

A CHECKLIST OF MADEIRAN FRESHWATER MACROINVERTEBRATES

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With 4 tables

ABSTRACT. A checklist of Madeira's freshwater macroinvertebrates is given, and includes some shoreline water representatives of primarily freshwater families. The list is based on literature surveys and field collections made by HUGHES in 1991 and Furse during a brief visit in 1992. This paper includes zoogeographical data and provides a simple point of reference for each taxon of macroinvertebrate (as defined) occurring in Madeira. More detailed papers are planned on the taxonomy of selected groups and the ecology and biogeography of Madeira's aquatic macroinvertebrate fauna. Chironomidae records have been determined by BLACKBURN and LANGTON, the latter giving brief taxonomic comments. BLACKBURN has also identified several other groups. A total of 240 taxa are listed including 23 new records including 14 previously unknown forms. The majority of the freshwater fauna is primarily western Palaearctic in origin (34.6%), the Nearctic and Afrotropical (Ethiopian) regions are comparatively poorly represented. However, the percentage of endemic species is high (28.3%), emphasising the unique character of Madeira's freshwater fauna, the importance of its conservation and that of the island's freshwater habitats and the needs and opportunities for scientific studies.

RESUMO. Apresenta-se uma lista dos macroinvertebrados das águas interiores e da zona costeira da Madeira com dados zoogeográficos baseados em colheitas efectuadas em 1991 e 1992, por HUGHES e FURSE, e pesquisa bibliográfica. Espere-se aqu este artigo fornecerá uma ponte de referência por cada espécie abrangida pelo termo "macroinvertebrado" encontrada nas águas doces da Madeira. Prevê-se a publicação de artigos mais pormenizados sobre aspectos taxonómicos, ecológicos e biogeográficos de grupos seleccionados da fauna aquática. Material do gupos

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Chironomidae foi determinado por BLACKBURN e LANGTON, o Langton fornece detalhes taxonómicos sobre o grupo. O BLACKBURN identificou alguns outros grupos. A lista contém 240 espécies, incluindo 23 novos registos dos quais 14 são formas previamente desconhecidas. A maioria da fauna aquática tem origem Palearctica (34.6%). As regiões Holarctica e Africana estão menos representadas. A taxa de endemismo é alta (28.3%), realçando a importância e o valor do meio aquático na Madeira no estudo e investigação das formas únicas e a conservação dos habitats aquáticos.

INTRODUCTION

The Madeiran Archipelago is volcanic in origin and lies between 32.30 °N - 33.00°N and 16.30°E - 17.30°E, comprising Madeira island (or Madeira proper), Porto Santo (plus satellite islands), the Desertas (Ilha Chão, Deserta Grande and Bugio) and the Selvagens islands (Selvagem Grande and Selvagem Pequena). The archipelagos of Madeira, the Azores, the Canary Islands and Cabo Verde form the biogeographical region known as Macaronesia.

The Laboratório Regional de Engenharia Civil, Departamento de Recursos Naturais e Hidráulica (LREC/DRNH) has been researching the development of a biomonitoring system for the streams and small rivers of Madeira proper since 1991, based on their benthic macroinvertebrate fauna (HUGHES, 1995). The term aquatic macroinvertebrate, as used here, includes any species that has at least one life stage dependant on an aquatic environment and which attains a length of at least 1mm during its aquatic stage(s). The current checklist comprises all freshwater taxa meeting this description, together with a small number of brackish water taxa from families predominantly associated with fresh waters.

The distribution, and sometimes ecology, of many individual groups of Madeiran taxa have been the subject of many specialist studies. The principal works are summarised in Table 1 and these have often been published in the Boletim de Museu Municipal de Funchal. However, no complete listing of Madeira's aquatic macroinvertebrate fauna exists. Publications that list several orders of aquatic macroinvertebrates (generally collected as adults) include WOLLASTON's *Insecta Maderensia*, published in 1854, a second paper of his published in 1858 and papers by HAGEN (1859, 1865a, 1865b) and McLACHLAN (1882). Until now, STAUDER's (1991) collections of macroinvertebrate fauna along Riberia das Cales, with notes on new records and biogeographical comment, provided the most comprehensive listing of the island's freshwater fauna. However some groups were omitted from her list, including Hemiptera (Heteroptera) and several families of Diptera such as Psychodidae, Ceratopogonidae, Dolichopodidae, Ephydriidae and Muscidae. It is also unclear in the text where and when material constituting new records was collected (ie locality), where it is deposited and by whom it was positively identified.

TABLE 1 - The principal publications providing information on the occurrence of freshwater macroinvertebrate taxa in Madeira (often based on collections of winged adults).

Invertebrate group	Author(s) and Year of Publication
General Works	Baez, 1993; Stauder, 1991.
Mollusca	Paiva, 1867; Wollaston, 1878; Nobre, 1931; Hughes, 1995.
Oligochaeta	Brinkhurst, 1969.
Hydracarina	Lundblad 1941, 1942.
Isopoda	Schodduyn, 1926; Remy, 1936; Henry, Magniez, Stock & Vermeulen 1992; Henry & Magniez, 1995.
Ephemeroptera	Eaton, 1871; Brinck & Scherer, 1961.
Odonata	McLachlan, 1882; Gardner, 1955, 1960; Gardner & Classey, 1963.
Hemiptera	Puton, 1889; Reuter, 1890; Noualhier, 1897; Lindberg 1941, 1960, 1961; Tamanini, 1947, 1954; Lundblad, 1949; Hoberlandt, 1967.
Coleoptera	Wollaston, 1854, 1857, 1861, 1865, 1871; D'Orchymont, 1938; Falkenstrom, 1938; Jansson, 1940; Uyttenboogaart, 1947; Lindberg, 1963; Lundblad, 1958; Gardner & Classey, 1959; Svensson, 1970, 1973, 1977; Serrano, 1987; Cuppen & Dettner, 1986, Erber & Wheeler, 1987; Erber & Hinterseher, 1988; Balke & Hendrich, 1989.
Trichoptera	Hagen 1859, 1865a, 1865b; Eaton, 1873; McLachlan 1874-80, 1882, 1884; Mosely 1938; Nybom 1948, 1963, 1965.
Diptera (General)	Becker 1908b; Frey, 1949; Stauder, 1991
Tipulidae	Wollaston, 1858, Nielsen, 1961, Mannheims, 1962; Theowald, 1977.
Psychodidae	Satchell, 1955; Nielsen, 1964.
Culicidae	Edwards, 1916; Christophers, 1929; Mattingly, 1955; Capela, 1982.
Thaumaleidae	Vaillant, 1963.
Ceratopogonidae	Storå in Frey, 1949.
Simuliidae	Carlsson, 1963; Santos Grácio, 1984; Crosskey, 1987.
Chironomidae	Storå in Frey, 1949; Freeman, 1959; Saether, 1990; Baez & Armitage, 1990.

The biogeography of Madeiran invertebrate groups, including aquatic taxa, has been discussed by a number of authors. Studies on the zoogeography of Madeira's invertebrate fauna include QUARTAU (1982), STAUDER (op. cit.), and BAEZ (1993). QUARTAU examined historical and biological aspects of the possible origins of Madeira's fauna in relation to the theory of island biogeography, taxon cycles and phenomena related to adaptation to island habitats. BAEZ (op.cit) reviewed Madeira's principal vertebrate and invertebrate groups (terrestrial and aquatic) and provided quantitative information on species numbers and zoogeographical distribution of the major taxonomic groups. STAUDER (op. cit.) concentrated on the zoogeography of the aquatic fauna. She combined published information with her own collections along a single river in order to present tabulated data on the number and distribution of selected aquatic macroinvertebrate groups in Macaronesia. Her published data included the distribution, total number of species, and the individual numbers of endemic, Macaronesian and widely distributed species in 13 major groups of freshwater macroinvertebrates found in Madeira. All authors remarked upon the low diversity exhibited by Madeira's macroinvertebrate fauna, with the total absence of some groups (Plecoptera) and the poor representation of others (e.g. three species of Ephemeroptera). Attention was commonly drawn to the high level of endemism in several groups (e.g. Trichoptera, Coleoptera) and to the predominantly Palaearctic origin of most taxa.

There is growing interest in the freshwater fauna and habitats of Macaronesia's constituent archipelagos especially since they are increasingly threatened by development. This threat has led to LREC/DRNH developing an ecological assessment system (EAS) and Geographical Information System (GIS) for evaluating surface water quality on Madeira. Similar concerns have led to detailed conservation studies of the freshwater streams and waterbodies of the Canaries, including Tenerife (MALMQVIST *et al.* 1993, 1995) and Gran Canaria (NILSSON *et al.* 1998). The ready availability of relevant and contemporary information is of paramount importance for such studies. The current paper provides a concise checklist of Madeira's freshwater macroinvertebrate fauna with biogeographical details. The checklist is derived from extensive field collections carried out during 1991 and 1992, literature surveys carried out at the British Museum of Natural History (BMNH) in 1994 and 1997, and consultations with taxonomists. New records resulting from the field collections are listed, along with details of Madeiran locality and information on where specimens are deposited. It is not within the scope of this paper to give detailed notes on the taxonomy or ecology of the listed groups; such areas of study will be presented in future papers.

METHODOLOGY

In 1991, the LREC/DRNH biological monitoring programme involved sampling along six of the island's principal rivers: Ribeira de Machico, Ribeira de Santa Cruz,

Ribeira de São João, Ribeira Brava, Ribeira de São Vicente and Ribeiro Frio. A total of 27 sites were sampled every month by the first author (SJH). These sites covered an apparent range of water quality from “pristine” to heavily organically polluted and were situated on the North and South of the island over a wide altitudinal range. Water samples for physico-chemical analyses and semi-quantitative macroinvertebrate samples were taken at each site. The biological samples were preserved in 70% alcohol. The preserved material was sorted and identified to predetermined levels in the laboratory. Specimens which were difficult to identify in Madeira were sent to the Institute of Freshwater Ecology, in the United Kingdom, where they were determined by Mr. JOHN BLACKBURN (JHB). All collected material from the 1991 sampling programme is deposited at LREC/DRNH (preserved in alcohol).

In June 1992, as part of an inter-regional cooperative project developed by LREC/DRNH (cofinanced by the European Regional Development Centre, CEDRE), Dr. MIKE FURSE (MTF) a freshwater ecologist at the Institute of Freshwater Ecology (IFE) made qualitative collections at the following sites in Madeira: 1. Ponds at the Botanical Gardens, Funchal 27.06.92; 2. Caldeirão Verde, waterfall pool 28.06.92.; 3. Levada de Caldeirão Verde 28.06.92.; 4. Ribeira Brava village 29.06.92.; 5. Ribeira Grande (São Vicente) 29.06.92.; 6. Ribeira de São Vicente, (Laranjal) 29.06.92.; 7. Ribeira de São João (Muro de Coelho) 30.06.92.; 8. Levada do Serra do Faial 30.06.92.; 9. Ribeira da Santa Cruz 30.06.92. Collected material (larvae, pupal exuviae and adults) was sorted, mounted and provisionally identified by JHB. The collected chironomid material, mainly pupal exuviae and pharate adults, was subsequently determined by Dr. PETER LANGTON (PHL) in January 1993 and is deposited in his reference collection. Remaining material collected by MTF and identified by JHB is deposited at the Dorset Laboratory of the IFE.

