УДК 551.89/581.9

ON VEGETATIONAL DYNAMICS IN THE FOOTHILLS OF THE EASTERN CARPATHIANS DURING THE LATE GLACIAL AND THE HOLOCENE

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Vegetation and climatic changes in the East-Carpathian foothills are reconstructed on the basis of pollen analysis of the Pidluzhya peat bog. It is shown that the Late Glacial, Preboreal and Boreal deposits are separated from the Subatlantic by the break in peat accumulation.

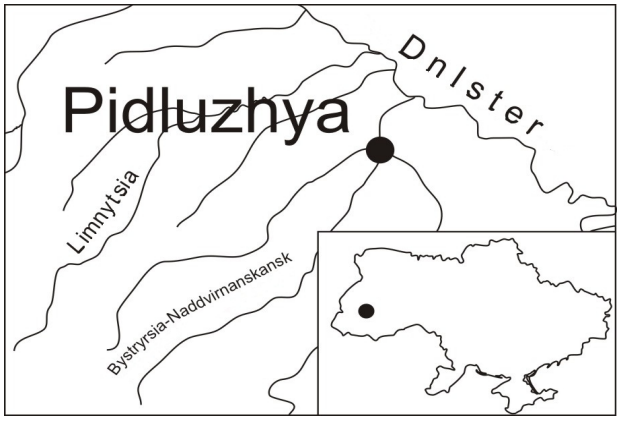
Key words: pollen analysis; Pleistocene; Holocene; paleovegetation; paleoclimate; East-Carpathian foothills.

Introduction. The modern vegetation is the result of human impact during the last few millennia on vegetation cover which has been primarily formed during the long processes of climatic changes. In this paper, vegetation and climatic dynamics of the East-Carpathian foothills during the Late Glacial and Holocene is studied Fig.1 Location of the investigation site on the basis of pollen analysis of the Pidluzhya peat bog. The Pidluzhya peat bog, which has never been exploited, is located in the vicinity of the village Pidluzhya (near the Ivano-Frankivsk town) (fig. 1). It is related to the Sambir-Ivano-Frankivsk geobotanic district of the European broad-leaved forest region [2, p. 44]. The natural vegetation has been changed by human impact, and it is now represented by meadows. The nearest forest (of the small size) is located in 5 km from the bog.

Material and methods. In the core studied, the upper layers are represented by a peat soil: A1 (0.00 – 0.13 m) - dark-brown, not compacted, with crumbly structure, the lower transition is distinct; Bth (0.13 – 0.14 m) – ochre-brown, not compacted, with crumbly structure and few sand grains, the lower transition is sharp (discontinuity in peat accumulation). Below, there is a dark-brown strongly decayed peat (0.14 – 1.15 м), underlain by light-grey clays. The peat from the depth 1.00 – 1.12 м has been ^{14}C-dated to the Late Glacial: 12,350±190 yr BP (conventional dating), or 14,500±370 cal yr BP (LU-6841). The pollen samples have been taken each 2.5 cm. They were processed with the Post's techniques (with additional treatment of HF and HCl). On the average, 200 grains of arboreal pollen (AP) has been counted in each sample.

In the surface sample, the sum of non-arboreal pollen (NAP) prevails over the AP (70 and 30 %, respectively). The pollen percentages of broad-leaved trees is 9 % (*Carpinus* 6 %, *Quercus* 1 %, *Tilia* 1 %, and *Fagus* 0,5 %). In the NAP, pollen of Herbetum mixtum dominate (40 %), especially Apiaceae (24 %). From 20 % of Poaceae pollen 2 % belong to Cerealia. The pollen percentage of swamp and aquatic plants is 12 %.

Results of pollen analysis. Ten pollen zones have been distinguished in the diagram (Fig. 2). PZ 1 (1.125



– 1.050 m) is distinguished by the high NAP percentages (83 – 65 %). Cyperaceae pollen dominate (44 – 58 %), pollen of Poaceae, *Artemisia* and Herbatum mixtum are present. The AP include *Pinus* (16-30 %), *Betula* and *Salix*. In PZ 2 (1.05 – 1.00 m), the AP increase up to 40-43 %. *Pinus* dominates (39 – 43 %), and pollen percentages of Cyperaceae became smaller (26 – 33 %). In PZ 3 (0,975 – 0,925 м), the AP value declines due to an increase in *Artemisia* pollen (2 – 8 %) and Bryales spores (8 – 10 %). In PZ 4 (0.90 – 0.75 m), the AP again increase to 45-45 %. Pollen grains of *Ephedra* and *Juniperus* were found here. In the NAP, Cyperaceae pollen slightly prevails (16 – 20 %). In PZ 5 (0.725 – 0.500 m), the pollen values of *Betula* (5 – 10 %), *Artemisia* (7 %), Poaceae (up to 11 %) and Bryales (up to 25 %) increase. In PZ 6 (0.475 – 0.450 m), the AP pollen percentages become higher. Pollen grains of *Salix* and Asteraceae disappear, and pollen values of *Betula* drop. PZ 7 (0.425 – 0.400 m) is distinguished by the appearance of broad-leaved trees pollen and dominance of Filicales monolete spores (33 – 53 %). PZ 8 (0.375 – 0.250 m) starts with an increase in *Picea* pollen (up to 11 %). In PZ 9 (0.225 – 0.015 m), the *Pinus* and *Picea* pollen values decrease again due to the higher Cyperaceae pollen values. PZ 10 is distinguished by the low AP (14 – 22 %). Pollen grains of *Picea, Pinus, Abies* occur. The pollen percentages of diverse broad-leaved trees (*Fagus, Carpinus*, *Quercus, Ulmus, Acer, Tilia, Juglans*) still do not

