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Species composition and diets of ladybird beetles (Coleoptera: Coccinellidae) associated with black alder (*Alnus glutinosa* (L.) Gaertner) in a marshy forest

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ABSTRACT

The paper presents preliminary data on the species composition and diets of arboreal Coccinellidae in a patch of alder carr forest in the Kampinos National Park (central Poland). Of eight ladybird species recorded, the most numerous were the marshy habitat specialists, i.e. *Calvia quindecimguttata* (Fabricius, 1777) and *Sospita vigintiguttata* (Linnaeus, 1758), which are considered to be rare in Europe. We also encountered quite high numbers of an invasive Asiatic species, *Harmonia axyridis* (Pallas, 1773). Larval diets of ladybirds inhabiting alders, as determined using a method of faeces analysis, mostly consisted of aphids.

Key words: alder carr, Coccinellidae, *Calvia quindecimguttata*, *Sospita vigintiguttata*, diet analysis

INTRODUCTION

Black alder (*Alnus glutinosa* (L.) Gaertner) is a host plant for a variety of hemipterans, such as aphids of the genus *Pterocallis*, a froghoppers *Aphrophora alni* (Fallen, 1805) or a psyllid *Psylla alni* (Linnaeus, 1758) (Soika & Łabanowski, 2003; Tomków, 1977). Very little is known about the guilds of enemies of these hemipterans, especially in natural habitats of marshy forests. This applies also to

Coccinellidae, one of the most important groups of predators of sternorrhynchan hemipterans. To our knowledge, the only Polish studies of alder entomofauna that consider ladybird beetles have been those conducted by Tomków (1976, 1977). These studies, however, did not explore natural forest stands, but young alder trees planted on experimental plots.

Although species composition of Coccinellidae in natural marshy forests has not been studied in detail, it is known that these forests are the main habitat for some rare, stenotopic ladybirds, such as *Sospita vigintiguttata* (Linnaeus, 1758) or *Calvia quindecimguttata* (Fabricius, 1777) (Bielawski, 1959; Stebnicka, 1972; Czechowska & Bielawski, 1981; Koch, 1989).

There is a lack of consensus about the food specialization of these rare ladybird species. Although *S. vigintiguttata* and *C. quindecimguttata* have been regarded as aphidophagous by some authors (e.g. Koch, 1989), there are reports indicating the precedence for both species of food sources other than aphids. Palmeri *et al*. (1996) found that of the three phytophagous insects commonly occurring in alder woods in southern Italy, a psyllid (*Psylla cordata* Tamanini, 1977) was much more suitable food for larvae of *S. vigintiguttata* than an aphid (*Crypturaphis grassii* Silvestri, 1935) or a chrysomelid beetle (*Galerucella solarii* Burlini, 1942) eggs and larvae. Moreover, in guts of adult *S. vigintiguttata* the remnants of *P. cordata*, but not of the remaining two species, were detected. As to *C. quindecimguttata*, it has been reported from Finland as a specialized predator of chrysomelid immature stages (Kanervo, 1940).

This paper reports on preliminary investigations into the species composition and diets of ladybird beetles associated with alder carr forests in central Poland. The main purpose was to assess the contribution of stenotopic *S. vigintiguttata* and *C. quindecimguttata* to the community of alder carr ladybirds and to determine larval food of these species.

MATERIAL AND METHODS

Our investigations were conducted in a patch of alder carr forest (*Ribeso nigri-Alnetum*) situated in the eastern part of the Kampinos National Park, near the village Sieraków (52°20'N, 20°50'E). Due to the fact that we worked with rare species in a protected area of a national park, we attempted to collect samples in a way minimizing the number of insects removed from their habitat.

Species composition

From the beginning of May till the end of July 2010, black alder trees were sampled once a week using a 1m x 1m beating sheet. Invertebrates were shaken down on the sheet by beating tree branches with a wooden stick. One sample

consisted of five subsamples, each of them comprising ten beats in different alder branches (50 beats per sample). Ladybird adults and older larvae (3rd and 4th instar) falling onto the sheet were identified as to the species level and their numbers were noted. Then, they were either released at the place of sampling or transferred to a laboratory for diet analyses.

