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New account on the thysanurans of the Azores (Insecta, Microcoryphia and Zygentoma) with description of a new species

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Summary

Samples of thysanurans (orders Microcoryphia and Zygentoma) collected in the Azores were studied. The known distributions in the archipelago of *Parapetrobius azoricus*, *Dilta saxicola*, *Lepisma saccharina* and *Ctenolepisma longicaudata* are substantially enlarged. *Machilinus* cf. *rupestris gallicus* as well as the genus *Machilinus* and the family Meinertellidae are reported for the first time in the Azores. *Trigoniophthalmus borgesii* sp.n. (Microcoryphia: Machilidae), is described from the laurisilva forest of the Terceira island.

Key words: Thysanurans, Azores, new species, new records

Introduction

The first notice on the presence of thysanurans in the Azores, is due to Moniez (1890), who reported *Machilis* sp. (nowadays impossible to recognise, though almost certainly not a *Machilis*) to the Fogo Lake, a deep volcanic crater in São Miguel; recent (1990) searches in this same spot, revealed unsuccessful. Silvestri (1907) points females of *Praemachilis italica* to the Vila Franca islet, in São Miguel also. Wygod-

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zinsky (1941 b) studies one of the Silvestri's specimens and refers other females from São Miguel and Terceira, considering all of them under *Dilta* sp.; later, (Wygodzinsky 1962) he reports for the first time in the Azores *Lepisma saccharina* (as well as the family Lepismatidae and the order Zygentoma), refers *Lepismachilis* sp. to São Miguel, Terceira and Faial – none sample of this genus has been found further, and this determination needs to be verified – and points *D. saxicola* as present in 5 islands; he emphasises, further, that the "*Praemachilis italica*" of Vila Franca "...shall correspond..." to this same species. At last, Mendes (1980, 1982) describes *Parapetrobius azoricus* from the Formigas islets, reports for the first time the synanthropic *Ctenolepisma longicaudata* in the archipelago, registers *Proatehurina pseudolepisma* (as well as the family Ateluridae) as new to the Azores and adds new data on *D. saxicola* and *L. saccharina*; the azorian *Dilta* are considered, further, as not distinguishable from the continental European populations representatives of the species. Meanwhile, the specimens studied by Silvestri (1907) and deposited in the Museum National d'Histoire Naturelle (Paris, France), have been studied again by one of us (Mendes) and belong undoubtedly to this genus; as it must be seen ahead, *D. saxicola* remains the only species of the genus known along the archipelago and so, all the azorian *Dilta* sp. must be considered as belonging to this species.

In the present paper, new samples of *P. azoricus*, *D. saxicola*, *L. saccharina* and *C. longicaudata* are studied, being their known geographical distribution substantially enlarged along the archipelago. The genus *Machilinus* and the family Meinertellidae are reported as faunistic novelties to the Azores. *Trigoniophthalmus borgesii* sp.n. (Microcoryphia: Machilidae) is described and compared with some related species of the genus.

The studied material is deposited in the following institutions: Centro de Zoologia, Instituto de Investigação Científica Tropical, Lisbon (CZ); Museu Nacional de História Natural / Museu Bocage, Lisbon (MB); Sociedade Portuguesa de Entomologia (SPEN); Museu da Universidade dos Açores, Terceira, Azores (UA); Departamento de Biología, Cordoba University, Spain (UC); Departamento de Zoología, UAB, Barcelona, Spain (UAB); and Zoological Museum of Copenhagen, Denmark (MK). The specimens obtained in Santa Maria in the June 1990 were collected during the „Mis-são Santa Maria / Formigas“ organised by the University of Azores. The collectors names are abbreviated as follows: Bivar de Sousa: BS; Centro dos Jovens Naturalistas: CJN; Frias Martins: FM; Luis Arruda: LA; Luis Mendes: LM; Paulo Borges: PB; Salette Rodrigues: SR; and Vasco Marques: VM.

