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On the oribatid and mesostigmatid mites (Acari) of the High Arctic island of Hopen

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Abstract: The archipelago of Svalbard in the European High Arctic lies on the convergence of the Palaearctic and Nearctic flora and fauna and contains elements of both regions. The island of Hopen is located in the south east of the archipelago within the path of the cold south-westerly flowing East Svalbard Current originating in the Arctic ocean and flowing along the north Russian coast. This current is postulated as a colonization route of the invertebrate fauna of Svalbard. Few reports of the terrestrial invertebrates of Hopen exist and none of the mite suborders Oribatida or Mesostigmata. With the taxonomic confusion existing in the inventories of this important region of the Arctic, new sampling campaigns with species identified by modern taxonomic principles and with material deposited in accessible museums and collections are essential. Identified mites included six species of oribatid mites with *Diapterobates notatus* dominating, and five species of Mesostigmata with *Zercon forsslundi* forming the dominant species. None of the species collected was a new record for Svalbard and all have wide circumpolar, Palaearctic or Holarctic distributions. Dispersal to Svalbard from northern Russia is hence neither supported nor rejected. The expected oribatid and mesostigmatid diversity of the island is greater than observed from the limited sampling described here.

Key words: Arctic, Svalbard, Hopen, Acarina, diversity, dispersal.

Introduction

The island of Hopen lies 76°33’ N, 25°07’ E in the European High Arctic and forms a part of the archipelago of Svalbard, approximately 200 km east of the

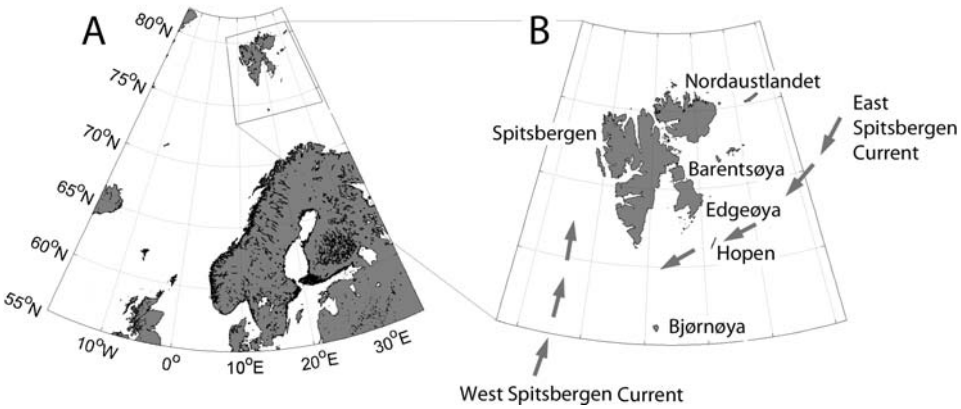

Fig. 1 **A**. The location of Svalbard in the European High Arctic. **B**. the position of Hopen in the archipelago and the directions of movement of the main ocean currents.

southern tip of the principle island, Spitsbergen (Fig. 1). Hopen is a long, narrow island some 34 by 2.5 km (47 km^2) consisting of several plateau shaped mountains between 200 and 370 m.a.s.l. and with a north-east south-west orientation. Twenty six species of vascular plants are recorded from the island (Sykes 1989) forming a community typical of the northern Arctic tundra widespread in the rest of Svalbard (Jónsdóttir 2005). Svalbard has one of the most up to date invertebrate species inventories for any region of the Arctic (Hodkinson 2013), but the inventories are derived from surveys largely conducted along the west coast with very few from the more remote eastern regions (Coulson 2013). In particular, only scarce descriptions of the invertebrates of Hopen exist (Linnaniemi 1935; Fjellberg 1984; De Smet 1990; Beyens and Chardez 1995; Van Rompu and De Smet 1996) and none reports the oribatid or mesostigmatid fauna. Although some 81 species of Oribatida are recorded from Svalbard as a whole (Bayartogtokh *et al*. 2011), it is likely that the actual diversity is substantially lower, due to confusion and uncertainty in the literature (Coulson and Refseth 2004). The Mesostigmata diversity is better known, having been recently revised, with 22 species listed by Ávila-Jiménez *et al*. (2011), yet new species are constantly being recorded for the archipelago and the current list has increased to 29 species (Ávila-Jiménez *et al*. 2011; Gwiazdowicz *et al*. 2012; Coulson *et al.* 2014).

