

## LAND AMPHIPODS FROM THE AZORES AND MADEIRA<sup>1</sup>

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With 3 figures

The present report deals with the terrestrial talitrid amphipods (= Talitridae, sensu Bulycheva 1957). Land amphipods turned out to be a very important element in the soil fauna, especially in the Azores, and our collections from 1957 are extensive. In all 6 species of terrestrial talitrids were found. They will be dealt with individually below. The general discussion treats the composition and distribution of the land fauna of the Macaronesian Islands and attempts to analyze the far-reaching changes which have apparently taken place in recent time.

### LIST OF SPECIES

#### *Orchestia gammarellus* (Pallas)

Azores, São Miguel (fig. 1a): Vila Franca do Campo, among boulders on upper beach, 2 spp., 28.II. (Loc. 2).—São Populo, 7.5 km. E of Ponta Delgada, rocky beach, 10 spp., 4.III. (Loc. 10).—Fonte da Rocha, near Relva, 4.5 km. W of P. Delgada, around spring among rocks, 14 spp., (incl. ♀ ov.), 5. III. (Loc. 11).—Valley of Ribeira Quente, 2 km. SE of Furnas, on the beach, 9 spp., 11 III. (Loc. 23).—Ribeira da Praia, 3 km. W of Vila Franca do Campo, below the bridge, under stones, 6 spp. (incl. ♀ ov.), 13. III. (Loc. 27).—Relva, Nascente dos Lagos, under stone, near the spring, 16 spp., (incl. ♀ ov.), 15. III. (Loc. 32).—Ribeira das Três Voltas, near Ribeira Chã, under stone on sandy clay, 9 spp., (incl. ♀ ov.), 23. III., 5 spp., 16. III. (Loc. 35).—Ribeira Seca, W of Ribeira Grande, below drift mate-

1) Report No. 50 from the Lund University Expedition in 1957 to the Azores and Madeira.

2) Zoological Institute of the University of Lund, Sweden.

rial on beach with sandy grassy ground, 3 spp., 18.III. (Loc. 37).—1 km. W Ribeira Seca, W of Ribeira Grande, under stones, on sandy grassy ground, 89 spp., (incl. ♀ ov.), 22.III. (Loc. 53).—1 km. N of Povoação, Ribeira dos Lagos, 8 spp., (incl. ♀ ov.), 24.III. (Loc. 60).—3 km. E of Ri-

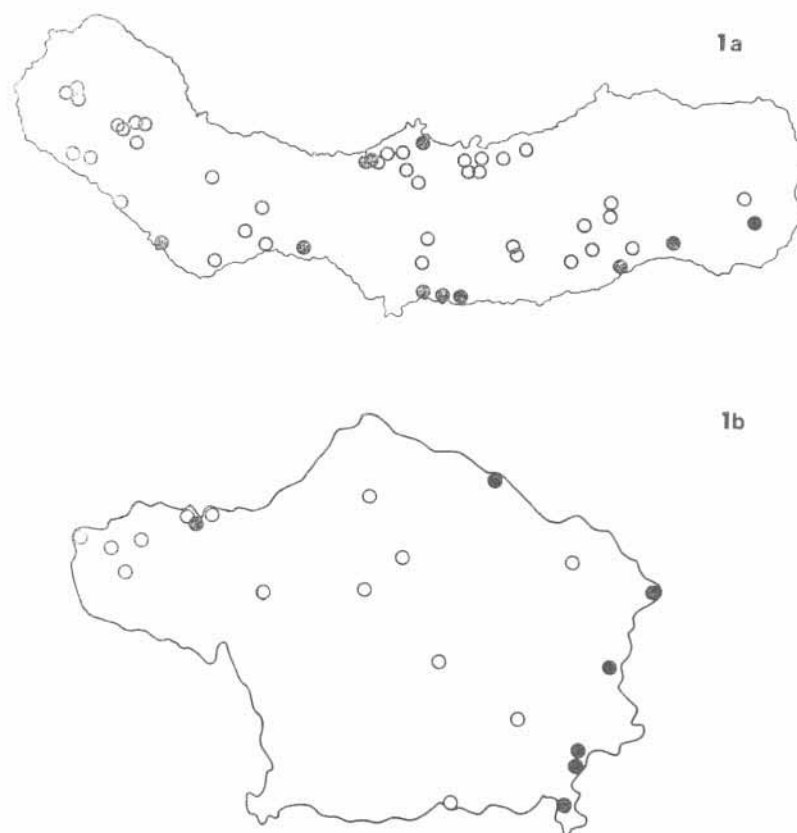


Fig. 1. — Investigated localities and findings of *Orchestia gammarellus* (filled circles) in a. São Miguel, b. Faial.

beirinha (N coast), under stones and decaying plants in the ravine, 15 spp., 25.III. (Loc. 63).—Nascente dos Lagos, Relva, at the spring, 36 spp., 15.III. (Loc. 32).—2.5 km. E of Ribeirinha, under stone in a ravine, 2 spp., (incl. ♀ ov.) 25.III. (Loc. 63).

