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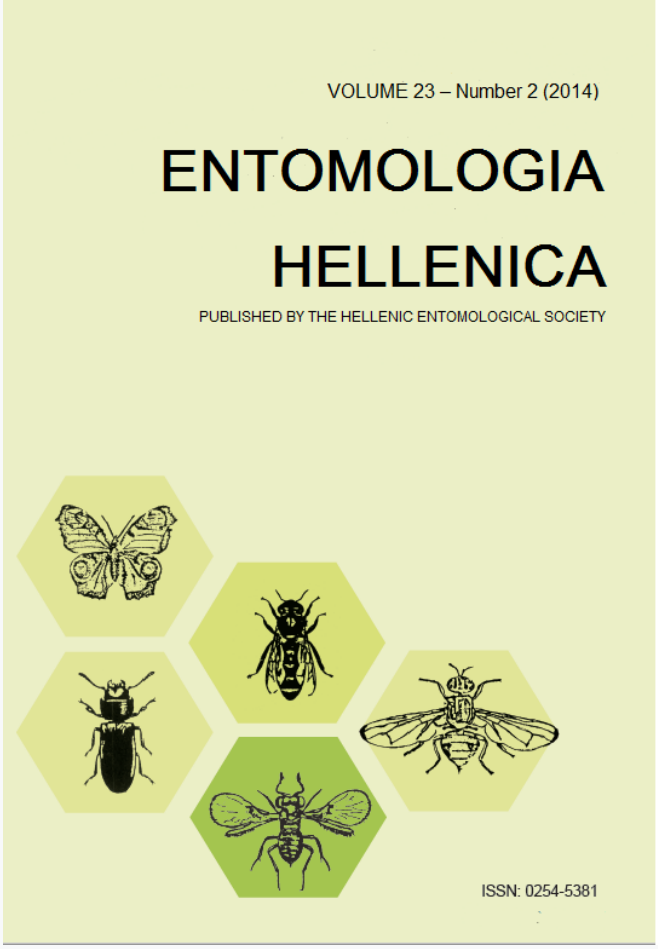

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The entomofauna on the leaves of two forest species, *Fagus sylvatica* and *Corylus avelana*, in Menoikio Mountain of Serres

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ABSTRACT

The insect species composition and their abundance were investigated on the leaves of beech (*Fagus sylvatica*, Fagaceae) and hazel trees (*Corylus avelana*, Betulaceae) in the mixed forest located in Menoikio Mountain of Serres. For that purpose from April to June 2011 leaves were collected from the two forest species at weekly intervals and the insects found were reared in the laboratory under outdoor conditions and checked every day till their pupation and adult emergence. A total of 27 insect species was recorded. These insects belonged to seven orders. Fifteen Coleoptera species, 4 Hemiptera species, 3 of Lepidoptera species, 2 of Hymenoptera species and 1 species to the orders Diptera, Neuroptera, and Ephemeroptera were found. The results disclose that the number of insect species found on leaves of hazel trees was fewer than the insect species on beech trees. On hazel trees the population of *Lymantria dispar* (Lepidoptera: Lymantriidae) was much higher than in beech trees. The species of Coleoptera collected from hazel trees were *Phyllobius pyri* (Coleoptera: Curculionidae), *Rhynchaenus populi* (Coleoptera: Curculionidae) and *Agiotes acuminatus* (Coleoptera: Elateridae). In beech trees the insect species found more frequently were *Rhynchaenus fagi* (Coleoptera: Curculionidae), *Phyllobius pyri* (Coleoptera: Curculionidae) and *Anobium punctatum* (Coleoptera: Anobiidae). The largest population of insects was observed at the end of spring, because the life cycle of the foliage insects were synchronized with leaf- flushing of the foliage.

KEY WORDS: *Corylus avelana*, entomofauna, *Fagus sylvatica.*

Introduction

It is well known that tree species may host several insect species but others, comparatively few. The number of insect species associated with a certain tree species reflects the abundance or scarcity on this tree in the certain period (Southwood et al. 2004, Avtzis et al. 2014). The life cycle of the foliage feeding insects is synchronized with leaf-flushing and the peak quality of the foliage (Alonso and Herrera 2000, Kalapanida and Petrakis 2012).

So far, a lot of studies on the insect fauna on leaves of *Fagus sylvatica* (Fagaceae) have been conducted (Fernandes et al. 2003, Petrakis et al. 2011, Kot and Kmiec 2012). In hazel trees, *Corylus avelana* (Betulaceae) there are few. According to Southwood (1961) the total number of insect species inhabiting hazel tree is 26 in Russia and 73 in Britain. In Greece, Markalas (2010) referred 25 insect species on the leaves of hazel tree and 37

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species in *F. sylvatica*. Most of the insects collected from hazel and beech leaves were also recorded on other forest species especially in poplar and oak (Skuhravy et al. 1998). However, they recorded only the insects that fed on leaves.

