DOI: 10.1515/frp-2017-0038
Available online: www.lesne-prace-badawcze.pl

Leśne Prace Badawcze / *Forest Research Papers*
Grudzień / December 2017, Vol. 78 (4): 337–345

SHORT COMMUNICATION

e-ISSN 2082-8926

Insects mining leaves of English oak *Quercus robur* L. in Bydgoszcz and its vicinity

Danuta Wrzesińska

UTP University of Science and Technology in Bydgoszcz, Department of Entomology and Molecular Phytopathology, ul. Kordeckiego 20, 85–225 Bydgoszcz, Poland

Tel. +48 52 3749365, e-mail: danuta@utp.edu.pl

Abstract. This research on the occurrence of insects mining leaves of the English oak *Quercus robur* was performed between 2011–2012 in Bydgoszcz and in nine neighbouring sites: seven in forest areas and two in an urbanized environment. The analysis of the gathered material revealed the occurrence of insects from three different orders, Coleoptera, Hymenoptera and Lepidoptera, and 10 families: Curculionidae, Tenthredinidae, Bucculatricidae, Coleophoridae, Eriocraniidae, Gracillariidae, Heliozelidae, Incurvariidae, Nepticulidae and Tischeriidae. In total, 21 insect species were collected from *Q. robur* ; most of them at forest sites. A slightly lower number of species was recorded at Janowo, where oaks were growing on the edge of the forest in the vicinity of a transport route with heavy traffic. Even fewer taxa were observed in the vicinity of urbanised areas; in the city park on the Bydgoszcz Canal and in Fordon.

The most abundant species on the English oak were *Tischeria ekebladella* (Bjerk.) and *Phyllonorycter heegeriella* (Zell.).

Keywords: English oak, mining insects, *Tischeria ekebladella*, *Phyllonorycter heegeriella*

1. Introduction

English oak *Quercus robur* (L.) occurs almost in whole Europe and shows great adaptation abilities to different climate conditions. It grows in mixed forests, flood plains and oak-hornbeam forests. It's common in parks, squares and along roadside alleys. English oak is also commonly planted as a memorial tree.

On oak, amongst all ligneous plants, can be found as the most numerous and very diversified fauna of phytophagous arthropods (Glavendekic et al. 2010; Skrzypczyńska 2007; Wrzesińska 2013). The author, whilst running research on folivores leaving gallnuts on *Q. robur* on the areas of Bydgoszcz and neighbouring sites, also observed numerous leaf mines that often occurred on the same leaf blades (Wrzesińska 2013). Owing to the fact that there were few reports on mining insects on mentioned above areas, an attempt was taken to mark those insects and to compare the species composition on chosen study sites.

Mines are corridors or chambers drilled by larvae of insects feeding in the inside of live parenchyma or skin cells. The trace of larvae feeding is visible on the outside as a stain or a serpentine-shaped strip differing from healthy tissue in colour. Insects drill holes usually in leaf parenchyma (*phyllonomium*), less frequently in stalk chlorenchyma (*caulonomium*), exceptionally in sepals of calyx or perianth (*anthonomium*) or in green fruit (*carponomium*). Majority of insects are leaving mines through whole period of larval development or even pupate inside of a mine what is a permanent feature of some species and an important hint in identification to which species given mine should be assigned. Some species mine leaves only in early larval development period (Beiger 2004).

The aim of the study was the recognition and comparison of species composition of folivores leaving mines on *Q. robur*, their number and domination on different sites in Bydgoszcz and its vicinity.

2. Research area

Faunistic research on entomofauna mining on English oak was conducted in 2011–2012 on the area of Bydgoszcz and its vicinity on nine chosen sites – seven were localised

Arrived: 28.06.2017, reviewed: 25.08.2017, accepted: 29.11.2017

in forest and two on urbanised area (Fig. 1). In the study, species composition and structure of domination of oak-mining species in those localisations were compared.

Two first study sites (no. 1 and 2) were localised on the area of Forest Park of Culture and Leisure in Myślęcinek, which is a part of great anthropogenic urban ecosystem. It is situated on the area of 830 ha on the northern edge of administrative borders of the city. Five study sites (no. 3–7) were situated in forest stands of Żołędowo forest inspectorates subordinated to Regional State Forest Directorate in Toruń. Two study sites (no. 3 and 4) were localised in mixed forest close to Osowa Góra housing estate in Bydgoszcz. Study site no. 5 was localised in Osówiec. The oaks grew on the edge of pine forest stand in well-insulated position. Study areas no. 6 and 7 were localised near Koronowska Route, which is a road of heavy traffic. One of the sites was localised near Szczutki and the second one behind the crossroad of Koronowska Route with a road heading to Janowo. Another site (no. 8) was situated in public park very close to city centre. The site was placed in narrow lane along Bydgoszcz Canal. For the research, oaks growing in western part of the park – between 5th and 6th water gates – were chosen. On the eastern end of Bydgoszcz, study site no. 9 was localised. It was situated on Fordon on which grew English oaks and between them scrub community *Rosa canina* (L.), *Crataegus laevigata* (Poir.) and *Crataegus monogyna* (Jacq.) and also xerothermic grasslands with young pines *Pinus sylvestris* (L.).

