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Observations on the distinctions between *Polietes lardarius* (Fabricius) and *Polietes meridionalis* Peris & Llorente (Diptera: Muscidae)

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Abstract

The main characteristic for the differentiation of *Polietes lardarius* (Fabricius) and *Polietes meridionalis* Peris & Llorente, the colour of the anterior spiracle, is re-evaluated and three hitherto not applied morphological characters, which have been used successfully as confirmatory characters for distinguishing between the two species, are presented. A revised key for both sexes is proposed for the separation of these very similar species.

Keywords: *Polietes lardarius*, *Polietes meridionalis*, morphological distinctions, key

1. Introduction

When Pont & Falk ^[1] and Martens *et al.* ^[2] reported in 2013 on the distribution of *Polietes meridionalis* Peris & Llorente, 1963 in Britain and Belgium respectively the distinctions between *P. meridionalis* and *Polietes lardarius* (Fabricius, 1781) were an important subject and were extensively discussed in both papers. Pont & Falk ^[1] summarised for identification purposes taxonomic characters for both species, based on information they had received from other dipterists with the colour of the anterior spiracle as the most important criterion for differentiation. Further distinctions were the colour of pruinosity on parafacial and anterior part of gena as well as of postgenal setae, the number and location of anteroventral setae of hind tibia, and the width of parafacial at level of insertion of arista. But they also emphasised that care needs to be taken with some of these characters as they are very variable. The authors also suggested the difference in the conformation of the lower calypter in the two species as a new confirmatory character for males. This requires, however, that the wings are extended at right angles from the body. Martens *et al.* ^[2] re-evaluated the taxonomic characters published by Peris & Llorente ^[3], Gregor *et al.* ^[4] and Pont & Falk ^[1] and compared them with their own observations by means of a table. The outcome regarding the distinctions between *P. lardarius* and *P. meridionalis* was summarized as follows:

"Morphological differentiation

Anterior spiracle brown, often partly greyish. Anterior part of head partly brown, partly greyish-white. In male hind margin of lower calypter diverging from margin of scutellum at angle of ca. 90°, when fly set with wings extended at right angles from the body. Secondary characters (subject to some variation): width of parafacial at level of insertion of arista in male ca. 1.0 times and in female ca. 1.25 times width of postpedicel, setae on postgena mostly all black (but sometimes with some brown setae), in male (3-) 4-7 (-8) and in female (2-) 3-5 (-6) anteroventral setae on hind tibia. *P. lardarius*

Anterior spiracle yellow, sometimes partly yellowish-white. Anterior part of head golden yellow. In male hind margin of lower calypter diverging from margin of scutellum at angle of much less than 90°, when fly set with wings extended at right angles from the body. Secondary characters (subject to some variations): width of parafacial at level of insertion of arista in male ca. 1.2 times and in female ca. 1.5-1.75 times width of postpedicel, postgena mostly with some pale (whitish or brownish) setae, in male 2-6 and in female 2-4 anteroventral setae on hind tibia. *P. meridionalis*".

Examining unidentified specimens of these two *Polietes* species of the Muscidae collection of the Institute of Biodiversity and Ecosystem Research (IBER), Bulgarian Academy of Sciences in Sofia, it became evident that for the identification of a few specimens even these well-defined distinctions

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were only limited helpful. Additionally to the broad and overlapping ranges of variations of the so-called secondary characters, as already discussed by Pont & Falk ^[1] and Martens *et al.* ^[2], the colour of parafacials and genae of these specimens varied depending on the point of view and the incidence of light between white, grey and yellowish/brown to brown and very dark brown, making the reliability of this character for differentiation doubtful. In few specimens of *P. lardarius* even the colour of the anterior spiracle varied depending on the light angle between yellowish and brownish to brown. However, there were also some morphological distinctions noticed, which seem to have not raised attention in earlier investigations but which proved themselves as useful additional criteria for the differentiation of *P. lardarius* and *P. meridionalis*.

