

New records of braconid wasps (Hymenoptera: Braconidae) from Denmark

Jonas Lutz¹, Simon Haarder², Mathias Fløe Holm³, Fons Verheyde⁴ & Cornelis van Achterberg⁵

¹ Ebbeskovvej 12, 4140 Borup, Denmark, e-mail: brac-ich@hotmail.com (corresponding author)

² Knudsskovvej 62, 4760 Vordingborg, Denmark, e-mail: simon.haarder@gmail.com

³ Hovhedevej 13, 8370 Hadsten, Denmark, e-mail: mathias@bio-con.dk

⁴ Aartshertoginnestraat 58/01, B-8400 Ostend, Belgium, e-mail: fonsverheyde@hotmail.com

⁵ Naturalis Biodiversity Center, Darwinweg 2, 2333 CR Leiden, The Netherlands, e-mail: kees@vanachterberg.org

Abstract

This paper presents new records of braconid wasps (Hymenoptera: Braconidae) from Denmark. The records span a period of 15 years (2007 to 2022) and have been obtained through a variety of methods: hand-collecting, light trapping and rearing. In total, 59 species are reported as new to Denmark. In addition, a new lepidopteran host, *Phyllonorycter esperella* (Gracillariidae), is reported for *Pholetesor elpis*. A general comment on the species list is given and rare or noteworthy species are discussed in more detail.

Sammendrag

I denne artikel præsenteres nye fund af braconide hvepse (Hymenoptera: Braconidae) fra Danmark. Fundene strækker sig over en 15-årig periode (2007–2022) og er indsamlet ved flere forskellige metoder, herunder manuel fangst i felten, ved lyslokning samt klækning. I alt meldes 59 arter som nye for Danmark. En ny værtsrelation meldes ydermere for arten *Pholetesor elpis*, nemlig styitemøllet *Phyllonorycter esperella*. Der gives en generel kommentering af artslisten, mens sjældne og bemærkelsesværdige fund bliver uddybet.

Introduction

Braconidae Nees, 1811 (Hymenoptera: Ichneumonoidea) is a cosmopolitan family of nearly exclusively parasitoid wasps and is one of the largest families of insects. The family consists of more than 21,200 described species arranged into about 40 subfamilies (Yu et al., 2016; Chen & van Achterberg, 2019), but the actual species number is estimated to be in the range of 42–70,000 species (Dolphin & Quicke, 2001; Jones et al., 2009; Chen & van Achterberg, 2019). The majority of species are endo- or ectoparasitoids of other insects. In some subfamilies, e.g. Braconinae and Euphorinae, the host range covers several insect orders, whereas others are more specialized. Alysiniinae and Opiinae are associated with Diptera, while Aphidiinae parasitize aphids (Hemiptera), and Rogadinae s. str. employ Lepidoptera as hosts and mummify their host larva (Wharton, 1993; Quicke, 2015). Species with narrow host ranges (mono- or oligophagous) are used in biocontrol to regulate insect pest species.

In Denmark, braconids have been investigated in a variety of contexts during the 20th and 21st century. Two subfamilies, Opiinae and Alysiniinae, have been studied in detail. Opiinae was revised by Fischer (1964), who described several species new to science based on Danish material: *Opius mutus*, *O. peterseni* and *O. schlicki*. Thorkild Munk and Javier Peris-Felipo – from Denmark and Spain, respectively – collaborated on a number of papers dedicated to Alysiniinae (e.g. Munk et al., 2013; Peris-Felipo et al., 2014), culminating in a catalogue of the

subfamily in Denmark, including the description of several new species (Peris-Felipo et al., 2016). Other subfamilies have been investigated more sporadically. A key to the braconid genera (and Hymenoptera in general) found near water was published by Henriksen (1919). The list includes species occurring in Denmark and Europe, and hosts are included when known. The publication is outdated from a taxonomical point of view, but still contains important biological observations and notes on occurrences of several Danish species. Van Achterberg (1982) provided an overview of the type species (spanning four subfamilies) described by the influential Danish entomologist Johan Christian Fabricius (1745–1808). The recently deceased expert of Braconinae, Dr. J. Papp, incorporated material from Denmark in his studies and revisions. He described several species new to science from material partly or wholly collected in Denmark, and named one of the species *Bracon (Glabrobracon) munki* after the collector, Thorkild Munk (Papp, 2011). A number of Euphorinae species from the genera *Meteorus* and *Zele* were added to the Danish fauna list as a result of the revision of the tribe Meteorini in Fennoscandia (Stigenberg & Ronquist, 2011). Likewise, several species of *Aleiodes* (Rogadinae), which had not previously been documented from Denmark, were reported in the recently published first two parts of the revision of the European species (van Achterberg & Shaw, 2016; van Achterberg et al., 2020).

The effect of braconids on pest species has also been studied in Denmark. The complex of natural enemies associated with pest tortricids (Lepidoptera) in Danish plantations was studied by Esbjerg (1972) and Münster-Swendsen (1979, 1989). Here, each host species produced a variety of ichneumonids and typically only a single species of Braconidae. The braconids were, however, a dominant part of the parasitoid complex and would account for a significant part of host mortality in all three host species as larval endoparasitoids. In a later study (Nielsen, 1994), the wingless braconid *Chasmodon apterus* (Nees, 1812) was the most frequently found parasitoid of different dipteran larvae in grass stems in a farmland setting, accounting for 67.6% of all reared specimens and almost exclusively parasitizing the agriculturally important *Oscinella frit* (Linnaeus, 1758).

Finally, a few papers have dealt with Braconidae in relation to non-pest species in a natural setting in Denmark. Overgaard (1989) studied the wasp fauna associated with burnets (Lepidoptera: Zygaenidae) in Mols (Jutland) and reared specimens of the primary parasitoid *Cotesia zygaenarum* (Marshall, 1885) from *Zygaena lonicerae* (Scheven, 1777). Gasque et al. (2018) reported a new association between Neoneurini (Euphorinae), a well-known group of ant parasitoids, and the ant *Formica polyctena* (Förster, 1850): the first instar larva recovered from the body of a worker ant in northern Zealand was – tentatively – referred to the genus *Elasmosoma* Ruthe, 1858. The study provides the first documented record of neoneurine parasitoids of ants in Denmark (Gasque et al., 2018). Recently, *Opius pulchriceps* Szepliget, 1898 was reported from the island of Bornholm (eastern Denmark) as a larval endoparasitoid of the leaf-miner *Phytomyza ilicis* Curtis, 1846 (Haarder, 2021; records also included here for the sake of completeness).

We have investigated the Danish braconid fauna, dating back to 2007, in a variety of habitats and localities throughout the country. This paper documents the findings of 59 species hitherto not reported from Denmark in the literature (Yu et al., 2016, and other faunistic literature).