3. Materials and methods

On the nine study sites, 10 trees were randomly chosen, and from each tree, 40 leaves were collected. In both years, 18 samples (9 samples each year) were collected, which means that 64,800 leaves were analysed. On forest areas, oaks growing in close distance to each other were chosen, whilst on two urban sites (Bydgoszcz Canal and Fordon), trees localised in greater distance from each other were chosen. Inspection was conducted from first decade of June until the beginning of October, every 14–20 days. Collected samples were placed in plastic bags and labelled. They were segregated in the laboratory and their look was described. Chosen mines were prepared and characterised in terms of quantity, and species of insects creating mines were marked. Inbreeding of some insect species (in jars or Petri dishes) was set up to make sure whether mine makers were marked properly. Such procedure was also used with marking of species that drilled holes similar to each other and their faecal line fell apart into small grains similar to that in case of species from the genus *Stigmella* – *Stigmella roborella* (Joh.) and *Stigmella ruficapitella* (Haw.). To provide proper humidity conditions, sand or lignin was placed on the bottom of the dishes. During winter, the inbreeding was kept in the garden in the ambient temperature.

Species of insects being originators of mines on leaf blades were marked on the base of keys and entomological atlas (Beiger 2004; Nunberg 1964; Łabanowski, Soika 2003; Schna-

1 – Myślęcinek1
2 – Myślęcinek2
3 – Osowa Góra1
4 – Osowa Góra2
5 – Osówiec
6 – Szczutki
7 – Janowo
8 – Nad Kanałem Bydgoskim
9 – Fordon

Figure 1. Distribution of study sites in the city of Bydgoszcz and in the vicinity (©2013 Google)

ider 1976; Toll 1959; Wojtusiak 1976). Order, family, genus and species of insects were presented in the alphabetical order.

On the basis of the number of occurring species, ratio of dominance was calculated and expressed in percentage (called also individual dominance or relative count):

$$D = \frac{n}{N} \cdot 100\%$$

where D is the ratio of individual dominance of a species,
n is the number of mines of given species,
N is the number of mines of all species present on host.

In the study, individual dominance (D) of given species on examined study sites was also determined (Kasprzak, Niedbała 1981). For descriptive presentation of D-ratio value, five classes of dominance were adopted: D_5 – eudominants – the most numerous species, including over 10% of specimen of analysed taxonomic group; D_4 – dominants, that are medium-abundant species including 5.1–10% of specimen; D_3 – subdominants – from 2.1% to 5%, D_2 – recedents – from 1.1% to 2% and species of very small number; D_1 – subrecedents – below 1.1% specimen.

4. Study results and discussion

During research conducted in years 2011–2012, 64,800 leaves of *Q. robur* were analysed, on which, 19,771 insect mines were found. These belonged to representatives of 3 orders, Coleoptera, Hymenoptera and Lepidoptera, and 10 families: Curculionidae, Tenthredinidae, Bucculatricidae, Coleophoridae, Eriocraniidae, Gracillariidae, Heliozelidae, Incurvariidae, Nepticulidae and Tischeriidae. The most mines were created by insect species belonging to Lepidoptera order, whereas significantly less mines were created by Hymenoptera and Coleoptera (Table 1)

The most mines were stated on forest sites and the least on sites localised on urbanised area, that is, Fordon, and in park over the Bydgoszcz Canal (Table 1). According to Trojan and Winiarska (2001), the richness of entomofauna on certain sites on urbanised areas depends on many factors. The most important of them are size, localisation and species composition of the host plants. On these areas, a phenomenon of environment fragmentation can observed be often as a result of what groups of insects of small count and small number of individual species occur. Such specific conditions were present on urbanised area situated on Fordon and in park over the Bydgoszcz Canal. On these areas, oaks were dispersed between other trees, bushes and underbush community.

