

New records of Aphelinidae (Hymenoptera, Chalcidoidea) from Norway, with additional information on host associations and description of a new species

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The material of the family Aphelinidae at the Natural History Museum of Oslo is revised. Twelve species not previously recorded from Norway have been found. One species *Aphelinus quercus* n. sp. is described and illustrated. This brings the total number of Norwegian aphelinids up to 22 species, including two species introduced for biological control of whiteflies in greenhouses. Biology and distribution of each species are briefly given. For some hatched species new information about host associations are given.

Key words: Chalcidoidea, Aphelinidae, Diaspididae, Aleyrodidae, new records, host-associations, *Aphelinus quercus* new species, Norway.

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Introduction

The chalcid family Aphelinidae represents an important agent in biological control of insects occurring as plant pests, particularly in greenhouses. They are, together with the family Encyrtidae, successfully used to control many pest species (Noyes 1985, Nikolskaya & Yasnosh 1966). Even though several insect orders are attacked by aphelinids, including Orthoptera, Hymenoptera, Diptera and Lepidoptera, the major targets are aphids, whiteflies and scale insects, all belonging to the suborder Sternorrhyncha (Hemiptera: Aphidoidea, Aleyrodoidea, Coccoidea) (Gauld & Bolton 1988, Liu *et al.* 2015).

These hosts represent some of the most destructive pest species found on cultivated plants. They cause considerable economic loss, due to severe crop damage in horticulture, orchards and plantations, and transfer frequently bacteria and viruses resulting in leaf distortion, wilting, twig dieback and reduced growth and vigor (Dolling 1991). Due to these host choices, the aphelinids must be considered as particularly beneficial from a human point of view.

Despite the economic importance of the family Aphelinidae, few contributions are present from Norway. Japoshvili & Hansen (2014) revised the Norwegian species of *Aphelinus* Dalman, 1820, and eight species were recorded.

Two more species are used in biological control in greenhouses (Johansen *et al.* 2005). The aim of this contribution is to highlight the distribution of the family Aphelinidae in Norway, and finally provide a catalogue of Norwegian Chalcidoidea.

Material and Methods

This contribution focuses on both pinned and ethanol preserved material of Aphelinidae in the collections at the Natural History Museum in Oslo. The material was sorted and dried using ethanol and hexamethyldisilazane (HMDS), then card mounted, or, if necessary, slide mounted, following the guidelines of Noyes (2015). For identification, the key for Aphelinidae of the European part of USSR and Caucasus was used (i.e. Nikolskaya & Yasnosh 1966), together with the key to the insects of the Russian Far East (Yasnosh 1995), in addition to other related publications on lower taxa (Hayat 1998, Rosen & DeBach 1979, Schmidt & Polaszek 2007, Viggiani 1987).

The faunistic divisions within Norway follow Økland (1981), and are given in **bold**, and the coordinates are given in decimal degrees (Grid: *Lat/Lon hddd.dddd°*; datum: *WGS84*). The taxonomy follows Noyes (2015). Data on biology and distribution is extracted from Noyes (2015) and Polaszek (2015), and for distribution in Europe all countries are listed, but outside Europe, only the regions are mentioned. All records refer to fully labeled specimens or slides deposited in the collections at the Natural History Museum of Oslo, and for some duplicates in the collection at the Institute of Entomology, Agricultural University of Georgia, Tbilisi.

List of species

Ablerus atomon (Walker, 1847)

Material examined: ØSTFOLD [Ø], Moss: Jeløy, Nes [N59.47846° E10.63548° ±50m], 9♀♀5♂♂ ex *Leucaspis pini* (Hartig, 1839) (Hemiptera: Diaspididae) on *Pinus sylvestris* L. collected 23 March–19 May 2013, leg. Ove

Sørlibråten; Hvaler: Kjærkøy, Skjærhalden, [N59.02409° E11.03597° ±50m], 15♀♀8♂♂ ex *L. pini* on *P. sylvestris* collected 8 May 2013, leg. Ove Sørlibråten. AKERSHUS [AK], Oslo: Hovedøya (NE), «Kong Sverres Utsikt» [N59.89529° E10.74067° ±10m], 1♀ 21 July–26 August 2005, Malaise trap / slope, leg. Øivind Gammelmo & Ole J. Lønnve.

