Acta entomologica serbica, 2009, 14(1): 83-91 UDC 595.773.4(437.61)

THE MINING SPECIES ON WOODY PLANTS OF URBAN ENVIRONMENTS IN THE WEST SLOVAK AREA

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Abstract

From 2005 – 2008 in the cities Nitra, Topoľčany, Komárno, Partizánske, Prievidza, Piešťany and Trnava research into mining insect species was carried out. The aim of the research was to monitor mining insects on allochthonous and autochthonous woody plants in urban environments. In total 118 species, 15 families and 4 orders of mining species were found. The richest abundance had the Gracillariidae (38), Nepticulidae (25) and Agromyzidae (16) families. The largest number of insect species was recorded on host woody plants from the Betulaceae (24), Fagaceae (22), Rosaceae (17) and Salicaceae (13) families and the *Quercus* (18), *Betula* (14) and *Populus* (8) genera. We found 14 non-indigenous species for Slovakia. The migration of some alien insects on autochthonous woody plants has been confirmed.

KEY WORDS: urban environment, mining insect, alien insect

Introduction

Urban green areas are excessively damaged by pollutants, thawing salt, and humans either directly or indirectly, through mediational, mainly investment, activities (SUPUKA, 1987). Woody plants growing under the influence of various harmful urban environmental factors and in changed ecological conditions more readily succumb to various diseases and pests. Various insect pests are another negative factor influencing greenery planting (HRUBÍK, 1988).

Insects are the richest group in the animal kingdom with a large scale of ecological demands. Some species cause damage to various plant tissue, which may not necessarily lead to the death of the woody plants, but may cause aesthetic problems (galls, resin outflow…). According to feed type we can distinguish the series of

damage types as well. On woody plants which grow in non-forest environments, the most significant damage (surface feeds, mines, skeletation, deflection, distortion or gall forming, etc.) (GREGOROVÁ, 2006) is suffered by various leaves, buds, shoots and wood.

In this paper we have dealt with insect pest groups which cause mines on leaves, shoots, and eventually on other parts of woody plant bodies. According to the record, the first mines made by lepidopterans appeared in late Jurassic, ca. 150 millions years ago. Their number showed a steep increase in the Cretaceous, probably correlated with the radiation of angiosperms. In the last few decades leaf miners have become popular study organisms. Several ecological and evolutionary hypotheses have been tested on them, the attention spent on them exceeding their economical importance. The evolutionary success of leaf mining insects is proven by their large numbers, and by the fact that leaf mining species can be found in several orders. According to present knowledge, ca. 10,000 species of leaf mining insects have been described so far. These insects belong to ca 50 families from 4 orders (Coleoptera, Hymenoptera, Diptera and Lepidoptera) (CSÓKA, 2003).

STOLINA *et al.* (1985) defined mining as feeding inner tissues and needles, without damaging epidermis. Mines can be created by caterpillars, beetle larvae, hymenopteran and dipteran insects. Mines are always created only by insect larvae (STOLINA *et al*., 1985). Leaf mines vary considerably in shape and size, and can therefore be classified in many different ways. Mines can be serpentine and blotchy. Serpentine mines develop if larvae feed step by step in one direction. Blotchy mine forms if larvae turn during feeding (CSÓKA, 2003). Mining insects are the second most prevalent group of insects in urban greenery. If they don't occur in large numbers, they don't cause serious damage to host plants (HRUBÍK, 1988). WINIARSKA (1979) discovered that along with the composition of woody plants species, the number of mining lepidopteran species in the urban environment is changing in dependence on urbanization degree.