Amongst 21 insect species revealed, 7 belonged to Gracillariidae family, 5 to Nepticulidae and 2 to Tischeriidae. In remaining insect families, one species from each family was noted (Table 2). Kollár and Hrubík (2009) in Slovakia noted 18 leaf-mining species on *Quercus* sp. Majority of them are from Lepidoptera order that belong to the following genus: *Phyllonorycter* – four species; *Coleophora* – four species;

Table 1. Number of leaf mines and their percentage share in the material collected from *Quercus robur* in 2011–2012

Order/family	Number of leaf mines collected									Total	Relative number [%]
	locality										
	1	2	3	4	5	6	7	8	9		
Coleoptera											
- Curculionidae	45	23	57	24	14	8	0	0	0	171	0.86
Hymenoptera											
- Tenthredinidae	23	20	55	56	31	6	5	0	0	196	0.99
Lepidoptera											
- Bucculatricidae	43	64	67	30	43	73	4	3	0	327	1.65
- Coleophoridae	8	6	4	6	0	0	1	0	0	25	0.13
- Eriocraniidae	0	0	5	12	1	1	2	0	0	21	0.11
- Gracillariidae	1,285	1,218	1,250	1,300	851	681	659	897	596	8,737	44.19
- Heliozelidae	48	38	13	21	10	50	43	14	0	237	1.20
- Incurvariidae	9	8	0	10	6	0	24	0	0	57	0.29
- Nepticulidae	296	283	379	284	334	249	163	152	203	2,343	11.85
- Tischeriidae	1,398	753	1,025	1,246	971	969	750	380	165	7,651	38.73
Total	3,155	2,413	2,855	2,989	2,261	2,037	1,651	1,446	964	19,771	100

1 – Myślęcinek1, 2 – Myślęcinek2, 3 – Osowa Góra1, 4 – Osowa Góra2, 5 – Osówiec, 6 –Szczutki, 7 –Janowo, 8 – Nad Kanałem Bydgoskim, 9 – Fordon

Table 2. Percentage of respective species of insects forming leaf mines in *Quercus robur* in 2011–2012 / specimen dominance (*D*)

Order/Family/Species	Locality					
	1		2		3	
	2011	2012	2011	2012	2011	2012
	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*
Coleoptera						
Curculionidae	**0.69**	**1.94**	**0.39**	**1.36**	**0.88**	**3.03**
Orchestes quercus (Linnaeus 1758)	0.69 D_1	1.94 D_2	0.39 D_1	1.36 D_2	0.88 D_1	3.03 D_3
Hymenoptera						
Tenthredinidae	**0.84**	**0.65**	**0.69**	**0.93**	**1.76**	**2.08**
Profenusa pygmaea (Klug 1816)	0.84 D_1	0.65 D_1	0.69 D_1	0.93 D_1	1.76 D_2	2.08 D_2
Lepidoptera						
Bucculatricidae	**1.45**	**1.30**	**2.73**	**2.59**	**1.90**	**2.76**
Bucculatrix ulmella (Zeller 1848)	1.45 D_2	1.30 D_2	2.73 D_3	2.59 D_3	1.90 D_2	2.76 D_3
Coleophoridae	**0.23**	**0.27**	**0.39**	**0.14**	**0.07**	**0.20**
Coleophora (Hübner 1822) spp.	0.23 D_1	0.27 D_1	0.39 D_1	0.14 D_1	0.07 D_1	0.20 D_1
Eriocraniidae	**0**	**0**	**0**	**0**	**0.22**	**0.13**
Dyseriocrania subpurpurella (Haworth 1828)	0 -	0 -	0 -	0 -	0.22 D_1	0.13 D_1
Gracillariidae	**44.03**	**38.40**	**48.68**	**51.80**	**36.80**	**50.20**
Acrocercops brongniardella (Fabricius 1798)	0.83 D_1	0.81 D_1	1.27 D_2	1.58 D_2	0.73 D_1	1.14 D_2
Caloptilia alchimiella (Scopoli 1763)	2.99 D_3	2.27 D_3	4.61 D_3	4.38 D_3	2.93 D_3	2.62 D_3
Phyllonorycter harrisella (Linnaeus 1761)	3.60 D_3	3.30 D_3	0.10 D_1	0.57 D_1	0.51 D_1	0.87 D_1
Phyllonorycter heegeriella (Zeller 1846)	7.81 D_4	6.82 D_4	8.91 D_4	8.41 D_4	7.17 D_4	10.42 D_5
Phyllonorycter lautella (Zeller 1846)	1.23 D_2	1.79 D_2	0.78 D_1	0.94 D_1	4.10 D_3	7.19 D_4
Phyllonorycter quercifoliella (Zeller 1839)	7.89 D_4	12.49 D_5	13.42 D_5	14.30 D_5	13.75 D_5	16.67 D_5
Phyllonorycter roboris (Zeller 1839)	19.68 D_5	10.92 D_5	19.59 D_5	21.62 D_5	7.61 D_4	11.29 D_5

