REPORTS ON ANTARCTIC FIELD WORK

ECOLOGY OF TERRESTRIAL ARTHROPODA OF SELECTED COMMUNITIES AT SOUTH GEORGIA

By C. C. WEST

FOUR terrestrial study sites were established in November 1976 in the area around Grytviken and Maiviken, South Georgia. The sites are representative of communities dominated by a grass *Festuca contracta,* a moss turf of *Polytrichum alpestre* and *Chorisodontium aciphyllum,* the dwarf shrub *Acaena magellanica* and the rush *Rostkovia magellanica.* The first two are major sites and the last two have been studied less extensively.

The aims of the study were to investigate the roles of the Arthropoda within the community with special reference to decomposition processes and to examine the biology of selected species.

The major method of sampling employed was heat extraction of animals from a 3.8 cm diameter core, 3 cm in depth, by a Macfadyen-type extractor. The major sites were sampled monthly at two depths (0–3 and 3–6 cm) for 15 months at 16 replicates per site followed by 12 months at five replicates per site. Extracted animals were counted, identified (usually to species) and preserved. The range of densities recorded for the two most important groups were:

Total	maximum	163 000 m^{-2}	Moss-turf site, July 1978
Acari	minimum	6 500 m^{-2}	Grass site, August 1978
Total	maximum	107 000 m^{-2}	Grass site, May 1978
Collembola	minimum	2 500 m^{-2}	Grass site, August 1978

Other cores for heat extraction were taken from the subsidiary sites (six times), all four sites to a depth of 12 cm (four times), bird and rat-nest material (irregularly), and also from originally sterile litter, enclosed in nylon mesh bags, after burial in the soil for varying periods of time. More arthropod material was gathered from pit-fall traps (20 traps on each site for 15 days on five occasions; maximum number of Coleoptera per 1 000 trap hours: 205 individuals, *Acaena* site, January 1978). A fan-driven aerial fauna sampler was used at three locations.

Throughout the course of the work, information on the biology of selected species both in the field and in culture was recorded and experiments on diet, micro-climate preferences and on heat tolerance were made.

The first planned publications from this work are a field guide to the terrestrial invertebrates of South Georgia and some observations on the biology of selected species. Analysis of the population data will yield information on the effect of season, micro-climate, soil and vegetation factors on the density of certain species, and allow a preliminary classification of trophic levels and inter-specific relationships within the terrestrial Arthropoda. Furthermore, it is hoped to correlate species densities with decomposition processes both in time and with respect to soil depth.

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CELLULOSE DECOMPOSITION ON SOUTH GEORGIA

By M. J. SMITH

THE rapid and drastic climatic changes experienced annually on the Antarctic continent are reflected in the climates of the sub-Antarctic islands, and in this respect South Georgia is no exception. South Georgia's oceanic "polar-alpine" environment and its isolation, both geographically and from the sphere of Man's influence, present ideal opportunities to study comparatively simple, undisturbed terrestrial ecosystems. Most terrestrial biological research here has concentrated on aut- and synecology, and primary production, but little was known of the microbial flora in such ecosystems. Preliminary studies on decomposition of cellulosic materials by bacteria and fungi were carried out by the author in four contrasting plant communities in the Cumberland Bay area of South Georgia between 1977 and 1979.

A standard substrate was used to investigate the differences in cellulolytic activity in the soil and litter between the sites. Strips of specially woven cotton material (Walton and Allsopp, 1977) were placed vertically in the four sites from the surface to a depth of 20 cm in February and November 1977, and harvested at intervals. The loss in tensile strength of these strips along their length gives both an estimation of the variation of cellulolytic activity with depth at each site, and, by employing overlapping sequences of strips, information on the rate of decomposition for various periods of the year. The main study areas were a deep *Polytrichum alpestre*-dominated moss bank and a *Festuca contracta* grassland. The subsidiary study areas were a dense stand of the deciduous dwarf shrub, *Acaena magellanica,* and a *Tortula robusta–Rostkovia magellanica* bog. A number of strips, enriched with phosphate or nitrate, were used to study the speed of colonization of the strips at all the sites in the summer of 1979. As yet, less than one-third of the strips have been analysed but available results indicate that the new test cloth is of a superior quality to that previously employed (Latter and Howson, 1977). While a 50% reduction in tensile strength may take over a year at the moss-bank site and slightly less than a year at the grassland site, this loss can be achieved after only a month or two for some areas of the strips from the bog, and the greater part of each strip from the dwarf-shrub site loses practically all tensile strength.

