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Research Article

Hymenopteran parasitoids reared from European gall midges (Diptera, Cecidomyiidae)

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Abstract

We report the results of investigations 2010 through 2023 of hymenopteran parasitoids associated with gall midges in Europe. A total of 242 collections of gall midges were made, from each of which one to several parasitoid species emerged, resulting in ca. 200 recorded parasitoid species and 267 host-parasitoid interaction records. The parasitoid families involved were Eulophidae (63 species), Platygastridae (56 species), Torymidae (34 species), Pteromalidae (31 species), Ceraphronidae (5 species), Eupelmidae (4 species), Eurytomidae (2 species) and Encyrtidae (1 species). As many as 159 interactions are reported for the first time, significantly enlarging our knowledge of gall midge – parasitoid interactions on the species level. Even more interesting, 51 host records are for parasitoid species for which no host was previously known. Similarly, 28 species of gall midge are reported as host to named parasitoids for the first time. Additionally, 91 parasitoid records were the first for the country in question. Differences between the rearing methods applied and their suitability for recording species with contrasting life histories, are discussed.

Keywords

Cecidomyiidae, host-parasitoid interactions, Eltonian shortfall, rearing methods, Ceraphronidae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae, Torymidae, Platygastridae

Introduction

The gall midges (Diptera, Cecidomyiidae) are arguably the largest and most diverse insect family and, simultaneously, one of the most incompletely known in terms of both basic species cataloguing and knowledge of species' biology (e.g. Espírito-Santo and Fernandes 2007, Hebert et al. 2016, Chimeno et al. 2022, Srivathsan et al. 2023). The families of parasitoid Hymenoptera associated with gall midges remain similarly very poorly known. Srivathsan et al. (2023) identified 20 insect families that account for more than half of Malaise-trapped insect species richness at sites across the globe. Cecidomyiidae and two families of parasitoid Hymenoptera frequently associated with them, i.e. Platygastridae and Eulophidae, figured prominently in the list. The large proportion of undescribed species, "dark taxa", highlights the shortfall in current biodiversity knowledge. Another equally important knowledge gap is the ignorance of species' trophic interactions, something that has been coined the "Eltonian shortfall" (Hortal et al. 2015).

The Cecidomyiidae are small delicate flies (Tokuda and Yukawa 2021). The majority of species are phytophagous and display a wide range of host-plant relationships and life-history strategies (Dorchin et al. 2019). Many species induce galls on the host plants, but others inhabit leaf sheaths, grass spikelets or dense inflorescences without causing obvious malformation of the plant parts. Many species are univoltine, fewer are bivoltine or multivoltine. In most temperate species, larvae leave their host plant to hibernate and later pupate in the soil. Pupation in situ, for example, in galls, seems to have arisen several times within the clade. All of these life-history characteristics have been shown to influence the size and family composition of their associated parasitoid assemblages (Hawkins and Gagné 1989).

The study of gall midge parasitoids is almost as old as studies of the gall midges themselves. For example, J.-J. Kieffer (1857-1925) described several hundred species of Cecidomyiidae and Platygastridae and some Chalcidoidea. H. F. Barnes (1902-1960) and his students made numerous biological studies on gall midges and their parasitoids, in particular, species associated with crops and ornamental plants. More recently, Skuhravá and Thuróczy (2007) reported 39 species of Chalcidoidea and Platygastroidea reared from galls of 50 species of gall midges, which had been collected between 1955 and 1996 in the Czech Republic and elsewhere in central and southern Europe. Similar studies have been published by Tudor and Neacşu (1983), Askew and Harris (2007), Buhl and Jørgensen (2010), Jennings (2021) and others. Nevertheless, the knowledge of gall midge - parasitoid relationships remains incomplete at best and is mainly based on rearing adult parasitoids directly from midge-induced galls.

The Chalcidoidea parasitoids of gall midges are mainly found in the families Eulophidae, Pteromalidae (incl. Pirenidae and Systasidae) and Torymidae, with fewer species of Braconidae, Encyrtidae and Eurytomidae being involved (Yukawa et al. 2021). Another *major* group of gall midge parasitoids is Platygastridae (Platygastroidea), while fewer Ceraphronidae (Ceraphronoidea) have been recorded. This suite of hymenopteran parasitoids exhibits a wide and complex array of life-history characteristics. One helpful simplification is the division of parasitoids into koinobionts and idiobionts (sensu Askew and Shaw (1986)). Koinobionts let their hosts continue normal development and behaviour, such as the midge larvae leaving the galls to continue life and to pupate elsewhere. Koinobionts are usually endoparasitoids and expected to be more narrowly host-specialised, due to the prolonged physiological intimacy with a living and metabolising host (Hawkins 1994). Idiobionts, in contrast, immediately kill or permanently paralyse their hosts. They are typically ectoparasitoids and they sometimes show association with particular host plants, attacking phylogenetically diverse assemblages of phytophagous insects using that particular host plant (Hawkins 1994).

Here, we report primary data on the parasitoid Hymenoptera that, during the years 2010 – 2023, we have reared from larvae of Cecidomyiidae in Europe using a suite of methods. The methodology is discussed in relation to the life-history characteristics of both gall midge hosts and of their koinobiont and idiobiont parasitoids.

Materials and methods

Gall midge larvae of a suite of species were collected from their natural feeding site, be it plant galls, plant inflorescences or rust (Pucciniales) sori on plants. The majority of collections were made in Denmark, several from Sweden and Poland and few from other European countries (Spain, Hungary, Romania and Lithuania). Some collections were specifically bred out to obtain adult parasitoid wasps. Other collections were made with the aim of rearing adult gall midges for taxonomic work and studying their life cycles, the parasitoids being obtained as a bycatch. Thus, the collection strategy may be considered opportunistic, dictated by the species of gall midges that we have happened to encounter.

Methods for obtaining adult parasitoid hymenoptera:

1. Adults extracted from galls (1A) or collected while ovipositing on midge-inhabited galls (1B);
2. Adults emerging directly from galls or other plants parts inhabited by gall midge larvae, sometimes from galls kept over winter;
3. Adults emerging from mature larvae or pupae extracted from galls and transferred individually to gelatine capsules;
4. Adults emerging from soil in pots, to which gall midge larvae had been transferred earlier the same year (4A) or in the preceding year (4B). Parasitoid emergence is often simultaneous with adult gall midge emergence, but is sometimes delayed (even up to a year);

5. No rearing attempted, or rearing failed; parasitoid reported at the genus level if possible.

Method 4 was applied to gall midge species which hibernate and pupate in the soil. Midge larvae were either transferred to clean soil in pots using a small paintbrush or, in some cases, the inhabited plant parts were left on the soil surface in similar pots for a few days (then removed to avoid mould), allowing the larvae to move to the soil of their own accord. Often, a combination of the two ways was used, first an appreciable number of larvae were transferred by hand to ensure a minimum number were secured, and then additional inhabited plant parts were added. Larvae of endoparasitic, koinobiont Hymenoptera would be transferred with the midge larvae, while ectoparasitic larvae destined to pupate in situ may potentially have been discarded with the plant parts. Pots with inhabited soil were kept overwinter outdoors in Kårup Skov, Denmark under ambient conditions of temperature and precipitation until early the following spring, then taken indoors to allow adult insects to emerge from pots in mesh bags or spacious perforated plastic bags.

The identification work was based on available keys, original diagnoses, revisions and comparision with paratypes and other specimens kept in the personal collections of RRA and PNB. With regard to the many Platygastridae originally described by Walker, we based our work on the revision and re-description of species by Vlug (1985). We report all parasitoid records that can be considered new to the given gall midge host, even in the many cases where the parasitoid identification is incomplete and requires more work, including rearing more material, undertaking taxonomic revisions and describing new species. That choice is motivated by our focus on the “Eltonian shortfall”.

Results

A total of 242 collections was made, representing 109 Cecidomyiidae species, some of which belong to species that are yet to be formally described (designated an interim name to avoid ambiguity).

A number of gall midge samples were reared without yielding any parasitoids, despite quite plentiful material (> 100 of adult midges emerged). These species include *Coniophora graminicola* Nijveldt, 1959, *Dasineura irregularis* (Bremi, 1847), *Dasineura sisymbrii* (Schrank, 1803), *Jaapiella chelidonii* Fedotova 2008 and *Wachtliella caricis* (Loew, 1850). Clearly, these observations may represent nothing more than chance absence of parasitoids in single gall midge populations.

Approximately 200 parasitoid taxa emerged, belonging to eight Hymenoptera families, i.e. Ceraphronidae (5 species, Fig. 1), Encyrtidae (1 species), Eulophidae (63 species, Fig. 2), Eupelmidae (4 species, Fig. 3), Eurytomidae (2 species, Fig. 4), Platygastridae (56 species, Fig. 5), Pteromalidae (31 species, Fig. 6) and Torymidae (34 species, Fig. 7). The figures given must be regarded as approximate because certain identification to known species was far from always possible. The full results are presented in Table 1 (with record details in Suppl. material 1). In the Table, the degree of certainty in identification to species

level is indicated as follows: 1. Identified to the genus level (in one case family level), but not identified further, for example, "*Aprostocetus* sp."; 2. Positively placed in a named species group, for example, "*Acerotella* sp. (*evanescens* group)"; 3. Morphologically close to a named taxon, but probably a separate species, for example, "*Synopeas* sp. nr *inerme*"; 4. Probably the mentioned species, but confirmatory work, such as comparison to type material, is required, "*Aprostocetus* cf. *suevius*"; 5. Identified to species beyond reasonable doubt. Only identifications at level 3 to 5 were included in statistics of new host-parasitoid relations and significant biogeographic records, unless the finding represented the first record for a gall midge host of the relevant parasitoid taxon.

Table 1.

Records of hymenopteran parasitoids reared from European Cecidomyiidae. All Ceraphronidae and Platygastridae were identified by Peter Neerup Buhl. With few exceptions, Richard R. Askew identified all Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae, Pteromalidae and Torymidae. Identities of collectors: AM Asta Malakauskienė, AP Alexandru Pintilioaie, BA Belinda Andersen, BK Birgit Knudsen, BWP Brian Willum Petersen, EF Emil Førby, HHB Hans Henrik Bruun, JS Johan Svedholm, KA Ken Alminde, KH Kresten Hansen, KN Klavs Nielsen, LKT Linda Kjær-Thomsen, MB Martin Bjerg, ND Netta Dorchin, PB Peder Brøgger, PBJ Peter Bonde Jensen, SH Simon Haarder. Method of rearing (details in the main text): 1, Adults extracted from galls (1A) or collected while ovipositing (1B); 2, Adults emerged directly from galls; 3, Adults emerged in gelatine capsules; 4, Adults emerged from soil, to which gall midge larvae had been transferred, earlier the same year (4A) or in the preceding year (4B); 5, No rearing of adults. "Emg. month": Start of emergence (month, year). "C.": Country. Novelty of interaction ("Int. nov."): N, New host-parasitoid interaction; FH, First host record for parasitoid species; FCH, First Cecidomyiidae host record for parasitoid species; FP, First parasitoid record for host species. Biogeographic novelty ("Biogeo. nov."): First record of species for the country indicated. Details of the records (collection site name and geographic coordinates, as well as number of females and males obtained and identity of the gall midge host plant) are given in Suppl. material 1.

