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ORIGINAL RESEARCH ARTICLE

Flower chafer *Protaetia speciosissima* (Scopoli, 1786) (Coleoptera: Scarabaeidae) – protected saproxylic species of oak stands in Poland

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Abstract. This paper presents the results of our studies on the preferences of the flower chafer, *Protaetia speciosissima* (Scopoli, 1786). The studies were carried out in 2009–2010 in the Forest Districts of Hajnówka, Krotoszyn, Łochów, Pińczów, and Puławy, located in various regions of Poland. Barrier traps consisting of a Moericke's trap and a Malaise's trap combined with a barrier of fine net were used to collect beetles. Traps were installed at two heights in over 100 years old oak stands, with the upper level in the canopy layer (mean height of 20.5 m) and the lower level adjacent to the tree trunk (mean height of 4.5 m). During two-year study, we collected a total of 328 specimens of *P. speciosissima*, 299 from the upper- and 29 from the lower forest layer. Thus, we confirmed strong preferences of the adult *P. speciosissima* for the canopy layer in oak stands. Furthermore, our observations on phenology indicate that the second half of June and all of July are the months with the highest population density of *P. speciosissima*. This paper also proposes modes of action for conservation of the species.

Key words: saproxylic beetles, oak stand, forest strata, yellow pan traps, vertical distribution

1. Introduction

The recently revision of the genus *Scarabaeus* revealed that the currently valid name for the flower chafer is *Protaetia speciosissima* (Scopoli, 1786), while the so far functioning name *Protaetia aeruginosa* (Drury, 1770) is its junior synonym (Krell et al. 2012).

In Poland *P. speciosissima* (Fig. 1) is a protected species (Regulation of the Minister of Environment of 12 October 2011). It is listed as a species vulnerable to extinction (VU) in the Red List of Threatened Animals (Pawłowski et al. 2002), whereas it has the status of species at risk of extinction in the near future (NT) in the European Red List of Saproxylic Beetles (Nieto, Alexander 2010). *P. speciosissima* belongs to the group of saproxylic invertebrates, i.e. it dependents on decaying wood (Speight 1989). The larvae develop in the cavities of deciduous trees, mainly oaks *Quercus* spp., although the species is sometimes also encountered in limes *Tilia* spp., beeches *Fagus* spp., poplars *Populus* spp., willows *Salix* spp., elms *Ulmus* spp. and even cherry *Prunus avium* L. (Tauzin 2005). Medvedev (1964) and Tauzin (2005) presented a description of the developmental stages of the species.

The habitat preferences of *P. speciosissima* have not yet been studied in detail. It is assumed that the species finds suitable conditions for its development in trees that are about 200–years–old (Gutowski et al. 2004). Larval development takes place in decaying wood within cavities located in the upper parts of trunks and in thick branches. In favourable habitats, the species occurs allopatrically with the larvae of other flower beetles (*Cetoniinae*), as well as with the hermit beetle *Osmoderma barnabita* (Motsch.), however, it avoids the cavities at the bottom of tree trunks (Burakowski et al. 1983, Byk, Cieślak 2011). Little is known about the biology and

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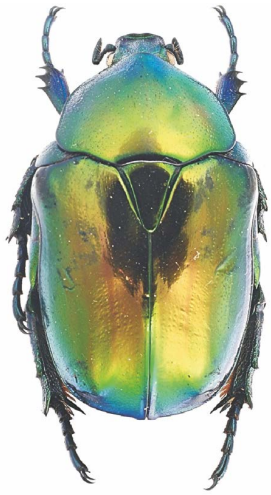

Figure 1. Adult of *Protaetia speciosissima* (Scop.) (photo by G. Tarwacki).

ecology of the adults. Most frequently, single individuals are encountered feeding on the sap juice seeping from tree trunks and fruits (e.g. pear and apple), and also sporadically feeding on the pollen of flowers or tree inflorescences (Pawłowski 1961; Stebnicka 1978; Śliwiński, Kowalczyk, 1995; Byk, Cieślak 2011). The presence of the species can also be confirmed on the basis of dead individuals or their remains found in the vicinity of trees, in which they probably developed (Marczak et al. 2010; Plewa 2011: unpublished; Marczak et al. 2012).

