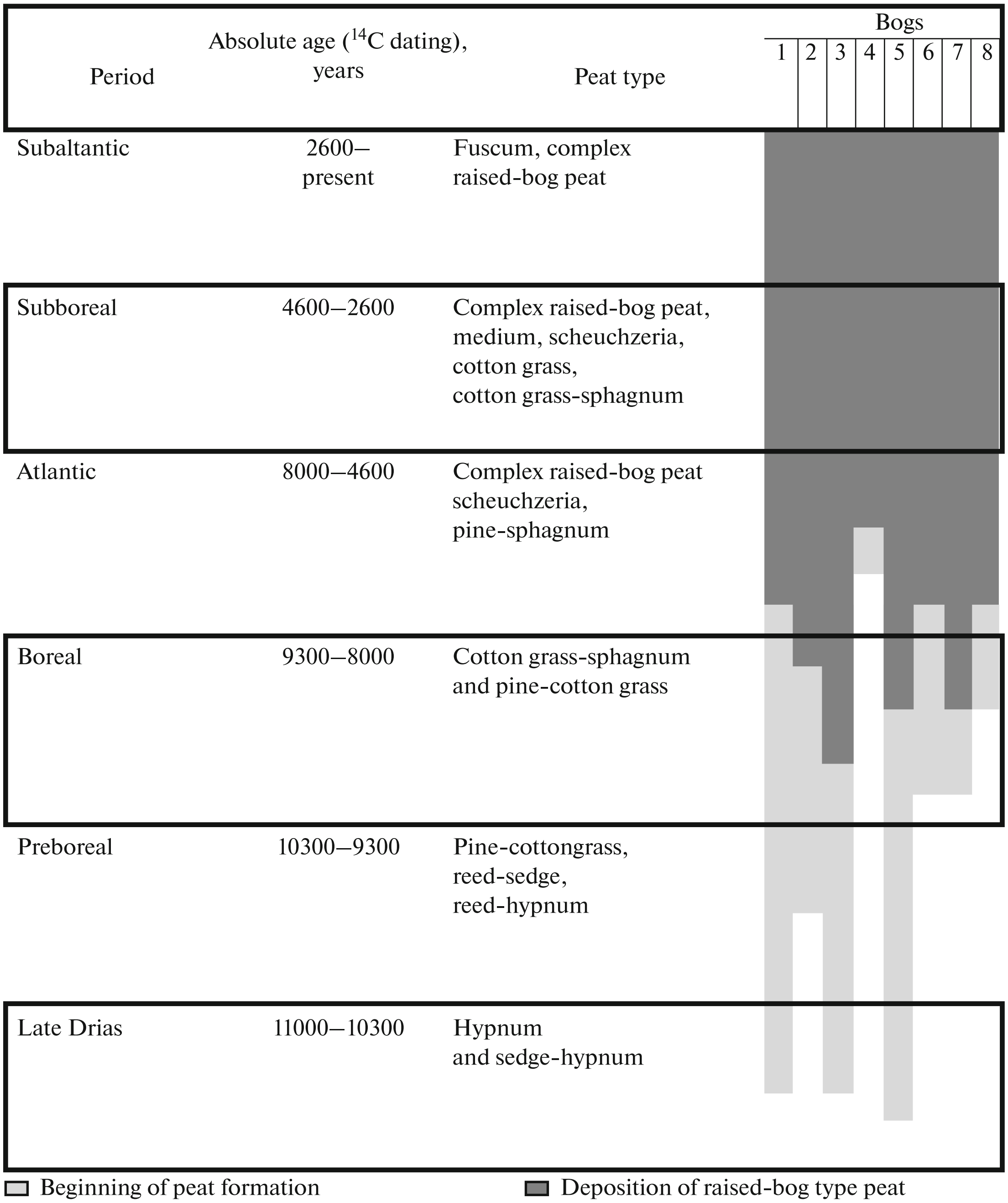

Fig. 2. Stages of formation of individual raised bogs of the Belarusian Lakeland (the localization of the bogs is shown in Fig. 1).

The bog insect assemblage was supplemented with forest species associated with pine, such as *Schizolachnus pineti* (Fabricius, 1781) (Sternorrhyncha), *Brachonyx pineti* (Paykull, 1792), *Hylobius abietis* (L., 1758) (Coleoptera), and others. Colonization of the bogs by sphagnicole species *Agonum ericeti* Panzer, 1809 (Coleoptera), *Formica forshlundi* Lohmander, 1949, F. *uralensis* (Hymenoptera), and others became possible as the sphagnum cover appeared and developed. These insects, with the exception of pine phytophages, live only or primarily at raised bogs in the area at present. Moreover, complementation of the epigaeal insect complex by moisture-loving beetles [*Pterostichus diligens* (Sturm, 1824), *Atheta arctica* Thomson, 1856, *Gymnusa brevicornis* (Paykull, 1800), etc.] apparently occurred; nowadays these species are mostly encountered in Euro-Siberian, trans-Eurasian, and boreal zoogeographic complexes at present.