Parasitoid name	**Gall midge host name**	**Method**	**Collection date**	**Emg. month**	**Coll.**	**C.**	**Int. nov.**	**Biogeo. nov.**
Ceraphronidae								
Aphanogmus abdominalis (Thomson, 1858)	*Dasineura odoratae* Stelter, 1982	2	02.ix.2010	NA	HHB	DK	-	-
Aphanogmus abdominalis (Thomson, 1858)	*Dasineura odoratae* Stelter, 1982	2	03.ix.2010	NA	HHB	DK	-	-
Aphanogmus abdominalis (Thomson, 1858)	*Dasineura odoratae* Stelter, 1982	2	19.ix.2010	NA	HHB	DK	-	-
Aphanogmus abdominalis (Thomson, 1858)	*Dasineura odoratae* Stelter, 1982	3	26.xii.2018	i.2019	SH	DK	-	-
Aphanogmus abdominalis (Thomson, 1858)	*Dasineura* violahirtae Stelter, 1982	2	31.iii.2020	iv.2020	HHB	DK	FP	-
Aphanogmus fasciipennis Thomson, 1858	*Mycodiplosis* cf. *melampsorae* (Rübsaamen, 1889)	4A	04.x.2020	x.2020	HHB	DK	FH	-
Aphanogmus cf. *fasciipennis* Thomson, 1858	*Contarinia festucae* Jones, 1940	4B	08.vii.2021	v.2022	HHB	DK	N	-

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Aphanogmus cf. *fasciipennis* Thomson, 1858	*Stenodiplosis* sp. ex *Elymus repens*	4B	18.vii.2021	v.2022	HHB	DK	N	-
Aphanogmus gracilicornis Förster, 1861	*Mycodiplosis melampsorae* (Rübsaamen, 1889)	4A	04.x.2020	x.2020	HHB	DK	FH	-
Aphanogmus microneurus Kieffer, 1907	*Mycodiplosis melampsorae* (Rübsaamen, 1889)	4A	04.x.2020	x.2020	HHB	DK	FH	-
Aphanogmus vicinus Förster, 1861	*Mycodiplosis melampsorae* (Rübsaamen, 1889)	4A	04.x.2020	x.2020	HHB	DK	FH	-
Encyrtidae								
Pseudencyrtus misellus (Dalman, 1820)	*Rabdophaga salicis* (Schrank, 1803)	NA	03.iv.2021	iv.2021	PBJ	DK	-	-
Pseudencyrtus misellus (Dalman, 1820)	*Rabdophaga salicis* (Schrank, 1803)	3	08.iii.2021	iii.2021	SH	DK	-	-
Pseudencyrtus misellus (Dalman, 1820)	*Rabdophaga salicis* (Schrank, 1803)	NA	14.iv.2020	NA	KH	DK	-	-
Eulophidae								
Aprostocetus aethiops (Zetterstedt, 1838)	*Contarinia pulchripes* (Kieffer, 1890)	3	26.vii.2015	viii.2015	SH	DK	-	DK
Aprostocetus amenon (Walker, 1839)	*Dasineura ulmaria* (Bremi, 1847)	NA	14.vii.2021	NA	AP	RO	-	RO
Aprostocetus anodaphus (Walker, 1839)	*Ozirhincus millefolii* (Wachtl, 1884)	2	16.viii.2020	viii.2020	HHB	DK	-	-
Aprostocetus anodaphus (Walker, 1839)	*Ozirhincus millefolii* (Wachtl, 1884)	2	16.viii.2020	viii.2020	HHB	DK	N	DK
Aprostocetus apama (Walker, 1839)	*Planetella granifex* (Kieffer, 1898)	2	06.iv.2016	vi.2016	HHB	DK	FH	DK
Aprostocetus apama (Walker, 1839)	*Planetella gallarum* (Rübsaamen, 1899)	2	07.vi.2016	vii.2016	HHB	DK	N	-
Aprostocetus artemisiae (Erdös, 1954)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	08.viii.2022	viii.2022	HHB	DK	N	-
Aprostocetus artemisiae (Erdös, 1954)	*Dasineura artemisiae* (Rübsaamen, 1915)	2	17.viii.2021	viii.2021	HHB	DK	FP	DK
Aprostocetus catius (Walker, 1839)*[2]	*Contarinia festucae* Jones, 1940	4B	08.vii.2021	v.2022	HHB	DK	FHFP	DK
Aprostocetus cecidomyiarum (Bouché, 1834)	*Dasineura artemisiae* (Rübsaamen, 1915)	2	17.viii.2021	viii.2021	HHB	DK	N	DK
Aprostocetus clavicornis (Zetterstedt, 1838)	*Semudobia betulae* (Winnertz, 1853)	2	03.xii.2015	i.2016	SH	DK	-	DK

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Aprostocetus clavicornis (Zetterstedt, 1838)	*Semudobia betulae* (Winnertz, 1853)	2	25.xii.2015	i.2016	KA	DK	-	-
Aprostocetus crino (Walker, 1838)	Unknown cecidomyid inquiline ex *Aceria galiobia*	2	18.vii.2021	vii.2021	HHB	DK	N	-
Aprostocetus dotus (Walker, 1839)	*Dasineura ulmaria* (Bremi, 1847)	2	07.vii.2022	vii.2022	HHB	DK	-	DK
Aprostocetus dotus (Walker, 1839)	*Dasineura ulmaria* (Bremi, 1847)	2	14.vii.2022	vii.2022	HHB	DK	-	-
Aprostocetus elongatus (Förster, 1841)	*Mikiola fagi* (Hartig, 1839)	3	13.ii.2020	iii.2020	SH	DK	-	-
Aprostocetus elongatus (Förster, 1841)	*Mikiola fagi* (Hartig, 1839)	3	20.xi.2015	xii.2015	SH	DK	-	-
Aprostocetus elongatus (Förster, 1841)	*Mikiola fagi* (Hartig, 1839)	3	22.xi.2017	xii.2017	SH	DK	-	-
Aprostocetus elongatus (Förster, 1841)	*Mikiola fagi* (Hartig, 1839)	3	29.i.2015	ii.2015	SH	DK	-	-
Aprostocetus epicharmus (Walker, 1839)	*Dasineura serotina* (Winnertz, 1853)	3	20.vi.2016	vii.2026	SH	DK	FP	DK
Aprostocetus escherichi (Szelenyi, 1941)	*Semudobia tarda* Roskam, 1977	3	12.iii.2019	iii.2019	SH	PL	-	PL
Aprostocetus gratus (Giraud, 1863)	*Giraudiella inclusa* (Frauenfeld, 1862)	2	12.iii.2021	iv.2021	HHB	DK	-	-
Aprostocetus luteus (Ratzeburg, 1848)	*Mikiola fagi* (Hartig, 1839)	3	01.xii.2015	x.2016	SH	DK	-	DK
Aprostocetus lycidas (Walker, 1839)	*Hartigiola annulipes* (Hartig, 1839)	3	01.xi.2015	xii.2015	SH	DK	-	-
Aprostocetus lycidas (Walker, 1839)	*Hartigiola annulipes* (Hartig, 1839)	3	13.x.2020	xi.2021	SH	DK	-	-
Aprostocetus lysippe (Walker, 1839)	*Dasineura crataegi* (Winnertz, 1853)	4B	08.vii.2021	vii.2021	HHB	DK	-	-
Aprostocetus lysippe (Walker, 1839)	*Dasineura crataegi* (Winnertz, 1853)	3	08.viii.2017	viii.2017	SH	DK	-	DK
Aprostocetus menius (Walker, 1839)	*Lasioptera calamagrostidis* Rübsaamen, 1893	3	27.ii.2015	iv.2015	SH	DK	FH	DK
Aprostocetus micantulus (Thomson, 1878)	*Piceacecis abietiperda* (Henschel, 1880)	3	13.ii.2016	iv.2016	SH	DK	N	DK
Aprostocetus microscopicus (Rondani, 1877)	*Cystiphora taraxaci* (Kieffer, 1888)	3	08.viii.2018	viii.2028	SH	DK	-	DK
Aprostocetus cf. *myrsus* (Walker, 1839)	*Contarinia rumicis* (Loew, 1850)	3	10.viii.2022	viii.2022	SH	DK	N	DK

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Aprostocetus orithyia (Walker, 1839)	*Giraudiella inclusa* (Frauenfeld, 1862)	2	10.iii.2019	iii.2019	HHB	DK	-	-
Aprostocetus orithyia (Walker, 1839)	*Giraudiella inclusa* (Frauenfeld, 1862)	3	27.i.2016	ii.2016	SH	DK	-	-
Aprostocetus pallipes (Dalman, 1820)	*Semudobia skuhravae* Roskam, 1977	2	03.xii.2015	i.2016	SH	DK	-	DK
Aprostocetus pallipes (Dalman, 1820)	*Semudobia* sp. (*betulae* / *tarda*)	2	13.iii.2020	iii.2020	SH	DK	-	-
Aprostocetus sp. nr *pallipes* (Dalman, 1820)	*Iteomyia major* (Kieffer, 1889)	3	20.x.2020	xi.2020	SH	DK	N	-
Aprostocetus cf. *phineus* (Walker, 1839)	*Stenodiplosis* sp. ex *Elymus repens*	4B	18.vii.2021	iv.2022	HHB	DK	FH	-
Aprostocetus planiusculus (Thomson, 1878)	*Planetella* cf. *tarda* (Rübsaamen, 1899)	2	01.v.2019	v.2019	HHB	DK	N	-
Aprostocetus planiusculus (Thomson, 1878)	*Planetella* cf. *gallarum* (Rübsaamen, 1899)	2	16.iii.2019	v.2019	HHB	DK	N	-
Aprostocetus planiusculus (Thomson, 1878)	*Planetella granifex* (Kieffer, 1898)	2	16.iii.2019	v.2019	HHB	DK	-	DK
Aprostocetus planiusculus (Thomson, 1878)	*Planetella granifex* (Kieffer, 1898)	2	30.iv.2022	v.2022	HHB	DK	-	-
Aprostocetus rhacius (Walker, 1839)	*Dasineura spadicea* Rübsaamen, 1917	2	05.viii.2022	viii.2022	HHB	DK	N	DK
Aprostocetus rubi Graham, 1987	*Lasioptera rubi* (Schrank, 1803)	2	01.iv.2020	v.2020	HHB	DK	-	-
Aprostocetus rubi Graham, 1987	*Lasioptera rubi* (Schrank, 1803)	3	24.ix.2018	x.2018	SH	DK	-	DK
Aprostocetus rubicola Graham, 1987	*Lasioptera rubi* (Schrank, 1803)	3	17.xii.2015	i.2016	KA	DK	-	DK
Aprostocetus rubicola Graham, 1987	*Lasioptera rubi* (Schrank, 1803)	3	18.xii.2015	i.2016	KA	DK	-	-
Aprostocetus rubicola Graham, 1987	*Lasioptera rubi* (Schrank, 1803)	3	30.iii.2021	iv.2021	SH	DK	-	-
Aprostocetus cf. *suevius* (Walker, 1839)	*Dasineura ulmaria* (Bremi, 1847)	2	04.vii.2022	vii.2022	HHB	DK	FCH	DK
Aprostocetus cf. *suevius* (Walker, 1839)	*Dasineura ulmaria* (Bremi, 1847)	2	14.vii.2022	vii.2022	HHB	DK	-	-
Aprostocetus tanaceticola Graham, 1987	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	18.ix.2016	xii.2016	SH	DK	-	DK
Aprostocetus tanaceticola Graham, 1987	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	22.viii.2017	ix.2017	KN	DK	-	-

