JOURNAL OF FOREST SCIENCE, *53*, 2007 (Special Issue): 53–56

Contribution to knowledge of *Hylesinus fraxini* (Panzer, 1779) (Coleoptera: Scolytidae) natural enemies from Northern Moravia (Czech Republic)

O. Nakládal, M. Turčáni

Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Prague, Czech Republic

ABSTRACT: Predation by natural enemies was studied as mortality factors of *Hylesinus fraxini* in 2006–2007. Predation by birds was not recorded and predation rate by insect reached 0.1%. Only one insect predator was reared – *Thanasimus formicarius* (Linnaeus, 1758). The total rate of parasitism was 54.0%. At least 8 species of parasitoids from the order Hymenoptera were recorded. The most abundant parasitoid was *Eurytoma morio* Boheman, 1836 (44.1% from the total number of all reared parasitoids; 23.8% of the total mortality), subsequently *Eurytoma arctica* Thomson, 1876 (31.7%; 17.1%), *Cheiropachus quadrum* (Fabricius, 1787) (12.8%; 6.9%), Braconidae (6.3%; 3.4%), *Rhaphitelus maculatus* Walker, 1834 (3.9%; 2.1%), *Mesopolobus* sp. (0.5%; 0.3%), were not identified Pteromalidae (0.5%; 0.3%) and *Tetrastichus* sp. (0.2%; 0.1%).

Keywords: predators; parasitoids; natural enemies; bark beetles; *Hylesinus fraxini*; *Thanasimus formicarius*; *Cheiropachus quadrum*; *Eurytoma morio*; *Eurytoma arctica*; Czech Republic; Central Europe

Hylesinus fraxini (Panzer, 1779) is a bark beetle attacking mainly logs with thin and smooth bark of the ash-trees in the Czech Republic. Here, was made no detailed quantitative research of its natural enemies. However such a quantitative study of parasitoids was made in south Spain by Lozano and Campos (1991). Mainly due to easy rearing of this bark beetle it was made some interesting bionomic study with it and its parasitoids. Mills (1991) studied searching strategies and attack rates of parasitoids and its relevance to biological control. Lozano et al. (1994) studied the role of the parasitism and intraspecific competition in the population dynamics of the bark beetle. Campos and Lozano (1994) on *H. fraxini* researched reproductive biology of *Cheiropachus quadrum* (Hymenoptera: Pteromalidae) and *Dendrosoter protuberans* (Hym.: Braconidae) (its two of the most important parasitoids). We may find numerous records about association and parasitoids of the *H. fraxini* mainly in older literature. 16 species of braconids (Hymenoptera: Braconidae), 12 pteromalids (Hym.: Pteromalidae), 2 eulophids (Eulophidae), 2 eurytomids (Eurytomidae), 2 torymids (Torymidae), 1 trichogrammatids (Trichogrammatidae) and 1 bethylids (Bethylidae) are known as parasitoids of *H. fraxini* and so it is the bark beetle with relatively high number of parasitoids in comparison with the other species of bark beetles.

MATERIAL AND METHODS

There were taken 4 chunks of European ash (*Fraxinus excelsior*) that were attacked by *H. fraxini* in Central Moravia. Each chunk was 50 cm long and on average 7.6 cm thick. The bark of the all chunks was smooth and without fissures. Date of chunk collection was July 12, 2006. The exact site location of collection and description of habitat: Moravia bor., Litovel, faunistic square (6268c) (Pruner, Míka 1996), altitude 230 m a.s.l., GPS 49°42'26.42"N, 17°4'17.88"E, site of collection is situated close to outskirts of the city with numerous gardens and solitary urban vegetation.

