JOURNAL OF FOREST SCIENCE, *50*, 2004 (12): 579–585

Notes to distribution and seasonal activity of spruce diprionids (*Hymenoptera: Diprionidae*) in the eastern part of the Czech Republic

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ABSTRACT: A study of diprionids associated with spruce was done at 31 sites of the eastern part of the Czech Republic in 1988–2003. In total 45 specimens belonging to *Gilpinia abieticola* (6 specimens), *G. hercyniae* (3) and *G. polytoma* (36) were collected using Malaise traps, emergency traps, bark-beetle pheromone baited traps or sweeping. The spruce diprionids were recorded in 30% of the studied sites only. *G. polytoma* was the most abundant and it is probably bivoltine with adult activity from April to August. The results of emergence trap-monitoring in Paskovský les indicate that this species is in latency.

Keywords: *Gilpinia*; *Diprionidae*; Malaise trap; spruce forests; faunistics; ecology; Czech Republic

Four species of the genus *Gilpinia* are associated with spruce *Picea* sp. (ZHELOKHOVTSEV 1988; TAEGER et al. 1998). *G. abieticola* (Dalla Torre, 1894), *G. hercyniae* (Hartig, 1837) and *G. polytoma* (Hartig, 1834) are widespread throughout Europe and Asia including Japan (ZHELOKHOVTSEV 1988; ABE, TOGASHI 1989), while *G. fennica* (Forsius, 1911) has been found only in Finland (VIITASAARI, VIKBERG 1985) (Table 1).

Fluctuations of the spruce diprionids seem to be of "latent type" (THALENHORST 1960) although *G. hercyniae* was an important pest in northern America in the period 1930–1940 (MORRIS 1958). In Central Europe, rare outbreaks of *Gilpinia* species have been recorded only occasionally (ESCHERICH, BAER 1913; ECKSTEIN 1937; KALANDRA, PFEFFER 1938; HOLZSCHUH 1997).

Biology of the spruce diprionids is relatively well known (PSCHORN-WALCHER 1982). The number of generations per season is not fixed (THALENHORST 1960). In Central Europe all three species produce two generations in lowlands. Adults of bivoltine populations fly from the end of April to the end of May and from late July to August. The second generation can be partial under less favourable conditions. Single generation with adult activity in June occurs in mountains (summarized by PSCHORN-WALCHER 1982). The spruce diprionids prefer lower branches of older spruces, from the stage of pole timber, at forest edges.

In the eastern part of the Czech Republic, few faunistic data on the spruce diprionids are known (KOLUBAJIV 1939, 1958; GREGOR, BAŤA 1940; KUDELA, KOLOFÍK 1955; MARTINEK 1960). Only KŘÍSTEK (1973, 1980) gave more detailed data on *Gilpinia* species associated with spruce in 28 localities of Moravia and Silesia (i.e. historical countries in the eastern part of the Czech Repub-

Table 1. Occurrence of spruce diprionids in some European countries

Species	C	B	EST	FIN	G	M	PL	SK	U	UK
Gilpinia abieticola (Dalla Torre, 1894)	×	×	×	×	×	×	×	×	×	
Gilpinia fennica (Forsius, 1911)				×						
Gilpinia hercyniae (Hartig, 1837)		×	×	×	×	×	×	×	×	×
Gilpinia polytoma (Hartig, 1834)	×	×	×	×	×	×	×	×	×	

C – Croatia (PEROVIĆ, LEINER 1996), B – Bohemia, M – Moravia (BENEŠ 1989), EST – Estonia (VIITASAARI et al. 1998), FIN – Finland (VIITASAARI, VIKBERG 1985), G – Germany (BLANK et al. 1998), PL – Poland (HUFLEJT 1997), SK – Slovakia (ROLLER 1999; ÚRADNÍK, KULFAN 2002), U – Ukraine (ZHELOKHOVTSEV, ZINOVJEV 1996), UK – United Kingdom (LISTON 1995)

Supported by the Ministry of Agriculture of the Czech Republic, Grant No. MZe 0002070201.