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Aprostocetus tanaceticola Graham, 1987	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	24.ix.2016	x.2016	SH	DK	-	-
Aprostocetus veronicae Graham, 1987	*Jaapiella veronicae* (Vallot, 1827)	3	15.viii.2017	ix.2017	SH	DK	-	DK
Aprostocetus viridinitens Graham, 1987	*Anthodiplosis rudimentalis* (Kieffer, 1901)	2	29.viii.2022	ix.2022	HHB	DK	FHFP	DK
Aprostocetus sp. A (probably undescribed)	*Asphondylia menthae* Kieffer, 1902	3	17.xii.2020	i.2021	SH	DK	-	-
Aprostocetus sp. B	*Contarinia arrhenatheri* Kieffer, 1901	4B	25.vi.2020	v.2021	HHB	DK	-	-
Aprostocetus sp. C	*Contarinia arrhenatheri* Kieffer, 1901	4B	25.vi.2020	v.2021	HHB	DK	-	-
Aprostocetus sp. D	*Dasineura fraxini* (Bremi, 1847)	3	08.x.2018	x.2018	SH	DK	-	-
Aprostocetus sp. E	*Dasineura ulmaria* (Bremi, 1847)	3	06.viii.2017	viii.2027	SH	DK	-	-
Aprostocetus sp. F	*Parallelodiplosis galliperda* (F. Löw, 1889)	3	25.ix.2018	x.2018	SH	DK	-	-
Aprostocetus sp. G	*Rhopalomyia artemisiae* (Bouché, 1834)	2	14.x.2016	i.2016	MB	DK	-	-
Aprostocetus sp. H	*Rhopalomyia artemisiae* (Bouché, 1834)	2	22.xii.2016	i.2016	MB	DK	-	-
Aprostocetus sp. I	*Stenodiplosis* sp. ex *Elymus repens*	4B	18.vii.2021	v.2022	HHB	DK	-	-
Aprostocetus sp. K	*Wachtliella persicariae* (Linnaeus, 1767)	2	09.viii.2022	viii.2022	HHB	DK	-	-
Aprostocetus sp. L	*Contarinia acrocecis* Stelter, 1962	4B	08.vii.2021	iv.2022	HHB	DK	-	-
Aprostocetus sp. M	*Contarinia* sp. "*euonymi*" nom.inedit.	4B	13.vi.2021	iii.2022	HHB	DK	-	-
Aprostocetus sp. N	*Dasineura* sp. A sensu Harris (2010)	2	20.vi.2020	vii.2020	HHB	DK	-	-
Aprostocetus sp. P	*Rhopalomyia tubifex* (Bouché, 1847)	2	06.viii.2020	viii.2020	HHB	DK	-	-
Asecodes congruens (Nees, 1834)	*Mikiola fagi* (Hartig, 1839)	3	29.i.2015	ii.2015	SH	DK	FH	

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Euderus albitarsis (Zetterstedt, 1838)	*Rabdophaga rosaria* (Loew, 1850)	NA	01.iv.2020	iv.2020	KH	DK	N	-
Ionympha carne (Walker, 1839)	*Mycodiplosis* cf. *melampsorae* (Rübsaamen, 1889)	4A	04.x.2020	x.2020	HHB	DK	FHFP	DK
Omphale aethiops Graham, 1963	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	iv.2023	HHB	DK	-	-
Omphale aethiops Graham, 1963	*Dasineura acrophila* (Winnertz, 1853) and *Macrolabis pavida* (Winnertz, 1853)	4B	06.vi.2022	iii.2023	HHB	DK	N	
Omphale aetius (Walker, 1839)	*Dasineura tiliae* (Schrank, 1803)	4B	01.vi.2021	iii.2022	HHB	DK	N	-
Omphale aetius (Walker, 1839)	*Dasineura urticae* (Perris, 1840)	4A	09.20.2020	vii.2020	HHB	DK	-	DK
Omphale cf. *aetius* (Walker, 1839)	*Dasineura tiliae* (Schrank, 1803)	4B	09.vi.2022	iii.2023	HHB	DK	N	DK
Omphale sp. (*aetius* group)	*Rondaniola bursaria* (Bremi, 1847)	4A	11.vii.2020	ix.2020	HHB	DK	-	-
Omphale sp. nr *chryseis* Graham, 1963	*Diodaulus linariae* (Winnertz, 1853)	4B	09.viii.2022	iii.2023	HHB	DK	N	-
Omphale clymene (Walker, 1839)	*Dasineura plicatrix* (Loew, 1850)	4B	14.viii.2022	iv.2023	HHB	DK	N	-
Omphale cf. *clymene* (Walker, 1839)	*Dasineura fructum* (Rübsaamen, 1895)	4B	12.vii.2020	v.2021	HHB	DK	N	-
Omphale connectens Graham, 1963	*Dasineura urticae* (Perris, 1840)	4A	09.20.2020	vii.2020	HHB	DK	FH	-
Omphale sp. nr *grahami* Gijswijt, 1976	*Monarthropalpus flavus* (Schrank, 1776)	2	13.iii.2022	iii.2022	HHB	DK	N	DK
Omphale lugens (Nees, 1834)	*Dasineura tortilis* (Bremi, 1847)	4B	06.vi.2022	iii.2023	HHB	DK	-	-
Omphale lugens (Nees, 1834)	*Mikiola fagi* (Hartig, 1839)	3	22.xi.2017	iv.2018	SH	DK	-	-
Omphale phaola (Walker, 1839)	*Dasineura oxyacanthae* Rübsaamen, 1914	4B	05.vi.2022	iii.2023	HHB	DK	FHFP	DK
Omphale phaola (Walker, 1839)	*Dasineura tortilis* (Bremi, 1847)	4B	06.vi.2022	iii.2023	HHB	DK	FH	-
Omphale phruron (Walker, 1839)	*Dasineura galiicola* (F. Löw, 1880)	4B	06.vii.2022	iii.2023	HHB	DK	FH	-
Omphale telephe (Walker, 1839)	*Dasineura saxifragae* (Kieffer, 1891)	4B	01.vi.2020	iii.2021	HHB	DK	FHFP	DK

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Omphale theana (Walker, 1839)	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	iv.2023	HHB	DK	N	-
Omphale theana (Walker, 1839)	*Contarinia scrophulariae* Kieffer, 1896	4B	08.vii.2022	iii.2023	HHB	DK	-	-
Omphale theana (Walker, 1839)	*Contarinia scrophulariae* Kieffer, 1896	1B	19.vi.2021	vi.2021	HHB	DK	FH	DK
Omphale theana (Walker, 1839)	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	N	-
Quadrastichus anysis (Walker, 1839)	*Monarthropalpus flavus* (Schrank, 1776)	2	12.xii.2014	xii.2014	SH	DK	-	-
Quadrastichus anysis (Walker, 1839)	*Monarthropalpus flavus* (Schrank, 1776)	3	12.xii.2014	xii.2014	SH	DK	-	DK
Quadrastichus anysis (Walker, 1839)	*Monarthropalpus flavus* (Schrank, 1776)	2	15.iii.2020	iv.2020	HHB	DK	-	-
Quadrastichus anysis (Walker, 1839)	*Monarthropalpus flavus* (Schrank, 1776)	3	24.iii.2017	iv.2017	SH	DK	-	-
Quadrastichus lasiocerus (Graham, 1961)	*Wachtliella persicariae* (Linnaeus, 1767)	2	14.vii.2022	vii.2022	HHB	DK	-	DK
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia baudysi* Vimmer, 1937	3	01.ix.2020	ix.2020	KA	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	01.vii.2016	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	3	02.vii.2016	vii.2016	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	03.vii.2013	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	03.vii.2016	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	03.viii.2020	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	07.viii.2020	NA	SH	DK	-	-

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Sigmophora brevicornis (Panzer, 1804)	*Kiefferia pericarpiicola* (Bremi, 1847)	5	08.viii.2022	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	12.vi.2017	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	13.vi.2020	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia melanopus* Kieffer, 1890	5	16.viii.2017	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	17.vii.2016	vii.2016	BA	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia menthae* Kieffer, 1902	3	17.xii.2020	i.2021	SH	DK	N	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	3	19.v.2016	v.2016	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Kiefferia pericarpiicola* (Bremi, 1847)	2	23.viii.2018	viii.2018	HHB	PL	-	-
Sigmophora brevicornis (Panzer, 1804)	*Kiefferia pericarpiicola* (Bremi, 1847)	1A	24.ix.2016	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	26.vii.2017	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	5	28.vii.2023	NA	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia* sp.	3	30.ix.2020	x.2020	SH	DK	-	-
Sigmophora brevicornis (Panzer, 1804)	*Asphondylia sarothamni* (Loew, 1850)	3	30.vi.2016	vii.2016	SH	DK	-	-
Eupelmidae								
Eupelmus cf. *tremulae* Delvare 2014*[7]	*Harmandiola cavernosa* (Rübsaamen, 1899)	1A	10.viii.2018	viii.2018	HHB	DK	FP	DK
Eupelmus confusus Al khatib, 2015	*Asphondylia sarothamni* (Loew, 1850)	3	22.vii.2017	viii.2017	SH	DK	N	-