Methods

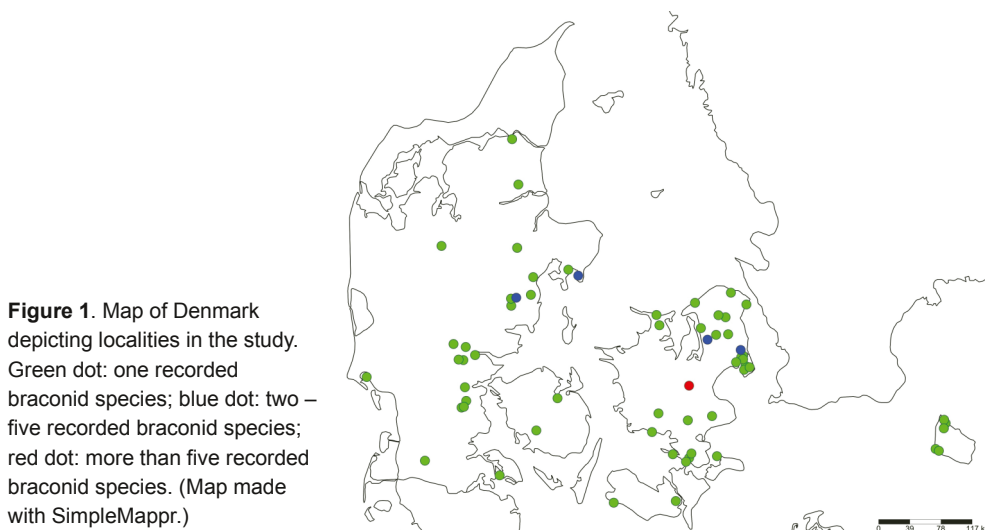
The species presented in this study have, in general, been obtained using three different methods:

- 1) Capturing free-flying specimens in low vegetation, on leaves or trees using a sweep net or beating tray, or directly into transparent containers – “caught by hand”.
- 2) Attracting nocturnal species using a UV-lamp (Osram ULTRA VITALX 300W E27) in the first authors’ garden in Ebbeskov (55°29'44.7"N 11°56'10.3"E), intermittently since 2017. The UV-lamp was active from the onset of dusk for the following one or two hours.
- 3) Rearing of specimens from host species. Parasitized hosts were isolated, placed in a rearing container and kept indoors until the emergence of adults.

All species records have been verified by an expert and specimens are deposited in the collection of the expert responsible for the identification. Exceptions are specimens of *Opius pulchriceps* and *Polemochartus melas*. They are currently stored in the personal collection of the second author but will be deposited in the collection of the Natural History Museum of Denmark (NHMD). Furthermore, specimens of *Aleiodes apicalis*, *Rogas luteus*, *Meteorus ruficeps*, *Earinus elator* and *Leiophron fascipennis* collected by the third author are stored in the personal collection of the latter. Danish specimens attributed to some species reported here are found in NHMD (Lars Vilhelmsen, NHMD, pers. comm.). We have not scrutinized this material and will therefore only include the field records; the species in question are supplemented with a short note in the Results section.

Results

A total 59 braconid species are new to the fauna of Denmark. They belong to the following subfamilies: Agathidinae (3), Alysiinae (4), Aphidiinae (4), Brachistinae (5), Braconinae (5), Cheloninae (1), Doryctinae (5), Euphorinae (7), Helconinae (3), Macrocentrinae (5), Microgastrinae (4), Opiinae (2), and Rogadinae (11). The records are from 2007–2022, distributed across 64 localities (Fig. 1). The species are presented below, arranged by subfamily (in alphabetical order). Photographed specimens are marked by an asterisk.



SUBFAMILY AGATHIDINAE HALIDAY, 1833

GENUS *AGATHIS* LATREILLE, 1804

Agathis varipes Thomson, 1895: 1♀, Ebbeskov (Køge), 55°29'59.6"N 11°56'15.4"E (precision: 50 m), caught on *Cirsium* sp., 27.VII.2016, leg. J. Lutz, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

GENUS *EARINUS* WESMAEL, 1837

Earinus elator (Fabricius, 1804) (Fig. 2): 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), 01.V.2015, photo J. Lutz (not collected), det. K. van Achterberg; 1♂, Græse Bakkeby (Frederikssund), 55°51'41.4"N 12°04'08.2"E (precision: 15 m), 20.IV.2016, photo J. Lutz (not collected), det. K. van Achterberg; 1♀, Sonnerup Skov (Odsherred), 55°56'40.4"N 11°34'10.7"E (precision: 50 m), 01.IV.2017, photo B. Valeur and Lars H. Hansen (not collected), det. K. van Achterberg; 1♀* 1♂, Vissing (Favrskov), 56°21'57.3"N 10°00'18.7"E (precision: 50 m), caught by sweeping in vegetation, 25.III.2020, leg. M. F. Holm, det. Hilco Meijer & M. F. Holm; 1♂, Præstesø (Furesø), 55°46'31.8"N 12°20'22.9"E (precision: 15 m), 20.III.2022, photo K. Bertelsen (not collected), det. J. Lutz; 1♂, Nordskoven (Bornholm), 55°08'28.8"N 15°07'58.4"E (precision: 50 m), 21.III.2022, photo H. Dühmert (not collected), det. J. Lutz; 1♀, Vråby Hestehave (Stevns), 55°20'17.2"N 12°09'37.8"E (precision: 100 m), 10.IV.2022, photo F. M. Hansen (not collected), det. J. Lutz; 1♀, Iglemose (Bornholm), 55°07'42.5"N 14°56'36.7"E (precision: 15 m), 22.IV.2022, photo H. Dühmert (not collected), det. J. Lutz; 1♀ 1♂, Hørret Skov (Århus), 56°05'12.9"N 10°11'49.1"E (precision: 300 m), 04.IV.2023, photo J. Carter (not collected), det. J. Lutz.

Note: additional unverified specimens are present in NHMD.

GENUS *THEROPHILUS* (WESMAEL, 1837)

Therophilus tumidulus (Nees, 1812) (Fig. 3): 1♀*, Hylkehuse (Kolding), 55°29'08.5"N 9°25'06.1"E (precision: 200 m), caught by sweeping in vegetation, 5.VII.2017, leg. M. F. Holm, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.



Figure 2. *Earinus elator* (Fabricius, 1804), female, habitus.



Figure 3. *Therophilus tumidulus* (Nees, 1812), female, habitus.



Figure 4. *Polemochartus melas* (Giraud, 1863), male, habitus.

SUBFAMILY ALYSIINAE LEACH, 1815

GENUS *DINOTREMA* FÖRSTER, 1863

Dinotrema (*Synaldis*) *distractum* Nees, 1834: 1♂, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught in morning dew on car windshield, 08.VIII.2017, leg. J. Lutz, det. J. Peris Felipo.

GENUS *ORTHOSTIGMA* RATZEBURG, 1844

Orthostigma pusillum (Zetterstedt, 1838): 1♂, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 10.IX.2017, leg. J. Lutz, det. J. Peris Felipo.

GENUS *PHAENOCARPA* FÖRSTER, 1863

Phaenocarpa subruficeps Gurasashvili, 1983: 1♂, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 19.VI.2017, leg. J. Lutz, det. J. Peris Felipo.

GENUS *POLEMOCHARTUS* SCHULZ, 1911

Polemochartus melas (Giraud, 1863) (Fig. 4): 1♂*, Sønderstrand (Lolland), 54°44'28.8"N 11°05'23.6"E (precision: 50 m), reared from gall of *Lipara rufitarsis* (Diptera: Chloropidae) on *Phragmites communis* 02.IV.2020, coll. 19.III.2020, leg. S. Haarder, det. S. Haarder & K. van Achterberg.

SUBFAMILY APHIDIINAE HALIDAY, 1833

GENUS *APHIDIUS* NEES, 1818

Aphidius rosae Haliday, 1833: 1♀, Vejgård (Aalborg), 57°02'18.4"N 9°56'53.6"E (precision: 10 m), reared from mummified aphid (probably *Macrosiphum rosae*) on *Rosa rubiginosa* 05.VI.2016, coll. 04.VI.2016, leg. L. Sabroe, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

Aphidius setiger (Mackauer, 1961) (Fig. 5): 1♀* 1♂*, Ornebjerg (Vordingborg), 55°01'50.8"N 11°56'10.5"E, reared from mummified *Periphyllus* aphids (Hemiptera: Aphididae) on *Acer pseudoplatanus* 25.VI.2020, coll. 23.VI.2020, leg. S. Haarder, det. K. van Achterberg.



Figure 5. *Aphidius setiger* (Mackauer, 1961), male and female (above); host aphids (*Periphyllus*, below).

