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Number dynamics of *Thelaxes dryophila* (Schrank, 1801) /Hemiptera, Aphidoidea/ on common oak (*Quercus robur*) in natural and degraded landscape

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Introduction

The aim of the research was to determine the number of *Thelaxes dryophila* (Schrank, 1801). The experiments were carried out on pedunculate oak (*Quercus robur*) in two different sites: in the forest communities of the Poleski National Park and in copes near the Zakłady Azotowe Puławy S.A. (Nitrogen Factory) in the town of Puławy.

Material and methods

Site description

The area of the Poleski National Park is characterized by high naturalness of plant communities. Different types of forest communities were used throughout the research. The area of the Nitrogen Factory in Puławy is a highly degraded site where trees were planted on the site of former forests degraded by air pollution caused by emissions of the factory. Plant communities in Puławy underwent and undergo continuously strong antropopressure. They have a strong altered species composition. Moreover, water shortage in the surface soil layers was observed in Puławy. Four research sites were selected in each areas.

Poleski National Park (PNP)

Site 1 (PNP 1) is situated on the border of the forest and waste land about 1500m from the Lublin-Włodawa highway. Oak trees grow here in the *Tilio-Carpinetum* communities.

Site 2 (PNP 2) is situated between former meliorating ditches. Oak trees that grow there are uncovered, and behind the ditches there is *Potentillo-albae-Quercetum* where sessile oak (*Quercus petraea*) dominates.

Site 3 (PNP 3) is situated in the *Ribeso nigri-Altnetum* community bordering with young trees of *Quercus robur*.

Site 4 (PNP 4) is an area where oak trees grow on the borderline of the *Ribeso nigri-Altnetum* community surrounded by *Betula pendula*. The site is located 400 m away from the Lublin-Włodawa highway.

Area of the Nitrogen Factory in the town of Puławy

Site 1 (Puławy 1) is situated by the highway from Puławy to Dęblin. Oak trees grow here by the highway surrounded by common pines (*Pinus sylvestris*), black locust (*Robinia pseudoacaccia*) and European white birch (*Betula pendula*).

Site 2 (Puławy 2) is situated 200 m away from the Nitrogen Factory. Oak trees in this site grow in the open space and are surrounded by green plants.

Site 3 (Puławy 3) is situated 400 m away from the Nitrogen Factory. Oak trees grow here along with black locusts (*R. pseudoacaccia*), bird cherry trees (*Prunus padus*), the apples (*Malus domesticus*) and European white birch (*B. pendula*).

Site 4 (Puławy 4) is situated by the Puławy-Dęblin highway, by the former Vistula river-bed, at the opposite side of the road in relation to site 1. Oak trees are surrounded here by common pine (*P. sylvestris*), black locusts (*R. pseudoacaccia*), and European white birch (*B. pendula*).

Methods of sample collection

In each of the 8 research site samples from 3-5 trees were collected. From each site 100 green and wooden shoots, each 30-40 cm long, as well as leaves that were on them (at least on 100 pieces), inflorescence and fruit were collected. The samples were collected every fourteen days from May until October. The collected material was examined under a stereoscopic microscope. Species identification was carried out on the basis of aphids on persistent microscope slides. For identification the keys of Blackman & Eastop (2000) and Müeller

(1976) were used. The following abbreviations were used: Puławy – to refer to the Nitrogen Factory in Puławy, and PNP – to refer to the Poleski National Park.

All photographs included in the chapter have been taken by the author.

Results

The following aphid species were found on the pedunculate oak tree in the research sites: *T. dryophila*, *Myzocallis castanicola*, Baker, 1917, *Tuberculatus annulatus* (Hartig, 1841), *Phylloxera coccinea* (von Heyden, 1837), *Lachnus roboris* (Linnaeus, 1758), *Lachnus longirostris* (Mordvilko, 1909), *Stomaphis querceus* (Linnaeus, 1758).

T. dryophila turned out to be the most numerous species to occur throughout the three years of research, of which in total 8725 specimens were collected. In Puławy – 6780 and much fewer in the PNP – 1945.

T. dryophila settled the underside of leaves, leaf petioles, fruit peduncles and only oak fruit. (Figs. 1-4). Their highest number on fruit, leaf petioles and green one-year-old shoots were observed. The specimens of *T. dryophila* settled bottom layers of the leaf blades and were feeding every time along the main veins of leaf (Figs. 2 and 3).