A literature survey was necessary in order to compile as full a list as possible of the aquatic macroinvertebrate taxa known from Madeira. Numerous specialists of specific macroinvertebrate groups were consulted concerning contemporary nomenclature and biogeography; literature was also requested (see acknowledgments). With funding from the Centro de Ciências Biológicas e Geológicas (CCBG) of the University of Madeira, SJH was able to carry out a literature survey at the BMNH library. Literature was also consulted at the Museu Municipal do Funchal.

RESULTS

A total of 240 taxa are listed as having been recorded in Madeira, up until 1995, either by the authors or from previous collectors. These comprise the checklist of the freshwater macroinvertebrates of Madeira (Table 2). Information on the recorded presence of these taxa on the other islands of Macaronesia and elsewhere are documented as a basis for biogeographical analyses (Tables 3 and 4).

TABLE 2 - A checklist of the aquatic macroinvertebrates of Madeira.

Cosmopolitan (Cos) defined as occurring in all zoogeographic regions, Holarctic (Hol), Nearctic (Nr), Palearctic (*sensu lato* (Pl), South (SPl), North (NPl), West (WPl) East (EPl)); Europe (Eur), Iberian peninsula (IbPen.), Mediterranean (Med), North Africa (NAf), Afrotropical (= Ethiopian) (Aft), Neotropical (Neo), Oriental (Or), Macaronesia (Mc): Azores (Az): Corvo (C), Faial (Fa), Flores (Fl), Graciosa (Gr), Pico (P), São Jorge (SJ), Santa Maria (SMa), São Miguel (SMg), Terceira (Tr). Cabo Verde (CV); Santo Antão (SA), São Nicolau (SN), São Tiago (ST), São Vicente (SV), Canary Islands (Cn): Fuerteventura (Fu), Gran Canaria (GC), Gomera (Go), Hierro (H), Lanzarote (L), La Palma (LP), Tenerife (Tn). Madeira (Md): Desertas (D), Madeira Island (M), Porto Santo (PS), Selvagens (S), Unknown distribution or unconfirmed identity (Un) (New Record; † endemic to Madeira Island, § endemic to Madeiran archipelago, ‡ Macaronesian taxon, ? Questionable record).

The emboldened region for each species is the one to which it is assigned in Tables 3 and 4.

Tricladida**DugesIIDae**

♦ *Dugesia gonocephala* group (Duges, 1830)

Pl. Mc: Az (Fl, SMa, SMg), CV (SN, ST), Cn (Tn), Md (M)

Gastropoda**Hydrobiidae**

Pseudamnicola confusa (Frauenfeld, 1867)

Pl. Mc: Cn (Tn), Md (M)

Physidae

Physella acuta (Draparnaud, 1805)

Pl. Mc: Cn (Fu, GC, Go, L, LP, Tn), Md (M)

Physa fontinalis (Linnaeus, 1758)

Pl. Mc: Md (M)

Lymnaeidae

Lymnaea (Galba) truncatula (Müller, 1774)

Pl. Mc: Cn (Tn), Md (M)

L. (Radix) peregra (Müller, 1774) var *oblonga* (Jeffreys)

Pl. Mc: Md (M)

Planorbidae

Planorbarius corneus (Linnaeus, 1758)

Pl. Mc: Md (M)

Gyraulus parvus (Müller, 1774)

Hol. Mc: Md (M)

Ancylidae

Ancylus fluviatilis Müller 1774

Pl. Mc: Md (M)

Bivalvia**Sphaeridae**

Pisidium casertanum (Poli, 1791)

Cos. Mc: Az (Fa, P, SMg), Cn. (Tn), Md (M)

P. personatum Malm, 1855

Pl. Mc: Md (M)

Oligochaeta**Lumbriculidae**

Lumbriculus variegatus (Müller, 1774)

Cos. Mc: Az (Fa, SMg), Cn (Tn) Md (M)

Naididae

Nais communis Piguët 1906 / *Nais variabilis* Piguët 1906

Cos. Mc: Cn (Tn), Md (M)

Nais elinguis Müller, 1774

Cos. Mc: Az (Fa, Fl, SMa, SMg), Cn (Tn) Md (M)

♦ *Dero (Aulophorus) furcatus* (Müller, 1773)

Cos. Mc: Cn (Tn), Md (M)

Slavina appendiculata (d'Udekem, 1855)

Hol, N. Zealand. Mc: Md (M)

<i>Allonais paraguayensis</i> (Michaelson, 1905)	Nr, Aft. Mc: Md (M)
Tubificidae	
♦ <i>Tubifex tubifex</i> (Müller, 1774)	Cos. Mc: Az (P, SMg), Cn (Tn), Md (M)
Lumbricidae	
<i>Eiseniella tetraeda</i> (Savigny, 1826)	Cos. Mc: Az (SMa, Smg), Cn (Tn), Md (M)
Hirudinea	
Glossiphoniidae	
♦ <i>Helobdella stagnalis</i> (Linnaeus, 1758)	Pl. Mc: Cn. (Tn), Md (M)
Erpobdellidae	
<i>Dina lineata</i> (Müller, 1774)	Pl. Mc: Az (Fa, SMa, SMg), Md (M)
Hydracarina	
Hydryphantidae	
‡ <i>Trichothyas (Lundbladia) petrophila</i> var. <i>rutae</i> (Lundblad 1941)	Mc: Cn (Go, Tn, LP), Md (M)
† <i>Thyopsis maderensis</i> Lundblad, 1941	Md (M)
† <i>Thyas incerta</i> Lundblad, 1942	Md (M)
Spherconidae	
<i>Sperchon brevirostris</i> var. <i>brevirostris</i> Koenike, 1895	Pl. Mc: Az (Fl, SMg), Md (M)
Lebertiidae	
† <i>Lebertia madericola</i> (Lundblad, 1942)	Md (M)
† <i>Lebertia maderigena</i> Lundblad, 1942)	Md (M)
Torrenticolidae	
† <i>Torrenticola (Torrenticola) affinis</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) crassirostris</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) crassus</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) elliptiformis</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) insulicola</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) maderensis</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) mandibularis</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) nesiototes</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) pharyngealis</i> var. <i>pharyngealis</i> (Lundblad, 1941)	Md (M)
† <i>T. (T.) rotundus</i> (Lundblad, 1941)	Md (M)
Limnesiidae	
† <i>Limnesia (Limnesia) atlantica</i> (Lundblad, 1941)	Md (M)
Hygrobatidae	
† <i>Atractides (Atractides) insulanus</i> (Lundblad, 1941)	Md (M)
† <i>A. (A.) macaronensis</i> (Lundblad, 1941)	Md (M)
† <i>A. (A.) maderensis</i> (Lundblad, 1941)	Md (M)
† <i>A. (A.) rutae</i> (Lundblad,)	Md (M)
† <i>Maderomegapus hystricipes</i> Lundblad, 1941	Md (M)
Unionicolidae	
† <i>Neumania (Neumania) atlantida</i> (Lundblad, 1941)	Mc: Cn (Go, Tn), Md (M)
Aturidae	
† <i>Aturus atlantis</i> Lundblad, 1942	Md (M)
Arrenuridae	
† <i>Arrenurus (Megaluracarus) autochthonus</i> (Lundblad, 1942)	Md (M)

Ostracoda**Cyprididae***Strandesia (Neocypris) obliqua* (Brady, 1868)**Hol.** Mc: Az (Fa, Fl, SMa) Cn (Tn), Md (M)**Cypriopsidae***Potamocypris pallida* Alm, 1915**Hol.** Mc: Md (M)*Cypridopsis lusatica* Schöfer, 1943**Pl** (SPI). Mc: Az (SMa, SMg) Cn (Go, Tn), Md (M)**Copepoda****Cyclopidae***Eucyclops serrulatus* (Fischer, 1851)**Pl.** Mc: Az (Fa, Fl, Gr, P, SJ, SMa, SMg, Tr), Md (M)**Isopoda****Asellidae***Asellus (Asellus) aquaticus* (Linnaeus, 1758)*sensu* Racovitza, 1919**Pl.** Mc: Md (M)† *Proasellus coxalis* var *perarmatus* (Remy, 1936)**Md**(M)**Janiridae***Jaera (Jaera) nordica* Lemercier, 1958**Hol.** Mc: Az (SMg ?), Md (M)**Ephemeroptera****Baetidae***Baëtis rhodani* (Pictet, 1844)**Pl.** Mc: Cn. (GC, Tn), Md (M)† *B. pseudorhodani* Müller-Liebenau 1971**Mc:** Cn (GC, Go, LP, Tn), Md (M)*Cloëon dipterum* (Linnaeus, 1761)**Hol.** Mc: Az (Fa, SMa, SMg), Cn (Tn), Md (M)*Centroptilum* sp. *sensu* Classey 1966b**Un, Cos.** Mc: Md (M?)**Odonata****Zygoptera****Coenagrionidae***Ischnura pumilio* (Charpentier, 1840)**Pl.** Mc: Az (Fa, Fl, P, SMa, Tr), Md (M)*I. senegalensis* (Rambur, 1842)**Pl** (NAf), Aft.(Egypt, Senegal). Mc: Az (Fa, Fl, SJ, SMa, SMg, Tr), Cn (GC), Md (M, PS)**Anisoptera****Gomphidae***Gomphus* sp.**Un, Cos.** Mc: Md (M?)**Aeshnidae***Anax imperator* Leach, 1815**Pl.** Mc: Az (Fa, Fl, P, SMg, Tr), Cn (GC, Go, LP,

Tn), Md (M, PS?)

Libellulidae*Sympetrum fonscolombii* (Sélys, 1840)**Pl.** Mc: Az (C, Fa, Fl, P, SJ, SMa, SMg), Cn (GC, Tn), Md (D, M)† *S. nigrifemur* (Sélys, 1884)**Mc:** Cn (GC, Tn), Md (M)**Hemiptera (Heteroptera)****Veliidae**† *Velia maderensis* (Noualhier, 1897) Taminini, 1947**Md**(M)† *Microvelia gracillima* Reuter, 1883 *f. azorica*

Lindberg, 1941

Mc: Az (Fl, SMa, SMg), Md (M, PS)**Corixidae***Corixa affinis* Leach, 1817**Pl** (SPI, WPI, NAF), Or (India). Mc: Az (Fa, Fl, P, SMa,

SMg, Tr), Cn (Fu, GC, H, Tn), Md (M, PS?)