Adults of *P. speciosissima* are effective flyers; they can penetrate the layers of a stand, for example in search of food or suitable sites for development.

The aim of this study was to determine the preferences of the species in the vertical structure of the stand, as well as to provide additional information about its phenology.

2. Materials and methods

Data on the habitat preferences of *P. speciosissima* were collected in 2009–2010 during research aimed at assemblages of saproxylic beetles inhabiting managed oak stands and their vertical distribution in the stand, i.e. in the top layer defined as the crown zone, and in the lower layer at the base of the trunks. The study areas were located in five Forest Districts in Poland:

Hajnówka (52°42′31″N, 23°37′55″E, UTM: FD74),
Krotoszyn (51°39′18″N, 17°30′01″E , XT72),
Łochów (52°21′25″N, 22°05′56″E; ED70),
Pińczów (50°28′12″N, 20°35′05″E; DA79) and
Puławy (51°22′33″N, 21°55′59″E; EB69).

The stands were characterised by intermittent to moderate canopy closure. Pedunculate oak *Q. robur* L. aged 115–169 years was the dominant tree species in each locality.

To analyse the structure of the saproxylic beetle assemblages, we used original traps consisting of an opaque plastic roof (acting as a Malaise trap) and a yellow pan (Moericke trap), connected to each other by two crossed vanes made of fine net (Fig. 2a). Because the trap was vulnerable to damage in strong winds, we modified it in 2010 by replacing the plastic roof with permeable mesh (Fig. 2b). In both types of traps the upper part was equipped with a container to catch insects. Both the containers and yellow pans were filled with a solution of eth-ylene glycol and water in a ratio of 1:1 with the addition of a detergent to reduce the surface tension of the liquid to prevent captured insects from escaping.

The traps in the upper part of the stand were installed in the crowns of trees at an average height of 20.5 m, while the lower layer traps were placed on low lying branches near the trunk at an average height of 4.5 m. A total of 60 traps were installed, 30 traps in each stand layer. Due to the difficulty in accessing the crowns of trees in the centre of the stand, trees growing next to natural gaps or small clear-cuts were chosen. In both years of the study the traps were checked approximately every 3–4 weeks.

To examine the significance of differences between the number of beetles caught in the upper and lower layers, the Mann–Whitney non-parametric *U*-test was used (with $\alpha = 0.05$). Statistical analyses were performed using the Statistica ver. 8 program (StatSoft 2007).

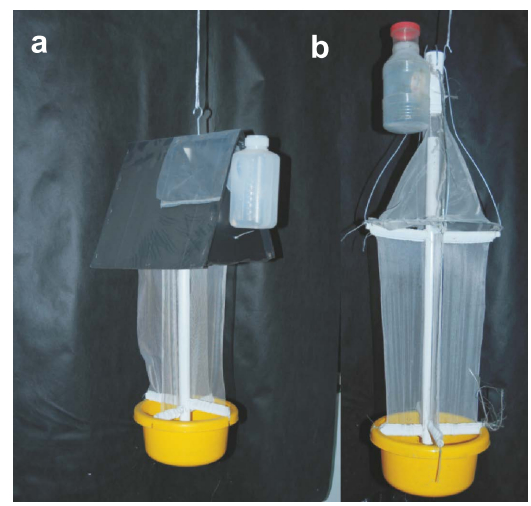

Figure 2. Trap for collecting saproxylic beetles in oak stands in 2009 (a) and 2010 (b).

The phenology of *P. speciosissima* was studied based on the number of individuals caught in both the top and bottom layers of the stand for a total of five study areas throughout the duration of the study.