Materials and Methods

From 2005 – 2008 terrain research was carried out in the selected cities of Nitra, Topoľčany, Komárno, Partizánske, Prievidza, Piešťany and Trnava. The aim of the research was to monitor mining insects, mainly on ornamental woody plants planted in urban environments. In the terrain, woody plant damage was controlled visually and from 2005-2008 samples of symptoms were collected three times per vegetation period in all localities. Eventually, some samples were collected to be reared in the laboratory and for determination. Some species were determined directly in the terrain. For the determination of mine samples on individual woody plant species we used the publications by LAŠTŮVKA & LAŠTŮVKA (1997), CSÓKA (2003) and SCHNAIDER (1976). The correct woody plant nomenclature is passed from publications ČERVENKA (1986) and (MARHOLD-HINDÁK, 1998).

Results

During the research we found 118 species of mining insects, belonging to 4 orders and 15 families. The greatest number of species belonged to the Gracillariidae (38), Nepticulidae (25) and Agromyzidae (16) (Fig. 1a) families. Lepidoptera (91) and Diptera (16) (Fig. 1b) orders were the most abundant.

The following review (Tab. I) presents the list of found mining species. Species are classified according to individual orders, families and host plants. The non-indigenous species are marked by an asterisk.

Table I. List of recorded mining insects.

Order	Family	Species/variety	Host plant
Lepidoptera	Gracillariidae	*Parna tenella* Klug., 1816	*Tilia* sp.
		Caloptilia betulicola (Hering, 1927)	*Betula verrucosa* Ehrh.
		Caloptilia cuculipennella (Hübner, 1796)	*Fraxinus excelsior* L.
		* *Caloptilia roscipennella* (HB., 1796)	*Acer pseudoplatanus* L., *Juglans regia* L.
		Xanthospilapteryx syringella (Fabr., 1794)	*Fraxinus* sp., *Ligustrum* sp., *Syringa* sp., *Sambucus* sp.
		Phyllonorycter acernella Zll., 1846	*Acer* sp.
		Phyllonorycter acerifoliella Z., 1839	*Acer pseudoplatanus* L., *A. tataricum* L.
		Phyllonorycter platanoidella Joan., 1920	*Acer* sp.
		Phyllonorycter ulmifoliella (Hbn., 1817)	*Ulmus* sp., *Betula* sp.
		Phyllonorycter agilella Z. 1846	*Ulmus sp.*
		* *Phyllonorycter platani* Staudinger, 1870	*Platanus occidentalis* L., *P.* x *acerifolia* (Ait.) Willd.
		Phyllonorycter froelichiella Zll. 1839	*Alnus glutinosa* (L.)
		Phyllonorycter tenerella Joan., 1915	*Carpinus betulus* L.
		Phyllonorycter apparella H.S., 1855	*Populus alba* L., *Populus nigra* L.
		Phyllonorycter spinicolella Z., 1846	*Prunus cerasifera* Ehrh., *P. avium* L., *P. spinosa* L.
		Phyllonorycter lautella Zll., 1846	*Quercus* sp.
		Phyllonorycter salictella Zll., 1846	*Salix alba* L.
		Phyllonorycter nicellii Stt., 1851	*Corylus colurna* L.
		Phyllonorycter pastorella Zll., 1846	*Salix alba* L.
		* *Phyllonorycter robiniellus* Clemens, 1859	*Robinia* sp.
		Phyllonorycter quinnata Geoffr., 1851	*Carpinus betulus* L.
		Phyllonorycter cerasicolella (Herrich-Schäffer, 1855)	*Prunus avium* L., *P. serrulata* Lindl., *P. subhirtella* Miq.
		Phyllonorycter schreberella (Fabricius, 1781)	*Ulmus* sp.
		Phyllonorycter heegeriella (Zeller, 1846)	*Quercus* sp.
		Phyllonorycter quercifoliella (Zeller, 1839)	*Quercus robur* L., *Quercus* x *turneri* Willd. 'Pseudoturneri'
		Phyllonorycter comparella (Duponchel, 1843)	*Populus alba* L.
		Phyllonorycter trifasciella (Haworth, 1828)	*Lonicera fragrantissima* L., *Symphoricarpos albus* L.
		Phyllonorycter tristrigella (Haworth, 1828)	*Ulmus minor* Mill.
		Phyllonorycter coryli (Nicelli, 1851)	*Corylus colurna* L., *Sorbus aria* (L.) Crantz
		Phyllonorycter maestingella Zeller, 1764	*Fagus sylvatica* L.
		Phyllonorycter roboris Zeller, 1839	*Quercus* sp.
		* *Phyllonorycter issikii* Kumata, 1963	*Tilia* sp.
		* *Phyllonorycter leucographellus* (Zeller, 1850)	*Pyracantha coccinea* Roem.
		* *Parectopa robiniella* Clemens, 1863	*Robinia pseudoacacia* L.
		* Cameraria ohridella (Deschka & Dimic, 1986)	*Aesculus hippocastanum* L.
		Acrocercops brongniardella Fbr., 1798	*Quercus cerris* L.
		Parornix finitimella Zll., 1850	*Prunus cerasifera* Ehrh., *Prunus avium* L.
		Parornix anglicella Stt., 1850	*Crataegus monogyna* Jacq.