- C. punctata* (Illiger, 1807) **PI** (WPI, Naf). Mc: Cn?, Md (M)
- Sigara lateralis* (Leach, 1817) **PI** (Med), Aft (Kenya). Mc: Cn (Fu, GC, Tn), CV (?), Md (D, M, PS)
- Sigara (Vermicorixa) nigrolineata* Fieber, 1848 **Un**, Pl. Mc: Md (M?)
- Notonectidae**
- Anisops debilis* Gerstaecker, 1873 ssp. *canariensis* Noualhier, 1893 **PI** (Med, Naf). Mc: Cn (Fu, GC, LP), CV, Md (M, PS)
- Coleoptera**
- Dytiscidae**
- Hygrotus confluens* (Fabricius 1787) **Cos**, Pl (SPI, WPI). Mc: Az (SMa, SMg), Cn (Fu, GC, Go, L, Tn), Md (D, M, PS)
- † *Hydrotarsus lundbladi* Falkenstrom, 1938 **Md** (M)
- Hydroporus obsoletus* Aubé, 1836 **PI** (SPI, WPI). Mc: Md (M)
- † *Potamonectes dubius* (Aubé, 1838) **Md** (M)
- Agabus nebulosus* (Forster, 1771) **Aft**, Asia, Pl (SPI, WPI). Mc: Cn (GC, Go, H, LP, Tn), Md (M)
- § *A. maderensis* Wollaston, 1854 **Md** (M, PS)
- † *A. wollastoni* Sharp, 1880-82. **Md** (M)
- † *Meladema lanio* (Fabricius, 1792) **Md** (M)
- Eretes sticticus* (Linnaeus, 1767) **Hol**, Aft. Mc: Cn (GC, Tn), CV (SV), Md (M, PS)
- Hydrophilidae**
- † *Anacaena conglobata* Wollaston, 1854 **Md** (M)
- † *A. marchantiae* Wollaston 1857 **Md** (M)
- § *Laccobius atricolor* d'Orchymont, 1938 **Md** (M, PS)
- Enochrus politus* (Küster, 1849) **PI** (SPI, NAF). Mc: Cn (Fu, GC, Go, L, Tn), Md (M, PS)
- Hydraenidae**
- Ochthebius rugulosus* Wollaston, 1857 **PI** (Eur). Mc: Cn (Fu, GC, Go, LP, Tn), Md (D, M, PS)
- O. quadrioveolatus* Wollaston, 1854 **PI** (IbPen.) Mc: Cn (GC, Go, LP, Tn), CV (SV), Md (M)
- O. subpictus subpictus* Wollaston, 1857 **PI** (SPI, Med). Mc: Cn (Fu), Md (M, PS)
- † *O. algicola* Wollaston, 1871 **Md** (M)
- O. quadricollis* Mulsant, 1844 **PI** (W Med.). Mc: Cn (Gc, Go, L, LP, Tn), Md (D, M, PS, S)
- † *Limnebius grandicollis* Wollaston 1854 **Md** (M)
- Dryopidae**
- Dryops luridus* (Erichson, 1847) **PI**. Mc: Az (Fl, Gr, SMg), Cn (GC, Go, Tn, LP) Md (M)
- D. gracilis* Karsch, 1881 **PI** (Spl, WPI). Mc: Cn (GC, Tn), Md (M)
- Trichoptera**
- Glossosomatidae**
- † *Synagepetus punctatus* (Hagen, 1859) **Md** (M)
- † *S. lundbladi* (Mosely, 1938) **Md** (M)
- Hydroptilidae**
- † *Hydroptila fortunata* Morton, 1893 **Mc**: Cn (GC, LP, Tn), Md (M)
- H. juba* Enderlein, 1929 **PI** (SPI, IbPen., NAF). Mc: Cn (Fu, Tn), Md (M)

<i>H. vectis</i> Curtis, 1834	Pl (S & C Eur, IbPen., Naf). Mc : Az (Fl, SMg, Tr), Md (M)
† <i>Oxyethira spinosella</i> McLachlan 1884	Mc : Cn (GC, Go, Tn), Md (M)
† <i>Stactobia atra</i> (Hagen, 1865)	Md (M)
† <i>S. nybomi</i> Schmid 1959	Md (M)
Psychomyiidae	
† <i>Tinodes cinerea</i> Hagen, 1865	Md (M)
† <i>T. grisea</i> Hagen, 1865	Md (M)
† <i>T. merula</i> McLachlan, 1882	Md (M)
Polycentropodidae	
† <i>Polycentropus flavostictus</i> Hagen, 1865	Md (M)
Hydropsychidae	
† <i>Hydropsyche maderensis</i> Hagen, 1865	Mc : Cn ?(GC), Md (M)
Limnephilidae	
† <i>Mesophylax oblitus</i> (Hagen, 1865)	Md (M)
† <i>Limnephilus nybomi</i> Malicky, 1984	Md (M)
Diptera	
Tipulidae	
† <i>Nephrotoma antithrix</i> (Mannheims, 1962)	Md (M)
† <i>N. brevipennis</i> (Wollaston, 1858)	Md (M)
† <i>N. lucida</i> (Schiner, 1868)	Md (M)
† <i>Tipula (Savtshenkia) lundbladi</i> Mannheims, 1962	Md (M)
† <i>T. (S.) rufina</i> ssp. <i>maderensis</i> Lackschevitz 1936	Md (M)
† <i>T. (Tipula) atlantica</i> Mannheims, 1962	Md (M)
<i>T. (T.) paludosa</i> Meigen, 1830	Pl. Mc : Cn (GC, Tn), Md (M)
Limoniidae	
<i>Dicranomyia (Dicranomyia) chorea</i> (Meigen 1818)	Pl. Mc : Cn. (GC, LP, Tn), Md (M)
† <i>D. (D.) maderensis</i> (Wollaston, 1858)	Md (M)
‡ <i>D. (D.) michaeli</i> (Theowald, 1977)	Mc : Az (Fa, Fl, P, SJ, SMg, Tr), Cn (Go, Tn), Md (M)
‡ <i>D. (D.) vicina</i> (Macquart, 1839)	Mc : Az (Fa, SJ, SMg, P, Tr), Cn (GC, Go, LP, Tn), Md (M)
‡ <i>Geranomyia atlantica atlantica</i> (Wollaston, 1858)	Mc : Az (P, SJ, SMg), Md (D, PS)
† <i>G. bivittata</i> Becker, 1908	Md (M)
‡ <i>G. canariensis</i> Bergroth, 1889	Mc : Cn (Fu, GC, Go, L, LP, Tn), Md (M)
<i>G. unicolor</i> Haliday, 1833	Pl (WPl). Mc : Az (Fa, Fl, P, SMg, Tr), Cn (GC, LP, Tn), Md (M)
† <i>Phylidorea (Phylidorea) contraria</i> (Wollaston, 1858)	Md (M)
‡ <i>Cheilotrichia (Empeda) nemorensis</i> (Santos Abreu, 1923)	Mc : Cn (GC, Go, LP, Tn), M (M)
<i>Symplecta (Trimicra) pilipes</i> (Fabricius, 1787)	Cos. Mc : Az (Fl, Gr, SMg, Tr), Cn (GC, Go, LP, Tn), Md (D, M, PS)
‡ <i>Molophilus (Molophilus) baezi</i> Theowald 1981	Mc : Cn (Go, Tn), Md (M)
<i>Austrolimnophila</i> sp.	Un. Mc : Cn ?(Go, LP), Md (M)
<i>Gonomyia</i> sp.	Un. Cos , Md (M?)
Psychodidae	
<i>Clytocyclus (Boreoclytocyclus) wollastoni</i> Satchell, 1955	Pl (NAf). Mc : Md (M)
† <i>Paramormia cornuta</i> Nielsen, 1964	Md (M)

- ‡ *Telmatoscopus meridionalis* Eaton, 1904
(*nomen dubium* ?) **Mc:** Az (SMg), Cn (GC), Md
- Tinearia alternata* (Say, 1824) **Cos. Mc:** Az (Fa, SMg), Cn (GC, LP, Tn), Md (M)
- Psychoda cinerea* Banks, 1894 **Cos. Mc:** Az (Fa, Fl, SMA, SMg) Cn (Tn), Md (M?)
- ‡ *Nielsenella brinki* (Nielsen, 1964) **Mc:** Cn (Tn), Md (M)
- † *N. maderensis* (Satchell, 1955) **Md** (M)
- Dixidae**
- Dixa* nov. sp. ? (*sensu* Stauder 1991) **Un.** Md (M?)
- ‡ *Dixa tetrica* Peus, 1934 **Mc:** Cn (Gc, Go, LP, Tn), Md (M?)
- Culicidae**
- Anophilinae
- Anopheles (Cellia) cinereus* Theobald 1901 **PI** (SPI), Aft (Zimbabwe). **Mc:** Cn (Fu, GC, Go, LP, Tn), Md (PS)
- Culicinae**
- ‡ *Aedes (Finlaya) eatoni* (Edwards, 1916) **Mc:** Cn (LP, Tn), Md (M)
- Culiseta (Allotheobaldia) longiareolata* (Macquart, 1838) **PI** (SPI), Afr (S Africa), Or (India). **Mc:** Az (Fl, SMg, Tr), Cn (Fu, GC, Go, H, L, LP, Tn), Md (D, M, PS, S)
- Culex (Culex) pipiens* Linnaeus, 1758 **PI**, Aft (E & S Africa), Neo (S. America), Australian. **Mc:** Az (Fa, Fl, SJ, SMg, Tr), Cn (Fu, GC, Go, H, L, LP, Tn), Md (M, PS)
- C. (C.) pipiens molestus* Forskal, 1775 **PI**, Aft (E & S Africa), Neo (S. America), Australian **Mc:** Md (M, PS)
- C. (C.) theileri* Theobald, 1903 **PI** (NAf), Aft, Or. **Mc:** Cn (GC, Go, Tn), Md (M, PS)
- † *C. (Maillotia) hortensis maderensis* Mattingly, 1955 **Md** (M)
- Thaumaleidae**
- † *Thaumalea brinki* Vaillant, 1960 **Md** (M)
- ‡ *T. subafricana* (Becker, 1908) **Mc:** Cn (LP, Tn), Md (M)
- Ceratopogonidae**
- ‡ *Ceratopogon (Isohelea) griseipennis* Storå, 1945 **Mc:** Az (P, SJ, SMg, Tr), Md (M)
- Dasyhelea (Pseudoculicoides) flavoscutellata* (Zetterstedt, 1850) **PI** (NAf), Or. **Mc:** Az (Fl), Cn (GC, LP, Tn), Md (M)
- Simuliidae**
- Simulium (Eusimulium) petricolum* (Rivosecchi, 1963) **PI** (SPI). **Mc:** Md (M)
- S. (Simulium) intermedium* Roubaud, 1906 **PI** (Spl, WPI, Med). **Mc:** Cn (GC, Tn), Md (M)
- Chironomidae**
- Telmatogenoninae**
- Thalassomya frauenfeldi* Schiner, 1856 **PI** (Eur). **Mc:** Az (C, Fa, Fl, P, SJ, SMg, Tn), Cn (LP), Md (M)
- Tanypodinae**
- Apsectrotanypus trifascipennis* (Zetterstedt, 1838) **PI.** **Mc:** Md (M)
- ♦ *Macropelopia nebulosa* (Meigen, 1804) **PI.** **Mc:** Az (Fl, SJ, SMg, Tr), Cn (GC, Tn), Md (M - coll MTF site 3 det PHL)
- ♦ *Paramerina* sp. **Un.** **Mc:** Md (M - coll MTF site 4, 5, 6, 7 det PHL)

Zavrelimyia nubila (Meigen, 1830)

♦ *Zavrelimyia* sp.

Diamesinae

Boreoheptagyia legeri (Goetghebuer, 1933)

‡ *Diamesa alata* Storå, 1945

♦ *D. cf. latitarsus* (Goetghebuer, 1921)

♦ *D. cf. tonsa* (Haliday, 1856)

Orthocladinae

Bryophaenocladus sp.

♦ ?*Cardiocladius capucinus* (Zetterstedt, 1850)

‡ *C. freyi* Storå, 1936

Chaetocladus melaleucus (Meigen, 1818)

Cricotopus (Cricotopus) beckeri Hirvenoja, 1973

C. vierriensis Goetghebuer, 1935

Cricotopus sp. A *sensu* Baez & Armitage, 1991

♦ *Cricotopus* sp. X

♦ *Cricotopus* sp. Y

Halocladus (Halocladus) varians (Staeger, 1839)

Eukiefferiella devonica (Edwards, 1929)

♦ *Eukiefferiella* sp. X

♦ *Eukiefferiella* sp. Y

♦ *Eukiefferiella* sp. Z

?*Limnophyes* sp. nr. *exiguus* (Goetghebuer, 1913)

L. minimus (Meigen, 1818)

L. prolongatus (Kieffer, 1921)

† *L. madeirae* Sæther, 1990

Metriocnemus fuscipes (Meigen, 1818)

M. sp. nr. *martinii* Thienemann, 1921 *sensu* Baez & Armitage, 1991

M. eurynotus var. *Holmgren*, 1883 *sensu* Sæther 1995

M. ochraceus van der Wulp 1858 (*nomen dubium* ?)

♦ *Orthocladus (Eudactylocladius) fuscimanus* (Kieffer, 1908)

Parametriocnemus stylatus (Kieffer, 1924)

stylatus (Kieffer 1924)

Paraphaenocladus impensus (Walker, 1856)

♦ *Paraphaenocladus* sp.