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Eupelmus confusus Al khatib, 2015	*Rhopalomyia artemisiae* (Bouché, 1834)	2	22.xii.2016	i.2016	MB	DK	N	DK
Eupelmus confusus Al khatib, 2015	*Asphondylia sarothamni* (Loew, 1850)	3	26.vii.2017	viii.2017	SH	DK	-	-
Eupelmus urozonus Dalman, 1820	*Lasioptera rubi* (Schrank, 1803)	3	30.iii.2021	iv.2021	SH	DK	-	-
Eupelmus urozonus sensu lato	*Mikiola fagi* (Hartig, 1839)	3	20.xi.2015	xii.2015	SH	DK	-	-
Eupelmus vesicularis (Retzius, 1783)	*Lasioptera rubi* (Schrank, 1803)	3	30.iii.2021	iv.2021	SH	DK	-	-
Eurytomidae								
Eurytoma dentata Mayr, 1878	*Asphondylia sarothamni* (Loew, 1850)	1A	04.viii.2020	NA	SH	DK	-	-
Eurytoma dentata Mayr, 1878	*Asphondylia sarothamni* (Loew, 1850)	1A	07.viii.2020	NA	SH	DK	-	-
Eurytoma dentata Mayr, 1878	*Asphondylia sarothamni* (Loew, 1850)	3	21.xii.2020	i.2021	SH	DK	-	-
Eurytoma dentata Mayr, 1878	*Asphondylia sarothamni* (Loew, 1850)	3	22.vii.2017	viii.2017	SH	DK	-	DK
Sycophila fasciata (Thomson, 1876)	*Giraudiella inclusa* (Frauenfeld, 1862)	2	12.iii.2021	iv.2021	HHB	DK	-	-
Platygastridae								
Acerotella sp. (*evanescens* group)	*Dasineura pulsatillae* (Kieffer, 1894)	4B	13.vi.2021	iv.2022	HHB	DK	FH	-
Anopedias lacustris (Kieffer, 1926)	*Planetella granifex* (Kieffer, 1898)	2	06.iv.2016	vi.2016	HHB	DK	FH	-
Anopedias lacustris (Kieffer, 1926)	*Planetella granifex* (Kieffer, 1898)	2	16.iii.2019	v.2019	HHB	DK	-	-
Anopedias lacustris (Kieffer, 1926)	*Planetella granifex* (Kieffer, 1898)	2	17.iii.2019	iv.2019	HHB	DK	-	-
Anopedias lacustris (Kieffer, 1926)	*Planetella granifex* (Kieffer, 1898)	2	30.iii.2019	v.2019	HHB	DK	-	-
Anopedias lacustris (Kieffer, 1926)	*Planetella* cf. *gallarum* (Rübsaamen, 1899)	2	30.iv.2022	v.2022	HHB	DK	N	-
Anopedias obscurus Thomson, 1859	*Planetella gallarum* (Rübsaamen, 1899)	2	07.vi.2016	vi.2016	HHB	DK	FP	-

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Anopedias obscurus Thomson, 1859	*Planetella granifex* (Kieffer, 1898)	2	30.iii.2019	v.2019	HHB	DK	FH	-
Anopedias sundholmi Huggert, 1974	*Planetella granifex* (Kieffer, 1898)	2	30.iii.2019	v.2019	HHB	DK	FH	-
Inostemma boscii (Jurine, 1807) sensu Kozlov 1978	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	iv.2023	HHB	DK	N	-
Inostemma sp. nr *boscii* (Jurine, 1807) sensu Kozlov 1978	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	N	-
Inostemma koponeni Buhl, 2005	*Dasineura medicaginis* (Bremi, 1847)	4A	10.vii.2020	viii.2020	HHB	DK	FH	DK
Inostemma lycon Walker, 1835 sensu Szelényi 1938	*Stenodiplosis* sp. ex *Elymus repens*	4B	18.vii.2021	v.2022	HHB	DK	FH	DK
Inostemma walkeri Kieffer, 1914 sensu Szelényi 1938	*Dasineura pulsatillae* (Kieffer, 1894)	4B	13.vi.2021	v.2022	HHB	DK	FP	-
Inostemma walkeri Kieffer, 1914 sensu Szelényi 1938	*Contarinia* "*quercuscupuli*" nom.inedit.	2	14.vii.2015	iii.2016	HHB	DK	FP	-
Inostemma walkeri Kieffer, 1914 sensu Szelényi 1938	*Lathyromyza florum* Rübsaamen, 1916	4B	15.viii.2022	v.2023	HHB	DK	N	-
Inostemma sp. nr *walkeri* Kieffer, 1914	*Dasineura fructum* (Rübsaamen, 1895)	4B	12.vii.2020	v.2021	HHB	DK	N	-
Isocybus ocellaris Kieffer, 1916	*Planetella arenariae* (Rübsaamen, 1899)	2	04.x.2020	iv.2021	HHB	DK	FH	-
Leptacis tipulae (Kirby, 1798)	*Contarinia quinquenotata* (F. Löw, 1888)	2	04.vii.2021	vii.2021	HHB	DK	N	-
Leptacis tipulae (Kirby, 1798)	*Contarinia quinquenotata* (F. Löw, 1888)	2	05.vii.2021	vii.2021	HHB	DK	-	-
Leptacis tipulae (Kirby, 1798)	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	N	-
Leptacis vlugi Buhl, 1997	*Mycodiplosis* cf. *melampsorae* (Rübsaamen, 1889)	4A	12.viii.2021	ix.2021	HHB	SE	FH	-
Metaclisis germanica Buhl, 2019	*Dasineura minungula* Stelter, 1986	2	03.viii.2022	iii.2023	HHB	DK	FHFP	-
Metaclisis montagnei Maneval, 1936	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	iv.2023	HHB	DK	FH	DK
Metaclisis phragmitis Debauche, 1947	*Semudobia tarda* Roskam, 1977	1A	ultimo.iii. 2022	NA	SH	HU	N	HU

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Platygaster athamas Walker, 1835	*Contarinia* " *quercuscupuli*" nom.inedit.	2	14.vii.2015	iii.2016	HHB	DK	N	-
Platygaster sp. nr *athamas* Walker, 1835	*Dasineura urticae* (Perris, 1840)	4A	09.20.2020	vii.2020	HHB	DK	N	-
Platygaster betulae (Kieffer, 1916)	*Semudobia betulae* (Winnertz, 1853)	2	10.iv.2012	iv.2012	HHB	DK	-	-
Platygaster betulae (Kieffer, 1916)	*Semudobia betulae* (Winnertz, 1853)	1A	14.iii.2014	NA	SH	DK	-	-
Platygaster betulae (Kieffer, 1916)	*Semudobia tarda* Roskam, 1977	1A	medio.ix. 2021	NA	AM	LT	N	LT
Platygaster compressicornis (Thomson, 1859)	*Planetella arenariae* (Rübsaamen, 1899)	2	10.v.2020	v.2020	HHB	DK	N	-
Platygaster damokles (Buhl, 1998)	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	iv.2023	HHB	DK	FH	-
Platygaster demades Walker, 1835	*Dasineura urticae* (Perris, 1840)	4A	06.20.2020	vii.2020	HHB	DK	N	-
Platygaster demades Walker, 1835	*Dasineura urticae* (Perris, 1840)	4A	09.20.2020	vii.2020	HHB	DK	-	-
Platygaster demades Walker, 1835	*Contarinia* " *quercuscupuli*" nom.inedit.	2	14.vii.2015	iii.2016	HHB	DK	N	-
Platygaster demades Walker, 1835	*Lasioptera rubi* (Schrank, 1803)	3	30.iii.2021	iv.2021	SH	DK	N	-
Platygaster dryomyiae Silvestre, 1916	*Dryomyia lichtensteinii* (F. Löw, 1878)	2	01.iv.2018	iv.2018	HHB	ES	-	-
Platygaster dryomyiae Silvestre, 1916	*Dryomyia lichtensteinii* (F. Löw, 1878)	2	02.iv.2018	iv.2018	HHB	ES	-	-
Platygaster dryope Walker, 1836	*Mycodiplosis* cf. *melampsorae* (Rübsaamen, 1889)	4A	12.viii.2021	ix.2021	HHB	SE	FH	-
Platygaster entwistlei Buhl, 1997	*Oligotrophus valerii* (Tavares, 1904)	2	23.iv.2019	vi.2019	HHB	ES	FHFP	ES
Platygaster entwistlei Buhl, 1997	*Oligotrophus valerii* (Tavares, 1904)	2	26.iv.2019	vi.2019	HHB	ES	-	-
Platygaster eriphyle Walker, 1835	*Rabdophaga salicis* (Schrank, 1803)	1A	15.i.2018	NA	SH	DK	N	-
Platygaster euhemerus Walker, 1835	*Ametrodiplosis thalictricola* (Rübsaamen, 1895)	2	18.vii.2021	v.2022	HHB	DK	FH	-
Platygaster sp. nr *jutlandica* Buhl, 2006	*Putoniella pruni* (Kaltenbach, 1872)	4B	13.vi.2021	iv.2022	HHB	DK	FH	-

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Platygaster leptines Walker, 1835	*Dasineura saxifragae* (Kieffer, 1891)	4B	01.vi.2020	iii.2021	HHB	DK	FH	-
Platygaster leptines Walker, 1835	*Dasineura aparines* (Kieffer, 1889)	4B	05.vii.2021	v.2022	HHB	DK	FP	-
Platygaster leptines Walker, 1835	*Dasineura acrophila* (Winnertz, 1853) and *Macrolabis pavida* (Winnertz, 1853)	4B	06.vi.2022	iii.2023	HHB	DK	N	-
Platygaster marginata Thomson, 1859	*Contarinia* sp. " *uliginosi*" nom. inedit.	4B	27.vi.2019	iv.2020	HHB	DK	FH	-
Platygaster sp. nr *munita* Walker, 1835	*Dasineura inflata* Stelter, 1986	4B	05.vii.2021	iv.2022	HHB	DK	FP	-
Platygaster sp. nr *munita* Walker, 1835	*Dasineura inflata* Stelter, 1986	4B	18.vii.2021	iv.2022	HHB	DK	-	-
Platygaster oebalus Walker, 1835	*Dasineura fructum* (Rübsaamen, 1895)	4B	04.vii.2022	iii.2023	HHB	DK	N	-
Platygaster oebalus Walker, 1835	*Lathyromyza schlechtendali* (Kieffer, 1886)	4B	18.vi.2022	iii.2023	HHB	SE	FP	-
Platygaster sp. nr *oebalus* Walker, 1835	*Dasineura fructicola* (Kieffer, 1909)	2	14.vii.2022	iii.2023	HHB	DK	FP	-
Platygaster oeclus Walker, 1835	*Janetiella glechomae* Tavares, 1930	4B	19.vi.2020	iii.2021	HHB	DK	FHFP	-
Platygaster cf. *oeclus* Walker, 1835*[4]	*Dasineura glechomae* (Kieffer, 1889)	4B	21.vi.2020	iii.2021	HHB	DK	N	-
Platygaster pelias Walker, 1835	*Dasineura oxyacanthae* Rübsaamen, 1914	4B	05.vi.2022	iii.2023	HHB	DK	N	-
Platygaster phragmitiphila Buhl, 2006	*Lasioptera arundinis* Schiner, 1854	NA	02.iv.2018	iv.2018	LKT	DK	-	-
Platygaster phragmitiphila Buhl, 2006	*Lasioptera arundinis* Schiner, 1854	2	07.v.2017	v.2017	SH	DK	FH	DK
Platygaster phragmitiphila Buhl, 2006	*Lasioptera arundinis* Schiner, 1854	2	10.iii.2019	v.2019	HHB	DK	-	-
Platygaster phragmitiphila Buhl, 2006	*Lasioptera arundinis* Schiner, 1854	2	16.iii.2019	iii.2019	SH	PL	-	PL
Platygaster robiniae Buhl & Duso, 2008	*Obolodiplosis robiniae* (Haldeman, 1847)	2	04.xi.2019	xii.2019	SH	DK	-	-
Platygaster robiniae Buhl & Duso, 2008	*Obolodiplosis robiniae* (Haldeman, 1847)	3	09.x.2019	NA	JS	SE	-	-

