

Ecological studies on Pipunculidae (Diptera)

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Zusammenfassung: Es wird über Freilandbeobachtungen an Augenfliegen berichtet. Räumlich begrenzte Vorkommen erwiesen sich als erstaunlich artenreich. Sie werden im einzelnen vorgestellt, sowie eine bemerkenswerte Begleitfauna genannt. Betrachtungen von Verhaltensweisen runden das Bild ab, zeigen aber gleichzeitig die Notwendigkeit für weitere Studien.

Abstract: Studies on Pipunculid flies in their natural environment are presented. Certain places are described, which proved to be astonishingly rich in species. Some remarkable associating insect species are listed. As far as investigated comments on the behaviour of the adult flies are added.

Key words: Diptera, Pipunculidae, behaviour, ecology

Introduction

Pipunculid flies are rather small mostly black insects, developing as parasitoids inside leafhoppers, with the ability of hovering (relationship to Syrphidae) and with enormous compound eyes, useful for males in search for females, and for females in search for a potential victim, a cicad larva.

Most specimen of Pipunculidae studied so far were collected by Malaise traps. This material allows to describe the existing species, to secure their systematical stand, and to mark their distribution. Many questions in this chapter are still open. On the other hand the development as parasitoids in leafhoppers show fascinating aspects of adaptations to this life and even has an ecological/economical content regarding pest control. For these questions the natural behavior, the occurrence during daytime, the dependence on weather conditions, the ecological niches that enable various species to live together, etc. are essential. Because in literature hints in these directions are scarce this article tries to add knowledge to the ecological side of Pipunculid flies.

Pipunculids in their environment

Since several years I am studying Pipunculid flies concerning systematics. In the beginning it seemed difficult to find these insects in their natural environment at all. Meanwhile the eyes are adapted and some places in my vicinity proved to host several species at the same time. These „heavily crowded“ habitats are surveyed in the following chapters.

1. Clover stand on sandy wasteland

On the Eastern margin of the city of Erlangen/Middle Franconia arces, in former times used as military training area, are now left to its own since more than 10 years. On sandy soil, poor in nutrients, a scattered flora developed with clover (*Trifolium dubium*, *T. arvense*, *T. pratense*, *T. repens*), diverse grasses (*Agrostis tenuis*, *Lolium perenne*), and flowering plants like plantain (*Plantago media*, *P. lanceolata*), wild carrot (*Daucus carota*), primrose (*Oenothera biennis*), aster (*Stenactis annua*), and others. Especially the clover patches are the habitat to some Pipunculids:

<i>Eudorylas zermattensis</i>	<i>E. subterminalis</i>
<i>E. ruralis</i>	<i>E. terminalis</i>
<i>E. slovacus</i>	<i>Pipunculus campestris</i>

From July to August 1995, '96, and '97 during sunshine hours from 11 a.m. to 5 p.m. the flies were active. *Eudorylas zermattensis* (4 couples, 7 males) and *E. subterminalis* (1 couple, 3 males, 1 female) could be observed. Males and females controlled in a height of 8-10 cm between the clover flowers an area of 2-3 m in diameter. Several couples of both species were found sitting on grass leaves in '95 and '96. Joined to their abdomen tips the animals were sitting in one line, looking in opposite directions.

Additional species were *Eudorylas terminalis* (2 males, one in '96 and one in '97), *E. slovacus* (1 male on July 20th '97), and *E. ruralis* (1 male on July 12th '96). All may have been accidental. *E. ruralis* is rather abundant on single standing willows not far away (observed 28 males and 1 female). One male of *Pipunculus campestris* was caught on July 8th. '95. Because I never met further specimen I argue that this specimen might have 'travelled' through to other sites with higher standing and more dense growing vegetation.

Leafhoppers found in this habitat belonged to the family Dephacidae. In particular *Deltocephalus pulicaris*, *Psammotettix* sp., *Euscelis incisus*,

Arthaldeus pascuellus are wide spread. HUQ 1982, SANDER 1985, and WA-LOFF & JERVIS 1987 mark these cicads - ecologically characteristic for pastures, grassland, arid waste lands (REMANE & WACHMANN 1993) - as hosts for the observed Pipunculids.

