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SHORT COMMUNICATION

Invasive insect pests of introduced plants of the “Olexandria” Dendrological Park. Report 5: Notes on the biology of *Pineus pineoides* (Cholodkovsky, 1907) (Hemiptera, Adelgidae), a pest of Norway spruce

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Abstract

The article describes the biological characteristics of *Pineus pineoides*, an invasive species that entered the “Olexandria” Dendrological Park during the introduction of Norway spruce (*Picea abies*). Data on phenology, feeding activity, number of generations, and life cycle pattern of this pest are provided. The existence of summer diapause in the life cycle of this species is reported for the first time. A name is proposed for the morph and its variations that appear in the seasonal development cycle of *P. pineoides*.

Keywords: *Pineus pineoides*, spruce plantings, harm, monomorphic anholocycle, summer diapause, paraprogreddiens

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Introduction

The Norway spruce (*Picea abies* (L.) H. Karst.) is one of the main landscape-forming species, and its plantings are a famous feature of the “Olexandria” Dendrological Park. The history of this species’ introduction to the arboretum spans more than 200 years. There are still specimens in the plantings that have survived since its foundation. Currently, 237 spruce trees are growing in the arboretum. This number is significantly lower than the previous inventory conducted in 2012, which recorded 739 trees. The reason for the decrease in spruce numbers was a period of trees’ drying out that lasted over ten years (2008–2020). The dying of the trees was accompanied by the mass reproduction of xylophagous insects, with one species dominating – the spruce bark beetle (*Ips typographus* L., 1758). Other species

that were found in large amounts included the spruce leaf beetle (*Epinotia tedella* Clerck, 1759), the spruce sawfly (*Pristiphora abietina* Christ, 1791), the spruce false shield bug (*Physokermes piceae* Schrank, 1801), the spruce aphid (*Pineus pineoides* Cholodkovsky, 1907), and some other Adelgidae species. Given the need to account for the activity of mass-associated pest species in relation to the weakening and drying out of spruce plantations, it is important to study their biology in detail. Among the listed pest species, *P. pineoides* is one of the least studied.

The article provides data on its biology, some of which are new to science. The discovery of a species of the genus *Pineus* Shimer, 1869 on the bark of spruce trunks was first reported by Dreyfus (1889). He classified it as *Pineus strobi* (Hartig, 1839). Börner (1908) considered it to be a variation of the hermes (adelgid) of the Weymouth pine. Cholodkovsky

(1915), while studying this species, concluded that it was very close to *Pineus pini* L. and classified it as a variation of the pine hermes – *P. pini* var. *pineoides*. Later, Chlodkovsky leaned towards the view that the specified variation is, in fact, an independent species. Börner (1908) later also changed his initial point of view and agreed with Chlodkovsky's assumption of species validity, giving it the name *Pineus pineoides* (Chlodkovsky 1907).

The biology and morphology of the bark spruce adelgid have been studied by many researchers (Börner, 1908; Marshal, 1913; Chlodkovsky, 1915; Schneider-Orelli, 1940; Börner & Heinze, 1957; Underwood, 1963; Steffan, 1963, 1968, 1972; Carter, 1971; Havill & Footitt, 2007; Allbrecht, 2017; Favret & Aphid Taxon Community, 2026). Steffan (1972), who studied the life cycle of this species in the greatest detail in Europe, classified it as a relict. He believed that the lifestyle of this species provides insight into the lifestyle of the authentic predecessors of modern hetereous adelgid species.

The distribution of *P. pineoides* roughly corresponds to the range of *Picea abies*, scattered from Scandinavia to Switzerland and from France to western Eurasia. In Europe, *P. pineoides* is found not only on *Picea abies* but also on *P. omorika* (Pančić) Purk. (Steffan, 1963). According to Steffan (1968, 1972), the annual anolocyte of *P. pineoides* consists of two wingless morphologically similar generations. Many other authors shared this opinion (Börner & Heinze, 1957; Underwood, 1963; Carter, 1971; Allbrecht, 2017; Favret & Aphid Taxon Community, 2026). In this version of *P. pineoides* life cycle, this species has one winter and one summer generation. The offspring of the summer generation overwinter at the 1–2 instar larval stage. Other studies indicate that *P. pineoides* develops in three generations.

As for Ukraine, no detailed study of the biology of *P. pineoides* has been conducted here; this work is the first study of the biological characteristics of this unique adelgid species.

Material and methods

The research was conducted in the “Olexandria” Dendrological Park with

interruptions from 1986 to the present. We studied mixed-age stands of *Picea abies* for the presence and population density of *P. pineoides*. Observations of the seasonal development cycle of this species were carried out on model trees. For the same purpose, container cultures of *Picea abies* (5–7-year-old seedlings) were used in the studies.