Biology: Recorded from 17 different primary host species, all diaspidids, including *L. pini* (Hemiptera: Diaspididae) (Noyes 2015); pine (*Pinus*) is listed among the plant associates, but not *P. sylvestris*.

Distribution: Europe: Austria, Czech Republic, France, Italy, Poland, Russia (St. Petersburg), Slovakia and Spain; Asia; N and S America (Noyes 2015).

Aphelinus humilis Mercet, 1927

Material examined: VESTFOLD [VE], Re [Våle]: Langøya N [N59.49981° E10.36611° ±10m], 1♀ 28 May–8 July 1991, Malaise trap / calcareous meadow / seashore, leg. Lars Ove Hansen.

Biology: Recorded from various primary host species, all aphids, i.e. *Brachycaudus helichrysi* (Kaltenbach, 1843), *B. spiraeae* Börner, 1932, *Hyalopterus pruni* (Geoffroy, 1762), *Macrosiphum Passerini*, 1860, *Myzus ligustri* (Mosley, 1841) and *Protaphis* Börner, 1852) (Hemiptera: Aphididae) (Noyes 2015).

Distribution: Europe: Belarus, Czech Republic, Moldova, Netherlands, Portugal, Slovakia, Spain, Sweden, Ukraine and United Kingdom; Asia, S America (Noyes 2015).

Aphelinus subflavescens (Westwood, 1837)

Material examined: TELEMARK coastal [TEY], Drangedal: Steinknapp [N59.07956 E9.03810 ±25m], 1♀ 28 June 2011, oak canopy fogging: tree #07 / oak forest, leg. Karl H. Thunes.

Biology: Recorded from almost 20 different primary host species, all aphids (Hemiptera: Aphididae) (Noyes 2015), and oak (*Quercus*) is listed among the plant associates.

Distribution: Europe: Bosnia Hercegovina, Croatia, Czech Republic, England, France, Ireland, Netherlands, Slovakia; Asia, Africa, N

and S America, Australia (Polaszek 2015, Noyes 2015).

***Aphelinus quercus* sp. n. Japoshvili & Hansen**

Description: Holotype ♀ Length of body 1.44 mm. All body yellow without dark markings. Head almost as wide as height. Ocelli forming an angle of about 100°. Toruli placed closer to clypeal margin than to eyes and clypeal margin and 0.8x as far as its length. Antenna with apex of clava more or less pointed (Figure 4). Malar space 0.57x as long as eye length. Eye reaching occipital margin; upper temple rounded in facial view. Scrobes moderately deep, U-shaped. Mandibles with one tooth and truncation. Pedicel 1.67x as long as broad and as long as F₁₋₃; Clava almost as long as F₁₋₃ plus pedicel. Forewing 2.3 as long as broad. Submarginal vein longer than marginal. Thorax as long as gaster. Mesoscutum with 30 fine pale setae and a pair of long setae at the apex, scutellum with three pair of long setae arranged on the sides arranged in equidistance. Mesoscutum and scutellum with similar polygonal cell sculpture.

Wing, Antennae, Thorax, Ovipositor, mandible and midtibia as Figures 1–5. Exserted part of ovipositor 0.2x as long as gaster without exserted part of ovipositor. Midtibial spur shorter than basitarsus (5:6), Ovipositor 1.48x as long as midtibia.

Material examined: Holotype: TELEMARK coastal [TEY], Drangedal: Steinknapp [N59.07953 E9.03756 ±25m], 1♀ [slide mounted] 28 June 2011, oak canopy fogging: tree#08 / oak forest, leg. Karl H. Thunes. Holotype deposited at the Natural History Museum, University of Oslo, Norway.

Biology: Unknown; most probably associated with aphids on oak.

Distribution: Europe: Norway.

Etymology: Living or associated with oak (*Quercus*).

Comments: The new species is most closely related to *A. subflavescens*, but differs by the following morphological characters: Midtibia of *A. subflavescens* widening at the apex, while midtibia of *A. quercus* is subparallel; ovipositor of *A. quercus*. well exserted, while ovipositor

of *A. subflavescens* not exserted. F₁₋₃ segments subquadrate in *A. subflavescens*, while in *A. quercus* they are transverse.