(Table I - continued)

Order	Family	Species/variety	Host plant
Lepidoptera	Bucculatricidae	*Bucculatrix frangulella* (Goeze, 1783)	*Rhamnus catharticus* L.
		Bucculatrix thoracella (Thunberg, 1794)	*Tilia* sp.
	Alucitidae	*Alucita hexadactyla* (Linnaeus, 1758)	*Lonicera xylosteum* L.
	Heliozelidae	*Antispila metallella* (Denis & Schiffermüller, 1775)	*Swida sanguinea* (L.) Opiz
		Antispila treitschkiella (Fischer von Röslerstamm, 1843)	*Cornus mas* L.
	Phyllocnistidae	*Phyllocnistis unipunctella* Steph., 1834	*Populus alba* L., *P. nigra L.*
		Phyllocnistis xenia Hering, 1936	*Populus* sp.
		Phyllocnistis saligna Z., 1839	*Salix alba* L.
		Phyllocnistis suffusella Zll., 1848	*Populus* x *canescens* Smith
	Yponomeutidae	* *Argyresthia thujella* (Packard, 1871)	*Thuja occidentalis* L.
		* *Argyresthia trifasciata* Staudinger, 1871	*Juniperus* sp., *Cupressocyparis* x *leylandii* Dall.
		Prays fraxinella (Bjerkander, 1784)	*Fraxinus excelsior* L.
	Lyonetiidae	*Lyonetia clerkella* (L., 1758)	*Betula* sp., *Prunus* sp., *Malus* sp., *Crataegus* sp., *Sorbus intermedia* (Ehrh.)
		Leucoptera scitella (Zeller, 1839)	*Prunus avium* L., *P. subhirtella*
	Coleophoridae	*Coleophora fuscedinella* Zeller, 1849	*Betula verrucosa* Ehrh.
		Coleophora palliatella Zincken, 1813	*Quercus robur* L.
		Coleophora serratella (Linnaeus, 1761)	*Betula verrucosa* Ehrh.
		Coleophora ibipennella Zeller, 1849	*Quercus robur* L.
		Coleophora flavipennella Duponchel, 1843	*Quercus robur* L.
		Coleophora lutipennella (Zeller, 1838)	*Quercus robur* L.
		* *Coleophora hemorobiella* Scop., 1763	*Spiraea* x *vanhottei* (Briot) Zab., *S. japonica* L. f.
	Tortricidae	* *Coleotechnites piceaella* (Kft., 1903)	*Picea pungens* Engelm., *P. omorica* (Pančić) Purkyně
		Epinotia tedella (Cl., 1759)	*Picea abies* (L.) Karst., *Picea pungens* Engelm.
		Epinotia rufimitrana H. S., 1851	*Abies alba* Mill.
	Nepticulidae	*Stigmella speciosa* (Frey, 1858)	*Acer* sp.
		Stigmella confusella WOOD., 1894	*Betula* sp.
		Stigmella microtheriella Stainton, 1854	*Corylus colurna* L.
		Stigmella nivenburgensis (Preissecker, 1942)	*Salix alba* L.
		Stigmella hahniella (Wörtz, 1890)	*Sorbus torminalis* (L.) Crantz
		Stigmella luteella (Stainton, 1857)	*Betula verrucosa* Ehrh., *Betula pubescens* Ehrh.
		Stigmella lemniscella (Zeller, 1839)	*Ulmus glabra* Huds., *Ulmus minor* Mill.
		Stigmella szoecsiella (Borkowski, 1972)	*Quercus cerris* L.
		Stigmella atricapitella Haw., 1828	*Quercus* sp.
		Stigmella betulicola (Stainton, 1856)	*Betula verrucosa* Ehrh., *B. maximowicziana* Regel
		Stigmella prunetorum (Stainton, 1855)	*Prunus avium* L.
		Stigmella salicis (Stainton, 1854)	*Salix alba* L.
		Stigmella crataegella (Klimesch, 1936)	*Crataegus monogyna* Jacq., *Crataegus laevigata* (Poir.) DC