Diet analyses

Most of our analyses were performed in June and July 2010 and focused on the food of 4th instar larvae of five ladybird species: *S. vigintiguttata* (12 larvae tested), *C. quindecimguttata* (7 larvae), *Calvia decemguttata* (Linnaeus, 1767) (6 larvae), *Calvia quatuordecimguttata* (Linnaeus, 1758) (1 larva) and *Anatis ocellata* (Linnaeus, 1758) (3 larvae). Apart from these tests with larvae, we checked only one adult for its diet. It was *S. vigintiguttata* collected and checked in mid-May. In our food tests we used the method of faeces analysis recently applied by Davidson & Evans (2010) which, in contrast to methods based on gut dissection, enables insight into gut content of an insect without its killing. Field-collected ladybirds were transferred to the laboratory and put individually into Petri dishes. A drop of sucrose solution was added to each Petri dish to prevent starvation of the tested insects. After 48 hours ladybirds were removed from the dishes and subsequently reared on pea aphid - *Acyrthosiphon pisum* (Harris, 1776) until adulthood, to be released at the site from where they were collected as larvae. Pellets of faeces found in the dishes were placed on glass slides with a drop of water, crumbled, and then examined microscopically and photographed. In addition to faeces analyses, we conducted some field observations of feeding bahaviour of ladybirds in the alder carr forest.

RESULTS AND DISCUSSION

On alder trees in the studied forest we recorded seven predatory and one, *Vibidia duodecimguttata* (Poda, 1761) mycophagous ladybird species (Fig. 1). The most numerous were the marshy forest specialists, *C. quindecimguttata* and *S. vigintiguttata*. They intensively reproduced and developed there as could be deduced from the abundant occurrence of their larvae. The remaining ladybirds recorded by us have been known as arboreal species living on various deciduous trees and shrubs, except *A. ocellata*, which occurs mainly on coniferous trees (Bielawski, 1959; Stebnicka, 1972; Koch, 1989).

One of the ladybird species found in the course of this study, *Harmonia axyridis* (Pallas, 1773), requires a special consideration. This invasive Asiatic species may represent a serious threat for indigenous predators due to its high competitive ability and efficiency as an intraguild predator (e.g. Soares *et al*., 2008; Cichocka &

Lubiarz, 2010; Roy & Migeon, 2010). In newly invaded areas *H. axyridis* tends to occur mainly in anthropogenic habitats and some time is needed before it adapts to natural habitats in these new areas (Adriaens *et al*., 2008; Ceryngier, 2008; Roy & Migeon, 2010). Taking into account the fact that *H. axyridis* arrived in Poland very recently (it was recorded first time in 2006) (Przewoźny *et al*., 2007), quite numerous occurrence of its larvae and adults in a natural alder carr forest is worrying. Further increase of *H. axyridis* abundance in marshy forests may be especially dangerous for *C. quindecimguttata* and *S. vigintiguttata* which are strict habitat specialists and probably cannot develop in other habitats.

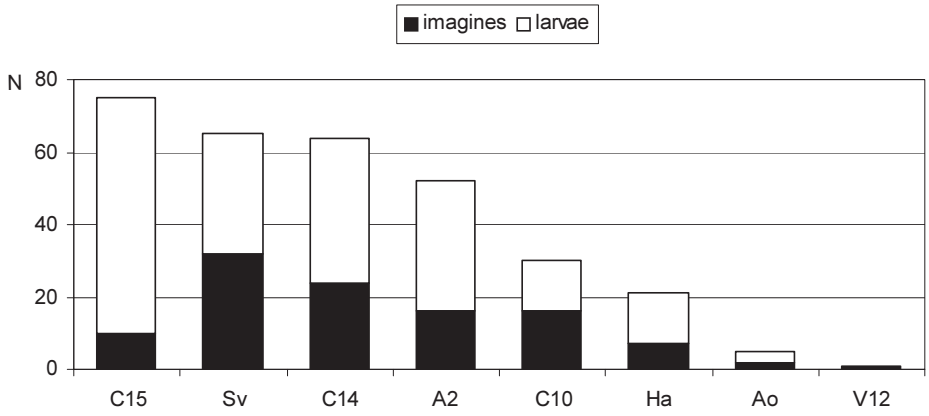

Figure 1. Species composition of Coccinellidae on *Alnus glutinosa* trees in alder carr forest. Vertical axis – total number of individuals recorded during the whole sampling period (May-July 2010)
Species symbols: C15 = *Calvia quindecimguttata*, Sv = *Sospita vigintiguttata*, C14 = *Calvia quatuordecimguttata*, A2 = *Adalia bipunctata*, C10 = *Calvia decemguttata*, Ha = *Harmonia axyridis*, Ao = *Anatis ocellata*, V12 = *Vibidia duodecimguttata*