Azores, Terceira: Freshwater lagoon N of Praia da Vitória, under

stones, partly in the water, 15 spp., 27. III. (Loc. 68) — 0,5 km. S of Praia da Vitória, under stone at the dune-edge, 1 sp., 27. III. (Loc. 69). — 0.5 km. E of Angra do Heroísmo, in a stream-ravine under stone, 10 spp., (incl. ♀ ov.), 28. III. (Loc. 70).

Azores, Faial (fig. 1 b): Horta, Ribeira dos Flamengos, under stone, 3 spp., 31. III., (Loc. 71). — Praia do Almocharife, under stone on sandy grassy ground, 28 spp., (incl. ♀ ov.), 31. III., on the slope, under stone, near the shore, 6 spp., 1. IV. (Loc. 72). — Porto da Boca da Ribeira 1 km. E of Ribeirinha, under stone in a ruined house and under plant debris in a stream-ravine, 20 spp., 1. IV. (Loc. 74). — Porto do Salão, under stone on the shore and on rocky hillside, 13 spp., 1. IV. (Loc. 75). — Baía da Areia das Fontes 1 km. N of Praia do Norte, under stone on a shore-meadow, 29 spp., (incl. ♀ ov.), 2. IV. (Loc. 77). — Horta, coast. Poço No. 2., under stones near a well, 1 sp., 2. IV. (Loc. 82). — Horta, Porto Pim, under stones on rocky shore and volcanic sand beach, 33 spp., (incl. ♀ ov.), 7. IV. (Loc. 94). — At mouth of Rib. do Faial, Poço de Mar, estuary of Ribeira do Faial, 1 sp., 26. IV. (Loc. 129).

Azores, Pico; 1 km. S of Areia Larga, under stones, 9 spp., 11. IV. (Loc. 107).

Azores, Flores: Ribeira d'Além da Fazenda, rocky hill-side under stones on dry grassy ground, 2 spp., 14. IV. (Loc. 108).

Madeira: Funchal, W part of Funchal, under stones below the cliff near the shore, 16 spp., (incl. ♀ ov.), 19. IV. (Loc. 111).

*O. gammarellus* is widely distributed along the west coast of Europe from central Norway and the Baltic southwards to the Mediterranean, where it has been recorded both from the European and African coast and penetrates as far eastwards as the Black Sea. It has previously been recorded from the Azores, Madeira and the Canary Islands.

*O. gammarellus* throughout its range never occurs far away from the sea. In the northern part it is a typically supralittoral species living among the decaying seaweed and under stones near the edge of the sea. Further south, although never occurring far from the sea, it is not confined to the immediate vicinity of the coast, and in the Azores it was frequently found under stones, plant debris and in the ground vegetation along small fresh water streams up to a kilometre or more inland. The species also often occurred abundantly around springs in the cliffs up to an altitude of about 200 meters above sea level.

*Orchestia platensis* Kröyer

Azores, São Miguel: Vila Franca do Campo, stony beach, 2 spp., (incl. ♀ ov.) 28. II. (Loc. 2). — São Roque de Pópulo, on shore, 2 spp., 1. III. (Loc. 3). — 2.5 km. E of Ribeirinha, under stones in a ravine, 4 spp., 25. III. (Loc. 63).

Azores, Santa Maria: Praia, under stone, 1 sp., 20. III. (Loc. 47) — Valverde, among decaying plants (*Tradescantia*) on soft and wet ground near a stream, 13 spp., 20. III. (Loc. 49).

Azores, Pico: Praia da Areia Larga, on sandy beach, 13 spp., 9. IV. (Loc. 104).

Azores, Flores: Ribeira d'Além da Fazenda, under stones on shore of estuary of a small stream, 3 spp., 14. IV. (Loc. 108).

Madeira: Faial, at mouth of Rib. do Faial, under stone, 1 sp., 21. IV. (Loc. 116).

*O. platensis* is a wide-spread species, probably accidentally introduced in many places. In the northernmost part of its range, in Scandinavia and on the Atlantic seaboard of Northern North-America, it is a purely supralittoral species, confined to the same types of localities as *O. gammarellus*, i. e. under the decaying seaweed, stones etc. just above the water's edge or in the upper part of the tidal zone. Like *O. gammarellus* in areas with a less exacting winter climate it is much less dependent upon the vicinity of the sea, and although it will often be found in or just above the tidal zone, it also occurs comparatively far inland, especially along streams.

