# SURVEY OF THE MADEIRAN LIMNOLOGICAL FAUNA AND THEIR ZOOGEOGRAPHICAL DISTRIBUTION

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With 2 tables

*ABSTRACT.* The water of Madeiran streams show a poor ion and nutrient content due to the geological formation. The community composition is very poor as it is expected for an island. Some groups of the waterfauna like Gammaridae and Plecoptera are completely missing. At present, the entire freshwater fauna of Madeira is composed of 60 endemic, 18 macaronesic and 60 species, which are more widely distributed. The non-endemic species show a predominantly European and Mediterranean influence.

## INTRODUCTION

In the summer of 1988 and the spring of 1989 macrozoobenthos samples were taken and chemical and microbiological analyses were carried out at 5 sampling sites on the Ribeira das Cales, a small stream situated above Funchal. The origin of this stream lies below the Pico do Areeiro, it passes near Monte and reaches the sea at Funchal. With a total length of 9 km and a difference of 1500 m in altitude, the stream has a very steep slope, which is common for Madeiran streams. Extensive literature studies were carried out to show the actual distribution of the species.

## RESULTS

Characterization of the community

The animals mentioned in the following short characterization of the community composition are listed up systematically as well as their distribution range in table 1.

The most abundant species in the Ribeira das Cales at all sampling sites was *Baetis rhodani* PICT. together with larvae of Simuliidae. This species was also well represented in the other streams of the island but in the northern region it was not as dominant among the

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 ISSN 0870-3876

community. Another Ephemeroptera *B. pseudorhodani* M.-L. was rarely observed and occured never at higher regions (above 700m a.s.l.) and never at the sampling sites which fell dry. *B. pseudorhodani* seems to be more sensible than the very adaptable *Baetis rhodani*. The third species *Cloeon dipterum* L. was found in small pools and ponds with a lot of vegetation near the streambed. This species occured only in man-made or influenced habitats and never in streams in the north. This is an indication that Cloen dipterum was introduced only recently.

The most common Trichoptera was *Hydropsyche maderensis* HAG., which occured at every sampling site and it was also very common in other streams. The family Hydroptilidae is represented by 3 genus on Madeira and they were all present at the Ribeira das Cales. Only the male adults of this group can be determined without doubts, but not the larvae. The larvae of Hydroptila were sometimes quite abundant, whereas the larvae of Stactobia was only present at splashwater zones near water falls in association with ancylus, a mollusc, and larvae of Thaumaleidae, a Diptera. The third genus Oxyethira is represented by one species *Oxyethira spinosella* MCL., which is very seldom. It was only found twice. Also very rare was *Limnephilus nybomi* MAL., which was found only once. Besides at all sites occured *Polycentropus flavostictus* HAG. and larvae of the genus Tinodes but not as frequent as the larvae of *Hydropsyche maderensis*.

Two endemic species *Synagapetus punctatus* HAG. and *Mesophylax oblitus* HAG. did not occur in the Ribeira das Cales. Both species were found only in streams on the northern side of the island, where the climate is more humid and a lot of pristine laural vegetation is still existing.

The dragonflies are represented by five species. In the Ribeira das Cales just the larvae of *Sympetrum nigrifemur* (SELYS) were occuring. *S. fonscolombei* (SELYS) and *Anax imperator* LEACH could be captured only as adults so that it is not sure if these two species are breeding in the Ribeira das Cales or just flying up and down there. GARDNER & CLASSEY (1963) mentioned two further species from the genus Ischnura.

The larvae of the family Chironomidae have never been studied on Madeira, only the adults have been found but a revision of this group is urgently necessary. Interesting were the extended colonies from the larvae of Rheotanytarsus sp., which were found for the first time on Madeira.

From the family Culicidae six species are known and three of them were present at the Ribeira das Cales. *Culex hortensis maderensis* MATT., an endemic species was in the 1930's the most common and widely distributed Culicidae species on Madeira, but nowadays it seems that *Culiseta longiareolata* (MAQ.), an ehtiopian element, is the most widely distributed Culicidae (CAPELA,1981).

The occuring species of Dixidae is not, as often mentioned, *Dixa tetrica*. It is a new species and the determinations are still in course. From the family Thaumaleidae, *Thaumalea brincki* VAILL. is occuring on Madeira and not *Thaumalea subafricana*, which is occuring

only on the Canary Islands.