Taxonomic part

Order Microcoryphia

Family Meinertellidae

Machilinus cf. *rupestris gallicus* Bitsch, 1968

Material examined: PICO ISL. – P/A, Lages, 12–14, ano 1989, nº 4067, Costa leg., 1 female (UAB)

This only specimen is one young female, with 5.5 mm of body length and with antennae long as 3.0 mm, what means that for a precise specific determination further specimens, particularly males, must be found. It could be determined by the antennal

pattern of sensilla only, which agrees with the data given by Notario-Muñoz et al. (1997) for this subspecies; one H-type sensillum appears in division 5 of one chain, not in the following one in this position (and then it occurs in unity 1) and again it is present in the next chain in division 5. It is the first time that the Meinertellidae are registered in the archipelago (Map 1).

Family Machilidae

Sub-family Petrobiinae

Parapetrobius azoricus Mendes, 1980

Material Examined: FORMIGAS ISLETS – 31/8/1979, BS, 2 males 1 female (SPEN). PICO ISL. – P/A, Lajes, 12-14, ano 89, nº 4067, Costa leg., 1 male 1 female (UAB).

The material deposited in the SPEN was collected with the type series; it is in quite bad condition, as though now in alcohol, it has been dried before. The specimens from the Pico, from where *P. azoricus* has never been reported (Map 1), agree fairly with the original description (Mendes 1980); the male is 6.0 mm long and the female 7.5 mm.

Sub-family Machilinae

Dilta saxicola (Womersley, 1930)

Material examined: SANTA MARIA ISL. – Alto da Nascente, subcortical, 26/9/1980, CJN, 2 females nº A-120-121 (MB). Ibid., 26/6/1986, 3 females 4 j, nº 4103 (CZ). Ibid., 28/6/1986, 2 males, nº 4103 (CZ). Mata de Monserrate, subcortical in *Cryptomeria japonica* and *Pinus*, no date, CJN, 1 male 2 j, nº A-129-131 (MB). Mata dos Pi-quinhos, sub-cortical in *Eucalyptus*, 8/6/1986, CJN, 3 females, nº 4103 (CZ). Farropo, 18/7/1986, CJN, 1 male 2 females 2 j, nº 4103 (CZ). Pico do Facho, among stones of wall, 16/6/1990, LM & SR, 26 j, nº 4501 (CZ). Ibid., stones on the soil, 4 j, no number (UA). Pico Alto (foothill), 16/6/1990, LM & SR, 2 females, nº 4502 (CZ). Pico Alto, among leaf-litter, 12/6/1990, LM & SR, 1 j, nº 4498 (CZ); Ibid., 16/6/1990, PB, 1 male 2 females 22 j, nº 4503 (CZ). Ibid., 17/6/1990, LM & SR, 14 j, nº 4506 (CZ). Ibid., vinegar pitfall in natural vegetation, 12-18/6/1990, PB, 1 j, nº 1 (UA). Pine-wood near Anjos, 14/6/1990, LM & SR, 1 female, no number (UA). Ibid., 18/6/1990, 15 j (UA). Ibid., 16/6/1990, PB, 1 j, nº 4504 (CZ). Ibid., *Acacia* wood, 21/8/1990, nº 7,3 females (UA). Panasco, 17/6/1990, FM, 1 male, nº 4505 (CZ). SÃO MIGUEL ISL. – Arrifes, 6 Km from Ponta Delgada, wall of house, ?/12/1979, BS, 1 female, nº A-112 (MB). Ponta da Galera, on old wood door, 21/7/1980, VM, 1 female, nº A-116 (MB). Ponta Delgada, public garden, 11/7/1986, CJN, 3 j, nº 4104 (CZ). Ibid., sub-cortical in *Eugenia*, 20/2/1989, CJN, 1 female, nº 4309 (CZ). Near Ribeira Seca, sub-cortical in *Eucalyptus*, 25/2/1989, LM, 5 males 2 females, nº 4308 (CZ). Stº António, sub-cortical in *Acacia*, 7/8/1989, PB, 2 females 1 j, nº 4 (UA). Ibid., 10/8/1989, 1 female 2 j, nº 3 (CZ). Tronqueira, 8/8/1989, natural vegetation, PB, 1 female 1 j, nº 5 (CZ). Lombo Gordo, sub-cortical in *Cryptomeria japonica*, 8/8/1989, PB, 1 j, nº 6 (CZ). North coast, near S. Martinho dos Remédios, sub-cortical in *Platanus*, 10/6/1990, LM & SR, 3 females, nº 4497 (CZ). Mata José do Cinto, road to Caldeira Velha/Valagantes, sub-cortical in oaks, PB., 12 males 23 females, nº 5 (CZ). Pico da