Table 2. Survey of study sites and abundance of recorded *Gilpinia* species (Y – young forest-thicket, pole timber; M – mature, high forest; number of specimens male/female)

Site	Nearest village	Longitude; Latitude	Grid mapping square	Altitude	Forest	Period	Year of investigation	Method	*Gilpinia abieticola*	*Gilpinia hercyniae*	*Gilpinia polytoma*
Bařiny	Čeladná	18°19′; 49°27′	6576	830	M	IV–X	2001–2002	MA	–	–	–
Daličany No. 1	Čeladná	18°22′; 49°29′	6576	900	M	IV–X	2001–2002	MA	–	–	0/1
Daličany No. 2	Čeladná	18°22′; 49°29′	6576	920	M	IV–X	2001–2002	MA	–	–	–
Hůrky I enclave	Palkovice	18°17′; 49°38′	6375	560	Y/M	IV–VI	1999	MA	–	–	–
Javorníček hill	Velké Karlovice	18°19′; 49°20′	6675	670	Y	IV–VIII	2003	MA	–	–	–
Kabátice hill	Chlebovice	18°16′; 49°39′	6375	550	Y/M	III–VI	1998	MA, SW	–	–	0/1
Kněhyně Mt.	Čeladná	18°19′; 49°30′	65751	1,120	Y	IV–X	2003	MA	–	–	–
Kyčera hill	Krásná	18°27′; 49°36′	6476	750	Y	IV–VI	2001	MA	–	–	–
Leskovecký les	Skřipov	17°55′; 49°48′	61-6273	490	Y/M	IV–X	1999–2000	MA	0/1	0/1	1/9
Lipina wood	Oprechtice	18°16′; 49°44′	6275	260	Y	III–VI	1998	MA, SW	–	–	–
Loucký les	Albrechtice	18°35′; 49°47′	6277	230	Y	III–VI	1998	MA, SW	–	1/0	–
Lysá hora Mt.	Krásná	18°27′; 49°32′	6476	1,170	Y	IV–X	2002	MA	–	–	–
Malá Stolová Mt.	Čeladná	18°19′; 49°31′	6475	1,000	Y	IV–VI	1999	MA	–	–	–
Nošovický les	Dobrá	18°16′; 49°41′	6376	340	Y	IV–VI	2001	MA	–	–	–
Noříčí hora Mt.	Trojanovice	18°15′; 49°31′	6475	580	Y	IV–VI	2000	MA	–	–	1/0
Obora hill	Pražmo	18°29′; 49°36′	63-6476	540	Y	IV–IX	2000–2001	MA	0/1	0/1	–
Palesek wood	Stará Bělá	18°14′; 49°45′	6275	260	Y	III–VI	1998	MA, SW	–	–	–
Paskovský les	Paskov	18°17′; 49°43′	6275	275	Y/M	III–XI	1998–2003	MA, SW, ET	0/2	–	7/11
Podolánky enclave	Čeladná	18°21′; 49° 29′	6576	850	M	IV–X	2001–2002	MA	–	–	–
Pustá Polom	Pustá Polom	18°00′; 49°52′	6174	430	Y/M	IV–IX	1997, 2001	MA, Theysohn®	–	–	1/2
Radhošť Mt.	Prostřední Bečva	18°15′; 49° 29′	6575	880	M	IV–X	2001	MA	–	–	–
Rovná wood	Bystřice nad Olší	18°41′; 49°38′	6378	390	M	IV–X	2000–2002	MA	0/1	–	–
Slavíč Mt.	Morávka	18°36′; 49°33′	6477	900	Y/M	IV–X	2003	MA	–	–	1/0
Smrk Mt.	Ostravice	18°25′; 49°31′	6476	1,060	Y/M	IV–X	2003	MA	–	–	–
Stanovnice reservoir	Karolínka	18°16′; 49°20′	6675	540	Y	IV–VI	1999	MA	–	–	–
Stolářka Mt.	Lhotka	18°19′; 49°36′	6475	700	Y/M	III–VI	1998	MA, SW	–	–	–
Travný Mt.	Krásná	18°31′; 49°34′	6477	1,150	Y/M	IV–X	2003	MA	–	–	–
Ostrý Mt.	Tyra	18°38′; 49°37′	62-6477-78	950	M	IV–IX	2002–2003	Theysohn®	–	–	0/1
Václavovický les wood	Sedliště	18°21′; 49°44′	6276	310	Y	III–VI	1998	MA, SW	–	–	–
Visalaje- Zemřelov	Krásná	18°33′; 49°31′	6477	750	M	VII	1998	SW	0/1	–	–
Zámrklí wood	Fryčovice	18°15′; 49°40′	6375	315	Y/M	III–VI	1998	MA, SW	–	–	–