Remarkable accompying insect species of other orders are:

Saltatoria: *Myrmeleotettix maculatus*, *Oedipoda caerulescens*

Coleoptera:

- Cicindelidae: *Cicindela hybrida*
- Carabidae: *Poecilus cupreus*, *Amara* sp.
- Malachiidae: *Malachius bipustulatus*

Hymenoptera:

- Symphyta: *Athalia cordata*, *Selandria serva*
- Formicidae: *Myrmica ruginodis*, *Lasius niger*
- Chrysididae: *Hedychrum nobile*
- Sphecidae: *Ammophila sabulosa*
- Apidae: *Andrena bicolor*, *A. haemorrhoea*, *Bombus pascuorum*
- Vespidae: *Paravespula rufa*

Diptera:

- Asilidae: *Machimus rusticus*, *Leptogaster cylindrica*
- Bombyliidae: *Thyridanthrax fenestratus*, *Hemipenthes maurus*, *Villa paniscus*, *V. hottentotta*, *Systoechus ctenopterus*
- Muscidae: *Graphomyia maculata*
- Tachinidae: *Ectophasia crassipennis*, *Gymnosoma costatum*, *Tachina fera*

2. A blackthorn hedge

Surrounded by momentarily unused acres, this hedge crosses a hilly slope along a small way near my hometown. With the exception of some wild roses (*Rosa canina* ssp.) all shrubs are blackthorn (*Prunus spinosa*). The 54 m long hedge, running SE to NW stands 3 - 3.5 m high and is 3 - 5 m wide at its base. While ending at a forest's rim the open other end proved to be of special attraction to various insects. This may be caused by acting as a landmark. The districts where Pipunculids are present belong to the first 10 meters, measured from the open SE-end.

Eudorylus zermattensis

E. obscurus

Cephalops ultimus

C. (Beckerias) pannonicus

E. jenkinsoni

E. longifrons

Chalcarus spurius

Once a couple of *Eudorylas* was seen on a grass leaf's top below a twig of blackthorn. They were sitting in a line, abdomen to abdomen. While watching the couple departed and took off. So the species could not be determined. But it may have been *E. zermattensis*, because this species is common in this habitat (captured 16 males and 9 females). Less common are *E. jenkinsoni* (7 specimen until now; 3 females, 4 males), *E. obscurus* (4 males), and *E. longifrons* (1 male). The 4 *Chalarus* are females of *C. spurius*.

There are two findings of representatives of a different genus: *Cephalops* (*Beckerias*) *pannonicus* and *C. ultimus*, both males. The specimen occurred on low branches up to 35 cm above ground. Because I only found these two during 3 years I think their main habitats are somewhere else, probably in the open areas in the vicinity. *Stenocranus minutus*, the host of *Beckerias* cited in literature, is monophag on *Dactylis glomerata*, a common way-side grass. *Javesella pellucida*, *Criomorphus* sp., *Eurysa lineata*, and *Dicranotropis* sp., cited as hosts of *C. ultimus*, are characteristic cicads of grassland, and present in the neighbourhood. Unfortunately further *Cephalops* specimen in the open fields next to the hedge could not be found.

As hosts for *Eudorylas jenkinsoni* and *obscurus* 2 leafhopper species living in meadows are given: *Errastunus ocellaris* and *Arhaldeus pascuellus*, so these Pipunculids might also have flown in from the neighbouring sites.

On blackthorn itself the leafhoppers *Psammodictya confinis* (Dahlb.) and *Allygidius commutatus* (Fieb.) are present. Both might act as hosts for *Eudorylas zermattensis*. A search for infested larvae was without success so far.

As main associates among the insects the following were found:

Neuroptera: *Chrysoperla carnea*, *Nineta flava*

Megaloptera: *Panorpa communis*

Coleoptera:

- Coccinellidae: *Halyzia 16-guttata*, *Adalia bipunctata*

- Cerambycidae: *Cerambyx scopolii*

- Chrysomelidae: *Cryptocephalus bipunctatus*

Heteroptera: *Heterotoma planicornis*, *Pentatoma rufipes*

Homoptera: *Cixius nervosus*

Hymenoptera:

- Sphegidae: *Hoplocampa rutilicornis*, *Sterictophora furcata*

- Sphecidae: *Crossocerus 4-maculatus*

- Apidae: *Halictus* sp., *Andrena bicolor*
- Vespidae: *Polistes dominulus*, *Paravespula media*
- Ichneumonidae, Braconidae, Chalcidoidea div.sp.

