

## Short communication

# Winter occurrence of diprionid larvae (Hymenoptera, Symphyta) on pines in Central Europe: an effect of global warming?

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### Abstract

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During two winter seasons (2013–2014 and 2014–2015), we collected insects from branches of Scotch pine trees in the Borská nížina lowland (western Slovakia) using beating method. Four hymenopteran species in the larval stage were recorded in December 2013: *Diprion similis* (Hartig, 1834), *Gilpinia frutetorum* (Fabricius, 1793), *Gilpinia pallida* (Klug, 1812) and *Gilpinia variegata* (Hartig, 1834). The occurrence of diprionid larvae in the non-growing season has not been so far reported from Central Europe and may be a result of global warming.

### Keywords

Diprionidae, *Pinus sylvestris*, sandy soils, Scotch pine, Slovak Republic, winter activity

### Introduction

Diprionid sawflies (Symphyta: Diprionidae) are primitive Hymenoptera with holarctic distribution (VIITASAARI, 2002). In Europe and North America, their larvae feed on needles of various conifers. Some species undergo an unpredictable outbreak and hence might be responsible for considerable damages in Europe (BEAUDOIN et al., 1994; VIITASAARI, 2002).

Depending on climatic conditions and altitude, diprionid sawflies may have one or two generations per year (VIITASAARI, 2002). As a rule, bivoltine populations of pine feeding diprionids occur in lowlands of Central Europe. Their larvae feed preferably on the Scotch pine from May till October (LORENZ and KRAUS,

1957; PSCHORN-WALCHER, 1982). Sawflies of the family Diprionidae endure adverse conditions (e.g. winter) in diapause, typically in the eonymph stage localized inside cocoons. These can be found on twigs and understorey or in forest litter. *Neodiprion sertifer* (Geoffroy, 1785) represents an exception since it overwinters as eggs on twigs. Diapause also helps synchronize reproduction and development with suitable climatic conditions (PSCHORN-WALCHER, 1982; KNERER, 1983; BEAUDOIN et al., 1994; VIITASAARI, 2002).

There are only few data about overwintering larvae of phyllophagous insects dwelling on branches of coniferous trees (e.g. DVOŘÁČKOVÁ and KULFAN, 2009; PARÁK et al., 2015; KULFAN et al., in press).

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## Material and methods

The study of diprionid sawflies was carried out in Scotch pine forests of different age and structure, growing on the sandy soils in the Záhorská nížina lowland, western Slovakia (Table 1). The eight investigated study plots belong to the biotope of managed pine forests and seminative pine-oak forests. The area is warm with moderately dry climate and mild winters, whereby the average temperature in January is usually above  $-3$  °C. The average annual temperature is 9 °C, and annual rainfall about 550 mm (LAPIN et al., 2002). Study plots were visited during December 2013–March 2014 and December 2014–March 2015. Sawfly larvae were sampled monthly by beating from Scotch pine branches at heights of 1–3 m above the ground, using a beating tray with a diameter of 1 m. One sample consisted of larvae that had dropped into the beating tray from a total of 20 branches which were 1 m long each. In total, ten samples (200 branches) were taken. The larvae were preserved in 70% ethanol and examined in the laboratory, using a stereomicroscope Leica EZ4. Identification of sawfly larvae was made according to LORENZ and KRAUS (1957) and VIITASAARI and VARAMA (1987). The voucher specimens of all sawfly species detected in the present study are deposited in the collection of the first author.

## Results and discussion

Twenty-three diprionid larvae were collected during the first winter season in December 2013 (Table 2). Despite the comparatively low average temperature on several

sampling days in December 2013, i.e. the temperature did not rise above 0 °C, all larvae were active during most of the time (for further details, see Table 2). Over the winter season from December 2014 to March 2015 no larvae were obtained.

This unusual finding of active diprionid larvae in winter has not been yet reported from Central Europe (LORENZ and KRAUS, 1957; PSCHORN-WALCHER, 1982; HELLRIGL, 1996). According to PSCHORN-WALCHER (1982), a partial third generation of *Diprion pini* occasionally emerge in the United States, but months of its occurrence were not specified.