Table 1. The results of rearing: species, taxomonic position of the species, association with *H. fraxini* and count of emerged individuals

Species	Taxonomic position	Association	Count of ♀	Count of ♂	In total
Cheiropachus quadrum (Fabricius, 1787)	Hymenoptera: Pteromalidae	parasitoid	60	46	106
Rhaphitelus maculatus Walker, 1834	Hymenoptera: Pteromalidae	parasitoid	22	10	32
Mesopolobus sp.	Hymenoptera: Pteromalidae	parasitoid	0	4	4
Not identified Pteromalidae	Hymenoptera: Pteromalidae	parasitoid	–	–	4
Tetrastichus sp.	Hymenoptera: Eulophidae	parasitoid	2	0	2
Eurytoma morio Boheman, 1836	Hymenoptera: Eurytomidae	parasitoid, hyperparasitoid	140	226	366
Eurytoma arctica Thomson, 1876	Hymenoptera: Eurytomidae	parasitoid, hyperparasitoid	155	108	263
?	Hymenoptera: Braconidae	parasitoid	?	?	52
Thanasimus formicarius (Linnaeus, 1758)	Coleoptera: Cleridae	predator	–	–	2
Hylesinus fraxini (Panzer, 1779)	Coleoptera: Scolytidae	host	–	–	706

The attacked chunks were moved under the laboratory conditions, subsequently individuals of bark beetles with their predators and parasitoids were reared. Predators and chalcid wasps were identified to species (some problematic chalcids only to genus) and braconids only to families. All specimens were identified by authors and revised by Vladimír Kalina (Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Czech Republic).

At first bark surface was evaluated with respect to predation of birds. Subsequently, the rate of the predation was estimated in the following way. Predation was counted as ratio of bark damaged by birds and total bark area with galleries. The influence of insects' predation and parasitoids on the total population of the bark beetle was calculated on base of the following mathematic relations.

Presumptions of utilize mathematic relations is that one individual of parasitoid or predator will kill only one bark beetle larvae (it does not have to be in case of predators).

REARING RESULTS

Rearing results are given in Table 1, where are recorded counts of males and females for all species of chalcid wasps parasitoids. Braconids sex was not discovered because these were not identified to the species. Table 1 also shows taxonomic positions and associations with *H. fraxini* for all species. Percentage rates of total predation (together birds and insects), total parasitism and total mortality of bark beetles *H. fraxini* for single species are given in Table 2.

$$\text{Mortality}_{\text{parasitism}} = \frac{\sum \text{emerged parasitoids individuals}}{(\sum \text{em. predators individuals} + \sum \text{em. parasitoids ind.} + \sum \text{em. bark beetles ind.})} 100\%$$

$$\text{Mortality}_{\text{insect predation}} = \frac{\sum \text{emerged predators individuals}}{(\sum \text{em. predators individuals} + \sum \text{em. parasitoids ind.} + \sum \text{em. bark beetles ind.})} 100\%$$

$$\text{Mortality}_{\text{total}} = (\text{Mortality}_{\text{parasitism}} + \text{Mortality}_{\text{insect predation}}) \times (1 - \text{Mortality}_{\text{birds}}) + (\text{Mortality}_{\text{birds}})$$

Table 2. Percentage rates: on total predation, on total parasitism and on total mortality of bark beetles *H. fraxini*

Species	Total rate of predation caused by insects and by birds (%)	Rate of total number emerged parasitoids (%)	Total rate of *H. fraxini* mortality (%)
Cheiropachus quadrum (Fabricius, 1787)	–	12.8	6.9
Rhaphitelus maculatus Walker, 1834	-	3.9	2.1
Mesopolobus sp.	–	0.5	0.3
Not identified Pteromalidae	–	0.5	0.3
Tetrastichus sp.	–	0.2	0.1
Eurytoma morio Boheman, 1836	–	44.1	23.8
Eurytoma arctica Thomson, 1876	–	31.7	17.1
Braconidae	–	6.3	3.4
Thanasimus formicarius (Linnaeus, 1758)	100.0	–	0.1
Birds	0.0	–	0.0
Hylesinus fraxini (Panzer, 1779) (host)	–	–	45.9

DISCUSSION

Jamnický (1957) mentioned birds (woodpeckers) like significant natural enemies of this species of bark beetle but especially during the winter season. In case of this study birds do not participate on mortality of bark beetle hence they kill 0% of bark beetle population.