Very abundant at each sampling site in the Ribeira das Cales and also at the other waterbodies of the island were the larvae and puppae of the Simuliidae. Following the key of CROSSKEY (1987) only the two species *Simulium petricolum* (RIVOS.) and *Simulium intermedium* ROUB. are present on Madeira, but two additional species did not run through the key. So maybe more species are present.

From the group of the Hydracarina twenty-five species are recorded from Madeira (LUNDBLAD, 1942). Five of the species are present at the Ribeira das Cales and each of them showed a significant distribution patterns in altitude and significant seasonal changes (STAUDER, 1991).

The group of the Copepodae is represented by *Eucyclops serrulatus* (FISCH.), which is one of the most adaptable and widely distributed species of Cyclopidae. It was recorded for the first time from Madeira. The same is valid for the three observed species of Ostracoda. Nearly all of the collected Oligochaeta have a cosmopolitan distribution and the occuring Hirudinea, *Dina lineata* (O.F.MÜLL.), is also wider distributed. In the group of the Molluscs, the species show a European and Mediterranean distribution, only *Gyraulus parvus* (O.F.MÜLL.) is also an element of the Northamerican fauna. It was brought to the Mediterranean region in the 1940's and since 1970 it occurs in Central Europe and it is also present in the Ribeira das Cales. The amphibes and fishes were all introduced to Madeira in this century.

In total there were 50 species present at the Ribeira das Cales, 17 of them are endemic and the others are wider distributed. At present the entire freshwater fauna of Madeira is composed of 60 endemic species. It is clear that not all 60 endemic species are occuring in running waters, but it shows clearly the human influence on the Ribeira das Cales. From the pristine laural vegetation, nearly nothing is left at the southern side. The great parts are reaforrested with eucalyptus or pines and sometimes after a fire the hills are without vegetation, so erosion is a grave problem. This circumstances do have an influence of course to the freshwater fauna. The streams examined in the northern part of the island showed a significant different community composition of benthic macroinvertebrates.

Distribution patterns

Table 2 shows the number of species which are endemic, macaronesian or widely distributed in absolute numbers and percentages for selected groups.

The number of indigenous species of Coleoptera and Hydracarina is noticeably high, although these animals are not necessarily restricted to a narrow distribution range. This indicates an early invasion, which probably occured under more favorable geological and climatic conditions. Due to a long isolation period and the resulting lack of genetic exchange endemic species could develop.

Other largely endemic species belong to the groups of Trichoptera, Empididae, Thaumaleidae, Limoniidae and Tipuliidae. These are very conservative insects with a small home range, however, they may be drifted by winds.

Dragonflies and blackflies show a wide distribution pattern. Both are very active insects and especially the dragonflies are able to fly long distances.

The Ephemeroptera show a perplexing distribution pattern, since none of them are endemic. They are like Tricoptera very conservative insects, so that one would expect a high percentage of indigenous species. Thus recent introduction by humans cannot be excluded. We may draw from the example of *Cloeon dipterum* which is an palaearctic species and among the best investigated Ephemeroptera. In the 19th century it was not found by two water investigators on the Azores, whereas Brinck and Scherer, two other investigators of freshwater found it very often in the middle of this century (BRINCK & SCHERER, 1957). Of course we cannot fix the arrival of this species on the island but the facts are indicating a recent introduction. Furthermore Cloeon dipterum occurs only in habitats, which were created or heavily influenced by human action.

Several other groups could likewise have been introduced by humans. Copepoda, Ostracoda, Oligochaeta, Hirudinea and Molluscs are all widely distributed and some of them are even cosmopolitans. In the 19th century two species of trouts were introduced as well as water plants. Together with the plants and trouts other animals could have been released into the streams. Copepoda, Ostracoda, Oligochaeta, Hirudinea and Mollusca have all very good possibilities for dispersal through passive transport. They can support low dissolved oxygen concentrations and some of them have permanent stages to pass unfavourable conditions.

All these facts are indicating that these groups have been introduced to Madeira only recently by human action.