In the feaces of all ladybird larvae tested for their diets, the great majority of distinguishable food remnants were aphids (Figs 2-5). Other prey items, such as mites (Fig. 3), thrips (Fig. 4) or ladybird larvae (Fig. 5), were found sporadically in the faeces of *C. quindecimguttata* larvae. No psyllids were detected in the diets of the tested larvae, although these hemipterans have been reported as essential food of *S. vigintiguttata* (Palmeri *et al*., 1996) and *C. quatuordecimguttata* (Semyanov, 1980; Palmeri *et al*., 1996). Most probably it was due to a weak synchronization in the occurrence of alder psyllid (*P. alni*) and ladybird larvae in the study area. While the population of *P. alni* was developing in May and disappeared from alder leaves and twigs at the beginning of June, the 4th instar larvae of Coccinellidae were being recorded and collected for diet analysis beginning from the first

half of June. In contrast to psyllids, aphids of the genus *Pterocallis* were present on alder leaves from May till late July and, hence, could serve as food for ladybird larvae throughout their development. Unlike the diets of larvae, the spring diet of the adult *S. vigintiguttata* mostly consisted of non-arthropod food, such as pine pollen and fungal spores (Fig. 6).

The method of diet analysis used in this study allows for identification of food items on the basis of indigestible fragments (e.g. legs, antennae and other chitinized body parts) present in the faeces. However, not always is prey consumed with its chitinous covers. Large prey is usually incised by a ladybird with its mandibles and sucked out (Hodek, 1996), which gives no morphologically distinguishable remains in the predator's faeces. The diets of our ladybirds might also in part consist of liquids drawn from the prey. We observed such kind of food intake in a larva of *S. vigintiguttata* cannibalizing conspecific pupa (Fig. 7) as well as in a larva of *C. quindecimguttata* preying on a larva of a chrysomelid, *Agelastica alni* (Linnaeus, 1758) (Fig. 8). The latter finding confirms the statement of Kanervo (1940) that *C. quindecimguttata* is a chrysomelid feeder.

Figure 2. Early aphid instars could be consumed by ladybird larvae as a whole – young aphid in the faeces of *Calvia quindecimguttata* larva

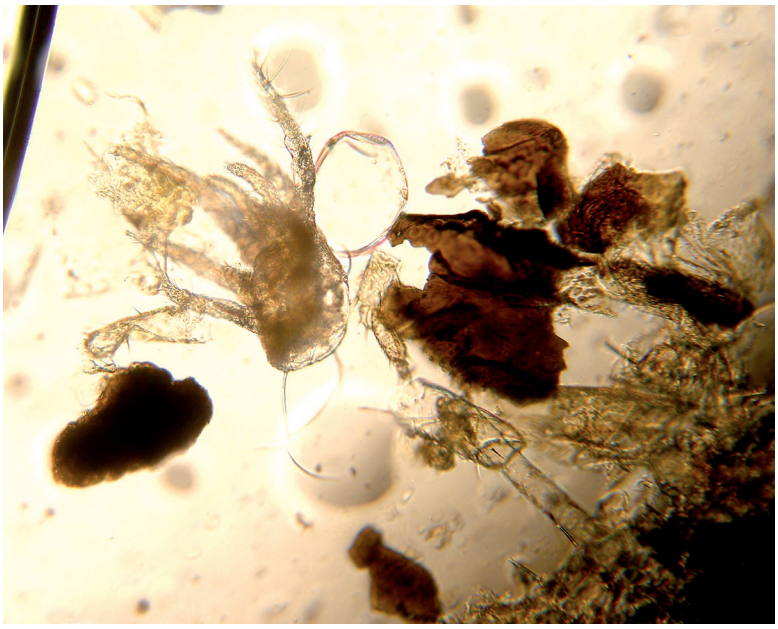

Figure 3. A mite among aphid remnants in the faeces of fourth instar larva of *Calvia quindecimguttata*

Figure 4. Thrips (Thysanoptera) wing and aphid remnants in the faeces of fourth instar larva of *Calvia quindecimguttata*

