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The occurrence of *Megastigmus pictus* (Förster) (Hymenoptera: Torymidae) and *Resseliella skuhravyorum* Skrzypcz. (Diptera: Cecidomyiidae) in the Chełmowa Góra forest reserve of the Świętokrzyski National Park (Poland)

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ABSTRACT: A study conducted in 1999–2000 in 6 compartments of the Chełmowa Góra forest reserve, situated in the Świętokrzyskie Mountains, was aimed at harmful insects infesting cones and seeds of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin. Insect rearing and seed and cone cutting yielded 1,045 specimens of insects belonging to 8 species. *Resseliella skuhravyorum* Skrzypcz. (Diptera: Cecidomyiidae) and *Megastigmus pictus* (Förster) (Hymenoptera: Torymidae) were the most abundantly represented species. They were present in cone samples of all investigated trees. The index of infestation of cones by insects (WZS) was higher in the case of trees growing at the forest edge. The analysis by cutting showed an insignificant percent increase – 6.7% of sound seeds while 88.9% of seeds were blind. *M. pictus* damaged 2.6% of larch seeds, while *R. skuhravyorum* 1.7%. The parasitoid *Mesopolobus zetterstedtii* (Dalla Tore) was received from the mass rearing where its host is *M. pictus.*

Keywords: insects infesting cones and seeds; larch; Świętokrzyski National Park

The larch *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin is considered to be a valuable tree in forestry, mainly due to its longevity, relatively low climatic requirements and high light tolerance, the greatest among larches.

This subspecies of European larch, i.e. Polish larch, occurs in central and eastern regions of the belt of uplands of Middle Poland, and also in the Beskid Zachodni Mountains and foothills of the Carpathians. The centre of its occurrence is situated in the Świętokrzyskie Mountains, where it takes up only 0.5% of the forest area (Bałut 1962).

The demand for Polish larch seeds in forestry is high. Their quality is seriously lowered by insects, and this affects the quality of the larch planting material in forest nurseries. Insects also reduce natural regeneration of this tree in the forest.

Megastigmus pictus (Förster) (Hymenoptera: Torymidae) and *Resseliella skuhravyorum* Skrzypcz. (Diptera: Cecidomyiidae) belong to the most frequent insect pests of larch seeds. The latter species, apart from seeds, also damages the seed scales in cones.

According to Bouček (1970) *M. pictus* was described by Förster (1841) as *Torymus pictus* on the basis of females only, and then by Hoffmeyer (1929) as *Megastigmus setineri*.

In Poland, its females were found by Nunberg (1947) and Kapuściński (1948). The first male of this species was found by Graham in England in 1960 (Bouček 1970).

The data on this seed pest may be found in publications of Čermák (1952), Karpiński (1963), Szmidt (1965), Skrzypczyńska (1973a,b, 1974, 1983), Roques (1983), and other authors.

Frequently, the flat orange larvae of *R. skuhravyorum* may be found in ripening larch cones, under the seed scales and on seeds. In the anterior part of their body there is a brown *spatula sternalis*. The data on this species may be found in European entomological literature (Postner 1982; Roques 1983; Křístek, Skrzypczyńska 1992).

