The European birch sawfly, *Arge pullata* (Hymenoptera: Argidae), in Sweden, and the first national record of its parasitoid *Scolobates testaceus* (Hymenoptera: Ichneumonidae)

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Anderbrant, O. & Broad, G.R.: The European birch sawfly, *Arge pullata* (Hymenoptera: Argidae), in Sweden, and the first national record of its parasitoid *Scolobates testaceus* (Hymenoptera: Ichneumonidae). **[Blåsvarta björkstekeln, *Arge pullata* (Hymenoptera: Argidae), i Sverige och första fyndet i landet av dess parasitoid *Scolobates testaceus* (Hymenoptera: Ichneumonidae).]** – Entomologisk Tidskrift 140 (1): 59–64. Uppsala, Sweden 2019. ISSN 0013-886x.

The European birch sawfly *Arge pullata* (Zaddach) was found for the first time in Sweden in the early 2000s. According to a report in the local newspaper it was present on the Falsterbo peninsula, Skåne province, from 2000 at the latest, and in the following years a number of records were reported from the same restricted area. Subsequently it has expanded its range in southern Sweden. It is unusual that a sawfly receives public attention, but in the case of this species its presence is of general interest because of the toxic properties of its larvae, which can be consumed by cattle and pets. Here we give a short description of the biology of the species, its spread in southern Sweden, and report the first record in Sweden of its parasitoid *Scolobates testaceus* Morley, which is also the first record of *S. testaceus* from *A. pullata*. We speculate that this and possibly other natural enemies have attenuated the spread and build-up of large populations, which were feared when the species was first detected in the country.

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Arge pullata (Zaddach) belongs to the second largest sawfly family, Argidae, with around 800 described species (Smith 1993). Most species in the family feed on deciduous trees and can occasionally cause considerable damage. In Europe, other *Arge* species have received more attention, although *A. pullata* defoliated large areas in Pommern (modern Germany and Poland) in 1876–1878 (Pschorn-Walcher 1982). When the species was recorded for the first time in Sweden in the early 2000s, it induced worries about future possible outbreaks and about effects caused by its poisonous larvae. Here we briefly describe the biology and toxicity of the species, its spread in Sweden, and report the first record of a parasitoid new to Sweden and new to *A. pullata*.

Biology

The female oviposits in the middle of the summer on birch leaves and the larvae feed during late summer to early autumn (Fig. 1). They then leave the trees and spin a cocoon in the litter layer, where they spend the winter. In late spring and early summer the large, dark, rather metallic-looking adults (Fig. 2) emerge from the cocoons

Figure 1. Larvae of *Arge pullata* feeding on birch August 5, 2005. Photo: Olle Anderbrant.

Larver av *Arge pullata* som äter på björk, 5 augusti 2005. Foto: Olle Anderbrant.

Figure 2. Female *Arge pullata* (from the Netherlands, Natural History Museum specimen NHMUK010636226). Scale bar = 10 mm.

Hona av *Arge pullata* (från Nederländerna). Skala = 10 mm.

and soon they look for mates. Mating can take place on the surfaces of leaves in the undergrowth vegetation (e.g. on blackberry or ground elder, which were both common at some of the most infested sites), but the means by which males and females find each other remain unknown. Attempts to identify sex attractants (pheromones), which are highly effective in other sawfly groups (Anderbrant 1993, 1999), have so far been unsuccessful.

Toxicity

On their way to a site for cocoon spinning, the larvae may spend some time in the ground vegetation, for instance grass, and this is where grazing (or just curious) animals may incidentally consume them. The poison is probably produced *de novo* by the larvae (Oelrichs et al. 1999), obviously for protection purposes; birds do not feed on them. The toxic substance is an octapeptide, lophyrotomin (Kannan et al. 1988), and a number

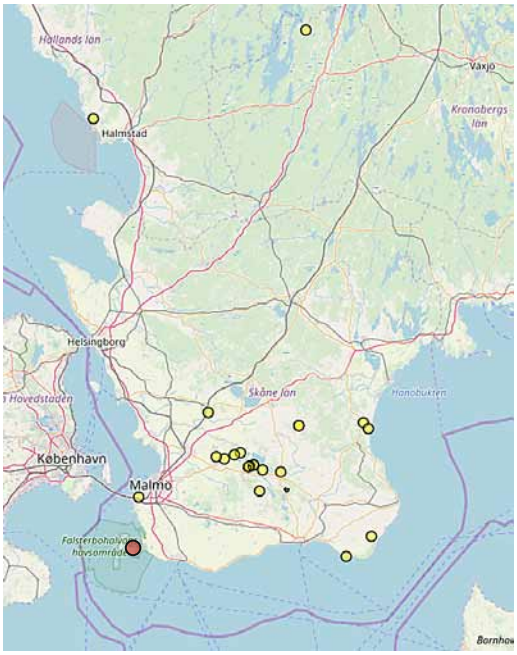

Figure 3. Records (yellow dots) of *Arge pullata* outside the Falsterbo peninsula (red dot) reported to Artportalen (the Swedish Species Observation System) and validated until May 14, 2019.

