

Biological observations on *Buquetia musca* (Robineau-Desvoidy) (Diptera: Tachinidae), a parasitoid of *Papilio machaon* Linné (Lepidoptera: Papilionidae)

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Abstract. *Buquetia musca* is a tachinid that parasitizes the caterpillars of *Papilio machaon*. Oviposition behaviour of this parasitoid has been studied and, for the first time, deposition of eggs on the skin of the caterpillar has been observed and filmed. Subsequently, the development of parasitized caterpillars has been followed and recorded.

Keywords. *Buquetia musca*, *Papilio machaon*, Tachinidae, Papilionidae

INTRODUCTION

Buquetia musca (Robineau-Desvoidy, 1847) (Fig. 1) belongs to the very large dipteran family Tachinidae (tachinids). The species of this family are parasitoids of insects, and rarely other Arthropoda. Reproductive strategies vary greatly between tachinid species.



Fig. 1 a, b. *Buquetia musca* (Robineau-Desvoidy, 1847)

Little is known about the biology of *Buquetia musca*. *Papilio machaon* (Linné, 1758) is by far the most often recorded host (e.g. Herting, 1960), and only a single documented record exists from *P. alexenor* (Esper, 1799) (Richter, 1995), which means *Buquetia musca* is a specialist, which is not a common feature among Tachinidae.

Buquetia musca is widespread in Europe, as far North as St. Petersburg (Herting, 1984). The species is rarely collected in the field, but often reared from its specific host. In Europe it is much more common in the South than in the North .

Before this current investigations, the mode of host searching, the oviposition strategy and many other developmental details of *Buquetia musca* have not been reported in the literature.

Caterpillars of *Papilio machaon* infected by tachinid maggots were regularly found in Callas (France: Var) between 2007 and 2012, from April until September, during which time *Papilio machaon* has three to four generations.

All infections were most probably caused by *Buquetia musca*. In 2013 attempts were made to rear the parasitoids from the caterpillars to find out which species was, or were, responsible for the parasitism. During the

summer of 2013 we performed studies on *Papilio machaon* and *Buquetia musca* to seek answers to the following questions:

- How does *B. musca* find the caterpillars?
- How does *B. musca* parasitize the host?
- Which caterpillar instar is chosen for oviposition?
- How long does it take for the maggot to develop?
- Where does the maggot become a puparium?
- How long before the adult fly emerges?
- How many annual generations does *B. musca* have?
- At what stage does *B. musca* hibernate?

MATERIALS AND METHODS

During early spring and summer 2013, from 25 March up to 13 August (neither eggs nor caterpillars were found after this date), experiments were undertaken near Callas on 15 days with caterpillars of *Papilio machaon*. The experimental hosts were reared from eggs on Fennel (*Foeniculum vulgare*), their main food plant in this area, in order to be sure that they had not yet been infected. In total 28 caterpillars were reared from eggs during this period. The butterflies reared from unparasitized caterpillars were liberated and are not taken in account with the caterpillars from the wild collected caterpillars. For the experiments, caterpillars from different stages were exposed on leaves of Fennel growing in front of a small stone wall, facing south (Table 1).

Table 1 : Experiments with *Papilio machaon* caterpillars to observe parasitism.