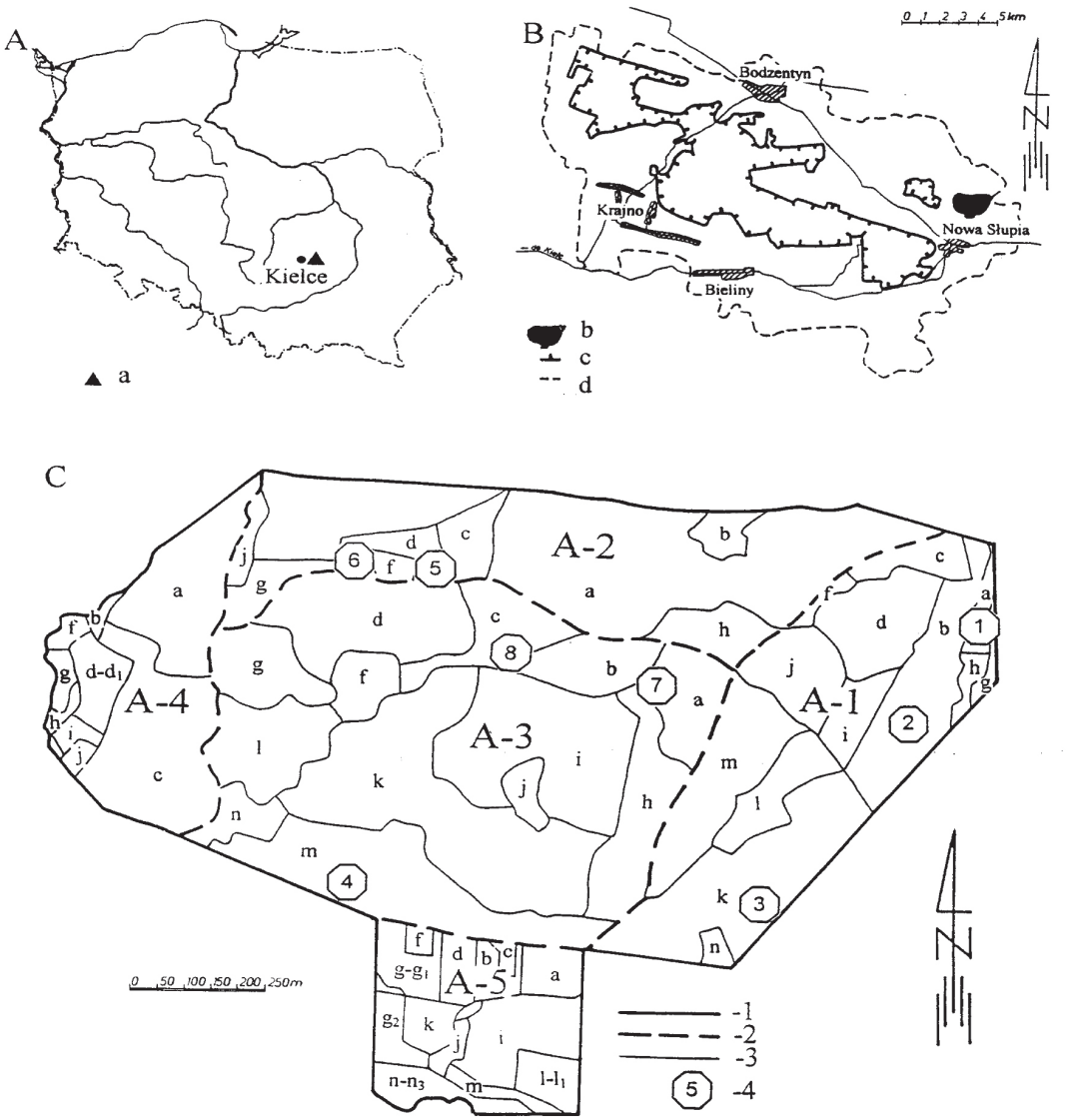

Fig. 1. Study area and arrangement of sample plots in the Chełmowa Góra forest reserve in the Świętokrzyski National Park
A – location in Poland, a – study plot; B – location in relation to Świętokrzyski National Park, b – Chełmowa Góra reserve, c – boundaries of Świętokrzyski National Park, d – boundaries of protection zone; C – Chełmowa Góra reserve, 1 – boundaries of the reserve, 2 – boundaries of compartments, 3 – boundaries of sub-compartments, 4 – study plots

The objectives of the present study were to:
- ascertain the presence of *Megastigmus pictus* and *Resseliella skuhravyorum* in the Chełmowa Góra forest reserve,
- determine their numbers,
- detect any relationships between these numbers and the position of trees in the forest,
- determine the seed losses caused by these insect species,
- point out the parasitoids reducing the pest numbers.

MATERIALS AND METHODS

The field and laboratory investigations were conducted in 1999–2000. The cones of *Larix decidua* subsp. *polonica* were collected in 6 compartments of the Chełmowa Góra reserve. This is the oldest reserve of larch in Poland, and it is situated in the Świętokrzyski National Park (Fig. 1). The compartments A1 a, b, k, A2 c, f, A3 a, c, m are located on the mixed upland and fresh upland forest sites. Four trees were selected at random in each compartment to collect cones. Each year (1999 and 2000) the cone samples (0.5 kg each) were collected in July–August (ripening cones) and in the second half of February (ripe cones). In total, 4,100 cones were collected.

Ten per cent of ripening cones collected from each tree were analysed by cutting. Some larvae found during the cutting analyses were placed in test-tubes with 75% ethyl alcohol, while the remaining ones were used for individual rearing (1 larva per glass

Table 1. Numbers of cones of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin collected in the Chełmowa Góra reserve in the Świętokrzyski National Park in 1999–2000

Year of collection	Total number of cones	Ripening cones (number of cones)				Ripe cones	
		total	cultivated		analysed by cutting method	total number of collected cones	number of analysed seeds
			in masses	individually			
1999	2,320	1,100	750	240	110	1,220	7,200
2000	1,780	820	500	240	80	960	7,200
Total	4,100	1,920	1,250	480	190	2,180	14,400

test-tube). The remaining cones (1,250) were used for mass rearing.