In this paper, we consider the entomofauna on leaves of the hazel and beech trees; not only the phyllophagus but any insect found on the leaves (predators and opportunistic insects) was recorded.

Materials and Methods

Study Area

Samplings were conducted on the Menoikio Mountain located in Central Macedonia, 32km east of Serres and 40km west of Drama and covers an area of 27.542 hectares with an altitude up to 1963 meters (Fig. 1). It is a mountain with intense and varied terrain with small differences in altitude. Most of its area is occupied by meadows and rocks (31.3%), beech forests and mixed deciduous hardwoods (19.2%), shrubs (19.8%) and partially forested land (19.6%). Coniferous forests have been created by reforestation and occupy a small part of the forest. There is a rich flora and fauna: more than 500 plant species, 31 mammals, 15 reptiles, six amphibians and 132 species of birds have been recorded (Karagiannakidou and Kokkini 1987).

The sampling areas were Tsairoudia (41º 9′36.06′′N, 23º 45′56.96′′E) and Kambera (41º 9′49.08′′N, 23º 46′18.88′′E) located at 900 and 960 meters altitude, respectively. The distance between them is approximately 2000 m. The area Tsairoudia is covered by hazel tree forests (Fig. 2) with intense relief and is grazed by cattle and sheep.

The area of Kambera is mainly covered by mixed forests of hazel and beech trees and north ends in beech forest and has also intense relief and is grazed by cattle and sheep. Moreover, in the area has been built an earthen dam that is wetland habitat and recreation area for visitors, due to its natural landscape and the paths through the forest. Finally, in the areas there is the hunting activity mainly wild boar, hare, woodcock and deer.

Samplings

The investigation was carried out in the regions of Tsairoudia and Kampera. These two regions were selected because they are close one to each other and the results could be compared, because in the Kambera area only beech branches were cut and in Tsairoudia area only hazel branches were cut. Although the forest in Kambera is mixed the samplings were taken from the north end of the forest where only beech trees planted.

In the region of Tsairoudia, in forest of hazel trees, sampling was performed during a period of eight weeks from April 4 to June 8 of 2011. From each of 5 trees per week, for the first 2 weeks and from 6 trees per week, for the next six weeks (46 hazel trees totally), 4 branches, each about 1m long, were randomly selected and cut down. The insects collected on each of them were transferred to the laboratory.

In the region of Kambera, sampling lasted again for 8 weeks from April 4 to June 8, 2011. Branches were collected from 44 beech trees (from 5 trees per week, for the first four weeks and from 6 trees per week, for the next four weeks).

In the laboratory, the adults of any insect found were collected and preserved at the fridge. Then, stored in boxes for drying. Two weeks later the insects examined and photographed in the laboratory with the aid of the stereomicroscope (Olympus SZX7) with camera and identified with Swhwenke (1978) key books. Finally the insects deposited to storage boxes in the laboratory.

The immature were placed into rearing boxes, stored under outdoor conditions and checked daily till their pupation and adult emergence. Then, the adults were identified to species following the key book as referred above.

FIG. 1 .The sampling areas (Tsairoudia and Kambera) on MountMenoikio, North East Greece.

FIG. 2. Forest of hazel trees in Tsairoudia area.

Results

A total of 27 insect species was recorded. These species belonged to seven Classes: 15 species in Coleoptera, 4 species in Hemiptera, 3 species in Lepidoptera, 2 species in Hymenoptera and one species in each of Diptera, Ephemeroptera and Neuroptera. In table 1 the species found have been reported in regard to their feeding habits (phyllophagous, sap-wood feeders and predators). In tables 2 and 3 the species found on hazel and beech trees are shown.

In hazel trees the dominant species was *Lymantria dispar* L. (Lepidoptera: Lymantriidae) because its population was extremely high. Larvae of this species were collected in April (4, 22 and 30) of 2011, but they did not survive in the laboratory. The larvae collected in May (22, 25 and 30) and June 8 pupated and adults emerged. On the contrary the population of *L. dispar* was very low in the beech trees.

The most abundant species in the two forest trees belonged to family Curculionidae. In hazel trees 4 Curculionidae species were recorded. *Phyllobius pyri* L. (Coleoptera: Curculionidae) (Fig. 3) and *Rhyncaenus populi* L. (Coleoptera: Curculionidae) were the most abundant species. Five adults of *P. pyri* collected on April 30, May (15 and 28) and June 8 and finally 5 adults of *R. populi* on May 28, 2011. Only one adult of *Phyllobius oblongus* L. (Coleoptera: Curculionidae) and *Byctiscus betulae* L. (Coleoptera: Curculionidae) was recorded.