2013	Hour	Caterpillar	Length	<i>B. musca</i>	Remark
15 Mai	10h00 - 12h00	Instars 3, 3, 4		No visit	
20 Mai	14h00 - 17h00	Instars 2, 3, 4, 5		No visit	
22 Mai	14h30 - 17h00	Instars 2, 3, 4, 5		No visit	
24 Mai	12h00 - 14h00	Instars 3, 3, 4		No visit	
26 Mai	14h00 - 15h05	Instars 3, 3, 4		Visit	
	14h55 - 14h59	Instar 3	13mm	Attack 1	Tachinid parasitized this caterpillar. Result: one dead maggot (see Table 2).
	15h02 - 15h05	Instar 3	12mm	Attack 2	Same tachinid parasitized this caterpillar. Result: one adul fly (see Table 2).
	15h12 - 15h53	Instars 2, 2, 4		Visit	Two new instar 2 caterpillars were placed on the same leaf.
	15h53 - 15h53	Instar 2	7mm	Attack 3	New tachinid observed but no attack. This instar 2 moult one hour later.
	15h53 - 15h53	Instar 2	7mm	Attack 4	Same tachinid parasitized this caterpillar. Result: One maggot (see Table 2).
31 Mai	15h30 - 16h45	Instars 2, 4		No visit	
1 June	14h00 - 15h00	Instars 3, 4		No visit	
3 June	14h00 - 15h00	Instars 3, 4		No visit	
7 June	11h15 - 13h00	Instars 4, 4, 4		Visit	
	12h22 - 12h31	Instars 4, 4, 4		No attack	One tachinid observed two caterpillars but flies away after some minutes.
8 July	12h00 - 12h30	Instars 2, 3		No visit	Too much wind.
18 July	11h00 - 13h45	Instar 2		No visit	
19 July	11h00 - 12h15	Instars 4, 4		No visit	
20 July	12h00 - 13h30	Instars 2, 3			
7 August	13h30 - 16h00	Instar 3		Visit	
	13h40 - 14h35	Instar 3	12mm	Attack 5	Tachinid tries to parasitize this instar 3. This caterpillar moulted the next day and was not parasitized.
13 August	16h15 - 17h31	Instar 5		Visit	
	16h20 - 17h31	Instar 5	45mm	Attack 6	Tachinid lays more than 6 eggs on this caterpillar but it becomes not parasitized?
	17h32 - 18h00	Instar 4		Visit	New caterpillar.
	17h32 - 17h35	Instar 4	25mm	Attack 7	Same tachinid tries to parasitize this caterpillar, but no infection. This caterpillar moulted the next day.

For many years these plants have been regularly used by *Papilio machaon* for egg laying. The caterpillars were measured before they were placed on the leaves. The experiments were performed at various times between 10h and 18h in good weather conditions (temperature above 17 °C, sunny and not too much wind), a total of 29 hours of observations (see Table 1). The infected caterpillars were then reared in the safety of a cage preventing the entry of any flies.

In the descriptions of oviposition behaviour we use the term "ovipositor" for the extensible cuticular egg-laying tube employed, although it is not homologous with the piercing ovipositor seen in parasitic wasps.

During the same season and in the same area, but independently from the experiments above, an additional 18 caterpillars of *Papilio machaon* were also collected. From nine of these caterpillars *Buquetia musca* was reared (Table 2), and observations on larval and pupal development given below include this source.

After the maggots had erupted and become puparia they were all kept under the same conditions, in a small plastic tube 5 x 2.5cm, on top of 1cm moist humus-rich earth. The tubes were kept indoors, away from direct sunlight.

During the experiments a Canon XL2 with a 20x L IS zoomobjectif XL 5.4-108mm with extender 72mm close-up lens500D was used to record the attacks. The footage is registered on mini DV60 tapes. From the footage a video was made of every attack and can be seen on the website Filming VarWild; links in the References.

The reared adult tachinids (all *B. musca*, identified by Hans-Peter Tschorasnig, Stuttgart) were each given a reference and are deposited in our personal collection at Callas.

RESULTS

Buquetia musca appeared on three of the fifteen days, attacking in total seven of the unparasitized caterpillars at different stages that were under observation (Table 1). Only three of these infected caterpillars produced adult flies (Table 2). No instances of *B. musca* feeding on flowers were seen, although this species is known to do so (Tschorasnig, et al., 2003).

The outcome from the 19 wild-collected caterpillars included 9 caterpillars parasitized by *B. musca* (Table 2) and 3 caterpillars parasitized with the larva-pupal ichneumonid parasitoid *Trogus lapidator* (Fabricius), also a specialist on *P. machaon*. 7 wild-collected caterpillars became butterflies. No caterpillar became a hibernating chrysalis.

Observations of attacks

Interactions between *Buquetia musca* and its host were observed on 26 May, 7 August and 13 August.

