

## **THYREOPHORA CYNOPHILA (PANZER, 1794): COLLECTED IN SPAIN 160 YEARS AFTER IT WAS THOUGHT TO BE EXTINCT (DIPTERA: PLOPHILIDAE: THYREOPHORINI)**

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**Abstract:** The piophilid *Thyreophora cynophila* (Panzer) has been collected in Spain after having disappeared for 160 years. Unpublished data on its ethology and biology are given.

**Key words:** Diptera, Piophilidae, *Thyreophora cynophila*, rediscovery, Spain.

**Thyreophora cynophila (Panzer): capturada en España 160 años después de darse por extinguida (Diptera: Piophilidae: Thyreophorini)**

**Resumen:** El piofílido *Thyreophora cynophila* (Panzer) se captura en España después de haber desaparecido durante 160 años. Se dan datos inéditos sobre su etología y biología.

**Palabras clave:** Diptera, Piophilidae, *Thyreophora cynophila*, redescubrimiento, España.

Videos vinculados a este artículo: disponibles en el sitio web de la S.E.A.:

You can find the associated videos at the S.E.A.'s website:

[www.sea-entomologia.org/BSEA46/Thyreophora](http://www.sea-entomologia.org/BSEA46/Thyreophora)

### **Introduction**

On the 18 december 2009 the second author (PCR) sent an e-mail with an attached photograph (Fig. 1) to the first author (MC-T). The message said that a colleague of his, that was interested in photography (JV), had sent him the photograph and if he knew anyone who could identify the flies that appeared in it. He also mentioned that “it was a very striking dipteran”. The first reaction when seeing the photo was to say that it wasn't from here, it must be tropical. But instances later, when observing the orange head with the enlarged scutellum, I realized (MC-T) what I had in front of my eyes. At that moment I couldn't remember its scientific name, but I knew that it was a Thyreophoridae. As I was consulting the bibliography of this family, the emotion and the sensation that I experienced, as I was trying to confirm its identity, was undescrivable. Why? Simply because I knew that that fly had been thought to become extinct for a long time. How long?, since the XIX century. It was a photograph of *Thyreophora cynophila* (Panzer, 1794), a dipterous species that after its description at the end of the XVIII century suddenly disappeared 50 years later. The last time that this species was observed was in 1850, that is 159 years ago (Freidberg, 1981; Gómez-Gómez *et al.*, 2008; McAlpine, 1977; Michelsen, 1983; Pape, 2009; Papp, 1984; Paramonov, 1954; Sack, 1939; Schumann *et al.*, 1999; Séguy, 1932, 1934).

### **Identification**

*Thyreophora cynophila* (Fig. 1-10) has a shiny metallic dark blue body and legs, while the head is shiny orange, except the third antennal joint, the eyes, the ocellar tubercle, a small spot on the occiput, and the proboscis posterobasally, that are black (Fig. 3, 4). This combination of colours makes it spectacular and at the same time unmistakable, making it easy to

identify. We have to add to this the dark spots that are present on both transversal veins (Fig. 3, 5). The male has distinct dilated hind femora and a very long scutellum, trapezoidal (Fig. 6), while the female doesn't have dilated hind femora and the scutellum is short, rounded (Fig. 7). You can see full coloured drawings of the habitus of this species in Séguy (1932: VI: male; 1950: male), Lindner (1949: XXIII: female), Morge (1976: CL: male and female) and Pape (2009: 143: male), and in black and white in Papp (1978: 57: male) and Ozerov (2000: 356: male). Additionally, the male genitalia has been compared with the figures of the male genitalia included in McAlpine (1977: 22).