Diptera:

- Stratiomyiidae: *Sargus cuprarius*, *Microchrysa polita*
- Dolichopodidae: *Syntormon aulicus*, *Medetera* sp.
- Hybotidae: *Platypalpus* sp.div.
- Syrphidae: *Pipizella viduata*, *Neoascia podagrica*
- Lauxaniidae: *Tricholauxania praeusta*, *Calliopum aeneum*
- Sarcophagidae: *Sarcophaga* sp.
- Tachinidae: *Phryno vetula*

3. A mixed hedge with singular oak trees

Near the village of Neuhaus (vicinity Höchstadt/Aisch, Middle Franconia) a hedge with hazelnut (*Corylus avellana*), dogwood (*Cornus sanguinea*), willow (*Salix* sp.), hawthorn (*Crataegus monogyna*), and privet (*Ligustrum vulgare*) is enriched by a few low standing oak trees (*Quercus robur*). Each oak is apparently infested by certain leafhoppers, but only one oak attracts most of Pipunculids roaming around.

The hedge is orientated North - South, about 120 m long, and coming down a slope between rather intensely used fields. The special oak grows near the the open end of the hedge. During morning hours the sun shines on that side, where a path accompanies the hedge. Here a rich wayside vegetation grows with various flowers visited especially by Syrphids. After noon the sun turns over to the other side of the hedge, facing the fields. Mainly during the afternoon up till 8 o'clock in the evening I watched Pipunculids on this side (July and August '96, and June and July '97):

<i>Pipunculus tenuirostris</i>	<i>Eudorylas obscurus</i>
<i>P. oldenbergi</i>	<i>E. fuscipes</i>
<i>P. campestris</i>	<i>E. demeyeri</i>
<i>Jassidophaga setosa</i>	<i>E. melanostolus</i>
<i>Chalarus spirius</i>	<i>E. terminalis</i>
<i>Ch. juliae</i>	<i>E. subterminalis</i>
<i>Ch. fimbriatus</i>	<i>Cephalops semifumosus</i>

The genus *Pipunculus* is represented by 3 species: *P. campestris*, *P. tenuirostris* and *P. oldenbergi*. A striking species is *Pipunculus oldenbergi*. The large black males (6) were seen encircling the branches and leaf-tips in a rather rapid manner, only slowing down here and there on the outermost

points. They were not seen resting during a 2 hour watch. About 30 cm above the ground, below the lowest oak branch 2 couples could be observed. Each was hovering for 10 or 14 minutes at one place, the male on top with wings in motion, joined to the female below in same orientation, but with the long wings kept quiet parallel near the abdomen, touching the combined abdomen ends of both on either side. While in the air one couple was caught. The second disappeared after 14 minutes of watching towards the interior of the hedge. It was luck to meet with this species because the flight period is rather short (DEMPPEWOLF 1996 a).

The rather small *Pipunculus tenuirostris* (21 males, 2 females) did not move so fast. They preferred flying in the outer parts of the oak, but were also seen in the shady inner districts. No couple could be observed. The 3 females showed no different behavior than the males. *P. campestris* (4 males) visited the lower branches of the oak. This species is thought to belong more to the open land fauna.

Eudorylas obscurus occurred in the same level as the *Pipunculus* species. In June 27th '96 a couple hovered 1 m above the ground on the Northern side of the oak at 5 p.m. No sun was shining, but it was warm. Mating was watched for 5 minutes. Nearly 3 minutes the couple stayed at the same spot in the air, then lowered towards the grass. At this moment I caught them. Inside the net they departed soon. The attitude while mating was the male above and the female below, both facing in the same direction and both moving their wings. 12 more males were stated till today, but no female.

One male *Eudorylas demeyeri* was caught shortly after noon on June 22nd '96, basking in the sun on one leaf. Unfortunately no couple could be found. This would have given certainty about the still unknown female.