lic). ÚRADNÍK and KULFAN (2002) have recently studied species composition and seasonal changes of the spruce sawflies using the shaking of larvae on lower branches in Poľana Mts., Slovakia.

In this paper, faunistic and autecological data on *Gilpinia* species resulting from an extensive study on sawflies associated with spruce (HOLUŠA 1999, 2002) are presented and discussed. To extend our poor knowledge of the spruce diprionids in Slovakia, new faunistic data are given here in addition.

MATERIAL AND METHODS

The study area is situated in the eastern part of the Czech Republic. The study was carried out in 1997–2003 at 31 sites (Table 2), located in intensively cultivated hills (Ostravská pánev plateau, Podbeskydská pahorkatina hills) with forest coverage 9–20% (dominance of Norway spruce, *Picea abies* [L.] Karst., 30–50%), in the Nízký Jeseník hills (forest coverage 70%, dominance of Norway spruce 68%) and in the Moravskoslezské Beskydy Mts. (forest coverage is 90%, dominance of Norway spruce 76%). Two sites were situated in the Javorníky highlands (forest coverage is 55%, dominance of Norway spruce 67%) (CULEK 1996). All spruce forests are of the artificial origin and have recently been stressed by drought and honey fungus in hills (HOLUŠA, LIŠKA 2002).

Sawflies were collected using Malaise traps – model TOWNES (1972) at selected study sites during 1998–2003 (Table 2). The traps were exposed in various Norway spruce forest stands from March/April to October and were emptied at irregular, two to four weeks intervals. In 1998, the majority of traps were operated only from March to June and emptied every three days. In addition sweeping on a permanent section of the young forest border was performed at these study sites in 1998. Several individuals were caught into the bark beetle pheromone baited trap of Theysohn® type. In the locality Paskovský les several dozens of emergence traps (50 × 50 cm) were installed in an older spruce forest (height 20 m, age 60 years) each year (Table 3) of the study.

Diprionids were identified using keys of BENEŠ and KŘÍSTEK (1979) and ZHELOKHOVTSEV (1988) and deposited in the collection of Forestry and Game Management Research Institute Jíloviště-Strnady. Additional material from Slovakia was studied for comparison.

(Abbreviations: ET – emergence traps, F – female (-s), M – male (-s), MA – Malaise trap, SW–sweeping.)

RESULTS AND DISCUSSION

Three species of the genus *Gilpinia* were found only in the total of 45 specimens. Adults of spruce diprionids were recorded only in 10 out of 31 sites studied (Table 2). *G. polytoma* was the most abundant spruce diprionid. The low number of recorded diprionids is probably a result of main collecting method, i.e. Malaise trap. Diprionids are weak and slow fliers and are underestimated in Malaise trap collections (Dr. Taeger, Deutsches Entomogisches Institut, Müncheberg, Germany, pers. commun.). However, the results of supporting collecting methods, and those of emergence traps in particular, also showed low diprionid activity.

Gilpinia abieticola

Material:

Krásná-Visalaje (place of Zemřelov), 750 m a.s.l. (6477), 1F, 1. 7. 1998, SW; **Paskovský les**, 1F, 31. 5.–2. 6.