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**TABLE 1** - List of animals and their distribution

| | Azores | Madeira | Canaries | Distribution |
|---|---|---|---|---|
| **Ephemeroptera** | | | | |
| Baetidae | | | | |
| *Baetis rhodani* PICT. | | x | | palaearctic |
| *B. pseudorhodani* M.-L.* | | x | x | macaronesic |
| *Cloeon dipterum* L. | x | x | x | holarctic |
| **Trichoptera** | | | | |
| Hydropsychidae | | | | |
| *Hydropsyche maderensis* HAG. | | x | x | macaronesic |
| Hydroptilidae | | | | |
| *Hydroptila juba* END. | | x | x | Iber. Peninsula, Tunisia |
| *H. fortunata* MORTON | x | x | | macaronesic |
| *H. vectis* CURTIS | x | x | | Europe, N-africa |
| *Stactobia atra* HAG. | | x | | endemic |
| *S. nybomi* SCHMID | | x | | endemic |
| *Oxyethira spinosella* MCL. | | x | x | macaronesic |
| Limnephilidae | | | | |
| *Limnephilus nybomi* MAL. | | x | | endemic |
| *Mesophylax oblitus* HAG. | | x | | endemic |
| Polycentropidae | | | | |
| *Polycentropus flavostictus* HAG. | | x | | endemic |
| Psymyidae | | | | |
| *Tinodes cinerea* HAG. | | x | | endemic |
| *T. grisea* HAG. | | x | | endemic |
| *T. merula* MCL. | | x | | endemic |
| Glossomatidae | | | | |
| *Synagapetus punctatus* HAG. | | x | | endemic |
| **Odonata** | | | | |
| Coenagrionidae | | | | |
| *Ischnura pumilio* (CHARP.) | x | x | | N-Africa, Middle East |
| *I. senegalensis* (RAMB.) | x | x | x | N-Africa |
| Libellulidae | | | | |
| *Sympetrum fonscolombei* (SELYS) | x | x | x | Medit., Middle East |
| *S. nigrifemur* (SELYS) | x | x | x | macaronesic |
| Aeschnidae | | | | |
| *Anax imperator* LEACH | x | x | x | Europe, Mid.-East, S-Afr. |
| **Diptera** | | | | |
| Chironomidae | | | | |
| *Rheotanytarsus sp.* | | | | |

| (**TABELA 1** - cont.) | Azores | Madeira | Canaries | Distribution |
|---|---|---|---|---|
| Culicidae | | | | |
| *Aedes eatoni* EDW. | | x | x | *macaronesic* |
| *Culiseta longiareolata* (MAQ.) | | x | ? | ethiopic |
| *Culex hortensis maderensis* MATT. | | x | | endemic |
| *C. molestus* FORSK. | ? | x | ? | palaearctic |
| *C. pipiens* L. | ? | x | ? | palaearctic |
| *C. theileri* THEOB. | x | x | ? | ethiopic, Med., East |
| Dixidae | | | | |
| *Dixa nov. sp.* | | | | |
| Thaumaleidae | | | | |
| *Thaumalea brincki* VAILL. | | x | | endemic |
| Simuliidae | | | | |
| *Simulium petricolum* (RIVOS.) | | x | | SW-palaearctic |
| *Simulium intermedium* ROUB. | | x | x | W- palaearctic |
| Spec. I/specII | | | | |
| **Hydracarina** | | | | |
| Aturidae | | | | |
| *Aturus atlantis* KRAM. | | x | x | macaronesic |
| Hygrobatidae | | | | |
| *A. rutae* (LDBL.) | | x | | endemic |
| *A. maderensis* (LDBL.) | | x | | endemic |
| Lebertiidae | | | | |
| *Lebertia madericola* LDBL. | | x | | endemic |
| Sperchonidae | | | | |
| *Sperchon brevirostris* KOEN. | x | x | | palaearctic |
| Torrenticolidae | | | | |
| *Torrenticola mandibularis* (LDBL.) | | x | | endemic |
| *T. insulicola* (LDBL.) | | x | | endemic |
| *T. rotundos* (LDBL.) | | x | | endemic |
| *T. nesiotis* (LDBL.) | | x | | endemic |
| *T. crassirostris* (LDBL.) | | x | | endemic |
| *T. elliptiformis* (LDBL.) | | x | | endemic |
| *T. crassus* (LDBL. | | x | | endemic |
| **Copepoda** | | | | |
| *Eucyclops serrulatus* (FISCH.)* | x | x | ? | holarctic |
| **Ostracoda** | | | | |
| Cyprididae | | | | |
| Cypricercinae | | | | |
| *Strandesia obliqua* SARS* | x | x | ? | Europe, Asia, N-Africa |
| Cypridopsinae | | | | |
| *Cypridopsis brincki* PETK.* | x | x | ? | Spain, Port., Mazedonia |