Observationer (gula prickar) av *Arge pullata* utanför Falsterbohalvön (röd prick) rapporterade till Artportalen och validerade t.o.m. 14 maj 2019.

of veterinary investigations have been carried out to reveal mechanisms behind the toxicity and to possibly develop a serum against its severe effects on domestic animals (Olaechea et al. 1991, Thamsborg et al. 1996). The same compound has been isolated from other sawfly species and toxic effects, sometimes even lethal, have been documented for various domestic animals (Tessele et al. 2012). Additional information about the toxicity to grazing animals can be found at the National Veterinary Institute (2019).

Distribution and occurrence in Sweden

Arge pullata is reported from most of continental Europe, from France in the west and Italy and the northern Balkans in the south, to Finland and Russia in the north (Fauna Europea 2018). Its distribution continues east through Siberia to China and Japan (Li et al. 2012). The species was first reported from Denmark in 1972 and assumed to have been introduced from the Baltic area (Kannan et al. 1988). It is not known exactly when the European birch sawfly entered Sweden, or how it happened. In the local newspaper Sydsvenskan from 2002 (Gustafson 2002), there are strong indications, based on defoliated birch trees, that it occurred on the Falsterbo peninsula at least from 2000. During the following years the population increased and spread. A survey mainly based on visible defoliation was carried out by OA on September 18, 2006, and it was clear that the sawfly was present from the very south of the peninsula to the southern part of the city Skanör. No signs of infestation were observed east of the heath Ljungen at that time. After 2006 the species spread east and north and on the map linked from the website of the Swedish Forest Agency (2017) the increase in range until 2016 can be followed. The few validated records of those reported to the Swedish Species Observation System (Artportalen 2019) are shown in Fig. 3.

Cocoon sampling and emerging adults

In order to obtain material for studies of the potential pheromone of the sawfly, cocoons were collected from the litter at various sites around Falsterbo peninsula from 2004 until 2009. In total over 1500 cocoons were found, 818 females (distinguished by being considerably larger than male cocoons, as is the case for many other sawflies) and 758 males, thus a quite even sex ratio. During the first three years only *A. pullata* emerged from the cocoons, e.g. 197 adults from 510 cocoons collected in April–June 2006. However, from each of four female cocoons sampled on April 20, 2007, an unidentified ichneumonid parasitoid emerged. An additional seven parasitoids emerged from cocoons (male as well as female) sampled on May 21, 2008, and on June 23, 2009. It turned out to be a difficult task to identify the species, and they ended up at the Natural History Museum in London where GB could verify the first record of *Scolobates testaceus* Morley from Sweden.

Scolobates testaceus* Morley, a new species to Sweden and a new parasitoid of *A. pullata

Scolobates testaceus (Fig. 4) was described from India (Morley, 1913) and has since been found in Taiwan, China, Japan and probably South

Korea (see below) (Yu et al. 2016). With such a distant range, *S. testaceus* seems an unlikely species to arrive in Sweden. However, parts of its range are temperate and it is possible that it is a trans-Palaearctic species, as the ranges of most Ichneumonidae are poorly known. Or the presence of *S. testaceus* in Sweden could provide a clue to the origins of its host.

The genus *Scolobates* can be recognised by the lack of the occipital carina dorsally, the densely pectinate tarsal claws, first metasomal tergite flat, shiny and rectangular, and in most specimens with the epipleurae conspicuously protruding. Most species, including *S. testaceus*, have a conspicuous medial tooth on the clypeus (Fig. 5). As with other species of the subfamily Ctenopelmatinae, the fore tibia has a small 'tooth' on the outer, apical margin.

Scolobates testaceus is rather easily identified by the colour pattern (basically dull yellow with black markings, but with the mesoscutum largely pale red), the strongly rounded, protruding scutellum (Fig. 5) and by the expanded hind tarsus (Fig. 6), a combination not shared by any other known species of *Scolobates*. Sexes seem to be very similar. However, there has been some confusion over the identity of this species. Lee et al. (2006) illustrate and describe a different species under the name *S. testaceus*; the characters used to diagnose '*Scolobates longicornis*' in that paper actually fit *S. testaceus* better and it is likely that the two species have been transposed. Specimens have been deposited in the Biological Museum, Lund and in the Natural History Museum, London. The holotype of *S. testaceus* is in the NHM and has been examined.

