15 Soil Fauna of Antarctic Coastal Landscapes

I.D. Hogg and M.I. Stevens

15.1 Introduction

The endemic soil fauna of the maritime and continental Antarctic is taxonomically limited and consists almost entirely of arthropods, particularly the springtails (Collembola), and mites (Acari). Chironomid midges (Diptera) and beetles (Coleoptera) have also been recorded from the Antarctic Peninsula and the South Shetland, and Orkney Islands (Gressitt 1964; Balfour-Browne and Tilbrook 1966; Wirth and Gressitt 1967). Notable exceptions to this generalisation are the smaller protozoans, tardigrades, rotifers and nematodes, which are also commonly found in both continental and maritime areas (Gressitt 1965; Utsugi and Ohyama 1989; Bullini et al. 1994). Unfortunately, ecological work on these latter taxa is limited, and our focus here will be primarily on the larger, soil-dwelling arthropods.

Much of the information available on the soil fauna has come from reports documenting the fauna and/or describing new species (e.g. Janetschek 1963; Weiner 1980; Miller et al. 1988), with comparatively few studies examining ecological and physiological aspects (e.g. Matsuda 1977; Block 1985). More recently, interest has been targeted towards predicting the responses of invertebrates to environmental change (e.g. Block and Harrison 1995; Kennedy 1995) as well as evaluating patterns of diversity and dispersal among locations through studies of population genetics (e.g. Valbonesi et al. 1994; Frati et al. 1996). As we will discuss, these latter issues may be inextricably linked.

In this chapter we will discuss the invertebrate soil faunas of the continental and maritime Antarctic. We use the criteria and terminology of Holdgate (1977), referring to the Antarctic Peninsula and South Shetland Islands as ‘maritime’ and all other regions on the Antarctic coast (and inland) as ‘continental’. In keeping with the theme of this volume we pay particular attention to those taxa associated with the continental coastal regions (Windmill Islands and Ongul Island) of East Antarctica and those of the South Shetland Islands. The remainder of the chapter will consist of five sections. Sections 15.2–15.3 will compare and contrast the faunal composition of soil invertebrates from the two regions, and discuss ecological and physiological factors affecting their distribution. Section 15.4 will consider the interhabitat
dispersal of taxa as well as the role of population genetic studies in assessing levels of gene flow among habitats. For this purpose we will also draw on our own and other data from habitats in and around Victoria Land in the Ross Sea sector. Section 15.5 will discuss the potential responses of the soil fauna to environmental changes resulting from both global (e.g. enhanced greenhouse effect) and local disturbances (e.g. habitat destruction), and finally Section 15.6 will provide a summary of further research needs.

15.2 Faunal Composition

From the earliest Antarctic expeditions, several reports have described, added to and revised the inventories of soil invertebrates (e.g. Willem 1902; Salmon 1962; Greenslade and Wise 1984). Perhaps the most comprehensive lists have been provided by Wise (1967, 1971) for the Collembola, and Hunter (1967), Strandtmann (1967) and Wallwork (1967) for the mites. To date, roughly 15 species of springtail and 25 species of mites have been recorded from the Antarctic continent. Of these, only two species of springtail and six species of mite have been recorded from Ongul I. and Windmill Is. (Tables 15.1, 15.2, respectively). The nearby maritime regions (e.g. South Shetland Islands), have recorded higher levels of taxonomic richness with 16 species of springtail and 36 species of mite found on the South Shetland Islands alone (Tables 15.1, 15.2). These lists are undoubtedly incomplete and will continue to be modified, particularly with the advent of molecular taxonomy (e.g. Valbonesi et al. 1994). Such studies have been able to assess diversity to levels previously unattainable, and have frequently revealed the existence of previously unknown, morphologically cryptic species (e.g. Valbonesi et al. 1994; Carpelli et al. 1995a, 1995b).

The taxonomic richness seen throughout maritime and continental Antarctica contrasts with the considerably greater species richness found on the Subantarctic islands (e.g. Crozet, Kerguelen, Heard, Marion, Bird and Macquarie Islands) where between 50–150 species of land arthropods have been recorded. It is evident that Subantarctic islands contain mostly cosmopolitan species (Greenslade 1987; Greenslade and Wise 1984; Greenslade and Wise 1986). The same is also true for maritime regions and Marshall and Pugh (1996) noted that of the total number of mite species found in the maritime Antarctic, 42.5 % are endemic, contrasting with 85.7 % for continental Antarctic. Within the maritime Antarctic, the South Shetland Islands may harbour among the greatest diversities of soil invertebrates. Block and Starý (1996) found that 19 % of all oribatid mite species recorded in the maritime regions were found in the South Shetland Islands, the highest of any of the sites they surveyed. The status of the beetle taxa (endemic or introduced) remains uncertain (Balfour-Browne and Tilbrook 1966), and at least two other species