2. Material and Methods

The analysis of taxonomic characters is based on the investigation of males and females of a total of 374 and 68 specimens of *P. lardarius* and *P. meridionalis*, respectively. Flies studied at the collection of IBER originated from Bulgaria, Germany, Great Britain and Poland, specimens from Austria were examined at the muscid collection of the Vienna Museum of Natural History, Austria and those originating from Czech Republic and Slovakia have been examined at the Moravian Museum, Brno (Czech Republic). *P. meridionalis* was only among the material collected in Bulgaria and Austria. Of the 68 *P. meridionalis* 13 specimens were loaned for comparison: five males and one female from Oxford University Museum of Natural History (OUMNH) all determined by A. C. Pont and kindly loaned to IBER by Zoë Simmons, as well as four males and three females from the entomological collection of the Royal Belgian Institute of Natural Sciences (RBINS), all determined by C. Martens and kindly loaned to IBER by Wouter Dekoninck. The specimens from OUMNH originated not only from Great Britain but also one specimen each from Spain, Germany and Israel whereas those from the RBINS had all been collected in Belgium. External morphological features were examined using a ZEISS Stemi 2000-C stereomicroscope. For illustrations, Axio Cam ERc5s was used and for further processing Helicon Focus 6 and Adobe Photoshop CS2 have been applied.

3. Results

3.1 Distinguishing characteristics for both sexes

Colour of anterior spiracle as function of light conditions: Independent from incidence of light the colour of the anterior spiracle of *P. meridionalis* was consistently yellow. The intensity of the yellow colour could vary between light and dark yellow when points of view were changed but the ground colour of the spiracle remained at all times yellow. The colour of the anterior spiracle of *P. lardarius* however was never consistently yellow. Usually it changed depending on the incidence of light between greyish-white or brown to dark grey, dark brown or almost black. In some specimens even yellowish anterior spiracles were observed at certain light conditions, but as soon as the point of view was changed, the colour changed as well to the typical greyish or brownish colouration of *P. lardarius*. This species-specific reaction of the colour of the anterior spiracle as a function of light conditions was observed at all examined *P. lardarius* and *P. meridionalis* specimens, independent of their origin.

3.2 Dark frame of upper calypter

The outer margin of the upper calypter of both sexes of all examined *P. meridionalis* specimens including all loaned reference specimens from OUMNH and RBINS was framed by a narrow, but contrasting dark seam (Fig. 1), obviously due to the dark basis of the hairs of the calypter fringe. The intensity of the dark colour of the frame varied individually and was also depending on the incidence of light, but at a certain point of view the black margin was usually distinctly visible. Only in very few specimens of the examined material the black seam was weakly developed, but even then it was still recognizable. In contrast all examined *P. lardarius* specimens had at no point of view a dark frame on the upper calypter, although in some specimens several individual hairs of the calypter-fringe could appear blackish at certain point of view.

3.3 Sex-specific confirmatory characteristics

Setae on the upper half of the anterior surface of male hind tibia:

Males of *P. meridionalis* had on the hind tibia additionally to the one or two long anterodorsal setae all over the length of the upper anterior surface an irregular row of conspicuously long setae. As the setae were usually erected, they were less conspicuous or they were even hardly to be seen when the tibia was viewed directly from anterior or posterior, however they were very striking (Fig. 2) from anteroventral or anterodorsal point of view. The majority of the setae was significantly longer than the depth of tibia and they were usually also stronger developed than the anteroventral setae of the apical half of the hind tibia.

Males of *P. lardarius* had apart from the one or two long anterodorsal only distinctly shorter setae on the anterior upper surface of the hind tibia. The length of the setae was about equal to the depth of tibia (Fig. 3) and the length of the anteroventral setae of the distal half.

Only few males of *P. meridionalis* had an anterior row of the hind tibia with less conspicuously developed setae and some *P. lardarius* males had some slightly stronger anterior setae. But on the whole, the chaetotaxis of the male hind tibia was a very helpful confirmatory character. Males with conspicuously long anterior setae on the hind tibiae proved to be *P. meridionalis*.

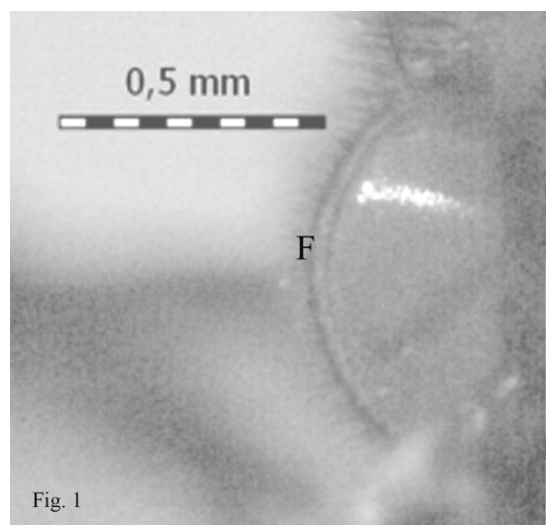


Fig 1: *Polietes meridionalis* Peris & Llorente: female, dark frame (F) of upper calypter

