

TERRESTRIAL ENCHYTRAEIDAE FROM SOUTH GEORGIA AND THE MARITIME ANTARCTIC

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ABSTRACT. Seven taxa of enchytraeid worms have been identified in soil and peat samples collected on South Georgia, and Signy Island (South Orkney Islands). They are all different from the 16 enchytraeid taxa previously recorded from the Antarctic Region. Five of the seven enchytraeids occur in the Holarctic Region, and it seems likely that their presence in the Antarctic is connected with human activity.

INTRODUCTION

Earthworms (Families Megascolecidae and Lumbricidae) have been recorded from several sub-Antarctic islands, e.g. Macquarie, South Georgia, Marion (Benham, 1905, 1922; Pickford, 1932; Burger, 1978). Smaller oligochaete worms of the Family Enchytraeidae have been found in various locations in the Antarctic, and this preliminary paper brings together the information obtained so far. It also records the finding of two taxa new to science.

Sixteen taxa of enchytraeids have been recorded from the Antarctic Region and southern cold temperate zone (Table I), and much remains to be investigated in terms of their taxonomy and distribution. Three genera (*Marionina*, *Lumbricillus* and *Enchytraeus*) are also widespread throughout Europe and North America, whilst several species are common to both Europe and the sub-Antarctic.

Little is known of the ecology of enchytraeid worms in the Antarctic, but highest numbers have been recorded in soil under species of grass in the maritime zone (Block, 1979) and in the sub-Antarctic (Smith and Stephenson, 1975).

METHODS

Live material was collected in soil and peat from five terrestrial habitats on South Georgia (54° 20' S, 36° 40' W) and one on Signy Island, and a few preserved worms were obtained from Signy and Lynch Islands (South Orkney Islands; 60° S, 45° W) and Deception Island (62° 57' S, 60° 38' W) in the South Shetland Islands. Soil and vegetation samples from South Georgia were transported to Copenhagen in small plastic bags, maintained at *c.* 5° C for most of the time. Immediately upon arrival the worms were extracted by the wet funnel technique (Whitehead and Hemmings, 1965) and inspected alive. In most cases the material was studied 3–4 months after field collection. It is believed that this procedure is satisfactory for a qualitative study of this kind, since replicate samples kept in the laboratory at 4°C for up to 2 years still contained live worms, and the species in question occurred in the expected relative numbers. Where possible the samples were subdivided into three sections (surface

Table I. Enchytraeidae previously recorded from the Antarctic Region and the southern cold temperature zone.

Taxon	Location
<i>Marionina georgiana</i> (Michaelsen)	South Georgia ^{1,3} , Iles Crozet ³ , Falkland Islands ³
<i>M. grisea</i> Stephenson	Antarctic Peninsula ³
<i>M. aestuum</i> Stephenson	South Georgia ³
<i>M. antipodum</i> Benham	Macquarie Island ²
<i>M. benhami</i> Stephenson	Macquarie Island ³
<i>M. exigua</i> Michaelsen	South Georgia ^{1,3}
<i>M. werthi</i> Michaelsen	Iles Kerguelen ³ , Macquarie Island ²
<i>Lumbricillus lineatus</i> (Müller)	Antarctic Peninsula ³ , South Orkney Islands ³ , South Georgia ³ , Tierra del Fuego ³
<i>L. maximus</i> (Michaelsen)	South Georgia ^{1,3} , Antarctic Peninsula ³ , South Orkney Islands ³ , New Amsterdam ³
<i>L. macquariensis</i> Benham	South Georgia ³ , Macquarie Island ² , Auckland and Campbell islands ³
<i>L. antarcticus</i> Stephenson	South Georgia ³
<i>Enchytraeus albidus</i> Henle	South Georgia ^{1,3} , Iles Crozet ³ , Iles Kerguelen ³ , Falkland Islands ³ , Tierra del Fuego ³ , southern Patagonia ³ , New Zealand shelf islands ³
<i>E. australis</i> Stephenson	South Georgia ³ , Gough Island ³
<i>E. colpites</i> Stephenson	South Georgia ³
<i>Michaelsena monochaeta</i> (Michaelsen)	South Georgia ^{1,3}
<i>Achaeta</i> sp. (indet.)	South Georgia ³

Data from Michaelsen (1888, 1905)¹; Benham (1905, 1922)² and Stephenson (1932)³.

vegetation and litter, 0–3 cm and 3–6 cm depth of soil from the surface) on collection, and extracted separately. There was a strong predominance of worms in the upper (0–3 cm) soil section.