Locality											
4		5		6		7		8		9	
2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*
0.45	**1.10**	**0.32**	**0.83**	**0.11**	**0.61**	**0**	**0**	**0**	**0**	**0**	**0**
0.45	1.10	0.32	0.83	0.11	0.61	0	0	0	0	0	0
D_1	D_2	D_1	D_1	D_1	D_1	-	-	-	-	-	-
2.16	**1.64**	**1.83**	**1.05**	**0.22**	**0.35**	**0.39**	**0.23**	**0**	**0**	**0**	**0**
2.16	1.64	1.83	1.05	0.22	0.35	0.39	0.23	0	0	0	0
D_3	D_2	D_2	D_1	D_1	D_1	D_1	D_1	-	-	-	-
1.04	**0.97**	**2.05**	**1.80**	**4.27**	**3.05**	**0.13**	**0.34**	**0**	**0.34**	**0**	**0**
1.04	0.97	2.05	1.80	4.27	3.05	0.13	0.34	0	0.34	0	0
D_1	D_1	D_2	D_2	D_3	D_3	D_1	D_1	-	D_1	-	-
0.15	**0.24**	**0**	**0**	**0**	**0**	**0**	**0.11**	**0**	**0**	**0**	**0**
0.15	0.24	0	0	0	0	0	0.11	0	0	0	0
D_1	D_1	-	-	-	-	-	D_1	-	-	-	-
0.37	**0.43**	**0**	**0.08**	**0**	**0.09**	**0.09**	**0**	**0**	**0**	**0**	**0**
0.37	0.43	0	0.08	0	0.09	0.09	0	0	0	0	0
D_1	D_1	-	D_1	-	D_1	D_1	-	-	-	-	-
38.24	**47.78**	**35.78**	**47.78**	**38.24**	**33.22**	**35.01**	**44.20**	**61.72**	**62.24**	**61,33**	**62,19**
0.82	1.45	0.54	1.45	0.11	0.79	0.26	0.34	0	0	0	0
D_1	D_2	D_1	D_2	D_1	D_1	D_1	D_1	-	-	-	-
4.68	3.47	1.29	2.10	4.49	4.46	5.02	4.46	0	0	0	0
D_3	D_3	D_2	D_3	D_3	D_3	D_3	D_3	-	-	-	-
1.49	1.28	4.20	3.97	0.90	1.48	0.64	0.46	6.38	4.16	5,42	8,60
D_2	D_2	D_3	D_3	D_1	D_2	D_1	D_1	D_4	D_3	D_4	D_4
8.33	9.85	10.88	6.90	7.53	6.36	7.08	10.41	29.13	29.13	25,37	24,55
D_4	D_4	D_5	D_4	D_4	D_4	D_4	D_5	D_5	D_5	D_5	D_5
4.98	7.42	3.45	5.78	3.71	4.53	5.15	5.26	0	0	0	0
D_3	D_4	D_3	D_4	D_3	D_3	D_4	D_4	-	-	-	-
10.57	11.91	7.22	7.65	7.64	6.71	6.69	9.50	22.93	3.28	25,12	23,84
D_5	D_5	D_4	D_4	D_4	D_4	D_4	D_4	D_5	D_3	D_5	D_5
7.31	12.40	8.19	11.63	9.33	8.89	10.17	14.19	3.28	0.52	5,42	5,20
D_4	D_5	D_4	D_5	D_4	D_4	D_5	D_5	D_3	D_1	D_4	D_4