The climate became even warmer and more humid (Nazarov 1988) during the Atlantic period of the Middle Holocene (8–4.6 thousand years ago), especially in the second half of the period, and this promoted the massive expansion of bog formation. Even more bogs of the northern and central parts of modern Belarus reached the oligotrophic stage of development during that period. Raised bogs expanded to occupy almost the entire country (Belen'kii and Kurzo, 1988).

Climate change was a challenge for subarctic and boreal flora elements, which were the relics of periglacial vegetation. According to the current concepts, the periglacial landscapes at the territory of modern Belarus were represented by tundra with small patches of herb assemblages, and the three main ecological groups that formed the fossil fauna of insects of that time were tundra inhabitants, inhabitants of coastal biotopes, and insects associated with cereal and cruciferous plant associations (Nazarov, 1981). Consequently, the cryophiles *Betula nana, Rubus chamaemorus,* and *Chamaedaphna calyculata* were displaced to raised bogs, where isolated populations of these species (Gel'tman, 1982) and, apparently, many psychrophilic insects, have survived till present.

A complex layer of raised-bog peat, which includes shrub debris, lies on top of the pine-cotton grass (or pine-sphagnum) and cotton grass-sphagnum peat in the peat deposits (Pidoplichko, 1961; Elovicheva et al., 2008; Zelenkevich et al., 2016) (Fig. 2). It should be noted that complex raised-bog peat is genetically associated with treeless or scarce-forest vegetation groups, ridge-hummock complexes, and waterlogged areas with a prevalence of hummocks and a small number of ridges (Pidoplichko, 1961). As a rule, these phytocenoses are currently confined to the slopes of strongly convex bogs.

One can assume that such lepidopteran insects as *Colias palaeno* (L., 1761), *Clossiana frigga* (Thunberg, 1791), *Oeneis jutta* (Hübner, 1806), *Boloria aquilonaris* Stichel, 1908, and *Vacciniina optilete* (Knoch, 1781) (Table 1), which currently show an arctoboreal distribution pattern, found refuge at raised bogs under the conditions of the Atlantic climatic optimum. At present, they are characteristic inhabitants of raised bogs of the temperate zone and permanent components of a number of other ecosystems of the northern latitudes of Europe (Mikkola and Spitzer, 1983; Spitzer and Danks, 2006).

Raised bogs provided both suitable microclimatic conditions and nutrition to periglacial insects. Conditions that enabled the addition of species trophically associated with ericaceous shrubs (Ericales) to the bog massif insect assemblages were formed at that time. This group of species included ledum monophages *Cacopsylla ledi* (Flor, 1861) (Sternorrhyncha), *Lyonetia ledi* Wocke, 1859, *Argyroploce lediana* (L., 1758), and *Eupithecia gelidata* Möschler, 1860 (Lepidoptera), ericaceous shrub oligophages *Stephanitis oberti* Kolenati, 1857 (Heteroptera), *Macaria brunneata* (Thunberg 1784), *Carsia sororiata* (Hubner, 1813) (Lepidoptera), and others, predominantly boreal (according to the latitudinal component of the living range) species. Many polyphages [*Diacrisia sannio* (L., 1758), *Callophris rubi* (L., 1758), *Plebeius argus* (L., 1758) (Lepidoptera), *Cixius similis* (Auchenorryncha), and *Lygus pratensis* (Heteroptera)], which currently feed on ericaceous plants, among others, have also found niches at raised bogs.

Climate humidity varied and summer droughts occurred in the subboreal of the Middle Holocene (4.6–2.6 thousand years ago), (Konoiko, 1974; Gel'tman, 1982; Belen'kii and Kurzo, 1988). Various types of peat, including pine-cotton grass peat, medium peat, and complex raised bog peat, were deposited at that time (Pidoplichko, 1961).

The botanical composition of peat shows that the majority of representatives of extant local flora grew at bogs, and the main spectrum of currently existing phytocenoses, including cotton grass-sphagnum, pine-shrub-sphagnum, and especially ridge-hummock complexes, was present (Fig. 2). The formation of the core insect assemblage with a set of characteristic species (including stenobionts) at the most ancient raised bogs had obviously ended by that time. It is most likely that the formation of the extant fauna of the East European Plain as a whole was also completed at that time (Aleksandrovich, 1995). The waterlogging of peat massifs increased in the subboreal, lake fragments were formed, and isolated bogs were fused into bog massifs (Matveev, 1990). This supposedly contributed to a wider spreading of aquatic and amphibious insects, including the currently specialized inhabitants of raised bogs [*Somatochlora arctica* (Zetterstedt, 1840), *Aeschna subarctica* (Walker, 1908), *Leucorrhinia dubia* (Van der Linden, 1825), *L. rubicunda* (L., 1758) (Odonata), *Cymatia bonsdorffii* (C. Sahlberg, 1819) (Heteroptera), *Enochrus affinis* (Thunberg, 1794) (Coleoptera), and others].