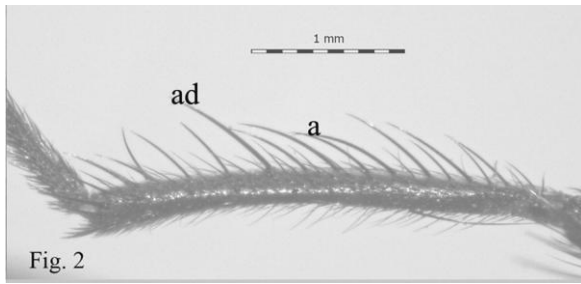


Fig 2: *P. meridionalis*: male, hind tibia with a row of long anterior (a) setae on the upper surface and a long anterodorsal (ad) seta.

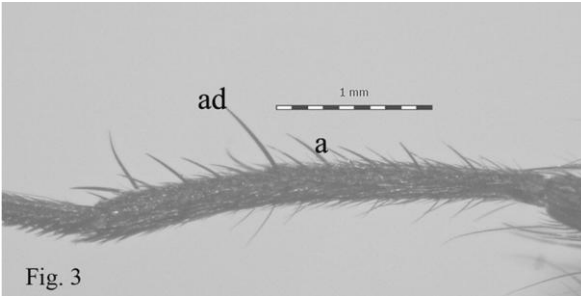


Fig 3: *Polietes lardarius* (Fabricius): male hind tibia with distinctly shorter anterior (a) setae on the upper surface and a long anterodorsal (ad) seta.

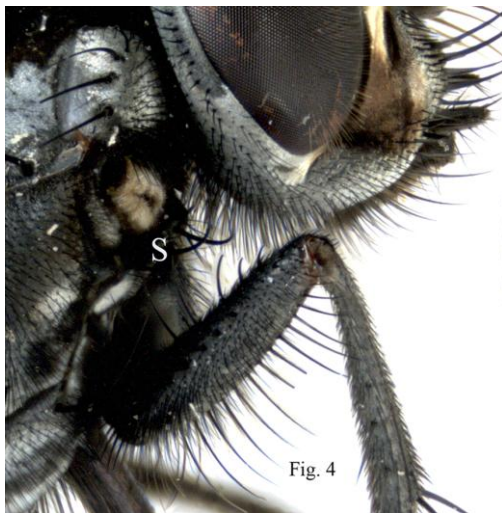


Fig 4: *P. lardarius*: female,



Fig. 5

Fig 5: *P. lardarius*: female, predominantly white anterior spiracle (S).

3.4 Shape of frontal vitta of females

When viewed from about halfway between anterior and dorsal of the head, the frontal vitta of *P. meridionalis* females was conspicuously concavely narrowed at the height of the insertion of the crossed interfrontal setae. The narrowest distance between the margins of the frontal vitta was close to the distance between the interfrontal setae. A large majority but not all of the examined females of *P. meridionalis* had this marking. Females of *P. lardarius* females had usually an almost straight sided frontal vitta or at most a weakly concave margin on the whole length when viewed similarly from halfway between anterior and dorsal of the face.

4. Discussion

Martens *et al.* [2] did not only re-evaluate the morphological characters but also analyzed the information from mitochondrial gene COI sequence data of *P. lardarius* and *P. meridionalis* to investigate whether they are two distinct species in spite of the strong morphological similarity. The DNA analysis revealed a distinct divergence between the haplotypes of both species of 1.22%, the intraspecific divergence, however, was 0%. Taking into consideration that the sampling of specimens for DNA analysis was limited for both widely distributed species to a small geographic region only, the authors concluded that the observed consistent morphological and molecular differences support the assumption that *P. lardarius* and *P. meridionalis* are different species. The presently described additional differences between the two species support this assumption of Martens *et al.* [2].