Paratrachocladus rufiventris (Meigen 1830)

Rheocricotopus atripes (Kieffer, 1913)

Rheocricotopus cf. atripes (Kieffer, 1913)

Smittia aterrima (Meigen, 1818)

S. nudipennis (Goetghebuer, 1913)

Synorthocladus semivirens (Kieffer, 1909)

Thalassosmittia atlantica (Storå, 1936)

PI (Eur). **Mc**: Az (Fa, Fl, P, SJ, SMg), Cn (GC, Tn), Md (M)

Un. Mc: Md (M – coll MTF site 2 det. PHL)

PI (NAf). **Mc**: Md (M)

Mc: Az (Fa, Smg, Tr), Md (M)

Un. Mc: Md (M – coll MTF site 2 det PHL)

Un. Mc: Md (M – coll MTF site 3 det PHL)

PI (Europe). **Mc**(M)?

PI. Mc: Md (M – coll MTF site 3, 4, 5, 6 det PHL)

Mc: Az (Fl, SMg, Tr), Cn (GC, Tn), Md (M)

Aft. Pl. Mc: Az (Fl, SMg, Tr), Md (M)

PI (SW Med., NAf). **Mc**: Md (M)

Hol. Mc: Cn (GC), Md (M)

Un. Mc: Md (M)

Un. Mc: Md (M – coll MTF 2, 3, 5, 6, 8 det PHL)

Un. Mc: Md (M – coll MTF 2 det PHL)

PI. Mc: Az (Fa, SJ, SMg), Md (M)

Hol. Mc: Cn (Tn), Md (M)

Un. Mc: Md (M – coll MTF site 4, 5, 6 det PHL)

Un. Mc: Md (M – coll MTF site 2 det PHL)

Un. Mc: Md (M – coll MTF site 2,3, 6 det PHL)

PI. Mc: Cn (GC, LP), Md (M)

PI. Mc: Az (Fa, Fl, P, SMg, Tr), Cn (GC, LP), Md (M)

PI. Mc: Md (M)

Md(M)

PI. Mc: Az (Fa, Fl, P, SMg, Tr), Cn (LP, Tn?), Md (M)

Un. Mc: Md (M)

Un. Mc: Md (M)

status uncertain

PI. Mc: Cn (GC), Md (M - coll. MTF site 4 det. PHL)

PI. Mc: Az (Fl, SMg, Tr), Cn (GC, Tn), Md (M) ♦ *P. cf.*

Un. Mc: Md (M – coll. MTF site 3,4,5,6,7,8 det. PHL)

Hol. Mc: Md (M)

Un. Mc: Md (M – coll. MTF site 3 det. PHL)

PI. Mc: Cn (GC, Tn), Md (M)

PI. Mc: Az (Fl, SMg, Tr), Cn (GC, Tn), Md (M) ♦

Un. Mc: Md (M – coll. MTF site 4, 5, 7 det. PHL)

PI. Mc: Az (SMg), Cn (LP, Tn), Md (M)

PI (Wpl, EPl). **Mc**: Md (M)

Hol. Mc: Md (M)

Mc: Az (Cv, Fa, Fl., P, SMg, Tr), Cn (GC, H, Tn),

Md (M).

<i>Thienemanniella clavicornis</i> (Kieffer, 1911)	Pl. Mc: Az (SMg), Cn (Tn), Md (M)
Chironominae	
<i>Chironomus (Chironomus) dorsalis</i> Meigen, 1818	Hol. Mc: Az (Fa, Fl, SJ, SMg, Tr), Cn (GC, LP, Tn), Md (M)
<i>C. (C.)</i> sp. nr. <i>pseudothummi</i> Strenzke, 1959 <i>sensu</i> Baez & Armitage 1991	Un. Mc: (M)
<i>C. (C.) cf riparius</i> Meigen, 1804	Un. Mc: Md (M)
<i>Dicrotendipes septemmaculatus</i> (Becker, 1908)	Pl (SPl) Aft (Southern Africa), Or (India), Australian. Mc: Cn (GC, Tn), Md (M)
♦ <i>Glyptotendipes pallens</i> (Meigen, 1804)	Pl (Eur). Mc: Md (M - coll MTF site 1 det PHL)
<i>Phaenospectra</i> sp.	Un. Mc: Md (M - coll MTF site 2 det PHL)
<i>Polypedilum (Pentapedilum)</i> sp.	Un. Mc: Md (M)
<i>P.(Polypedilum) convictum</i> (Walker, 1856)	Hol. Mc: Md (M)
♦ <i>Microspectra</i> sp. <i>atrofasciata</i> group Kieffer, 1911	Un. Mc: Md (M - coll MTF site 2 det PHL)
‡ <i>M. freyi</i> Storå, 1945	Mc: Az (SJ), Md (M)
<i>M. junci</i> (Meigen, 1818)	Pl (Eur). Mc: Az (C, Fa, Fl, P, SJ, SMg, Tr), Md (M)
<i>M. lindrothi</i> Goetghebuer, 1931 / <i>M. notescens</i> Walker, 1856	Un, Hol./Pl (Eur). Mc: Cn (Tn)?, Md (M)?
♦ <i>Tanytarsus cf curticornis</i> Kieffer, 1911	Un, Mc: (M - coll MTF site 2, 3 det PHL)
♦ <i>Rheotanytarsus guineensis</i> Kieffer, 1918	Aft (S of Sahara). Mc: (M - coll MTF site 4, 5, 6, 8 det PHL)
<i>Virgatanytarsus albisutus</i> (Santos Abreu, 1918)	Pl (SPl). Mc: Cn (GC, LP), Md (M)
Empididae	
<i>Chelifera</i> sp.	Un, Cos. Mc: Md (M)
† <i>Clinocera (Kowarzia) haemorrhoidalis</i> (Becker, 1908)	Md (M)
† <i>C. (K.) rabacali</i> Frey, 1939	Md (M)
† <i>Roederioides longirostris</i> Frey, 1939	Md (M)
Dolichopodidae	
Hydrophorinae	
† <i>Aphrosylus atlanticus</i> Dahl, 1960	Md (M)
‡ <i>A. jucundus</i> Becker, 1908	Mc: Cn (GC, LP, Tn), Md (M)
† <i>A. madeirensis</i> Frey, 1949	Md (M)
<i>A. venator</i> Loew, 1857	Pl (Eur, NAf). Mc: Cn (GC, Go, H, LP), Md (M)†
<i>Liancalus glaucus</i> Becker, 1908	Md (M)
<i>L. virens</i> Scopoli, 1763	Pl. Mc: Md (M)
Sympycninae	
† <i>Sympycnus hispidus</i> Becker, 1908	Md (M)
<i>Syntormon pallipes</i> Fabricius, 1794	Pl. Mc: Az (SJ, Tr), Cn (GC, Go, LP, Tn), Md (M)
<i>Campsicnemus curvipes</i> (Fallén, 1823)	Pl (Eur). Mc: Az (C, Fl, SJ, SMg, Tr), Cn (GC, LP, Tn), Md (M)
Diaphorinae	
† <i>Chrysotus barretoii</i> Becker, 1908	Md (M)
† <i>C. lundbladi</i> Frey, 1939	Md (M)
† <i>C. subfemoratus</i> Frey, 1939	Md (M)
Syrphidae	
<i>Eristalis (Eristalis) tenax</i> (Linnaeus, 1768)	Cos. Mc: Az (Fa, Fl, SJ, SMg, Tr), CV (SA, SN, SV), Cn (GC, Go, LP, Tn) Md (M)

Ephydriidae*Hydrellia albilabris* Meigen, 1830**PI** (Eur). Mc: Md (M)*H. griseola* (Fallén, 1813)**Hol**, Or, Australian. Mc: Az (C, Fl, Gr, P, SJ, SMg, Tr), Cn (GC, Tn), Md (M)*H. maura* Meigen, 1838**PI** (Eur, NAF). Mc: Az (Fa, Fl, SJ), Cn (GC), Md (M)*Ephydra (Ephydra) riparia* (Fallén, 1813)**Hol**. Mc: Az (Tr), Cn (Tn), Md (M)*Scatella (Neoscatella) crassicosta* Becker, 1896**Hol**. Mc: Md (M)*S. (Scatella) major* (Becker, 1908)**PI**. Mc: Cn (LP), Md (M)*S. (S.) stagnalis* (Fallén, 1813)**Hol**, Aft, Australian. Mc: Az (Fl), Cn (GC, Go, LP), Md (M)*Limmellia quadrata* (Fallén, 1813)**PI** (Eur). Mc: Az (SMg), Cn (GC, Tn), Md (M)**Muscidae**‡ *Phaonia sordidissima* Stein, 1908**Mc**: Cn (GC, Tn), Md (M)‡ *Limnophora bipunctata* (Stein, 1908)**Mc**: Cn (GC, LP, Tn), Md (M)*L. riparia* (Fallén, 1824)**PI**. Mc: Cn (Tn), Md (M)*L. setinerva* Schnabel, 1911**PI**. Mc: Cn (GC, Tn), Md (M)*L. nana* Macquart, 1835**PI**, Aft, Or. Mc: Az (Fa, Fl, SMg, Tr), Cn (GC, Tn), Md (M)*L. tentaculata* (DeGeer, 1776)**Hol**, Aft, Or. Mc: Cn (LP, Tn), Md (M)

TABLE 4 - The percentage of the Madeiran macroinvertebrate fauna associated with six biogeographic areas or regions.

Zoogeographic Region	#	%
Endemic	68	28.3%
Macaronesian	27	11.3%
Palearctic	78	32.5%
Holarctic	16	6.7%
Nearctic	1	0.4%
African	3	1.3%
Cosmopolitan	17	7.1%
unknown	30	12.5%
Total	240	100%

Comments on new Records

Dugesia gonocephala group (DUGES, 1830): Collected by SJH, determined by JHB. Several variants of this species are known to exist, hence the denomination “group”. The taxon occurs in considerable numbers at lower sites along Ribeira São Vicente and Ribeira Brava, and to a lesser extent along Ribeira do Faial (lower catchment of Ribeiro Frio). These are all permanent water courses, a factor which may influence the distribution of this taxon. Madeira locality: Ribeira Brava downstream of abattoir September (number of specimens = 16); Ribeira Brava, above town: July 1991 (n=44), September 1991 (n=4); Ribeira Brava, adjacent to town, September 1991 (n=1); Ribeira de São Vicente, Laranjal: January 1991 (n = 2) September 1991 (n=14), November, 1991 (n=7); São Vicente, adjacent to the town, January 1991 (n=3), May 1991 (n=2), September 1991 (n=5), November 1991 (n=2); São Vicente, approximately 30m upstream of the beach, September 1991 (n=1), November 1991 (n=2); Ribeira do Faial, Faial: May 1991 (n =1).