### **Distribution**

*T. cynophila* was described from Germany (Mannheim) (from France after Papp, 1984) and later it was recorded from France and Austria (Gómez-Gómez *et al.*, 2008). Ozerov (2000) recorded it from Denmark, but it is a mistake as the later catalogues of Petersen & Meier (2001) and Ozerov (2009) showed. Consequently, the genus *Thyreophora* Meigen, 1803 and the species *T. cynophila* (Panzer) are now recorded for the first time from Spain (and from the Iberian Peninsula), increasing to 10 the number of species recorded from Spain of the family Piophilidae (Carles-Tolrá y Báez, 2002; Gómez-Gómez *et al.*, 2008).

### **Taxonomy**

Years ago, the Thyreophoridae was a family, but now they are included in the Piophilidae as a subfamily, tribe or subtribe, depending on the authors. Following Ozerov (2000), the family Piophilidae includes 70 species and it is divided into two

subfamilies: Neottiophilinae and Piophilinae. This last is also divided into three tribes: Mycetaulini, Thyreophorini and Piophilini. The tribe that interests us here, the Thyreophorini, includes three genera and four species in the Palearctic region. Of these, only two genera and three species have been recorded from Europe up to now: *Centrophlebomyia furcata* (Fabricius, 1794), *Centrophlebomyia orientalis* Hendel, 1907 and *Thyreophora cynophila* (Panzer, 1794) (Ozerov, 2000; Gómez-Gómez *et al.*, 2008).

## Food

According to the bibliography (Contini & Rivosecchi, 1993; Franz, 1989; Freidberg, 1981; Gómez-Gómez *et al.*, 2008; Lindner, 1949; Michelsen, 1983; McAlpine, 1977; Papp, 1984; Paramonov, 1954; Robineau-Desvoidy, 1830, 1841, 1849; Sack, 1939; Séguy, 1932, 1934, 1950), the species of this tribe are necrophilous and are found on cadavers (as carrion, carcasses, skeletons ...) of big mammals like horses, cows, donkeys, ass, mules, deers, and more rarely on dogs and even humans. It seems that their larvae develop in this type of substrate, preferably in marrow bones, in advanced stage of decay, and also in the medular canal.

## “Extinction”

The adults are extremely rare in collections. Consequently, some workers believe that all European thyreophorid species are now extinct. As it was said above, the last time that *T. cynophila* was observed was in 1850, so it was thought to be extinct. Recently, Pape (2009) speaking about the extinctions of dipterans wrote: “Permanent anthropogenic extinctions of dipteran species must have occurred as soon as early man started to eradicate the megafauna. .... A more recent case is that of the European bone skipper *Thyreophora cynophila* (Panzer). This conspicuous, red-headed fly was described at the end of the 18th century, at that time it could be observed on big cadavers like dead dogs, mules and horses in the early spring. Museum specimens exist from Germany, France and Austria, all taken in the first half of the 19th century, but suddenly, 50 years after its discovery, *T. cynophila* disappeared and has never been collected again. Its disappearance may be due to changes in livestock management and improved carrion disposal following the Industrial Revolution in Europe, but the underlying scenario probably is the reduction of the megafauna, including the near absence of large predators to leave large carcasses with partly crushed long-bones to give access to the medular canal and bone marrow, which may have been the favoured breeding habitat for *T. cynophila*. Some 50 years after its description in 1794, this remarkable species was no longer collected and may be extinct as a result of the European megafauna impoverishment”.

Paramonov (1954) in explaining the rarity of Australian thyreophorids in Australian collections observed that they are not rare in nature but only rarely collected. This is because they occur in cold periods of the year when most collectors are not collecting, and because few people collect insects on carrion. One wonders if this may not be the case with the European species as well. And, effectively, the recent and unexpected finding of *Centrophlebomyia furcata* (Fabricius, 1794) in Spain by Gómez-Gómez *et al.* (2008) demonstrates it.