Table 3. Number of *G. polytoma* specimens caught by emergence traps (0.5 × 0.5 m) in the locality Paskovský les. Bold style indicates putative prolongation of diapause in specimens

Year of installation	Year of emergence	Number of traps*	Male	Female	Mean density per year (ex/m^2)
1998	1998	30	0	0	0
1998	1999	30	0	0	0
1998	2000	10	0	**1**	0.9
1998	2001	10	0	0	0
1998	2002	10	0	**1**	0.1
2003	2003	8	0	1	0.2
2000	2000	20	3	3	–
2000	2001	8	0	0	–
2000	2002	8	0	0	–
2000	2003	2	0	0	–
2001	2001	11	0	0	–
2001	2002	10	0	0	–
2001	2003	7	0	0	–
2002	2002	11	0	0	–
2002	2003	5	0	0	–

*The decrease of trap number in 2003 is a result of permanent cutting and disturbance of places

1999, SW; 1F, 18. 4.–21. 5. 2002, ET; **Leskovecký les**, 1F, 5. 5. 2000, MA; **Obora**, 1F, 4. 5.–9. 5. 2000, MA; **Rovná wood**, 1F, 20. 4.–6. 5. 2002, MA.

Comparative material from Slovakia:

Poľana Mts., Predná Poľana Mt., 1,300 m a.s.l., 1F, 11. 5. 2000, SW, M. Úradník leg., det. et coll. L. Roller; Vysoké Tatry Mts., Mengusovská dolina, 1F, May 2000, SW, M. Úradník leg., det. et coll. L. Roller.

Flight activity of *G. abieticola* was low in the study area and the species was recorded in 5 out of 31 sites studied. This is in contrast to KŘÍSTEK (1980), who found *G. abieticola* in almost all studied localities (constancy 96%). The species was found in a mountain spruce forest at an altitude of 1,300 m in Slovakia as well as in an artificial and stressed forest at an altitude of 275 m (Paskovský les). Most of specimens were collected in May and only one was recorded later in the season, in July. The late record appears to be a result of non-synchronized emergence of single generation at a site of higher altitude.

Gilpinia hercyniae

Material:

Loucký les, 1M, 19.–21. 4. 1998, MA; **Obora**, 1F, 29. 4.–3. 5. 2000, MA; **Leskovecký les**, 1F, 21.4.–5. 5. 2000, MA.

Flight activity of *G. hercyniae* was very low in the study area. All studied adults were recorded in spring months. The species is known to be obligatory thelytokous (BENSON 1950; ERMOLENKO 1975), so the finding of one male in our small material is unexpected. However, KŘÍSTEK (1980) found the almost equal sex ratio (42M, 50F).

Note: To distinguish females of *G. hercyniae* from *G. polytoma* ovipositor characters (BENEŠ, KŘÍSTEK 1979; ZHELOKHOVTSEV 1988) should be used. In our experiences coloration (labrum, ventral parts of thorax and hind femur) is variable. The application of coloration characters led to the identification of false *G. hercyniae* specimens.

Gilpinia polytoma

Material:

Pustá Polom, 2F, 1.–15. 5. 1997; 1M, 2. 7. 1997, Theysohn®; **Kabátice**, 1F, 13.–15. 5. 1998, MA; **Paskovský les,** 1M, 3.–10. 6. 1998; 1M, 1F, 22. 7.–31. 8. 1999; 1M, 29. 4.–1. 5. 2000; 1F, 27.–28. 4. 2000, MA; 1M, 3. 5. 2000, SW; 1M, 3F, 18. 4.–24. 4. 2000; 1F, 18. 4.–21. 5. 2002; 2M, 1F, 25.–28. 4. 2000, ET; 1F, 6.–13. 5. 2003, MA; 2F, 15. 4.–3. 6. 2003; 1F, 4. 6.–10. 10. 2003, ET; **Leskovecký les,** 1F, 1.–3. 5. 1998; 1F, 12.–26. 4. 1999; 1F, 4.–11. 5. 1999; 1F, 11.–23. 8. 1999; 1F, 6.–17. 5. 2000; 1M, 4F, 21. 4.–5. 5. 2000, MA; **Nořičí hora**, 1M, 23.–30. 5. 2000, MA; **Daličany No. 1**, 1F, 19. 6.–24. 7. 2002, MA; **Slavíč**, 1M 23. 5.–14. 6. 2003, MA; **Tyra** (Ostrý Mt.), 950 m a.s.l. (62-6477-78), 1F, 20.–27. 5. 2003, Theysohn®.