In the case of ripe cones, seeds were extracted manually: 14,400 seeds in total (Table 1). A hundred seeds from each sample were analysed by cutting to determine the percentage of blind and sound seeds, as well as those infested by insects. The remaining extracted seeds were used for mass rearing. During autumn and winter the rearing containers with seeds were kept in the room at a temperature of about +4°C, and in spring they were transferred to the laboratory. The individuals obtained by rearing were placed in glass test-tubes and labelled (locality and date of collection). The publications of Čermák (1952), Kapuściński (1966), and Skrzypczyńska (1996) were used for their identification.

In order to compare the infestation of cones by insects in different localities the index of cone infestation (WZS) was calculated. It was the ratio of the number of insect specimens of a given species to the number of cones in a sample.

RESULTS

The cutting of seeds and cones, and the mass and individual rearing, yielded 1,045 insect specimens belonging to 8 species (Table 2).

Diptera were the most numerous insects found in larch cones – 621 individuals (59.43%) belonging to 3 species. Less abundant were Hymenoptera – 314 individuals (30.04%) of 3 species. There were also 98 individuals of Coleoptera and 12 of Lepidoptera (Table 2). *Resseliella skuhravyorum* Skrzypcz. was the most numerous dipteran (562 individuals), while *Megastigmus pictus* (Först.) the most numerous hymenopteran (283 individuals). Also 22 individuals of *Mesopolobus zetterstedtii* (Dalla Tore), a parasitoid of *M. pictus,* were found in larch cones.

Table 2. List of insects according to orders found in cones of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin in the Chełmowa Góra reserve in 1999–2000

No.	Order	Number of species	Number of individuals	(%)
1	Coleoptera	1	98	9.38
2	Hymenoptera	3	314	30.04
3	Lepidoptera	1	12	1.15
4	Diptera	3	624	59.43
Total		8	1,045	

Table 3. Index of infestation of cones of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin by *Megastigmus pictus* (Förster) and *Resseliella skuhravyorum* Skrzypcz. in the Chełmowa Góra reserve

Tree position	Forest section	*Megastigmus pictus* (average for 4 trees)	*Resseliella skuhravyorum* (average for 4 trees)
Forest border	A1a	0.049	0.35
	A1b	0.052	0.34
	A1k	0.058	0.34
	A3m	0.045	0.31
Interior border	A2c	0.031	0.21
	A2f	0.026	0.23
	A3a	0.031	0.24
	A3c	0.029	0.25

Table 4. Results of the analyses of cones of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin in the Chełmowa Góra reserve

Year	Number of seeds in analysed cones							
	full	(%)	barren	(%)	damaged by			
					M. pictus	(%)	*R. skuhravyorum*	(%)
1999	482		6,290		190		98	
2000	452		5,996		171		140	
Total	934	6.76	12,286	88.9	361	2.6	238	1.72

During this study a special attention was paid to the two most abundant insect species found in larch cones, i.e. *Resseliella skuhravyorum* and *Megastigmus pictus*.

Both these species occurred in each seed sample analysed. They were present in all investigated localities. The index of infestation (WZS) for cones colonised by *M. pictus* ranged from 0.01 to 0.075. The samples of cones collected from trees growing in compartments situated at the forest edge (A1a, b, k, A3m) were found to have a higher index of infestation (mean value from 0.045 to 0.058) (Table 3) than the samples of cones collected from trees growing in the forest interior (compartments A2c, f, A3a, c) (mean value from 0.026 to 0.031). A similar relationship was observed in *R. skuhravyorum*. The index of infestation for this species in the samples of cones collected in localities situated at the forest edge ranged from 0.31 to 0.35, while for samples collected in the forest interior from 0.21 to 0.25 (Table 3).

In the case of the parasitoid *Mesopolobus zetterstedtii* the number of individuals found in cones collected from larches growing at the forest edge (16 specimens in compartments A1a, b, k, A3m) was more than twice as high as the number of individuals found in cones collected from trees growing in the forest interior (6 specimens in compartments A2c, f, A3a).

The analysis of seeds by cutting showed that there were only 6.7% of sound seeds, i.e. able to germinate, while 88.9% of seeds were blind. The remaining seeds were damaged by *M. pictus* (2.6%) and *R. skuhravyorum* (1.7%) (Table 4).

