

Observations on host plants and behaviour of egg-laying females of *Cheilosia* Meigen (Diptera, Syrphidae) in Central Europe

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Based on field observations hints are given for detection of egg-laying females of the genus *Cheilosia* Meigen. The results of a number of observations are reported, including some previously unknown host relationships. Oviposition occurs on the larval host plant. Therefore observing egg-laying females is a powerful method to improve knowledge of the spectrum of potential larval hosts and habitat.

Zusammenfassung

Auf der Grundlage von Freiland-Beobachtungen werden Hinweise zum charakteristischen Verhalten eiablagebereiter Weibchen der Gattung *Cheilosia* Meigen gegeben. Einige Ergebnisse von teilweise bisher unbekanntem Wirtsbeziehungen werden mitgeteilt. Nach gegenwärtigem Kenntnisstand erfolgt die Eiablage an die Wirtspflanze der Larve. Daher bietet das Beobachten von Weibchen bei der Eiablage eine gute Möglichkeit, die Kenntnisse um das Wirtspflanzenspektrum und das Habitat der Larven zu erweitern.

Introduction

Cheilosia Meigen, 1822 is one of the largest genera of the Syrphidae worldwide. About 300 Palaearctic species are listed by Peck (1988). The larvae are endophytophagous in stems, roots or leaves of herbs, more rarely under the bark of conifers, or they live in fungal fruiting bodies. Concerning the fauna of western Europe, data on the larval biology of almost 40 species are available (Stuke 1995a). Host records have been summarized e.g. by Smith (1979), Stubbs & Falk (1983), Rotheray (1993), Torp (1994), and Barkemeyer (1995). Most of these records are based on one or few observations only. In view of the present progress in taxonomy of *Cheilosia* many of the old plant host records are now obsolete and require verification. Consequently, the number of valid data on larval host plants is considerably lower. The hosts even of some of the most common species like *C. barbata* Loew, 1857 or *C. impressa*

Loew, 1840 are still unknown.

To find a yet unknown plant host without a clue to a potential candidate species is difficult. Unfortunately, the signs of attack the larvae cause are usually rather inconspicuous (Rotheray 1993). This might be a major reason why so little is known about this matter.

Lepidopterists use a powerful method to gain data on larval host plants and habitats: watching gravid females where they lay eggs (e.g. Ebert & Rennwald 1991). Trials to apply this method to hoverflies, especially *Cheilosia*, have been successful. The intention of the present account is to draw attention to this method and to report on some new information of (probable) hosts of *Cheilosia* larvae.

Material and methods

All observations have been made in the field without manipulation of either the flies or the plants until an observation was stopped. The flies have been caught and determined in the laboratory. Voucher specimens are deposited in the private collection of the author. Identification of the host plant most often took place in the field. All observations have been made either in the southwestern part of Germany or the central part of the Alps (South Tirol).

The format used for the species accounts is: locality (names in German spelling), altitude, habitat, date, observation of egg-laying (behaviour) and host-plant, remarks.

Generalized pattern of egg-laying behaviour of *Cheilosia*

Hövmeyer (1995) reports on the behaviour sequence of ovipositing ♀ of *C. fasciata* Schiner & Egger, 1853. On the whole this pattern is similar in all *Cheilosia* species observed so far, and may be described as follows:

1. ♀ alights on the plant, most often on a leaf,
2. it walks about, often changing the direction as if searching for something, often touching the leaf surface with the extended ovipositor,
3. it moves to the underside of the leaf,
4. it searches either on the leaf or on the stem for a suitable spot to lay an egg, repeatedly touching the surface with the ovipositor, if the egg is laid just above the ground level the fly moves backward (this phase is the most time consuming of all),
5. it lays one or more eggs,
6. the fly reappears on the upper leaf surface and flies away.

Differences may occur, especially concerning phases 2 and 3, relating to the structure of the plant and the position of the egg. The whole procedure may take only 15 - 20 seconds (*C. fasciata*: Hövmeyer 1992). But it may last a rather long time especially if no egg is laid. In one case I stopped the observation of a ♀ of an un-

described *Cheilosia* species (not included in the species accounts) after 40 minutes. In many cases where this behaviour has been observed no eggs have been found.