Figure 4. *Scolobates testaceus* Morley, lateral view. Photo: G. Broad (NHMUK).

Scolobates testaceus Morley, från sidan. Foto: G. Broad (NHMUK).

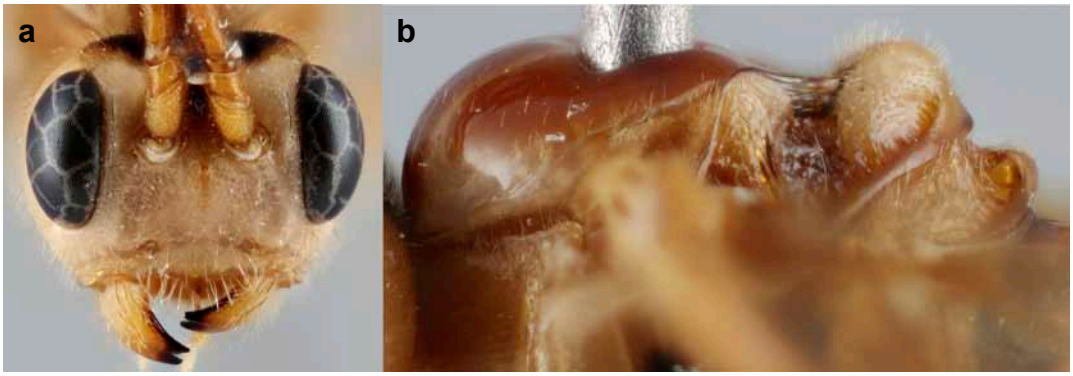

Figure 5. – a) Head of *Scolobates testaceus* in frontal view, showing large clypeal tooth and clypeus poorly differentiated from face; – b) mesoscutum and scutellum in lateral view, head to the left. Photos: G. Broad (NHMUK).

a) Huvud av *Scolobates testaceus* framifrån, som visar den stora tanden på clypeus och att clypeus är svagt skilt från ansiktet; – b) mesoscutum och scutellum från sidan, huvud till vänster. Foton: G. Broad (NHMUK).

Figure 6. *Scolobates testaceus*: – a) propodeum and first metasomal segment, – b) hind tarsus, – c) hind tarsal claw. Photos: G. Broad (NHMUK).

Scolobates testaceus: – a) propodeum och första metasomala segmentet, – b) bakre tars, – c) bakre tarsens klo. Foton: G. Broad (NHMUK).

Hosts of the 13 described *Scolobates* species are poorly known, with only the Holarctic *S. auriculatus* (Fabricius) having been reared previously, from several species of *Arge* (Pchorn-Walcher & Kriegl 1965). It is therefore impossible to know whether *S. testaceus* is likely to be host-specific, parasitizing only *Arge pullata*, or whether this is merely one of several potential hosts. Several species of parasitoids (Hymenoptera and Diptera) were reared from *A. pullata* cocoons in Hubei Province, China (Li et al. 2012), but *S. testaceus* was not among them. Most, if not all of the species reported by Li et al. (2012) are likely to be rather generalist parasitoids of the cocoons, whereas *S. testaceus* will be a larval parasitoid, by analogy with other species of Ctenopelmatinae, presumably completing development in the *Arge* larva after the host has spun its cocoon.

Conclusions

The European birch sawfly has spread rapidly east and north from its original area in the very southwestern corner of the country since 2006 (Fig. 3). At the same time, the feared outbreak with widespread heavy defoliation and an increased incidence of cattle poisoning has not taken place. One reason for this modest impact might be the appearance of the parasitic wasp and possibly other parasitoids.

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References

Anderbrant, O. 1993. Pheromone biology of sawflies. – In: Wagner, M.R. & Raffa, K.F. (eds.). Sawfly Life History Adaptations to Woody Plants: 119–154. Academic Press, San Diego.

Anderbrant, O. 1999. Sawflies and seed wasps. – In: Hardie, J. & Minks, A.K. (eds.). Pheromones of Non-Lepidopteran Insects Associated with Agricultural Plants: 199–226. CAB International, Wallingford.

Fauna Europea Secretariat. 2018. – https://fauna-eu.org/cdm_dataportal/taxon/9b319fb2-ef89-477e-ab17-ebd8384c0b6a

Artportalen. 2019. – https://www.artportalen.se/

Gustafson C. 2002. Giftig skönhet. – Sydsvenskan (Sydsvenska Dagbladet Snällposten) 6 sept 2002. https://www.sydsvenskan.se/2002-09-06/giftig-skonhet

Kannan, R., Oelrichs, P.B., Thamsborg, S.M. & Williams, D.H. 1988. Identification of the octapeptide lophyrotomin in the European birch sawfly *Arge pullata*. – Toxicon 26: 224–226.