GENUS *DYSCRITULUS* HINCKS, 1943

Dyscritulus planiceps (Marshall, 1896): 1 pupa, Kastrup Overdrev (Næstved), 55°19'06.7"N 11°35'31.6"E (precision: 200 m), mummified *Drepanosiphum platanoides* aphid (Hemiptera: Drepanosiphidae) on *Acer pseudoplatanus*, 19.VII.2015, photo Y. Engmann (specimen not collected), det. S. Haarder, S. Madsen & K. van Achterberg; 1 pupa, Kristiansholm Plantage (Næstved), 55°11'55.0"N 11°31'11.2"E (precision: 200 m), mummified *Drepanosiphum platanoides* aphid (Hemiptera: Drepanosiphidae) on *Acer pseudoplatanus*, 12.VIII.2015, photo Y. Engmann (specimen not collected), det. S. Haarder, S. Madsen & K. van Achterberg; 1 pupa, Seden (Odense), 55°24'56.2"N 10°27'29.1"E (precision: 200 m), mummified *Drepanosiphum platanoides* aphid (Hemiptera: Drepanosiphidae) on *Acer pseudoplatanus*, 17.VIII.2015, photo Y. Engmann (specimen not collected), det. S. Haarder, S. Madsen & K. van Achterberg; 1 pupa, Landbohøjskolen (Frederiksberg), 55°41'12.0"N 12°32'35.1"E, mummified *Drepanosiphum platanoides* aphid (Hemiptera: Drepanosiphidae) on *Acer pseudoplatanus*, 30.X.2015, photo and det. S. Haarder (specimen not collected).

GENUS *PARALIPSIS* FÖRSTER, 1863

Paralipsis planus van Achterberg, 2016: 1 imago, Krogenlund Mose (Egedal), 55°49'08.6"N 12°14'23.6"E (precision: 1000 m), under bark of fallen spruce tree (*Picea* sp.), 15.IV.2010, photo O. Bidstrup (specimen not collected), det. K. van Achterberg.

SUBFAMILY BRACHISTINAE FÖRSTER, 1863

GENUS *EUBAZUS* NEES, 1814

Eubazus lepidus (Haliday, 1835): 1♂, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 28.VI.2022, leg. J. Lutz, det. K. van Achterberg.

Eubazus nigroventralis van Achterberg, 2003 (Fig. 6): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 20.VII.2016, leg. J. Lutz, det. K. van Achterberg.



Figure 6. *Eubazus nigroventralis* van Achterberg, 2003, female, habitus.

GENUS *DIOSPILUS* HALIDAY, 1833

Diospilus abietis (Ratzeburg, 1844): 1♀, Knudshoved Odde (Vordingborg), 55°03'20.2"N 11°45'13.3"E (precision: 1000 m), specimen found indoors, 13.V.2020, leg. S. Haarder, det. K. van Achterberg.

Note: The specimen was probably brought in with leaf litter material from nearby Knudsskov. Additional unverified specimens are present in NHMD.

GENUS *SCHIZOPRYMNUS* FÖRSTER, 1862

Schizoprymnus pullatus (Dahlbom, 1833): 1♀, Enghaven (Copenhagen), 55°39'51.2"N 12°32'34.4"E (precision: 10 m), caught by hand, 4.VII.2022, leg. J. Lutz, det. K. van Achterberg.

GENUS *VADUMASONIUM* KAMMERER, 2006

Vadumasonium vardyorum van Achterberg & Broad, 2013: 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 4.VII.2022, leg. J. Lutz, det. K. van Achterberg.

SUBFAMILY BRACONINAE NEES, 1812

GENUS *ATANYCOLUS* FOERSTER, 1863

Atanycolus sp.: 1♂, Onsbæk, outside Rønne (Bornholm), 55°04'39.6"N 14°44'32.4" (precision: 15 m), 30.VI.2021, photo J. Lutz (not collected), det. K. van Achterberg; 1♀, Ammetofte Mose (Egedal), 55°43'22.9"N 12°18'11.3"E (precision: 100 m), 27.VI.2022, photo P. Ulrik (not collected), det. K. van Achterberg.

GENUS *BRACON* FABRICIUS, 1804

Bracon caudiger Nees, 1834: 1♀, Moseparken (Copenhagen), 55°72'31.7"N 12°51'62.3"E (precision: 15 m), caught by hand, 25.VIII.2015, leg. J. Lutz, det. J. Papp.

Bracon subrugosus Szépligeti, 1901: 1♀, Vestamager (Copenhagen), 55°37'16.2"N 12°34'14.6"E (precision: 50 m), caught by hand, 14.IX.2015, leg. J. Lutz, det. J. Papp.

GENUS *HABROBRACON* ASHMEAD, 1900

Habrobracon stabilis (Wesmael, 1838): 1♀, Kongenshus Mindepark (Viborg), 56°22'40.4"N 9°09'18.1"E (precision: 200 m), caught in vegetation, 23.III.2019, leg. L. Kjær-Thomsen & L. Thomas, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.



Figure 7. *Coeloides forsteri* Haeselbarth, 1967, female, habitus.



Figure 8. *Dendrosoter protuberans* (Nees, 1834), male, habitus.

Habrobracon variegator (Spinola, 1808): 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 31.VIII.2016, leg. J. Lutz, det. J. Papp.

SUBFAMILY CHELONINAE FÖRSTER, 1863

GENUS *ASCOGASTER* WESMAEL, 1835

Ascogaster cf. *reticulata* Watanabe, 1967: 1♂, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 20.VII.2016, leg. J. Lutz, det. K. van Achterberg.

SUBFAMILY DORYCTINAE FÖRSTER, 1863

GENUS *COELOIDES* WESMAEL, 1838

Coeloides forsteri Haeselbarth, 1967 (Fig. 7): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, caught by hand, 22.VI.2021, leg. J. Lutz, det. K. van Achterberg.

GENUS *DENDROSOTER* WESMAEL, 1838

Dendrosoter protuberans (Nees, 1834) (Fig. 8): 3♂, Hvidovre (Hvidovre), 55°38'43.0"N 12°27'51.0"E (precision: 50 m), examining exit holes of *Scotylus mali* on *Pyrus communis*, 30.VI.2016, photo J. Ravn Jensen (specimens not collected), det. J. Ravn Jensen & K. van



Figure 9. *Hecabolus sulcatus* Curtis, 1834, female, habitus.



Figure 10. *Chrysopophthorus hungaricus* (Zilahi-Kiss, 1927), female, habitus.

Achterberg; 1♂*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 14.IX.2020, leg. J. Lutz, det. K. van Achterberg; 1♂ 1♀, Svinninge (Odsherred), 55°52'46.5"N 11°36'10.7"E (precision: 30 m), 17.II.2023 & 25.II.2023, photo I. Jelbech (not collected), det. J. Lutz.

Note: additional unverified specimens are present in NHMD.

GENUS *DORYCTES* HALIDAY, 1836

Doryctes heydenii Reinhard, 1865: 2♀, Svinninge (Odsherred), 55°52'46.5"N 11°36'10.7"E (precision: 30 m), 2.III.2022 & 7.III.2022, photo I. Jelbech (not collected), det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

GENUS *HECABOLUS* CURTIS, 1834

Hecabolus sulcatus Curtis, 1834 (Fig. 9): 1♀*, Snekkersten (Helsingør), 56°00'38.6"N 12°34'48.7"E (precision: 50 m), caught by hand, 18.VIII.2015, leg. J. Lutz, det. K. van Achterberg; 1♀, Vestereng (Århus), 56°10'58.0"N 10°11'06.4"E (precision: 50 m), 21.VI.2017, photo J. Ravn Jensen (specimen not collected), det. Gavin Broad.