Most sightings of *Cheilosia* ♀ concern specimens that are not going to lay eggs. The observer usually becomes aware of a ♀ when it sits down on a plant. Sometimes the fly moves to the lower side of the leaf or crawls down the stem. The most important sign for egg-laying is the extended ovipositor that examines the plant surface. Furthermore, the way of movement on the plant, difficult to describe with words, seems to be characteristic for egg-laying ♀.

Sometimes a ♀ alights on a leaf and walks about with extended ovipositor, but then stops the sequence and flies away, or moves on foot to a neighbouring plant. Such observations may concern an inappropriate plant species. In the following listing the term 'egg-laying behaviour' is restricted to observations of the complete sequence without egg-laying itself being observed.

Species accounts

Cheilosia albipila Meigen, 1838

(1) D, Baden-Württemberg, Merklingen near Ulm, nature reserve Mönchsteig, 680m; burnt patch within a poor unimproved pasture; 8th May 1990; one ♀ with egg-laying behaviour on *Carduus* cf. *nutans* L. agg. rosette. (2) D, Baden-Württemberg, Neusatz near Karlsruhe, Holzbachtal, 470m; fallow wet meadow; 29th April 1995; one ♀ with egg-laying behaviour on *Cirsium palustre* (L.) Scop. rosette.

The larva is known to feed within the roots of *Cirsium palustre* (Rotheray 1988), old records that require verification refer to *Cirsium oleraceum* (L.) Scop. (Boie 1850) and *Carduus crispus* L. (Weyenbergh 1869). According to the places where the adults can be found *C. albipila* should have a wide host spectrum.

Cheilosia albitarsis (Meigen, 1822)

(1) D, Baden-Württemberg, Conweiler near Pforzheim, Dorfbachtal, 450m; rather eutrophic wet meadow; 2nd June 1991; one ♀ with egg-laying behaviour on *Ranunculus acris* L. agg. (2) D, Baden-Württemberg, Völkersbach near Karlsruhe, Moosalbtal, 300m; ± sunny way side in an old beech forest; 23rd May 1995; one ♀ with egg-laying behaviour on *Ranunculus repens* L.

Egg-laying on *Ranunculus* spp. has been reported by Trittler (1989) and Rotheray (1991). Rotheray (1991) has found larvae in *Ranunculus* sp. [according to Rotheray (1993) *R. repens*]. As the adults are invariably found at places where *Ranunculus* is present its host range is probably confined to that genus.

Cheilosia bergenstammi Becker, 1894

(1) D, Baden-Württemberg, Bischweier near Gaggenau, Vogelsand, 175m; mesophytic meadow (Arrhenatheretum) that was mowed about two weeks before;

17th August 1994; one ♀ laid one egg on *Senecio erucifolius* L.

The larva has been found in stems and roots of *Senecio jacobaea* L. (Smith 1979).

Cheilosia chlorus (Meigen, 1822), or *C. fraterna* (Meigen, 1830)

(1) D, Baden-Württemberg, Haueneberstein near Baden-Baden, Littersbach, 140m; small clearing in riverside forest; 1st May 1992; one ♀ laid one egg on *Cirsium oleraceum*. An exact identification was not possible as the fly escaped. Claußen (pers. comm.) has observed several *C. chlorus* ♀ with egg-laying behaviour on *Cirsium oleraceum* in northern Schleswig-Holstein.

According to Kaltenbach (1874) the larva of *C. chlorus* lives in the roots of *Petasites paradoxus* (Retz.) Baumg., but this is certainly an error. *C. chlorus* is a rather common species in SW-Germany, but rarely found near *Petasites* stands. The larva of *C. fraterna* is a well known inhabitant of stems and rosettes of *Cirsium palustre* (e.g. Rotheray 1988). Kassebeer (1993) has observed oviposition on *Cirsium palustre*.

Cheilosia chrysocoma (Meigen, 1822)

(1) D, Baden-Württemberg, Völkersbach near Karlsruhe, nature reserve Heidenfeld, 470m; mesophytic meadow near hedge; 11th May 1995; one ♀ laid two eggs on *Angelica sylvestris* L., and a few minutes later a large egg batch on another specimen of *Angelica sylvestris*. The eggs were placed between the base of a leaf stalk and the axis.

One additional plant with a single egg has been found. As there are more *Cheilosia* species living in *Angelica sylvestris* [one ♀ of *C. pagana* Meigen emerged from a rotten root found in September 1995 at the same site] it is not certain that this was an egg of *C. chrysocoma*, too.