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Platygaster robiniae Buhl & Duso, 2008	*Obolodiplosis robiniae* (Haldeman, 1847)	3	17.xi.2018	NA	SH	SE	-	SE
Platygaster sagana Walker, 1835	*Contarinia acrocecis* Stelter, 1962	4B	08.vii.2021	iv.2022	HHB	DK	N	-
Platygaster sagana Walker, 1835	*Contarinia festucae* Jones, 1940	4B	08.vii.2021	v.2022	HHB	DK	N	-
Platygaster sagana Walker, 1835	*Dasineura inflata* Stelter, 1986	4B	18.vii.2021	iv.2022	HHB	DK	N	-
Platygaster sp. nr *sagana* Walker, 1835	*Ametrodiplosis thalictricola* (Rübsaamen, 1895)	2	18.vii.2021	v.2022	HHB	DK	N	-
Platygaster sp. (*splendidula* group)	*Mayetiola phalaris* Barnes, 1927	3	02.v.2016	v.2016	SH	DK	-	-
Platygaster sp. (*splendidula* group)	*Planetella arenariae* (Rübsaamen, 1899)	2	04.x.2020	iv.2021	HHB	DK	-	-
Platygaster sp. (*splendidula* group)	*Mayetiola* ventricola (Rübsaamen, 1899)	2	17.iii.2020	iv.2020	HHB	DK	-	-
Platygaster szelenyii Huggert, 1975	*Giraudiella inclusa* (Frauenfeld, 1862)	2	10.iii.2019	iii.2019	HHB	DK	-	-
Platygaster szelenyii Huggert, 1975	*Giraudiella inclusa* (Frauenfeld, 1862)	2	12.iii.2021	v.2021	HHB	DK	-	-
Platygaster uniformis Buhl, 2006	*Rabdophaga dubiosa* Kieffer, 1913	2	16.iii.2019	iii.2019	HHB	DK	FH	-
Platygaster sp. A	*Dasineura rosae* (Bremi, 1847)	1A	09.viii.2019	NA	SH	DK	-	-
Platygaster sp. B	*Dasineura acrophila* (Winnertz, 1853) and *Macrolabis pavida* (Winnertz, 1853)	4B	06.vi.2022	iii.2023	HHB	DK	-	-
Platygaster sp. C	*Lathyromyza florum* Rübsaamen, 1916	4B	14.vii.2022	iv.2023	HHB	DK	-	-
Platygastridae indet.	*Dasineura galiicola* (F. Löw, 1880)	4B	06.vii.2022	iii.2023	HHB	DK	-	-
Synopeas ciliatum Thomson, 1859	*Mycodiplosis* cf. *melampsorae* (Rübsaamen, 1889)	4A	12.viii.2021	ix.2021	HHB	SE	FH	-
Synopeas convexum Thomson, 1859	*Dasineura hygrophila* (Mik, 1883)	2	10.viii.2022	viii.2022	HHB	DK	FHFP	DK
Synopeas gibberosum Buhl, 1997	*Dasineura ulmaria* (Bremi, 1847)	2	07.vii.2022	vii.2022	HHB	DK	FH	-
Synopeas gibberosum Buhl, 1997	*Dasineura ulmaria* (Bremi, 1847)	2	14.vii.2022	vii.2022	HHB	DK	N	-

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Synopeas inerme Thomson, 1859	*Contarinia solani* (Rübsaamen, 1892)	4A	02.vii.2022	vii.2022	HHB	DK	N	-
Synopeas inerme Thomson, 1859	*Dasineura angelicae* Rübsaamen, 1916	4B	08.viii.2021	v.2022	HHB	SE	FP	-
Synopeas sp. nr *inerme* Thomson, 1859	*Dasineura fructum* (Rübsaamen, 1895)	4B	04.vii.2022	iii.2023	HHB	DK	N	-
Synopeas larides (Walker, 1835)	*Contarinia tiliarum* (Kieffer, 1890)	4B	01.vi.2021	iii.2022	HHB	DK	N	-
Synopeas larides (Walker, 1835)	*Dasineura fructum* (Rübsaamen, 1895)	4B	04.vii.2022	iii.2023	HHB	DK	FP	-
Synopeas larides (Walker, 1835)	*Dasineura thomasiana* (Kieffer, 1888)	4B	14.vi.2021	iv.2022	HHB	DK	FP	-
Synopeas myles (Walker, 1835)	*Lathyromyza florum* Rübsaamen, 1916	2	14.vii.2022	vii.2022	HHB	DK	N	-
Synopeas myles (Walker, 1835)	*Contarinia medicaginis* Kieffer, 1895	2	14.viii.2020	ix.2020	HHB	DK	N	-
Synopeas sp. nr *myles* (Walker, 1836)	*Dasineura crataegi* (Winnertz, 1853)	1A	08.viii.2017	NA	SH	DK	N	-
Synopeas sp. nr *myles* (Walker, 1836)	*Lathyromyza florum* Rübsaamen, 1916	4B	14.vii.2022	iv.2023	HHB	DK	N	-
Synopeas rhanis (Walker, 1835)	*Dasineura urticae* (Perris, 1840)	4A	09.20.2020	vii.2020	HHB	DK	-	-
Synopeas sp. (subgenus *Sactogaster*)*[9]	*Contarinia solani* (Rübsaamen, 1892)	4B	02.vii.2022	iv.2023	HHB	DK	-	-
Synopeas sosis (Walker, 1835)	*Contarinia fagi* Rübsaamen, 1921	1A	07.viii.2020	NA	SH	DK	N	-
Synopeas sosis (Walker, 1835)	*Wachtliella persicariae* (Linnaeus, 1767)	2	14.vii.2022	vii.2022	HHB	DK	N	-
Synopeas sosis (Walker, 1835)	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	N	-
Synopeas subaequalis (Förster, 1856)	*Contarinia* sp. "*hesperidis*" nom. inedit.	4B	13.vi.2021	iii.2022	EF	DK	FH	-
Synopeas ventrale (Westwood, 1833)	*Contarinia tiliarum* (Kieffer, 1890)	4B	01.vi.2021	iii.2022	HHB	DK	FH	-
Pteromalidae								
Gastrancistrus acontes Walker, 1840	*Dasineura acrophila* (Winnertz, 1853) and *Macrolabis pavida* (Winnertz, 1853)	4B	06.vi.2022	iii.2023	HHB	DK	FH	DK

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Gastrancistrus affinis Graham, 1969*[1]	*Contarinia anthobia* (F. Löw, 1877)	4B	12.vi.2021	iv.2022	HHB	DK	FCH	DK
Gastrancistrus affinis Graham, 1969	*Lathyromyza florum* Rübsaamen, 1916	4B	15.viii.2022	iv.2023	HHB	DK	N	-
Gastrancistrus sp. nr *affinis* Graham	*Lathyromyza florum* Rübsaamen, 1916	4A	15.viii.2022	ix.2022	HHB	DK	-	DK
Gastrancistrus glabellus (Nees, 1834)	*Diodaulus linariae* (Winnertz, 1853)	4B	09.viii.2022	iii.2023	HHB	DK	N	-
Gastrancistrus glabellus (Nees, 1834)	*Lathyromyza florum* Rübsaamen, 1916	4B	14.vii.2022	iv.2023	HHB	DK	FHFP	DK
Gastrancistrus salicis (Nees, 1834)	*Rabdophaga salicis* (Schrank, 1803)	3	13.iii.2015	iv.2015	SH	DK	-	-
Gastrancistrus salicis (Nees, 1834)	*Rabdophaga dubiosa* Kieffer, 1913	2	16.iii.2019	iii.2019	HHB	DK	N	-
Gastrancistrus salicis (Nees, 1834)	*Rabdophaga salicis* (Schrank, 1803)	3	29.ii.2016	NA	LKT	DK	-	-
Gastrancistrus unicolor Walker, 1834	*Lathyromyza schlechtendali* (Kieffer, 1886)	4B	18.vi.2022	iii.2023	HHB	SE	FH	-
Gastrancistrus sp. (*vagans* group)	*Dasineura epilobii* (F. Löw, 1889)	4B	05.vii.2022	vii.2022	HHB	DK	N	-
Gastrancistrus sp. (*vagans* group)	*Dasineura plicatrix* (Loew, 1850)	4B	14.viii.2022	iv.2023	HHB	DK	-	-
Gastrancistrus sp. (*vagans* group)	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	vii.2022	HHB, ND	DK	-	-
Gastrancistrus sp. nr *vulgaris* Walker, 1834	*Dasineura fructicola* (Kieffer, 1909)	2	14.vii.2022	iii.2023	HHB	DK	FH	DK
Gastrancistrus sp. ('sp. indet' in Graham's (1969) key)	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	-	-
Gastrancistrus sp. A	*Dasineura aparines* (Kieffer, 1889)	4B	05.vii.2021	v.2022	HHB	DK	-	-
Gastrancistrus sp. B*[8]	*Planetella arenariae* (Rübsaamen, 1899)	2	04.x.2020	v.2021	HHB	DK	-	-
Lampoterma bianellatum Graham, 1969*[5]	*Dasineura inflata* Stelter, 1986	4B	18.vii.2021	v.2022	HHB	DK	-	DK
Lamprotatus cf. *pschorni* (Delucchi, 1953) sensu Graham 1969	*Contarinia* sp. "*glycyphylli*" nom.inedit.	4B	21.vi.2022	iv.2023	HHB, ND	DK	FH	DK
Macroglenes bouceki (Graham, 1969)	*Dasineura rosae* (Bremi, 1847)	1A	03.viii.2020	NA	SH	DK	FH	DK
Macroglenes chalybeus (Haliday, 1833)	*Contarinia steini* (Karsch, 1881)	1A	03.viii.2020	NA	SH	DK	FP	DK

