Ant (Hymenoptera: Formicidae) parasitism by Neoneurinae wasps (Hymenoptera: Braconidae) in Denmark

Neoneurinae snyltehvepse (Hymenoptera: Braconidae) som parasit hos skovmyrer (Hymenoptera: Formicidae) i Danmark

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Abstract

The present note reports the first authenticated record of Neoneurinae wasps (Hymenoptera: Braconidae) parasitizing ants (Hymenoptera: Formicidae) in Denmark. This is based on a first instar larva of a probable species of *Elasmosoma* (Ruthe) developing in the body cavity of a worker ant, *Formica polyctena* (Förster 1850), in the Northern part of Bidstrup Forests. This ant species is a new host record for members of the Neoneurinae.

Sammendrag

Denne note rapporterer den første autoriserede observation af Neoneurinae snyltehvepse (Hymenoptera: Braconidae) som parasitter i myrer (Hymenoptera: Formicidae) i Danmark. Observationen omfatter hvad der sandsynligvis er det første larvestadie af *Elasmosoma* (Ruthe) fundet i gaster hos en arbejder af *Formica polyctena* (Förster 1850) i den nordlige del af Bidstrupskovene. Dette er første observation af *F. polyctena* som værtsart for repræsentanter af Neoneurinae.

Findings

Ants (Hymenoptera: Formicidae) are attacked by a number of metazoan parasites, including wasps of the subfamily Neoneurinae (Hymenoptera: Braconidae). The two genera in this subfamily (*Elasmosoma* Ruthe and *Neoneurus* Haliday) are widespread but uncommon and representatives of both genera have the unique characteristic of depositing their eggs into adult worker ants. Female wasps hover over ant nests, suddenly descending and depositing an egg in the ant's abdominal cavity (Donisthorpe 1927; Shaw 1993; Poinar, 2004).

On October 12, 2016, a neoneurine first instar larva was discovered in the body cavity of a worker European Red Wood Ant, *Formica polyctena* (Förster 1850), collected at the edge of an anthill (55°34'40"N 11°52'22"E) in the Northern part of Bidstrup Forests. The ant is one of 173 *F. polyctena*, which has been collected and dissected during 2016-2017. The Bidstrup forests, which contain a mixture of hardwood and coniferous trees in a hilly terrain, occur in Hvalsø, which is approximately 45 km from Copenhagen, Denmark. This ant species is common and found throughout most of Denmark. It forms large colonies, preferably in shady parts of mixed forests (Nielsen and Larsen 2012). This is the first instance of *F. polyctena* serving as host to a neoneurine braconid.

The neoneurine first instar larva from the Danish *Formica polyctena* was similar in size and shape to the first instar larvae of *Elasmosoma michaeli* Shaw 2007 developing in *Formica obscuriventris clivia* Creighton in Western North America (Poinar, 2004; Shaw, 2007)(Fig. 1). There are 3 larval instars of *E. michaeli*, all of which occur in the abdomen of the host. Development of the first larval instar occurs inside a trophamnion (a cellular sac formed from the serosal membrane of the egg). After leaving the trophamnion, the first larval instar possesses several unique features not found in the second or third larval instars. One is a pronounced head capsule lacking eyes or antennae but containing large, sickle-shaped

mandibles. Another is the elongate tail containing small spines. Apparently, the tail is used for movement through the abdominal cavity and a thrashing movement of the tail assists in the breakdown of the host's fat body. The large mandibles undoubtedly are also used to break down adipose tissue. Ants parasitized by first instar larvae of *E. michaeli* had particulated fat body, while the fat body in non-parasitized ants was entire (Poinar, 2004).