DISCUSSION

The subspecies of European larch *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin, occurring in the Świętokrzyskie Mountains, is undoubtedly distinct from larch (Białobok 1986).

The literature dealing with this larch and its entomofauna is rather scarce. Insects infesting its cones and seeds were investigated mainly in southern Poland by Skrzypczyńska (1973a,b, 1974, 1975, 1977).

According to Skrzypczyńska (1996) *M. pictus* is a serious pest of larch. The percentage of larch seeds with its larvae ranged from 2.1 to 63.6%, 23.6% on average (Skrzypczyńska 1996). In the Chełmowa Góra reserve this insect species infested 2.6% of seeds. The percentage of blind seeds often reached 90% (Skrzypczyńska 1994/1995), and sometimes even 97% (Skrzypczyńska 1996). This percentage in the Świętokrzyski National Park was 88.9%.

In the Piwniczna Forest District and the Experimental Forest in Krynica *M. pictus* attacked from 1 to 12% (average 2.18%) of seeds of European larch, while the percentage of blind seeds ranged from 65 to 99% (average 90.57%). There were only 7.52% of sound seeds on average. In the case of *R. skuhravyorum* the losses in larch seeds in stands of the Piwniczna Forest District were about 20% (Skrzypczyńska 1983). In the material from the Chełmowa Góra reserve investigated during the present study the seed losses were small amounting to 1.7% (Table 4).

The investigations of Banaszak and Szmidt (1987), carried out in seed plantations in Kórnik, Brzeziny and Plewy, showed that *M. pictus* damaged about 0.5%, while *R. skuhravyorum* 6.3% of larch seeds.

The numbers of seed and cone pests of Polish larch are affected by many factors, including the position of a sample tree in the forest stand. In the case of the two insect species under discussion the index of cone infestation was lower for larches growing in the forest interior than for larches growing at the forest edge. A similar relationship was found for the parasitoid *M. zetterstedtii*.

Since the material for this study was collected during two growing seasons only, it is too early to draw more general conclusions in this respect.

RESULTS AND CONCLUSIONS

– Cones and seeds of *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin in the Chełmowa Góra

reserve in the Świętokrzyski National Park were infested by 8 species of insects. The most frequent were 2 species: *Resseliella skuhravyorum* and *Megastigmus pictus*.

– *Resseliella skuhravyorum* accounted for 562 individuals (53.8%) and *Megastigmus pictus* for 283 individuals (27.08%).
– The number of the insect species investigated during this study may be affected by the location of the trees in the forest; the cones of larch trees growing at the forest edge were more strongly infested by insects.
– The seed losses for *Megastigmus pictus* and *Resseliella skuhravyorum* were 2.6% and 1.72%, respectively.
– The presence of *Mesopolobus zetterstedtii,* a parasitoid of *M. pictus,* indicates a certain environmental resistance in respect of this seminiphagous insect.

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Výskyt *Megastigmus pictus* (Förster) (Hymenoptera, Torymidae) a *Resseliella skuhravyorum* Skrzypcz. (Diptera, Cecidomyiidae) v lokalitě Chełmowa Góra v Národním parku Świętokrzyski (Polsko)

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ABSTRAKT: Výzkumy, prováděné v letech 1999–2000 na území šesti lesních oddělení v rezervaci Chełmowa Góra v horách NP Świętokrzyski, se týkaly škodlivého hmyzu, napadajícího šišky a semena modřínu polského *Larix decidua* Mill. subsp. *polonica* (Racib.) Domin. Jako výsledek chovu a ze vzorku krájení semen a šišek bylo získáno 1 045 kusů hmyzu, náležejícího k osmi druhům. Nejpočetněji se objevily dva druhy: *Resseliella skuhravyorum* Skrzypcz. (Diptera, Cecidomyiidae) a *Megastigmus pictus* (Förster) (Hymenoptera, Torymidae). Tyto druhy napadaly všechny zkoumané stromy, přičemž ukazatel napadení šišek (UNŠ) byl vyšší u stromů, které rostly na okraji porostu. Analýza semen s použitím metody krájení ukázala malou účast plných semen (6,7 %); planých semen bylo 88,9 %. *Megastigmus pictus* poškodil 2,6 % semen modřínu a *Resseliella skuhravyorum* 1,7 % semen. Jako výsledek hromadného chovu byl získán parazitoid *Mesopolobus zetterstedtii* (Dalla Tore) (Hymenoptera: Pteromalidae), jehož hostitelem je *M. pictus.*

Klíčová slova: hmyz napadající šišky a semena; modřín; Národní park Świętokrzyski

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