(Table I - continued)

Order	Family	Species/variety	Host plant
Lepidoptera	Nepticulidae	*Stigmella argentipedella* Z., 1839	*Betula verrucosa* Ehrh.
		Stigmella carpinella Hein., 1862	*Carpinus betulus* L.
		Stigmella hemargyrella Koll., 1832	*Fagus sylvatica* L.
		Stigmella subtrimaculella Dufr., 1949	*Populus* sp.
		Stigmella tityrella (Stainton, 1854)	*Quercus* sp.
		Stigmella centifoliella Zll., 1848	*Rosa* sp.
		Stigmella ulmifoliae Htg., 1931	*Ulmus* sp.
		Stigmella plagicolella S.H., 1854	*Prunus cerasifera* Ehrh., *Malus* sp.
		Stigmella tiliae Frey., 1856	*Tilia* sp.
		* *Acalyptris platani (Müller-Rutz, 1934)*	*Platanus x acerifolia* (Ait.) Willd.
		Ectoedemia cerris (Zimmermann, 1944)	*Quercus cerris* L.
		Ectoedemia occultella (L., 1767)	*Betula verrucosa* Ehrh.
	Tischeriidae	*Tischeria ekebladella* Bjk., 1795	*Quercus* sp.(*Q. rubra* L.), *Castanea sativa* Mill., *Castanea millissima* Blume
		Tischeria decidua Wck., 1876	*Quercus* sp.
		Tischeria dodonea (Stainton, 1858)	*Quercus robur* L.
		Coptotriche angusticollella (Duponchel, 1843)	*Rosa canina* L.
Coleoptera	Buprestidae	*Trachys minutus* (Linnaeus, 1758)	*Tilia platyphyllos* Scop.
	Curculionidae	*Rhynchaenus jota* F., 1787	*Alnus glutinosa* (L.)
		Rhynchaenus fagi L., 1758	*Fagus sylvatica* L.
		Rhynchaenus alni L., 1758	*Alnus glutinosa* (L.)
		Rhynchaenus quercus (L., 1758)	*Quercus robur* L.
Hymenoptera	Tenthredinidae	*Profenusa pygmaea* (Klug, 1816)	*Quercus cerris* L., *Q. robur* L., *Q. aliena* Blume, *Q. rubra* L.
		Heterarthrus aceris (Kaltenbach, 1856)	*Acer pseudoplatanus* L.
		Heterarthrus vagans (Fallén, 1808)	*Betula verrucosa* Ehrh.
		Messa nana (Klug, 1814)	*Betula verrucosa* Ehrh.
		Scolioneura betulae Zdd., 1858	*Betula verrucosa* Ehrh.
		Scolineura nigricans (Klug, 1818)	*Betula verrucosa* Ehrh.
Diptera	Agromyzidae	*Liriomyza amoena* MQ., 1830	*Sambucus nigra* L.
		Agromyza albitarsis MG., 1830	*Populus tremula* L., *P. nigra* L.
		Agromyza alnibetulae Hend., 1931	*Alnus glutinosa* (L.)
		* *Amauromyza elaeagni* (Rohdendorf-Holmanová, 1959)	*Elaeagnus angustifolia* L.
		Napomyza xylostei Kltb., 1862	*Lonicera* sp., *Symphoricarpos* sp.
		Amauromyza verbasci (Bouche, 1847)	*Buddleja globosa* Hope
		Phytomyza periclymeni Hend., 1922	*Lonicera* sp.
		Phytomyza agromyzina Meigen, 1830	*Cornus* sp., *Swida* sp.
		Phytomyza atricornis Meigen, 1838	*Laburnum anagyroides* Med.
		* *Agromyza demeijerei* Hendel, 1920	*Laburnum anagyroides* Med.
		Paraphytomyza xylostei R.D., 1851	*Lonicera xylosteum* L., *L. tatarica* L.