| (**TABELA 1** - cont.) | Azores | Madeira | Canaries | Distribution |
|---|---|---|---|---|
| *Potamocypris pallida* ALM.* | | x | ? | Europe |
| **Oligochaeta** | | | | |
| Lumbricidae | | | | |
| *Eiseniella tetraedra* (SAV.) | x | x | x | cosmopolitan |
| Lumbriculidae | | | | |
| *Lumbriculus variegatus* (MÜLL.)* | x | x | ? | cosmopolitan |
| Naididae | | | | |
| *Nais communis P./N. variabilis* P.? | x | x | ? | cosmopolitan |
| *N. elinguis M[ü]LL.** | x | x | ? | cosmopolitan |
| *Slavina appendiculata* (OD.)* | | x | ? | Europe |
| **Hirudinea** | | | | |
| Erpobdellidae | | | | |
| *Dina lineata* (O.F.MÜLL.) | x | x | ? | Europe, Middle-E, N-Afr. |
| **Mollusca** | | | | |
| Ancylidae | | | | |
| *Ancylus fluviatilis* O.F.MÜLL. | x | x | x | Europe, Mediterranean |
| Hydrobiidae | | | | |
| *Pseudamnicola similis* DRAP. | | ? | | |
| sp.?* | | | | |
| Lymnaeidae | | | | |
| *Galba truncata* (SAY) | x | x | x | Europe, Mediterranean |
| Planorbidae | | | | |
| *Gyraulus parvus* (O.F.MÜLL.)* | ? | x | ? | Europe, N-America |
| Physidae | | | | |
| *Physa acuta* DRAP. | ? | x | ? | Europe |
| **Amphibia** | | | | |
| Hylidae | | | | |
| *Hyla meridionalis* BOETT. | | x | x | Europe, N-Africa |
| Ranidae | | | | |
| *Rana perezi* SEOAN. | x | x | x | mediterranean |
| *R. temporaria* L. | | x | | Europe |
| **Pisces** | | | | |
| Salmonidae | | | | |
| *Salmo gaidneri* (RICH.) | ? | x | ? | cosmopolitan |
| *S. trutta fario* (L.) | ? | x | ? | cosmopolitan |

macaronesic: Found on Azores, Madeira and/ or Canaries
*: species new report for Madeira
?: Occurrence doubtful or insufficiently investigated for Madeira

**TABLE 2**

Distribution patterns of different groups in absolute numbers and percentage in numbers

| | Total number of species | endemic species | | macaronesic species | | widely distributed species | |
|---|---|---|---|---|---|---|---|
| | | # | % | # | % | # | % |
| Hydracarina | 25 | 21 | 84 | 3 | 12 | 1 | 4 |
| Coleoptera | 22 | 14 | 63.6 | 1 | 4.6 | 7 | 31.8 |
| Trichoptera | 14 | 9 | 64.3 | 3 | 21.4 | 2 | 14.3 |
| Empedidae | 3 | 3 | 100 | - | - | - | - |
| Limoniidae | 13 | 5 | 38.5 | 5 | 38.5 | 3 | 23 |
| Thaumaleidae | 1 | 1 | 100 | - | - | - | - |
| Tipulidae | 4 | 3 | 75 | - | - | 1 | 25 |
| Odonata | 5 | - | - | 1 | 20 | 4 | 80 |
| Simuliidae | 2 | - | - | - | - | 2 | 100 |
| Ephemeroptera | 3 | - | - | 1 | 33.3 | 2 | 66.6 |
| Culicidae | 6 | 1 | 16.6 | 1 | 16.6 | 4 | 66.6 |
| Isopoda | 2 | 1 | 50 | 1 | 50 | - | - |
| Copopoda | 1 | - | - | - | - | 1 | 100 |
| Ostracoda | 3 | - | - | - | - | 3 | 100 |
| Oligochaeta | 5 | - | - | - | - | 5 | 100 |
| Hirudinea | 1 | - | - | - | - | 1 | 100 |
| Mollusca | 3 | - | - | - | - | 3 | 100 |