On 26 May, 14h00, two caterpillars of 12 and 13mm body length (3rd instar) were placed on a leaf. At 14h55 a tachinid visited the leaf and attacked first one caterpillar and later the other, which was 10cm away on the same leaf. After the attacks the adult fly left, and two new caterpillars of 7mm (2nd instar) were placed on a leaf next to the first leaf at 15h12. These caterpillars were attacked 41 minutes later at 15h53. On 7 August one caterpillar of 12mm (3rd instar) was placed on a leaf at 13h30. This caterpillar was attacked at 13h40. On 13 August, at 16h15, one caterpillar of 45mm (5th instar) was placed on a leaf and was attacked at 16h20. At 17h32 another caterpillar of 25mm (4th instar) was placed outside the experiment cage and was immediately attacked by the same tachinid.

Behavioural details of these interactions are given below.

Host searching

From the seven attacks observed we have the impression that *Buquetia musca* finally finds its host by sight. Most probably the female tachinid initially orientates to the host plant (presumably at least in part from chemical cues) and begins the search for caterpillars from there. Females flying swiftly and zigzagging around the leaves or stems were often observed, sometimes landing and searching the surface more closely. Caterpillars spin silk threads on plant surfaces which they may use to retrace their steps, and inevitably leave a chemical record of their presence. Perhaps the tachinids are able to detect these cues and look closer in the immediate vicinity.

Ovipositor behaviour

Attack 1:

On 26 May, 14h55 a tachinid landed on and searched a leaf neighbouring one where there were two instar 3 caterpillars (13mm). This leaf was used on 24 May (see Table 1) for a caterpillar experiment without any success. After less than a minute the tachinid flew to an instar 3, approached the caterpillar's head and waited motionless for 3 minutes (Fig. 2).



Fig. 2. *Buquetia musca* attacking an instar 3



Fig. 3. *Buquetia musca* parasitizing an instar 3

It seemed the caterpillar was aware of the presence of the tachinid. Then the wind blew the leaf. The tachinid brought its ovipositor into position and tried to touch the caterpillar. The caterpillar reacted in defence with head shaking movements, causing the tachinid to retreat and try a different approach, this time from behind (away from the flailing head).

Successfully repositioned at the end of the host abdomen, it carefully brought the apex of its abdomen (Fig. 3, white circle) and made a fast second attempt to parasitize the caterpillar before flying away. Immediately the caterpillar tried to get rid of the egg by biting its abdomen.

Attack 2:

After the first attack the tachinid flew 10cm further to the other instar 3 (12mm) on the same leaf. It carefully approached the caterpillar from behind (Fig. 4), touching the abdomen of the caterpillar with its front legs. Immediately the caterpillar started shaking its head. The tachinid waited 25 seconds then tried again, instantly provoking a strong reaction from the caterpillar. It flew onto the caterpillar, momentarily touching its back with the ovipositor; it then landed next to the caterpillar and very carefully, but briefly, inspected the caterpillar's back and then flew away (Fig. 5). The caterpillar was left trying to rid itself of something troublesome on its back.

Fig. 4. *Buquetia musca* attacking an instar 3Fig. 5. *Buquetia musca* observes after parasitizing.

When the tachinid involved in attack 2 had gone, the first two caterpillars were replaced by two new instar 2 caterpillars (7mm) on the same leaf at 15h12.

Attack 3:

At 15h53 a tachinid landed on a leaf adjacent to the leaf with the two new caterpillars. It searched and flew to the first caterpillar which was almost ready to moult, approaching very carefully, and stopping one centimeter from the caterpillar. It studied it for 25 seconds (Fig. 6).

Fig. 6. *Buquetia musca* observing an instar 2.Fig. 7. *Buquetia musca* using its supravibrissal setae.

Moving closer, it touched the caterpillar's skin with its front leg and then used the supravibrissal setae around its mouth (Fig. 7). The caterpillar made one violent shaking movement and the tachinid retreated. Shortly afterwards it passed close to the caterpillar, but no longer showed any interest. One hour later this caterpillar moulted into an instar 3.