*Orchestia chevreuxi* De Guerne

Azores, São Miguel (fig. 2 a): Fonte da Rocha near Relva, 4.5 km. W of P. Delgada, among rocks near a spring, 1 sp., 5. III. (Loc. 11). — Fonte Grande SE Feteiras, at spring under a crag, 3 spp., 6. III. (Loc. 12). — Fonte Casas Telhadas, SW of Rib. Grande, sandy grassy ground, under stone, 1 sp., 18. III. (Loc. 36).

Azores, Santa Maria: 2 km. ENE Almagreira, alt. 440 m. Miradouro dos Picos, under stone, 1 sp., 19. III. (Loc. 39). — Pico Alto, alt. 590 m., under stone on the summit, 5 spp., 19. III. (Loc. 40). — Pico Alto, alt. 550 m., under stone near the summit, 6 spp., (incl. ♀ ov.), 19. III. (Loc. 42). — Águas dos Moros SE of Pico Alto, under stone, 4 spp., 19. III. (Loc. 43).

Azores, Faial (fig. 2 b): Horta, Ribeira dos Flamengos, under stone in the ravine, 10 spp., (incl. ♀ with hatched juv.) 31. III. (Loc. 71). — 0.5

km. WNW of Ribeirinha, under plant debris in ravine, 16 spp., (incl. ♀ ov.), 1. IV. (Loc. 73). — Porto da Boca da Ribeira, 1 km. E of Ribeirinha, under stone 2 spp., 1. IV. (Loc. 74) — Ribeira das Cabras, 1 km. NE of Praia do Norte, under stone, 12 spp., 2. IV. (Loc. 76). — Zona do Mistério, 2 km. W of Praia do Norte, in detritus in a wood, 4 spp., 2. IV. (Loc.

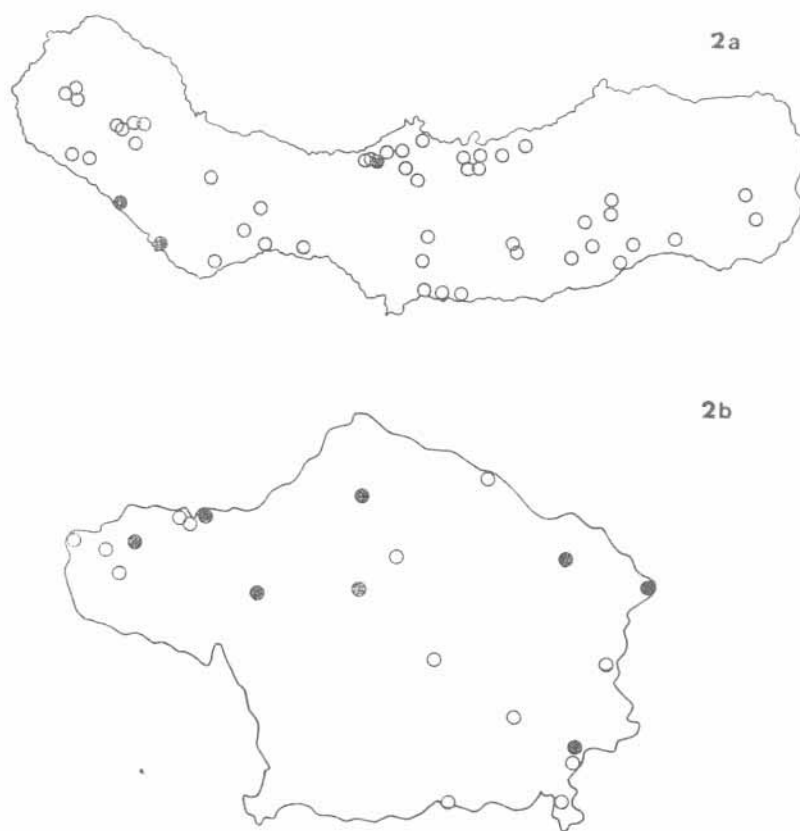


Fig. 2. — Investigated localities and findings of *Orchestia chevreuxi* (filled circles) in a. São Miguel, b. Faial.

80). — Pool 1 km. ESE of Cabeço do Fogo, in *Erica*-scrub, under livermoss, 16 spp., 4. IV. (Loc. 90). — Nasce Água 3 km. S of Cedros, under stone, on a damp meadow near a stream, 8 spp., 5. IV. (Loc. 93). — Caldeira, under stone, 1 sp., 10. IV. (Loc. 105).