***Aphytis proclia* (Walker, 1839)**

Material examined: ØSTFOLD [Ø], Hvaler: Kjærkøy, Skjærhalden [N59.02409° E11.03597° ±50m ±50 m], 8♀♀ [cardmounted] and 1♀ [slide mounted] ex *Chionaspis salicis* (Hemiptera: Diaspididae) on *Salix aurita* L., collected 8 May 2013, leg. Ove Sørlibråten.

Biology: Recorded from approximately 60 different primary host species, almost all diaspidids including *C. salicis* (Hemiptera: Diaspididae), and in addition one coccid (i.e. *Coccus hesperidum* L., 1758) (Hemiptera: Coccidae) and one whitefly (i.e. *Dialeurodes citri* (Ashmead, 1885)) (Hemiptera: Aleyrodidae) (Noyes 2015); *A. proclia* is previously recorded from *Salix*, but this seems to be the first record from *S. aurita*.

Distribution: Europe: Austria, Bulgaria, Croatia, Cyprus, Czech Republic, England, France, Germany, Hungary, Italy, Macedonia, Moldova, Netherlands, Poland Portugal, Russia (St. Petersburg), Serbia, Slovakia, Slovenia, Spain, Sweden and Switzerland; Africa, Asia, N and S America, Australia (Polaszek 2015, Noyes 2015).

***Aphytis luteus* (Ratseburg, 1852)**

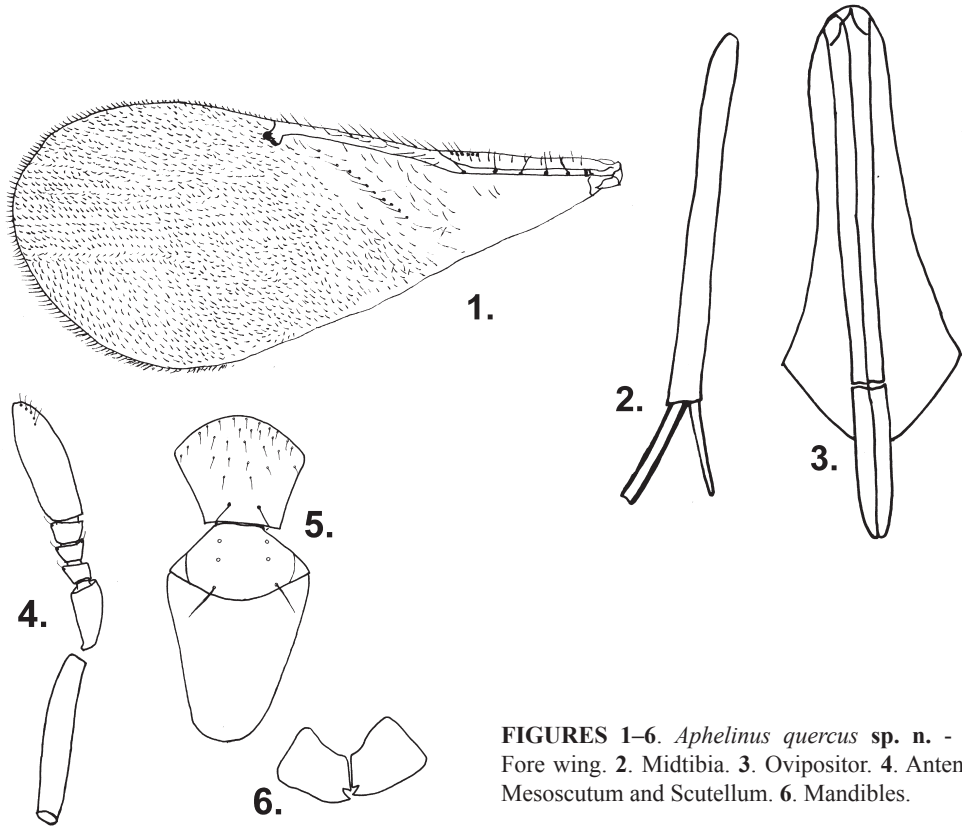
Material examined: ØSTFOLD [Ø], Hvaler: Kjærkøy, Skjærhalden [N59.02409° E11.03597° ±50m], 11♀♀4♂♂ [cardmounted] and 1♀1♂ [slide monted] ex *L. pini* on *P. sylvestris* collected 8 May 2013, leg. Ove Sørlibråten.