Attack 4:

At 15h54 the tachinid involved in attack 3 flew straight to the second caterpillar which had moulted half an hour previously. It flew over the caterpillar, touching it very quickly with its ovipositor and then flew away. The caterpillar tried to get rid of something on its back.

Attack 5:

On 7 August, 13h40 a *Buquetia musca* flew 1cm behind an instar 3 caterpillar, of 12mm, that sat on a small leaf. After one minute it flew up and landed a little closer and walked towards the end of the abdomen of the caterpillar. There it waited for another minute, then the caterpillar moved its abdomen and the tachinid moved closer (Fig. 8).



Fig. 8 - 9 - 10. *Buquetia musca* attacking an instar 3

With every gust of wind the ovipositor became visible (Fig. 9); after 20 minutes a stronger gust of wind shook the leaf and the tachinid touched the caterpillar which started to shake its abdomen. The tachinid moved and then hung half under the caterpillar. In this hanging position the tachinid stayed for 25 minutes and now and then touched the abdomen of the caterpillar (Fig. 10).

After 55 minutes, at 14h35, the caterpillar shook its head and the tachinid flew away. The caterpillar did not scratch its head or body to get rid of something but sat motionless on its leaf.

The next day the caterpillar moulted into an instar 4 caterpillar.

Attack 6:

On 13 August 16h20 a *Buquetia musca* landed first above the head of an instar 5 (45mm) caterpillar and flew to a leaf a little further away (Fig. 11). After 3 minutes it flew up and landed 5cm behind the caterpillar. After 4 minutes it walked slowly closer to the caterpillar. When it was almost touched the caterpillar moved a little bit as if it was aware of the tachinid. After a couple of minutes the tachinid brought its ovipositor into position and tried to parasitize the caterpillar (Fig. 12).



Fig. 11. *Buquetia musca* observing an instar 5.

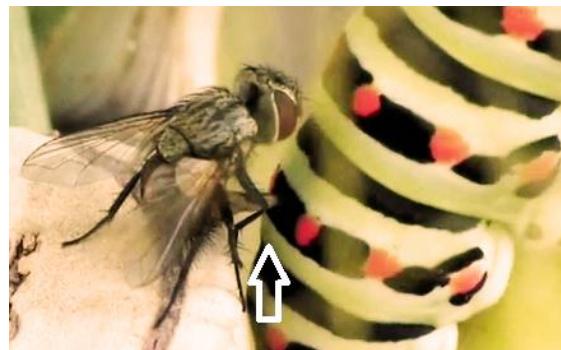


Fig. 12. *Buquetia musca* attacking an instar 5.

The fly waited for a couple of minutes and flew to a small leaf next to the caterpillar. After two minutes it flew 10cm above the caterpillar on a stem and walked to 1cm from the head. There it waited almost motionless

for more than 14 minutes. Then the tachinid moved closer and immediately the caterpillar started moving and the fly backed off and waited three minutes.

Then the tachinid moved to the left side of the head of the caterpillar and after some minutes it moved closer, and the caterpillar reacted immediately. After waiting three minutes, the tachinid tried to oviposit, and went on to lay 6 to 7 eggs on the caterpillar over the next 20 minutes. Here we could observe closely how the egg was glued on the body of the caterpillar (Fig. 13 & 14, egg in the red circle).



Fig. 13. *B. musca* parasitizing an instar 5.



Fig. 14. Egg-larva glued on an instar 5.



Fig. 15. Empty eggs.

Just over ten minutes later, the maggots from the eggs penetrated the skin of the caterpillar and entered its body, each leaving behind an empty transparent eggshell (Fig. 15).

When the caterpillar moved its head towards the fly, the tachinid walked away to the left side of the caterpillar and laid another 5 eggs. Than after one hour and 10 minutes (17h32) the tachinid flew away.

When another caterpillar was taken out of the cage the tachinid from attack 6 flew directly towards it, from a distance of 7 meters, and positioned itself, on the same leaf, at 10cm distance.