Note: additional unverified specimens are present in NHMD.

GENUS *SPATHIUS* NEES, 1818

Spathius exarator (Linnaeus, 1758): 1♂, Egedam (Hillerød), 55°55'49.1"N 12°20'45.9"E (precision: 50 m), caught by hand, 15.IX.2015, leg. J. Lutz, det. K. van Achterberg; 1♀, Udlejre (Egedal), 55°47'18.1"N 12°08'36.1"E (precision: 10 m), caught by hand, 8.VII.2017, leg. J. Lutz, det. K. van Achterberg; 1♀, Mårslet (Århus), 56°04'17.9"N 10°09'32.9"E (precision: 10 m), 7.X.2021, photo Niels Jørgen Rosenkrants (specimen not collected), det. Jonathan Vogel; 1♀, Enghaven (Copenhagen), 55°39'51.2"N 12°32'34.4"E (precision: 10 m), caught by hand, 27.X.2021, leg. J. Lutz, det. Jonathan Vogel; 1♀, Bøghoved (Haderslev), 55°15'01.0"N 9°27'52.8"E (precision: 50 m), 12.III.2022, photo D. Klindt (not collected), det. J. Vogel; 1♀, Svinninge (Odsherred), 55°52'46.5"N 11°36'10.7"E (precision: 30 m), 31.V.2022, photo I. Jelbech (not collected), det. J. Vogel; 1♀, Levring (Silkeborg), 56°18'44.9"N 9°28'59.3"E (precision: 30 m), 14.IX.2022, photo J. Østergaard, det. J. Lutz.

Note: additional unverified specimens are present in NHMD.

SUBFAMILY EUPHORINAE FÖRSTER, 1863

GENUS *CHRYSOPOPTHORUS* GOIDANICH, 1948

Chrysopophthorus hungaricus (Zilahi-Kiss, 1927) (Fig. 10): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, attracted to light, 26.VI.2019, leg. J. Lutz, det. K. van Achterberg; 1♀, Tømmerup (Tårnby), 55°36'47.1"N 12°36'58.6"E (precision: 100 m), caught by hand, 02.V.2021, leg. L. Thomas and L. Kjær-Thomsen, det. K. van Achterberg; 1♂, Allerslev (Lejre), 55°36'08.9"N 11°58'05.0"E (precision: 30 m), 20.IV.2022, photo. S. P. Pinnerup (not collected), det. S. Haarder; 1♂, Arnøje (Stevns), 55°19'07.2"N 12°17'20.3"E (precision: 15 m), attracted to light, 17.VIII.2022, leg. P. Andersen, det. S. Haarder.

GENUS *LEIOPHRON* NEES, 1818

Leiophron fascipennis (Ruthe, 1856) (Fig. 11): 1♀*, Fårbjerg (Skanderborg), 56°00'09.6"N 9°56'18.8"E (precision: 50 m), caught by sweeping in vegetation, coll. 29.V.2019, leg. M. F.



Figure 11. *Leiofaron fascipennis* (Ruthe, 1856), female, habitus.



Figure 12. *Leiofaron (Mama) reclinator* (Ruthe, 1856), male, habitus.

Holm, det. A. Tore Mjøs & M. F. Holm; 1♀, Ambjerg Skov (Vordingborg), 55°03'37.8"N 11°57'45.1"E (precision: 75 m), caught with beating tray in low vegetation, 20.V.2020, leg. S. Haarder, det. K. van Achterberg; 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, caught by hand, 10.V.2022, leg., det. J. Lutz.

Note: additional unverified specimens are present in NHMD.

Leiofaron (Mama) reclinator (Ruthe, 1856) (Fig. 12): 1♀ 1♂* (mating couple), Udlejre (Egedal), 55°47'18.3"N 12°08'35.6"E (precision: 10 m), caught underneath a birch (*Betula* sp.) tree, 17.VI.2019, leg. J. Lutz, det. K. van Achterberg.

GENUS *METEORUS* HALIDAY, 1835

Meteorus affinis (Wesmael, 1835) (Fig. 13): 1♀*, Anderup (Kolding), 55°21'20.6"N 9°22'50.0"E (precision: 200 m), caught by sweeping in vegetation, 15.VII.2018, leg. M. F. Holm, det. J. Stigenberg.

Note: additional unverified specimens are present in NHMD.

Meteorus obsoletus (Wesmael, 1835) (Fig. 14): 1♀*, Strandkær (Syddjurs), 56°13'46.4"N 10°34'47.1"E (precision: 200 m), caught by sweeping in vegetation, coll. 24.V.2017, leg. M. F. Holm, det. J. Stigenberg & M. F. Holm.

Meteorus ruficeps (Nees, 1834) (Fig. 15): 1♀*, Brænøre Mose (Kolding), 55°23'54.9"N 9°25'58.2"E (precision: 80 m), caught by sweeping in vegetation, coll. 23.VII.2018, leg. M. F. Holm, det. J. Stigenberg & M. F. Holm.

Note: additional unverified specimens are present in NHMD.

GENUS *PYGOSTOLUS* HALIDAY, 1833

Pygostolus otiorhynchi (Boudier, 1834): 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, attracted to light, 30.VIII.2022, leg. J. Lutz, det. K. van Achterberg.



Figure 13. *Meteorus affinis* (Wesmael, 1835), female, habitus.



Figure 14. *Meteorus obsoletus* (Wesmael, 1835), female, habitus.

SUBFAMILY HELCONINAE FÖRSTER, 1863

GENUS *HELCON* NEES, 1814

Helcon angustator Nees, 1812 (Fig. 16): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, caught by hand, 14.VI.2020, leg. J. Lutz, det. K. van Achterberg.

Helcon nunciator (Fabricius, 1793) (Fig. 17): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, caught by hand, 12.VII.2021, leg. J. Lutz, det. K. van Achterberg.

GENUS *WROUGHTONIA* CAMERON, 1899

Wroughtonia spinator (Lepelletier, 1825): 1♂, Toreby (Guldborgsund), 54°45'08.0"N 11°47'14.2"E (precision: 1000 m), 14.VI.2007, photo F. Krone (specimen not collected), det. J. Lutz; 1♂ 1♀, Thorslund (Faaborg-Midtfyn), 55°12'31.6"N 10°13'12.3"E (precision: 5 m), on cut logs, 5.VI.2018, photo L. Christensen (specimens not collected), det. K. Van Achterberg; 1♀, Pinseskoven (Tårnby), 55° 35'50.38"N 12° 33'15.85"E, malaise trap, 22-25.V.2016, leg. W.



Figure 15. *Meteorus ruficeps* (Nees, 1834), female, habitus.



Figure 16. *Helcon angustator* Nees, 1812, female, habitus.

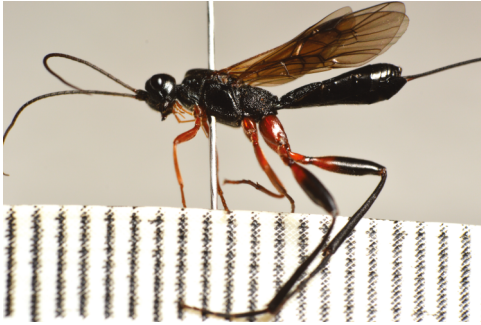


Figure 17. *Helcon nunciator* (Fabricius, 1793), female, habitus.



Figure 18. *Macrocentrus kurnakovi* Tobias, 1976, female, habitus.

Gritsch, det. F. Verheyde; 3♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E, attracted to light, 5.VII.2022, leg. J. Lutz, det. K. van Achterberg.

Note: specimens were observed at Thorslund again in June 2019, 2020, 2021, and 2022. Two females were collected on 17.VI.2019 and donated to NHMD. Additional unverified specimens are present in NHMD.