Comparative material from Slovakia:

Poľana Mts., Hriňová, 540 m a.s.l., 1M, 7. 7. 1995; 1M, 23. 8. 1995; 1F, 22. 8.1995; MA, L. Roller leg., det. et coll; Veľká Fatra Mts., Mošovce, 600 m a.s.l., 1M, 30. 5. 1995, SW, Ľ. Vidlička leg., L. Roller det. et coll; Veľká Fatra Mts., Nedozorská dolina valley, 600 m a.s.l., 1M, 20. 6. 2003, SW, L. Roller leg., det. et coll.

Adults were active from April to August with the peak of activity in May (Fig. 1). The first generation emerged mainly at the end of April while KŘÍSTEK (1980) reported the emergence from the last decade of May to the second decade of July. The long period of flight activity supports the existence of bivoltine populations in Central Europe. A bivoltine population was recently found also in Slovakia (ÚRADNÍK, KULFAN 2002).

G. polytoma was the most abundant and frequent species in our material (Table 2), which confirms the findings of KŘÍSTEK (1980). Compared to densities of the important pests of Norway spruce – *Pristiphora abietina* (Christ, 1791) and *Pikonema scutellatum* (Hartig, 1837) (HOLUŠA 1999), population densities of *G. polytoma* in emergence traps were low and similar to data from latency by THALENHORST (1960). KŘÍSTEK (1980) also found similar values (*Gilpinia abieticola* 0.05 ex/m^2; *Gilpinia*

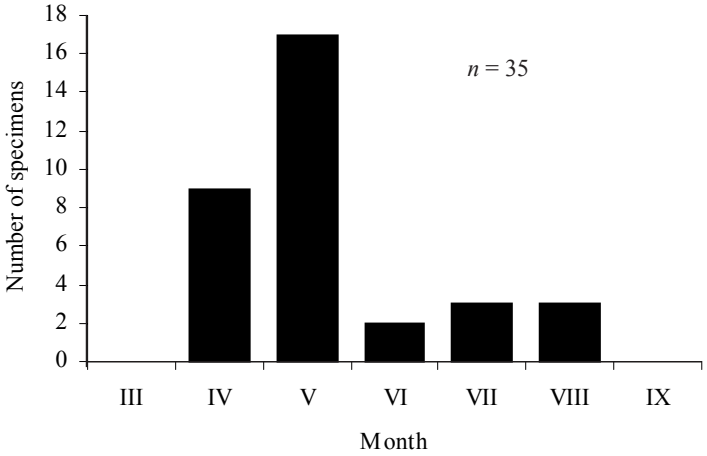

Fig. 1. Seasonal activity of *G. polytoma* in the eastern part of the Czech Republic in 1998–2003 (according to data of traps empties; data from the locality Paskovský les [4. 6.–10. 10. 2003] was excluded)

hercyniae 0.13 ex/m^2; *Gilpinia polytoma* 0.06 ex/m^2) in Rájec during 1973–1979.

Prolongation of diapause in a part of the population is well documented in Eastern Canada. Diapause can last for even six years (PREBBLE 1941). Two studied specimens collected by emergence traps in Paskovský les displayed possibly 2- and 4-year prolongation of diapause (Table 3).

CONCLUSION

Three *Gilpinia* species associated with spruce (*G. abieticola*, *G. hercyniae* and *G. polytoma*) occurred in forests of wide altitudinal range in the studied area. All three species may occur at a single site as we have found in Leskovecký les in May 2000. Adults were recorded in about 30% of the studied spruce stands only. The low number of recorded diprionids is probably a result of the main collecting method, i.e. Malaise trap.

Flight activity of the species began at the end of April and lasted until August. May was the month of main activity of adults. Bivoltine populations of *G. polytoma* may exist in the studied area. Adults of the second putative population (in July–August) were less abundant than those of the first spring generation. Possible prolongation of diapause was observed in this species.

In accordance with published data *G. polytoma* was the most common spruce diprionid. The results of emergence trap monitoring in Paskovský les indicate that this species is in latency.