The yellow colour of the anterior spiracle is the major criterion for determination of the species since the description of *P. meridionalis* by Peris & Lloret [3]. Gregor *et al.* [4], Martens *et al.* [2], and Gregor *et al.* [5] in the very recently published "Manual of Central European Muscidae (Diptera)" described the colour of *P. meridionalis* as yellowish-white to yellow or only as yellowish respectively. Only Pont & Falk [1] also assigned specimens with a pure white anterior spiracle to *P. meridionalis* and in their comparison of the two species the authors even stated for *P. lardarius*: "Anterior spiracle grey or greyish-black, never white or yellow." One *Polietes*-female from Northern Germany with conspicuously predominantly white anterior spiracles under the stereomicroscope even brighter white than shown on the photos (Figs. 4-5), reacted only very poorly on changes of light angles. According to the definition of Pont & Falk one could be attempted to label this female - due to the predominantly white anterior spiracles - as *P. meridionalis*. However, as the upper calypter of this female had no dark seam and the frontal vitta was straight sided, it was assigned to *P. lardarius*. Within the scope of another research project this female has been subject of DNA-analysis based on the information from mitochondrial gene COI sequence data. The obtained DNA sequences corresponded to 100% to the DNA-sequences of *P. lardarius* available as FJ025653.2 at Gen Bank [6]. Except for this single case it remains unsolved, to which species specimens with purely white spiracles have to be assigned to. The 68 examined specimens with consistent yellowish spiracles had all dark frames of the upper calypter. In those very few cases, where the seam was only very weakly developed, it was still recognizable at a certain point of view. Whereas those few *P. lardarius* specimens, which were found with predominantly white anterior spiracles among the examined material, had neither a framed upper calypter nor one of the newly described sex-specific confirmatory markings.

Apart from the yellow colour of the anterior spiracle of *P. meridionalis* almost all other hitherto applied characters for distinguishing between *P. lardarius* and *P. meridionalis*, such as colour of anterior part of head and of postgenal setae, the number of anteroventral setae on hind tibia, and the width of parafacials, are very variable and overlapping ^[1, 2]. The conformation of lower calypter as suggested for the identification of males ^[1] seems to be till now the most reliable confirmatory character for males. However the examination requires in some cases a specific handling of the males which might inflict damages to dried and fragile specimens. Although the dark framed upper calypter of both sexes of *P. meridionalis* has not been considered for identification in the past, this marking is very evident. Occasionally the dark seam is even distinctly visible on photos of *P. meridionalis* as for example on the photograph of a male *P. meridionalis* posted by Vikhrev 2010 ^[7] on the "Diptera.info-site". This character proved itself in the present investigation to be more reliable for the identification of the examined material than the hitherto applied confirmatory characters. For example the dark framed upper calypter of *P. meridionalis* and the unframed upper calypter of *P. lardarius* are also well visible on the *Polietes* females in figure 1 of the publication of Pont & Falk ^[1], whereas in the same photographs the difference between the colour of the parafacials, till now a major character for differentiation, is barely distinct.

The newly described morphological markings have been observed on specimens originating from nine European countries. The validity, however, has still to be proven in a greater number of specimens collected also at other geographic regions. In case that the introduced differences will be confirmed at the large majority of *Polietes*-specimens examined by other investigators, a revised key for the differentiation between *P. lardarius* and *P. meridionalis* could read as follows:

Independent from point of view colour of anterior spiracle always yellowish-white to dark yellow; outer margin of upper calypter usually at least at a certain point of view with a dark seam..... *P. meridionalis*
 Colour of anterior spiracle at different points of views never consistently yellow. The colour is white, grey or yellowish-brown to dark grey, brown and blackish and it usually changes when points of views are changed; upper calypter at no point of view with a dark seam, although at certain light angles several individual hairs of the calypter-fringe might appear blackish.....*P. lardarius*

5. Confirmatory characters

P. meridionalis: Anterior part of head at different points of view usually more consistently golden yellow to yellow brown. Male: Hind tibia at anterodorsal or anteroventral point of view with an irregular row of conspicuously long setae on upper half of anterior surface. Hind margin of lower calypter diverging from margin of scutellum at angle of much less than 90°. Female: Frontal vitta distinctly concavely narrowed, when viewed from halfway between anterior and dorsal of the face.

P. lardarius: Anterior part of head partly brown or greyish white, however, in some specimens at certain point of view also yellowish. Male: Hind tibia usually without conspicuously long anterior setae on the upper half. Hind margin of lower calypter diverging from margin of scutellum at angle of about 90°. Female: Frontal vitta usually straight sided or only weakly concavely narrowed when viewed from about halfway between anterior and dorsal of the face.

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