Azores, Pico: Volc. Pico, W side, Furna de Frei Mathias, cave-en-

trance, 1 sp., 8.IV. (Loc. 98).—1 km. NNW of Lajes, near fresh water pool, 1 sp., 9.IV. (Loc. 102).

*O. chevreuxi* is a truly terrestrial species. Unlike the two previous species it does not occur in the littoral or supralittoral zone. The species is endemic in the Azores and Canary Island groups.

Although the collection of *O. chevreuxi* contains a fairly large number of specimens and efforts were made to obtain as many large and therefore presumably sexually mature ones as possible, only a few ovigerous females and no male of fully adult type are present in our material. Consequently no male of the fully adult type described by Chevreux (1900) and by Andersson (1963) from the Canary Islands, has ever been found in the Azores. Nevertheless the descriptions of various stages of both sexes recently published by Andersson (l. c.) permitted a definite identification of the species. (cf. also Chevreux 1888). The age composition of our collection from the period March 5th to April 10th 1957 may indicate that few adults survive the winter. In both species previously dealt with adult specimens of both sexes were found to be numerous in the localities investigated in the Azores as is also the case in winter samples from Scandinavia. Another possible alternative is that sexual maturity in male *O. chevreuxi* is attained at an earlier stage of somatic development in the Azores than in the Canaries. The question must remain open.

***Talitrus saltator*** (Mont.)

Azores, São Miguel: Ribeira Grande, near the dune edge on exposed sandy beach, 4 spp., 27. II. (Loc. 1).—Vila Franca do Campo, on volcanic sand beach, 14 spp., 28. III. (Loc. 2).—São Pópulo, 7.5 km. E of Ponta Delgada, volcanic sand beach, 21 spp., 4. III. (Loc. 10).—Ribeira Seca, W R. Grande, on exposed sandy beach in sand, under decaying sea-weed and stones, 23 spp., 18. III. (Loc. 37).

Azores, Faial: Horta, Porto Pim, on sheltered sandy beach and on sandy, grassy ground, 26 spp., 7. IV. (Loc. 94).

*T. saltator*, a common species on sandy beaches along the European west coast and in the Mediterranean, was found in all suitable localities investigated. It was previously reported from Faial by Chevreux (1900).

***Talitrus pacificus*** Hurley

Azores, São Miguel (fig. 3 a): Charco do Madeira, 6 km. N of Ponta Delgada, on shore, 74 spp., 1. III. (Loc. 4).—Sete Cidades, at Lagoa Azul,

under stones and plant debris on shore, 45, spp., 2.III. (Loc. 7). — Sete Cidades, at Lagoa Verde, on shore, under stone, 1 sp. 2.III. (Loc. 8). — Ponta Delgada, in garden, 1 sp., 5.III. (Loc. 9). — Caldeira das Sete Cidades, under stones in the outer tunnel mouth, 15 spp., (incl. ♀ ov.) 8.III. (Loc. 18). — 3 km. W of Porto Formoso, in detritus near the road on a