Aphids of this species were often attended by ants, which protected aphid colonies against natural enemies feeding on honeydew produced by aphids (Fig. 5).

Average density of this aphid in Puławy was 49.51 specimens/ 100 leaves, and in PNP – 13.85 specimens/ 100 leaves (Tab. 2). This was not a statistically significant difference (Tab. 1). The *T. dryophila* density in the subsequent years of research increased from 8.60 specimens/ 100 leaves in 2002 up to 72.64/ 100 leaves in 2004. Statistically significant differences between the average numbers from subsequent years were registered, and the Tukey's test showed that the average density in 2004 was significantly different than that of 2002 (Tab. 2).

Table 1. Analysis of variance – *Thelaxes dryophila*

Sources of variability	df	F Calculated value of tested function	P Calculated probability of responding with tested function F
Research sites	1	3.32	0.0850
Year	2	4.42	0.0277

Significance level at the p = 0.005

Table 2. Average density (individuals/ 100 leaves) of *Thelaxes dryophila* depending on the research site and the year

Research site	Puławy	49.51
	PNP	13.85
Year of research	2002	8.60a
	2003	13.81ab
	2004	72.64b

a,b – submission to the homogeneous groups (Tukey test)

In Puławy in 2002 *T. dryophila* was observed only between June 6 and July 12 and was found to be the most numerous in site 1 (Fig. 5). In the second and third year of research this aphid occurred regularly from May until September. In 2003 their peak number (169 specimens/100 leaves) was recorded in site 2 as early as May 15, whereas in site 1 only on July 31 (37 specimens/100 leaves) (Fig. 5). These aphids were most numerous in 2004. During their peak numbers (in particular sites) there were from 8 to 10 times more specimens than in the previous years of observations. They were most numerous in site 4 in mid-June – 1314 specimens/ 100 leaves. Quite a high number of this aphid species remained in site 1 and 2 (9-10 specimens/ leaf) until mid-July. After this time the aphid number decreased significantly. Last specimens were found on oak trees on October 7. As it follows from Figure 5 their peak number in each year of research and on each research site took place at a different time.

In the Poleski National Park *T. dryophila* was registered on a regular basis from mid-May until mid-September throughout all years of research (Fig. 6). In 2002 aphids occurred in a small number (1-29 specimens/ 100 leaves), in three out of four research sites (2, 3 and 4). However, in 2003 and 2004 they were most numerous in site 1, in which their peak number was registered on June 13 and 21, respectively (about 130-150 specimens/ 100 leaves). However, the differences between the numbers in the studied years were not as significant as in Puławy (Fig. 3). In the PNP aphids fed on oaks the longest until September 20, after which they were no longer recorded in any research site.

Summary

T. dryophila was likely to settle leaf petioles, fruits and green shoots of pedunkulate oak in a large number, in the presented research areas. Their feeding was also recorded on the underside of leaves and on fruit peduncles. In total, 8725 individuals of *T. dryophila* were collected: 1945 in Poleski National Park, and – 6780 in Puławy.

T. dryophila was registered to occur on a regular basis in both research sites. The studied species was observed to be the most numerous in Puławy, where in site 4, on June 16, 2004 – 1314 specimens per 100 leaves were collected. In PNP *T. dryophila* was much less numerous. The highest number of aphids of this species, i.e. 152 specimens/ 100 leaves was collected at one time (on June 21, 2004) in site 1. Most likely, the cause for such significant differences in the numbers between the studied areas was the threshold of naturalness of the researched areas. As follows from the research carried out so far in polluted areas the piercing-sucking arthropods such as spider mites, aphids, scale insects amount to higher numbers than in natural areas (Chudzicka, 1979; Czechowska *et al.*, 1979; Rychlik, 1979; Cichocka *et al.*, 1990ab; Kropczyńska *et al.*, 1990; Cichocka, Goszczyński, 1991; Cichocka *et al.*, 1998). The presented research confirms those results, since in Puławy 6780 specimens of *T. dryophila* in total were collected, while in the PNP – 1945. It could be stated that the degree of naturalness or degradation of the environment determines the number of species which occur there.