Eudorylas fuscipes may belong to the regular crew as well. In '95 one male was found, in '96 two males, and now in '97 again two males. The species is rather small, but unmistakable by its huge membrane.

Surprisingly a male and a female of *Eudorylas melanostolus* occurred here in July, 14th '97. I count this species more to the fauna on open land. Other single specimen belonged to *Eudorylas terminalis* and *E. subterminalis*. They are members of the open land-fauna as well.

The genus *Chalarus* is not very common in this hedge. Within the last 3 years I only met 1 female of *C. spurius*, flying at 3.15 p.m. in nearly 3 m height, and 5 males flying shortly after noon (2) and again near the evening

in heights between 40 cm and 2.5 m. One male of *C. fimbriatus* was caught in the evening hours on July 19th. '96. Remarkable is a couple of *C. juliae*, observed on July 15th. '97 flying around each other in a neighbouring hawthorn bush.

One male of *Jassidophaga setosa* came up on July 12th. '97. Due to this date this specimen must represent the second generation in the year.

The last genus represented is *Cephalops* with its widespread species *C. semifumosus*. One female was collected in July '96. In accord with other findings this genus lives more on open grassy land.

Regarding the Northern side of the hedge I never saw Pipunculids between the herbs and only few single specimen on the foliage.

Accompanying insects:

Neuroptera: *Chrysopa perla*, *Micromus variegatus*

Megaloptera: *Panorpa communis*

Saltatoria: *Tettigonia viridissima*

Heteroptera: *Miris striatus*, *Pilophorus perplexus*

Coleoptera:

- Cantharidae: *Cantharis livida*, *Rhagonycha fulva*

- Buprestidae: *Agrilus sulcicollis*

- Coccinellidae: *Calvia 14-guttata*, *Propylaea 14-punctata*

- Curculionidae: *Attelabus nitens*, *Phyllobius argentatus*

Hymenoptera:

- Symphyta: *Rhogogaster viridis*, *Arge rustica*

- Cynipidae: *Neuroterus numismalis*

- Sphecidae: *Ectemnius rugifer*

- Apidae: *Andrena labiata*, *A. haemorrhoea*, *Prosopis hyalinata*

- Ichneumonidae, Braconidae, Chalcidoidea sp.div.

Diptera:

- Therevidae: *Thereva valida*, *Th. nobilitata*, *Dialineura anilis*

- Rhagionidae: *Rhagio tringarius*

- Stratiomyiidae: *Pachygaster atra*, *Chloromyia formosa*, *Oxycera rara*

- Asilidae: *Dioctria hyalipennis*, *Leptogaster guttiventris*

- Syrphidae: *Episyrphus balteatus*, *Xylota segnis*, *Melanostoma scalare*

- Sepsidae: *Sepsis punctum*

- Calliphoridae: *Lucilia sericata*

- Sarcophagidae: *Metopia argyrocephala*

- Tachinidae: *Ernestia rudis*

4. Willows beside a way inside a pine forest

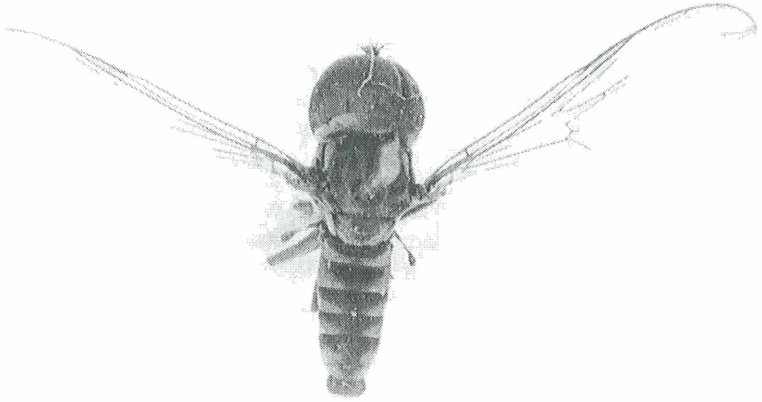
Pine forests in Middle Franconia are dissected by many paths. Here light can come through to the ground and support the growth of many flowers and softwood trees. Especially aspen, birch, and willow (mostly *Salix capraea*) settle along the paths. Because the trees in most cases are chopped after 3-4 years, they are not so tall. For Pipunculids this habitat looked at first not so inviting. But the contrary is right. At these places, mainly on willows, I found a surprising variety of species, and below in the grassy margins beside the ways some more.