Activity of woodpeckers was not probably recorded due to date of taking of chunks under laboratory condition (July).

Very small importance has insect predators. There was recorded only one species of predator – *Thanasimus formicarius* L. (Coleoptera: Cleridae), which consumed only 0.1% of bark beetle population.

Parasitoids kill 53.9% of bark beetle population. There were recorded 4 species of parasitoids from family Pteromalidae, 1 species of Eulophidae, 2 Eurytomidae and some Braconidae (see Tables 1 and 2). This parasitoid complex is relatively rich and count at least 8 species of parasitoids from the order Hymenoptera. Lozano and Campos (1991) made similar study in south Spain and they recorded only 5 species. In this experimentation was the most abundant parasitoids *Eurytoma morio* Boheman (44.1% from total count of all reared parasitoids) which killed 23.8% of bark beetle population. The second abundant parasitoid was *Eurytoma arctica* Thomson (31.7% reared parasitoids, caused 17.1% mortality). However in fact these data do not predicate number of killed bark beetle larvae. *E. morio* as well as *E. arctica* are able to act like primary parasitoids (Bouček et al. 1953; Nuorteva 1957; Hedqvist 1963; Pettersen 1976), hyperparasitoids (Sachtleben 1952; Nuorteva 1957) but also like kleptoparasitoids (Mills 1991). Both species are mainly known as hyperparasitoids of braconids, because of this it is more suitable to merge braconids and both hyperparasitoids into one group amounting 82.1% from total count of all reared parasitoids and causing the death to 44.3% of bark beetle population.

Lozano and Campos (1991) recorded braconids *Dendrosoter protuberans* (Nees, 1834) as the most effective parasitoid, which counted 51.9% reared parasitoids and caused 12.7% mortality of bark beetle population. They also recorded hyperparasitic species *Eurytoma morio* and *E. aloisifilippoi* (Russo, 1938) – but here they did not affect in so insignificant range on bark beetles. In case of this study the rate of braconids and hyperparasitic species was exactly the opposite. It seems that braconids may be very effective natural enemies of *H. fraxini*, but their effectivity is inversely proportionally depended on presence and abundance of eurytomids. These hyperparasitoids in reality do not affect parasitism height of just developing bark beetle larvae (if they affect only as hyperparasitoids) or they increase parasitism height (if they affect at least partly as primary parasitoid). In both cases they decrease a number of primary parasitoids – able to attack a next bark beetle generation. *Cheiropachus quadrum* was the most effective primary parasitoid from superfamily Chalcidoidea (counted 12.8% reared parasitoids and caused 6.9% mortality of bark beetle population).

This study showed total parasitism 53.9%. This exceeded two-time more, what have published Lo-

zano and Campos (1991) who have recorded parasitism 22%. On the other hand Jardak et al. (2002) researched mortality factors of *Hylesinus oleiperda* (Fabricius, 1792), related bark beetle to *H. fraxini* which is also developing on *Fraxinus excelsior* L., and they recorded parasitism rate to 70%.

Total mortality caused by birds (0.0%), by predaceous insect (0.1%) and by parasitoids (54.0%) was 54.1% hence vital bark beetles – able to base new generation – survived 45.9%.

References

BOUČEK Z., PULPÁN J., ŠEDIVÝ J., 1953. Notizen über die parasitischen Hymenopteren des Fichtenborkenkäfers *Ips typographus* L. in CSR. Folia Zoologica Entomologica, *2*: 148.

CAMPOS M., LOZANO C., 1994. Observations of the reproductive biology of two parasites of *Hylesinus varius* and *Phloeotribus scarabaeoides* (Col.: Scolytidae): *Cheiropachus quadrum* (Hym.: Pteromalidae) and *Dendrosoter protuberans* (Hym.: Braconidae). Entomophaga, *39*: 51–59.

HEDQVIST K.J., 1963. Die Feinde der Borkenkäfer in Schweden. I. Erzwespen (Chalcidoidea). Studia Forestalia Suecica, *11*: 1–176.