Order/Family/Species	Locality					
	1		2		3	
	2011	2012	2011	2012	2011	2012
	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*
Heliozelidae	**1.61**	**1.46**	**2.64**	**0.79**	**0**	**0.87**
Heliozela sericiella (Haworth 1828)	1.61 D_2	1.46 D_2	2.64 D_3	0.79 D_1	0 -	0.87 D_1
Incurvariidae	0.38	0.22	0.20	0.43	0	0
Incurvaria masculella (Denis & Schiffermüller 1775)	0.38 D_1	0.22 D_1	0.20 D_1	0.43 D_1	0 -	0 -
Nepticulidae	8.12	10.28	13.52	10.42	11.63	14.79
Ectoedemia albifasciella (Heinemann 1871)	0.69 D_1	0.98 D_1	1.47 D_2	0.86 D_1	1.90 D_2	1.41 D_2
Ectoedemia subbimaculella (Haworth 1828)	1.99 D_2	2.11 D_3	3.43 D_3	3.16 D_3	2.12 D_3	3.49 D_3
Stigmella basiguttella (Heinemann 1862)	1.61 D_2	2.49 D_3	2.74 D_3	2.81 D_3	1.24 D_2	2.22 D_3
Stigmella roborella (Johansson 1971)	1.69 D_2	1.73 D_2	1.86 D_2	1.15 D_2	2.71 D_3	2.76 D_3
Stigmella ruficapitella (Haworth 1828)	2.14 D_3	2.97 D_3	4.02 D_3	2.44 D_3	3.66 D_3	4.91 D_3
Tischeriidae	42.65	45.48	30.76	31.54	46.74	25.94
Tischeria dodonaea (Stainton 1858)	1.15 D_2	0.54 D_1	1.18 D_2	1.22 D_2	0.44 D_1	0.87 D_1
Tischeria ekebladella (Bjerkander 1795)	41.50 D_5	44.94 D_5	29.58 D_5	30.32 D_5	46.30 D_5	30.32 D_5

1 – Myślęcinek1, 2 – Myślęcinek2, 3 – Osowa Góra1, 4 – Osowa Góra2, 5 – Osówiec, 6 –Szczutki, 7 –Janowo, 8 – Nad Kanałem Bydgoskim, 9 – Fordon
D – Dominance class
D_5 – eudominats, D_4 – dominants, D_3 – subdominants, D_2 – recedents, D_1 – subrecedents

Stigmella – three species; *Tischeria* – three species; *Acrocercops* – one species; and *Ectoedemia* – 1 species, and one species from each of Coleoptera and Hymenoptera order (*Orchestes* and *Profenusa,* respectively). On the area of botanical garden in Nitra, Kollár and Donoval (2013) observed 14 species on *Q. robur*, including 11 taxa mining leaves. On forest study sites in Romania, Stolnicu (2008) stated 15 species of which 13 originated from Lepidoptera order and 1 from each of Coleoptera and Hymenoptera order. In forests on the area of Bydgoszcz and Świecie, Wrzesińska and Wawrzyniak (2001) noted 17 insect species whose larvae drilled holes or chambers in leaf blades. The authors stated the most mining insects on oaks growing in forest sites and the least in city centre and close to Frantschach Świecie S.A. cellulose plant (presently Mondi Świecie S.A.). Skrzypczyńska and Dramé (1987) stated seven species of insects mining oak leaves near Kraków. Most of them were noted on oaks growing in Wolski Forest on the area of Cracow and less on the area of Experimental Forest Facility in Krynica. Michalska (1988) whilst observing insects mining leaves of trees in Świętokrzyskie Mountains noted 14 species on oaks. Amongst these insects, 3 belonged to Coleoptera order and the remaining 11 to Lepidoptera. In Ojców National Park, Buszko (1993) noted 10 mining species from Lepidoptera.

Locality											
4		5		6		7		8		9	
2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*	%/*D*
0.22	**1.09**	**0.86**	**0.15**	**2.14**	**2.70**	**2.06**	**3.09**	**0.52**	**1.27**	**0**	**0**
0.22 D_1	1.09 D_1	0.86 D_1	0.15 D_1	2.14 D_3	2.70 D_3	2.06 D_2	3.09 D_3	0.52 D_1	1.27 D_2	0 -	0 -
0.52	0.18	0.43	0.15	0	0	1.67	1.26	0	0	0	0
0.52 D_1	0.18 D_1	0.43 D_1	0.15 D_1	0 -	0 -	1.67 D_2	1.26 D_2	0 -	0 -	0 -	0 -
8.11	10.64	15.09	14.55	12.02	12.38	8.24	11.53	12.41	9.24	21.92	20.43
1.79 D_2	2.36 D_3	1.62 D_2	1.26 D_2	2.47 D_3	1.48 D_2	0 -	0 -	0 -	0 -	0 -	0 -
1.04 D_1	1.16 D_2	2.16 D_2	2.11 D_3	0.90 D_1	1.66 D_2	1.29 D_2	2.40 D_3	1.37 D_2	0.81 D_1	0 -	0 -
0.73 D_1	0.73 D_1	3.56 D_3	3.30 D_3	2.47 D_3	2.70 D_3	2.44 D_3	1.95 D_2	3.28 D_3	3.00 D_3	9.61 D_4	6.63 D_4
2.16 D_3	3.53 D_3	2.04 D_2	1.95 D_2	4.72 D_3	5.49 D_4	2.32 D_3	4.46 D_3	4.48 D_3	2.08 D_2	3.69 D_3	5.20 D_4
1.93 D_2	2.86 D_3	5.71 D_4	5.93 D_4	1.46 D_2	1.05 D_1	2.19 D_3	2.52 D_3	3.28 D_3	3.35 D_3	8.62 D_4	8.60 D_4
48.74	35.93	43.64	42.46	47.53	47.60	52.24	39.36	25.35	26.92	16.75	17.38
0.08 D_1	0.37 D_1	0.32 D_1	0.67 D_1	0.23 D_1	0.96 D_1	0 -	0.34 D_1	0 -	0 -	0 -	0 -
48.66 D_5	35.56 D_5	43.32 D_5	41.79 D_5	47.30 D_5	46.64 D_5	52.24 D_5	39.02 D_5	25.35 D_5	26.91 D_5	16.75 D_5	17.38 D_5