But not every willow seems to be of same quality. First the tree has to get sun for most of the afternoon and second its branches should not be too dense and should stand somewhat horizontally. Along a 500 m section out of 100 small willows about 30 fulfil these conditions and 14 proved to host Pipunculids. The following species could be observed:

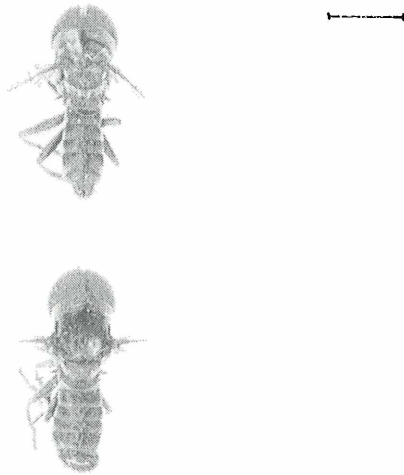
<i>Jassidophaga beatrix</i>	<i>Nephrocerus scutellatus</i>
<i>J. setosa</i>	<i>Chafarus spurius</i>
<i>Eudorylas zonellus</i>	<i>Ch. juliae</i>
<i>E. terminalis</i>	

Starting in May in my forests *Jassidophaga beatrix* is common. LAUTERER 1981 calls this species ecologically very tolerant. The places where I met *J. beatrix* are very similar, so I can not testify a wide amplitude until now. Most specimen occurring on the wing were females. In June 12th '95 I watched an attack on a cicad larva - *Aphrophora salicis* or *Philaenus*. The nymph was sitting rather safe in a twig's angle. The female *Jassidophaga* hovered in a distance of about 2-3 cm to that point. It stayed not on one place, but encircled the larva very slowly, always orientating the head towards the victim. This behavior went on for nearly 8 minutes! The female flew circles, semicircles, loops, etc., always fixing the cicad as if searching the right angle for an attack or waiting for the right time. And the cicad nymph did not move. Finally the female disappeared without further approach. As possible declarations I take that the fly may have searched for a suitable moment, which did not come, or apparently was able to check by distance, that this larva already had an egg inside.

Jassidophaga setosa is the second representative of this genus, which is not too rare (6 females, 2 males). The other related species must live in different habitats (compare LAUTERER 1981). Species of *Verrallia (aucta and helvetica)* only occasionally leave dry regions. Most areas with *V. auc-*



Eudorylas zonellus, female, one of the larger Pipunculid species



Eudorylas terminalis, above female, below male - scale bar = 1 mm

ta belong to dry grasslands on limestone.

In June the time has come for *Eudorylas*. The rather big species *E. zonellus* live on these willows. The striking light grey ringlets on the abdomen give additional certainty in determining. The flight period goes on till August.

E. terminalis is a second, but smaller species, flying around willow leaves. It starts not before mid of July (at least on this place) and goes on till September.

By accident one male of *Nephrocerus scutellatus* was found on June 12th. '96 between the willow branches in a height of 1.5 m. Being very similar to certain Syrphidae in appearance (e.g. *Baccha elongata*, *Melanostoma scalare* - male, *Meliscaeva cinctella*, *Platycheirus clypeatus*, and some others) which also live in this environment, the specimen got my attention not from the start. It became suspicious, when I noticed the specific encircling search-flight of a Pipunculid around the leaves, always head first. A Syrphid would have flown more direct, not avoiding air spaces, and taking a seat here and there for a rest in the sun or for the uptake of honey due. As host the great cicad *Ledra aurita* may serve known to live on these willows.

Chalarus spurius is not rare. Males and females fly 1 to 3 m high, also cumulating in a favorite time near the evening hours. On a neighboring birch one male of *Chalarus juliae* was collected on July 17th. '96.