Order	Family	Species/variety	Host plant
			(Table I - continued)
Diptera	Agromyzidae	*Aulagromyza heringii* (Hendel 1920)	*Fraxinus excelsior* L.
		Aulagromyza cornigera (Griffiths, 1973)	*Lonicera xylosteum* L., *Symphoricarpos albus* (L.) Blake
		Chromatomyia lonicerae (Robineau-Desvoidy, 1851)	*Lonicera xylosteum* L.
		Liriomyza congesta (Becker, 1903)	*Colutea arborescens* L.
		Aulagromyza populicola (Haliday, 1853)	*Populus nigra* L.

Recorded species feed on 40 genera and 18 families of host woody plants. The most mining species were recorded on the genera *Quercus* (18), *Betula* (14) and *Populus* (8) (Fig. 2a). Within woody plant families the highest number of mining insect species were recorded in the Betulaceae (24), Fagaceae (22), Rosaceae (17) and Salicaceae (13) families (Fig. 2b).

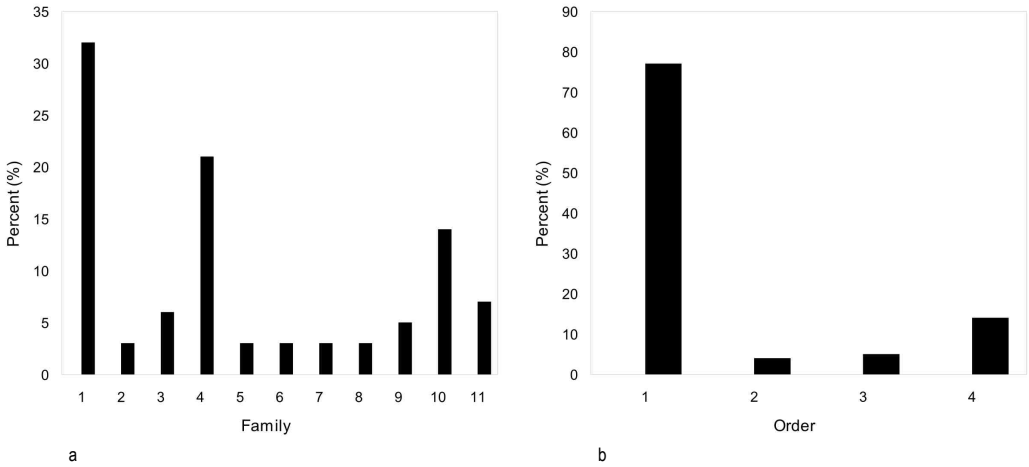

Figure 1. Proportion of found insect species according to families (a) and orders (b) [families: 1 – Gracillariidae (32%), 2 – Phyllocnistidae (3%), 3 – Coleophoridae (6%), 4 – Nepticulidae (21%), 5 – Tischeridae (3%), 6 – Yponomeutidae (3%), 7 – Tortricidae (3%), 8 – Curculionidae (3%), 9 – Tenthredinidae (5%), 10 – Agromyzidae (14%) and 11 – other (7%); orders: 1 – Lepidoptera (77%), 2 – Coleoptera (4%), 3 – Hymenoptera (5%) and 4 – Diptera (14%)].