The invertebrate species diversity of the western and eastern regions of Svalbard is suggested to be dissimilar (Coulson 2013) and Svalbard is a region of coalescence between the Palaearctic and Nearctic faunas and floras. In the south east of the archipelago, Hopen lies in the path of the cold oceanic current, the East Spitsbergen Current, which sweeps south-west transporting driftwood and other material originating from the great Russian rivers. Moreover, Bjørnøya (Bear Island), in the far south of the Svalbard archipelago, may represent a natural boundary between High Arctic and Arctic faunas, since the mesostigmatid mites *Zercon*

Table 1

Species and number of individuals of oribatid and mesostigmatid mites identified from Hopen. *Liochthonius sellnicki* was not differentiated by stage.

Species	Total	Density (ind./m^2)	Stage			Distribution
			adult	nymph	larva	
Oribatida						
Liochthonius sellnicki (Thor, 1930)	113	2,825	–	–	–	Holarctic
Liochthonius sp.	1	25	1	0	0	–
Oppiella translamellata Willmann, 1923	1	25	1	0	0	Holarctic
Camisia foveolata Hammer, 1955	15	375	6	8	1	Holarctic
Ceratoppia sphaerica (L. Koch, 1879)	1	25	0	0	1	Holarctic
Diapterobates notatus (Thorell, 1871)	324	8,100	171	111	42	Holarctic
Mesostigmata						
Antennoseius oudemansi (Thor, 1930)	1	25	1	0	0	Circumpolar
Arctoseius haarlovi Lindquist, 1963	1	25	1	0	0	Circumpolar
Arctoseius multidentatus Evans, 1955	1	25	1	0	0	Circumpolar
Zercon forsslundi Sellnick, 1958	207	5,175	99	92	16	Palaearctic
Zercon solenites Haarløv, 1942	31	775	24	6	1	Circumpolar

andrei Sellnick, 1958 and *Zerconopsis muestairi* (Schweizer, 1949) are recorded here but have yet to be observed in the principal islands located some 250 km to the north (Ávila-Jiménez *et al*. 2011). Both species have a central European distribution (Karg 1993). Since it is clear that many terrestrial invertebrates may survive extended periods exposed to ocean water (Coulson *et al*. 2002), these ocean currents may partially determine the observed differences in invertebrate biodiversity by acting as a dispersal mechanism (hydrochory) to isolated islands from mainland source populations (Gillespie *et al.* 2012). Community analysis of Hopen, this remote island in the European Arctic, may shed further light on the post-glacial colonization, dispersal and dispersal routes of the fauna and flora not only to Svalbard but the Arctic in general (Pugh and McInnes 1998; Ávila-Jiménez and Coulson 2011). We hypothesized that invertebrate species originating from northern Russia, and absent along the western margins of Svalbard, may occur in the eastern regions of the archipelago, and therefore are presenting information on the first identified species of Oribatida and Mesostigmata from the island of Hopen.

Materials and methods

Four soil samples, approximately 10×10 cm in size, were collected from grass/moss tundra close to the Norwegian Meteorological Institute station on Hopen (N 76°30’31.8”, E 25°00’55.7”) and the shipping navigation beacon at Koefoedodden (N 76°27’18.2” E 24°58’23.5”) (Fig. 1) in September 2008. The mite fauna was ex-

tracted from the samples into 96% alcohol in a Tullgren-type system at the University Centre in Svalbard. Identification of oribatid species followed Colloff (1993: *Camisia foveolata*), Weigmann (2006: *Liochthonius sellnicki*, *Oppiella translamellata*), Bayartogtokh *et al*. (2011: *Ceratoppia sphaerica*, *Diapterobates notatus*). *Liochthonius* individuals were not differentiated by stage. Mesostigmata identification follows Evans (1955) and Gwiazdowicz *et al.* (2011a, b). Material is deposited at University Centre in Svalbard (UNIS), Longyearbyen, Norway.

Results and discussion

Six species of oribatid mites were identified (Table 1). Two species, *Liochthonius sellnicki* (Thor, 1930) and *Diapterobates notatus* (Thorell, 1871), occurred in the greatest densities. Four other species: *Oppiella translamellata* Willmann, 1923, *Camisia foveolata* Hammer, 1955, and *Ceratoppia sphaerica* (L. Koch, 1879), were noted but at far lower numbers (Table 1). All six species are known from other locations in Svalbard (Bayartogtokh *et al*. 2011) and have Holarctic distributions, but *C. sphaerica* is restricted to the Holarctic (Bayartogtokh *et al*. 2011). Their occurrence on Hopen was therefore not surprising, especially since they are a common element of the invertebrate fauna within the Svalbard archipelago (Coulson and Refseth 2004 and references therein).