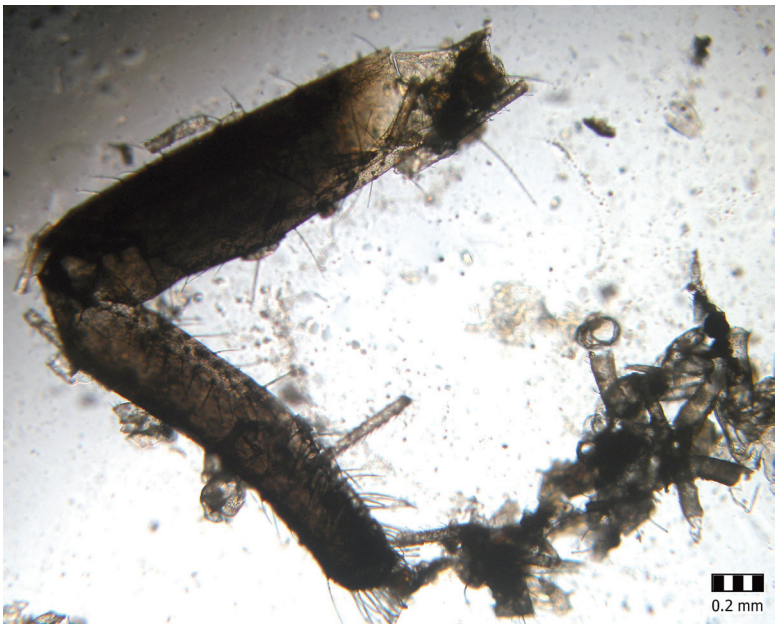

Figure 5. Leg of a ladybird larva (probably *Sospita vigintiguttata*) and aphid remnants in the faeces of fourth instar larva of *Calvia quindecimguttata*

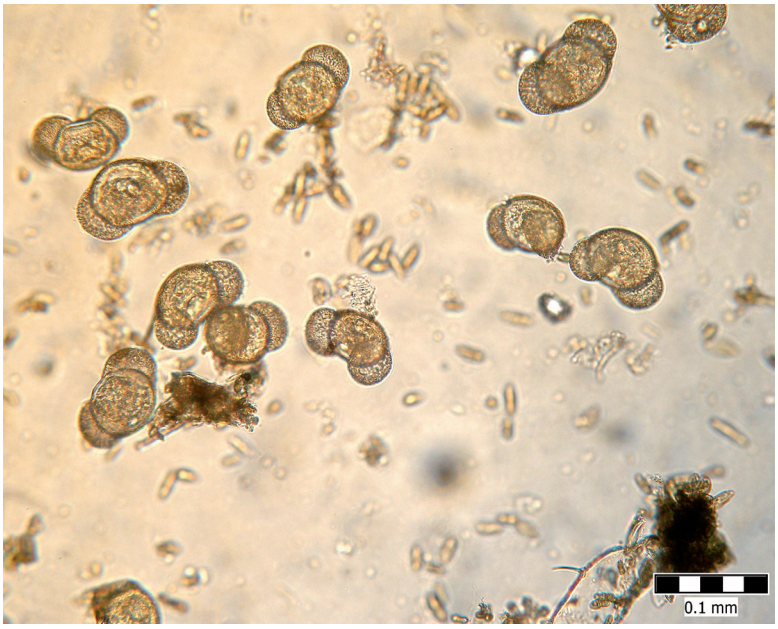

Figure 6. Pine pollen and fungal spores in the faeces of adult *Sospita vigintiguttata*

Figure 7. Fourth instar larva of *Sospita vigintiguttata* cannibalizing a conspecific pupa

Figure 8. Fourth instar larva of *Calvia quindecimguttata* preying on a larva of a chrysomelid *Agelastica alni*

CONCLUSIONS

C. quindecimguttata and *S. vigintiguttata*, the two ladybird species considered to be very rare in Europe, were surprisingly abundant in the alder carr forest of the Kampinos National Park. However, these habitat specialists may be threatened by the expansion to marshy habitats of the invasive generalist, *H. axyridis*. Thus, from the nature conservation point of view, it would be reasonable to monitor the population trends of ladybird beetles in marshy forests. Our preliminary results and literature data on the diets of marshy ladybirds suggest that specialization in *C. quindecimguttata* and *S. vigintiguttata* concerns habitat rather than food selectivity. Although chrysomelid beetle immatures and psyllids have been postulated to be the essential food of *C. quindecimguttata* and *S. vigintiguttata*, respectively, we observed that both species thrived on a predominantly aphid diet.

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Skład gatunkowy i dieta biedronek (Coleoptera: Coccinellidae) występujących na olszy czarnej w lesie bagiennym

Streszczenie

W pracy przedstawiliśmy wyniki wstępnych badań nad składem gatunkowym i dietą nadrzewnych Coccinellidae w bagiennym lesie olszowym na terenie Kampinoskiego Parku Narodowego. Z ośmiu stwierdzonych przez nas gatunków biedronek, najliczniejsze były wyspecjalizowane gatunki środowisk bagiennych, *Calvia quindecimguttata* (Fabricius, 1777) i *Sospita vigintiguttata* (Linnaeus, 1758), oba uznawane za rzadkie w Europie. Odnotowaliśmy również dość liczne występowanie w badanym środowisku inwazyjnego gatunku z Azji, *Harmonia axyridis* (Pallas, 1773). Dieta larw biedronek związanych z olszami, określana przy pomocy analizy ich odchodów, składała się głównie z mszyc.