First record of *Hyposoter placidus* (DESVIGNES, 1856) (Hymenoptera: Ichneumonidae) in Poland: the specialized parasitoid of *Lycaena FABRICIUS, 1807* butterflies (Lepidoptera: Lycaenidae)

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ABSTRACT. Adult ichneumonids of *Hyposoter placidus* were reared from caterpillars of the large copper butterfly *Lycaena dispar* collected in NE Poland, feeding on *Rumex confertus*, *R. hydrolapathum* and *R. obtusifolius*. This is the first record of this parasitoid in the country. We hypothesize that *H. placidus* may be a factor limiting the abundance of populations of *L. dispar*, a widespread species but usually occurring in low numbers.

KEY WORDS: Campopleginae, endoparasitoid, koinobiont, larval parasitoid, *Lycaena dispar*.

INTRODUCTION

The large Campopleginae subfamily of parasitoid wasps (Hymenoptera, Ichneumonidae) includes mostly solitary koinobiont endoparasitoids of holometabolous insects (QUICKE 2015). The vast majority of them parasitize Lepidoptera, and the genus *Hyposoter* FÖRSTER, 1869, with about 120 species, is a typical example (YU et al. 2012). Some species of the genus, e.g. *H. didymator* (THUNBERG, 1822) and *H. ebeninus* (GRAVENHORST, 1829), are natural enemies of serious agricultural pests (see e.g. MEDINA et al. 2007, HARVEY et al. 2010).

Females of *Hyposoter* oviposit into young caterpillars, which in some cases are still unhatched, e.g. *H. horticola* (GRAVENHORST, 1829) infests clutches of eggs of *Melitaea cinxia* (LINNAEUS, 1758) (CASTELO et al. 2010). Hosts are usually killed in the penultimate

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larval instar and the end of the parasitoid's development is quite peculiar: in contrast to many other ichneumonid wasps, larvae of *Hyposoter* do not leave their hosts but pupate inside their skin – their spotted cocoons may be even visible through it (SHAW et al. 2009).

A total of 28 *Hyposoter* species have been recorded from Poland so far (YU et al. 2012). In the present paper, we document for the first time the presence of *H. placidus* (DESVIGNES, 1856) in the country with some remarks on the relationship with its host, the large copper butterfly *Lycaena dispar* (HAWORTH, 1802) (Lepidoptera: Lycaenidae).

MATERIALS AND METHODS

Twenty caterpillars of the large copper butterfly *Lycaena dispar*, feeding on *Rumex confertus* WILLD., were collected in the southern outskirts of Białystok (NE Poland) (N53°06'39", E23°05'55") on 5-8 May 2015. They were reared at room temperature in plastic containers and fed with *Rumex* leaves.

The adult parasitoids reared from *L. dispar* caterpillars were identified on the basis of the draft key to the genus *Hyposoter* (K. HORSTMANN, unpublished). The voucher specimens are in the authors' collections, which are deposited at the Institute of Biology, University of Białystok.

RESULTS

The reared caterpillars varied in size (Fig. 1): the twelve larger ones pupated quickly, whereas while the other eight grew little, eventually, at the end of the third instar, becoming immobile. Superficially, they resembled those preparing to pupate, but they were considerably smaller (Fig. 2). After a few days, their colour turned brown and finally black – this resembled a fungal infection (Fig. 3). The skin also hardened. After another two weeks, *Hyposoter placidus* adults (Fig. 5 and 6) emerged from the mummified larvae (always as a solitary parasitoid), leaving a large hole (Fig. 4). The emerged butterflies were released at the sites of origin.

Some larvae of *L. dispar* parasitized by *H. placidus* were also collected on *Rumex obtusifolius* L. at Uhowo near the Narew National Park (N52°59'51" E22°56'23"), on *R. hydrolapathum* HUDS. at Brzeziny near the Biebrza National Park (N53°14'50", E22°32'56") and again on *R. hydrolapathum* at Zabuże (N52°19'14", E23°02'50"). In addition, an 'empty' mummified caterpillar was found on *R. hydrolapathum* at Górne (N54°15'37" E22°26'24") near Goldap in mid-August 2013.