In beech trees, 3 Curculionidae species recorded and among them *Rhynchaenus fagi* Meyers (Coleoptera: Curculionidae) was the most abundant. Twelve adults collected on April 12, 19 and 30. Also, 7 adults of the species *P. pyri* were collected on April (12 and 19), May 15 and June 28 of 2011 and only one of the species *Phyllobius viridicolis* Fabricius (Coleoptera: Curculionidae).

On hazel trees, *Agriotes acuminatus* Stephens and *Agriotes gallicus* Lacordaire (Coleoptera: Elateridae) were collected (Fig. 4). The first species, *A. acuminatus*, was collected on May (20 and 28) and June 8 of 2011, in hazel trees. The second species *A. gallicus* was collected on June 8.

FIG. 3. Adult of *Phyllobious pyri.*

TABLE 1. Total number of insect species (phyllophagous, sap-wood feeders and predators) collected on the leaves of hazel and beech trees.

	Order	Family	Genus	species	Number
Phyllophagous	Lepidoptera	Lymantriidae	*Lymantria*	*dispar*	**212**
	Coleoptera	Attelabidae	*Byctiscus*	*betulae*	**2**
	Coleoptera	Attelabidae	*Byctiscus*	*populi*	**3**
	Coleoptera	Attelabidae	*Phyllobius*	*oblongus*	**1**
	Coleoptera	Attelabidae	*Phyllobius*	*pyri*	**12**
	Coleoptera	Attelabidae	*Phyllobius*	*viridicolis*	**1**
	Coleoptera	Attelabidae	*Rhynchaenus*	*fagi*	**8**
	Coleoptera	Attelabidae	*Rhynchaenus*	*populi*	**5**
	Coleoptera	Elateridae	*Agriotes*	*acuminatus*	**5**
	Coleoptera	Elateridae	*Agriotes*	*gallicus*	**3**
	Coleoptera	Chrysomelidae	*Haltica*	*quercetorum*	**1**
	Coleoptera	Scarabaeidae	*Melolontha*	*melolontha*	**1**
	Hemiptera	Cercopidae	*Philaenus*	*spumarius*	**1**
	Lepidoptera	Noctuidae	*Sesamia*	*nonagriodes*	**1**
	Lepidoptera	Tortricidae	*Archips*	*xylosteana*	**1**
Sap – wood feeders	Coleoptera	Anobiidae	*Ernobius*	*mollis*	**2**
	Coleoptera	Anobiidae	*Anobium*	*punctatum*	**4**
	Hemiptera	Cercopidae	*Aphrophora*	*alni*	**2**
Predators	Coleoptera	Coccinellidae	*Coccinella*	*septempunctata*	**4**
	Coleoptera	Coccinellidae	*Calvia*	*halyziacalvia*	**3**
	Hemiptera	Membracidae	*Centrotus*	*cornutus*	**1**
	Hymenoptera	Ichneumonidae	*Lissonota*	*setosa*	**2**
	Diptera	Sarcophagidae	*Sarcophaga*	*haemorrhoidalis*	**2**
	Neuroptera	Osmylidae	*Osmylys*	*fulvicephalus*	**1**
	Ephemeroptera	Siphlonuridae	*Siphlonurus*	*lacustris*	**2**
	Hemiptera	Diaspididae	*Diaspis*	*pentagona*	**1**
	Hymenoptera	Formicidae	*Formica*	*rufa*	**1**

TABLE 2. Date of collection and respective number of individuals collected per insect species on hazel trees.

Species	Day of collection (d/m/y)	Number
Lymantria dispar	4/4-8/6/11	**207**
Sesamia nonagrioides	6/5/11	**1**
Phyllobius pyri	30/4, 15/5, 28/5, 8/6/11	**5**
Phyllobius oblongus	15/5/11	**1**
Bycticus betulae	28/5/11	**2**
Rhynchaenus populi	28/5/11	**5**
Agriotes acuminatus	20/5, 28/5, 8/6/11	**5**
Agriotes gallicus	8/6/11	**3**
Haltica quercetorum	20/5/11	**1**
Melolontha melolontha	23/5/11	**1**
Centrotus cornutus	28/6/11	**1**
Formica rufa	30/4/11	**1**
Coccinella septempunctata	30/4, 28/5, 8/6/11	**4**
Calvia halyziacalvia	30/4/11	**3**
Sarcophaga haemorrhoidalis	8/6/11	**2**

TABLE 3. Date of collection and respective number of individuals collected per insect species on beech trees.

