Tardigrada from the Husvik area, South Georgia, sub-Antarctic

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Eleven species of tardigrades in South Georgia, of which two are new to science, were found in samples collected at fifteen localities. The highest number of species was found in moss from a scree field. Twenty species of tardigrades are presently known from South Georgia, but the island remains insufficiently investigated. The species composition is similar to that of southern South America. The high number of cosmopolitan species makes the geographical distribution pattern of the South Georgian tardigrades more similar to that of macrolichens than to that of insects and vascular plants.

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While the tardigrades of the continental and maritime Antarctic have been extensively studied (i.e. Murray 1906, 1910; Jennings 1976a, b; Everitt 1981; Dastych 1984; McInnes & Ellis-Evans 1987; Usher & Dastych 1987; Miller et al. 1988), few studies have been carried out in the sub-Antarctic. Richters (1920), Iharos (1963) and Mihelčič (1967) identified tardigrades from the southern part of South America, Richters (1920) from the Falkland Islands and Richters (1920), Jennings (1976b) and Dastych (1984) from South Georgia. Previous sampling at South Georgia has been done in the Royal Bay and Cumberland Bay areas, particularly at King Edward Point, and in Grytviken.

This paper reports species found by the British Antarctic Survey terrestrial ecology expedition to Husvik in the Stromness Bay area on South Georgia in 1988 (Block et al. 1988).

Material and methods

The samples for tardigrade extraction were collected between 11 and 13 March 1988 northwest of the abandoned Husvik whaling station (54°10'S, 36°42'W) and at the Tønsberg Point peninsula at altitudes from sea level to 80 m a.s.l. (Fig. 1). Each sample had a volume of approximately 300 cm^3. Each was placed in a plastic bag and kept in a refrigerator at 4°C during transport to Rio de Janeiro, arriving in Norway one day later. The samples were extracted according to the method of Morgan & King (1976), i.e. soaked in water for 24 hours, then squeezed dry over a Petri dish, resoaked and allowed to stand for several minutes, then squeezed again. The tardigrades were removed from the water in the Petri dish with a capillary tube under 30 × magnification and transferred to a microscope slide. They were mounted in Hoyer's medium and identified using a compound microscope at 400 and 1,000 × magnifications. The primary identification manual was Ramazzotti & Maucci (1983). Terje Meier identified the tardigrades and supplied information on distribution and ecology.

Results

A description of the fifteen localities, from the wettest to the driest communities, is given in Table 1. Their distribution in the Husvik area is shown in Fig. 1. A list of the tardigrades in the various samples is given in Table 2. Approximately half of the samples, among them the dense moss banks which form deep peat deposits (loc. 10 and 11), contained no tardigrades. We had hoped to find some tardigrades living in gravel and sandy soil (loc. 12 and 13) as this habitat has been reported recently to contain interesting species in the alpine grassland of Italy (Manicardi & Bertolani 1987) and on Dundee Island in the maritime Antarctic (Usher & Dastych 1987). In

Table 1. List of sampling localities, from the approximately wettest (1) to the driest (15) habitat.

1: Pond, 10 × 4 m, 1 m deep, 30 m a.s.l., surrounded by *Rostkovia* vegetation at both ends, gravel and stones on sides. Bottom with mosses and algae, some spots with sand. The sample contained mud from the bottom.
2: As in 1, but the sample consisted of aquatic mosses.
3: Moss-sample from bog dominated by *Juncus scheuchzerioides*, i.e. a wet nutrient rich bog.
4: Moss-sample from bog with *J. scheuchzerioides, Rostkovia magellanica* and herbs; drier than 3.
5: Moss growing among and above stones along a small creek.
6: Moss growing among stones close to the water line at 'Reservoir Lake' (old water reservoir for the Husvik whaling station).
7: Moss growing below the dam at 'Reservoir Lake', sprayed with water from the outlet waterfall.
8: Steep cliff, exposed towards the south, water dripping down the wall. Partly covered with a rich vegetation of mosses and lichens, several grasses and herbs, such as *Acaena*. The sample consisted of mosses.
9: As in 8, but sample consisted of lichens.
10: Moss bank, c. 10 m a.s.l., with dense stands of mosses of the genera *Polytrichum* and *Dicranum*, covering large areas.
11: As in 10, but c. 50 m a.s.l.
12: Soil sample from grassland dominated by *Festuca contracta*. Dry soil.
13: As in 12.
14: Scree-field with some mosses, *Acaena* and scattered grasses at c. 30 m a.s.l. Sample contained mosses.
15: Temporary pond, at 80 m a.s.l. Dry when sampled. Sample consisted of mosses.