## Comments on the photographs (Fig. 1, 2)

Figure 1 shows three specimens of *Thyreophora cynophila*. In the foreground you can see two specimens: one (specimen A) on top of the other (specimen B). The sex of specimen A is easily deducible because of the extension of the scutellum, and also because it has distinct dilated hind femora. In specimen B, even though you can't see the scutellum, you can clearly see the left hind femur dilated, making it another male. How about the third specimen? Just behind and on the right of male B's head, you can see a small orange spot. This spot corresponds to the head of the third specimen (C) (you can even partially see its left eye), of which it is impossible to know its sex. This beautiful and unexpected photograph, besides proving the non extinction of *T. cynophila*, shows a moment of the ethology of this species that wasn't described in the available bibliography. Let's analyse what the scene represents. We think that there are three possibilities:

- 1) three males fighting;
- 2) specimen C is a female that was mating with male B, and male A came to try to make male B leave so as to stay with female (C); and
- 3) two males (A, B) are fighting to try to mate with female (C).

Taking into account that specimens B and C have parallel bodies and the heads on the same side, we have to presume that the most probable option is the second.

This photograph is in reality an enlarged part of another more general (Fig. 2), being this the original taken by the third author (JV). This picture was taken one month before, that is 18 november 2009 and in it you can see, besides the three mentioned, two more specimens of *T. cynophila* (one on each side of the image). Both specimens aren't focused. However, you can confirm by enlarging the image and studying it carefully that the specimen on the left is a male, because even though you can't see the scutellum, you can clearly see the left hind femur dilated. Concerning the specimen on the right, you can see the scutellum, that doesn't seem to be long, even though the photograph is blurry. Besides, you can't see the hind femora dilated so we can presume that it is a female.

## Habitat

These photographs were obtained in the Natural Park of Sierra de Cebollera. This zone is found in the region of La Rioja (Spain) and it was declared as Natural Park in 1995. It has a surface of 23.640 ha belonging to the towns of Villoslada de Cameros and Lumbreras. Its altitude varies between 975 and 2.168 m a.s.l. It has a mountain climate with an ocean influence and, then, with high grade of rain and snow (600 mm in basal zone and until 1.200 mm in the top of mountain), so it has many rivers and streams. Regarding to the temperature, it can arrive to -17 °C in winter. These intrinsic characteristics gives it a great variety of natural systems, and that's why there are so many forests of *Fagus sylvatica*, *Pinus sylvestris*, *Quercus pyrenaica*, *Populus* spp., as well as undergrowth (*Ilex aquifolium*, *Betula alba*, etc.), bushes and pastures. Among the most characteristic fauna, we can find mammals like deers, roe deers, wild boars, common genet, badgers, beech martens, weasels, and birds like griffin vultures, grey partridges and common crossbills. Likewise, it is a region with great tradition in livestock with lots of horses, cows and sheep.



**Fig. 1-6.** *Thyreophora cynophila* (Panzer, 1794): **1.** habitus, detail of the general photograph; **2.** habitus, general photograph; **3.** habitus (male); **4.** detail of the head (male). **5-6.** habitus in different angles (males).

**Table I. Specimens, sexes and percentages of *Thyreophora cynophila* collected on the different cadavers and forests. (Only one carcasse during two days was found).**

	calf		horse		deer		roe deer		Totals	%
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀		
<i>Fagus sylvatica</i>	6	15	20	8	3	3	0	0	55	61.8
<i>Pinus sylvestris</i>	5	8	0	2	8	10	0	1	34	38.2
Totals	34		30		24		1		89	
%	38.20		33.71		26.97		1.12			100

How has *T. cynophila* been able to survive in the Sierra de Cebollera? As we have said, in this region live wild mammals, especially deers and roe deers, whose cadavers are found in the mentioned forests. Also house animals like cows, horses and dogs get lost in the mountain, they die and consequently they become carrion. Due to major hunting of deers and roe deers, the hurt ones can also become carrion. It is evident that these loads of cadavers have permitted *T. cynophila* to survive in these latitudes. We must take into account that in the picture of Figure 2 we were able to capture five specimens of *T. cynophila* in one single image and, according to its author (JV), they were flying in a swarm of about 20 specimens, which indicates that this species may be abundant in this region.

