Description of puparium of *Neottiophilum praeustum* (Meigen, 1826) (Diptera, Neottiophilidae) with new host species

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**Abstract:** Detailed description and illustration of the puparium of the European nest skipper fly are presented. Information about 8 new hosts is given. The distribution of *N. praeustum* in Poland is presented.

**Key words:** Neottiophilidae, *Neottiophilum praeustum*, new hosts, puparium, morphology, faunistics, taxonomy, Poland

**INTRODUCTION**

The Neottiophilidae are a very small family of the Acalyptratae group of Diptera and their family status has only recently been given. The family contains two genera: *Actenoptera* Czerny, 1904 with two Palaearctic and one Nearctic species and *Neottiophilum* Frauenfeld, 1868 with one European species (Schoemann 1999, Ozerv 2000a,b, 2005). *Neottiophilum praeustum* has been recorded from the following countries: Austria, Switzerland, France, Germany, Great Britain, and the North European territory of Russia (Soós 1984), Poland (Nowakowski 1991), the Czech and the Slovak Republics (Doskočil 1960, Zuska & Barták 1997), Hungary (Papp 2001a) and Norway (Greve & Olsen 1992). From Poland, there has been recorded only one species – *Neottiophilum praeustum* (Meigen, 1826), but without more detailed data (Nowakowski 1991: 188) – “Three specimens taken probably in the southern part of Poland, in coll. of S. Kapuściński”.

The larvae of *Neottiophilum praeustum* are ectoparasites, and live in nests of birds where they feed on the blood of the nestlings. They are often found in open nests of small passerines (Ozerv 2000b). A great number of maggots in one nest causes the death of some or of all nestlings (Zumpt 1965). Imagines were collected on windows, in Malaise traps or rarely, in shady forests and clearings (McAlpine 1977, Soós 1984).

The puparium is formed by the hardening of the 3rd instar cuticle. In most species of Cyclorrhapha the larva retracts its head and contracts its body at pupariation, to produce the typical very often barrel-shaped puparium which is different from the longer, thinner, tapered larva. The larval spiracles are normally also clearly visible on the puparium. In most species the puparium retains many characters of the third instar larva. The majority of Diptera the puparia of which are found in birds’ nests are parasites. Identification of a particular species of Diptera on the basis of the puparium is very important in ornithological studies.

The 15 species of birds from the nests of which *N. praeustum* has been recorded have been listed by the following authors: Patton (in Keilin 1924) – *Chloris chloris* (L.), Bezzi (1922) – *Fringilla coelebs* (L.) and *Passer domesticus* (L.), Keilin (1924) – *Carduelis cannabin* (L.) and *Sylvia atricapilla* (L.), Séguy (1934) – *Luscinia megaryncha* Brehm, Armstrong (1953) – *Troglodytes troglodytes* (L.), Hesse (1923) – *Certhia familiaris* L. and *Turdus merula* L.,
Collin (in Keilin (1924) – *Turdus philomelos* Brehm, Hesse (1925) – *Accipiter nisus* (L.), Menegaux (1939) – *Hypolais icterina* (Vieillot), Séguy (1946) – *Pica pica* (L.), Peus (1960) – *Corvus corone* (L.), and Doskočil (1960) – *Carduelis carduelis* (L.). These 15 species of birds have also been listed by other authors: Czerny (1930), Tate (1954), Hicks (1959, 1962, 1971), Zumpt (1965), and Colyer & Hammond (1968).

The immature stages of *Neottiophilum praeustum* (Meig.) have been described by Hesse (1923), Keilin (1924), Hesse (1925), Tate (1954) and others, but so far the puparium has not been described and illustrated in detail.

The aim of this paper is to provide a more detailed description and illustration of the puparium of *Neottiophilum praeustum*. The host range of the European nest skipper fly is larger than previously recorded and some more information on the bird hosts of *Neottiophilum praeustum* is given. An updated distribution of *Neottiophilum praeustum* in Poland is presented.

Table 1. European nest skipper fly-*Neottiophilum praeustum* (Meigen) obtained from nests of various hosts (bird species) during ornithological research. * – no precise information about the site, L – number of larvae in host nest, P – number of puparia in host nest, ♂ – number of reared males, ♀ – number of reared females.