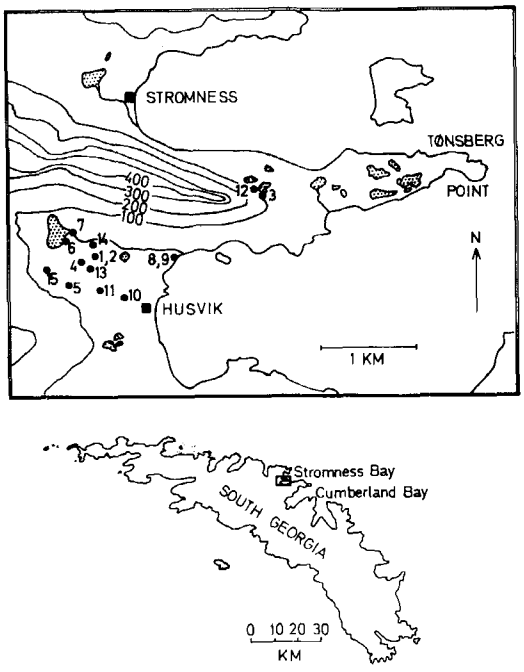

Fig. 1. Map of the sampling area. Locality numbers refer to Table 1. Shaded areas are lakes or ponds. Altitude in metres.

only one of our sandy soil samples (loc. 12) was a tardigrade found, *Macrobiotus furciger*, which is a common habitat generalist. Localities 2, 4, 5, 6 and 7 contained no tardigrades, perhaps due to the sampling procedure, or other unexplained factors.

Loc. 14, moss from a scree field, proved to be the richest habitat in terms of number of species and individuals. One of these species, *Isohypsibius* sp., is new to science. It resembles *I. improvisus*, but has different claws. Another species new to science was found in moss of a dry pond (loc. 15). This *Macrobiotus* sp. resembles *M. blocki*, but the eggs are different (R. Møbjerg Kristensen pers. comm.). Both of these new species will be described by Terje Meier in a separate publication.

Discussion

Table 3 provides a survey of the tardigrades known from South Georgia. Prior to the present study fifteen species were known, of which we found six, while five species are now reported as new to the island. Currently, twenty species of tardigrades are known from South Georgia. There is no doubt that more species of tardigrades exist on South Georgia.

Despite the scanty material, some patterns of the colonization of the South Georgia tardigrade fauna begin to appear. *Macrobiotus hufelandi* and *Milnesium tardigradum* are true cosmopolitan species, while *M. furciger, Hypsibius dujardini, Ramazzottius oberhaeuseri* and *Diphascon pingue* are fairly widespread throughout the world (Ramazzotti & Maucci 1983), including previous records from continental or maritime Antarctic. *Macrobiotus liviae, Hypsibius pallidus* and *Isohypsibius prosostomus* also have a world wide distribution, but they have not been reported from the Antarctic. *Mopsechiniscus imberbis* is a South American species. Although South Georgia has been poorly investigated, it is striking that a number of very common and widespread Antarctic species mentioned by Dastych (1984), such as *Echiniscus pseudowendti, E. jenningsi, Hypsibius renaudi* and *Diphascon puniceus*, have not yet been found there. Although it is dangerous to base conclusions on negative records, it would seem likely that the original distribution centre of the South Georgian tardigrade fauna was to be sought in the Falkland Islands and South America

Table 2. List of tardigrade species from Husvik in systematic order. Locality numbers refer to Table 1. The numbers in the table refer to the number of individuals found, while X denotes 'common', XX 'very common' and — 'absent'.