The next step was to collect at least one specimen. As it was said, *T. cynophila* appears preferably in the cold months: in late autumn and late winter and early spring, after the melting of the snow and disappearing in the snowed months. When PCR sent the photograph, Spain and of course the mentioned Natural Park was under cold and snow storms (the same as many other European countries). That is why we had to wait until the end of February, when the climate permitted it and the snow started to melt, to go to the Sierra de Cebollera.

## Material and methods

To collect specimens, two methods were used:

a) Aspirator. With this method, specimens that were on cadavers (as carrion, carcasses, skeletons ...) of deers, horses and one roe deer, as well as on backbones (without spinal cord) of calves, were collected. They were found in very different stages of decay: from more or less fresh (with skin, hairs, some meat, but without entrails) to being more or less clear. Likewise, the cadavers were in two different kinds of forests: *Fagus sylvatica* (beech) and *Pinus sylvestris* (pine). This collecting method was only used on the weekends: from the 27 February to 28 March. On the weekend of 13 and 14 March due to the bad weather conditions, we couldn't go to look for flies.

b) Traps. 19 traps containing cut up horse and calf bones with marrow as bait were set. The traps were set on the ground and hanging from trees (at a height of more or less 180 cm) of two different types of forests: *Fagus sylvatica* (beech) and *Pinus sylvestris* (pine). The flies, when entering through holes made in the traps, fell in a container that had water with salt and soap. The trap period was prolonged one month, from the 27 February until 27 March 2010. The material was emptied weekly, except the one from the 13-14 due to the bad weather.

## Results

A total of 89 specimens have been collected (42 males and 47 females). The collecting data are the following:

Aspirator (62 specimens: 33 males and 29 females):

27.2.2010 1 male 1 female (on deer); 28.2.2010 17 males 4 females (on horse), 1 male (on deer), 1 female (on roe deer); 6.3.2010 3 males 2 females (on deer); 19.3.2010 1 female (on deer); 20.3.2010 2 males 4 females (on deer); 21.3.2010 2 males 3 females (on deer); 21.3.2010 2 males 6 females (on calf); 27.3.2010 1 male (on deer); 27.3.2010 3 males 4 females (on calf); 28.3.2010 1 male 3 females (on calf). All M. Carles-Tolrà leg.

Traps (24 specimens: 8 males and 16 females):

27.2.-6.3.2010 1 male 1 female (on horse), 3 males 6 females (on calf); 6-20.3.2010 2 males 2 females (on horse), 2 males 4 females (on calf); 20-28.3.2010 3 females (on horse). All M. Carles-Tolrà and P.C. Rodríguez leg.

We have included three specimens (1 male and 2 females) that were collected with a small bottle by A. Rodríguez on 1.3.2010 on a skeleton of a deer.

The material is preserved in alcohol (70°) and pinned in the private collections of M. Carles-Tolrà (80 specimens) and P.C. Rodríguez (3 specimens), and also in the Muséum d'histoire naturelle, Genève (6 specimens).

We have to stress that some more specimens were observed, but not collected, on different cadavers of deers by forest guards.

Obviously, besides all of these specimens of *T. cynophila*, we have also obtained abundant material of other families (especially of Heleomyzidae and Sphaeroceridae). This material will be studied and published in another paper.