In June '96 also a couple of *Cephalops vittipes* was discovered between the way-side grasses. In July '95 already several *Pipunculus campestris* were observed on the same place. Skillful the specimen hovered through the dense standing plants in a height of less than 30 cm. In front of a bunch of nettle a male of *Tomosvaryella sylvestris* was taken in the sun.

Accompanying insect species:

Blattodea: *Ectobius sylvestris*

Saltatoria: *Pholidoptera griseoptera*

Heteroptera: *Acanthosoma haemorrhoidale*

Homoptera: *Ledra aurita*, *Aphrophora alni*, *Spilaena spumaria*

Coleoptera:

Buprestidae: *Trachys minuta*

Coccinellidae: *Coccinella hieroglyphica*, *Thea 22-punctata*

Chrysomelidae: *Galerucella linela*, *Phytodecta viminalis*, *Lochmaea c.*

Curculionidae: *Rhynchites auratus*, *Rhynchaenus salicis*

Hymenoptera:

- Symphyta: *Pontania caprae*, *Arge ustulata*, *Tenthredo livida*
- Apidae: *Halictus calceatus*
- Ichneumonidae, Braconidae, Chalcidoidea sp.div.

Diptera:

- Rhagionidae: *Rhagio scolopacina*, *R. lineola*
- Stratiomyiidae: *Beris chalybeata*, *Chloromyia formosa*
- Asilidae: *Choerades marginata*
- Syrphidae: *Baccha elongata*, *Eumerus flavitarsis*, *Melanostoma* sp.,
Meliscaeva cinctella
- Muscidae: *Phaonia rufiventris*, *Helina impuncta*

There were several leafhoppers found to live on these willows. *Aphrophora alni*, *Philaenus spumarius*, *Macropsis infuscata*, and *Allygus maculatus* are common. None of these is reported as host for those species living here.

Observations to behaviour

Pipunculids are mainly active in the sun. In the early morning hours one can find only a few specimen, which are, due to my experience, in most cases females. At about 11 o'clock a. m. the main number of specimen starts to fly in the sunny sides of their habitat. Males fly rather fast. They controll projecting leaves and twigs by keeping a distance of about 2 cm. They always stay in the same level, avoiding to fly lower or higher than the leaf they are encircling. This kind of flying is so characteristic, that one can recognize Pipunculids one had seen them once. Their flight is steady without loops or sudden turns, but their route not systematically. They like to stay in eye-contact with the plant they are encircling. Therefore they are seldom to be seen to cross pure air as members of most other fly families do. If it is necessary they take the shortest way rather fast. Where they reach the next twig they continue their searchflight.

It may depend on a precise sight that the favorite places for actions are nearly always directed towards sunlight. The flies prefer outer contours and appear only further inside a vegetation if there is enough light. Beside light temperature is a second factor (cf. DEMPEWOLF 1996 b). If it is warm enough - not less than 16 degrees - Pipunculids fly even then, when clouds temporarily hide the sun. If it is warmer than 20 degrees they may fly even below a totally cloudy sky. Moisture in the air seems also be essential, too. Warm and dry conditions bring less flies on the wing than medium warm and moist or even sultry before a thunderstorm.

The flies come along with wind rather good. A mean shaking of twigs and leaves by a steady wind seems not to disturb them. Only if the wind turns gusty they change sides and move towards wind shade - rather often to be seen in tiny *Chalarus* - or hide somewhere. Otherwise they adapt their flight very skillful.

Staying on the wing for about 5 to 10 minutes, that means controlling an area of several meters in length more than once the males rest on a leaf's surface, basking in the sun. They lay the wings one above the other, so that a typical bronze reflection becomes visible. In most cases they land and stay where they are. Only sometimes I saw a male „hopping“ around on a leaf's surface, that is sitting, walking 2-3 steps, stopping, flying 1-2 cm, sitting again, etc. After 3 to 6 hops on one leaf it flew away. Looking closer while sitting the fly lowered its head by bending front knees and took honey due from the surface below with its proboscis. A sequence of stretching and bending makes the whole movement look jerky.

Never I saw Pipunculids disappear under a leaf by turning upside down. If disturbed by whatever the flies are able to speed off surprisingly fast. The main flight direction in this case seems to be always steep upwards.