Dero (Aulophorus) furcatus (MÜLLER, 1773): Collected and initially determined by SJH, confirmed by JHB. A cosmopolitan species collected from a single site. Locality in Madeira: Ribeira Brava, downstream of abattoir, July 1991 (n =1377).

Tubifex tubifex (MÜLLER, 1774): Collected by SJH determined by JHB. Another cosmopolitan oligochaete found at several sites generally occurring in low numbers. Organically enriched sites support higher densities of this taxon. Locality in Madeira: unnamed tributary of Ribeira da Santa Cruz (receiving piggery effluent) Santo do Serra: January 1991 (n=48), March 1991 (n = 48), November 1991 (n = 290); Ribeira Santa

Cruz approximately 1.5km above town: March 1991 (n=1), May 1991 (n=4); Ribeira São João, Muro do Coelho: September 1991 (n=1), São João: July 1991 (n=2); Ribeira do Faial, Faial November 1991 (n=1).

Helobdella stagnalis (LINNAEUS, 1758): Collected by MTF from the ponds of the Botanical Gardens amongst aquatic macrophytes. Almost certainly accidentally introduced with exotic plant material. Prior to this record, *Dina lineata* (MÜLLER, 1774) was the only freshwater leech known to occur in Madeira. Locality in Madeira: Ponds in the Botanical Gardens.

Chironomidae: all taxonomic comments are provided by PHL upon the material collected by MTF from the sites described in the Methods section. The chironomid material was prepared and also examined by JHB.

Macropelopia nebulosa (MEIGEN, 1804): Recorded from all over Europe and North Africa. Locality in Madeira: site 3.

Paramerina sp.: The pupal material collected is nearest to “spec. Griechenland” Fittkau known from running waters in the Northern Mediterranean. Further material is necessary in order to confirm the taxon’s identity. Locality in Madeira: sites, 4, 5, 6, 7, 9.

Zavrelymia sp.: There is some difficulty in accurately identifying the species of this genus. Further material necessary. Locality in Madeira: site 2.

Diamesa cf latitarsus (GOETGHEBUER, 1921): Adult specimens are necessary for confirmation. Locality in Madeira: site 2.

Diamesa cf tonsa (WALKER, 1856): Adult confirmatory material required for the pupal exuvial material collected by MTF. Locality in Madeira: site 3.

Cardiocladius capucinus (ZETT., 1850): A tentative identification of pupal exuvial material collected by MTF as the pupal form of *Cardiocladius freyi*, the Macaronesian representative of the genus, is not known. Adult material necessary. Locality in Madeira: sites 3, 4, 5, 6.

Cricotopus X: Adults required to confirm identity of this form of *Cricotopus*. Collected from several sites indicating a fairly widespread form. Locality in Madeira: sites 2, 3, 5, 6, 8.

Cricotopus Y: Adults required to confirm identity of this form of *Cricotopus*. Locality in Madeira: site 2.

All of the *Eukiefferiella* pupal exuvial material examined by PHL and listed below require adult material in order to confirm identity:

Eukiefferiella sp. X: Locality in Madeira: sites 4, 5, 6.

Eukiefferiella sp. Y: Possibly a new form, with very small thoracic horns on the pupal exuvia. Locality in Madeira: site 2.

Eukiefferiella sp. Z: Locality in Madeira: sites 2, 3, 6.

Orthocladius (*Eudactylocladius*) *fuscimanus* (KIEFFER, 1908): This species is known from all over Europe and North Africa. Locality in Madeira: site 2.

Parametrioctenemus cf. *stylatus* : This possibly new form was collected from a number of sites. The form occurring in Madeira is neither the European *P. stylatus* nor the African *P. scotti*. Locality in Madeira: sites 3, 4, 5, 6, 7, 8.

Paraphaenocladius sp. (KIEFFER, 1924); A single adult was collected. Possibly the adult of the aforementioned taxon since the two genera are very closely related. Locality in Madeira: site 3.

Rheocricotopus cf. *atripes* (KIEFFER, 1913): Adult material is necessary in order to confirm this material. PHL determined the material to the *atripes-glabricollis-gallicus* group. Examination of a single pharate adult with an antennal ratio of close to 1:4 placed it close to *gallicus*. Locality in Madeira: sites 4, 5, 7.

Glyptotendipes pallens (MEIGEN, 1804): Locality in Madeira: site 1.

Micropsectra sp. *atrofasciata* group KIEFFER, 1911: The pupal exuviae does not fit the key of Palaearctic Chironomidae compiled by PHL. Associated material necessary. Locality in Madeira: site 2.

Rheotanytarsus guineensis KIEFFER 1918: An African taxon occurring south of the Sahara. Similar material has been collected from the Canaries by Dr. PATRICK ARMITAGE. Locality in Madeira: sites 4, 5, 6, 8.

Tanytarsus cf. *curticornis* KIEFFER, 1911: Pupal exuvial form is very close to but not *curticornis sensu strictu*. Locality in Madeira: sites 2, 3.

DISCUSSION

Field collections and literature survey provide a total record of 240 species from 14 major taxonomic groups. There are 23 new records, including new forms and most of these are Chironomidae. The listing includes taxa that are known to have aquatic larval stages but have been collected as winged adults by authors of previous studies covered by the literature survey. STAUDER (op.cit.) cited 139 freshwater taxa, a considerably smaller number due to the omission of several groups. Diptera collected as adults or groups where the larval stage was not known to be truly aquatic were also

excluded by her.

The best represented order is the Diptera, containing 134 taxa although 27 taxa are either unknown forms or are considered *nomina dubia* (*Telmatoscopus meridionalis* Eaton 1904 and *Metriocnemus ochraceus* v. d. WULP 1858). The Diptera, consisting of 14 families, make up 55.8% of the aquatic macroinvertebrate fauna. The most diverse family is the Chironomidae, containing 60 taxa of which 15 are possible new forms, not readily identifiable forms or are new records for Madeira. The second largest group, forming 10.4% of the aquatic fauna, is the Hydracarina with 25 species, of which 22 (88%) are endemic and 2 (8%) are Macaronesian. The Coleoptera (8.8%), containing 21 species within 4 families, is the third largest macroinvertebrate group with 48% of the species listed as endemic. The Trichoptera (6.4%), with 15 species within 6 families, contains 10 (67%) endemic species. Tricladida, Mollusca, Oligochaeta, Hirudinea, Ostracoda, Copepoda, Isopoda, Ephemeroptera and Odonata collectively make up 19% of the remaining macroinvertebrate fauna, highlighting the low diversity.

Many of the groups commonly occurring in continental European waters are absent, supporting the observations made by BAEZ (*op. cit.*) and STAUDER (*op. cit.*) on the Madeiran fauna and MALMQVIST *et al.* (1993) on the macroinvertebrate fauna of Tenerife. It is possible that the species found in Madeira's freshwater habitats have extended beyond what is considered their typical ecological range due to the availability of niches that would otherwise be occupied. This phenomenon has been investigated with the larval Trichoptera of the island's lotic habitats (HUGHES, 1997). The aquatic macroinvertebrate fauna of Madeira is composed mainly of insects, with Oligochaeta, Crustacea and Mollusca being more poorly represented. This is probably due to the greater possibility of dispersal during the winged adult phase of the life cycle, i.e. many of the insect species may have arrived as sexually mature winged adults aided by wind action. The prevailing north-east winds over Madeira would facilitate the airborne transport of many of the taxa from the South-West Palaearctic to the archipelago. Other taxa, such as *Asellus aquaticus* LINNAEUS, 1758 and the newly recorded *Helobdella stagnalis* LINNAEUS, 1758 may have been introduced much later on through human activity, i.e. in association with the introduction of exotic aquatic plant species.

The Madeiran macroinvertebrate fauna is predominantly Western Palaearctic in origin (34.6% or 83 taxa). Many of the taxa are from the European region of the Palaearctic and to a lesser extent the Iberian Peninsula, Mediterranean and North African areas. Occurrences of predominantly Palaearctic species are also known from Africa, the Nearctic, the Orient, Australia and even New Zealand. Some families. (Hirudinea and Simuliidae) are entirely represented on Madeira by Palaearctic species.

Endemism in the macroinvertebrate fauna is surprisingly high, 28.3% (68 species and sub-species), with closely corresponding species in Palaearctic Europe. This figure is close to that quoted by BAEZ (27%) in his study upon the whole Madeiran fauna.

Endemism is highest in the Hydracarina (88.0%), Trichoptera (67%), Coleoptera (48%) and Diptera (18%). The records of possible new forms of Chironomidae may reveal endemic species in a group that is predominantly Palaearctic (34.6%). The value of Madeira's freshwater habitats as a source of study of various aspects of endemic species is obvious as is the necessity to implement measures to conserve them.

Taxa endemic to Macaronesia make up 11.3% of the aquatic macroinvertebrate fauna of Madeira. The majority of these taxa are not widespread throughout Macaronesia and most occur on only one other archipelago, other than Madeira. It is interesting to note that many of the listed Macaronesian species have a winged adult phase, a very significant factor concerning dispersal between the archipelagos. The Holarctic Region as a whole (6.7%) and the Afrotropical Region (1.3%) are each more poorly represented. Taxa exclusively from the Nearctic Region include *Gyraulus parvus* (MULLER, 1774) from the USA which was later introduced to Europe. Representatives of the predominantly Afrotropical fauna are found in the Odonata (*Ischnura senegalensis* (RAMBUR, 1842)) and the Diptera: Culicidae: *Culiseta* (A.) *longiareolata* Macquart, 1838 and Chironomidae *Rheotanytarsus guineensis* KIEFFER, 1918. It is possible that these taxa have been transported to the archipelago by the "Leste", occasional winds that cross the island from the Sahara (CLASSEY 1966a, BIVAR de SOUSA 1985). Cosmopolitan species (5%) include representatives of the Oligochaeta, Psychodidae and Syrphidae.

The compiled listing reveals that 12.5% of the aquatic macroinvertebrate fauna of Madeira requires further taxonomic study, meaning they are specimens that could not readily be identified due to damage, did not correspond to known species described in keys, or may represent new forms. The majority of these are Chironomidae (Diptera). Further investigation may reveal new endemic species.

CONCLUSION

This paper includes as complete a checklist as possible of the Madeiran freshwater macroinvertebrate fauna. The list is based on collection made in 1991 and 1992 and a literature survey. Several freshwater habitats are considered in the compilation of the checklist namely rivers and streams, pools and hygropetric biotopes and brackish/saline shorelines. The checklist comprises 240 taxa in 14 major taxonomic groups. There are 23 new records including 14 previously unknown forms of Chironomidae. These may include possible new species that can only be confirmed following the collection and analysis of associated material. As is typical of an island fauna (BAEZ op.cit), the composition of the freshwater fauna of Madeira is extremely "disharmonic", with low levels of diversity in the groups present and the absence of taxa (e.g Plecoptera) that occur commonly in continental Europe, Africa and North America. Local taxa occupy a large number of aquatic biotopes. The macroinvertebrate

fauna is predominantly made up of insects and the largest order is the Diptera with 134 listed species within 14 families.

Some orders exhibit particularly high levels of endemism such as the Hydracarina, Coleoptera and Trichoptera. It is possible that these taxa were early arrivals on Madeira and successfully exploited unoccupied freshwater niches, resulting in wide ecological ranges. The isolated gene pool formed by their arrival on an isolated archipelago resulted in the development of endemic species and subspecies.

