



Review paper

The terrestrial and freshwater invertebrate biodiversity of the archipelagoes of the Barents Sea; Svalbard, Franz Josef Land and Novaya Zemlya



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ABSTRACT

Arctic terrestrial ecosystems are generally considered to be species poor, fragile and often isolated. Nonetheless, their intricate complexity, especially that of the invertebrate component, is beginning to emerge. Attention has become focused on the Arctic both due to the importance of this rapidly changing region for the Earth and also the inherent interest of an extreme and unique environment. The three archipelagoes considered here, Svalbard, Franz Josef Land and Novaya Zemlya, delineate the Barents Sea to the west, north and east. This is a region of convergence for Palearctic and Nearctic faunas re-colonising the Arctic following the retreat of the ice after the Last Glacial Maximum (LGM). Despite the harsh Arctic environment and the short period since deglaciation, the archipelagoes of the Barents Sea are inhabited by diverse invertebrate communities. But there is an obvious imbalance in our knowledge of many taxa of each archipelago, and in our knowledge of many taxa. Research effort in Svalbard is increasing rapidly while there are still few reports, particularly in the western literature, from Franz Josef Land and Novaya Zemlya. Nevertheless, there appears to be a surprising degree of dissimilarity between the invertebrate faunas, possibly reflecting colonization history. We provide a baseline synthesis of the terrestrial and freshwater invertebrate fauna of the Barents Sea archipelagoes, highlight the taxa present, the characteristic elements of fauna and the complexity of their biogeography. In doing so, we provide a background from which to assess responses to environmental change for a region under increasing international attention from scientific, industrial and political communities as well as non-governmental organizations and the general public.

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1. Introduction

Arctic terrestrial ecosystems are often considered to be species poor and fragile. The high latitude archipelagoes of the Barents Sea are also isolated due to their geographic separation from Eurasia. Nonetheless, their intricate complexity, especially that of the invertebrate component of their communities, is beginning to emerge. The known terrestrial and freshwater invertebrate fauna of the Svalbard archipelago currently contains over 1000 named species (Coulson and Refseth, 2004; Coulson, 2007a, 2013b).

Investigations of poorly sampled regions within the islands along with studies of genetic diversity, including identification and quantification of cryptic speciation, are likely to lead to considerable increases in invertebrate diversity estimates (Ávila-Jiménez, 2011). The existing species inventories also suffer from taxonomic limitations, in particular relating to unidentified synonymies and misidentifications (Coulson, 2007a; Ávila-Jiménez et al., 2011; Bayartogtokh et al., 2011) and detailed knowledge of the distributions and biogeography of the majority of invertebrate species remains limited. Even in comparatively well-known regions such as western Svalbard, the publication of new species records for the archipelago is frequent, and new taxa continue to be formally described (e.g. Pilskog, 2011; Chauvet et al., 2013; Gwiazdowicz et al., 2012a, 2012b; Kaczmarek et al., 2012b). Just as with the uncertainties applying to Svalbard, the diversity of the Russian archipelagoes of Franz Josef Land and Novaya Zemlya remains understudied, while much of the information that is available is not readily accessible in the western (English language) literature.

It is clear that the invertebrate community plays a central role in many key ecosystem processes, such as nutrient cycling, energy flow, decomposition, herbivory, pollination and parasitism (Petersen and Luxton, 1982; Speight et al., 1999; Bardgett, 2005; Evensen et al., 2005; Ott et al., 2012). However, the relationship between species (alpha) diversity and ecosystem function often remains unclear despite considerable debate around the importance, or otherwise, of 'functional redundancy' in maintaining ecosystem stability (Brussaard et al., 2007). Polar (Arctic and Antarctic) ecosystems are considered to be

particularly valuable for studies addressing such fundamental questions of ecosystem function, providing examples across a wide range of levels of assemblage structure (Hodkinson et al., 2003, 2004; Adams et al., 2006; Post et al., 2009). In the context of these ecosystems, the relatively high species-level biodiversity of the terrestrial and freshwater ecosystems of the High Arctic (in comparison, for instance, with those of Antarctic regions; Convey, 2007, 2013) may provide them with a robustness and stability to the characteristically large annual variation in climate and hence also provide resilience to environmental change. Nonetheless, despite this possibly inherent resilience to natural environmental variability, these High Arctic systems may be particularly vulnerable to human disturbance (Jónsdóttir, 2005) predominantly due to lengthy recovery and regeneration times.

Attention has recently become focused on the Arctic due both to the importance of this rapidly changing region and to the inherent interest of an extreme and unique environment. Perhaps nowhere is this more evident than in Svalbard with the establishment of the Kongsfjorden International Research Base (KIRB) at Ny-Ålesund. Nevertheless, despite close to 600 published articles concerning the invertebrate fauna of Svalbard (Coulson, 2007a, 2013a, 2013b), research has largely been fragmented and individual, with little attempt at large scale coordination. Hence there is a disparity in our knowledge between the charismatic and the less studied taxa. The recent publication of species inventories (e.g. Coulson, 2007a; Ávila-Jiménez et al., 2011) have highlighted the Svalbard archipelago as having perhaps the most complete inventory of the invertebrate fauna of any Arctic region (Hodkinson, 2013). Nonetheless, an overall synthesis is lacking, either for Svalbard itself, or for the archipelagoes of the wider Barents Sea region. Now is a particularly opportune moment to provide such a synthesis, with a recent consideration of the Arctic invertebrate fauna calling for the establishment of an inventory of Arctic species as a high priority (Hodkinson, 2013). Moreover, the quantity of invertebrate studies is increasing rapidly, as is the importance of Svalbard as a High Arctic research platform, including the current agenda within Norway to establish the eastern regions of Svalbard as a "reference area for research" (Ministry of Justice and the Police, 2009) and the planned

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