When males meet each other, either belonging to the same species or not, they fly 2-3 times in circles as if they are upset, but then departing very soon and each continues in its search for a female. I did not have the luck to watch a meeting of 2 females. But it may happen in the same manner - if there is no leafhopper to fight for. Despite statements in literature I found no differences in the everyday behaviour between the two sexes - at least in those species studied.

The only exception where I can differ males from females at once is when males search for females also on foreign trees like red oak (*Quercus rubra*) or black locust (*Robinia pseudacacia*) without native leafhoppers. This error may be explained by a rather high hormone level. I am sure, females can identify a plant as native, because only here the search for those cicadas they are adapted to may be of success at all.

Trials with observing in captivity

The life span of a Pipunculid is marked in literature with 5-14 days (esp. HUQ 1982). To study feeding and interactive behavior I kept male *Pipunculus campestris* in 2 plastic containers in the dimensions of 20 x 20 x 10 cm, each filled with grass, *Salix caprea* leaves with honey due, and 5 flies.

At first the flies searched for an escape by hovering and moving very slowly. Again and again they turned around their own axis. About 15 minutes later they sat down, relaxed some minutes and started again. During the next break they cleaned their body, wings, and especially eyes. Once in a while only up to 2 flies were on the wing. They avoided contact and did not attack each other - probably a result of the case of emergency.

3-4 hours later the specimen became lethargic. They were sitting somewhere on the bottom of the container or on the leaves for the next hours. I did not watch all the time, but an uptake of honey dew was not to be seen. Until next day they nearly had not changed their position. The first 5 I released around noon after 24 hours in captivity. Sunlight and fresh air brought them back to life nearly 1 hour later.

The other 5 in the second box I set free in the evening. These flies looked rather weak, could hardly use their feet, and 2 held their wings angled. These 2 died within half an hour, their abdomen down curved. The other 3 were able to stand on their feet 20 minutes later. Till darkness came 3 hours later they had not left their spot. Next morning they were gone. I assume they finally flew away.

I do not know how to interpret these results. What was wrong? Did I give the right temperature? Do Pipunculids need a certain moisture in the air, especially during night hours? Were they disturbed or stressed by the presence of other members of their kind? Is it impossible to keep a species used to roam rather big areas in a tiny box? Was their life span nearly done? Experiments under different conditions might get better insights.

Remarks to a favorite flight level above ground

While flying certain species have favorite heights:

- *Jassidophaga* species like to roam the lower storey, that is up to 2 m. There is no difference between *J. beatricis* and *setosa*.
- *Eudorylas* species living in arboreal habitats I always saw between 1 and 3 m. This includes *E. obscurus*, *fascipes*, *fuscipes*, *demeyeri*, *zonellus*, and *terminalis*; Others like *E. zermattensis*, *ruralis*, *subterminalis*, *slovacus* are more open-land-species, appearing on bushes once in a while. The last group seems to be ecologically variable.
- *Chalarus* females seem to prefer higher levels, not less than 2 m.
- *Chalarus* males instead even look for females down to 15 cm above the ground. The reason could be, that mating takes place near the soil

surface - like in the other genera. So the chance of disturbing a couple and mating itself seems to justify this reaction.

- *Pipunculus* species may be divided in 2 groups: those dependant on aboreal cicads like *tenuirostris* (I only saw on low branches within 1.5 m height) and *oldenbergi* (seems to claim for medium levels, that is not below 1 m and apparently not above 2.5 m) and those usually living in grassland and making 'excursions' once in a while into branchy district nearby like *campestris*.
- *Nephrocerus scutellatus* was also found in the low arboreal level. Regarding the one specimen this statement is without significance.

Because there are too few 'natural looking' habitats with exclusively low vegetation in my vicinity I only have some scattered observations to other species of the genera named above and to *Cephalops*, *Dorylomorpha* and *Tomosvaryella* (compare LAUTERER (1981), WALOFF & JERVIS (1987), DE MEYER & DE BRUYN (1989), ALBRECHT (1990), and DEMPFWOLF (1996 a, b).)