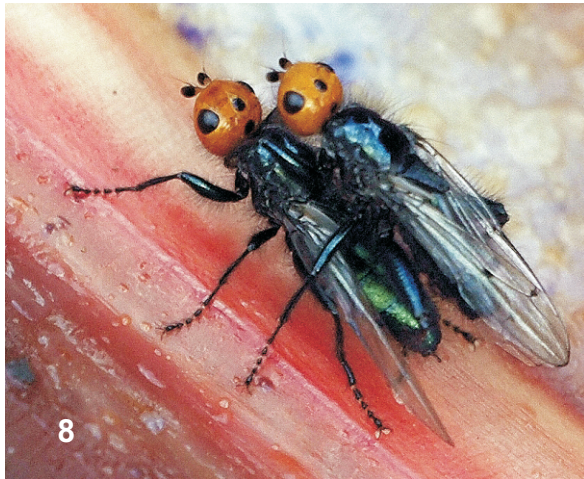
The material of *T. cynophila* has been analysed from two points of view: cadavers and forests. The results have been summarized in Table I.

## Conclusions

The surprising photograph of JV, which started this interesting study, the specimens observed on dead mammals, and those collected by aspirator and traps, have allowed us to arrive to the following conclusions on the ethology, biology and other aspects of *Thyreophora cynophila*:

- The last time that this species was observed was in 1850, so these captures are the first after 160 years!

- Even though the photograph of JV demonstrated it in its moment, all of these captures confirm that *T. cynophila* hasn't become extinct. Besides, because of the quantity of material, it seems to be abundant, at least in these latitudes.



**Fig. 7-10.** *Thyreophora cynophila* (Panzer, 1794): 7) habitus (female). 8-9. couple not mating; 10. couple mating.

- The first photograph (Fig. 1) seems to show the introduction of a male when a couple was mating.

- The general photograph (Fig. 2) shows specimens that were heating themselves in the sun, they seemed to be active. The author of the photograph (JV) also observed that they flew in a swarm of about 20 specimens. These specimens were in a sunny area which could explain such activity.

- From the material collected, you can now confirm in the general photograph (Fig. 2), that the specimen of the right, based on the form of the abdomen, is a male and not a female as it was thought firstly (see "Comments on the photographs").

- The metabolic activity of this species is reduced to low temperatures (4-8 °C). Effectively, when the tube of the aspirator was put close up, they didn't come out flying (like other dipterans did). They didn't move or they just turned around and walk away to hide under the piece. Only in a couple of cases the flies made a small jump and flew about 5 cm. They show a relatively slow, clumsy, but continuous walk. Some were able to be touched while they walked on the carrion. Sometimes, they fell from the carrion onto the ground (on the moss) and you were able to catch them with your fingers easily or by putting your finger in front so they could get on, to later put them on the carrion again to film and/or photograph them. On one occasion, one specimen, which was found on a hand to be photographed, left flying about 4 m until it got lost among a bush. It's very possible that it flew because it reached the adequate corporal temperature due to the hand's heat.

- The maximum number of specimens that were observed at once on a piece was of 16, including three mating couples.

- Seven specimens introduced in a bottle showed a great sexual activity. The males looked for females quickly and tried to mate with them several times.

- The traps contained big cut up bones with marrow, this means that the specimens came attracted by this bait, which seems to confirm the supposition that this species looks for marrow for feeding and/or for its larval development.

- Concerning the cadavers, the specimens were found in diverse parts: under the same ones, among the coat, inside the eye's orbits, inside the mouth, on the skin, on the ribs, on the bones, on the spinal column, etc. A few specimens were observed in the medular canal. Nevertheless, because of the briefness of the observation you can't say that they look for this way for the larval development, as it is mentioned in the bibliography.

- The altitude of the captures was between 1.230 and 1.500 m a.s.l.

- The specimens collected with the aspirator were caught between 4 and 12 °C.

- Apparently, regarding to the number of specimens, no preference for a concrete species of mammal seems to exist: calf = 34 (38.20 %), horse = 30 (33.71 %) and deer = 24 (26.97 %).

- However, it seems there is a slight preference to the forest of *Fagus sylvatica* (55 specimens, 61.8 %) than to that of *Pinus sylvestris* (34 specimens, 38.2 %). Surely due to the climate (humidity, sun...), but a more complete study is needed to be able to confirm this preference.