Five species of mesostigmatid mites were collected: *Antennoseius oudemansi* (Thor, 1930), *Arctoseius haarlovi* Lindquist, 1963, *Arctoseius multidentatus* Evans, 1955, *Zercon forsslundi* Sellnick, 1958, and *Zercon solenites* Haarløv, 1942 (Table 1). Most mesostigmatid mites occurred in very low densities and only *Z. forsslundi* appeared in high numbers. As it was with the oribatid mites, the mesostigmatids have wide distributions being generally circumpolar; only one species, *Z. forsslundi*, is restricted to the Palaearctic (Table 1). Species diversity of both Oribatida and Mesostigmata was low, but it is almost certain that additional species occur on Hopen. Here we can only confirm the presence of these six oribatid and five mesostigmatid mites. Similarly, little confidence should be applied to the estimated densities due to low sample numbers.

It is generally believed that the invertebrate fauna of Svalbard is relatively young (Coulson *et al.* 2014) and that it has colonized the islands in the last 10–15 000 years since the retreat of the ice (Lubinski *et al*. 1999; Ingólfsson and Landvik 2013). Dispersal via oceanic currents is often suggested to explain the presence of the flora and fauna on these islands (Gillespie *et al*. 2012). Since the eastern and western margins are influenced by different oceanic currents (Fig. 1) it is possible that the invertebrate fauna on both coasts may originate from different source populations. The few articles that describe the terrestrial invertebrate fauna in the eastern regions of Svalbard indicate that these communities contain elements absent in the western part of the archipelago (Fjellberg 1997; Zawierucha *et al*. 2013). How-

ever, all of the 11 mite species identified here are also known from other regions in the Svalbard archipelago (Coulson and Refseth 2004 and references therein; Coulson 2007; Ávila-Jiménez *et al*. 2011) and have widespread distributions (Table 1). There is therefore no clear evidence that the mite fauna of Hopen has dispersed to Svalbard from northern Russia. Similarly there is no evidence that these taxa could be introduced by humans although the sampling sites were located in the vicinity of human activities. Molecular studies may yet reveal source populations, but dispersal processes will be more difficult to ascertain. Natural colonization of an island is a complex and accidental process (Jacot 1934; Coulson *et al*. 2013), and such small organisms as mites may be transported by seabirds (Lebedeva 2012) as well as by ocean currents and driftwood.

There are few other studies on the invertebrates of Hopen by which we can set these results in context. Fjellberg (1984) collected 12 species of Collembola from the island but, as with our results on the mites, none of these 12 collembolan species are restricted to a particular region of Svalbard and they have generally also wide Holarctic or Palaearctic distributions (Fjellberg 1998, 2007). The same is true for the Tardigrada which are also either cosmopolitan or have Holarctic distributions (Van Rompu and De Smet 1996). Although one species, *Pseudechiniscus islandicus* (Richters, 1904), is so far recorded only from Hopen within the Svalbard archipelago (Zawierucha *et al.* 2013) it is considered a mountainous species (Ramazzotti and Maucci 1983) and is also known from Scotland, Shetland, Faroe Islands and Greenland (Van Rompu and De Smet 1996). Beyens and Chardez (1995) reported 15 species of Arctic testate amoebae from Hopen, but all are known from other locations in Svalbard and all have wide circumpolar distributions. The Rotifera were examined by De Smet (1990), who collected 14 taxa and recorded six species new to Svalbard. All of them were considered cosmopolitan taxa with the exception of *Notholca latistyla* (Olofsson, 1918) with a distribution restricted to the Arctic.

There is a taxonomic confusion in the oribatid mite checklist for Svalbard; many of the species names may be synonymies or misidentifications. For example, in the oribatid species list of Subías (2004, updated 2013), *Oppiella translamellata* was treated as a junior synonym of *Moritzoppia neerlandica* (Oudemans, 1900), an opinion shared by Bayartoktogh *et al.* (2011). Weigmann (2006) listed both names as valid species, but did not deny possible synonymy. Accurate inventories are required to better understand ecosystem functioning, species redundancy and response to environmental change. However, since many of the original specimens collected and identified are missing, or have been deliberately destroyed, re-examination is not possible. Hence, new sampling, such as the results presented here, is required with specimens identified using modern taxonomic concepts and with individuals deposited in appropriate museums and collections. The accuracy of such invertebrate inventories will enhance the importance of this region for Arctic ecological studies.

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