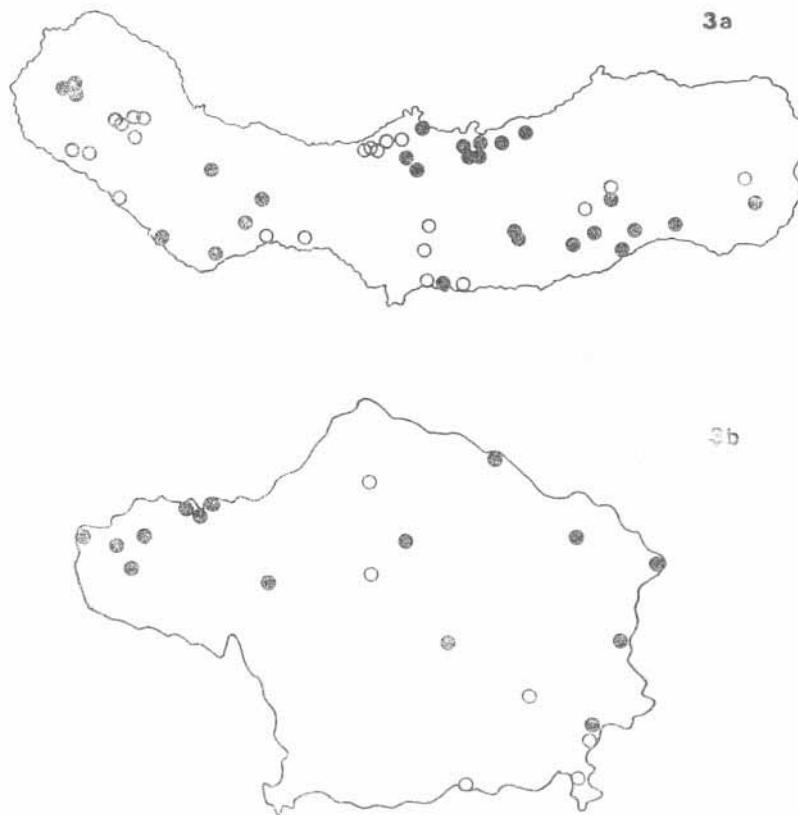


Fig. 3. — Investigated localities and findings of *Talitrus pacificus* (filled circles) in a. São Miguel, b. Faial.

steep hill-side. 4 spp., 9.III. (Loc. 20). — 2 km. SW of Porto Formoso, stone quarry, 13 spp., 11.III. (Loc. 21), 1 km. WSW of P. Formoso, 2 spp., 9.III. — At Lagoa das Furnas, under stones and leaves, in drift material on lake shore, 30 spp., 10.III. (Loc. 22). — Valley of Ribeira Quente, 2 km. SE of Furnas, on shore of stream, under stones and among plant debris,

25 spp., (incl. ♀ ov.), 11.III. (Loc. 23). — Furnas, park, 4 spp., 11.III. (Loc. 24). — Ribeira da Praia, 3 km. W of Vila Franca do Campo, on shore of stream, under stones among plant debris, 7 spp., (incl. ♀ ov.) 13.III. (Loc. 27). — Caldeiras 5 km. SE of Ribeira Grande, on shore of the pool of the power plant, near hot and cold springs, 24 spp., 14.III. (Loc. 28.) — River 5 km. SSE of Ribeira Grande, among plant debris near stream, 169 spp., 14.III. (Loc. 29). — Tanque (pond) 1 km. SE Lagoa do Congro, under stones near the pond, 8 spp., 16.III. (Loc. 33). — Lagoa do Congro, in a wood in plant debris and under stones, 5 spp., 16.III. (Loc. 34). — Pico da Azeitona NE of Ponta da Garça, grassy ground among decaying leaves, 5 spp., 23.III. (Loc. 56). — River NW Água Retorta, near stream under stone, 1 sp., 23.III. (Loc. 57) — 1 km. N of Povoação, Ribeira dos Lagos, near stream under stone, 7 spp., (incl. ♀ ov.) 24.III. (Loc. 60). — 1.5 km. S of Maia, ravine, 2 spp., 25.III. (Loc. 62). — 3 km. E of Ribeirinha (N coast), in ravine, under stones in a gravel-pit and among plant debris, 3 spp., 25.III. (Loc. 63). — 3 km. S of Pico da Pedra, under stones and in scrub, 3 spp., 25.III. (Loc. 64). — 1 km. S of Porto Formoso, among decaying leaves, 4 spp., 9.III. — Bodes Mtns. SE Furnas, among boulders on a steep hill-side, 2 spp., 23.III. — 2 km. NE of Ponta Delgada, near swimming-pool, 2 spp., — . III. (Loc. 9).

Azores, Terceira: At Lagoa do Ginjal, under stones near the road, 4 spp., 27.III. (Loc. 66). — 4 km. S of Vila Nova, drift material, 5 spp., 27.III. (Loc. 67).

Azores, Faial (fig. 3 b): Horta, Ribeira dos Flamengos, under stones, 2 spp., 31.III. (Loc. 71). — Praia do Almoxarife, under stones and plant debris in estuary of dry stream bed, 3 spp., (incl. ♀ ov.) 31.III. (Loc. 72). — 0.5 km. WNW of Ribeirinha, in a ravine, under stones and plant debris in a wood, 26 spp., 1.IV. (Loc. 73). — Porto da Boca da Ribeira, 1 km. E of Ribeirinha, under stones and plant debris in a stream valley, 62 spp., 1.IV. (Loc. 74) — Porto do Salão, grassy ground under stones, 1 sp., 1.IV. (Loc. 75). — Ribeira das Cabras 1 km. NE of Praia do Norte, under stones, 6 spp., 2.IV. (Loc. 76). — Baía da Areia das Fontes 1 km. N of Praia do Norte, under drift material of terrestrial plants at H. W. M. in dry stream estuary, 14 spp., 2.IV. (Loc. 77). — Fajã 2 km. W of Praia do Norte, in plant debris in wood, 4 spp., 2.IV. (Loc. 78) — 2 km. SW of Praia do Norte, under stones on lava fields, 2 spp., 2.IV. (Loc. 79). — Zona do Mistério 2 km. W of Praia do Norte, in plant debris in a wood, 5 spp.,