- The sex proportion is almost 1:1 (42 males and 47 females).

- According to the bibliography, *T. cynophila* measures 6 to 9 mm. After having measured our specimens, they fit perfectly between these measures.

- According to the bibliography, *T. cynophila* has an orangish to orange head. Having observed numerous live specimens it has been confirmed that the head is effectively of that colour (Fig. 1-8). However, it has also been observed that it can also be yellowish or yellowish orange (Fig. 9, 10). At first, it was thought that this difference of colour could be due to sexual dimorphism, but no, both sexes show this chromatic variety. According to the material collected, the dominating seems to be the orangish to orange. In Lindner's (1949: XXIII) figure the head is yellow, but surely due to that it is an old discoloured specimen.

- According to the bibliography, *T. cynophila* has a dark shiny metallic blue body and legs. However, the observation of live specimens shows that depending on the angle of the light they also show green iridescences (Fig. 8).

- Theoretically, we should find this species (and why not other Thyreophorini like *C. furcata*) in other Spanish regions and European countries, especially of the east, where we also find big wild and domestic mammals that serve as carrion, once dead. Or maybe it is not like this and the distribution of *T. cynophila* is reduced to only some few areas of the Spanish geography. Time will tell.

- We agree with Pape (2009) that *T. cynophila* has become extinct, but in the human environment. This finding confirms the above mentioned supposition of Paramonov (1954). *T. cynophila* is probably more geographically extended than we think, but its type of food (carrion, carcasses, skeletons ...) and climate conditions (cold months) that the larvae and adults need for their development has contributed to not being noticed and not being collected for so many decades.

- The abundant material collected in a small area of the Natural Park and in a short time period makes you think that this species is far from extinction.

- They have been able to be photographed (Fig. 1, 2 by J. Verdú and 3-10 by P. C. Rodríguez) and filmed on video (Videos 1-7 by M. Carles-Tolrá and 8 by P. C. Rodríguez) in their natural and artificial habitats. Part of their behaviour can be observed at the following websites:

[www.sea-entomologia.org/BSEA46/Thyreophora](http://www.sea-entomologia.org/BSEA46/Thyreophora)