The macroinvertebrate fauna is predominantly Western Palaearctic, originating mainly from European, Iberian, Mediterranean and North African areas of that sub-region. Macaronesian taxa (i.e. found on Madeira and at least one other Macaronesian archipelago) constitute 11.3% of the faunal composition. The other major biogeographic regions are poorly represented. It is possible that African taxa have been transported by occasional trans-Saharan winds known as the "Leste". Endemic species form 28.3% of the total macroinvertebrate fauna, highlighting the importance and value of the freshwater environment in Madeira as a source of endemic species and in evolutionary or biogeographical studies. It is possible that the percentage of endemism may become even higher through continued collections and further investigation of the unknown forms mentioned.

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LITERATURE CITED AND CONSULTED*

ARMITAGE P. D.:

- *1986. A redescription of male *Eukiefferiella atlantica* Storå (Chironomidae, Diptera) based on type material and recently collected specimens from Tenerife, Canary Islands. *Aquatic Insects* 8: 105-109.
- *1988. *Thalassosmittia atlantica* (Storå) comb. nov. Description of adult female and immature stages from Tenerife, Canary Islands. *Spixiana* Suppl. 14: 25-28.

ASHE P. & CRANSTON P.:

- *1990. Family Chironomidae, pp 113-355 in Catalogue of Palaearctic Diptera Vol. 2 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

ASSOUZI A. & LAVILLE H.:

- 1987. Premier inventaire faunistique des chironomidés (Diptera, Chironomidae) du Maroc. *Annls Limnol.* 23 (3): 217-224.

ASSOUZI A., LAVILLE H. & REISS F.:

- 1992. Nouvelles recouvertes de Chironomidés (Diptera) du Maroc. *Annls Limnol.* 28 (3): 225-232.

BAEZ M.:

- *1987. Atlas preliminar de los mosquitos de las Islas Canarias (Diptera, Culicidae). *Vieraea* 17: 193-202.
- *1993. Origins and affinities of the fauna of Madeira. *Bol.Mus.Mun. Funchal* Suppl 2: 9-39.

BAEZ M. & ARMITAGE P. D.:

- *1990. Chironomidae (Diptera, Nematocera) from Madeira. *Bocagiana Mus. Mun. Funchal* 135: 6pp

BAEZ M. & FERNANDEZ J. M.:

- 1980. Notes on the mosquito fauna of the Canary Islands. *Mosq. Syst.* 12 (3): 349-355.

BALKE M. & HENDRICH L.:

- *1989. Verbreitung, Lebensweise, Taxonomie und Historie der Dytisciden der Ilha da Madeira (Coleoptera, Dytiscidae). *Bol. Mus. Mun. Funchal* 41 (212): 55-83.

BALKE M., HENDRICH L. & CUPPEN J. G. M.:

- 1990. Wasserkäfer von den Islas Canarias. (Coleoptera: Haliplidae, Dytiscidae, Gyridae, Hydrochidae, Hydrophilidae, Hydraenidae, Dryopidae). *Entomofauna* 11 (22): 349-373.

BARROIS TH. & MONIEZ R.:

1888. Materiaux pour servir à l'étude de la fauna eaux douces des Açores. 19pp.

BECKER TH.:

1896. Dipterologische Studien IV: Ephydridae. *Berl. Ent. Z.* 41 (2).
*1908a. Dipteren der Kanarischen Inseln. *Mitt. zool. Mus. Berl.* 4 (1): 1-180.
*1908b. Dipteren der Insel Madeira. *Mitt. zool. Mus. Berl.* 4 (1): 181-206.

BEYER G. & MEISCH C.:

1996. Freshwater Ostracoda collected on La Gomera with a redescription of *Cypridopsis obesa* (Brady & Robertson, 1869). *Trav. scient. Mus. nat. Hist. nat. Lux.* 23: 29-55.

BIVAR de SOUSA A.:

- *1985. Alguns dados sobre a fauna entomologica dos Açores e a origem da sua fauna endemica. *Bol. Soc. ent. Port.* 3-4 (74): 9pp.

*BRINCK P. & SCHERER E.:

1961. On the Ephemeroptera of the Azores and Madeira. *Bol. Mus. Mun. Funchal* 14 (47): 55-62.

BRINKHURST R.:

- *1969. Aquatic Oligochaeta of the Azores and Madeira. *Bol. Mus. Mun. Funchal* 23 (106): 46-48.

BRINKHURST R. O. & JAMIESON B. G. M.:

1971. *Aquatic Oligochaeta of the World*. Oliver and Boyd, Edinburgh.

CAPELA R. A.:

- *1982. Contribuição para o conhecimento dos Mosquitos (Diptera, Culicidae) dos Arquipelagos da Madeira e das Selvagens. *Bol. Mus. Mun. Funchal* 34 (148): 106-123.

CARLSSON G.:

- *1963. Black flies (Diptera, Nematocera) from Madeira and the Azores. *Bol. Mus. Mun. Funchal* 17 (65): 85-94.

CHARPENTIER T. de:

1840. *Libellulinae Europaea. Descriptae ac depictae: Lipsaiae.*

*CHRISTOPHERS, S. R.:

1929. Note on a collection of anopheline and culicine mosquitoes from Madeira and the

Canary Islands. *Indian J. med. Res.* 17: 518-530.

CHVÁLA M. and WAGNER R.:

1989. Family Empididae, pp 228-335 in Catalogue of Palaearctic Diptera Vol. 6 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

CLASSEY E. W.:

- *1966a. The "Leste" and migration. *Bol. Mus. Mun. Funchal* 20 (92): 38.
1966b. Notes on a small collection of Neuroptera, Ephemeroptera and Trichoptera collected in Madeira in 1966. *Bol. Mus. Mun. Funchal* 20 (94): 46-47.

COOK, D. R.:

1974. Water mite genera and sub-genera. *Mem. Am. ent. Inst.* 21: 200-201.

CRANSTON P. & ARMITAGE P.:

1988. The Canary Islands Chironomidae described by Becker and by Santos Abreu. *Dt. ent. Z.* 35 (4-5): 341- 354.

CROSSKEY, R. W.:

- *1987. The blackflies of Madeira. *Entomologist's Gaz.* 38: 143-157.

CUPPEN J. G. M. & DETTNER K.:

- *1986. The larval instars of *Agabus maderensis* Woll & *A. wollastoni* Sharp, with a key to the larvae of Madeiran *Agabus* Leach (Coleoptera: Dytiscidae). *Ent. Scand.* 17: 351-358.

D'ORCHYMONT A.:

- *1938. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O Lundblad Juli-August 1935. IX Coleoptera: Dytiscidae. *Ark. Zool.* (B) 30 (11): 19pp. 4 figs.

DAHL C.:

1960. Dolichopodidae (Diptera, Brachycera) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 13 (39): 109-117.

EATON A. E.:

1871. A monograph on the Ephemeridae. *Trans. R. ent. Soc. Lond.*: 1-164.
*1873. On the Hydroptilidae, a family of Trichoptera. *Trans. R. ent. Soc. Lond.* part II: 125-150.
*1885. A revisional monograph of recent Ephemeridae or mayflies. *Trans. Linn. Soc. Lond. Ser. 2* 3: 153-203.
1904. New genera of European Psychodidae. *Entomologist's mon. Mag.* 15: 55-59.

EDWARDS F. W.:

- *1916. Eight new mosquitoes in the British Museum collection. *Bulletin of Entomological Research* 6 (4): 357-364

ENDERLEIN G.:

- *1929. Entomologia Canaria II. *Zoologischer Anzeiger*. 84 (9-10): 221-234.

ERBER D. & WHEATER C. P.:

- *1987. The Coleoptera of the Selvagem islands, including a catalogue of the specimens in the Museu Municipal do Funchal. *Bol. Mus. Mun. Funchal* 39 (193): 156-187.

ERBER D. & HINTERSEHER W.:

- *1988. Contribution to the knowledge of the Madeira beetles. *Bol. Mus. Mun. Funchal* 40 (202): 139-214.

EVE R.:

- 1968. Aquatic Coleoptera collected in Madeira in 1966 by E.W. Classey. *Bol. Mus. Mun. Funchal* 22 (101): p34.

FALKENSTROM G.:

- *1938. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad Juli-August 1935. X. Coleoptera: Palpicornia. *Ark. Zool. (A)* 30 (19): 5pp.

FREEMAN P.:

- *1959. Chironomidae (Diptera, Nematocera) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 12 (29): 5-15.

FREY R.:

- *1936. Die Dipterenfauna der Kanarischen Insel und ihre Probleme. *Comm. biol Soc. sci. fenn.* 6 (1): 1-237.
- *1939. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad Juli-August 1935. XIX Diptera Brachycera. *Ark. Zool. (A)* 31 (20): 18pp.
- 1945. Tiergeographische Studien über die Dipterenfauna der Azoren. *Comm. biol Soc. sci. fenn.* 8 (10): 1-118.
- *1949. Die Dipterenfauna der Insel Madeira. *Comm. biol Soc. sci. fenn.* 8 (16): 47pp.

GARDNER A. E.:

- *1955. A study of the genitalia of the two species *Sympetrum nigrescens* Lucas and *S. nigifemur* (Selys) with notes on their distribution. *Entomologist's Gaz.* 6: 86-108.
- *1960. Odonata from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 13 (41): 119-122.

GARDNER A. E. & CLASSEY E. W.:

1961. Report on the insects collected by the E. W. Classey and A. E. Gardner expedition to Madeira in December 1957. Part 2: The Coleoptera. *Proc. S. Lond. Ent. nat. Hist. Soc.* 149-159.
1963. Report on the Insects collected by E. W. Classey and A. E. Gardner expedition to Madeira in December 1957 (with special reference to the life history of *Sympetrum nigrifemur*). *Proc. S. Lond. Ent. Nat. Hist. Soc.*: 62-85.

HAGEN H.:

- *1859. Die Phryganiden Pictets. *Stettin ent Ztg* 20: 131-170.
- *1865a. Beträge zur Kenntniss der Phryganiden III Die Phryganiden Maderas. *Stettin ent Ztg* 26 (7-9): 217-233.
- *1865b. The Neuroptera of Madeira. Phryganidae. *Entomologist's mon. Mag.* 2: 75-81.

HENRY J. P. & MAGNIEZ J. H.:

- *1995. Nouvelles stations d'*Asellus aquaticus* (Crustacea, Isopoda, Asellidae) dans l'île de Madère. *Bull. scient. Bourgogne* 47: 27-30.

HENRY J. P., MAGNIEZ, G. STOCK J. H. & VERMEULEN J.:

- *1992. Les Asellidae (Crustacea, Isopoda, Aselloidea) de Madère et leur intérêt biogéographique. *Proc. Int. Symp. Biospeleology*: 5pp;

HIGLER L. W. G.:

1974. *Oxyethira fischeri* n. sp. A new *Oxyethira* species from Madeira (Trichoptera: Hydroptilidae). *Ent. Ber., Amsterdam* 34: 62-63.

HIRVENOJA M.:

1973. Revision der Gattung *Cricotopus* van der Wulp und ihrer Verwandten (Diptera, Chironomidae). *Annls Zool. fenn.* 10: 1-36.

HOBERLANDT L.:

- *1967. On some species of Heteroptera collected in the Madeiran islands. *Acta. entomol. Musei. Nationalis Pragae.* 12 (117): 43-50.

HUGHES S. J.:

- 1995a. A biological monitoring system for the freshwater resources of Madeira. Some preliminary results. *Bol. Mus. Mun. Funchal* Suppl 4: 325-351.
- *1995b. Notes on the freshwater Mollusca of Madeira including records of species new to the region. *Bol. Mus. Mun. Funchal* 47 (259): 23-37.