2.IV., 1 sp., 3.IV. (Loc. 80). — Costa da Nau 3 km. NW of Capelo, *Erica* plant debris, under stones at the road, 15 spp., 4.IV. (Loc. 88). — Cabeço do Canto, *Erica* shrub, 3 spp., 4.IV. (Loc. 89). — Pool 1 km. ESE of Cabeço do Fogo, in *Erica* plant debris, 6 spp., 4.IV. (Loc. 90). — Ribeira dos Flamengos 2 km. WNW of Flamengos, in ravine on shore in drift material, 20 spp., (incl. ♀ ov.) 4.IV. (Loc. 91). — 3 km. WNW of Pedro Miguel, under stones on a damp meadow near the pond, 6 spp., 5.IV. (Loc. 92).

Azores, Pico: Volc. Pico, W side, altitude abt. 350 m., forest, 5 spp., 8.IV. (Loc. 99). — Volc. Pico, W side, altitude abt. 350 m., under stones, grassy ground, 4 spp., 9.IV. (Loc. 100). — 4 km WNW of Lajes, under stones in a wood, 2 spp., 9.IV., (Loc. 101). — São João, rocky shore; volcanic sand beach, 7 spp., 9.IV. (Loc. 103). — Madalena Areia Larga, under stones, 2 spp., 9.IV. (Loc. 104).

Azores, Flores: Ribeira d'Além da Fazenda, under stones and on grassy ground, 12 spp., 14.IV. (Loc. 108).

Madeira: Funchal, in a ravine in the W part of Funchal, 12 spp., 19.IV. (Loc. 111) — Santa Cruz, Rib. da Boaventura, under stones in a dry ravine, 1 sp., 22.IV. (Loc. 118). — Porto Novo, Rib. do Porto Novo, under stone in a ravine, 9 spp., (inc. ♀ ov.) 22.IV. (Loc. 119). — 1 km. W of Quinta Grande. 300 m., in a ravine, 5 spp., 28.IV. (Loc. 136).

As seen from the long list of localities given above *T. pacificus* was at the time of our visit without comparison the most common land amphipod in the Azores and fairly common also in Madeira. Among the islands visited by us only Santa Maria failed to yield a single specimen, despite the fact that 12 different localities were examined in the central and western parts of the island. According to Hurley (1955) *T. pacificus* is probably originally a South Pacific species but it has been secondarily introduced i. e. into the United States.

Descriptions and figures will be found in Hurley (l. c.) and Shoemaker (1936, as *T. sylvaticus*). Our material adds nothing new from a taxonomic point of view.

The species, which was not previously recorded from Europe, has most probably been introduced into the Azores and Madeira together with some of the numerous South Pacific plants which are now widespread in the islands.

***Talitrus alluaudi*** Chevreux

Azores, São Miguel: Fonte da Rocha near Relva, 4.5 km. W of

P. Delgada, spring, 1 sp., 5.III. (Loc. 11). — 2 km. SW of Porto Formoso, stone quarry, 1 sp., 11.III. (Loc. 21).

*T. alluaudi* is an Indo-Pacific species secondarily introduced into many different countries and often found in green-houses. It was recently reported by Andersson (1963) from the Canary Islands. It is here reported for the first time from the Azores, where, to judge from its very restricted range, it seems to have been introduced recently.

## DISCUSSION

### COMPOSITION OF THE FAUNA

As seen from the above list, the following 6 species of land amphipods were obtained by us in the Azores, viz.

*Orchestia gammarellus*  
*O. platensis*  
*O. chevreuxi*  
*Talitrus saltator*  
*T. pacificus*  
*T. alluaudi*

Two further species have been recorded from the Azores, viz.

*O. mediterranea*  
*O. guernei*

Both these species were recorded by Chevreux (1900) from the Bay of Horta in the island of Faial. Neither species has been observed elsewhere in the Azores or Madeira, but *O. mediterranea* has been recorded from the Canary Islands. Of *O. guernei* the slightly defective type, a male, probably not full-grown, is the only specimen ever recorded.

At the time of our visit the shore of the Bay of Horta had to a very large extent been built over and what remained in the northern part of the bay was covered by organic and inorganic refuse and very heavily contaminated. The beaches of the adjoining bays to the north and south were very carefully examined but although *O. gammarellus* and *T. saltator* turned out to be common no specimens of *O. mediterranea* or *O. guernei* were found. Despite the apparently distinctive features, e.g. in the spination of the telson (Chevreux 1900) the identity of the last mentioned

species must remain somewhat doubtful until further and preferably fully mature specimens can be found.