Attack 7:

At 17h32 the tachinid flew zigzagging around the instar 4 (25mm) caterpillar and landed a little further away on the same leaf. After 2 minutes it flew up and landed close to the head of the caterpillar (Fig. 16). With a gust of wind, the tachinid moved to the right side of the caterpillar (Fig. 17). When the caterpillar bent towards the tachinid it did not move, but when the tachinid tried to lay an egg on the caterpillar (Fig. 17), a minute later, it swung its head towards the fly which then retreated and disappeared without any success.



Fig. 16 - 17 - 18. *Buquetia musca* attacking an instar 4.



The next day this caterpillar moulted into an instar 5.

Although in some cases (attacks 1, 2 and 4) ovipositions evidently did occur no eggs were directly observed as a result of attacks 1 to 5. Only in attack 6 did we observe that the *Buquetia musca* laid an egg on the skin of the caterpillar (Fig. 14). In this attack we also saw that after a couple of minutes only transparent shells of the eggs were visible and the maggots had penetrated the caterpillar through its skin (Fig. 15).

Development of the maggots

Only the first attacks on 26 May (i.e. attacks 1, 2 and 4) resulted in parasitization. Most probably, *Buquetia musca* was not interested in the third caterpillar (attack 3) because it was almost ready to moult. It is remarkable that on 7 August (attack 5) the tachinid spent 55 minutes on a host that was ready to moult and did not become parasitized. Also attack 6, on 13 August, on the 5th instar caterpillar did not result in adult tachinids although at least 6 eggs had been glued on the skin of the caterpillar. After six days this caterpillar became a chrysalis (on 19 August). Unfortunately when the butterfly tried to hatch after 17 days on 5 September, it failed to liberate itself from the chrysalis. No maggots were found in its abdomen.

The three caterpillars parasitized on 26 May developed during the first 8 to 9 days as normal.

The caterpillar from the first attack had, after nine days, become 22mm and was resting on its stem 28 cm high. By now a black spot with a hole had developed on segment 5. The next day, 5 June, the host was hanging by its pro-legs, head down and a big hole had appeared in the middle of its body. Two maggots had left the body; one puparium was found, 30 cm further from the stem under a tile, and one maggot lay dead in the sand.

The caterpillar from the second attack also had become 22mm and rested on its stem 32 cm high after nine days. This caterpillar had developed a black spot on segment 4, and collapsed on 5 June when it was hanging by its pro-legs. One maggot had left its body and made a puparium in the sand.

The caterpillar from the third attack was not infested and moulted on 7 June into a 22mm, instar 5 caterpillar.

The caterpillar from the fourth attack became 20mm on day 10, on 5 June, and rested on its stem with a black spot on segment 4. On 6 June, after 11 days, at 5h45 in the morning the caterpillar was 20mm long, and hanging by its pro-legs under the leaf (Fig. 19).



Fig. 19 - 20. *Buquetia musca* larva leaving its host.



Fig. 21. Larva hanging on mucus strand.

At 6h33 a maggot erupted from segment 5 on the left side of the caterpillar (Fig. 20). It took this larva about one minute and 20 seconds to leave the body of the host. The caterpillar was hanging 42 centimeters from the ground. The maggot made a strand of mucus for the first 35 centimeters of its decent, taking around 8 minutes (Fig. 21). From a height of 7 centimeters the maggot then dropped to the ground.

On the ground it crawled away under an old flower bud. 15 minutes later it was no longer under the flower bud and unfortunately we were unable to find it again.

Parasitized caterpillars

From the attacks on 26 May 3 maggots hatched after 10 days from 2 caterpillars and 1 maggot hatched after 11 days. There was hardly any difference in development between parasitized and unparasitized caterpillars.

Many parasitized caterpillars develop, eight to nine days after being parasitized, one or more black spots on a segments of their body (Fig. 22). Sometimes small holes appear in the black spots (Fig. 23 & 24).



Fig. 22. Black spot on parasitized caterpillar.