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Macroglenes eximius (Haliday, 1833)	*Contarinia perplicata* Fedotova, 1997	4B	07.vi.2020	vi.2021	HHB	DK	FP	-
Macroglenes eximius (Haliday, 1833)	*Contarinia acrocecis* Stelter, 1962	4B	08.vii.2021	iv.2022	HHB	DK	FP	-
Macroglenes penetrans (Kirby, 1800)*[3]	*Contarinia* sp. "*holci*" nom.inedit	4B	11.vii.2020	v.2021	HHB	DK	N	DK
Mesopolobus aspilus (Walker, 1835)	*Oligotrophus juniperinus* (Linnaeus, 1758)	3	15.v.2017	v.2017	SH	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Dasineura trifolii* (F. Löw, 1874)	3	11.ix.2016	ix.2016	SH	DK	N	-
Mesopolobus diffinis (Walker, 1834)	*Wachtliella persicariae* (Linnaeus, 1767)	2	14.vii.2022	vii.2022	HHB	DK	N	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	14.x.2016	i.2016	MB	DK	N	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	17.xii.2016	i.2016	MB	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	21.xi.2016	i.2016	MB	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	22.viii.2017	ix.2017	KN	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	22.xii.2016	i.2016	MB	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	24.xii.2016	i.2016	MB	DK	-	-
Mesopolobus diffinis (Walker, 1834)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	25.x.2016	i.2016	MB	DK	-	-
Mesopolobus fagi Askew and Lampe, 1998	*Mikiola fagi* (Hartig, 1839)	3	01.i.2017	iii.2017	SH	DK	-	-
Mesopolobus fagi Askew and Lampe, 1998	*Mikiola fagi* (Hartig, 1839)	3	03.x.2014	x.2014	SH	DK	-	DK
Mesopolobus mediterraneus (Mayr, 1903)	*Oligotrophus valerii* (Tavares, 1904)	2	26.iv.2019	vi.2019	HHB	ES	N	-
Mesopolobus nobilis (Walker, 1834)	*Contarinia arrhenatheri* Kieffer, 1901	4B	25.vi.2020	v.2021	HHB	DK	FCH	DK

Parasitoid name	Gall midge host name	Method	Collection date	Emg. month	Coll.	C.	Int. nov.	Biogeo. nov.
Mesopolobus rhabdophagae (Graham, 1957)	*Rabdophaga rosaria* (Loew, 1850)	3	14.i.2016	i.2016	SH	DK	N	DK
Mesopolobus semiclavatus (Ratzeburg, 1848)	*Iteomyia major* (Kieffer, 1889)	3	20.x.2020	xi.2020	SH	DK	-	DK
Mesopolobus teliformis (Walker, 1834)	*Stenodiplosis* sp. ex *Elymus repens*	2	18.vii.2021	vii.2021	HHB	DK	FCH	DK
Mesopolobus sp. (probably undescribed)	*Dasineura galiicola* (F. Löw, 1880)	4B	06.vii.2022	iii.2023	HHB	DK	-	-
Pseudocatolaccus nitescens (Walker, 1834)	*Asphondylia sarothamni* (Loew, 1850)	1A	07.viii.2020	NA	SH	DK	-	-
Pseudocatolaccus nitescens (Walker, 1834)	*Asphondylia sarothamni* (Loew, 1850)	3	26.vii.2017	viii.2017	SH	DK	-	-
Psilonotus achaeus Walker, 1848	*Semudobia skuhravae* Roskam, 1977	2	03.xii.2015	i.2016	SH	DK	-	-
Psilonotus achaeus Walker, 1848	*Semudobia* sp. (*betulae* / *tarda*)	2	13.iii.2020	iv.2020	SH	DK	-	-
Psilonotus achaeus Walker, 1848	*Semudobia betulae* (Winnertz, 1853)	2	17.xii.2015	i.2016	KA	DK	-	-
Psilonotus achaeus Walker, 1848	*Semudobia tarda* Roskam, 1977	3	ultimo.iii. 2022	04-2022	SH	HU	-	HU
Psilonotus adamas Walker, 1834	*Semudobia tarda* Roskam, 1977	3	12.iii.2019	iii.2019	SH	PL	-	PL
Psilonotus adamas Walker, 1834	*Semudobia* sp. (*betulae* / *tarda*)	2	13.iii.2020	iv.2020	SH	DK	-	DK
Systasis encyrtoides Walker, 1834	*Dasineura crataegi* (Winnertz, 1853)	3	08.viii.2017	viii.2017	SH	DK	N	-
Toxeuma fuscicorne Walker, 1833	*Dasineura saxifragae* (Kieffer, 1891)	4B	01.vi.2020	iii.2021	HHB	DK	FCH	DK
Trichomalopsis cf. *caricicola* (Graham, 1969)	*Planetella granifex* (Kieffer, 1898)	2	17.iii.2019	v.2019	HHB	DK	FH	DK
Torymidae								
Torymus abbreviatus Boheman, 1834	*Lasioptera rubi* (Schrank, 1803)	3	18.xii.2015	xii.2015	KA	DK	-	DK
Torymus anthobiae Ruschka, 1921	*Contarinia anthobia* (F. Löw, 1877)	3	07.vi.2016	vi.2026	SH	DK	-	DK
Torymus arundinis (Walker, 1833)	*Lasioptera arundinis* Schiner, 1854	NA	02.iv.2018	iv.2018	LKT	DK	-	-
Torymus arundinis (Walker, 1833)	*Lasioptera arundinis* Schiner, 1854	2	07.iv.2014	iv.2014	SH	DK	-	-

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Torymus arundinis (Walker, 1833)	*Lasioptera arundinis* Schiner, 1854	2	07.v.2017	v.2017	SH	DK	-	-
Torymus arundinis (Walker, 1833)	*Giraudiella inclusa* (Frauenfeld, 1862)	2	12.iii.2021	iv.2021	HHB	DK	-	-
Torymus arundinis (Walker, 1833)	*Lasioptera arundinis* Schiner, 1854	2	17.iv.2014	iv.2014	SH	DK	-	-
Torymus chloromerus (Walker, 1833)	*Geocrypta* campanulae (Müller, 1871)	1A	11.viii.2022	viii.2022	HHB	DK	N	-
Torymus confinis (Walker, 1833)	*Dasineura urticae* (Perris, 1840)	3	21.xi.2015	xii.2015	SH	DK	-	-
Torymus cultriventris Ratzeburg, 1844	*Mikiola fagi* (Hartig, 1839)	3	13.ii.2020	ii.2020	SH	DK	-	-
Torymus cultriventris Ratzeburg, 1844	*Mikiola fagi* (Hartig, 1839)	3	20.xi.2015	xii.2015	SH	DK	-	-
Torymus cultriventris Ratzeburg, 1844	*Mikiola fagi* (Hartig, 1839)	3	22.ii.2020	iii.2020	SH	DK	-	-
Torymus sp. nr *curtisi* Graham & Gijswijt	*Kiefferia pericarpiicola* (Bremi, 1847)	2	23.viii.2018	viii.2018	HHB	PL	-	-
Torymus eglanteriae Mayr, 1874	*Contarinia tiliarum* (Kieffer, 1890)	3	11.vii.2017	vii.2017	SH	DK	-	-
Torymus filipendulae Graham & Gijswijt, 1998	*Dasineura ulmaria* (Bremi, 1847)	3	24.x.2016	xi.2016	SH	DK	-	DK
Torymus cf. *filipendulae* Graham & Gijswijt, 1998*[6]	*Dasineura* sp. A sensu Harris (2010)	2	20.vi.2020	vii.2020	HHB	DK	FP	-
Torymus fractiosus Graham and Gijswijt, 1998	*Dasineura rosae* (Bremi, 1847)	3	02.ix.2020	ix.2020	SH	DK	-	DK
Torymus fuscicornis (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	2	03.xii.2015	i.2016	SH	DK	-	-
Torymus fuscicornis (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	3	12.iii.2019	iii.2019	SH	PL	-	-
Torymus fuscicornis (Walker, 1833)	*Semudobia* sp. (*betulae* / *tarda*)	2	13.iii.2020	iv.2020	SH	DK	-	-
Torymus fuscicornis (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	NA	13.xii.2015	i.2016	LKT	DK	-	-
Torymus fuscicornis (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	2	17.xii.2015	i.2016	KA	DK	-	-
Torymus fuscicornis (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	2	30.xii.2015	i.2016	KA	DK	-	-
Torymus galeobdolonis Graham & Gijswijt, 1998	*Dasineura strumosa* (Bremi, 1847)	2	23.iv.2022	iv.2022	HHB	DK	-	DK
Torymus galii Boheman, 1834	*Geocrypta galii* (Loew, 1850)	3	06.viii.2020	viii.2020	SH	DK	-	-

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Torymus galii Boheman, 1834	*Geocrypta galii* (Loew, 1850)	1A	14.viii.2020	viii.2020	HHB	DK	-	-
Torymus heyeri Wachtl, 1883	*Piceacecis abietiperda* (Henschel, 1880)	3	13.ii.2016	v.2016	SH	DK	-	DK
Torymus juniperi (Linnaeus, 1758)	*Oligotrophus* sp.	3	24.viii.2018	xii.2018	SH	PL	-	-
Torymus microstigma (Walker, 1833)	*Lasioptera rubi* (Schrank, 1803)	3	10.xii.2015	i.2016	KA	DK	N	
Torymus microstigma (Walker, 1833)	*Putoniella pruni* (Kaltenbach, 1872)	4B	13.vi.2021	iv.2022	HHB	DK	-	-
Torymus nitidulus (Walker, 1833)	*Semudobia tarda* Roskam, 1977	2	03.xii.2015	i.2016	SH	DK	-	-
Torymus nitidulus (Walker, 1833)	*Semudobia betulae* (Winnertz, 1853)	3	12.iii.2019	iii.2019	SH	PL	-	-
Torymus sp. nr *partitus* Graham & Gijswijt, 1998	*Rabdophaga dubiosa* Kieffer, 1913	2	17.vii.2014	NA	HHB	DK	FH	DK
Torymus sp. nr *T. partitus*/*T. wachtliellae*	*Dasineura lotharingiae* (Kieffer, 1888)	2	26.ix.2015	x.2015	HHB	DK	-	-
Torymus persicariae Mayr, 1874	*Wachtliella persicariae* (Linnaeus, 1767)	2	09.viii.2022	viii.2022	HHB	DK	-	-
Torymus persicariae Mayr, 1874	*Wachtliella persicariae* (Linnaeus, 1767)	3	12.viii.2017	viii.2017	SH	DK	-	-
Torymus persicariae Mayr, 1874	*Wachtliella persicariae* (Linnaeus, 1767)	2	14.vii.2022	vii.2022	HHB	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	03.2021	iv.2021	PB	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	NA	01.iv.2020	iv.2020	KH	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	06.i.2019	i.2019	SH	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	13.iii.2015	iv.2015	SH	DK	-	DK
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga salicis* (Schrank, 1803)	NA	14.iv.2020	iv.2020	KH	DK	N	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	17.xii.2015	i.2016	KA	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	17.xii.2015	i.2016	KA	DK	-	-