The larva of *C. chrysocoma* is supposed to live in *Carduus crispus* and *C. nutans* (Batra et al. 1981).

Cheilosia illustrata (Harris, [1780])

(1) D, Rheinland-Pfalz, Büchelberg near Wörth, 122m; N-exposed (shady) edge of a wet deciduous forest; 29th July 1993; one ♀ with egg-laying behaviour on *Heracleum sphondylium* L.

Vappula (1941) has found larvae in the rootstock of *Pastinaca* L. Speight (pers. comm.) has an Irish specimen of *C. illustrata* in his collection, bred from *Pastinaca sativa* L. in rootstock.

Cheilosia lenis Becker, 1894, or *C. omissa* Becker, 1894

(1) D, Baden-Württemberg, Seewald bei Freudenstadt, Nagold-Stausee, 560m; sunny edge of conifer forest; 5th May 1995; one ♀ with egg-laying behaviour on *Senecio fuchsii* C.C.Gmelin.

The larva of *C. omissa* is already known to feed within *Senecio fuchsii* (Dusek 1962).

Cheilosia melanura Becker, 1894 (vid. Claußen)

(1) I, Südtirol, Martelltal, Lyfi-Alm, 2000-2500m; unimproved alpine pasture; 1st July 1995; three ♀ laid three eggs on *Cirsium spinosissimum* (L.) Scop.

C. melanura is one of the most common *Cheilosia* in the Alps. Despite this no host records have been published so far.

Cheilosia praecox (Zetterstedt, 1843)

(1) D, Baden-Württemberg, Freiburg, Attental, 450m; sunny bank of a track in mixed forest; 24th April 1992; one ♀ laid one egg in rosette of *Hieracium pilosella* L.

(2) D, Baden-Württemberg, Herrlingen, Lautertal, 550m; steep rocky slope with scattered vegetation; 3rd May 1995; one ♀ laid one egg in rosette of *Hieracium pilosella*.

(3) D, Baden-Württemberg, Oberprechtal near Hausach, Hirschfelsen, 600m; 7th May 1995; two ♀ laid two eggs in rosettes of *Hieracium pilosella*.

(4) D, Baden-Württemberg, Lautenbach-Sohlberg near Oberkirch, 650m; unimproved meadow; 8th May 1995; one ♀ laid two eggs in two rosettes of *Hieracium pilosella*.

Hieracium pilosella was first mentioned as an egg-laying host by Claußen (1980). Stuke (1996) has found the larva in *Hieracium pilosella*. Egg-laying on *Filipendula ulmaria* (L.) Maxim. has been reported by Kassebeer (1993).

Cheilosia rhynchops Egger, 1860

(1) D, Baden-Württemberg, Baden-Baden, Oostal, 630m; small wet clearing in mixed forest beside rivulet; 20th May 1992; one ♀ laid one egg on a leaf stalk of *Adenostyles alliariae* (Gouan) Kern.

The larval host plant was unknown so far. *Adenostyles* was unknown as a host of any *Cheilosia* species. A vast number of eggs, usually several on one plant, has been found on stems and on the lower side of leaflets of *Adenostyles alliariae* in a number of places in the northern parts of the Schwarzwald, in the vicinity of Oberstdorf (Bavarian Alps), and in the Silvretta region in the Austrian Alps. In 1995 I found larvae in the basal parts of the leaf stalks and in the rootstocks of *Adenostyles alliariae* at several sites in the northern Schwarzwald. At almost every site larvae were present, often in large numbers and usually more than one per plant. Stands of the host-plant were attacked in sunny places as well as at sites that are shady the whole day.

Cheilosia variabilis (Panzer, [1798])

(1) D, Baden-Württemberg, Kuppenheim near Rastatt, Schmetterling, 160m; mesophytic meadow near hedge; 15th May 1995; one ♀ with egg-laying behaviour on *Scrophularia nodosa* L.

Reliable records of the larval host plants refer to *Scrophularia nodosa* (Dušek 1962; Rotheray 1990; pers. observ.) and *S. auriculata* L. (Rotheray 1990). Other

plants (*Carduus acanthoides* L., *C. nutans*, *Cirsium vulgare* (Savi) Ten.) mentioned by Kaltenbach (1874) probably refer to another *Cheilosia* species.