Cruz, *Acacia* wood, 22/8/1990, PB, 2 females, nº 8 (UA). TERCEIRA ISL. – Praia da Vitória, under stones, 8/2/1975, J. Knudsen, 1 female (MK). Lagoa do Gingal, 2/8/1986, PB, 2 females 1 j, nº 4101 (CZ). Fonte Faneca, sub-cortical, 21/4/1989, PB, 2 males 2 females 2 j, nº 9 (UA). Ibid., vinegar pitfall in *Eucalyptus* wood, 19/5/1989, 1 female, nº 8 (UA). Ibid., 13/7/1989, 1 j, nº 14 (UA). Ibid., 16/8/1989, 1 j, nº 7 (UA). Ibid., 17/8/1989, 1 female, nº 17 (UA). Ibid., alcohol-trap, 1/7/1989, 6 j, nº 19 (UA). Ibid., 13/7/1989, 2 j, nº 15 (UA). Ibid., Turquin pitfall, 1 male, nº 18 (UAB). Ibid., *Cryptomeria japonica* wood, vinegar pitfall, 1 male, nº 13 (CZ). Ibid., *Eucalyptus* wood, 2 females, nº 11 (CZ). Ibid., alcohol-trap under natural vegetation, 1 j, nº 12 (UA). Ibid., 27/7/1989, 1 j, nº 16 (UA). Ibid., Raminho, *Pitosporum undulatum*, sub-cortical, 13/5/1989, PB, 5 j, nº 10 (UA). Pico Rachado, Turquin pitfall, 17/11/1989, PB, 1 j, nº 21 (CZ). Lomba, formaline pitfall in *Cryptomeria* wood, 20/7-1/8/1990, PB, 1 j, nº 2 (UA). Pico Alto, *Eucalyptus globulus* forest, formaline pitfall, 22/6/1990, PB, 1 male, nº 13 (UC). Ibid., vinegar pitfall, 5-18/8/1990, 1 female, nº 6 (UC). Ibid., 14-28/6/1990, 2 females, nº 9 (UA). Agualva, vinegar pitfall in *Eucalyptus globulus* forest, 10-24/11/1989, PB, 1 female, nº 4 (UA). Ibid., Turquin pitfall, 1 female, nº 5 (UA). Riviera, 16/10/1990, PB, 1 female, nº 10 (CZ). PICO ISL. – Cabeceiros, in *Laurus azoricus*, 23/5/1989, PB, 3 males 2 females, nº 2 (CZ). Ladeira Grande/Madalena, 25/5/1989, PB, 1 male, nº 1 (CZ). Manhenga, vinegar pitfall in natural vegetation, 7-19/3/1990, PB, 1 female, nº 9 (UAB). SÃO JORGE ISL. – Ribeira Vimes, 27/8/1987, PB, 1 j, nº 4102 (CZ). GRACIOSA ISL. – Seteira, 9/6/1988, CJN, 3 j, nº 4244 (CZ). Pico do Timão, 7/6/1988, CJN, 1 female, nº 4245 (CZ). FLORES ISL. – Piquinhos, 7/7/1989, PB, 1 female, nº 1 (CZ).

The species was already known from Santa Maria, São Miguel, Terceira, Pico and Faial (Wygodzinsky 1962; Mendes 1980, 1982) It is now reported by the first time to São Jorge, Graciosa and Flores (Map 1).

Trigoniophthalmus borgesii sp.n.