Lee, J.-W., Suh, K.-I., Choi, J.-K. & Kim, C.-H. 2006. Taxonomic study of the genus *Scolobates* (Hymenoptera: Ichneumonidae: Ctenopelmatinae) from Korea. – Korean J. Syst. Zool. 22: 179–184.

Li, T., Sheng, M.-L., Sun, S.-P. & Luo, Y.-Q. 2012. Parasitoids of the sawfly, *Arge pullata*, in the Shennongjia National Nature Reserve. J. Insect Sci. 12: 97. DOI: https://doi.org/10.1673/031.012.9701

Morley, C. 1913. The fauna of British India including Ceylon and Burma, Hymenoptera, Vol.3. Ichneumonidae. – British Museum. London.

National Veterinary Institute. 2019. Björkstekelförgiftning hos idisslare. – https://www.sva.se/djurhalsa/notkreatur/endemiska-sjukdomar-notkreatur/forgiftningar-notkreatur/bjorkstekel-notkreatur

Oelrichs, P.B., MacLeod, J.K., Seawright, A.A., Moore, M.R., Ng, J.C., Dutra, F., Riet, C.F., Mendez, M.C. & Thamsborg, S.M. 1999. Unique peptides isolated from sawfly larvae in three continents. – Toxicon 37:537–544.

Olaechea, F.V., Thamsborg, S.M., Christensen, N.O., Nansen, P. & Robles, A. 1991. Interference with sawfly (*Arge pullata*) poisoning in *Fasciola hepatica*-infected lambs. – J. Comp. Pathol. 104: 419– 433

Pschorn-Walcher, W. 1982. Unterordnung Symphyta, Pflanzenwespen. – In: Schwenke, W. (ed.). Die Forstschädlinge Europas. IV: Hautflügler und Zweiflügler: 4–234. Paul Parey Verlag, Berlin.

Pschorn-Walcher, H. & Kriegl, M. 1965. Zur kenntnis der Parasiten der Bürsthorn-Blattwespen der Gattung *Arge* Schrank (Hymenoptera: Argidae). – Z. Angew. Entomol. 56: 263–275.

Smith, D.R. 1993. Systematics, life history, and distribution of sawflies. – In: Wagner, M.R. & Raffa, K.F. (eds.). Sawfly Life History Adaptations to Woody Plants: 3–32. Academic Press, San Diego.

Swedish Forest Agency. 2017. Blåsvart björkstekel. – https://www.skogsstyrelsen.se/bruka-skog/skogsskador/insekter/blasvart-bjorkstekel/

Tessele, B., Brum, J.S., Schild, A.L., Soares, M.P. & Barros, C.S.L. 2012. Sawfly larval poisoning in cattle: Report on new outbreaks and brief review of the literature. – Pesq. Vet. Bras. 32: 1095–1102.

Thamsborg, S.M., Jørgensen, R.J., Brummerstedt, E. & Bjerregard, J. 1996. Putative effect of silymarin on sawfly (*Arge pullata*)-induced hepatotoxicosis in sheep. – Vet. Hum. Toxicol. 38: 89–91.

Yu, D.S., Achterberg, C. van & Horstmann, K. 2016. Taxapad 2016, Ichneumonoidea 2015. – Database on flash-drive. www.taxapad.com, Nepean, Ontario, Canada.

Svensk sammanfattning

Den blåsvarta björkstekeln *Arge pullata* (Zaddach) hittades för första gången i Sverige i början av 2000-talet. Enligt uppgifter i lokalpressen fanns den på Falsterbohalvön i Skåne åtminstone från år 2000 och de följande åren inkom flera rapporter från samma område. Därefter har den spritt sig i södra Sverige. Det är ovanligt att en växtstekel får uppmärksamhet i media, men i fallet blåsvarta björkstekeln beror det på dess giftiga larver och att dessa kan konsumeras av boskap och husdjur. I denna artikel beskrivs kortfattat artens biologi och dess förekomst i Sverige. Några år efter artens första uppträdande noterades att kokonger ibland var parasiterade av en stekel, *Scolobates testaceus* Morley, som visade sig vara ny för landet och för första gången noterad från blåsvarta björkstekeln. En kort beskrivning av denna nya art för Sverige ges. Även om björkstekeln spritt sig de senaste tio åren har de befarade omfattande utbrotten uteblivet. En möjlig orsak till detta är just förekomsten av *S. testaceus* och eventuella andra naturliga fiender.