Results and discussion

According to our data, the life cycle of *P. pineoides* on spruce trees proceeds as follows. The larvae of the penultimate (third) age, and occasionally the first and second ages, overwinter on the bark of spruce branches and trunks. In Western Europe, by contrast, it is usually the younger larvae that overwinter (Steffan, 1963). The emergence from diapause of overwintering larvae of the bark spruce adelgid occurs later than in other *Pineus* species living on the bark of pine trees, the secondary host of representatives of this genus of adelgids. The spring reactivation of *P. pineoides* is usually observed no earlier than mid- to late April. Wintering individuals go through four larval stages before transforming into imagoes. Adult egg-laying females appear in the first ten days of May. They lay up to 30 eggs, which is significantly more than has been reported for Western Europe (up to eight eggs – Steffan, 1972). The hatching of the first summer generation larvae begins in the second half of May. In mid- to late June, the *P. pineoides* population consists of adult females and larvae of the first and second generations. From this time onwards, molting in the aphid colonies on spruce bark ceases. New adult females usually appear only from late July to early August, when molting into imagoes resumes. They are represented by individuals who belong partially to the first summer generation but mainly to the second summer generation. Thus, during the life cycle of this species in the middle of summer, a larval diapause occurs, lasting 45–50 days. It is worth noting that none of the above authors have reported summer diapause in this species. Adult females of the third summer generation appear in September. The fertility of females of all summer generations is approximately the same and does not exceed 30–35 eggs. At the end of September,

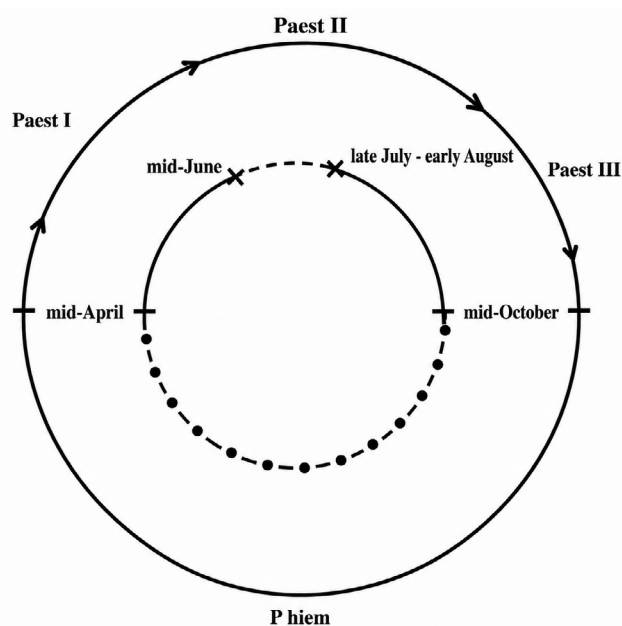


Figure 1. Life cycle diagram of *Pineus pineoides*. **Large circle:** Paests I-III – summer generations (paraestivosistens); P hiem – winter generation (parahiemosistens). **Small circle:** dashed line – summer diapause; dash-dotted line – winter diapause.

the population of the spruce adelgid moth in the arboretum reaches its seasonal maximum. The larvae that appear during this period develop until mid-October, after which they enter winter diapause.

Thus, under the conditions studied, the annual development cycle of *P. pineoides* consists of one winter and three summer generations (Fig. 1). It is interrupted by winter and summer larval diapauses. Individuals of all generations are morphologically uniform, have four larval instars, and belong to one type – progrediens. Taking into account their origin, it is proposed to name the wintering progrediens – parahiemoprogressiens (Fig. 2), and the summer ones – paraestivoprogressiens. Both winter and summer diapause are served by a non-specialized form of individuals.

This pest affected *Picea abies* trees in the the “Olexandria” Dendrological Park starting at five to six years old. Adelgids settled on the bark of trunks and thick branches. Under experimental conditions, *P. pineoides* larvae also colonized spruce buds. In this case, the buds exhibit deformations that vaguely resemble the galls of *Adelges* spp.

This reaction of bud tissue to the sucking of larvae and adults of this non-galloforming insect pest indicates the presence of physiologically active growth factors in their saliva. This discovery helps us understand how gall formation evolved in adelgids: from poorly organized plant deformations in their predecessors (obviously a side effect of feeding on host plant tissues) to the perfectly ordered structure of galls in modern species.

Conclusions

1. During the year, *Pineus pineoides* develops one winter and three summer generations. Biologically, individuals of all generations are of the same type. They belong to a single morph, paraprogrediens. There are two seasonal variations of this morph: winter (parahiemoprogressiens) and summer (paraestivoprogressiens).
2. In mid-summer, the *P. pineoides* population stops molting and enters a state of summer diapause, which lasts about 45–50 days. The total duration of diapause (summer and winter) for this species is about seven months.

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Figure 2. Parahiemoprogressiens of *Pineus pineoides*. A – general view (×140); B – cephalothorax shield details (×280).

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Інвазійні види шкідників інтродукованих рослин дендропарку “Олександрія”. Повідомлення 5. Особливості біології *Pineus pineoides* (Cholodkovsky, 1907) (Hemiptera, Adelgidae), шкідника ялини звичайної

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У статті описано біологічні характеристики *Pineus pineoides*, інвазивного виду, який потрапив до дендропарку “Олександрія” під час інтродукції ялини звичайної (*Picea abies*). Наведено дані про фенологію, харчову активність, кількість поколінь та характер життєвого циклу цього шкідника. Вперше повідомляється про існування літньої діпаузи в життєвому циклі цього виду. Запропоновано назву для циклічної форми та її варіацій, що з'являються в сезонному циклі розвитку *P. pineoides*.

Ключові слова: *Pineus pineoides*, ялинові насадження, шкода, мономорфний анголоцикл, літня діпауза, парaprogressiени