- *1997. Distribution of larval Trichoptera in the lotic habitats of Madeira. Proceedings of the 8th International Symposium on Trichoptera, Minneapolis, 1995: 167-175. Ohio Biological Survey.

ILLIGER C.:

1807. Fauna etrusca sistens insecta quae in provinciis Florentina et Pisana presertim collegit Petrus Rossius. Iterum edita et annotatis perpetuis aucts.

JÄCH M. A.:

1990. Revision of the Palaearctic species of the genus *Ochthebius* Leach V. The sub-genus *Asiobates* (Coleoptera: Hydraenidae). *Koleopt. Rundsch.* 60: 37-105.
1991. Revision of the Palaearctic species of the genus *Ochthebius* Leach VI. The *marinus* group (Hydraenidae, Coleoptera). *Entomologica Basiliensia* 14: 101-145,
1993. Revision of the Palaearctic species of the genus *Ochthebius*. XI. The subgenus *Calobius* Wollaston, 1854 (Insecta: Coleoptera: Hydraenidae). *Reichenbachia* 30 (7): 34-45.

JANSSON A.:

- *1940. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad. Coleoptera: Samtliche Familien unter Ausschluss der Familie der Carabidae, Dytiscidae, Hydrophilidae und der gattung *Cryptophagus* Herbst aus der Familie Cryptophagidae. *Ark. Zool.*(A) 32 (24): 1-64.
1986. The Corixidae (Heteroptera) of Europe and some adjacent regions. *Acta. ent. fenn.* 47: 1-94.

JONG H. de:

1987. Keys for the identification of the Tipuloidea (Insecta Diptera) recorded for the Canary Islands. *Eos* 63: 73 - 92.

KUIPER J.:

1966. Note on the *Pisidia* (*Pisidium* C.PF) of the Azores, the Canary Islands and Madeira. *Bol. Mus. Mun. Funchal* 20 (91): 34-37

LACKSCHEWITZ P.:

1936. New Species of *Tipula* from the Pyrenees and Madeira (Diptera, Tipuliidae). *Proc.R. ent. Soc Lond.* (B) 5 (6): 109-112.

LANSBURY I.:

1963. Notes on *Anisops debilis* Gerstaecker 1873 (Hem.-Heteroptera) and its closely related forms. *Entomologist's. mon. Mag.* 99: 97-108.

LEMERCIER A.:

1958. Sur l'existence d'un complex *Jaera nordmanni* (Rathke) (Isopoda: Asellota). *Cr. Acad. sci.* T.246: 3688-3690.

LINDBERG H.:

1936. Die Heteropteren der Kanarischen Inseln. *Comm. biol Soc. sci. fenn.* 6 (7): 43pp.
1941. Der Hemipteren der Azorischen Inseln. *Comm. biol Soc. sci. fenn.* 8 (8): 1-27.
- *1941. Zur Kenntnis der Hemipterenfauna von Madeira. *Comm. biol Soc. sci. fenn.* 8 (8): 28-31.
- *1953. Entomologische Ergebnisse der finnländischen Kanaren-Expedition 1947-51. No. 1 Hemiptera Insularum Canariensium. Systematik, Ökologie und Verbreitung der Kanarischen Heteropteren und Cicadinen. *Comm. biol Soc. sci. fenn.* 14 (1): 1-304.
- *1954. Zur Kenntnis der Hemipterenfauna der Azorischen Inseln. *Comm. biol Soc. sci. fenn.* 13 (18): 9pp
- *1960. Hemiptera from the Azores and Madeira. *Bol. Mus. Mun. Fun* 13 (33): 85-94.
- *1961. Hemiptera Insularum Maderensium. *Comm. biol Soc. sci. fenn.* 24 (1): 109pp.
- *1963. A contribution to the study of beetles in the Madeira Islands. Results of expeditions in 1957 & *1959. II Dytiscidae, Hydrophilidae, Silphidae, Liodidae, Clambidae, Scydmaenidae, Orthoperidae. *Comm. biol Soc. sci. fenn* 25 (2): 23-26.

LINDBERG K.:

1963. Cyclopides (Crustacés, Copepodes) des Açores. *Bol. Mus. Mun. Funchal* 15 (51): 5-19.

LUNDBLAD O.:

- *1941. Neue Wassermilben aus Madeira. *Ent tidskr.* 62: 93-96.
- *1942. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad. XXXI Hydrachnellae. *Ark. Zool.* (A) 34 (5): 121pp.
- *1949. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad. XXXIII Aquatile & semiaquatile Hemiptera. *Ark. Zool.*(A) 42 (16): 7pp.
- *1958. Die Kaferfauna der Insel Madeira. *Ark. Zool.* 11 (30): 461-524.
1961. Wassermilben von der Kanarischen Inseln. *Ark. Zool.* 15 (16): 285-298.

MALICKY H.:

1984. Vier neue mediterrane Kockerfliegen (Trichoptera). *Ent. Zeitschr.* 20: 297-301.
1987. *Hydroptila juba*, bona species. *Trichoptera Newsletter* 14: 30 Malmqvist B., Nilsson A.N., Baez M., Armitage P.D. & Blackburn J.H. .
- *1993. Stream macroinvertebrate communities in the island of Tenerife. *Arch. Hydrobiol*

128 (2): 209-235.

MALMQVIST B., NILSSON A. N. & BAEZ M.:

- *1995. Tenerife's freshwater macroinvertebrates: status and threats (Canary Islands, Spain). *Aquatic Cons.* 5: 23pp

MANNHEIMS B.:

- *1962a. *Tipula stenoptera* n. sp. von den Azoren (Dipt. Tipuliidae). *Notul. ent.* 62: 128-129.
- *1962b. Die Tipuliden Madeiras. *Notul. ent.* 62: 130-136.

MARCUS E. & MARCUS E.:

- 1959. Turbellaria from Madeira and the Azores. *Bol. Mus. Mun. Funchal* 12 (30): 15-42.

MARSHALL J.:

- 1979. A review of the genera of the Hydroptilidae (Trichoptera). *Bull. Br. Mus. nat. Hist. ent. Ser.* 39 (3): 240pp.

MATHIS W. M. & ZATWARNICKI T.:

- *1995. World catalogue of shore flies (Diptera: Ephydriidae). Volume 4.

MATTINGLY P. F.:

- *1955. Le sous-genre *Neoculex* (Diptera, Culicidae) dans le sous region Mediterraneane 1. Espèce, sous espèce et synonyme nouvelles. *Annls Parasit. hum. comp.* 30. 377-379.

McLACHLAN R.:

- *1874-80. A Monographic Revision & Synopsis of the Trichoptera of the European Fauna. E. W. Classey, London.
- *1882. The Neuroptera of Madeira and the Canary Islands. *Linn. Soc. J. Zool.* 16: 149-183.
- *1884. A Monographic Revision and Synopsis of the Trichoptera of the European fauna. 1st Additional Supplement. 76pp.

MEISCH C.:

- 1979. *Cypricerus alacer* n. sp. (Crustacea, Ostracoda) en provenance du Grand Duché de Luxembourg. *Archives de l'Institut Grand-Ducal de Luxembourg, section des Sc. nat., phys. et math.* 38: 191-196.

MEISCH C. & BROODBAKKER N.:

- 1993. Freshwater Ostracoda (Crustacea) collected by Prof. J. H. Stock on the Canary and Cape Verde islands. *Trav. scient. Mus. nat. Hist. nat. Luxemb.* 19: 45pp.

MEISCH C., MALMQVIST B. & NILSSON A. N.:

1995. Freshwater Ostracoda (Crustacea) collected in Tenerife, Canary Islands. *Mitt. hamb. zool. Mus. Inst.* 92: 281-293.

MINÀR J.:

1990. Family Culicidae, pp 74-112 in Catalogue of Palaearctic Diptera Vol. 2 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

MIRCEA-ALEXANDRU I.:

1978. Coleoptera. In Illies J. (Ed). *Limnofauna Europaea*: 291-314.

MORTON K. J.:

1893. Notes on the Hydroptilidae belonging to the European fauna, with descriptions of new species. *Trans. R. ent. Soc. Lond.* 26: 75-82.

MOSELY M. E.:

- *1938. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. Lundblad Juli-August 1935. VII Trichoptera. *Ark. Zool.* (A) 30 (14): 8pp.

MÜLLER-LIEBENAU I.:

1971. Ephemeroptera (Insecta) von den Kanarischen Inseln. *Gewäss. Abwäss.* 50/51: 7-40.

MÜLLER O. F.:

1774. *Vermium Terrestrium et Fluviatilium et Fluv.* II: 130

NAVAS R. P.:

1906. Catalogo descriptivo de los insectos neuropteros da las Islas Canarias. *Rev. Acad. Cienc. exactas fis. Nat.* 4 (6): 687-706 + 1pl.

NIELSEN B. O.:

- *1964. Psychodidae from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 28 (69): 103-109.

NIELSEN P.:

- *1961. Tipulidae from the Azores and Madeira. *Comm. biol Soc. sci. fenn.* 24 (2): 7pp.
1963. Nematocera Polyneura (Diptera) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 17 (64): 79-84.

NILSSON A. N., MALMQVIST B., BAEZ M., BLACKBURN J. H. & ARMITAGE P. D.:

- *1998. Stream insects and gastropods in the island of Gran Canaria (Spain). *Annls Limnol.*, 34 (4), 413-435.

NOBRE A.:

- *1931. Moluscos terrestres, fluviais e das águas do Arquipelago da Madeira. Instituto de Zoologia da Universidade do Porto. 203pp.

NOUALHIER M.:

- 1893. Voyage de M. Ch. Alluad aux iles Canaries. 2-me memoire. *Annls Soc. ent Fr., Paris* 62: 15-18.
- *1897. Hemiptères recueillis par M. A. Fauvel à Madère, en mai et juin 1896. *Revue Ent.* 16: 76-80.

NYBOM O.:

- *1948. The Trichoptera of the Atlantic Islands. *Comm. biol Soc. sci. fenn.* 8 (14), 1-19
- 1954. Entomological results of the Finnish expedition to the Canary Islands, 1947-1951. No. 9. Some additions to the trichopterous fauna of the Canary Islands. *Comm. biol Soc. sci. fenn.* 14 (9), 1-3.
- *1963. Further notes on the trichopterous fauna of Madeira. *Notul. ent.* 43: 114-117.
- *1965. Trichoptera from Madeira and the Azores. *Bol. Mus. Mun. Funchal* 29 (83): 88-94.

OOSTERBROEK P.:

- 1979. The western Palaearctic species of *Nephrotoma* Meigen, 1803. *Beaufortia* 28: 157-203.

OOSTERBROEK P. & THEOWALD BR.:

- 1992. Family Tipuliidae, pp 56-178 in Catalogue of Palaearctic Diptera Vol. 1 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

OSTEN-SACKEN C. R.:

- 1884. List of the Diptera of the Island of Madeira, so far as they are mentioned in entomological literature. *Entom. Mag. London.* 21: 32-34.

PAIVA C. de:

- *1867. Monographia molluscarum terrestium, fluvialium, lacustrim insularum Maderensium.

PECK L. V.:

- 1988. Family Syrphidae, pp 57-214 in Catalogue of Palaearctic Diptera Vol. 8 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

PETKOVSKI T. K.:

- 1963. Über Süßwasser-Ostracoden der Azoren. *Bol. Mus. Mun. Funchal* 17 (62): 49-65.

PETKOVSKI T. K., MEISCH C. & WOUTERS K.:

1993. Taxonomic revision of the freshwater Ostracoda species *Cypridopsis lusatica* Schafer, 1943 (Crustacea). *Trav. sci. Mus. nat. hist. nat. Lux.* 19:49-66.