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Received for publication February 12, 2004
Accepted after corrections May 26, 2004

Poznámky k výskytu a sezonní aktivitě smrkových hřebenulí *(Hymenoptera: Diprionidae)* ve východní části České republiky

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ABSTRAKT: V letech 1997–2003 byly studovány smrkové hřebenule rodu *Gilpinia* na 31 lokalitách východní části České republiky. Celkem bylo zjištěno 6 jedinců *Gilpinia abieticola*, 3 jedinci *G. hercyniae* a 36 jedinců *G. polytoma* pomocí Malaiseho lapačů, půdních fotoeklektorů, feromonových lapačů na lýkožrouty a smýkání. Hřebenule byly zjištěny jen na téměř 30 % lokalit. *G. polytoma* byla nejpočetnějším druhem a její populace jsou pravděpodobně bivoltinní s letovou aktivitou od dubna do srpna. Výsledky půdních fotoeklektorů na lokalitě Paskovský les dokumentují latenci tohoto druhu.

Klíčová slova: *Gilpinia*; *Diprionidae*; Malaiseho lapače; smrkové porosty; faunistika; ekologie; Česká republika

Na smrk (*Picea* sp.) jako hostitelskou rostlinu jsou vázány čtyři druhy hřebenulí rodu *Gilpinia* (ZHELOKHOVTSEV 1988; TAEGER et al. 1998). Druhy *G. abieticola* (Dalla Torre, 1894), *G. hercyniae* (Hartig, 1837) a *G. polytoma* (Hartig, 1834) jsou široce rozšířeny v Evropě a v Asii včetně Japonska (ZHELOKHOVTSEV 1988; ABE, TOGASHI 1989), zatímco *G. fennica* (Forsius, 1911) je známa jen z Finska (VIITASAARI, VIKBERG 1985) (tab. 1).

Populace hřebenulí vykazují jen fluktuace latentního typu (THALENHORST 1960), ačkoli *G. hercyniae* se stala v letech 1930–1940 významným škůdcem severní Ameriky (MORRIS 1958). Ve střední Evropě jsou známy jen lokální a krátkodobé gradace (ESCHERICH, BAER 1913; ECKSTEIN 1937; KALANDRA, PFEFFER 1938; HOLZSCHUH 1997).

O těchto druzích je z východní části České republiky známo jen několik údajů (KOLUBAJIV 1939, 1958; GREGOR, BAŤA 1940; KUDELA, KOLOFÍK 1955; MARTINEK 1960; KŘÍSTEK 1973, 1980).

V letech 1997–2003 jsme studovali hřebenule rodu *Gilpinia* ve smrkových porostech na 31 lokalitách (tab. 2) hlavně pomocí Malaiseho lapačů. Materiál byl

doplněn rovněž odchyty z půdních fotoeklektorů, smýkání a feromonových lapačů na lýkožrouty. Získané údaje byly porovnány i s doposud nepublikovaným materiálem ze Slovenska.

Celkem jsme zjistili jen 45 jedinců tří druhů. Hřebenule byly zjištěny pouze na deseti z 31 lokalit. V souladu s publikovanými údaji byla *G. polytoma* nejpočetnějším druhem v rodu *Gilpinia*. Nízký počet nachytaných dospělců je pravděpodobně důsledkem hlavní použité metody, tj. Malaiseho lapačů. Hřebenule jsou špatní a pomalí letci a tyto lapače je špatně zachytávají. Avšak také výsledky doplňujících metod, zvláště půdních fotoeklektorů (tab. 3), ukazují na nízkou početnost hřebenulí ve studované oblasti.

Letová aktivita dospělců hřebenulí začala na konci dubna a trvala až do srpna. Vrchol letové aktivity nastával v květnu. Ve studované oblasti pravděpodobně existují bivoltinní populace *G. polytoma* (obr. 1). Druhá generace je méně početná ve srovnání s generací létající na jaře. U tohoto druhu byla zjištěna prodloužená diapauza (tab. 3). Všechny tři druhy se mohou vyskytovat na stejné lokalitě, jak bylo zjištěno na lokalitě Leskovecký les (květen 2000).

Poznámka: rozlišení samic *G. hercyniae* od *G. polytoma* bylo provedeno pomocí počtu lišt na kladélku (BENEŠ, KŘÍSTEK 1979; ZHELOKHOVTSEV 1988). Podle našich zkušeností zbarvení (labrum, ventrální části hrudi a zadního stehna) jsou velmi variabilními znaky a jejich užití vede k nesprávné determinaci.

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