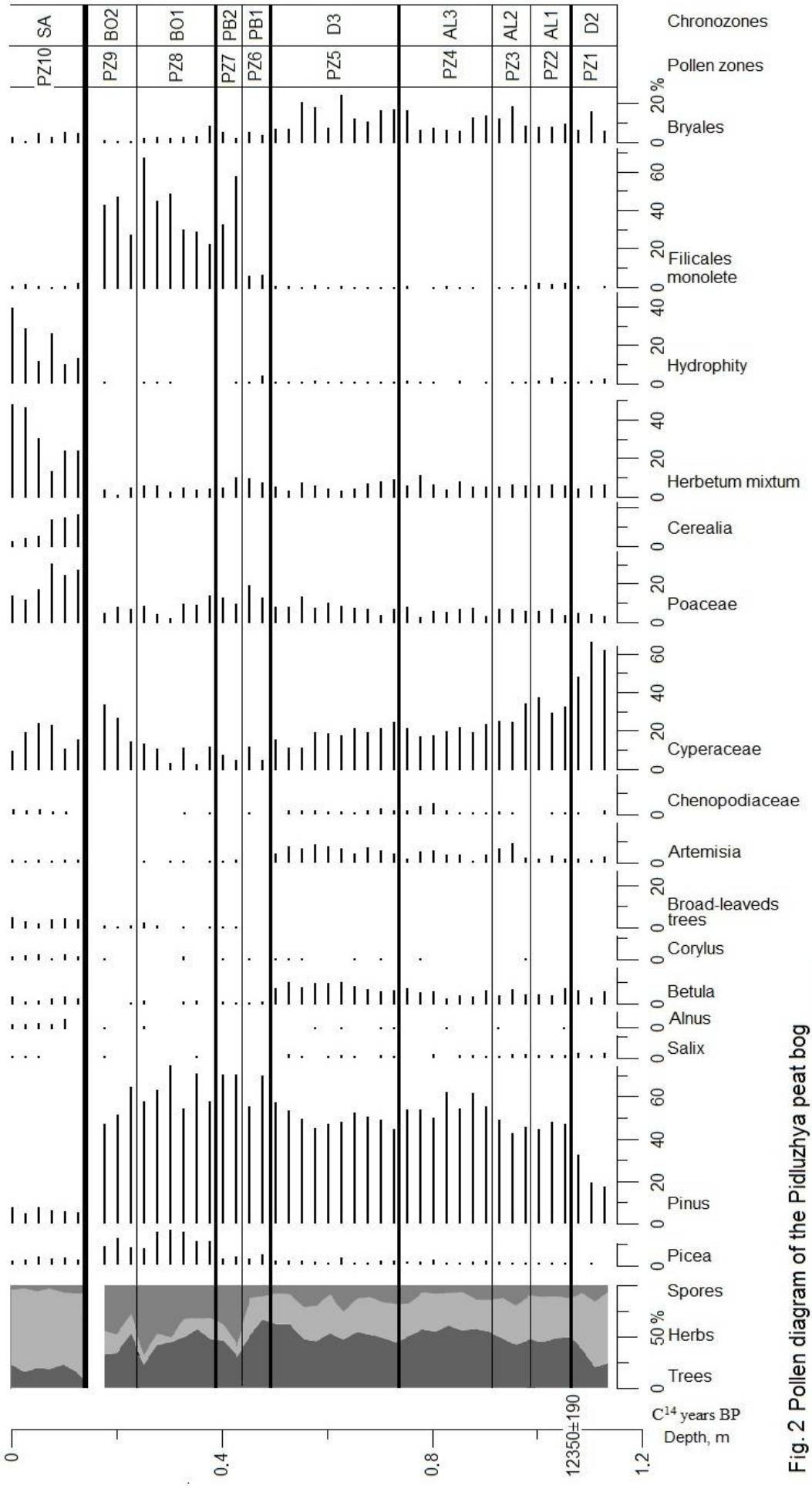


Fig. 2 Pollen diagram of the Pidluzhya peat bog
Рис. 2 Пилинологічна діаграма торфавища Підлужжя

exceed 5 % in sum. Herbetum mixtum dominate the NAP, but pollen percentages of hydrophytes are also high (10 – 39 %). A large amount of pollen of cultivated plants (especially Cerealia) and weeds is a characteristic of this zone.