The collected material is stored in the entomological collection of the Department of Forest Protection of the Forest Research Institute in Sękocin Stary.

3. Results

During two year studies, a total of 328 *P. speciosissima* specimens were captured in all of the analysed sites, with 299 individuals from the upper layer and 29 from the lower layer (Table 1). Most specimens were collected from the Puławy (205 individuals), Krotoszyn (66) and Hajnówka (53) Forest Districts. The species was confirmed for the first time in the Podlasie region at the Łochów Forest District. Despite the use of two elements for capturing insects in the traps, all of the *P. speciosissima* individuals were captured in the Moericke traps (yellow pan).

The statistical analysis showed significant differences between the number of *P. speciosissima* beetles occurring in the crown area and in the lower layer of the stand (Fig. 3).

P. speciosissima individuals were captured in the traps throughout the growing season (Fig. 4). The first beetles were found in May, and in the following months their number increased significantly, reaching maximum in July. After this period a decline in the population number occurred, and the last individuals were recorded at the end of August.

4. Discussion and summary

Until recently *P. speciosissima* was considered a very rare species in Poland. For example in the Białowieża Forest, which is considered well studied in terms of saproxylic beetles, the occurrence of this species had not been confirmed since the end of the 1940s (Karpiński 1949) until recently (Byk, Cieślak 2011). In other areas of Poland the species was known only from historical sites or there was a lack of information about its occurrence (Burakowski et al. 1983). The lack of data about the occurrence of *P. speciosissima* in many parts of the country may be surprising, as it is a species with a relatively long period with active adults, which was also confirmed by the results of our research. The large number of individuals captured in late August may suggest the presence of adults of this species even in September.

The probable reason *P. speciosissima* has been de-

Table 1. Number of *P. speciosissima* specimens collected in 2009 and 2010 in all localities from both stand layers.

Forest District	Stand layer			
	2009		2010	
	upper	lower	upper	lower
Krotoszyn	26	0	40	0
Puławy	82	3	94	26
Pińczów	0	0	3	0
Łochów	0	0	1	0
Hajnówka	26	0	27	0
Total	134	3	165	26

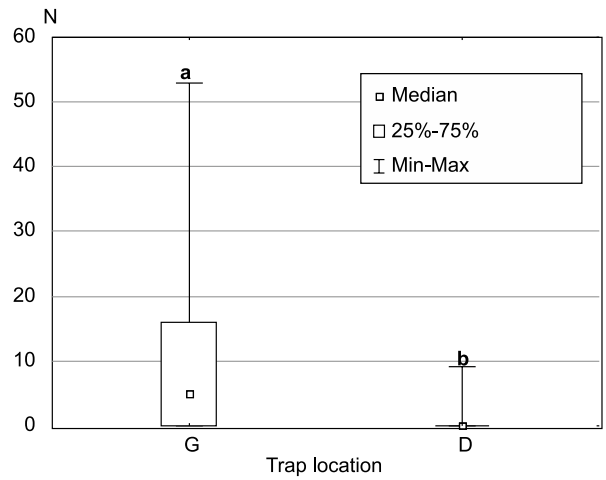

Figure 3. Median number of *P. speciosissima* specimens collected in traps installed in the upper (G) and lower (D) stand layer (Z = 3.5113; N = 60; $p = 0.0004$; different letters indicate significant differences at $\alpha = 0.05$).