Material examined: TERCEIRA ISL. – Pico Alto, vinegar pitfall in natural vegetation, 21/7-3/8/1990, PB., 1 male holotype 1 female allotype, nº 18 (CZ). Ibid., in *Eucalyptus* wood, 28/10-9/11/1990, 1 young male paratype, nº 11 (UA). Serra de S^{ta} Bárbara, Arriba Preta, colour-trap, 14/7/1989, PB, 1 male paratype, nº 23 (UA). Ibid., yellow colour-trap, 1-14/7/1989, 1 male paratype, nº 2 (UA). Ibid., red colour-trap, 14-28/7/1989, 1 male paratype, nº 3 (UC). Pico Rachado, vinegar pitfall, 17/11/1989, PB, 1 female paratype, nº 20 (UA). Ibid., 19/1-2/2/1990, 1 female paratype, nº 6 (CZ). Ibid., 16/2-2/3/1990, 1 young female paratype, nº 7 (UA). Ibid., 16-31/2/1990, 1 female paratype, nº 10 (CZ). Ibid., 11-27/5/1990, 1 male paratype, nº 11, (UC). Ibid., formaline pitfall, 1 male paratype, nº 22 (CZ). Ibid., 11-27/5/1990, 1 male paratype, nº 12 (UA). Ibid., 7-29/6/1990, 1 female paratype, nº 14 (UA). Ibid., 29/6-14/7/1990, 1 male 1 female paratypes, nº 15 (UAB). Ibid., 14-27/7/1990, 1 female paratype, nº 17 (UC). Ibid., Turquin pitfall, 2-16/3/1990, 2 young males paratype, nº 8 (UA). Ibid., 29/6-14/7/1990, 1 male paratype, nº 16 (UAB). Lomba, vinegar pitfall in laurisilva, 20/7-1/8/1990, PB, 1 male 1 female paratypes, nº 3 (CZ). Ibid., formaline pitfall, 1 male paratype, nº 4 (CZ). (Map1)

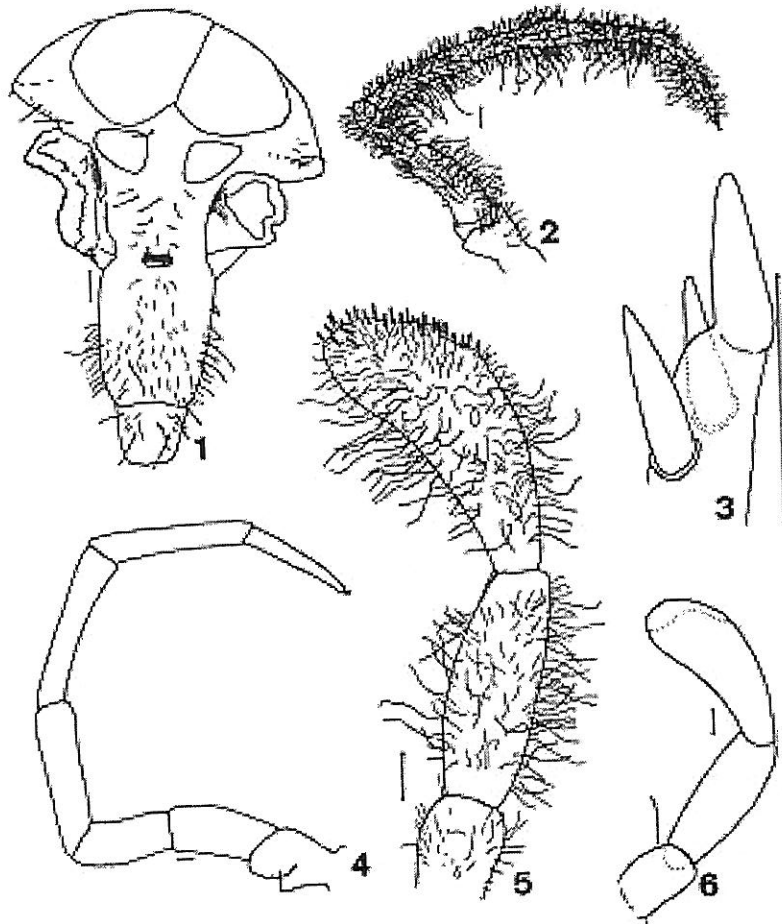
Description: Body length: 8.9–11.6 mm (male), 11.7–12.3 mm (female); total length: 17.2–21.7 mm (male), 21.4 mm (female); cerci length: 3.2–3.7 mm (male), 5.0 mm

→ P. Natural

→ Lomba Balc

(female); antennae length: 7.3–8.6 mm (male), 9.9–12.8 mm (female). Scale pattern unknown; hypodermal pigment almost completely lacking, restricted to the antennal lophus in both sexes and to a very light area in the inner surface of the maxillary palp basal article of some females.