JAMNICKÝ J., 1957. Prirodzení nepriatelia jaseňovca pestrého (*Leperisinus fraxini* Panz.) a možnosť ich využitia v boji proti nemu. Bratislava, SAV, Biologické práce, *3*: 1–66.

JARDAK T., MOALLA M., KSANTINI M., 2002. Mortality factors affecting populations dynamics of the scolytid *Hylesinus oleiperda* Fabr. (Coleoptera, Scolytidae). Acta Horticulturae, *586*: 823–826.

LOZANO C., CAMPOS M., 1991. Preliminary study about entomofauna of the bark beetle *Leperisinus varius* (Coleoptera, Scolytidae). Redia, *74* (3, Appendix): 241–243.

LOZANO C., CAMPOS M., KIDD N.A.C., JERVIS M.A., 1994. The role of parasitism and intraspecific competition in the population dynamics of the bark beetle, *Leperisinus varius* (Fabr.) (Col., Scolytidae) on European olives (*Olea europea* L.). Journal of Applied Entomology, *117*: 182–189.

MILLS N.J., 1991. Searching strategies and attack rates of parasitoids of the ash bark beetle (*Leperisinus varius*) and its relevance to biological control. Ecological Entomology, *16*: 461–470.

NUORTEVA M., 1957. Zur Kenntnis der parasitischen Hymenopteren der Borkenkäfer Finnlands. Suomen Hyönteistieteellinen Aikakauskirja, *23*: 47–71.

PETTERSEN H., 1976. Chalcid-flies (Hym., Chalcidoidea) reared from *Ips typographus* L. and *Pityogenes chalcographus* L. at some Norwegian localities. Norwegian Journal of Entomology, *23*: 47–50.

PRUNER L., MÍKA P., 1996. Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny. Klapalekiana (Supplementum), *32*: 1–115.

SACHTLEBEN H., 1952. Die parasitischen Hymenopteren des Fichtenborkenkäfer *Ips typographus* L. Beiträge zur Entomologie, *2*: 137–189.

Příspěvek k poznání přirozených nepřátel kůrovce *Hylesinus fraxini* (Panzer, 1779) (Coleoptera: Scolytidae) na severní Moravě (Česká republika)

ABSTRAKT: Byla zjištěna celková mortalita způsobená přirozenými nepřáteli, do které byla započítána predace ptáky, predace dravým hmyzem a parazitace. Predace ptáky byla zaznamenána ve výši 0,0 %, predace hmyzem 0,1 %, přičemž byl vychován pouze jeden predátor – *Thanasimus formicarius* (Linnaeus, 1758). Celková parazitace dosahovala výše 54,0 % a byla způsobena přinejmenším osmi druhy parazitoidů řádu Hymenoptera. Nejčetnějším parazitoidem byl druh *Eurytoma morio* Boheman, 1836 (44,1 % z celkového počtu vylíhlých parazitoidů s 23,8% podílem na celkové mortalitě), následně *Eurytoma arctica* Thomson, 1876 (31,7 %; 17,1 %), *Cheiropachus quadrum* (Fabricius, 1787) (12,8 %; 6,9 %), Braconidae (6,3 %; 3,4 %), *Rhaphitelus maculatus* Walker, 1834 (3,9 %; 2,1 %), *Mesopolobus* sp. (0,5 %; 0,3 %), nedeterminovaní Pteromalidae (0,5 %; 0,3 %) a *Tetrastichus* sp. (0,2 %; 0,1 %).

Klíčová slova: predátoři; parazitoidi; přirození nepřátelé; kůrovci; *Hylesinus fraxini*; *Thanasimus formicarius*; *Cheiropachus quadrum*; *Eurytoma morio*; *Eurytoma arctica*; Česká republika; střední Evropa

Corresponding author:

Ing. Oto Nakládal, Ph.D., Česká zemědělská univerzita v Praze, Fakulta lesnická a dřevařská,
165 21 Praha 6-Suchdol, Česká republika
tel.: + 420 224 383 738, fax: + 420 224 383 739, e-mail: nakladal@fld.czu.cz