Table 1 summarizes the distribution of the land amphipods of the Macaronesian Islands.

As seen from the table the Macaronesian Islands are comparatively well provided with land amphipods. Assuming the validity of *O. guernei* no less than three species,

*O. chevreuxi*  
*O. guernei*  
*O. canariensis*

appear to be confined to the area. *O. chevreuxi* was reported by Cecchini (1928) from Livorno in Italy but the identification was not accepted by

TABLE 1

General distribution of Macaronesian land amphipods

|                              | Azores | Madeira | Canary Islands | Western Europe | Mediterranean area | Trop. W. Africa | N. America | S. America | Indopacific area |
|------------------------------|--------|---------|----------------|----------------|--------------------|-----------------|------------|------------|------------------|
| <i>Orchestia gammarellus</i> | +      | +       | +              | +              | +                  | -               | -          | -          | -                |
| » <i>mediterranea</i>        | +      | -       | +              | +              | +                  | -               | -          | -          | -                |
| » <i>platensis</i>           | +      | +       | +              | +              | +                  | +               | +          | +          | +                |
| » <i>chevreuxi</i>           | +      | -       | +              | -              | -                  | -               | -          | -          | -                |
| » <i>guernei</i>             | +      | -       | -              | -              | -                  | -               | -          | -          | -                |
| » <i>canariensis</i>         | -      | -       | +              | -              | -                  | -               | -          | -          | -                |
| <i>Talitrus saltator</i>     | +      | -       | +              | +              | +                  | -               | -          | -          | -                |
| » <i>pacificus</i>           | +      | +       | -              | -              | -                  | -               | +          | -          | +                |
| » <i>alluaudi</i>            | +      | -       | +              | +              | +                  | -               | +          | -          | +                |

Bulycheva (1957) according to whom the specimens in question belong to *O. gammarellus*. *O. canariensis*, like *O. guernei* (cf. above), is known only

from the type locality (in Gran Canaria) where 4 specimens, including one apparently mature male, were collected by N. Odhner (Dahl 1950). *O. chevreuxi* and probably also *O. canariensis* are both apparently truly terrestrial (Andersson 1963), while the only record of *O. guernei* is supralittoral.

Three of the remaining six species are otherwise confined to western and southern Europe and immediately adjacent parts of N Africa. These species are

*O. mediterranea*  
*O. gammarellus*  
*T. saltator*

All of these are more or less exclusively littoral and epilittoral species. Only *O. gammarellus* in the southern part of its range penetrates limited distances inland along fresh water streams (cf. pp. 8-10).

One further species,

*O. platensis*

falls into a group by itself. It is widely distributed on both sides of the Atlantic Ocean, including western and southern Europe. Although mainly littoral, it is, in the warmer parts of its range, often found far away from the sea. Probably it has been accidentally introduced into parts of its present range (e.g. the Baltic area) and its zoogeographical origin appears obscure.

The two remaining species,

*T. pacificus*  
*T. alluaudi*,

were undoubtedly both introduced into the Macaronesian Islands in rather recent time.

In summing up, it can thus be concluded that out of the 9 species of land amphipods recorded from the Macaronesian Islands 3 are apparently endemic. A further 3 littoral species are common to the Macaronesian Islands and southern and western Europe, while a fourth species (*O. platensis*) also occurring in the same areas is almost cosmopolitan. It is impos-

sible to say whether it occurs spontaneously in the islands or has been accidentally introduced. Finally, 2 species are undoubtedly late and accidental introductions.

#### THE LOCAL DISTRIBUTION OF THE LAND AMPHIPODS

*The Azores.* The Azores with their humid and mild winter climate are certainly very favourable to land amphipods. They constitute one of the dominating elements of the soil mesofauna.

Amphipods were present in most of our terrestrial samples and on the whole they were only lacking in some moist and peaty localities in comparatively high altitudes.

Thus the general distribution and abundance of the amphipods appears to recall the situation described by Hurley (1959) from various South Pacific Islands but rarely encountered in Europe.

It is an interesting question whether the situation as we found it in 1957 resembles the one found before the introduction of foreign species. From this point of view the three most truly terrestrial species, *O. chevreuxi*, *T. pacificus*, and *T. alluaudi*, deserve particular attention. Of the three species *T. alluaudi* is either very recently introduced or it has not been very successful, for it was found only in two localities in the central part of S. Miguel. Consequently the following discussion can be confined to the present and past distribution of the two other species.