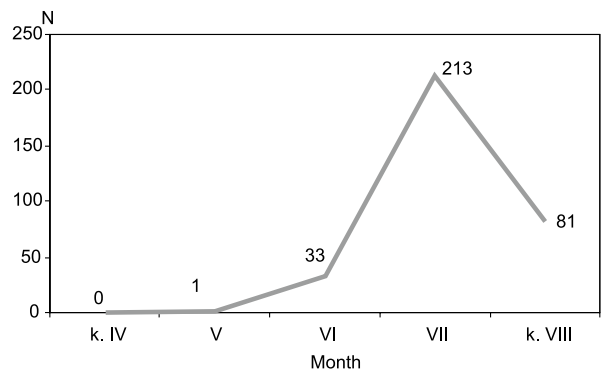

Figure 4. Number of *P. speciosissima* specimens collected during individual months of the study in 2009–2010 (*k.* – end of the month).

fined as a rare species is the characteristics of its biology, and in particular, its strong preference towards upper layers of the forest. The results of our study clearly indicate that *P. speciosissima* adults were more likely to be found in the treetops, rarely visiting the lower parts of the forest. For this reason, they can be overlooked during many types of research or inventory work, which for practical and methodological reasons generally relate to the lower part of the forest. Many locations (i.e. Krotoszyn, Puławy and Hajnówka Forest Districts) had numerous occurrences of this species, which indicates the possible existence of viable populations, even in sites with relatively low protection regimes, as is found in commercially managed stands.

The preference of *P. speciosissima* for the upper parts of the stand is probably due to the extensive requirements of this species relating to ambient temperature and potential sites for its development. On the basis of our observations, we concluded that favourable conditions for the occurrence of *P. speciosissima* are found in strongly sunlit oak stands that are over 100 years old. In the available literature most of the data refers to 250- to 300-year-old stands with loose canopy, free-standing old trees, park trees, trees growing along avenues, as well as trees growing on the southern slopes, well exposed to sunlight (Tauzin 2008; Mokrzycki et al. 2008; Oleksa et al. 2012).

Another noteworthy aspect of our research is the confirmation of luring *P. speciosissima* adults into traps made of yellow-coloured material (the yellow pan). This phenomenon is quite common among many insect species (Bańkowska 1993; Hilszczański 1995; Hilszczański, Plewa 2009) and is probably related to biological characteristics, such as the feeding on flower pollen (the so-called anthophilous species). This hypothesis may also be confirmed by similar observations of other authors studying adult *P. speciosissima* on flowers (Conrad, 1994). In turn, in the dry Mediterranean climate of southern Europe, adult beetles of the species preferably use food with higher water content, such as fruits juicy (Adlbauer, Fritz 1996).

Despite the numerous occurrence of *P. speciosissima* in a few of the Polish regions surveyed, its relative rarity in other parts of the country supports the continuation of its conservation status. In the case of managed stands, the conditions that should be fulfilled for the protection of *P. speciosissima* populations include:

a) Retention of living and dead deciduous trees, mainly oaks with visible tree holes, especially located in the upper, more sunlit parts of the trunk.

b) Maintaining stands that are over 100 years old, to the extent possible in sparse densities and with intermittent or loose canopies, with the removal of shrubs immediately surrounding the trunks.

c) Maintaining a variably aged stand structure in order to ensure the continuity of potential habitats of the species.

d) Introducing or maintaining native species of nectar and fruit producing shrubs, which can provide a valuable food base for adult beetles.

5. Conclusions

1. In commercially managed oak stands adults of *P. speciosissima* exhibit a clear preference for the upper layer of the stand.

2. *P. speciosissima* is a species more abundant than previously thought in suitable forest habitats.

3. The 'yellow pan trap' proved to be an effective tool for capturing *P. speciosissima* beetles. This type of trap could be used to monitor this species provided that modifications are introduced to ensure the survival of the trapped beetles.

4. Protecting *P. speciosissima* in commercially managed stands should take into account, as has been done thus far, leaving old trees with cavities, mainly oaks, which grow in forests with an intermittent or loose canopy closure.

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Authors' contribution

R.P. – conceptualisation of the study, data analysis, manuscript preparation, field and laboratory work. J.H., T.J. and G.T. – co-authors of the conceptualisation of the study, literature review, substantive and editorial comments to the manuscript, field work and photographs.

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