On the other hand, Jaworki (2009a), during research conducted on the area of three forest facilities in central Poland, stated seven species from *Phyllonorycter* genus mining leaves of English and Common oak.

Amongst 21 insect species observed on *Q. robur* in both years of the research, the most numerous species was *Tischeria ekebladella* (Bjerk.). Caterpillars of this Lepidoptera created the most mines on leaf blades of trees growing on forest sites. That fact decided of its first position amongst eudominants (D_5). Numerous mines of *T. ekebladella* were stated also on urbanised area. The results obtained confirm the data collected by other authors who indicated on numerous appearance of this Lepidoptera on both forest and urbanised sites. Stolnicu (2008) and Skuhravý et al. (1998) also noted *T. ekebladella* as the most numerous species on different species of oaks growing on various sites. On the area of urban botanical forest, Kollár and Donoval (2013) also stated mines of this folivore on *Q. robur*. Mines of this *Tischeria* in Poland on forest and urbanised areas were noted, among other things, by Wrzesińska and Wawrzyniak (2001), Płóciennik et al. (2011) and Skrzypczyńska and Dramé (1987). *T. ekebladella* is, according to Beiger (2003), a common species and appears anywhere where its host plant is. That is why mines of this Lepidoptera can be found in forests and also in city parks.

The least numerous folivore from Tischeriidae family was *Tischeria dodonaea* (Stainton). It was noted only on forest areas. This species is far less common than the previous one (Beiger 2004).

On urban sites (over Bydgoszcz Canal and on Fordon Slope), in both years of research, first position amongst eudominants was occupied by *Phyllonorycter heegeriella* (Zeller). On forest sites, this species was slightly less numerous and was qualified to group of dominants. Only in 2012, the number of *P. heegeriella* exceeded 10% on site in Janowo. Mines with larvae of this Lepidoptera species on English oak were observed by Michalska (1988) on the habitat of mixed coniferous forest in *Świętokrzyskie* Mountains. Those mines on *Q. robur* were also noted by Kollár and Donoval (2013), Jaworski (2009a; 2009b) and also Wrzesińska and Wawrzyniak (2001). Buszko (1990) revealed this species on grasslands and urban parks. This butterflies, considered by Beiger (2004) to be thermophilic, had also favourable conditions for the development on Fordon Slope on which English oaks grew in close neighbourhood of xerothermic grasslands and also in city park over the Bydgoszcz Canal. *P. heegeriella* dominated also in Jaworski's (2009a) research in forests of Rogów Forest Inspectorate which is characterised by high average temperature and quite mild microclimate.

Another species of Lepidoptera that is numerously noted on study sites was *Phyllonorycter roboris* (Zell.). *P. roboris* occurred in small numbers only on one site (in 2012 over the Bydgoszcz Canal). Also Jaworski (2009) and Stolnicu (2008) in Romania on forest areas and in central Poland have observed numerously this species of *P. roboris*. It was observed by Jaworski (2009) that this insect preferred vividly poorer habitats of fresh coniferous forest and fresh mixed coniferous forest where it reached its highest count. It was also noted in the area of Ursynów scarp in Warsaw (Jaworski 2009b) and in botanical garden in Nitra (Kollár, Donoval 2013). According to Beiger (2004) and Michalska (1988), *P. roboris* is a quite common species on plain and plateau, preferring well-insulated and warm sites. That is why this species could have found favourable development conditions on oaks growing in Bydgoszcz and surrounding forests.

In group of eudominants and dominants, *Phyllonorycter quercifoliella* (Zeller) was noted on oaks growing in forest and urbanised environments in both years of research. According to Beiger (2004), it is a common species. In Poland, it is quite common on plains and plateau (Michalska 1988). Jaworski (2009a) stated that amongst collected *Phyllonorycter*, this species showed relatively smallest preferences regarding habitat type and it was almost as numerous in conifer forest as it was in fertile forests.