The following reconstruction of vegetation and climate has been made based on pollen analyses. At the beginning of peat accumulation (12,350±190 yr BP), wet meadows were dominant consisting of sedges (dominant), Poaceae and Herbetum mixtum. This, as well as spread of willow, evidences the excessive underground moisture in the area. The absence of forest indicates cold continental climate. Such vegetation well corresponds to the Dryas 2 stadial (12,200 – 11,800 yr. BP) [2].

The expansion of birch-pine forest (PZ2-4) might characterize the Allerod interstadial (11,800 – 10,800 yr BP), and it indicates that the climate became warmer. Some areas were occupied by Poaceae – Herbetum mixtum coenoses. Sedges played less important role in the ground cover. The ground moisture obviously decreased due to the higher temperatures and an increase in evaporation. At the drier spots, xerophytes (*Artemisia*, Chenopodiaceae) grew in small numbers. However, during the interstadial, the phase of forest reduction occurred (PZ3), when the role of *Artemisia* increased, and Bryales dominated in the bog. It possibly can be correlated with the Middle Allerod fall in temperature, which has been established in the Eastern Europe [1]. Later on (PZ 5), the forest reduction happened, and the role of birch increased. Xerophytes (*Artemisia* and Chenopodiaceae) became more important in herbal associations, and Bryales dominated on the bog. This increase in climatic continentality enables correlation of the described interval to the Young Dryas stadial, whose climate was cold and dry [2]. The Late Glacial- Holocene boundary is marked by the further forests expansion, the increase of a role of spruce in the Carpathian Mountains forests, the disappearance of xerophytes from herb coenoses (PZ6). The climate became warmer and wetter. At the beginning of Preboreal, the birch and willow disappeared, and Bryales were replaced by Filicales, which are more typical for a warmer climate. Finally, the first broad-leaved trees appeared (PZ7). They were represented by elm, lime, and oak. Their participation in forests was still small, but indicative of the progressive warming (especially an increase in winter temperatures). Herb coenoses, represented by Herbetum mixtum and Poaceae, had a significant role, but they were less spread then ferns. The significant increase in spruce population (PZ8) indicates the beginning of Boreal [6, 7]. At that time, elm-pine-spruce forest (with the admixture of oak) existed, as well as Poaceae – Herbetum mixtum meadows. Climate became wetter and warmer. Later on (PZ9), sedges spread more extensively that was an indication of an increase in ground moisture.

Completely different vegetation was typical for the time interval after the discontinuity in peat accumulation (PZ10). Meadows from Herbetum mixtum dominated the vegetation cover. Mixed forest, represented by spruce, elm, maple and lime, occupied small areas. Large pollen percentages of aquatic plants indicate the existence of open water surfaces, which appeared as a result of changes in the hydrological regime. The frequent occurrence of Cerealia pollen is very important as it shows a very intense agriculture and also indicates the young age of these peat layers. The appearance of *Fagopyrum* in the upper beds enables the suggestion that these peat layers were formed not earlier than XIII cent. AD [5]. The deposits of PZ 10 are correlated with the Subatlantic period.

Conclusion. During the Late Glacial and Early Holocene, the landscapes of the Eastern Carpathian foothills evolved from meadow to closed forest. Cold-resistant meadow vegetation of the Dryas 2 was replaced by scarce birch-pine forests of the Allerod. The area of the forests was reduced during the Young Dryas as a result of spread of cold-resistant Poaceae-Herbetum mixtum coenoses with large participation of xerophytes (*Artemisia* and Chenopodiaceae). Sparse pine forests (with abundant fern cover) were formed during the Preboreal. Broad-leaved trees firstly appeared (in small numbers). During the Boreal, spruce-pine forests with some admixture of broad-leaved trees existed. During the Subatlantic period, the vegetation was changed by human impact (forest clearings). The area which should have been covered by the natural broad-leaved forests was occupied by the secondary meadow vegetation.

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Чумак Н. М. До динаміки рослинного покриву Прикарпаття у пізньольодовиків'ї та голоцені (за даними палінологічного вивчення торфовища Підлужжя). Зміни рослинності та клімату Східного Передкарпаття були реконструйовані на основі палінологічного аналізу торфових відкладів Підлужжя. Відклади післяльодовиків'я, пребореалу, бореалу відділені від відкладів що утворились у субатлантиці, перервою в торфонакопиченні.
Ключові слова: палінологічний аналіз; плейстоцен; голоцен; палеорослинність; палеоклімат; Передкарпаття.

Чумак Н. М. К динамике растительного покрова Предкарпатья в позднеледниковье и голоцене (по данным палинологического изучения торфянника Пидлужжя). Изменения растительности и климата Восточного Предкарпатья реконструированы на основании палинологического анализа отложений торфянника Пидлужжя. Отложения позднеледниковья, пребореала и бореала отделены от отложений, образовавшихся в субатлантическом периоде голоцена, перерывом в торфонакоплении.
Ключевие слова: палинологический анализ; плейстоцен; голоцен; палеорастительность; палеоклимат; Предкарпатье.