SUBFAMILY MACROCENTRINAE FÖRSTER, 1863

GENUS *MACROCENTRUS* CURTIS, 1833

Macrocentrus blandus Eady & Clark, 1964: 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught on *Impatiens parviflora* 31.VIII.2022, leg. J. Lutz, det. K. van Achterberg.

Macrocentrus cingulum Brischke, 1882: 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), caught by hand, 15.VII.2022, leg. J. Lutz, det. K. van Achterberg.

Macrocentrus gibber (Eady & Clark, 1964): 1♀, Gram (Skanderborg), 56°03'12.3"N 9°59'42.0"E (precision: 3 m), attracted to light, coll. 26.VIII.2016, leg. M. F. Holm, det. K. van Achterberg; 2♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 18.IX.2018, leg. J. Lutz, det. K. van Achterberg.

Macrocentrus kurnakovi Tobias, 1976 (Fig. 18): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 31.VI.2018, leg. J. Lutz, det. K. van Achterberg.

Macrocentrus nitidus (Wesmael, 1835) (Fig. 19): 1♀*, Udlejre (Egedal), 55°47'18.3"N 12°08'35.6"E (precision: 10 m), caught indoors, 15.VI.2018, leg. J. Lutz, det. K. van



Figure 19. *Macrocentrus nitidus* (Wesmael, 1835), female, habitus.

Achterberg; 1♂, Farum, 55°49'21.7"N 12°22'29.7"E (precision: 50 m), caught by hand, 15.VI.2019, leg. J. Lutz, det. K. van Achterberg.

SUBFAMILY MICROGASTRINAE FÖRSTER, 1863

GENUS *COTESIA* CAMERON, 1891

Cotesia spuria (Wesmael, 1837) (Fig. 20): 10 imagines*, Asserbo Plantage (Halsnæs), 56°01'16.4"N 12°00'10.8"E (precision: 50 m), reared from larva* of *Furcula bifida* (Lepidoptera: Notodontidae) 8.VIII.2016, coll. 29.VII.2016, leg. O. Martin, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

GENUS *MICROPLITIS* FÖRSTER, 1863

Microplitis flavipalpis (Brullé, 1832): 2♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 31.VI.2018, leg. J. Lutz, det. K. van Achterberg.

Microplitis sordipes (Ziegler [in Nees], 1834) (Fig. 21): 1♂, Ullerød (Hillerød), 55°56'35.0"N 12°15'57.8"E (precision: 25 m), reared from larva of *Acronicta psi* (Lepidoptera: Noctuidae)



Figure 20. *Cotesia spuria* (Wesmael, 1837) – top: cocoons on caterpillar of *Furcula bifida* (Lepidoptera: Notodontidae), bottom: female, habitus.

Figure 21. *Microplitis sordipes* (Ziegler [in Nees], 1834) – top: cocoon on caterpillar of *Acronicta psi* (Lepidoptera: Noctuidae), bottom: male, habitus.



Figure 22. *Pholetesor elpis* (Nixon, 1973), females (above) and cocoons (below), reared from mines of *Phyllonorycter esperella* (Lepidoptera: Gracillariidae).

14.IX.2014, coll. 8.IX.2014, leg. Linda Kjær-Thomsen & Lars Thomas, det. Mark Shaw; 1 imago*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), reared from larva* of *Acronicta psi* (Lepidoptera: Noctuidae) 7.VII.2018, coll. 2.VII.2018, leg. J. Lutz, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

GENUS *PHOLETESOR* MASON, 1981

Pholetesor elpis (Nixon, 1973) (Fig. 22): 2 imagines*, Ulvshale (Vordingborg), 55°02'35.1"N 12°14'57.9"E (precision: 50 m), reared from mines of *Phyllonorycter esperella* (Lepidoptera: Gracillariidae) 03-04.1.2021, coll. 13.10.2020, leg. S. Haarder, det. K. van Achterberg.

Note: *Phyllonorycter esperella* (Goeze, 1783) is a new host record. Unverified specimens in NHMD.

SUBFAMILY OPIINAE BLANCHARD, 1845

GENUS *OPIUS* WESMAEL, 1835

Opius pulchriceps Szépligeti, 1898 (Fig. 23): 1 imago, Frederiksberg Have (Frederiksberg), 55°40'34.0"N 12°31'17.0"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 18-24.V.2013, coll. 23.IV.2013, leg. W. Gritsch, det. S. Haarder & K. van Achterberg; 1 imago, Hesede Skov (Faxe), 55°16'26.3"N 11°55'21.2"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 14.IV.2016, coll. 21.III.2016, leg. L. Kjær-Thomsen & L. Thomas, det. S. Haarder & K. van Achterberg; 1♀*, Kirkeskov (Vordingborg), 55°00'25.5"N 11°54'07.6"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 7.V.2019, coll. 24.IV.2019, leg. S. Haarder, det. S. Haarder & K. van Achterberg; 5♀ 5♂, Galløkken (Bornholm), 55°05'22.5"N 14°42'20.5"E, reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 30.IV.2020 - 06.V.2020, coll. 11.IV.2020, leg. B. Andersen, det. S. Haarder & K. van Achterberg; 3♀, Jelling Skov (Vejle), 55°44'31.1"N 9°25'38.8"E, reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 12.V.2020, coll. 28.IV.2020, leg. K. Alminde, det. S. Haarder; 1♂, Ødsted

(Vejle), 55°39'31.6"N 9°24'01.6"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) primo V.2020, coll. 28.IV.2020, leg. K. Alminde, det. S. Haarder; 2♀, Allinge (Bornholm), 55°16'38.4"N 14°48'02.2"E, reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 12.V.2020 - 15.V.2020, coll. 30.IV.2020, leg. J. Kofoed, det. S. Haarder; 1♀ 1♂, Vork Bakker (Vejle), 55°39'43.4"N 9°20'51.0"E, reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 12.V.2020, coll. 04.V.2020, leg. K. Alminde, det. S. Haarder; 4♀, Smidstrup Krat (Vejle), 55°45'38.8"N 9°17'23.5"E, reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 16.V.2020 - 17.V.2020, coll. 04.V.2020, leg. K. Alminde, det. S. Haarder; 1♀, Sønderskoven (Vejle), 55°41'26.1"N 9°31'57.1"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 17.V.2020, coll. 04.V.2020, leg. K. Alminde, det. S. Haarder; 1♀, outside Olsker (Bornholm), 55°13'20.8"N 14°47'52.6"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 21.V.2020, coll. 10.V.2020, leg. T. L. Larsen, det. S. Haarder; 1♀, outside Astrup (Mariagerfjord), 56°45'33.0"N 10°01'07.3"E, reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 26.V.2020, coll. 14.V.2020, leg. G. Holm, det. S. Haarder; 1♀, Skanderborg Ladegårde (Skanderborg), 56°02'51.8"N 9°56'10.2"E (precision: 20 m), reared from mine of *Phytomyza ilicis* (Diptera: Agromyzidae) 10.V.2021, coll. ultimo IV.2021, leg P Andersen, det. S. Haarder; 2♀ 3♂, Draved Skov (Tønder), 55°00'50.4"N 8°58'09.1"E (precision: 500 m), reared from mines of *Phytomyza ilicis* (Diptera: Agromyzidae) 13.V.2021 - 20.V.2021, coll. early V.2021, leg. P. Thomassen, det. S. Haarder.

GENUS *PSYTTALIA* WALKER, 1860

Psyttalia carinata (Thomson, 1895) (Fig. 24): 1♂*, Moseparken (Copenhagen), 55°72'31.7"N 12°51'62.3"E (precision: 25 m), caught by hand, 08.IX.2015, leg. J. Lutz, det. K. van Achterberg; 1♀, Udlejre (Egedal), 55°47'18.1"N 12°08'36.1"E (precision: 10 m), caught by hand, 20.VIII.2022, leg. J. Lutz, det. K. van Achterberg.