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Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	18.xii.2015	i.2016	KA	DK	-	-
Torymus rosariae Graham and Gijswijt, 1998	*Rabdophaga rosaria* (Loew, 1850)	3	18.xii.2015	i.2016	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	09.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	10.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	11.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	11.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	15.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	17.xii.2015	xii.2015	KA	DK	-	-
Torymus rubi (Schrank, 1781)	*Lasioptera rubi* (Schrank, 1803)	3	18.xii.2015	xii.2015	KA	DK	-	-
Torymus ruschkai (Hoffmeyer, 1929)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	14.x.2016	i.2016	MB	DK	-	-
Torymus ruschkai (Hoffmeyer, 1929)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	17.xii.2016	i.2016	MB	DK	-	-
Torymus ruschkai (Hoffmeyer, 1929)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	22.xii.2016	i.2016	MB	DK	-	-
Torymus ruschkai (Hoffmeyer, 1929)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	25.x.2016	i.2016	MB	DK	-	-
Torymus ruschkai (Hoffmeyer, 1929)	*Rhopalomyia artemisiae* (Bouché, 1834)	2	31.viii.2016	NA	MB	DK	-	-
Torymus salicis Graham, 1994	*Iteomyia major* (Kieffer, 1889)	3	20.x.2020	xi.2020	SH	DK	FH	DK
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	03.v.2016	v.2016	SH	DK	-	DK
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	11.ix.2016	ix.2016	SH	DK	-	-
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	20.viii.2017	ix.2017	SH	DK	-	-

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Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	20.x.2016	xi.2016	SH	DK	-	-
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	22.viii.2017	ix.2017	KN	DK	-	-
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	24.ix.2016	x.2016	SH	DK	-	-
Torymus tanaceticola Ruschka, 1921	*Rhopalomyia tanaceticola* (Karsch, 1879)	3	30.ix.2020	xii.2020	SH	DK	-	-
Torymus tipulariarum Zetterstedt, 1838	*Rabdophaga salicis* (Schrank, 1803)	3	08.iii.2021	iv.2021	SH	DK	-	-
Torymus tipulariarum Zetterstedt, 1838	*Rabdophaga salicis* (Schrank, 1803)	3	17.xii.2015	i.2016	SH	DK	-	-
Torymus tipulariarum Zetterstedt, 1838	*Rabdophaga salicis* (Schrank, 1803)	NA	19.xi.2017	xii.2017	LKT	DK	-	-
Torymus veronicae Ruschka, 1921	*Jaapiella veronicae* (Vallot, 1827)	1A	13.xii.2015	xii.2015	LKT	DK	-	-
Torymus wachtliellae Graham and Gijswijt, 1998	*Dasineura rosae* (Bremi, 1847)	3	13.viii.2022	viii.2022	SH	DK	-	DK
Torymus sp. A	*Contarinia tiliarum* (Kieffer, 1890)	5	04.vii.2020	NA	BWP	DK	-	-
Torymus sp. B	*Dasineura urticae* (Perris, 1840)	5	08.x.2016	NA	SH	DK	-	-
Torymus sp. C	*Geocrypta galii* (Loew, 1850)	5	06.viii.2020	NA	SH	DK	-	-
Torymus sp. C	*Geocrypta galii* (Loew, 1850)	5	30.vi.2016	NA	SH	DK	-	-
Torymus sp. D	*Rabdophaga rosaria* (Loew, 1850)	5	29.iii.2019	NA	SH	DK	-	-
Torymus sp. E	*Rabdophaga salicis* (Schrank, 1803)	5	23.x.2021	NA	BK	DK	-	-

Of the 267 reported host-parasitoid interactions, more than half (i.e. 159) represent new host-parasitoid interaction records. Of these, 51 records make up the first host interaction for the involved parasitoid species. With 30 first host records, our method 4 (breeding out parasitoids from gall midge larvae transferred to soil to hibernate and later emerge) was particularly productive in yielding insights into the fundamental biology of the studied parasitoid species. Of the new interaction records, 28 constitute the first parasitoid record of the involved gall midge host.

Several (i.e. 85) of the records represents the first reported occurrence of the focal species in the relevant country, of which the majority (i.e. 69) refer to Denmark (Table 1).

The examined specimens are currently kept in the private collections of PNB, RRA and SH, but it is intended to place voucher specimens of the Chalcidoidea in the Natural History Museum (London) and of Ceraphronidae and Platygastridae in the Natural History Museum of Denmark (Copenhagen). The occurrence data have been uploaded to GBIF: https://doi.org/10.15468/45crz3.

Figure 1. doi

Family Ceraphronidae. Adult female *Aphanogmus abdominalis* emerged with its host *Dasineura odoratae* from galls on *Viola odorata*. Ornebjerg, Denmark. Photo: Simon Haarder.

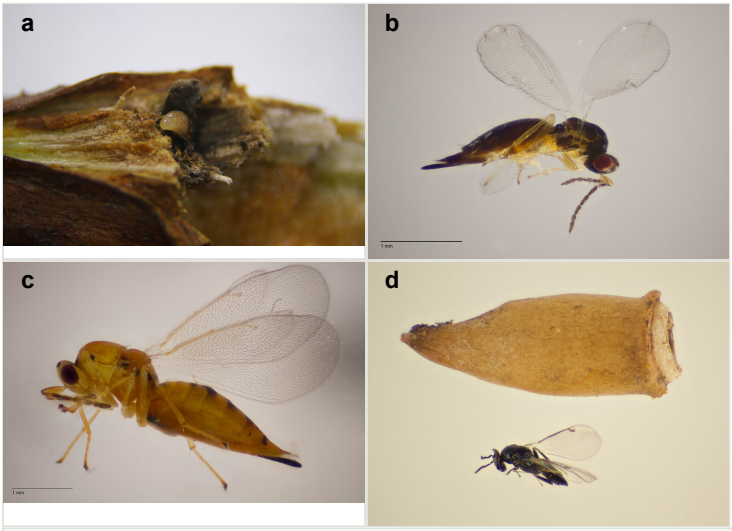

Figure 2.

Family Eulophidae. Photos: Simon Haarder.

a: Larva of *Aprostocetus rubicola* (Eulophidae subfamily Tetrastichinae) in situ in gall of *Lasioptera rubi* in *Rubus idaeus* cane. Horreby Lyng, Denmark. doi
b: Adult female *Aprostocetus rubi*, reared using method 3. Horreby Lyng, Denmark. doi
c: Adult female *Aprostocetus luteus*, an idiobiont ectoparasitoid of *Mikiola fagi* galling *Fagus sylvatica*, reared using method 3. Ornebjerg, Denmark. doi
d: Adult female *Omphale lugens* (Eulophidae subfamily Entedoninae) with the *Mikiola fagi* gall on *Fagus sylvatica*, from which it was reared. Valby, Denmark. doi

Figure 3. doi

Family Eupelmidae. Adult female *Eupelmus confusus*, an idiobiont ectoparasitoid of *Asphondylia sarothamni*, summer generation gall on *Cytisus scoparius*. Hårbølle Havn, Denmark. Photo: Simon Haarder.

Figure 4. doi

Family Eurytomidae. Adult female *Eurytoma dentata*, an idiobiont ectoparasitoid of *Asphondylia sarothmni*, summer generation gall on *Cytisus scoparius*. Ornebjerg, Denmark. Photo: Simon Haarder.

Discussion

Biotic interactions between species is an essential component of biodiversity (Gaüzère et al. 2022), but this element remains elusive as long as basic natural history knowledge on host-parasitoid relationships is incomplete or absent. Our results clearly demonstrate how incomplete our knowledge of gall midge – parasitoid interactions is. They also show that

parasitoid specimens may be obtained in reasonable quantities using simple methods. These could easily be applied in school teaching and citizen science. The identification work, in contrast, requires highly specialised knowledge and remains a severe bottleneck.

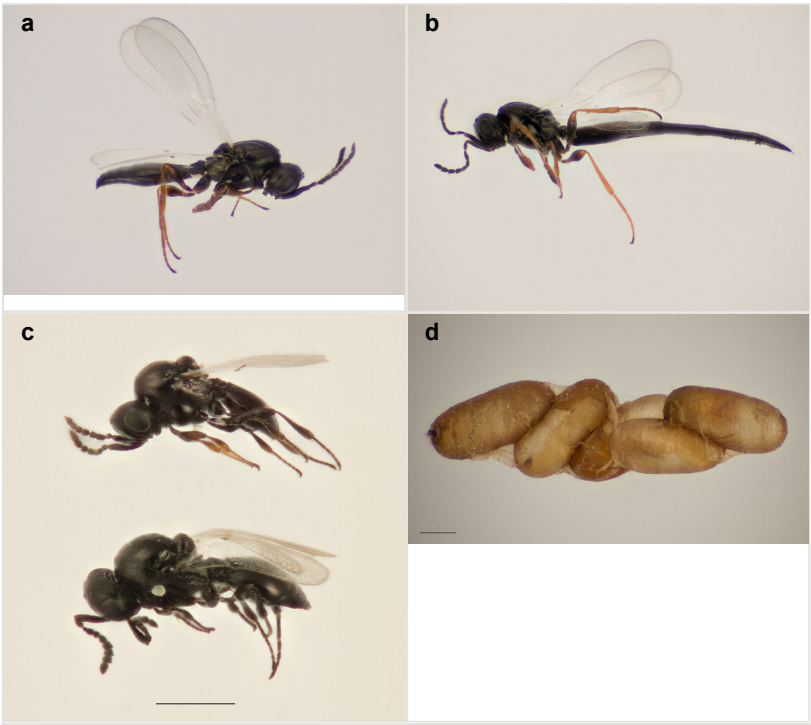

Figure 5.