Family/Species	Locality														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Echiniscidae															
Mopsechiniscus imberbis (Richters, 1920)	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—
Hypsibidae															
Hypsibius convergens (Urbanowicz, 1925)	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Hypsibius dujardini (Doyère, 1840)	—	—	—	—	—	—	—	—	—	—	—	—	—	XX	—
Isohypsibius sp. nov.	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—
Diphascon mirabile Dastych, 1984	—	—	1	—	—	—	—	1	—	—	—	—	—	1	—
Diphascon pingue (Marcus, 1936)	—	—	XX	—	—	—	—	XX	—	—	—	—	—	XX	—
Macrobiotidae															
Macrobiotus furciger Murray, 1906	XX	—	—	—	—	—	—	XX	—	—	—	XX	—	XX	XX
Macrobiotus hufelandi Schultze, 1843	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Macrobiotus liviae Ramazzotti, 1962	XX	—	—	—	—	—	—	—	XX	—	—	—	—	XX	—
Macrobiotus sp. nov.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	XX
Dactylobiotus dispar (Murray, 1907)	XX	—	XX	—	—	—	—	—	—	—	—	—	—	—	—

rather than in the Antarctic. In this respect the distribution of tardigrades would be similar to that of the South Georgian vascular plants (Greene 1964; Moore 1968) and the freeliving terrestrial arthropods (Gressitt 1970), since most species are found also on the Falkland Islands or in South America, but few in the Antarctic. According to R. Møbjerg Kristensen (pers.

Table 3. A survey of the tardigrades recorded from South Georgia. X = 'present', — = 'absent'.

	Richters (1920)	Jennings (1976b)	Dastych (1984)	This study
Echiniscidae				
Mopsechiniscus imberbis (Richters, 1920)	X[1]	—	—	X
Oreellidae				
Oreella sp.?	X[2]	—	—	—
Hypsibidae				
Hypsibius antarcticus Richters, 1904	—	X	—	—
Hypsibius arcticus Murray, 1910	—	—	X	—
Hypsibius convergens (Urbanowicz, 1925)	—	—	—	X
Hypsibius dujardini (Doyère, 1840)	X[3]	—	X	
Hypsibius pallidus Thulin, 1911	—	—	X	—
Isohypsibius asper (Murray, 1906)	X[4]	X	—	—
Isohypsibius prosostomus Thulin, 1928	—	—	X	—
Isohypsibius sp. nov.	—	—	—	X
Ramazzottius oberhaeuseri (Doyère, 1840)	—	—	X	—
Diphascon mirabile Dastych, 1984	—	—	—	X
Diphascon pingue (Marcus, 1936)	—	X	X	X
Diphascon scoticum (Murray, 1905)	—	X	—	—
Macrobiotidae				
Macrobiotus furciger Murray, 1906	X[5]	X	X	X
Macrobiotus hufelandi Schultze, 1843	—	—	X	X
Macrobiotus liviae Ramazzotti, 1962	—	—	X	X
Macrobiotus sp. nov.	—	—	—	X
Dactylobiotus dispar (Murray, 1907)	—	—	—	X
Milnesiidae				
Milnesium tardigradum Doyère, 1840	X	—	—	—

The following names were used by Richters (1920): [1]: *Echiniscus imberbis*, [2]: *Echiniscus macronyx* (present status unclear, probably an *Oreella* sp.), [3]: *Macrobiotus murrayi*, [4]: *Macrobiotus asper*, [5]: *Macrobiotus furcatus*.

comm.), the tardigrade fauna of South Georgia show similarities to that of Chile and Argentina. This similarity of the biota is probably a result of geological history and the prevailing winds which blow from the west. However, a major difference between the composition of terrestrial arthropods and vascular plants and tardigrades is the large amount of cosmopolitan or widespread tardigrade species. In this respect the tardigrade distribution of South Georgia is more like the macrolichen distribution. Lindsay (1974) calculated that 60% of the South Georgian macrolichen species are bipolar or cosmopolitan, compared with 17% for vascular plants (Greene 1964).

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