Of these two species *O. chevreuxi* has previously been recorded from Faial (2 localities), Flores (5 localities), Graciosa, and Corvo (1 locality each) (Chevreux 1900). *T. pacificus* has not been recorded before our visit when it turned out, however, to be the most common land amphipod on most islands. Our own results with respect to the occurrence of the two species are summarized in table 2. It should be noted that we had no opportunity to collect at Graciosa or Corvo.

As seen from table 2 the number of localities investigated in Terceira and Flores was too small to permit any definite conclusions concerning the land amphipod fauna. In S. Miguel and Faial, where a large number of localities were visited, *T. pacificus* was in 1957 undoubtedly much more abundant than *O. chevreuxi*. In particular this was evident in S. Miguel. *O. chevreuxi* occurred together with *T. pacificus* in 2 of the 3 localities where it was obtained. The third locality was in the neighbourhoop.

of the freshwater spring Fonte Grande in the precipitous shore cliffs near Feteiras. In Faial *O. chevreuxi* was found together with *T. pacificus* in 6 out of 8 cases. The two localities where *O. chevreuxi* was found alone were

TABLE 2

Distribution of *O. chevreuxi* and *T. pacificus* in the Azores 1957

|           | Number of localities<br>investigated | Number of records   |                     |
|-----------|--------------------------------------|---------------------|---------------------|
|           |                                      | <i>O. chevreuxi</i> | <i>T. pacificus</i> |
| S. Miguel | 52                                   | 3                   | 25                  |
| S. Maria  | 12                                   | 4                   | —                   |
| Terceira  | 6                                    | —                   | 2                   |
| Faial     | 26                                   | 8                   | 15                  |
| Pico      | 11                                   | 2                   | 5                   |
| Flores    | 3                                    | —                   | 1                   |

the bottom of the main crater (Caldeira), and a wet meadow high up on the northern slope of the volcano. On Pico the two species were not found together. The two localities where *O. chevreuxi* was found could be regarded as rather isolated and the one on the volcano (loc. 98) was situated above the uppermost one where *T. pacificus* was obtained. Finally in S. Maria *T. pacificus* was not found at all, while *O. chevreuxi*, which was obtained 4 times, seemed to occur in all suitable localities.

These observations appear to permit a few generalizations.

1. Our field observations indicate that the two species *O. chevreuxi* and *T. pacificus* are ecologically rather similar and that their natural range overlaps to a fairly large extent, although *O. chevreuxi* appears to penetrate to higher altitudes than *T. pacificus*. They were found together in 8 localities.
2. In S. Miguel, Faial, and Pico *T. pacificus* was found alone in many localities where conditions appeared to be favourable also to *O. chevreuxi*.
3. In the three islands mentioned *O. chevreuxi* was found without *T. pacificus* only in a limited number of localities in high altitudes or otherwise comparatively inaccessible.
4. In S. Maria *T. pacificus* was not found, while *O. chevreuxi* was abundant in several localities, where, judging from observations in the other islands, *T. pacificus* ought to have found favourable conditions. Obviously the latter species had not yet had the opportunity to colonize S. Maria.

Although, owing to the limited number of observations made previous to our visit, no definite conclusions can be drawn, the above facts may

well imply that *O. chevreuxi* was previously more abundant and more evenly distributed throughout the islands but that its place in some of them has been partly usurped by *T. pacificus*. If this is the case it appears probable that land amphipods have for a long time played an important part in the soil fauna of the Azores although the point of gravity may have shifted over from an endemic to a successful invading species.

*Madeira.* In Madeira land amphipods appeared to constitute a much less conspicuous element in the soil mesofauna than in the Azores. Non-littoral terrestrial amphipods, in this case always *T. pacificus*, were obtained only in 4 out of over 20 localities where terrestrial fauna was collected. However, we arrived in Madeira at the beginning of the dry season, when considerable changes and adjustments in the soil fauna were in progress. Thus roads, dykes and gutters were littered with diplopods apparently attempting to escape from unfavourable conditions, many of them dead or dying from desiccation. Consequently the situation then prevailing at Madeira was not directly comparable to that in the Azores at the time of our visit there. Nevertheless the comparative scarcity of land amphipods also in localities where conditions appeared to be suitable for them seemed to indicate that they are a less important fauna element in Madeira. As seen from the list of localities and table 1 none of the endemic Macaronesian forms have hitherto been encountered in Madeira and this may be symptomatic of less favourable conditions. *T. pacificus* has undoubtedly been introduced in fairly recent time. Apart from that species only the two mainly littoral species *O. gammarellus* and *O. platensis* were obtained.

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