SUBFAMILY ROGADINAE FÖRSTER, 1863

GENUS *ALEIODES* WESMAEL, 1838

Aleiodes apicalis (Brullé, 1832) (Fig. 25): 1♀, Gram (Skanderborg), 56°03'12.3"N 9°59'42.0"E (precision: 3 m), attracted to light, coll. 26.VII.2019, leg. M. F. Holm, det. M. R. Shaw & M. F.



Figure 23. *Opilus pulchriceps* Szepliget, 1898, female, habitus.



Figure 24. *Psyttalia carinata* (Thomson, 1895), male, habitus.



Figure 25. *Aleiodes apicalis* (Brullé, 1832), female, habitus.

Holm; 1♀*, Bjørnkær (Syddjurs), 56°11'31.6"N 10°41'27.9"E (precision: 40 m), attracted to light, coll. 08.VIII.2020, leg. M. F. Holm, det. M. R. Shaw & M. F. Holm.

Aleiodes coxalis (Spinola, 1808) (Fig. 26): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, coll. 7.VII.2018, leg. J. Lutz, det. K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

Aleiodes gastritor (Thunberg, 1822): 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), came to light, 13.X.2018, leg. J. Lutz, det. K. van Achterberg.

Aleiodes leptofemur van Achterberg & Shaw, 2016 (Fig. 27): 3♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, coll. 26.VII.2019, leg. J. Lutz, det. K. van Achterberg; 1♀, Sønderborg (Sønderborg), 54°55'08.3"N 9°48'30.5"E (precision: 3 m), reared from pupae of unidentified Lepidoptera, 25.IV.2021, coll. 15.IV.2021, leg. L. Christensen, det. K. van Achterberg.

Aleiodes nigriceps Wesmael, 1838 (Fig. 28): 1♀*, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 04.VI.2018, leg. J. Lutz, det. M. Shaw.

Aleiodes pictus (Herrich-Schäffer, 1838): 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 19.VII.2022, leg. J. Lutz, det. K. van Achterberg.



Figure 26. *Aleiodes coxalis* (Spinola, 1808), female, habitus.



Figure 27. *Aleiodes leptofemur* van Achterberg & Shaw, 2016, female, habitus.



Figure 28. *Aleiodes nigriceps* Wesmael, 1838, female, habitus.



Figure 29. *Aleiodes punctipes* (Thomson, 1892), male, habitus.

Aleiodes punctipes (Thomson, 1892) (Fig. 29): 1♂*, Brænøre Mose (Kolding), 55°23'54.9"N 9°25'58.2"E (precision: 80 m), caught by sweeping in vegetation, coll. 29.VII.2018, leg. M. F. Holm, det. M. R. Shaw.

Aleiodes similis (Curtis, 1834): 2♀, Moseparken (Copenhagen), 55°72'31.7"N 12°51'62.3"E (precision: 15 m), caught by hand, 23.VIII.2016, leg. J. Lutz, det. K. van Achterberg; 1♀, Udlejre (Egedal), 55°47'18.3"N 12°08'35.6"E (precision: 10 m), attracted to light, 18.VIII.2018, leg. J. Lutz, det. K. van Achterberg; 1♀, Ebbeskov (Køge), 55°29'44.7"N 11°56'10.3"E (precision: 50 m), attracted to light, 26.VII.2019, leg. J. Lutz, det. K. van Achterberg.

Aleiodes varius (Herrich-Schäffer, 1838) (Fig. 30): 1♂*, Frøruprød (Kolding), 55°21'38.6"N 9°24'22.8"E (precision: 200 m), collection method uncertain, either by sweeping in vegetation or caught in white/yellow pan traps, coll. 07.VII.2018, leg. M. F. Holm, det. M. R. Shaw & M. F. Holm.

GENUS *HETEROGAMUS* WESMAEL, 1838

Heterogamus dispar (Haliday, 1833): 1♀, Sandkås (Bornholm), 55°15'19.9"N 14°49'06.4"E (precision: 50 m), caught by hand, 16.VIII.2017, leg. J. Lutz, det. G. Broad & K. van Achterberg.

Note: additional unverified specimens are present in NHMD.

GENUS *ROGAS* NEES, 1818

Rogas luteus (Nees, 1834): 1♂, Rusland (Gribskov), 56°05'05.5"N 12°24'21.5"E (precision: 60 m), attracted to light, coll. 22.VIII.2020, leg. M. F. Holm, det. F. Verheyde; 1♀, Jørsløvlyst (Faxe), 55°18'04.6"N 12°11'38.4"E (precision: 10 m), attracted to light, 15.VIII.2020, photo J. Lund (specimen not collected), det. K. van Achterberg; 1♂, Marbæk Plantage (Esbjerg), 55°33'03.7"N 8°18'52.7"E (precision: 200 m), caught by hand, 14.VIII.2021, leg. L. Thomas and L. Kjær-Thomsen, det. F. Verheyde.

Discussion

We report the first findings of 59 species of Braconidae, not previously mentioned from Denmark in the literature (Yu et al., 2016, and other faunistic papers). According to Fauna Europaea, 363 braconid species are known from Denmark (de Jong et al., 2014), making a



Figure 30. *Aleiodes varius* (Herrich-Schäffer, 1838), male, habitus.

total of 422 species. However, the total number of braconid species would be 908 if our records are added to the already existing database at Arter.dk – the national species database of Denmark (Skipper et al., 2020). This number is partly based on published records, but is also derived from both updated and outdated names attributed to the many braconid individuals from the collection at the NHMD in Copenhagen. A critical examination of the specimens in NHMD is beyond the scope of this paper.

All species were listed and host records were analyzed using recent literature and Taxapad (Yu et al., 2016). Approximately half of the species reported here are parasitoids of Lepidoptera (29). Other groups used as a host are Coleoptera (15), Diptera (7), Hemiptera (6), and Neuroptera (1).

Hosts from the order of Hemiptera are linked to our findings of *Leiophron fascipennis* and *Leiophron (Mama) reclinator*. This remains hypothetical for the former, since no certain host records are available (Stigenberg & van Achterberg, 2015), but validly reared material of the latter has recently been reported from two species of Miridae in Europe (Mack & Haye, 2022).

Neuropterans are connected to *Chrysophthorus hungaricus*, an endoparasitoid of adult Chrysoptera. Its distribution range has been expanding in Europe over the last 25 years. After the revision of the genus by van Achterberg (1994), the species has been recorded in Britain (Shaw, 1996), Slovakia (Schlarmannová & Lukás, 2004), and recently in Belgium (Verheyde et al., 2019). It has not been recorded from Norway, but has recently been found in Sweden (J. Stigenberg, pers. comm). It is often caught at light (e.g. Verheyde et al., 2019), which was also true for some of the specimens recorded in this study.