Worms were examined alive under 100–500 × magnification and identified using Nielsen and Christensen (1959).

SAMPLES SITES

South Georgia

1. A dry grassland community consisting of *Festuca contracta* T. Kirk growing in short tussocks up to 20 cm in diameter with an understorey of mosses and lichens. The soil is an acid brown earth. The site was located close to a large lake at 84 m a.s.l. at the Maiviken end of Bore Valley to the north of King Edward Cove.

2. A moss bank composed of two principal species, *Polytrichum alpestre* Hoppe and *Chlorisodontium aciphyllum* (Hook f. et Wils.) Broth. These have developed a level moss turf overlying peat up to 2 m deep in parts. This site is closer to the sea (7 m a.s.l.), near Maiviken in Bore Valley.

3. A dwarf shrub association of *Acaena magellanica* (Lam.) Vahl with a dense understorey of the moss *Tortula robusta* Hook et Grev. on an organic soil overlying a glacial till. It is situated on the south side of King Edward Cove at c. 12 m a.s.l.

4. A eutrophic mire situated between Brown Mountain and Gull Lake at 91 m a.s.l. to the south of King Edward Cove. The vegetation comprises a continuous carpet of *Tortula robusta* and other mosses together with the short rushes *Rostkovia magellanica* (Lam.) Hook. f. and *Juncus scheuchzerioides* Gaudich. The soil comprises over 1 m deep waterlogged peat.

5. A tussock grassland, close to the BAS station on King Edward Point at c. 20 m a.s.l., dominated by large (1–2 m high) tussocks of *Poa flabellata* (Lam.) Hook. f. Areas of the site are enriched by elephant seals and c. 1 m of peat has developed beneath much of it.

Signy Island

6. The site at Signy Island is a small plot (c. 1 m²) in a moss community formed by *Polytrichum alpestre* and *Chorisodontium aciphyllum*, into which various flowering plants and grasses were transplanted from South Georgia and/or the Falklands in experiments conducted between 1967 and 1969 (Edwards, 1980; Edwards and Greene, 1973). It is in Factory Cove, c. 13 m a.s.l. and close to the BAS station (see Block, Burn and Richard (1984) for a description).

RESULTS

Enchytraeidae

Unless otherwise stated, reference should be made to the descriptions in Nielsen and Christensen (1959).

Mesenchytraeus pelicensis Issel 1905

Found in *Acaena* (site 3) collected on 12 March 1981 at King Edward Cove, South Georgia.

Cognettia sphagnetorum (Vejdovsky) 1877

Common in *Polytrichum* from moss bank, *Festuca*, *Poa*, *Rostkovia* vegetation and *Acaena* (sites 1–5) collected at King Edward Cove, South Georgia on 23 February 1978 and 12 March 1981. Sexually mature individuals were not observed. The chief method of reproduction seems to be fragmentation and subsequent regeneration. Mitotic divisions in regenerative buds showed many chromosomes and, although the exact number was not established, it is obvious that these sub-Antarctic forms are polyploids like most North European strains.

Cognettia glandulosa (Michaelsen) 1888

Identified from *Rostkovia* and *Acaena* from King Edward Cove, South Georgia; 12 March 1981. Abundant in these samples. Reproduction and chromosome number are similar to *C. sphagnetorum*.

Henlea perpusilla Friend 1911 augm. Cernovitov 1937.

Ex *Rostkovia* (as above). Analysis of mature eggs showed that the form present is what has been referred to as *cytotype 4x, MI* (Christensen, 1961). This is a tetraploid in which the chromosomes remain in the first meiotic metaphase until the eggs are laid.

Henlea ventriculosa (Udekem) 1854.

Found in *Rostkovia* and *Acaena* collected at King Edward Cove, South Georgia; 23 February and 12 March 1981.

Marionina sp.

Found only in *Rostkovia* (King Edward Cove, South Georgia; 12 March 1981). This species belongs to the '*M. argentea* complex' characterized by its small size (4–7 mm, about 25 segments), large refractile lymphocytes (intensely white in reflected light). Ectal duct of spermatheca covered with glands, ampulla spherical or pear-shaped. The two anterior pairs of septal glands merge dorsally, the last pair being free and elongate. The distinctive feature of the present species is the entire absence of setae except for the ventral bundles in segment II–VI. In segment III–VI each bundle contains two setae whereas there is usually only one seta present in segment II although this is occasionally absent.