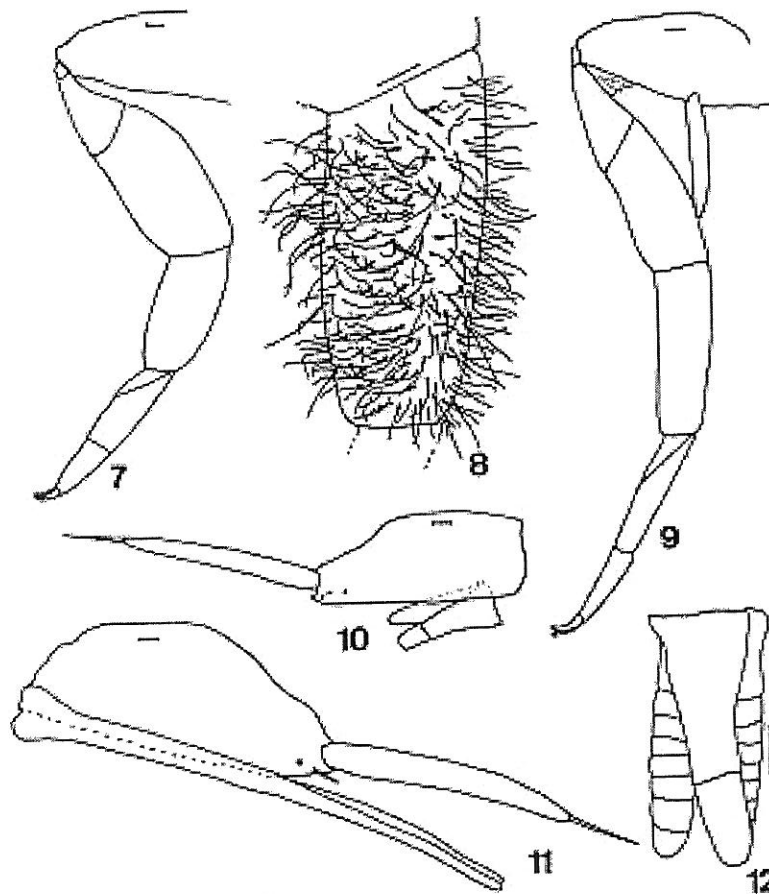
Head of male as in Fig. 1, the clypeus and labrum with a few setae in both sexes; one line of strong setae in the lower margin of the outer superior expansion, lateral to the eyes. Compound eyes rounded, not specially convex, uniformly dark (alcohol), the ratios $l/w = 0.87-0.96$ and $cl/l = 0.48-0.58$. Paired ocelli trianguloid, a little wider than long, very light (rose brown to flesh colour), sometimes difficult to spot due to their non-contrasting colour, their distance similar to their width. Head of female similar, with identical chaetotaxy, the ratios $l/w = 0.85-0.89$ and $cl/l = 0.48-0.54$.



Figs. 1–6. *T. borgesii* sp.n. Typus. 1. Head; 2. Male maxillary palp; 3. Ibid., detail of the distal spines; 4. Female maxillary palp; 5. Male labial palp; 6. Female labial palp. Scales: 0.1 mm

Antennae elongated, longer than the body when not damaged. Scapus robust, about 1.75 times as long as wide. Distal chain with 11–12 sub-units, the 2–3 distal ones almost hyaline, the remaining light brownish.; each division, about twice wider than long, presents a crown of medio-basal setulae, each one as long as the unity diameter, and a not so regular distal row of thinner and shorter setulae; the sensilla, almost hyaline, are cylindrical, very thin and elongated, sometimes incurved, and occur in the distal border; each division presents, further, small rosette sensilla.

Mandibles typical, with 4 well developed apical teeth. Maxillary palp of male delicate, as in Figs. 2–3; article III much shorter than II, the IV almost twice longer than III. All the articles with abundant long setae, the ventral ciliar setae more dense along the four distal articles, where they can be twice longer than the article diameter (mainly in article VI and in the basal half of VII). Hyaline strong dorsal spines in the apex of article V and along VI and VII, as follows: V: 0–3; VI: 5–9; VII: 8–12; apical