Figure 1. Larva and wingless female of *Thelaxes dryophila* feeding on green shoot

Figure 2. Larva of *Thelaxes dryophila* feeding on the under side of leaf by the main vein

Figure 3. Winged female Thelaxes dryophila feeding on the underside of leaf by the main vein

Figure 4. Thelaxes dryophila colony attended by ants on the oak fruit

Figure 5. Ant carrying a honeydew drop

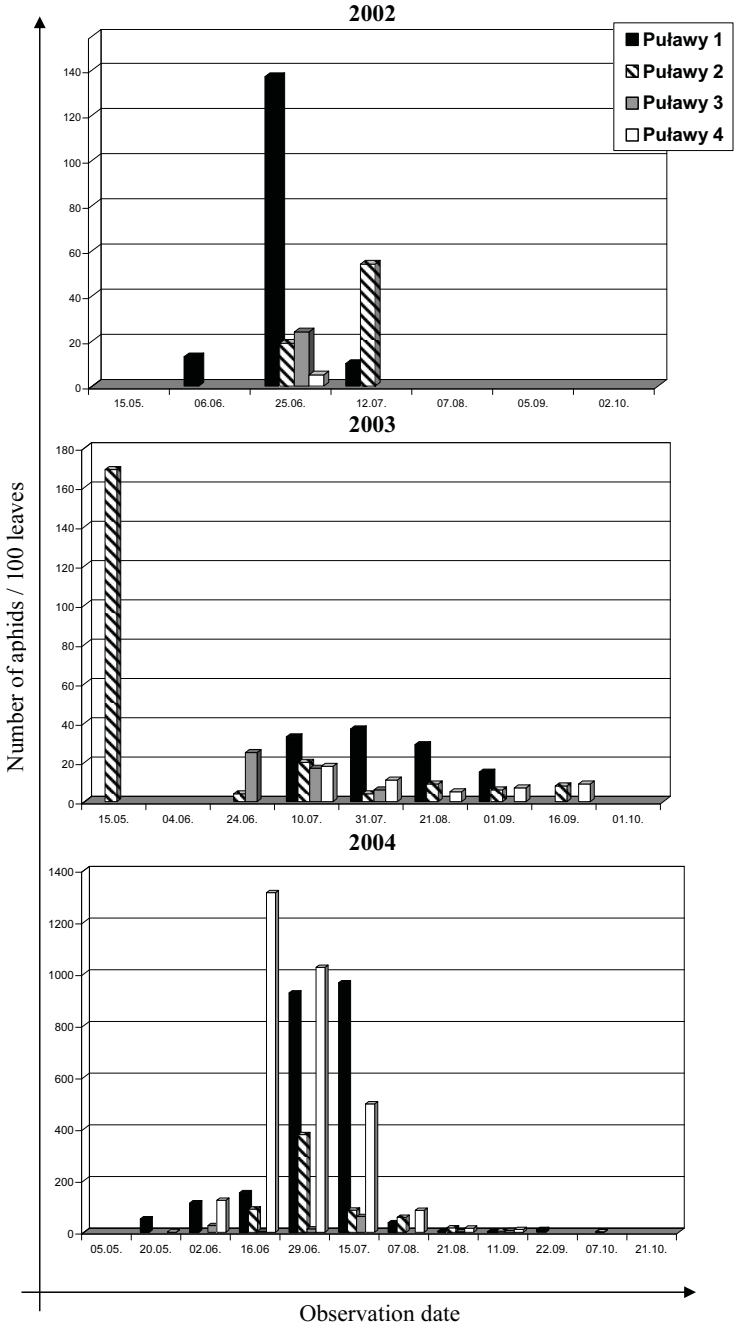

Figure 5. Dynamics of *Thelaxes dryophila* in numbers, Puławy 2002-2004

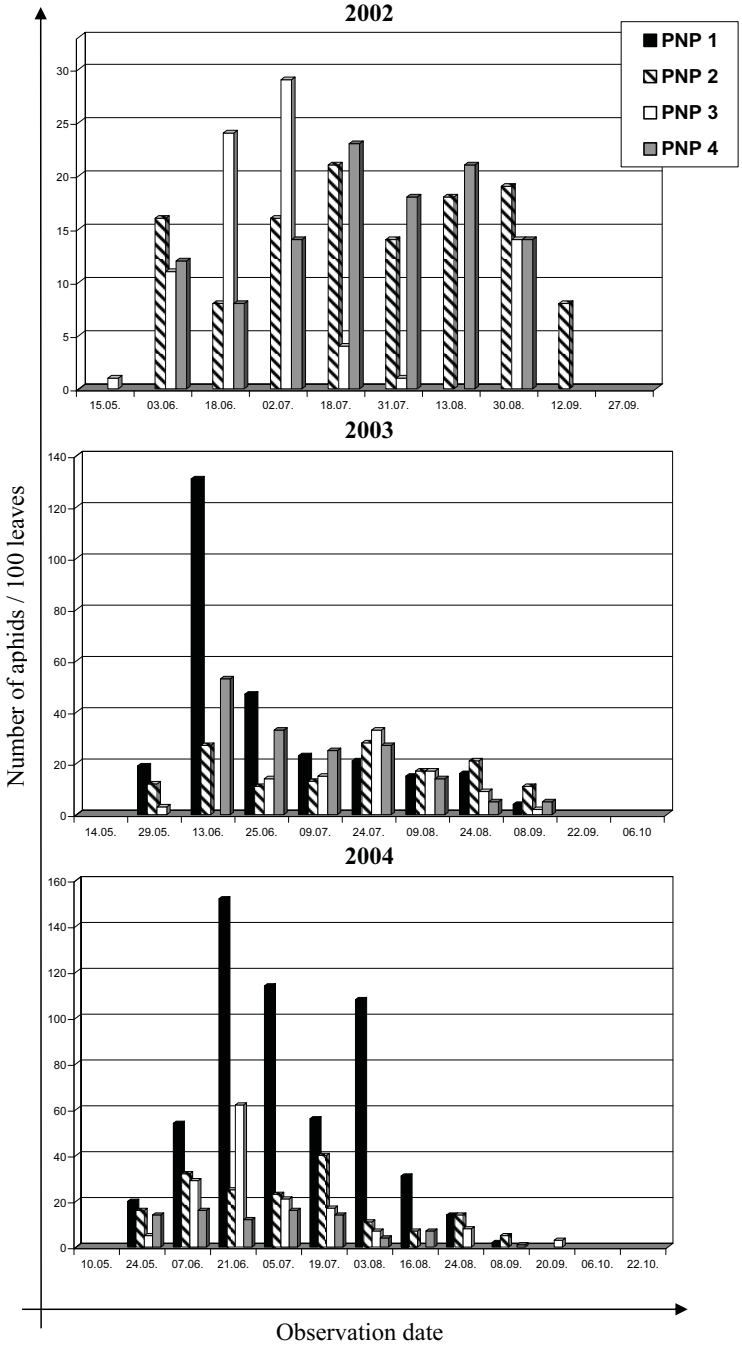

Figure 6. Dynamics of *Thelaxes dryophila* in numbers, PNP 2002-2004

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Dynamika liczebności *Thelaxes dryophila* (Schrank, 1801) /Hemiptera, Aphidoidea/ na dębie szypułkowym (*Quercus robur*) w krajobrazie naturalnym i zdegradowanym

Streszczenie

Praca przedstawia dynamikę liczebności *Thelaxes dryophila* (Schrk.) w dwóch obszarach badawczych: Poleskim Parku Narodowym i okolicach Zakładów Azotowych w Puła-

wach. Podczas badań zebrano 8725 osobników *Thelaxes dryophila*. Odpowiednio w Puławach – 6780 i 1945 osobników Poleskim Parku Narodowym. *Thelaxes dryophila* występowała dość regularnie w obu obszarach badawczych, ale ponad 3-krotnie liczniej w Puławach. Szczyt liczebności w poszczególnych latach badawczych i stanowiskach przypadał w różnych okresach sezonu badawczego. Badany gatunek zasiedlał spodnią stronę liści, ogonki liściowe, szypułki owoców i same owoce dębu. Najliczniej obserwowano jej występowanie na owocach oraz na ogonkach liściowych. Zasiedlające spodnią stronę liści osobniki *Thelaxes dryophila* zawsze żerowały w pobliżu nerwu głównego liścia. Osobniki *Thelaxes dryophila* były często i chętnie odwiedzane przez mrówki, które broniły kolonii korzystając z wydalanej przez mszyce spadzi.