Biology: Recorded from three different primary host species (i.e. *L. pini*, *L. pusilla* Low, 1883 and *P. signoreti* Signoret, 1869 (Hemiptera: Diaspididae) (Noyes 2015); pine (*Pinus*) is listed among the plant associates, but not particularly *P. sylvestris*.

Distribution: Europe: Cyprus, France, Germany, Greece and Hungary (Polaszek 2015, Noyes 2015).

***Coccophagus insidiator* (Dalman, 1826)**

Material examined: OPPLAND southern [OS], Gausdal: Ormtjernkampen NR, Dokkampen



FIGURES 1–6. *Aphelinus quercus* sp. n. - ♀. 1. Fore wing. 2. Midtibia. 3. Ovipositor. 4. Antenna. 5. Mesoscutum and Scutellum. 6. Mandibles.

E, [N61.20389° E9.82171° ±10m; 835m.a.s.l.], 2♀♀ 2 July–9 August 2010, Malaise trap No.2 / old spruce forest, leg. Finn Audun Grøndahl & Lars Ove Hansen.

Biology: About 20 reports from different primary host species, all from the scale insect families Coccidae, Diaspididae and Eriococcidae (Hemiptera) (Noyes 2015).

Distribution: Europe: Finland, France, Germany, Greece, Hungary, Italy, Poland, Russia (Karelian ASSR), Sweden and UK; Asia; N America (Noyes 2015).

***Coccophagus lycimnia* (Walker, 1839)**

Material examined: AKERSHUS [AK], Asker: Nesøya, Storenga [E] [N59.8700° E10.5408° ±25m], 1♀ 20 May–31 July 2003, Malaise trap / meadow, leg. Lars Ove Hansen; Oslo: Hengsenga [N59.91551° E10.67054°

±25m], 5♀♀ 25 June–8 August 2007, Malaise trap, leg. Andres Enderstøl; Oslo: Østensjøvannet, Abildsø [N59.88767° E10.81937° ±25m; 130m.a.s.l.] 1♀ 1–31 July 1997, Malaise trap, leg. Morten Falck. VESTFOLD [VE], Re [Våle]: Langøya, N [N59.49981° E10.36611° ±10m], 1♀ 28 May–8 July 1991, Malaise trap / calcareous meadow / seashore, leg. Lars Ove Hansen.

Biology: About 140 reports from different primary host species from several scale insect families (i.e. Asterolecaniidae, Coccidae, Diaspididae, Eriococcidae, Kermesidae, Margarodidae, Pseudococcidae and Stictococcidae), except one record from a psyllid (Psyllidae) (all Hemiptera) (Noyes 2015).

Distribution: Europe: Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, England, France, Germany, Greece, Hungary, Ireland, Italy, Moldova, Montenegro, Netherlands, Poland,

Portugal, Romania, Russia (St. Petersburg), Serbia, Slovakia, Spain, Sweden, Switzerland and Ukraine; Asia; Africa, S and N America; Australia (Polaszek 2015, Noyes 2015).

***Coccophagus piceae* Erdős, 1956**

Material examined: AKERSHUS [AK], Oslo: Maridalen, Dausjøen N [N60.01204° E10.78825° ±25m], 1♀ 19 July–26 August 2002, Malaise trap / river outlet, leg. Kjell M. Olsen & Sigve Reiso.

Biology: Only a few records from *Pulvinaria* (Hemiptera: Coccidae) as primary hosts; on *Betula* sp. (Noyes 2015).

Distribution: Europe: Czech Republic, Hungary, Poland, Russia (Karelian ASSR, St. Petersburg), Slovakia and Sweden; Asia (Polaszek 2015, Noyes 2015).

***Encarsia inaron* (Walker, 1839)**

Material examined: ØSTFOLD [Ø], Fredrikstad: Bjerringløgka NE [N59.19929° E10.99858° ±50m], 2♀♀6♂♂ ex nymphs *Aleyrodes lonicerae* Walker, 1852 (Hemiptera: Aleyrodidae) on *Lonicera periclymenum* L. collected 3 October 2013, leg. Ove Sørlibråten.