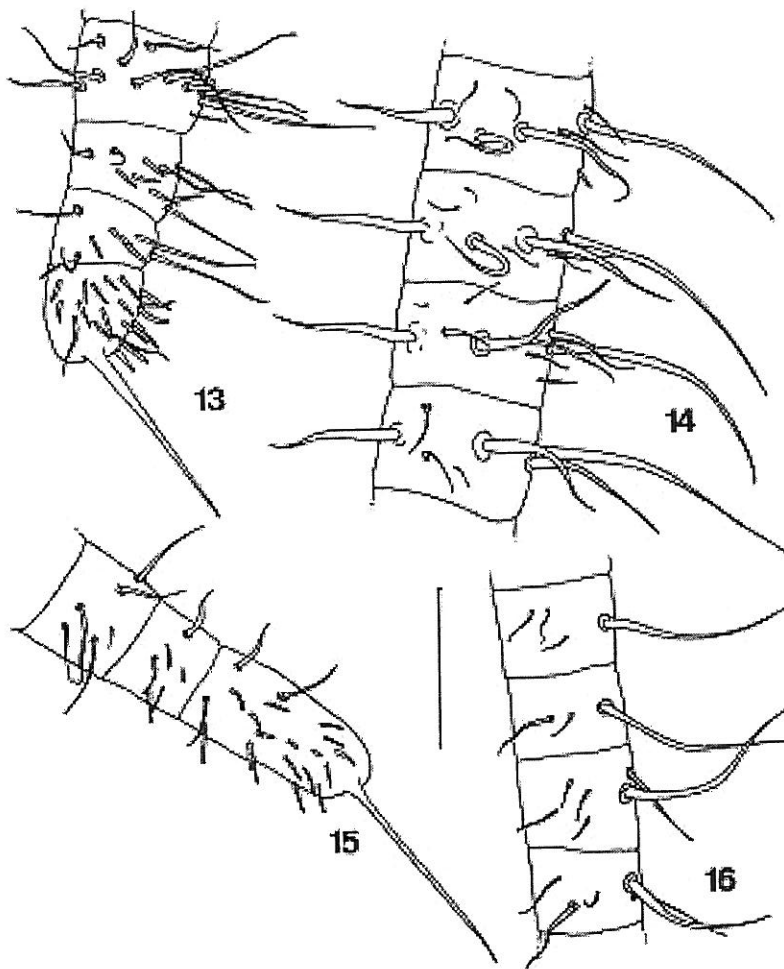


Figs. 7–12. *T. borgesii* sp.n. Typus. 7. Male P I; 8. Ibid., inner surface of tibia; 9. Male P III; 10. IXth coxite and stylet, and genitalia of male; 11. IXth coxite and stylet, and ovipositor of female; 12. Penis and paramera. Scales: 0.1 mm

spine (Fig. 3) quite robust and elongated, bigger than the preceding pair. Distal article thin, the ratio $n/n-1$: 0.80–0.95. Maxillary palp of female as in Fig. 4, devoid of specialized chaetotaxy; distribution of the hyaline dorsal spines: V: 2–3; VI: 13–17; VII: 12–17. Distal article elongated, the ratio $n/n-1 = 0.74-0.75$.

Labial palp of male as in Fig. 5 delicate, devoid of pigment. Apical article elongated, claviform, with the apical conules not very abundant but distributed along the distal dorsal area. Ciliar setae mainly in the medial and distal articles, abundant along the dorsal and ventral areas and almost attaining the length of the article diameter. Female labial palp (Fig. 6) similar, though devoid of ciliar setae.

P I robust (Fig. 7), the femur clearly more enlarged than in the remaining legs (Fig. 9). Stylets well developed in P II and P III. Inner surface of tibia I (Fig. 8) with



Figs. 13–16. *T. borgesii* sp.n. Typus. 13. Gonapophyses VIII, distal divisions; 14. Ibid., units 10–13; 15. Gonapophyses IX, distal divisions; 16. Ibid., units 9–12. Scale: 0.1 mm

numerous long and smooth setae. In femur I among the dense cover of setae, a few ciliar setae can attain 2/3 of the article diameter. Spines absent from the femur though very strong but elongated setae can occur. Tibias with 0–1 (P I and P II) or 1–3 (P III) delicate long spines among the dense cloth of usual strong and thin setae. Distribution of the spines (always thin) in the tarsi similar in both sexes, as follows: P I: (1–3) + (2–7) + (0–3); P II: (0–3) + (3–6) + (0–1); P III: (1–4) + (4–7) + (0–1). Length of tibiae: P I: 0.7–0.9 mm (male), 0.8–0.9 mm (female); P II: 0.7–0.8 mm (male), 0.7–0.9 mm (female); P III: 0.9–1.1 mm (male), 1.1–1.2 mm (female).