During the research we focused also on alien mining insect species and recorded in total 14 alien species. From this number the most abundant species come from the Mediterranean area [*Phyllonorycter platani* Staudinger, 1870; *Acalyptris platani* (Müller-Rutz, 1934); *Agromyza demeijerei* Hendel, 1920; *Amauromyza elaeagni* (Rohdendorf-Holmanová, 1959); *Argyresthia trifasciata* Staudinger, 1871; *Cameraria ohridella* (Deschka & Dimic, 1986)]. From North America four species [*Phyllonorycter robiniellus* Clemens, 1859; *Parectopa robiniella* Clemens, 1863; *Coleotechnites piceaella* (Kearfott, 1903) and *Argyresthia thujella* (Packard, 1871)] were brought to the Slovak area; from Asia three species [*Phyllonorycter issikii* Kumata, 1963; *Caloptilia roscipennella* (Hübner, 1796) and *Phyllonorycter leucographellus* (Zeller, 1850)]; and the

origin of one species is unknown [*Coleophora hemorobiella* Scop., 1763]. Some of these species occur not only on host plants from countries of their origin, but they also traverse to autochthonous woody plant species [for example, there are: *Coleotechnites piceaella* (Kearfott, 1903); *Phyllonorycter issikii* Kumata, 1963; *Caloptilia roscipennella* (Hübner 1796) and *Phyllonorycter leucographellus* (Zeller, 1850)]. We have recorded the occurrence of the Horse chestnut leaf miner *Cameraria ohridella* (Deschka & Dimic, 1986) on autochthonous Field Maple *Acer campestre* L.. Hrubík (2007) dealt with alien species in Slovakia in his publication too.