Cheilosia zetterstedti Becker, 1894

(1) D, Baden-Württemberg, Sandweier near Baden-Baden, Niederwald, 125m; military training area on open dunes, very scattered ruderal vegetation; 24th July 1994; two ♀ with egg-laying behaviour in two rosettes of *Verbascum densiflorum* Bertol.

Up to now no records of the larval host have been published. In the collections of the 'Staatliches Museum für Naturkunde Stuttgart' (SMNS) are two reared specimens (det. Claußen 1996) with the following data: (1) „Salgesch / Wallis coll. 19.6.1973 leg. D. Schröder“; (2) „ex *Verbascum nigrum* [L.] em. 5.6.1973 [♀, date must be wrong], 30.6.1973 [♂]“; (3) „*Chilosia gemina* Beck. Lindner det.“. Dufour (1848) has found larvae of *C. aerea* Dufour (a questionable synonym of *C. vernalis* Fallén) under decaying leaves of *Verbascum pulverulentum* Vill.

In SW-Germany *C. zetterstedti* is usually a scarce species of xerothermic open ground habitats. In the last few years it was rather abundant at certain localities in the Rhine valley. Almost all specimens have been found within a radius of few metres around stands of *Verbascum* spp. The exceptions mostly refer to flower visiting specimens (most often on *Euphorbia cyparissias* L.) where no flowers were present near the *Verbascum* stands. The males are preferably sitting on leaves of bushes or trees next to the *Verbascum* stands.

Discussion

Observations on egg-laying are not only interesting as a source of information on the larval hosts. It is an important fact that the egg-laying ♀ decides in which host and in which sort of habitat the larvae will live. Perhaps the larvae of many species could potentially develop in a wide range of plants.

The accounts presented here include observations of egg-laying behaviour only. In almost all cases where a host plant of the respective *Cheilosia* species is already known the observations on egg-laying behaviour recorded here refer to the same or a closely related plant. Therefore observations of definite egg-laying behaviour are almost as valuable as observed egg-laying itself.

Do the larvae live in the same plants where the ♀ lay the eggs? Too little is known so far on the larval biology of *Cheilosia* to give a definite answer to this question. Looking at better known phytophagous insects we must accept that this is not necessarily so. For example, in the butterflies there are species which lay their eggs not on the host plant of the larvae, but in the near vicinity (e.g. *Argynnis paphia* Linnaeus, 1758, *Clossiana dia* Linnaeus, 1767, and *C. euphrosyne* Linnaeus, 1758: Ebert & Rennwald 1991). This might be a strategy to escape specialised parasitoids.

Thus it is essential to strictly differentiate between hosts for egg-laying and larval hosts. However, the available informations suggest that in *Cheilosia* the eggs are laid on the host plants of the larvae. In almost all cases in which records are available on egg-laying (behaviour) as well as on larval host the plants concerned are either the same or they at least belong to the same systematic group. The only exceptions are two species whose larval biology is very poorly known: *C. chrysocoma* and *C. praecox*.

The larvae of certain species of *Cheilosia* live in plants that usually grow in large dense stands. The adults of these species are most often found within or close to the stands of the larval host. Examples are *C. fasciata* (associated with *Allium ursinum* L.), or *C. rhynchops* (associated with *Adenostyles alliariae*). Some species with still unknown hosts are closely associated with certain plants, too, and it can be expected that their larvae will be found in the respective plants: *C. derasa* Loew, 1857 in *Petasites* sp. (Speight & Lucas 1992; pers. observ.), *C. orthotricha* Vujic & Claussen, 1994 in *Petasites hybridus* (L.) G., M. & Sch. (Stuke 1995b), *C. pedemontana* Rondani, 1857 in *Peucedanum ostruthium* (L.) Koch (pers. observ.). The host plants of other *Cheilosia* species are more scattered. In these cases it is difficult to detect a host by coincident occurrence, but watching egg-laying ♀ could be a useful method.

The observations reported in this article are not the result of particular efforts. They have been obtained incidentally during field work for other purposes. Someone who specializes in this theme probably could gain much more data. In relation to the present knowledge on larval hosts of *Cheilosia* the method has already led to a remarkable increase in data. The observation of a ♀ with egg-laying behaviour can be the crucial first step to the study of larval bionomics.

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