The subatlantic period of the Late Holocene (2.6 thousand years ago—present time) was marked by climate cooling and variable humidity, which created even more favorable conditions for growth of sphagnum mosses in the raised bogs, so that the mosses became dominant (Gel'tman, 1982; Belen'kii and Kurzo, 1988). The degree of paludification in the area became close to the current level. Raised and transitional bogs were most common at the margins of the Central Berezina Plain and the Polotsk Lowland (Matveev, 1990).

Active expansion of the bogs to the adjacent forests in flatland landscapes and the growth of peat deposits occurred at that time. The convex parts of the bogs were at the ombrotrophic stage of development (atmospheric water supply and complete isolation from underlying soils and groundwater in them). The peat deposit thickness increased significantly from the margins to the center (Pidoplichko, 1961; Belen'kii and Kurzo, 1988). Fuscum peat was the predominant type of peat. It is genetically associated with treeless associations dominated by the xerophilous moss *Sphagnum fuscum* (Pidoplichko, 1961). Such associations are mainly confined to the convex top of the swamp at present. *Eriophorum vaginatum* and *Calluna vulgaris* predominate among the vascular plants. Large bog massifs are currently in a treeless sub-climax state caused by a deficit of pine seeds in the center of the massif (Pidoplichko, 1961; Bogdanovskaya-Gienef, 1969; Razumovskii, 1981). The insect assemblages associated with these bogs are distinguished by a low level of species richness and high abundance of individual tyrphobiont and tyrphophilic species (*Agonum ericeti, Formica forshlundi, Vacciniina optilete*, and others) and other insects associated with heather [*Lochmaea suturalis* (Thomson, 1866) and *Dicheirotrichus cognatus* Gyllenhal, 1827] and cotton grass [*Neophilaenus lineatus* (L., 1758)] (Peus, 1928; Spitzer and Danks, 2006).

Changes that occurred in the insect assemblages of raised bogs of the Belarusian Lakeland during the past century are primarily associated with drainage and an increase in cultivated land area, peat extraction, more frequent recreational use, and a change in the regional climate. The discovery of the southern bronze beetle species *Oxythyrea funesta* (Poda, 1761), which was repeatedly identified in the cotton grass-sphagnum associations of most of the wetlands studied during the past few years, is probably an example of the influence of the latter factor

The presence of species that are characteristic pests of agricultural crops, such as crucifer flea beetles [*Phyllotreta atra* (Fabricius, 1775) and *P. nemorum* (L., 1758)], the flea beetle *Aphthona euphorbiae* Schrank, 1781 (Lopatin and Nesterova, 2005), or the cabbage butterfly [*Pieris brassicae* (L., 1758)] was also recorded. The trophic relationships of these and several other species at raised bogs have not yet been studied. One could assume that the presence of these species in the ecosystems, sometimes in quite large numbers, is related to the zonal change of locations or the adaptation of some of these species to feeding on bog plants. These assumptions are to some extent supported by the findings of these species at raised bogs in other regions of Europe (Peus, 1928; Spungis, 2008).

CONCLUSIONS

Plant communities of raised bogs, which form a specific microclimate and provide food for phytophages, determined the direction of successive rearrangements of insect assemblages during the Holocene. The formation of insect assemblages of the most ancient bog massifs probably started during the early Holocene, when the oligotrophic stage of development started at individual bogs. Groups of chortobiont insects trophically associated with cotton grass, sphagnicoles, and species associated with pine, were apparently formed at that time.

The next stage of insect assemblage formation in these ecosystems occurred in the Atlantic period, when relics of periglacial fauna and flora, including phytophages that fed on ericaceous shrubs, moved to the bogs. Therefore, this stage can be considered the most important one in the genesis of raised bog insect assemblages in Belarus.

The formation of the core of insect assemblages with a set of characteristic stenobiont species probably ended in the subboreal, since the main range of currently existing plant communities was already present at that time, and thus the main ecological niches for the extant complex of insects were formed. In addition, a broader expansion of aquatic and amphibious insects became possible due to the increase in raised bog waterlogging by lake windows and the development of ridge-hummock complexes.

The characteristic insect assemblage of the heather communities, which was represented by a small number of species with heather-associated species predominating, expanded in the subatlantic period, as the expansion of wetlands to the adjacent territories continued and the central parts of the wetlands entered a sub-climax stage. Thermophilic forms and pests of agricultural crops migrating from agrocenoses are being added to the complex at present

Thus, a probable scenario of insect assemblage formation at raised bogs of the Belarusian Lakeland is proposed. This scenario can be used as the theoretical basis for further reconstructions that will employ paleontological methods.

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