Generis et species incerti

Peat was collected from near the BAS station on Signy Island, South Orkney Islands, on 20 November 1980 containing plant material thought to be introduced to this island from the Falkland Islands and/or South Georgia in the mid-1960s (see Block, Burn and Richard, 1984). The worms from this locality were inspected alive and are congeneric with some preserved specimens collected from Lynch Island (South Orkney Islands) and Deception Island (South Shetland Islands). As fully mature individuals were not present, a complete species description cannot be given at present. Since the taxon in question shows a combination of characters unknown in any existing genus, it is undoubtedly necessary to erect a new genus in which to include it, when it is fully described. Estimates of population density are > 3200 worms per square metre.

The main characteristics are as follows: Medium sized, *c.* 15 mm in length, rather stout, milkish white in colour, approximately 40 segments. Setae sigmoid: 2,3,4,5,6–2,3,4:6,7,8–4,5,6. Gradual transition between oesophagus and intestine. Chloragogen cells form a dense layer from VII, the diameter of the cells being slightly larger than the length of the lymphocytes, the chloragogen cells filled with brown refractile globules. All three pairs of septal glands free dorsally, ventral lobes in V and VI. The brain slightly incised posteriorly. Blood colourless, dorsal vessel arising in XIII. Anteseptale portion of nephridia with coils of the nephridial canal, efferent duct arising ventrally or nearly terminally on postseptale. Small elongate, hyaline lymphocytes pointed at both ends present in abundance. No other type of lymphocytes observed. Seminal vesicle apparently well developed. Spermathecae without diverticulae, its ectal duct rather long and well demarcated and apparently with a crown of glands round the ectal orifice. Entally the spermathecae communicate with oesophagus.

In the general shape of nephridia and spermathecae and in the presence of small hyaline lymphocytes the present finding resembles members of the genera *Fridericia* and *Buchholzia*. However, it differs from the former in having sigmoid setae (*Fridericia* has straight setae and innermost setae in the bundles pairwise shorter than the outer ones), and it differs from the latter in having a straight gut and postclitellar origin of the dorsal vessel (*Buchholzia* has an abrupt expansion of the gut at VII/VIII usually with intestinal diverticula from which the dorsal vessel arises).

Miscellaneous

A few immature Aelosomatidae and Tubificidae from living *Rostkovia* (site 4) (collected on 12 March 1981 at King Edward Cove, South Georgia).

DISCUSSION

Seven terrestrial species have been identified, and five of these (*Mesenchytraeus pelicensis*, *Cognettia sphagnetorum*, *C. glandulosa*, *Henlea perpusilla* and *H. ventriculosa*) are widely distributed also in the Holarctic region. The two *Cognettias* and the two *Henleas* are among the most common enchytraeids in a wide variety of habitats in northern Europe. It is likely that they have been introduced unintentionally by man into some of these isolated Antarctic sites.

Some of the species, particularly *Cognettia sphagnetorum* and *C. glandulosa*, occurred in such high numbers in the South Georgia habitats (the moss bank, *Festuca*, *Rostkovia* and *Acaena*) that their densities equal those reported from northern Europe (e.g. Nielsen, 1955; Peachey, 1963). Population estimates of enchytraeids up to 3110 m⁻² have been made for sheltered *Festuca contracta* grassland above the south side of King Edward Cove, South Georgia (Smith and Stephensen, 1975).

A detailed discussion of the zoogeographical and ecological implications of these results is inappropriate here, but some comments may be made. Only 16 taxa of Enchytraeidae have been recorded previously for the Antarctic region (mostly from littoral habitats) and none of the seven species identified from the present terrestrial collections has been found previously. That five of these new records are for species widely distributed in Europe and elsewhere in the Northern Hemisphere, suggests that they may have been transported by human or other agency into the Antarctic region. Dispersal may have been as worms, worm fragments or as cocoons. If this is the case, it complicates the biogeographical interpretation of the data.

Enchytraeids have been recorded from every continent, but they reach their greatest abundance in moist temperate soils. The family is commonly supposed to be of Arctic origin (Stephenson, 1930), and it is well represented there. These worms are terrestrial, littoral or aquatic in habitat, and some taxa may be bipolar in distribution. More information on their taxonomy and distribution within the Antarctic Region, and in the Southern Hemisphere generally, is required.

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