Fig. 1. Comparison of a fully-grown, healthy larva of *Lycaena dispar* (above) with a larva of similar age parasitized by *Hyposoter placidus*.

Fig. 2. Prepupa of *Lycaena dispar* (above) and a parasitized larva shortly before being killed by *Hyposoter placidus*.

Fig. 3. Larva of *Lycaena dispar* mummified by *Hyposoter placidus*.

Fig. 4. Mummy of a *Lycaena dispar* larva after the emergence of *Hyposoter placidus*.

Fig. 5. Male of *Hyposoter placidus*.

Fig. 6. Male (a) and female (b) of *Hyposoter placidus*.

It is worth noting here that males of *H. placidus* cannot always be distinguished with certainty from males of *H. ebeninus* (K. HORSTMANN, unpublished). However, the latter species uses different hosts (SHAW et al. 2009), so there can be little doubt that all the wasps reared in our studies were identified correctly.

DISCUSSION

Little is known about the life history of *H. placidus*, but young larvae of *L. dispar* are probably parasitized before the winter diapause, the parasitoid overwinters within its host (SHAW et al. 2016). However, *H. placidus*, at least in Poland, is probably double-brooded like its host (SIELEZNIEW 2015), as also suggested by the late summer finding near Góldap. Other species of the genus *Lycaena* FABRICIUS, 1807, i.e. *L. helle* (DENIS & SCHIFFERMÜLLER, 1775), *L. hippothoe* (LINNAEUS, 1761) and *L. phlaeas* (LINNAEUS, 1761), are also mentioned as its hosts (SHAW et al. 2016).

Hyposoter placidus has been recorded so far from Belgium, France, Germany, Ireland, the Netherlands, Spain and the United Kingdom (YU et al. 2012, SHAW et al. 2016). Hence, our records from Poland are the easternmost known localities of the wasp. At the same time *H. placidus* is the only known representative of the genus in Europe parasitizing *Lycaena* butterflies and one of three species associated with the Lycaenidae family. However, the hosts of the other two, i.e. *H. notatus* (GRAVENHORST, 1829) and *H. caudator* HORSTMANN, 2008, are restricted to a different lycaenid tribe, the Polyommagini (SHAW et al. 2009).

Lycaena dispar is listed in Appendix II of the Habitats Directive. Although rare or extinct in some western European countries, it is widely distributed in central and eastern Europe (PULLIN et al. 1998), even exhibiting a northward expansion (LINDMAN et al. 2015). It is not considered threatened at the continental scale (VAN SWAAY et al. 2010, MAES et al. 2019). Despite being usually recorded in low numbers (SIELEZNIEW 2015), *L. dispar* in Poland inhabits a variety of open biotopes, ranging from very wet to moderately dry ones; this is probably related wide availability of potential larval food plants – *Rumex* L. species, like *R. crispus* L., *R. hydrolapathum*, *R. obtusifolius* and even the invasive *R. confertus*.

Factors controlling butterfly population size have been little investigated (PULLIN et al. 1995). Most of the known larval parasitoids of *L. dispar* are hymenopterans: apart from *H. placidus*, the ichneumonids *Anisobas rebellis* WESMAEL, 1845 (Ichneumoninae), *Apechthis compunctor* (LINNAEUS, 1758) and *Pimpla rufipes* (MILLER, 1759) (Pimplinae), as well as the braconid *Cotesia cuprea* (LYLE, 1925) (Microgastrinae) have been recorded (SHAW et al. 2009). Caterpillars are also parasitized by the generalist tachinid fly *Phryxe vulgaris* (FALLÉN, 1810) (Diptera: Tachinidae), while eggs can be attacked by the idiobiont parasitoid *Trichogramma* sp. (Hymenoptera: Chalcididae) (PULLIN et al. 1995). Our studies suggest that *H. placidus* could be an important natural enemy of *L. dispar*, since 40% of the caterpillars collected in Białystok were parasitized by this ichneumonid.

Further studies are needed to explore the parasitoid complex of *L. dispar* and to assess the relative impact of *H. placidus* and other species on *L. dispar* populations. In addition, searching for *H. placidus* on other *Lycaena* species inhabiting the same areas may provide more knowledge about the biology of this parasitoid and its host preferences.

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