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## References

- CARLES-TOLRÁ, M. & M. BÁEZ 2002. Piophilidae: 182. In: Carles-Tolrá Hjorth-Andersen, M. (coord.): Catálogo de los Díptera de España, Portugal y Andorra (Insecta). *Monografías de la Sociedad Entomológica Aragonesa*, 8: 323pp.
- CONTINI, C. & L. RIVOCSECCI 1993. Sulla presenza in Sardegna di *Centrophlebomyia anthropophaga* (Robineau-Desvoidy, 1830) (sensu Michelsen, 1983) (Diptera, Thyreophoridae). *Fragmenta entomologica*, Roma, **25**(2): 275-280.
- FRANZ, H. 1989. *Die Nordost-Alpen im Spiegel Ihrer Landtierwelt. Band VI/2*. Universitätsverlag Wagner, Innsbruck. 445 pp.
- FREIDBERG, A. 1981. Taxonomy, natural history and immature stages of the bone-skipper, *Centrophlebomyia furcata* (Fabricius) (Diptera: Piophilidae, Thyreophorina). *Entomologica scandinavica*, **12**: 320-326.
- GÓMEZ-GÓMEZ, A., L.M. DÍAZ-ARANDA & V. MICHELSEN 2008. Rediscovery of *Centrophlebomyia furcata* (Fabricius, 1794) (Diptera: Piophilidae) in Europe. *Studia dipterologica*, **15**(1/2): 231-237.
- LINDNER, E. 1949. Handbuch. *Die Fliegen der palaearktischen Region*, 1: 422 pp. Schweizerbart, Stuttgart.
- MCALPINE, J.F. 1977. A revised classification of the Piophilidae, including "Neottiophilidae" and "Thyreophoridae" (Diptera, Schizophora). *Memoirs of the entomological Society of Canada*, **103**: I-VI + 1-66.
- MICHELSEN, V. 1983. *Thyreophora anthropophaga* Robineau-Desvoidy, an "extinct" bone-skipper rediscovered in Kashmir (Diptera: Piophilidae, Thyreophorina). *Entomologica scandinavica*, **14**: 411-414.
- MORGE, G. 1976. Dipteren-Farbtafeln nach den bisher nicht veröffentlichten Original-Handzeichnungen Meigens: "Johann Wilhem Meigen: Abbildung der europaeischen zweiflügeligen Insecten, nach der Natur". *Beiträge zur Entomologie*, **26**(1): 441, Pars II: Farbtafeln LXXXI-CLX.
- OZEROV, A.L. 2000. A.9. Family Piophilidae: 355-365. In Papp, L. and Darvas, B. (ed.): *Contributions to a Manual of Palaearctic Diptera (with special reference to flies of economic importance*. Appendix. Science Herald, Budapest. 604 pp.
- OZEROV, A.L. 2009. Fauna Europaea: Piophilidae. In: Pape, T. (ed.), *Fauna Europaea: Diptera Brachycera*. Fauna Europaea version 2.1, <http://www.faunaeur.org>. (last update 22 December 2009).
- PAPE, T. 2009. 5 Palaearctic Diptera - from tundra to desert: 121-154. In: Pape, T.; Bickel, D. & Meier, R. (eds.): *Diptera Diversity: Status, Challenges and Tools*. Koninklijke Brill NV, 459 pp.
- PAPP, L. 1978. 74. Thyreophoridae. *Fauna Hungariae*, Akadémiai Kiadó, Budapest, **133**(15)(9): 56-60.
- PAPP, L. 1984. Family Thyreophoridae: 240-241. In Soós, A.: *Catalogue of Palaearctic Diptera. Volume 9. Micropezidae-Agromyzidae*. Elsevier Science Publishers, Amsterdam & Akadémiai Kiadó, Budapest. 460 pp.
- PARAMONOV, S.J. 1954. Notes on Australian Diptera (XIII-XV). *Annals and Magazine of Natural History*, (12)**7**: 275-297.
- PETERSEN, F.T. & R. MEIER 2001. A preliminary list of the Diptera of Denmark. *Steenstrupia*, **26**(2): 119-276.
- ROBINEAU-DESVOIDY, J.B. 1830. Essai sur les myodaires. *Mémoires présentés par divers Savans à l'Académie Royal des Sciences de l'Institut de France*, **2**: 1-813.
- ROBINEAU-DESVOIDY, J.B. 1841. Note sur le *Thyreophora cynophila*. *Annales de la Société entomologique de France*, **X**: 273.
- ROBINEAU-DESVOIDY, J.B. 1849. Note sur le genre *Thyreophora*. *Annales de la Société entomologique de France*, (2)**VII**: v.
- SACK, P. 1939. 62b. Thyreophoridae. In Lindner, E. (ed.): *Die Fliegen der palaearktischen Region* 7(1,1): 7 pp. Schweizerbart, Stuttgart.
- SCHUMANN, H., R. BÄHRMANN & A. STARK 1999. Checkliste der Dipteren Deutschlands. *Studia dipterologica*, Supplement 2: 354 pp.
- SÉGUY, E. 1932. Contribution à l'étude des mouches phytophages de l'Europe occidentale. *Encyclopédie Entomologique* (B II) Diptera, 6: 145-212.
- SÉGUY, E. 1934. F. Thyreophoridae: 79-81. In 28. Diptères (Brachycères) (Muscidae Acalypterae et Scatophagidae). *Faune de France*, Paris, **28**: IV+1-832.
- SÉGUY, E. 1950. La biologie des diptères. *Encyclopédie Entomologique*, Série A 26: 5-609.