Not surprisingly, most braconid wasps reported here use lepidopteran hosts, being the order most commonly parasitized by Ichneumonoidea (Quicke, 2015). Within this group, the species-rich genus *Aleiodes* is represented with several first recordings from Denmark in this

study. Of those, especially the records of *Aleiodes varius* and *A. apicalis* are interesting, as both are rarely seen in Northern Europe. *A. varius* was not previously recorded from Scandinavia and the distribution in the rest of Europe is relatively restricted. *A. apicalis* is only known from a few other recordings from northern Europe: one specimen from Sweden (collected 2014), two specimens from Britain (collected 1932 and 2018), and one from the Netherlands (collected 2004) (van Achterberg et al., 2020). In the Western Palaearctic, the distribution mainly extends from Central Europe to North Africa. *Aleiodes* spp. are koinobiont endoparasitoids. Lepidopteran hosts are predominantly found among Erebidae and Noctuidae, but also the butterfly families Hesperidae, Lycaenidae, and Nymphalidae are known as hosts (van Achterberg & Shaw, 2016). The known hosts for *A. varius* and *A. apicalis* are *Euthrix potatoria* (Lasiocampidae) and *Autographa gamma* (Noctuidae) respectively. The recordings of *A. apicalis* most likely do not represent an established breeding population, as this would be dependent on whether or not the host can overwinter (van Achterberg et al., 2020), and up to now there is no evidence that this is possible in Denmark. However, the range of the overwintering population of *A. gamma* has very likely expanded north as a result of climate change, which would explain why more specimens of *A. apicalis* have been able to reach northern parts of Europe in recent years.

Apart from the abovementioned lepidopteran families, especially Tortricidae can be connected to some of the parasitoid wasp species we report. Examples are *Ascogaster* cf. *reticulata*, *Bracon caudiger*, *Habrobracon variegator*, *Macrocentrus nitidus*, *Meteorus obsoletus*, *Meteorus ruficeps*, *Rogas luteus*, and *Therophilus tumidulus* (van Achterberg, 1993; Stigenberg & Ronquist, 2011; Yu et al., 2016).

The record of *Ascogaster* cf. *reticulata* is uncertain: only one male was collected and more specimens – preferably females – are needed for final identification. If this species can be documented to occur in Denmark, the area of distribution will be greatly expanded as the nearest reported locality is Slovakia (Papp, 1996).

The wasps found with coleopterans as a host are interesting, because they relate to several tendencies from the last two decades in western Europe, especially 1) the advent of citizen science and social media, and 2) local environmental management with more respect for (standing) dead wood. Clear examples are *Helcon angustator*, *Helcon nunciator*, *Spathius exarator*, and *Wroughtonia spinator*. These species are increasingly reported in western Europe, not only in natural environments but also in urban gardens, where they can often be found on firewood. This is a far-reaching colonizing tendency which is also visible in other Ichneumonoidea and insects in general (see for example Verheyde et al., 2020).

As mentioned in the introduction, Diptera and Hemiptera are mainly associated with specific subfamilies of braconid wasps, namely Alysiinae/Opiinae and Aphidiinae, respectively.

Specimens of *Aleiodes leptofemur*, *Aphidius rosae*, *A. setiger*, *Cotesia spuria*, *Microplitis sordipes*, *Opius pulchriceps*, *Pholetesor elpis*, and *Polemochartus melas* were obtained from rearings. This method provides important biological information on parasitoid-host relations in nature and represents a good – but cumbersome – source of parasitoid specimens (for an introduction, see Shaw, 1997). None of the abovementioned species have been reported from Norway, whereas all but *O. pulchriceps*, *P. elpis*, and *P. melas* have been found in Sweden (Yu et al., 2016). Only *P. melas* has not been recorded from Finland – this species is new to Scandinavia. The most important host species of *O. pulchriceps* and *P. melas* is *Phytomyza*

ilicis (Agromyzidae) and *Lipara rufitarsis* (Chloropidae), respectively. *Psytalia carinata* is associated with *Rhagoletis* species (Tephritidae) in fruits. These hosts are distributed from South- to Central Sweden and Norway and their associated braconid parasitoids can therefore be expected to occur here, too. *Lipara rufitarsis* is not known from Finland. *Phyllonorycter esperella* (Gracillariidae) represents a new host record for *Pholetesor elpis*. A well-known leaf-miner moth on hornbeam (*Carpinus betulus*), *P. esperella* occurs in Sweden (but not in Norway) and could thus be expected to support *P. elpis* here as well. Other known hosts of *P. elpis* include *Phyllonorycter* species on *Malus* and *Populus*, as well as a few other species of micro-lepidopterans in the families Coleophoridae and Elachistidae. Most of these host species are known from Sweden and Norway (Yu et al., 2016).

The genus *Paralipsis* contained only one species, *P. enervis* (Nees, 1834), in the western Palaearctic region, until it was revised by van Achterberg and Ortiz de Zugasti (2016) and another species from northern Europe, *Paralipsis planus*, was described. The two species can be differentiated based on differences in widths of legs, tarsus, and scapus (van Achterberg and Ortiz de Zugasti, 2016). All species in the genus are parasitoids of root aphids associated with *Lasius* spp. (Formicidae). The Danish record of *P. planus* is the second finding of the species worldwide; the holotype is described based on specimens from the Netherlands. No specimens of the genus *Paralipsis* are deposited in the NHMD collection; *P. enervis* most likely also occurs in Denmark.

This study emphasizes the value of continuous monitoring on a single locality: a total of 29 braconid species mentioned here as new for Denmark were recorded from the first author's garden (Ebbeskov), and the majority of these were not found at other localities in this study. It also demonstrates the importance of using a variety of collecting methods. Rare and interesting species were obtained both from light traps, sweep nets and rearing. Future studies should implement a similar setup, perhaps supplemented with Malaise traps and fogging, in order to better assess the regional or national braconid fauna. Finally, considering that up to now 1158 species are reported from Sweden (SLU Artdatabanken, 2023) and 1404 species from Finland (FinBIF, 2023), many more species of this large and speciose family are expected to occur in Denmark and currently await discovery.

Acknowledgements

We wish to thank the specialists and experts who have kindly identified some of the species reported here: Javier Peris Felipo (Alysiinae), Jenő Papp (deceased; Braconinae), Julia Stigenberg (Meteorus), and Mark Shaw (Aleiodes). Also appreciated are the identifications and comments by Alf Tore Mjøs, Hilco Meijer, Gavin Broad, Lennart Bendixen, and Jonathan Vogel. Lars Vilhelmsen is thanked for providing access to the list of braconid specimens currently housed at the NHMD. Finally, we are indebted to all the Danish naturalists from various Danish citizen-science websites (e.g. Naturbasen, Arter.dk), who have allowed us to use their observations in this study. Without their contribution, the paper would have been much less complete.

References

- Chen, X.-X. & C. van Achterberg, 2019: Systematics, Phylogeny, and Evolution of Braconid Wasps: 30 Years of Progress. – *Annual Review of Entomology* 64: 335-358.
- Dolphin, K. & D.L.J. Quicke, 2001: Estimating the global species richness of an incompletely described taxon: an example using parasitoid wasps (Hymenoptera: Braconidae). – *Biological Journal of the Linnean Society London* 73(3): 279-286.
- Esbjerg, P., 1972: Danske snyltehvepse og -fluer fra fyrrevikleren, *Rhyacionia buoliana* Schiff. (Lepid., Tortricidae). – *Entomologiske Meddelelser* 40: 9-20.