P. thomsoni seems to be restricted to grassland exclusively. These creatures are hard to find. Three times I had one in my net after sweeping a tall meadow. 2 escaped with a surprising full speed upright flight towards freedom while I cautiously looked in. The third allowed to determine the species. Wet grasslands act as habitat to *Nephrocerus lapponicus*, captured near Neuhaus/Middle Franconia in 1993. In a comparable formation near Munich W. SCHACHT recently detected *N. lapponicus* as well. At this place he also found *Dorylomorpha maculata*, *D. confusa*, and numerous *Pipunculus zugmayeriae*.

Brief survey to trapping results with colour dishes

Though they are not known to visit flowers Pipunculids are trapped by blue and yellow dishes. K. MANDERY investigates the fauna of aculeate hymenoptera in several places on military ranges of Northern Bavaria. Thanks to him for giving me the opportunity of investigating non target catches.

The places where the dishes were standing are mostly South-exposed areas, warmed up by the sun. The vegetation around consists either of grass with various flowers and scattered small pine trees or of hedges with blackthorn, elder, wild roses, etc. In particular the following results are given:

On the military ranges near Wildflecken in the Rhön mountains yellow dishes were placed in position in '94 and '95. In the whole 20 different sites

captured 65 individuals out of 16 species between May and October:
(numbers before a comma are males, behind females)

Cephalops semifumosus 0,1, *Chalarus fimbriatus* 2,0, *Dorylomorpha xanthopus* 0,1, *Eudorylas fuscus* 0,2, *E. goennersdorfensis* 0,1, *E. kowarzi* 1,0, *E. obscurus* 1,0, *Microcephalops opacus* 7,3, *Pipunculus campestris* 0,1, *P. tenuirostris* 9,3, *P. thomsoni* 0,1, *Tomosvaryella kuthyi* 1,0, *T. minima* 8,8, *T. palliditarsis* 1,1, *T. sylvatica* 4,6, *Verrallia aucta* 2,1

On the military ranges of Hammelburg in the Rhön mountains yellow and blue dishes were used. Between March and September '96 out of 19 species 63 individuals were trapped:

yellow (8 places): *Cephalops semifumosus* 1,0, *C. subultimus* 1,0, *C. vittipes* 1,0, *Chalarus brevirostris* 0,1, *Eudorylas obscurus* 4,1, *E. ruralis* 0,1, *E. terminalis* 3,0, *E. zermattensis* 1,1, *Pipunculus calceatus* 2,0, *P. campestris* 7,1, *P. oldenbergi* 2,0, *P. zugmayeriae* 1,0, *Tomosvaryella minima* 4,3, *T. sylvatica* 1,0, *Verrallia aucta* 3,1

blue (4 places): *Cephalops carinatus* 1,0, *C. signatus* 0,1, *C. obtusinervis* 1,0, *Pipunculus campestris* 3,0, *Tomosvaryella minima* 7,4, *T. sylvatica* 0,1, *Verrallia helvetica* 2,3

Remarkable are several rare species (underlined) and the differences between yellow and blue. At the moment there is no possibility of interpreting these results.

Conclusions

As numbers in Malaise traps show Pipunculids are not that rare. Beside an always changing weather the ecological value of a locality decides the capture numbers. Between May and September only some ten individuals may occur or even more than 1000. DEMPEWOLF (1996 a, p. 47 f) for instance reports numbers up to 2559 individuals captured by one trap in one place, a lean meadow on dry-warm limestone! This trap probably stood across a main travelling route what guarantees a large catch. Due to my experience in Bavaria some 100 specimen per trap and year are an average amount. These numbers are of some importance, because a Malaise trap can catch only these specimen moving from one place to an other. Those searching on one spot as I have witnessed will hardly be trapped. Regarding this fact the real number of Pipunculids in one place might be enormous.

Due to their dark colour, their tinyness, and their timewise and spatial

unequal dispersal caused by their life as parasitoids, Pipunculids are easily overlooked. But if one knows where the vegetation could be infested by different species of leafhoppers one should be successful in searching for them. A patient spectator will be rewarded with more than 50 specimen on one place within two hours - if the weather supports flying and if at least one species is in the first third of its seasonal occurrence time, when males are in search for their biological task.

Many Pipunculids have more than one generation a year. In between there are no imagines. So if someone visits a potential place once he might see nothing. Only by visiting a place about every 2 weeks a success will come.

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