Amongst species from *Phyllonorycter* genus, *Phyllonorycter harrisella* (L.) and *Phyllonorycter lautella* (Zeller) occurred less numerously, which did not exceed 5% threshold in years 2011–2012 amongst all collected mining insects (Table 2). The most mines drilled by *P. lautella* were observed by Buszko (1990) on leaves of seedlings and underwood. In own studies, samples from oak's underwood were not collected. That could have been the reason why mines of this Lepidoptera were less frequently noted. *P. lautella* was not stated on two urban study sites. Jaworski (2009a) found mines of this species mainly on oak's underwood. In park over the Bydgoszcz Canal and in Fordon, seedlings of those trees were cleared out and that may be the reason for the lack of occurrence of this species on trees. Two other representatives of Gracillaridae, *Acrocercops brongniardella* (Fab.) and *Caloptilla alchimiella* (Scop.), were not observed on these sites, and on forest sites, they appeared in small numbers.

Some representatives of Nepticulidae, among others, *Ectodemia subbimaculella* (Haw.) and *Stigmella basiguttella* (Hein.), were rarely noted on examined site. In both years of research in dominant and subdominants' class, the presence of *S. ruficapitella* (Haw.) (with the exception of Fordon – D_4) and *S. roborella* (Joh.) (with the exception of site in Myślęcinek 1 and 2 and Osówiec) was stated. In dominant's group on one site in Fordon, *S. basiguttella* also appeared (Table 2). Beiger (2004) states that *S. ruficapitella*, *S. roborella* and *S. basiguttella* are insects often found in deciduous and mixed forests and in parks. Skuhravý et al. (1998) observed on different oak species, insects belonging to three taxa from Nepticulidae family: *Stigmella atricapitella, S. ruficapitella* and *S. samiatella.*

5. Conclusions

1. In 2011–2012, on leaf blades of *Q. robur,* the presence of mines caused by larvae of insects from 3 orders, Coleoptera, Hymenoptera and Lepidoptera, and 10 families, Curculionidae, Tenthredinidae, Bucculatricidae, Coleophoridae, Eriocraniidae, Gracillariidae, Heliozelidae, Incurvariidae, Nepticulidae and Tischeriidae, was noted.

2. In general, on *Q. robur,* 21 species of insects were collected – most of them were found on forest sites (from 20 to 21), slightly smaller number (18) were found in Janowo where oaks grew on the edge of the forest. Less taxa were observed in city park over Bydgoszcz Canal (11), and the least in Fordon (8).

3. Amongst species mining English oak, *Tischeria ekebladella* and *Phyllonorycter heegeriella* were represented the most numerously.

Conflict of interest

The author declares lack of potential conflicts.

Acknowledgements and source of funding

The study was financed within statutory research of Department of Entomology and Molecular Phytopathology of UTP University of Science and Technology in Bydgoszcz.

References

Beiger M. 2003. Materiały metodyczne i przeglądowe. Stan poznania fauny owadów minujących Polski. *Wiadomości Entomologiczne* 22(2): 101–105.

Beiger M. 2004. Owady minujące Polski. Klucz do oznaczania na podstawie min. Bogucki Wyd. Naukowe, Poznań, 894 s. ISBN 83-89290-80-4.

Buszko J. 1990. Studies on the mining Lepidoptera of Poland. X. Mining Lepidoptera of Toruń and surrounding areas. Acta Zoologica Cracoviensia 33: 367–452.

Buszko J. 1993. Badania nad motylami minującymi Polski. XIV. Motyle minujące (Lepidoptera) Ojcowskiego Parku Narodowego. *Wiadomości Entomologiczne* 12(3): 201–214.

Fauna Europaea 2013. Fauna Europaea version 2.6.2. http://www.faunaeur.org [30.09.2017].

Glavendekic M.M., Medarevic M.J. 2010. Insects defoliators and their influence on oak forests in the Djerdap National Park, Serbia. *Archives of Biological Sciences* 62(4): 1137–1141. DOI 10.2298/ABS 1004137G.

Jaworski T. 2009a. Struktura zgrupowań motyli z rodzaju *Phyllonorycter* Hbn. (Lepidoptera, Gracillariidae), minujących liście dębów w różnych typach siedliskowych lasu. *Leśne Prace Badawcze* 70(2): 143–150.

Jaworski T. 2009b. Kibitnikowate (Lepidoptera: Gracillariidae) rezerwatu „Skarpa Ursynowska" w Warszawie. *Wiadomości Entomologiczne* 28(1): 53–60.