In our material, the recorded larvae very likely belong to the second generation that did not complete their development. It is well known that the length of the larval feeding period depends on temperature (PSCHORN-WALCHER, 1982; BEAUDOIN et al., 1994; VIITASAARI, 2002). Both years 2013 and 2014 were distinctly warmer in their first half (until August) than the long-term average (Fig. 1), which might be the reason for the prolonged occurrence of larvae. During the warmer autumn 2014, larvae of the last naturally occurring seasonal wave (the autumnal larvae) could complete their development and reached the dormant eonymph stage. In contrast to the year 2014, the colder weather from September to December 2013 (Fig. 1) might have caused the prolonged development of the autumnal larvae, and hence, some of them were present on pine twigs even in December. Another possibility is that global climatic changes and thus warmer climate throughout the year enabled an extra late emergence of diprionids which larvae did not achieve the dormant eonymph. Although larvae did not complete their de-

Table 1. Study plot characteristics

Location	Study plot	GPS coordinates	Altitude m a.s.l.	Study plot characteristics
Lakšárska Nová Ves	1	48°34'56,85"N 17°10'33,41"E	222	About 25-year old pines free growing on sand dunes that gradually reach the adjacent stand about 100-year old.
	2	48°34'54,46"N 17°10'34,56"E	218	About 10-year old pines forming a dense forest stand close to a canopied stand.
	3	48°34' 51,43"N 17°10'22,78"E	218	About 25-year old pines forming a forest stand wall adjacent to a meadow.
	4	48°34'55,81"N 17°9'52,23"E	218	About 15-year old pines forming a dense, strongly canopied forest stand.
Studienka	5	48°32' 25,65"N 17°8'29,88"E	218	About 100-year old pines forming a stand with grassy undergrowth and surrounded by a meadow.
	6	48°32'16,49"N 17° 8'15,03"E	218	About 15-year old pines growing in irregular clusters with grassy undergrowth.
Pernek	7	48°23'16,5"N 17°6'10,7"E	203	About 8-year old scotch pines forming a strongly canopied forest stand without grassy undergrowth.
Moravský Svätý Ján	8	48°33'52,4"N 16°59' 54,1"E	159	About 10-year old pines forming a canopied forest stand wall.

Table 2. The number of collected diprionid larvae at eight study plots (SP 1–SP 8) in the Borská nížina lowland, western Slovakia, and average daily temperature on the sampling days (as measured by the meteorological station in Moravský Svätý Ján)

Sampling day	Study plot								Occurrence of larval stages in months according to LORENZ and KRAUS (1957) and PSCHORN-WALCHER (1982)
	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	
19.xii. 2013	19.xii. 2013	17.xii. 2013	16.xii. 2013	12.xii. 2013	12.xii. 2013	28.xii. 2013	30.xii. 2013		
Average daily temperature	–0.7 °C	–0.7 °C	–0.2 °C	0.2 °C	0.3 °C	0.3 °C	7.7 °C	2.7 °C	
<i>Diprion similis</i>	2	1	2	2		1	1		v. and ix.
<i>Gilpinia frutetorum</i>	1				2		1	1	v.–vi. and viii.–ix.
<i>Gilpinia pallida</i>	1				1	5	1		vi.–x.
<i>Gilpinia variegata</i>							1		v.–vi. and viii.

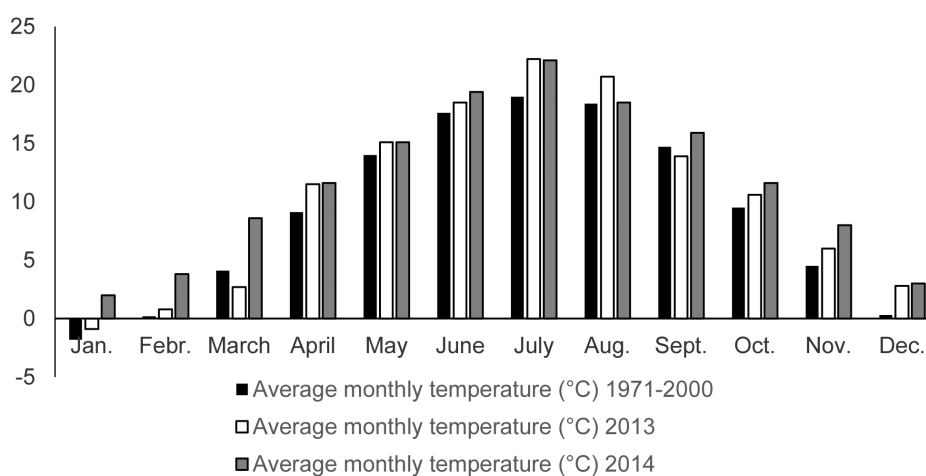


Fig. 1. Long-term average monthly temperatures (1971–2000) and average monthly temperatures in 2013 and 2014 (according to the measurements of the meteorological station in Kuchyňa).

velopment, they could serve as a food source for insectivorous animals in lowland Scotch pine forests during mild winters.

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