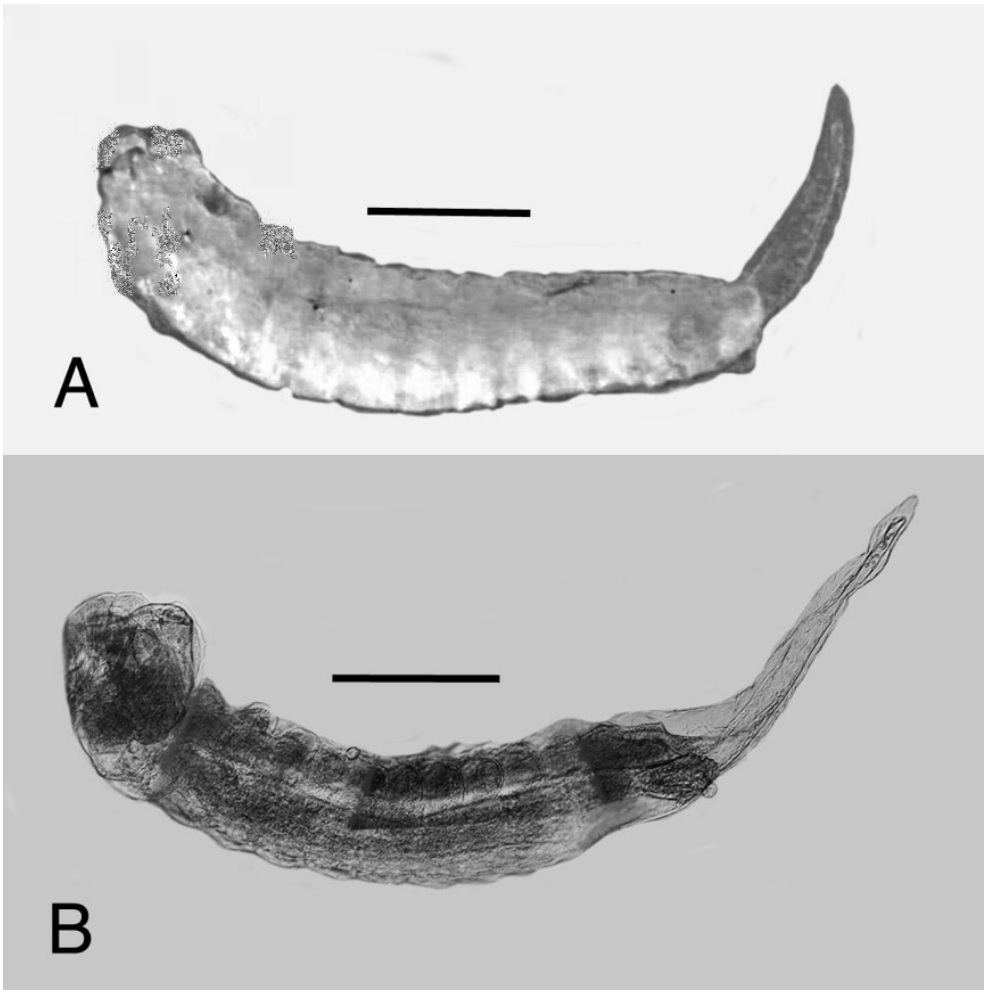

Fig. 1. First instar of Neoneurinae. **A.** Specimen from a worker ant of *Formica polyctena* in the Bidstrup Forests, Denmark. Scale bar = 280 μm. **B.** *Elasmosoma michaeli* from the Western North American worker ant, *Formica obscuriventris clivia*. Scale bar = 224 μm. **[**Første larvestadie af Neoneurinae. **A.** Species fra *Formica polyctena* arbejder i Bidstrupskovene, Danmark. Målestok = 280 μm. **B.** *Elasmosoma michaeli* fra en arbejder af den Nordamerikanske, *Formica obscuriventris clivia*. Målestok = 224 μm.**]**

The Danish Neoneurinae isolated from *F. polyctena* has similar morphological features to those of first instar larvae of *E. michaeli* (Fig. 1). It is not certain whether the Danish specimen belongs to the genus *Elasmosoma* or *Neoneurus*, however the presence of a dorsal anus in both specimens suggests that the Danish Neoneurinae isolated from *F. polyctena* and *E. michaeli* are congeneric. First instar larvae of many braconids have the anus on the ventral side of the body (Shaw *et al*., 2001). Unfortunately, first instar larvae of *Neoneurus* are unknown and cannot be compared with the Danish specimen or the North American *Elasmosoma michaeli*.

The large mandibles of first instar neoneurine larvae are also used to destroy other parasites present in the ant's hemocoel (Shaw *et al*., 2001; Poinar, 2004). Cysts of the digenean fluke, *Dicrocoelium dendriticum* (Rudolphi 1819) which are known to develop inside the body cavity of *F. polyctena* workers, would be susceptible to attacks by neoneurine first instar larvae. In addition, *D. dendriticum* infection manipulates ants to cling motionless to vegetation with its mandibles (Botnevik *et al*., 2016) leaving the ant vulnerable for wasp attack. Thus, if there was a high population of wasp larvae, they could be beneficial in lowering fluke populations.

Several species of *Elasmosoma* , including *E. luxemburgense* Wasmann, 1909, *E. berolinense* Ruthe, 1858 and *E. depressum* van Achterberg & Koponen, 2003 occur in Europe and populations of these species are associated with various ant genera and species (Bengtsson, 1918; Huddleston, 1976; van Achterberg & Koponen, 2003).

Bengtsson (1918) indicated that adult *Elasmosoma berolinense* have been observed from *Formica rufa* anthills in Geelskov, Denmark. However, no reference or further information was supplied, and, to our knowledge, no voucher specimens were deposited at the time, thus this reference is unsupported. Another reason this locality information is questionable is because in his revision of the genus *Elasmosoma*, Huddleston (1976) gave no indication that this genus had been reported in Denmark. In addition, Bengtsson (1918) did not report ants parasitized by larvae of either Elasmosoma or Neoneurus. Thus, the present study is the first definite indication that neoneurine braconids parasitize *Formica* ants in Denmark.

Associations between neoneurine braconids and ants have been in existence for at least 40 million years, as indicated by a mature neoneurine larva exiting from an ant in Eocene Baltic amber (Poinar and Miller, 2002). Also Brues (1933) described an adult neoneurine in Baltic amber as *Elasmosomites primordialis* Brues 1933. These reports indicate that ant parasitism by neoneurines was well established in the Eocene. This association could extend back to the Cretaceous since a case of endoparasitism of a Cretaceous adult weevil by a euphorine wasp (Hymenoptera: Braconidae) was recently reported. The subfamily Euphorinae is considered to be a sister group to the Neoneurinae but attack adult weevils rather than adult ants (Poinar and Shaw, 2016).

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Litterature

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