Coxites devoid of pigment, the I–VIII without setae or spines; sternites acute-angled, the angle of 70–80°. 2+2 eversible vesicles in the segments II–V. Coxite IX with 2–3 apical inner spines in both sexes (Figs. 10–11). Stylets as usual, the apical spine strong and elongated. Ratio stylet (without apical spine) / coxite (A) and apical spine / stylet (without apical spine) (B), as follows: Male (A)–V: 0.72–0.75; VIII: 0.75–0.80; IX: 0.95; (B)–V: 0.53–0.54; VIII: 0.43–0.47; IX: 0.32. Female (A)–V: 0.64–0.70; VIII: 0.82–0.90; IX: 0.74–0.85; (B)–V: 0.49–0.51; VIII: 0.43–0.44; IX: 0.29–0.35.

Paramera restricted to the IXth abdominal segment (Figs. 11–12), with 1 + (6–7) divisions and with the typical chaetotaxy. Penis attaining the level of the paramera, its distal part much shorter than the proximal one (ratio bp/tp = 1.8–2.0). Ovipositor of the primary type, attaining the apex of the IXth stylet without apical spine or shorter. Gonapophyses VIII (Figs. 13–14) with 32–35 units, each one clearly wider than long; outer and (mainly) inner setae very robust, attaining 1.5 times the length of each division – the former – or 2.5 times this length – the outer setae. Gonapophyses IX (Figs. 15–16) more delicate, with 35–36 divisions, each one less widened than in the anterior gonapophyses, the outer setae always delicate and equal or shorter than the unity length, the inner setae as long as two following units.

Cerci ending in one only acute and strong tooth. Terminal filaments with abundant scales, some cilia and acute spines, these ones mainly along the basal part; piliform scales absent.

Etymology: The new species is named after its collector, Dr. Paulo Borges, specialist in azorian Coleoptera.

Discussion: *T. borgesii* sp.n. is included for the time being in *Trigoniophthalmus* Verhoeff, 1910 *sensu* Wygodzinsky, 1941, despite of its geographical insulation relatively to the remaining species described in the genus; indeed, all of them are Balcanic or central-eastern Mediterranean, with the solely exception of the European *T. alternatus* absent, however, from Portugal and Scandinavia (see Mendes 1990) and quite distinct from the new species under the morphological point of view. All the main features exhibited by the new taxon from Azores fit, nevertheless, with those considered as typical to the genus.

Among the known *Trigoniophthalmus*, only two species share with *T. borgesii* sp.n. 2+2 eversible vesicles in the coxosternites II–V (in all the remaining taxa, in the II–IV): the already reported *T. alternatus* (Silvestri, 1904) and *T. remyi* Stach, 1939. The former, redescribed independently by Stach (1939) and by Wygodzinsky (1941 a), is easily distinguishable mainly due to the type of ovipositor (quite shortened and covered by long and thin setulae), by the sensorial femoral field, by the dark paired ocelli and by the specialized chaetotaxy of the male maxillary palp, among fur-

ther dissimilarities. *T. remyi*, closer to the new species, was described from the former Yugoslavia (Stach 1939) upon females only; later Wygodzinsky (1958), described the male sex upon material from the same country and it has been, further, signalized again to Yugoslavia (Paclt 1969 and Mendes 1981), to Greece (Paclt 1969), to the Austrian Tyrol (Bach 1981) and to the northern and eastern Italy (Bach 1982). It is distinguishable from *T. borgesii* sp.n. among other differences, by the dark coloured paired ocelli (pale in the new species), by the shape of the compound eyes (clearly wider in *T. remyi*), by the quite different number of divisions of the ovipositor (43–49 versus 32–36) and by the distinct male maxillary and labial palp chaetotaxy, being the ciliate setae much shorter and more numerous in the continental species.

Trigoniophthalmus cf. *borgesii*

Material examined: FAIAL ISL. – F/A, Ruim Boca, 9-13, ano 89, leg. Costa, 1 young female, nº 4238 (UAB).

This female, 5 mm long, with damaged antennae, cerci and paracercus, is suspected, on account of the shape and position of the paired ocelli, to belong to the newly described species. Its presence out of the Terceira island is considered, so, with doubts (Map 1).