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Location</th>
<th>UTM code</th>
<th>Host</th>
<th>Collector</th>
<th>L</th>
<th>P</th>
<th>♂</th>
<th>♀</th>
</tr>
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<td>4.07.1966</td>
<td>Bieszczady, Tarnica</td>
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<td><em>Prunella modularis</em> (Linnaeus, 1758)</td>
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<td><em>Fringilla coelebs</em> (Linnaeus, 1758)</td>
<td>J. Chowaniec</td>
<td>24</td>
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<td>DV 26</td>
<td><em>Turdus torquatus</em> Linnaeus, 1758</td>
<td>J. Chowaniec</td>
<td>61</td>
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<td>8.07.1969</td>
<td>Zakopane, Potok Ołczyski</td>
<td>DV 26</td>
<td><em>Motacilla cinerea</em> Thunstell, 1771</td>
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<td>DV 26</td>
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<td>11</td>
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<td>Poznań</td>
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<td>FD95</td>
<td><em>Phyllocopus sibilatrix</em> (Bechstein, 1793)</td>
<td>T. Wesołowski</td>
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Puparium of Neottiophilum praeustum

MATERIAL AND METHODS

This study is based on 368 specimens (puparia and adults) of Neottiophilum praeustum reared from many bird nests collected in Poland in different years (1966–1974), in 2003 and 2004. Most of the material (290 specimens) is from the Department of Systematic Zoology, University of Poznań. The detailed information about this material is presented in Table 1. Unfortunately, puparia from Cais’s material were thrown away after the emergence of imagines. [Dr. L. Cais died in 1966 and only a small part of his material was published (Cais 1965, Cais et al. 2001)]. The puparia used as the basis for the descriptions and for the photographs came from the Białowieża National Park, June, 2004. The puparia were found by T. Wesołowski (Department of Zoology, University of Wrocław) in a nest of the wood warbler Phylloscopus sibilatrix (Bechstein). They were collected after the nestlings had left the nests.

In the Białowieża National Park in 2003 and 2004, 110 nests of Phylloscopus sibilatrix were studied. The study area and the methods are presented in the paper Wesołowski et al. (2006). In the Białowieża National Park in 2004 there were studied 54 nests of Phylloscopus sibilatrix, but puparia and adults of the European nest skipper flies were found only in one nest. In the Białowieża NP. – 70 puparia yielded 11 imagines of N. praeustum (3 of which had not emerged from the puparium (with the head outside and the rest of the body in the puparium).

RESULTS

In my paper Neottiophilum praeustum was recorded from 14 species of birds (Table 1), and of these: Buteo buteo (L.), Milvus milvus (L.), Motacilla cinerea Thunstall, Muscicapa striata (Pallas), Phylloscopus sibilatrix (Bechstein), Prunella modularis (L.), Turdus pilaris (L.) and T. torquatus L. have been recorded as the hosts of the European nest skipper flies for the first time.

DESCRIPTION OF PUPARIUM

Pip-shaped, anteriorly pointed, and broadly truncated posteriorly (Figs 1–3), with similar dorsal and ventral sides, but the latter is more flat. About 5.1–7.8 mm in length and 1.9–3.9 mm in greatest width. The colour ranges from light brown to black brown. The segmentation is not clearly marked and is partly masked by transverse folds and various protuberances. Some parts of the cuticle of the puparium is thickly (Fig. 12) set with spines, the lengths of which vary in different regions of the body (Figs 4, 7 & 8). The spines of any given region show a wide range in length, but the majority are of similar size (Figs 8 & 12).

Anterior spiracles of 3rd instar larva fan-shaped entirely open (parallelly situated to the surface of puparium), each with 12–14 lobes (Figs 9–11). No pupal respiratory horns. Posterior spiracles sessile, reddish, spiracular plates blackish, small, each with 3 elongate, oval slits, set in a radiating pattern (Figs 15 & 16). The peritremes of the spiracles are closed. The buttons of any given region show a wide range in length, but the majority are of similar size (Figs 8 & 12).