Kasprzak K., Niedbała W. 1981. Wskaźniki biocenotyczne stosowane przy porządkowaniu i analizie danych w badaniach ilościowych, w: Metody stosowane w zoologii gleby (red. M. Górny, L. Grum). PWN, Warszawa, 397–416.

Kollár J., Hrubík P. 2009. The mining species on woody plants of urban environments in the West Slovak area. Acta *Entomologica* Serbica 14(1): 83–91.

Kollár J., Donoval L. 2013. Diversity of phyllophagous organisms on woody plants in the Botanical Garden in Nitra, Slovakia. Acta *Entomologica* Serbica 18(12): 195–205.

Łabanowski G., Soika G. 2003. Szkodniki ozdobnych drzew liściastych. Wyd. Plantpress, Kraków, 126 s. ISBN 83-85982-82-5.

Michalska Z. 1988. Badania nad owadami minującymi Gór Świętokrzyskich. Wydawnictwo Naukowe Uniwersytetu im. Adama Mickiewicza, Poznań, 231 s. ISBN 83-232-0060-2.

Nunberg M. 1964. Uszkodzenia drzew i krzewów leśnych wywołane przez owady. PWN, Warszawa, 162 s.

Płóciennik M., Pawlikiewicz P., Jaworski T. 2011. Nowe dane faunistyczne o motylach minujących (Lepidoptera) okolic Łodzi. *Wiadomości Entomologiczne* 30(2): 99–103.

Schnaider Z. 1976. Atlas uszkodzeń drzew i krzewów powodowanych przez owady i pajęczaki. PWN, Warszawa, 318 s.

Skrzypczyńska M., Dramé A. 1987. Próba ustalenia gęstości populacji owadów powodujących wyrośla i miny na liściach *Quercus* spp. w Polsce. *Polskie Pismo Entomologiczne* 56: 901–909.

Skrzypczyńska M. 2007. Muchówki pryszczarkowate (Diptera: Cecidomyiidae) na wybranych stanowiskach w południowej Polsce. *Dipteron* 23, 26–33.

Skuhravý V., Hrubik P., Skuhravá M., Pozgaj J. 1998. Occurrence of insects associated with nine Quercus species (Fagaceae) in cultured plantations in southern Slovakia during 1987–1992. *Journal of Applied Entomology* 122: 149–155.

Stolnicu A.M. 2008. Some leaf-mining species identified on the *Quercus* genus in the Harboanca and Balteni forest reserves (Vaslui County). Analele Ştiinţifice ale Universităţii „Al. I. Cuza" Iaşi *Biologie animală* 4: 113–121.

Toll S. 1959. Klucze do oznaczania owadów Polski. Motyle – Lepidoptera. Tischeriidae. PWN, Warszawa, 22 s.

Trojan P., Winiarska G. 2001. Miasto jako archipelag wysp śródlądowych, zurbanizowanych, w: Bioróżnorodność i ekologia populacji zwierzęcych w środowiskach zurbanizowanych (red. P. Indykiewicz, T. Barczak, G. Kaczorowski). Wyd. NICE, Bydgoszcz, 10–16. ISBN 83-887-16-11-5.

Wawrzyniak M., Wrzesińska D., Piesik D., Lamparski R. 1999. Występowanie i szkodliwość entomofauny zasiedlającej liście drzew w zadrzewieniach śródmiejskich w Bydgoszczy w latach 1997–1998. *Zeszyty Naukowe Akademii Techniczno-Rolniczej im. Jana i Jędrzeja Śniadeckich w Bydgoszczy. Rolnictwo* 44(220): 299–305.

Wojtusiak J. 1976. Klucze do oznaczania owadów Polski. Motyle – Lepidoptera – Heliozelidae, Incurvariidae. PWN, Warszawa, 61 s.

Wrzesińska D., Wawrzyniak M. 2001. Foliofagi występujące na dębach *Quercus* spp. na terenie województwa kujawsko-pomorskiego, w: Bioróżnorodność i ekologia populacji zwierzęcych w środowiskach zurbanizowanych (red. P. Indykiewicz, T. Barczak, G. Kaczorowski). Wyd. NICE, Bydgoszcz, 124–127. ISBN 83-887-16-11-5.

Wrzesińska D. 2013. Foliofagi tworzące wyrośla na *Quercus robur* (Linnaeus). Rozprawy nr 167. Uniwersytet Technologiczno-Przyrodniczy w Bydgoszczy, 110 s. ISBN 978-83-61314-79-0.

Translated by: Anna Wyszyńska