Species	Day of collection	Number
Lymantria dispar	30/4/11	**5**
Rhynchaenus fagi	30/4, 12/4, 19/4/11	**12**
Phyllobius pyri	12/4, 19/4, 15/5, 28/6/11	**7**
Phyllobius viridicolis	28/6/11	**1**
Anobium punctatum	28/6/11	**4**
Ernobius mollis	20/5, 28/6/11	**2**
Philaenus spumarius	28/6/11	**1**
Bycticus populi	30/4/11	**1**
Archips xylostena	28/6/11	**1**
Aphrophora alni	28/6/11	**2**

FIG. 4. Adult of *Agriotes gallicus.*

Discussion

The number of insect species attacking hazel trees and their abundance were higher than on beech trees in the Kampera region, likely because the vulnerability of mixed forests is lower (Avtzis et al. 2013). Another important reason for this paucity of insects in beech trees is associating with the management practice of coppicing forests. It has been stated that mix forests (beech and hazel trees) as those in Kambera region, are attacked less from insect pests than the hazel tree forests (Markalas 2010).

In hazel trees many larvae (207) of *L. dispar* captured. On the contrary, the population of *L. dispar* was remarkably low (5 larvae) on the leaves of beech trees. In that point we can highlight that while *F. sylvatica* and *C. avelana* are confamiliar, there are great differences in richness of the entomofauna between them. These differences are largely due to the secondary metabolites occurring in beech leaves (Petrakis et al. 2011).These polyphenols are key components of defense mechanisms against insects (Oszmianski et al. 2015).

On hazel trees, among coleopteran pests, members of the family Curculionidae were the most abundant belonging mainly to the following species: *P. pyri, B. betulae* and *P. oblongus*. On the beech trees three species of the family Curculionidae were collected which were: *R. fagi*, *P. pyri* and *P. viridicolis.* Two species of the family Elateridae were collected in the leaves of hazel trees: *A. acuminatus* a click beetle that inhabits forest soil and commonly found on a wide variety of broadleaves tree species (Tolasch et al. 2010) and *A. gallicus* that according to Chaton et al. (2008) inhabits crop fields.

This research is a first approach to record the leaf insects of *F. sylvatica* and *C. avelana* in Greece. Further research is needed to record in more properly the whole number of species on leaves of these forest species.

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Η καταγραφή της εντομοπανίδας πάνω στα φύλλα δύο δασικών ειδών, της οξιάς (*Fagus sylvatica*) και της φουντουκιάς (*Corylus avelana*), στο Μενοίκιο Όρος Σερρών

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ΠΕΡΙΛΗΨΗ

Ερευνήθηκε η σύνθεση και η αφθονία της εντομοπανίδας που απαντάται στα φύλλα της οξιάς (*Fagus sylvatica*) και της φουντουκιάς (*Corylus avelana*) στο μεικτό δάσος του Μενοίκιου Όρους των Σερρών. Για το σκοπό αυτό από τον Απρίλιο ως τον Ιούνιο του 2011 συλλέγονταν εβδομαδιαίως φύλλα από τα δύο δασικά είδη και τα έντομα που βρίσκονταν σε αυτά συλλέγονταν και διατηρούνταν στο εργαστήριο σε συνθήκες εξωτερικού περιβάλλοντος. Κατόπιν, ελέγχονταν κάθε ημέρα μέχρι την νύμφωση και την εμφάνιση των ενηλίκων. Συνολικά 27 είδη εντόμων καταγράφηκαν. Τα είδη αυτά ανήκαν σε 7 τάξεις: 15 είδη στα Κολεόπτερα, 4 είδη στα Ημίπτερα, 3 είδη στα Λεπιδόπτερα, 2 είδη στα Υμενόπτερα και από ένα είδος στις Τάξεις Δίπτερα, Νευρόπτερα και Εφημερόπτερα. Τα αποτελέσματα έδειξαν ότι υπήρχε μεγαλύτερη αφθονία εντόμων στα φύλλα της φουντουκιάς σε σχέση με τα φύλλα της οξιάς. Στα δένδρα της φουντουκιάς ο πληθυσμός του εντόμου *Lymantria dispar* (Lepidoptera: Lymantriidae) ήταν πολύ πιο υψηλός σε σχέση με αυτόν στα δένδρα της οξιάς. Επίσης τα παρακάτω είδη κολεοπτέρων ήταν σε αφθονία στις φουντουκιές: *Phyllobius pyri* (Coleoptera: Curculionidae), *Rhynchaenus populi* (Coleoptera: Curculionidae) και *Agriotes acuminatus* (Coleoptera: Elateridae). Στα δένδρα της οξιάς τα έντομα που ήταν σε αφθονία ήταν τα: *Rhynchaenus fagi* (Coleoptera: Curculionidae), *Phyllobius pyri* (Coleoptera: Curculionidae) και *Anobium punctatum* (Coleoptera: Anobiidae). Ο μεγαλύτερος πληθυσμός των εντόμων παρατηρήθηκε στα τέλη της άνοιξης, από 20/05/11 έως 08/06/11.