Fig. 23 - 24. Detail of black spot with hole on parasitized caterpillar.



It is possible that these black spots comprise a direct respiration opening by the maggot through the host cuticle (or perhaps a respiration funnel, attached to host tracheae, which shines through the cuticle), but this was not investigated by us in detail.

From the 12 parasitized caterpillars 17 maggots hatched. Eight caterpillars had 1 maggot, three had 2 and only one had 3.

Dying caterpillars normally fix themselves with their pro-legs on the stem they are sitting on. Most caterpillars collapse on the stem, between 20cm to 50cm from the ground (Fig. 25, 26 & 27), although we have observed dead caterpillars up to 120cm above the ground.



Fig. 25. Just before larva leaf its host.



Fig. 26 - 27. Dead host with mucus strands.



All maggots use a self-made mucus strand to descend to the ground (Fig. 21). The mucus strands are very fragile but can still be visible a couple of days after the maggot has left its host, if there is not much wind (Fig. 26 & 27).

The maggots of *Buquetia musca* are very mobile and will crawl directly away as soon as they have reached the ground, to find a good hiding place to become a puparium (Fig. 28). Distances of more than 30cm are easily travelled within a few minutes. The process of becoming a puparium can take up to 10 hours.



Fig. 28 a, b, c. *Buquetia musca* maggot becoming a puparium.

One remarkable observation

On 7 July 2013 a caterpillar of 20mm was found, which on 10 July developed black spots on segments 3, 4 and 5. For three days the caterpillar remained immobile sitting on its stem. On 13 July it moulted into an instar 5 without any black spots. On 20 July it became a chrysalis. On 13 September, 55 days later, an adult *Trogus lapidator* (Fabricius) emerged through a lateral hole in the wing case (Fig. 29), and was sent to, and identified by Dr. Mark R. Shaw (Edinburgh).

Trogus lapidator (Fig. 30) is a larva-pupal parasitoid in the family Ichneumonidae that only uses the caterpillars of *Papilio machaon* as host. Although caterpillars parasitized by *Trogus lapidator* are frequently observed we have never seen them to develop black spots. Presumably this caterpillar had been infested by two parasitoids: *Buquetia musca* and *Trogus lapidator*. It seems the larva of *Trogus* had killed the *Buquetia musca* larva (or probably larvae).



Fig. 29. *Trogus lapidator* emerging from a chrysalis.



Fig. 30. *Trogus lapidator* on fennel.

Host size preference

In total 12 caterpillars parasitized by *Buqueta musca* have been observed. The body lengths of the first three caterpillars on which attack and successful parasitization was observed were 13, 12 and 7mm. The *B. musca* larvae left the first two caterpillars after 10 days when they were 22mm, and the other after 11 days when it was 20mm in length. The body length of the parasitized caterpillars found in the wild when the maggot left the host varied between 16 up to 28mm with an average length of 21.6mm. It is clear that hosts from the 2nd instar (7mm) to the 3rd instar (12 to 18mm) are susceptible to successful attack.

Emerging adults

In total 15 puparia have been reared from 12 parasitized caterpillars. It is remarkable that the development in the puparium stage varies between 10 to 29 days. In total 6 females and 7 males have emerged between 5 June and 19 August, with an average of 14.3 days. Two puparia failed to emerge either in 2013 or 2014; it is not clear whether or not they attempted to overwinter.

Generations

It seems that the larval period in the host from the moment of egg laying until the maggot leaves its host, in normal weather conditions, is rather constant at around 10 days. The period during the summer as puparium is more variable, around 14 days. So from our observations we can suggest that the development, from egg to fly, should take around 24 days. Hence it is obvious that *Buquetia musca* can in principle have several generations per year in Southern Europe. From wider collection data it is likely that this tachinid has one generation in Central Europe and at least two generations in Southern Europe [pers. comm. H.-P. Tschorasnig].

Tab. 2: *Buquetia musca*: eruption of the tachinid maggots and emergence of adults in 2013.