Cephalopharyngeal skeleton of 3rd instar relatively stoutly built (Figs 17 & 19), adjoining lower part of puparium. The mouth-hooks are protruding and accompanied laterally by scraper-like structures. No windows shown in dorsal and ventral cornua. Dorsal bridge apparently absent, ventral pharyngeal ridges also absent.

Hesse (1923) recorded an adult of N. praeustum emerging from its puparium in a characteristic way (Hesse 1923: fig. 1–3). The phenomenon has also been observed in these studies (Figs 20 & 21).
REMARKS

Iwasa and Hori (1990) pointed out that the third instar larva described by Rohdendorf (1957) under the name of *Protocalliphora azurea* (Fallén) was not a *Protocalliphora*-larva. My present study supports this opinion. In the species of the genus *Protocalliphora* (Calliphoridae, Calyptratae) the buttons in the 3rd instar larva and the puparium are below the posterior spiracles, since these are turned up to the ventral side. This is well illustrated by Iwasa and Hori (1990: figs 8, 10, 14, 15) and by Cais et al. (2001: figs 9, 17, 25, 30). The buttons and posterior spiracles are situated differently in another parasite of nestlings, namely in the species of the genus *Protocalliphora* (Calliphoridae). Moreover the puparia in the species of the genus *Protocalliphora* are barrel-shaped and completely covered with very small spines (Cais et al. 2001). Therefore, in my opinion the third instar larva described by Rohdendorf (1957) as *P. azurea* (Fallén) is, in fact, *N. praeustum* (Meig.).

The buttons in the 3rd instar larva and the puparium of *Neottiophilum praeustum* (Meig.) are above the posterior spiracles, since these are turned up to the dorsal side. This is well visible (Figs 13, 15 & 16) and it was also illustrated by Rohdendorf (1957, fig. 3). The position of the buttons is different in the species of the genus *Protocalliphora* (Calliphoridae), also parasites of nestlings.
Puparium of *Neottiophilum praeustum*


Fig. 12. Puparium of *Neottiophilum praeustum*, body folds and spines of 3rd instar larva, dorsal side (SEM, photo M. Kowalewska).


ACKNOWLEDGMENTS

I should like to express my most cordial thanks to Dr Magdalena Kowalewska and Dr Jolanta Wytwer for taking the photographs and to Professors Klara Bartkowska and Tomasz Wesolowski for the materials which made it possible for me to carry out the study for this paper. I am very grateful to Prof. Przemysław Trojan for his critical review of my manuscript and for suggesting several valuable improvements.

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STRESZCZENIE

[Opis poczwarki Neottiophilum praeustum (Meigen, 1826) (Diptera, Neottiophilidae) i nowi żywiciele tej muchówki]

W pracy przedstawiona została bogato ilustrowana morfologia poczwarki, a także larwy trzeciego stadium. Podano również wykaz żywicieli gatunku Neottiophilum praeustum w Polsce.

Wróblinki (Neottiophildae, Diptera) zaliczane do grupy Acalyptrata uzyskały niedawno status rodziny. Na świecie znane są 4 gatunki należące do dwóch rodzajów: Actenoptera Czerny, 1904 oraz Neottiophilum Frauenfeld, 1868. W Europie stwierdzono dwa gatunki z tej rodziny, w Polsce jeden Neottiophilum praeustum. Formy dorosłe są wolnożywące, natomiast larwy są zewnętrznie pasożytnicze, odżywiającymi się krwią piskląt gatunków wróblowatych (Passeriformes). Dotychczas Neottiophilum praeustum stwierdzono w gniazdach 15 gatunków ptaków. W Polsce wróblinki znaleziono w gniazdach 14 gatunków ptaków. U 8 gatunków żywicieli: Buteo buteo (L.), Milvus milvus (L.), Motacilla cinerea Thunstall, Muscicapa striata (Pallas), Phylloscopus sibilatrix (Bechstein), Prunella modularis (L.), Turdus pilaris (L.) i T. torquatus L. stwierdzono N. praeustum po raz pierwszy. Larwa III stadium N. praeustum (Meig.) została opisana przez Rohdendorf (1957) jako Protocalliphora azurea (Fall.) (Diptera, Calliphoridae).

Accepted: 8 November 2006