PEUS F.:

1934. Über einige bisher nicht oder wenig bekannte *Dixa* Arten der Palaearktischen Region (Diptera: Nematocera). *Arb. morph. taxon. Ent. Berl.* 1 (3): 195-204.

PICTET F. J.:

- 1843-45. Insectes Neuropteres. Seconde Mon. Famille des Ephemerines Hist. nat. gen. part. 5: 248-251.

POISSON R.:

1948. Les Hémiptères aquatiques du Sahara Central. *Inst. Rech. Sahar. Univ. Alger* 1: 1-10.

PONT A. C.:

1986. Family Muscidae, pp 57-214 in Catalogue of Palaearctic Diptera Vol. 11 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

PUTON A.:

- *1889. Excursions hémipterologique à Tenerife et à Madère par Maurice Noualhier. *Revue ent.* 8: 293-310.

QUARTAU, J. A.:

- *1982. Reflexões sobre a zoogeografia dos Arquipelagos da Madeira e das Selvagens. *Bol. Mus. Mun. Funchal* 34 (10): 124-141.

RACOVITZA E. G.:

- 1919a. Notes sur l'Isopodes. -1 *Asellus aquaticus* auct. est une erreur taxonomique. 2 *A. aquaticus* L. et *A. meridionalis* n. sp. *Archs Zool. exp. gén.* 58: 31-43.

RAMBUR P.:

1842. Histoire des Insectes Néuroptères: 280pp.

RÉGIL CUETO J. A. & VALLADARES DIÉZ L. F.:

1983. Notas sobre dos adéfagos acuáticos de la isla de Madeira (Col. Dytiscidae). *Actas del I Congreso Iberico de Entomologia*: 657-665.

REMY P.:

- *1936. Un aselle nouveau de Madère. *Brotéria, Sér. Ciências naturais* 32 (1): 13-31.

REUTER O. M.:

- *1890. Notes sur quelques Hémiptères de Madère. *Revue Ent.* 9: 260-262.

RIBEIRO H., RAMOS H. C., CAPAELA R. A. & PIRES C. A.:

1984. Contribuição para o estudo da diversidade faunística da Madeira. *Bol. Soc. ent. Port.* 11/13 (43): 9pp.

RINGDAHL O.:

1960. Muscidae and Tachinidae (Diptera, Cyclorrhapha) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 13 (37): 98-100.

ROZKOŠNY R.:

1990. Family Dixidae, pp 66-71 in Catalogue of Palaearctic Diptera Vol. 2 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

SÆTHER O. A.:

- *1990. A review of the genus *Limnophyes* Eaton from the Holarctic and Afrotropical Regions. *Ent. Scand. Suppl.* 35: 1 - 139
- *1995. *Metriocmenus* van der Wulp: seven new species, revision of species and new records (Diptera: Chironomidae). *Annls Limnol.* 31 (1): 35-64.

SANFILIPPO N.:

1966. I Ditiscidi dell'Isola do Madera e notizie sulla fauna acquatica associata. *Boll. Soc. ent. ital.* 96 (3-4): 46-54.

SANTOS ABREU E.:

1918. Ensayo de una monografía de los tendipedidos da las Islas Canarias. *Mems. R. Acad. Cienc. Artes. Barcelona* 14 (2): 159-326.
1923. Monografía de los limonidos de las Islas Canarias. *Mems. R. Acad. Cienc. Artes Barcelona*, 18 (4): 35-164.
1924. Monografía de los syrphidos de las Islas Canarias. *Mems. R. Acad. Cienc. Artes Barcelona* 19 (1): 1-146.
1926. Monografía de los tipulidos da las Islas Canarias. *Mems. R. Acad. Cienc. Artes Barcelona*, 19 (12): 441-459.
1929. Monografía de los dolichopodidos de las Islas Canarias. *Mems R. Acad. Cienc. Artes Barcelona* 21 (17): 369-490.

SANTOS GRÁCIO A. J.:

- *1984. Os simulídeos (Diptera: Simuliidae) da Ilha da Madeira. *Bol. Soc. Port. Ciênc. nat.*

22: 77-80.

SATCHELL G. H.:

- *1955. The genus *Trichopsychoda* Tonnoir (Diptera, Psychodidae). *Proc. R. ent. Soc. Lond.* (B) 24 (3-4): 49-57.

SCHMID F.:

1957. Les genres *Stenophylax* Kol., *Micropterna* St. et *Mesophylax*, McL. (Trichopt. Limnoph). *Trab. Mus. Zool. Barcelona* 2 (2): 51pp.
1959. Le genre *Stactobia* McL. *Miscelánea Zoologia* 1 (2): 56pp

SCHODDUYN R.:

- *1926. Materiaux pour l'étude de la faune et la flore des eaux douces de Funchal (Madère). *Extrait des annales de Biologie Lacustre* 15: 217-218.

SCIACCHIATANO I.:

1961. Hirudinées des Açores et de Madère. *Bol. Mus. Mun. Funchal* 14 (42): 5-6.
1964. Oligochaeta des Açores (Part). *Bol. Mus. Mun. Funchal* 18 (72): 123-128.

SEGUY E.:

- *1921. Faune entomologique des Iles Canarias. Séjour de M.P. Lesne dans le Grande Canarie (1902-03) Psychodidae. *Bull. Mus. natn. Hist Nat.*, 4: 291-295.
- *1936. Voyages de MM L. Chopard et A Méquignon aux Açores (Aout-Septembre, 1930) X. Dipteres. *Annl. Soc. ent. Fr., Paris* 105: 11-26.

SELYS-LONGCHAMPS E. de:

1840. Mon. des Libellulidae d'Europe.

SELYS-LONGCHAMPS E. de & HAGEN H.:

1850. Revue des Odonates d'Europe. *Mem. Soc. r. Sci. Liège*. 6: 1-480.

SERRANO A. R. M.:

- *1987. Contribution à la connaissance des coléoptères de l'Archipel de Madère. Coleoptera Carabidae, Dytiscidae, Hydraenidae, Hydrophilidae et Staphilinidae. *Bol. Mus. Mun. Funchal* 39 (142): 141-155.

SHARP D.:

1882. On the aquatic carnivorous Coleoptera or Dytiscidae. *Scient. Trans. R. Dubl. Soc.* 2 (2): 179- 1003.

STAUDER A.:

- *1991. Water fauna of a Madeiran stream with some notes on the zoogeography of the Macaronesian islands. *Bol. Mus. Mun. Funchal* 43 (235): 243-299.

STAUDER A. & MEISCH C.:

- 1991. Freshwater Ostracoda (Crustacea) collected in a stream of the island of Madeira. *Bocagiana* 147: 9pp.

STEFFAN A.:

- 1963. A contribution to the study of beetles in the Madeira islands. Results of expeditions in 1957 & 1959 VIII. *Comm. biol Soc. sci. fenn* 25 (2) : 60-69.

STORÅ R.:

- 1941. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad Juli-August 1935. XXX. Diptera Nematocera: Thaumaleidae, Ceroplatidae, Mycetophilidae, Dixidae und Culicidae. *Ark. Zool.* (B) 33 (6): 6pp.

SVENSSON B.:

- *1970. Dryopidae (Coleoptera) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 25 (108): 44-48.
- *1973. Report N° 63 from the Lund University Expedition in 1957 to the Azores and Madeira. Palpicornia (Coleoptera) from the Azores. *Bol. Mus. Mun. Funchal* 27 (123): 90-93.
- *1977. Dytiscidae and Gyrinidae (Coleoptera) from the Azores and Madeira. *Bol. Mus. Mun. Funchal* 31 (137): 87-99.

TAMANINI L.:

- *1947. Contributo ad una revisione del genere *Velia* Latr. e descrizione di alcune specie nuove. *Memorie Soc. ent. ital.* 26: 17-73.
- *1954. Risultati entomologici della speciazione finlandese all Canarie. No. 5. *Velia lindbergi* n.sp. e *V. maderensis* Noualhier (Hem. Het. Veliidae). *Comm. biol Soc. sci. fenn.* 14 (5): 1-7.

THEOWALD B.:

- *1977. Die Tipuliden von Makaronesian (Insecta, Diptera, Tipulidae). Ein Systematischer und zoogeogrhischer Beitrag zur Kenntnis von Inselfaunen. *Beaufortia* 26 (335): 153-204.
- 1972. Die Tipuliden der Kanarischen Inseln (Diptera, Tipulidae). *Bull Zool. Mus. Univ. van Amsterdam* 2 (13): 135-146.
- 1981. Neues über Limoniiden und Tipuliden von Makaronesien (Insecta: Diptera). *Bull.*

zool. Mus. Univ. van Amsterdam 8 (6): 45-49.

UYTTENBOOGAART, D.:

1935. Report on Canarian Coleoptera collected by R. Frey & R. Storå in 1931 for the Museum Zoologicum Universitatis Helsingfors. *Comm. biol Soc. sci. fenn.* 6 (2): 17pp.
- *1947. Coleoptera (excl. Staphylinidae et Hydrophilidae) von den Azoren und Madeira. *Comm. biol Soc. sci. fenn.* 8 (12): 1-15.

VAILLANT, F.:

- *1963. A new thaumaleid (Diptera) from Madeira. *Bol. Mus. Mun. Funchal* 17 (60): 25-29.
1964. On some empidid flies of the Azores and Madeira. *Bol. Mus. Mun. Funchal* 18 (57): 61-67.

VALLE K. J.:

1940. Odonaten von den Azoren und Madeira. *Comm. biol Soc. sci. fenn.* 8 (5):1-7.

VEUILLE M.:

1977. Systematique et affinités continentales des *Jaera* (Isopodes, Asellotes) de l'Ile de Flores (Açores). *Bull. Mus. natn. Hist. nat., Paris* , 3 ser: 1334
1979. L'évolution du genre *Jaera* Leach (Isopodes, Asellotes) et ses rapports avec l'histoire de la méditerranée. *Bidj. Dierkunde* 49 (2): 206

VIEIRA R.:

1954. Lista de trabalhos sobre insectos do Arquipélago da Madeira. *Bol. Mus. Mun. Funchal* 7 (19): 63-77.

VIETS K.:

1956. Die Milben des Süßwassers und des Meeres. 870pp.

WAGNER R.:

1990. Family Psychodidae, pp 11-65 in Catalogue of Palaearctic Diptera Vol. 2 (A. Soós and L. Papp Eds.). Elsevier, Amsterdam.

WAGNER R. & BAEZ M.:

1987. Redescription and additional notes on *Dixa tetrica* Peus. *Vieraea* 17: 189-191.

WOLLASTON T. V.:

- *1854. *Insecta Maderensia*. London. 634 pp.
- *1857. Catalogue of the coleopterous insects of Madeira in the British Museum. Taylor &

Francis, London: 648pp.

- *1858. Brief diagnostic characters of undescribed aquatic insects. *Ann. Mag. nat. Hist.* 3 (1): 114-115.
- *1861. On additions to the Madeiran Coleoptera. *Ann. Mag. Nat. Hist. 3rd Ser.* 8 (10): 358-365.
- *1865. Coleoptera Atlantidum, Being an Enumeration of the Coleopterous Insects of the Madeiras, Salvages, and Canaries. J. van Voorst, London. 526 + 140pp.
- *1871. On additions to the Atlantic Coleoptera. *Trans. R. Ent. Soc. Lond.* 203-314
- *1878. Testacea Atlantica or the Land and Freshwater Snails of Madeira. 588pp.