Order Zygentoma

Family Lepismatidae

Lepisma saccharina Lin., 1756

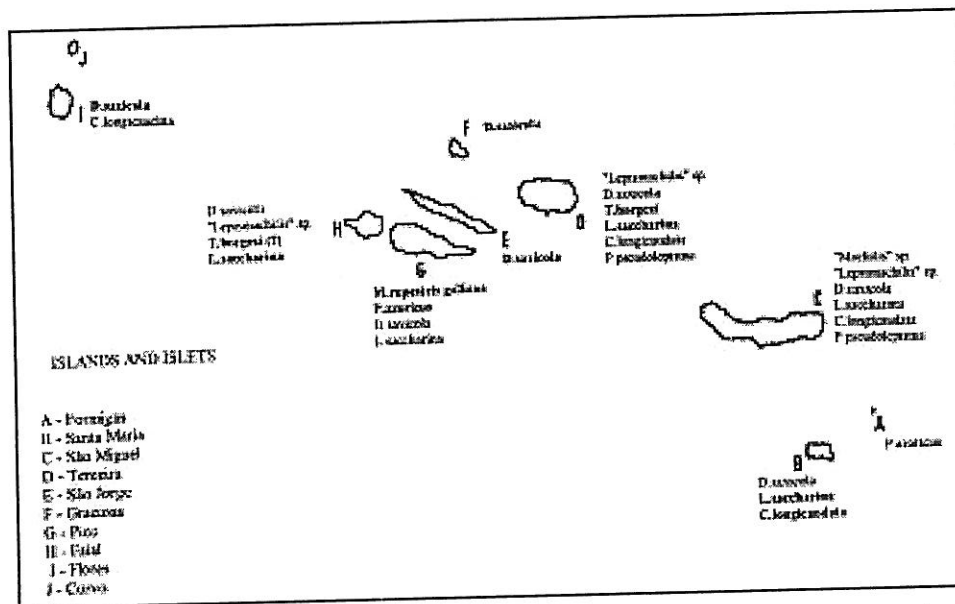
Material examined: SANTA MARIA ISL. – Airport, in houses, 31/8/1980, CJN, 1 female, nº A-117 (MB). Ibid., 25/10/1980, 1 male 1 female, nº A-122/123 (MB). Ibid., 11/1/1981, 2 males 2 females, nº A-125/128 (MB). Figueiral, 16/6/1990, FM, 1 male 1 female, nº 4500 (CZ). SÃO MIGUEL ISL. – Arrifes, 6 Km from Ponta Delgada, in house, ?/12/1979, BS, 1 male, nº A-115 (MB). Ponta Delgada, public garden, 11/7/1986, CJN, 1 male, nº 4104 (CZ). TERCEIRA ISL. – Lagoa do Gingal, 2/8/1986, PB, 1 male, nº 4101 (CZ). FAIAL ISL. – Horta, in house, 4/1/1981, LA, 1 female, nº A-124 (MB).

L. saccharina was known from São Miguel and Pico only (Wygodzinsky 1962; Mendes 1982). It is now reported for the first time in the islands of Santa Maria, Terceira and Faial (Map 1).

Ctenolepisma longicaudata Escherich, 1905

Material examined: SANTA MARIA ISL. – Airport, in buildings, 31/8/1980, CJN, 1 female 1 j, nº A-118/119 (MB). Ibid., 24/11/1983, 1 male, nº A-132 (MB). Ibid., 18/6/1990, LM & SR, 1 male, nº 4507 (CZ). SÃO MIGUEL ISL. – Arrifes, 6 Km of Ponta Delgada, in house, ?/12/1979, BS, 2 j, nº A-113/114 (MB). Ponta Delgada, in houses, 9/6/1990, LM, 1 female, nº 4494 (CZ). Ibid., 3/7/1990, SR, 6 males 10 females 3 j, no number (CZ).

C. longicaudata has been reported to the islands of São Miguel, Terceira and Flores (Mendes 1980, 1982). Though, like the preceding species, devoid of zoogeographical interest, this always synanthropic taxon is registered for the first time in Santa Maria.



Map 1 – Known distribution of the thysanurans species along the islands of the Azores archipelago. In bold, the newly reported faunistic novelties

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