Biology: Almost 30 records from different primary host species of whiteflies (Hemiptera: Aleyrodidae) including *A. lonicerae*; a few from coccids (Hemiptera: Coccidae); one diaspidid (Hemiptera: Diaspididae) and six from moths (Lepidoptera: Pyralidae, Tortricidae and Yponomeutidae) (Noyes 2015).

Distribution: Europe: Austria, Bulgaria, England, Finland, France, Germany, Greece, Hungary, Italy, Montenegro, Serbia, Spain, Sweden, Switzerland, Ukraine; Asia; Africa; N and S America; Australia (Polaszek 2015, Noyes 2015).

***Encarsia leucaspidis* (Mercet, 1912)**

Material examined: ØSTFOLD [Ø], Moss: Jeløy, Nes [N59.47846° E10.63548° ±50m], 1♀ [slidemounted] 1♀ 10♂♂ [cardmounted] ex *Leucaspis pini* (Hartig, 1839) (Hemiptera: Diaspididae) on *Pinus sylvestris* L. collected 23 March–19 May 2013, leg. Ove Sørlibråten.

Biology: Twelve records from different

primary host species of diaspidids, mainly *Leucaspis*, including *L. pini* (Hemiptera: Diaspididae) (Noyes 2015).

Distribution: Europe: Czech Republic, France, Germany, Hungary, Italy, Poland, Romania, Spain, Sweden, Switzerland, Ukraine; Asia; Africa (Polaszek 2015, Noyes 2015).

***Pteroptrix bicolor* (Howard, 1898)**

Material examined: BUSKERUD western [BV], Rollag: Bråtåsen [N60.01888° E9.24935° ±50m], 1♀ 1–31 August 1994, Malaise trap / slope / spruce forest, leg. Lars Ove Hansen & Bjørn A. Savgolden.

Biology: More than 30 reports from different primary host species, all from the family Diaspididae (Hemiptera) (Noyes 2015).

Distribution: Europe: Austria, Czech Republic, England, France, Germany, Hungary, Italy, Russia (Karelian ASSR), Slovakia, Spain, Switzerland and Ukraine; Asia; N Africa; N and S America (Noyes 2015).

Introduced species

Two species, *Encarsia formosa* Gahan, 1924 and *Eretmocerus eremicus* Rose & Zolnerowich, 1997, should be threatened particularly, because they are regularly introduced to Norway. The report of *E. formosa* as «true Norwegian» is doubtful. However, Noyes (2015) refers to as many as eleven articles on this species from Norway (e.g. Fuglestad 1974, Stenseth 1975, 1976, 1978, 1991), but all seem to be about the use of the species in biological control of whiteflies (Hemiptera: Aleyrodidae) in greenhouses, in particular the two species *Bemisia tabaci* (Gennadius, 1889) and *Trialeurodes vaporariorum* (Westwood, 1856). However, Hedqvist (2003) reports *E. formosa* from Skåne, Sweden, but without any information if it is occurring naturally or not.

E. eremicus may be considered the same way, but less information about this species is available. However, it is also used to combat whiteflies in greenhouses. Johansen et al. (2005) reviewed these two species and indicate that they are used frequently in biological control in greenhouses

in Norway and may be ordered from particular suppliers. *E. formosa* and *E. eremicus* may stay on the Norwegian list, but as introduced.

Discussion

Twelve species of Aphelinidae are reported for the first time from Norway in this contribution, including one species described as new to science. Together with the earlier eight species published by Japoshvili & Hansen (2014), and the two introduced species (Johansen *et al.* 2005), the total number is now 22. Ottesen (1993) estimated the number of species in Norway to 20. Hedqvist (2003), on the other hand, listed 32 species from Sweden. Even though the number of species in Sweden is higher than in Norway, more species may be expected in both countries. This contribution seems to be the first comprising hatched aphelinids from scale insects and white flies in Norway. This method may easily produce long series of specimens, and giving valuable ecological information both on primary hosts and plant associates.

This revised material represents only a small part of the aphelinids in the collections at the Natural History Museum of Oslo. The next step is to sort out more ethanol-preserved material, particularly from Malaise trap samples. In the next steps, the plan is to sample new material, including scale insects and aphids for hatching. This may both add species to the Norwegian list, but also give valuable information about host associations, as well.

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