- FinBIF, 2023: *Species search* [Braconidae]. Finnish Biodiversity Information Facility/FinBIF. – <https://laji.fi/en/taxon/list?target=MX.289206&onlyFinnish=true> (accessed 12.11.2023)
- Fischer, M., 1964: Die Opiinae Dänemarks (Hym., Braconidae). – *Entomologiske Meddelelser* 32: 236-260.
- Gasque, S.N., G.O. Poinar & B.L. Fredensborg, 2018: Ant (Hymenoptera: Formicidae) parasitism by Neoneurinae wasps (Hymenoptera: Braconidae) in Denmark. – *Entomologiske Meddelelser* 86: 27-30.
- Haarder, S., 2021: Kristtorn-minérfluen (*Phytomyza ilicis*) og dens snyltehvepsefauna på Bornholm. – *Natur på Bornholm* 19: 20-27.
- Henriksen, K.L., 1919: De europæiske Vandsnyltehvepse og deres Biologi. – *Entomologiske Meddelelser* 12: 137-251.
- Jones, O.R., A. Purvis, E. Baumgart & D.L.J. Quicke, 2009: Using taxonomic revision data to estimate the geographic and taxonomic distribution of undescribed species richness in the Braconidae (Hymenoptera: Ichneumonoidea). – *Insect Conservation and Diversity* 2: 204-212.
- de Jong, Y., M. Verbeek, V. Michelsen, P. Bjørn, W. Los, F. Steeman, N. Bailly, C. Basire, P. Chylarecki, E. Stloukal, G. Hagedorn, F. Wetzel, F. Glöckler, A. Kroupa, G. Korb, A. Hoffmann, C. Häuser, A. Kohlbecker, A. Müller, A. Güntsch, P. Stoev & L. Penev, 2014: Fauna Europaea – all European animal species on the web. – *Biodiversity Data Journal* 2: e4034. <https://doi.org/10.3897/BDJ.2.e4034>.
- Mack, A. & T. Haye, 2022: Erster Nachweis von *Leiophron reclinator* (Ruthe, 1856) (Hymenoptera: Braconidae) als Adultparasitoid zweier Miriden in Schleswig-Holstein. – *Heteropteron* 67: 13-15.
- Munk, T., F.J. Peris-Felipo & R. Jiménez-Peydró, 2013: New western Palaearctic *Dinotrema* species with mesoscutal pit and only medially sculptured propodeum (Hymenoptera, Braconidae, Alysiinae). – *Zookeys* 260: 61-76.
- Münster-Swendsen, M., 1979: The parasitoid complex of *Epinotia tedella* (Cl.) (Lepidoptera: Tortricidae). – *Entomologiske Meddelelser* 47: 63-71.
- Münster-Swendsen, M., 1989: Phenology and natural mortalities of the fir needleminer, *Epinotia fraternana* (Hw.) (Lepidoptera, Tortricidae). – *Entomologiske Meddelelser* 57: 111-120.
- Nielsen, L.B., 1994: Distribution and population densities of stem-boring fly larvae (Diptera) and their parasitoids in Danish farmland. – *Journal of Applied Entomology* 117: 321-331.
- Overgaard, S.M., 1989: Nogle snyltehvepse klækket fra danske køllesværmere (Lepidoptera, Zygaenidae: *Zygaena* Fabr. 1775, Hymenoptera: Braconidae, Ichneumonidae, Pteromalidae og Eupelmidae). – *Entomologiske Meddelelser* 57: 143-149.
- Papp, J., 1996: Contribution to the braconid fauna of Hungary, XI. Cheloninae and Sigalphinae (Hymenoptera: Braconidae). – *Folia Entomologica Hungarica* 57: 131-156.
- Papp, J., 2011: Twelve new *Bracon* Fabricius, 1804 species from the Western Palaearctic Region (Hymenoptera, Braconidae: Braconini). – *Annales Historico-Naturales Musei Nationalis Hungarici* 103: 277-314.
- Peris-Felipo, F.J., S.A. Belokobylskij & T. Munk, 2014: Three New Species of the Genera *Aspilota* Foerster and *Synaldis* Foerster from North Europe (Hymenoptera: Braconidae: Alysiinae). – *Annales Zoologici* 64(4): 683-692.
- Peris-Felipo, F.J., S.A. Belokobylskij, L. Vilhelmsen & T. Munk, 2016: Catalogue of Danish Alysiinae (Hymenoptera: Braconidae), with the description of two new species of *Aspilota* Foerster, 1863. – *European Journal of Taxonomy* 250: 1-48.
- Quicke, D.L.J., 2015: *The Braconid and Ichneumonid Parasitoid Wasps: Biology, Systematics, Evolution and Ecology*. Wiley-Blackwell, West Sussex. 704 pp.
- Schlarmannová, J. & J. Lukás, 2004: First records of braconids (Hymenoptera, Braconidae) from Slovakia. – *Biologia* 59(2): 203-204.
- Shaw, M., 1996: *Chrysopophthorus hungaricus* (Zilahi-Kiss) (Hymenoptera: Braconidae, Euphorinae) new to Britain, a parasitoid of adult Chrysopidae (Neuroptera). – *Entomologist's Gazette* 47(3):185-187.
- Shaw, M., 1997: Rearing parasitic Hymenoptera. – *The Amateur Entomologist* 25: 1-45.
- Skipper, L., I. Calabuig, J. Møller, D. Wenøe Breddam & J. Skovgaard Mathorne, 2020: National checklist of all species occurring in Denmark. Version 9.3. Miljøstyrelsen / The Danish Environmental Protection Agency. – <https://doi.org/10.15468/bpmaze> (Checklist dataset, accessed via GBIF.org on 2023-10-21). [Arter.dk]
- SLU Artdatabanken, 2023: *Braconidae* Nees von Esenbeck, 1812 | *bracksteklar*. SLU Artdatabanken, Artfakta. – <https://namnochslaktskap.artfakta.se/taxa/2001163/details> (accessed 12.11.2023).
- Stigenberg, J. & F. Ronquist, 2011: Revision of the Western Palaearctic Meteorini (Hymenoptera, Braconidae), with a molecular characterization of hidden Fennoscandian species diversity. – *Zootaxa* 3084: 1-95.
- Stigenberg J. & C. van Achterberg, 2015: Heads up on Swedish *Leiophron* (Braconidae, Euphorinae) – a key to species and three new species records. – *Entomologisk Tidskrift* 136: 175-184.
- van Achterberg, C., 1982: Notes on some type-species described by Fabricius of the subfamilies Braconinae, Rogadinae, Microgastrinae and Agathidinae (Hymenoptera, Braconidae). – *Entomologische Berichten* 42: 133-139.

- van Achterberg, C., 1993: Revision of the subfamily Macrocentrinae Foerster (Hymenoptera: Braconidae) from the Palaearctic region. – *Zoologische Verhandlungen* 286: 3-105.
- van Achterberg, C., 1994: The Palaearctic species of the genus *Chrysopophthorus* Goidanich (Hymenoptera: Braconidae: Euphorinae). – *Zoologische Mededelingen* 68(25): 301-307.
- van Achterberg, C. & N.F. Ortiz de Zugasti, 2016: Revision of the genus *Paralipsis* Foerster, 1863 (Hymenoptera, Braconidae), with the description of two new species. – *Zookeys* 606: 25-39.
- van Achterberg, C. & M.R. Shaw, 2016: Revision of the western Palaearctic species of *Aleiodes* Wesmael (Hymenoptera, Braconidae, Rogadinae). Part 1: Introduction, key to species groups, outlying distinctive species, and revisionary notes on some further species. – *Zookeys* 639: 1-164.
- van Achterberg, C., M.R. Shaw & D.L.J. Quicke, 2020: Revision of the western Palaearctic species of *Aleiodes* Wesmael (Hymenoptera, Braconidae, Rogadinae). Part 2: Revision of the *A. apicalis* group. – *Zookeys* 919: 1-259.
- Verheyde, F., P.-N. Libert, J. Soors & L. Janssen, 2019: First report of three braconid species in Belgium (Hymenoptera: Braconidae). – *Bulletin de la Société royale belge d'Entomologie* 155: 128-133.
- Verheyde, F., A. De Ketelaere, J. De Witte & W. Smets, 2020: Parasitaire wespen als biodiversiteitsindicatoren. – *Natuur.focus* 19(4): 172-179.
- Wharton, R.A., 1993: Bionomics of the Braconidae. – *Annual Review of Entomology* 38: 121-143.
- Yu, D.S., C. van Achterberg & K. Horstmann, 2016: *World Ichneumonoidea 2015: Taxonomy, Biology, Morphology and Distribution*. – Taxapad, Vancouver. DVD/CD.