Parasitized Caterpillar	Body length and black spots (BS) on caterpillar when the maggot erupts	Date of eruption of the maggots	Number of maggots	Date of emergence of the adults	N°HPT	Flies	Remarks
1 (RE)	22mm BS: 1 (segment 5)	5 June	2	25 June	N° 12	1 ♀	Attack described under number 1 One dead maggot.
2 (RE)	22mm BS: 1 (segment 4)	5 June	1	29 June	N° 14	1 ♀	Attack described under number 2 Adult did not expand its wings.
3 (RE)	20mm BS: 1 (segment 4)	6 June	1				Attack described under number 4. Maggot escaped
4 (WC)	25mm BS: 1 (segments 5, 8)	10 June	1	27 June	N° 13	1 ♂	
5 (WC)	18mm BS: 1(segment 7)	10 June	1	23 June	N° 17	1 ♂	
6 (WC)	16mm BS: 5 (segments 4, 7)	11 July	1	24 July	N° 18	1 ♀	Black spots from segment 4 up to 7.
7 (WC)	25mm BS: 1 (segment 3)	25 July	1		N°22		Failed to emerge.
8 (WC)	20mm BS: 2 (segments 3, 4)	27 July	1	8 August	N° 23	1 ♀	Maggot crawled around for 45 minutes and it took altogether 10 h to become a puparium.
9 (WC)	23mm BS: 2 (segments 4, 5)	3 August	2	1 September	N° 26	1 ♀	Caterpillar almost transparent. One adult failed to emerge.
10 (WC)	18mm BS: 1 (segment 1)	4 August	1	15 August	N° 27	1 ♀	
11 (WC)	23mm BS: 2 (segments 4, 5)	11 August	2	24 August 25 August	N° 28	1 ♂ 1 ♀	
12 (WC)	28mm BS: none	19 August	3	1 September 14 September 15 September	N° 29	1 ♂ 1 ♂ 1 ♀	

N°HPT = numbers of container sent for identification to H.-P. Tschorasnig; RE = reared from egg; WC = wild-collected.

Hibernation

Unfortunately no infested caterpillars were found after September. Although adult female *Papilio machaon* were seen until the end of October, no eggs or caterpillars have been found later than 8 September.

Papilio machaon hibernates as chrysalis. As far as we know *Buquetia musca* has never been reared from hibernated pupae of the host. It seems almost certain that *Buquetia musca* hibernates in its puparium, but we were unable to confirm that.

DISCUSSION AND CONCLUSION

During the research period the observed caterpillars of *Papilio machaon* only have been parasitized by two parasitoids; *Buquetia musca* and *Trogus lapidator*.

Although this research gives some insight in the biology of *Buquetia musca*, in relation to its most important host the caterpillars of *Papilio machaon*, there still remain questions, e.g., does the tachinid stay in a certain home range or does it constantly search for new host caterpillars in different places? No courtship or mating has been observed, and we have no information on the lifespan of the females. Nor can we say for certain how the winter is passed.

ACKNOWLEDGEMENT

Our gratitude goes to Hans-Peter Tschorasnig (Stuttgart) and Mark R. Shaw (Edinburgh) for their participation, critical questions and remarks, perfecting the manuscript. Many thanks to Roger Gibbons (Roquebrune-sur-Argens, France) for linguistic improvements.

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Tachinidae : *Buquetia musca* - Attack 2, Callas, 26 May 2013
<https://www.youtube.com/watch?v=vs6MP5QT8Z0>

Tachinidae : *Buquetia musca* - Attack 3, Callas, 26 May 2013
<https://www.youtube.com/watch?v=4icmLldQKK0>

Tachinidae : *Buquetia musca* - Attack 5, Callas, 7 August 2013
<https://www.youtube.com/watch?v=KV9FcQ6YuIM>

Tachinidae : *Buquetia musca* - Attack 6, Callas, 13 August 2013
https://www.youtube.com/watch?v=hH6_UqXCWUI

Tachinidae : *Buquetia musca* - Attack 7, Callas, 13 August 2013
https://www.youtube.com/watch?v=0s_4ydyi2uw