To supplement the cotton-strip studies, an investigation of the local nutrient turn-over based on the decomposition of "natural" litter in litter bags of two mesh sizes at various depths has been in progress at the moss-bank and grassland sites since February 1977. At the moss bank, 36 bags each of two mesh sizes (1.5 mm^2 and less than 0.1 mm^2) and each containing *c.* 3 g of dried moss from the 2–10 cm level were inserted at three depths (0–5, 5–10 and 10–15 cm), and replicates have been removed at intervals over the following 2 years. At the grassland site, 45 bags of each of the two mesh sizes, each containing *c.* 3 g of dried *Festuca* culms (these being the least fungally pre-infected organs on the grass), were inserted at two depths (0–5 and 5–10 cm, effectively litter and A1 horizon) and replicates have been removed over the ensuing 2 years. Chemical analyses of the partly decomposed litter will be used to investigate the rates of decomposition of cellulose, hemicellulose, α-cellulose and lignin in the natural environment.

Agar-plate counts were used to determine the numbers of cellulolytic and ligninolytic organisms directly and to ascertain what proportion of the total populations these represented throughout the experimental period. A surface-spread technique was employed on replicate soil samples from both the moss-bank and grassland sites. Total numbers of bacteria were determined on 10% tryptone soya agar (plus actidione to inhibit fungi) and of fungi on Czapek-Dox agar (plus aureomycin to inhibit bacteria). To determine the proportions of these totals exhibiting cellulolytic activity, tryptone soya and Czapek-Dox agar plates, to which reprecipitated particulate cellulose had been added, were observed. Cellulolytic activity was then seen, after incubation, as an area of clearing around and under bacterial and fungal colonies. The presence

of ligninolytic organisms was detected by the use of an agar medium containing gallic acid. This shows a diffuse chestnut-brown coloration in the presence of polyphenol oxidases produced by bacteria and fungi, and indicates the probable ability to break down lignin. To check the reliability and reproducibility of the total plate-count methods, permanent stained slides of moss-bank and grassland material were made monthly following the methodology of Jones and Mollison (1948).

Respiration data were used as another means of assessing microbial activity. Monthly Gilson respiration studies were carried out at 10°C on the moss-bank and grassland sites from March 1977 to January 1979 and on these main sites, plus the subsidiary dwarf-shrub and bog sites, from October 1977 to January 1979. In all cases quadruplicate cores, 3.8 cm in diameter by 3 cm deep, from at least two levels at each site were investigated. Soil respiration rates at the dwarf-shrub site were consistently several times greater than at the other sites throughout the year with the highest rates measured corresponding to the parts of the profiles showing maximum cotton-strip decomposition.

Whilst investigating the major microbiological components influencing nutrient cycling on South Georgia, many isolates have been made from a previously unknown fungal and bacterial flora. Many of the fungi appear to belong to the Fungi Imperfecti but is is intended to identify as many species as possible. Chromobacteria appear to constitute an unusally high percentage of the bacterial flora. Using micro-meteorological data from the sampling sites, together with the respiration data and plate counts, it is hoped to explore the interactions between micro-climate and micro-organisms in relation to decomposition processes in these relatively simple systems.

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REFERENCES

JONES, P. C. T. *and* J. E. MOLLINSON. 1948. A technique for the quantitative estimation of soil micro-organisms. *J. gen. Microbiol.*, **2,** No. 1, 54–69.

LATTER, P. M. *and* G. HOWSON. 1977. The use of cotton strips to indicate cellulose decomposition in the field. *Pedobiologia,* **17,** No. 2, 145–55.

WALTON, D. W. H. *and* D. ALLSOPP. 1977. A new test cloth for soil burial trials and other studies on cellulose decomposition. *Int. Biodeterior. Bull.,* **13,** No. 4, 112–15.

STUDIES OF ARTHROPOD COLD HARDINESS

By W. BLOCK *and* L. SØMME*

THE mechanisms of cold hardiness were examined in six species of terrestrial arthropods (Collembola: 2, Acari: 4) at Signy Island, South Orkney Islands, during January–March 1980. Field samples were studied together with laboratory experiments on starvation and temperature acclimation, cold hardiness being assessed by measurement of individual supercooling points and analysis of polyols present in their body fluids. Supercooling is the extension of the liquid phase below the equilibrium freezing point of tissue fluids, and the supercooling point represents the temperature at which instantaneous death occurs in freezing-susceptible species. Death is detected by the temporary rise in body temperature associated with the release of latent heat when freezing occurs in the supercooled state. Preliminary analyses of glycerol were undertaken using paper chromatography, with further detailed GLC work being undertaken at the British Antarctic Survey, Cambridge, and at the University of Oslo to ascertain the concentrations of possible cryoprotectant compounds.

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