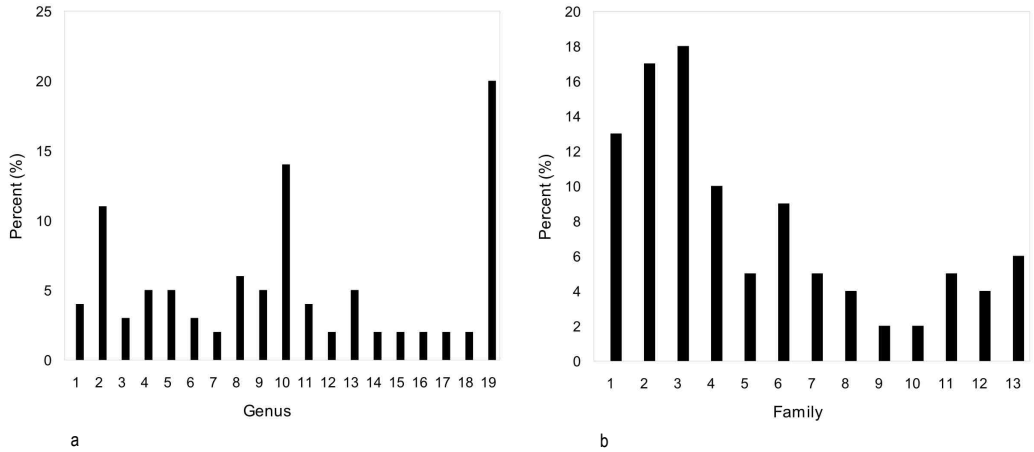

Figure 2. Proportion of found host plant genera (a) and families (b) [genera: 1 – *Tilia* (4%), 2 – *Betula* (11%), 3 – *Fraxinus* (3%), 4 – *Acer* (5%), 5 – *Ulmus* (5%), 6 – *Alnus* (3%), 7 – *Carpinus* (2%), 8 – *Populus* (6%), 9 - *Prunus* (5%), 10 – *Quercus* (14%), 11 – Salix (4%), 12 – *Corylus* (2%), 13 – *Lonicera* (5%), 14 – *Symphoricarpos* (2%), 15 – *Sorbus* (2%), 16 – *Fagus* (2%), 17 – *Crataegus* (2%), 18 – *Cornus* (2%) and 19 – other (20%); families: 1 – Rosaceae (13%), 2 – Fagaceae (17%), 3 - Betulaceae(%), 4 – Salicaceae (10%), 5 – Sapindaceae (5%), 6 – Caprifoliaceae (9%), 7 – Oleaceae (5%), 8 – Fabaceae (4%), 9 – Cupressaceae (2%), 10 – Cornaceae (2%), 11 – Ulmaceae (5%), 12 – Tiliaceae (4%) and 13 – other (6%)].

Conclusions and Discussion

In 2008 we recorded some occurrences of a decrease in mining species on woody plants, not only in urban environments but in forest crops as well. Their abundance began to increase until the end of August and in September a phenomenon which could have been caused by an oscillation (amplitude) in temperature during the vegetation period. During the research we did not find more damage to woody plants. More marked damage was caused by species as *Cameraria ohridella* (Deschka & Dimic, 1986); *Phyllonorycter platani* Staudinger, 1870; *Coleotechnites piceaella* (Kearfott, 1903) and *Epinotia tedella* (Clerck, 1759). From 2002 – 2004 Šefrová (2005) carried out research into mining lepidopteran species in the Czech Republic area of the Arboretum of Mendel University of Agriculture and Forestry in Brno. Her results show that the most abundant were species from the Nepticulidae (41%) and Gracillariidae (36%) families. Our findings are very similar: the most numerous species were from the same families, but from Gracillariidae, 32% and Nepticulidae, 21%. In terms of host plants, the mining species are fixed on the Betulaceae (18%), Fagaceae (17%) and Rosaceae (13%) families. Comparison of these results with data from Šefrová (2005) – Rosaceae (28%), Fagaceae

(17%), Betulaceae (14%), shows the abundance of the most numerous families is the same, but again in opposed sequence. These anomalies can be caused by a variability in the examined assortment of woody plants which depend on the biodiversity in individual research areas. We also analyzed all orders of mining species, not only Lepidoptera, as ŠEFROVÁ (2005) did. In the last years we recorded a high increase of a non-indigenous termophilic species number from the Mediterranean. This higher migration of Mediterranean species to our area can be a result of global warming.

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ИНСЕКТИ МИНЕРИ НА ДРВЕНАСТИМ БИЉКАМА У УРБАНИМ СРЕДИНАМА ЗАПАДНЕ СЛОВАЧКЕ

Јан Колар и Павел Хрубик

Извод

У периоду од 2005. до 2008. године на шест локалитета у Словачкој истраживани су минери дрвенастих биљака. Циљ рада је био мониторинг минера на алохтоним и аутохтоним врстама дрвенастих биљака у урбаним срединама. Утврђено је 118 врста минера, које су класификоване у 15 фамилија и 4 реда. Најбројније фамилије су Gracillariidae (38), Nepticulidae (25) и Agromyzidae (16). Највећи број врста уловљен је на биљкама из фамилија Betulaceae (24), Fagaceae (22), Rosaceae (17) и Salicaceae (13); затим на родовима *Quercus* (18), *Betula* (14), *Populus* (8). Утврђено је 14 унесених врста за Словачку. Потврђене су миграције неких интродукованих врста у аутохтоне шумске заједнице, односно биљке.

Received March 23rd, 2009
Accepted May 27th, 2009