Family Platygastridae. Photos: Simon Haarder.

a: Adult male *Platygaster phragmitiphila* (Platygastridae subfamily Platygastrinae) emerged directly from galls of *Lasioptera arundinis* on *Phragmites australis*. Warszawa, Poland. doi
b: Adult female of the same collection. doi
c: Adults of *Platygaster robiniae*, a polyembryonal koinobiont endoparasitoid of *Obolodiplosis robiniae*, scale bar 0.5 mm. Nykøbing Sjælland, Denmark. doi
d: Cluster of *Platygaster robiniae* pupae within the puparial skin of one host individual, scale bar 0.5 mm. Oxie, Sweden. doi

With few exceptions, our host gall midge collection had low levels of replication, with most species being represented by a single collection. Thus, we expect that more species of parasitoid per gall midge species – and, conversely, more hosts per hymenopteran parasitoid - would have resulted, had our sampling allowed collection of larger quantities of hosts from more geographically dispersed sites and – in particular for gall midge species with more than one generation per year – more dispersed over the year and also between years. Previous analyses have shown plant galling Diptera, including Cecidomyiidae, to be generally associated with a low number of parasitoids per host species (Hawkins 1994). However, detailed studies of parasitoid complexes associated with individual gall midge species or groups of species using a single host plant, have demonstrated that the

parasitoid communities typically consist of a dozen or more species (e.g. Tscharntke et al. (1991), Roskam (2013)). Better coverage per host species would also establish primary host-parasitoid relationships with greater certainty.

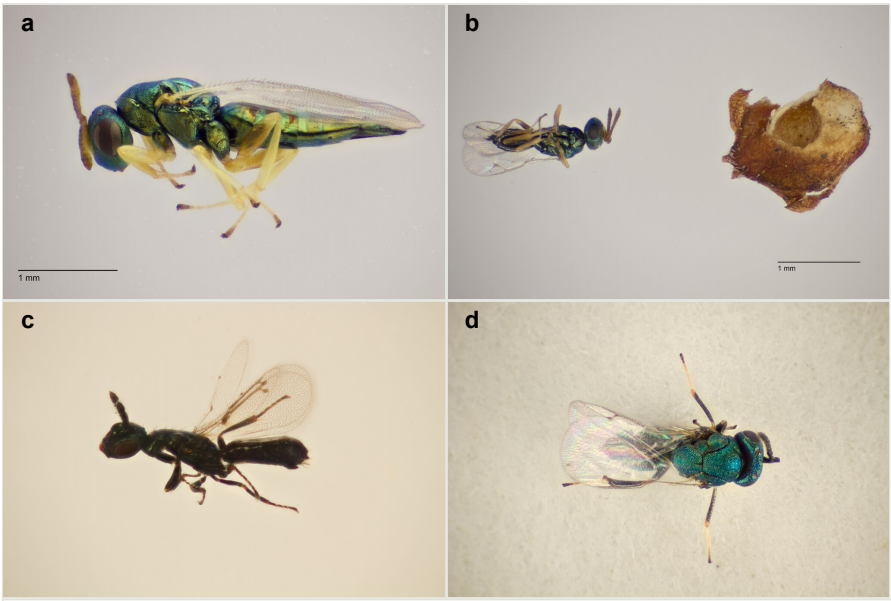

Figure 6.

Family Pteromalidae. Photos: Simon Haarder.

a: Adult female *Mesopolobus rhabdophagae* (Pteromalidae subfamily Pteromalinae), an idiobiont ectoparasitoid of *Rabdophaga rosaria*, inducing rosette galls of *Salix* sp. Soldaterskov, Denmark. doi

b: Adult female *Psilonotus achaeus* (Pteromalidae subfamily Pteromalinae), emerged directly from *Semudobia betulae* induced seed gall in *Betula pendula*. Vingsted, Denmark. doi

c: Adult female *Macroglenes chalybeus* (Pteromalidae subfamily Pireninae, syn. Pirenidae) extracted directly from a gall of a *Contarinia steini* flower bud gall on *Silene latifolia*. Svanninge Bjerge, Denmark. doi

d: Dorsal view of adult female *Systasis encyrtoides* (Pteromalidae subfamily Systasinae, syn. Systasidae), an idiobiont ectoparasitoid of *Dasineura crataegi* galling *Crataegus* sp. Vordingborg, Denmark. doi

Previous analyses of the parasitoid communities associated with gall midges have found idiobionts to dominate over koinobionts by a factor two to four (Hawkins 1994, table 4.1). Our results seem to suggest a more even balance between koinobionts and idiobionts. For example, Platygastridae, which attack eggs and young larvae of gall midges (Askew 1975), are exclusively endoparasitic and koinobiont and stand out as one of the two most speciose parasitoid families, only outnumbered by Eulophidae. At the opposite end of the continuum is Torymidae subfamily Toryminae, in which the majority of species are idiobiont ectoparasitoids of insect inhabitants of plant galls, mainly attacking third instar larvae or pupae of gall midges. Pteromalidae, Eulophidae and Eurytomidae appear to take a position intermediate between these two extremes (Yukawa et al. 2021).

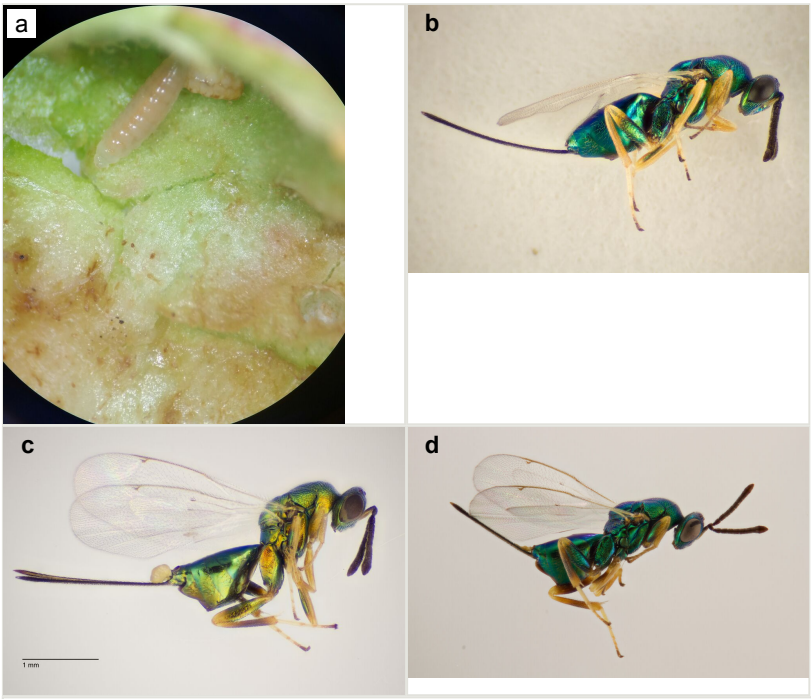

Figure 7.

Family Torymidae. Photos: Simon Haarder.

a: Larva of *Torymus persicariae* (Torymidae subfamily Toryminae) together with host larvae of *Wachtliella persicariae* in leaf roll gall on *Persicaria amphibia*. Slangerup, Denmark. doi
b: Adult female of the same collection, reared using method 3. Slangerup, Denmark. doi
c: *Torymus anthobiae*, ectoparasitoid of *Contarinia anthobia* gallling *Crataegus monogyna*. Landbohøjskolen, Denmark. doi
d: *Torymus rosariae*, ectoparasitoid of *Rabdophaga rosaria* galling *Salix* sp. Rask Skov, Denmark. doi

Torymidae were mainly obtained by our rearing method 3, i.e. extraction of mature parasitoid larvae or pupae by dissecting galls and rearing adults in gelatine capsules. In contrast, Platygastridae were mainly obtained through our method 4, i.e. breeding adult parasitoids from soil, to which host larvae had been transferred earlier. These patterns were to be expected from the life history of the parasitoids and their gall midge hosts. For Eulophidae and Pteromalidae, the two methods were about equally productive. These results suggest that more complete knowledge of parasitoid faunas of Cecidomyiidae are best obtained by a combination of rearing methods. The advantage of the first mentioned method is that it is targeted and establishes host-parasitoid relationships with greater certainty, while its disadvantage is that endoparasitoids are overlooked. Our method 2, i.e. rearing parasitoids directly from galls, the method used by far the most frequently in the past, involves the risk of obtaining parasitoids associated not with gall midges, but with other insects inhabiting the galled plant parts. Additionally, this method targets gall midge species that pupate in the galls. The main advantage of method 4 is that it is suitable for

obtaining the mainly koinobiont parasitoids of gall midges leaving the galls as larvae to pupate in the soil, which is the most common condition amongst temperate Cecidomyiidae. If midge larvae are transferred to soil individually, rather than by placing inhabited plant parts on the soil surface for larvae to move voluntarily, this method is as accurate in establishing host-parasitoid relationships as is method 3. The fact that most of the first host records for parasitoid species and first parasitoid records for gall midge hosts were obtained using method 4, i.e. transfer of larvae to soil, is because this method has rarely been applied in the past. It suggests that this method is indispensable for obtaining primary life history data for koinobiont parasitoid species and for filling the knowledge gap of gall midge–parasitoid interaction networks.

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Author contributions

Hans Henrik Bruun: Conceptualisation, Data curation, Investigation, Methodology, Writing – original draft; Simon Haarder: Investigation, Methodology, Writing – review & editing; Peter Neerup Buhl: Investigation, Methodology, Writing – review & editing; Richard R. Askew: Investigation, Methodology, Writing – review & editing;

Conflicts of interest

The authors have declared that no competing interests exist.

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Supplementary material

Suppl. material 1: Supplementary data table doi

Authors: Hans Henrik Bruun, Simon Haarder, Peter Neerup Buhl, Richard R. Askew
Data type: Host-parasitoid interactions
Brief description: Records of hymenopteran parasitoids associated with European gall midges (Diptera, Cecidomyiidae).
Download file (73.27 kb)

Endnotes

*1 Agrees with paratypes from Rostherne and Wychwood (Graham 1969).

*2 Compared with *Aprostocetus* emesa det. Marcus Graham in making identification.

*3 Males run to M. decipiens Graham in Graham (1969), but M. decipiens Graham has been synonymised under M. *penetrans* by Mitroiu (2010); Graham described only the male of M. decipiens.

*4 With the reservation that the single female has less slender antennae than expected for P. *oeclus*.

*5 Agrees with specimens mentioned in Askew and Harris (2007), which were identified by Marcus Graham.

*6 Determination queried because mesoscutal sculpture and gaster shape differ from paratype and specimens reared from *Dasineura* ulmariae from Fredricia; probably an aberrant specimen.

*7 The legs of the single specimen are darker than Al Khatib et al. (2014) describes for E. *tremulae*, but otherwise it agrees quite well with the original description.

*8 Specimen in poor condition.

*9 Certainly not *Synopeas inerme*, which emerged from the same collection in 2022.