An oribatid species *Provertex kuehnelti* Mihelčič, 1959 (Acari, Oribatida) new to Fennoscandia

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The soil living oribatid *Provertex kuehnelti* Mihelčič, 1959 was sampled for the first time in Fennoscandia in the western part of Norway at Dalsnibba (Møre og Romsdal). We found seven individuals in pit fall traps during the snow free period of 2009. The specimens were sampled on a ridge 1332.2m.a.s.l. Between 15 July and 12 August 2009 three adults, one shell of an adult and three juveniles of *P. kuehnelti* were sampled. Up until now, the species was only known from alpine sites in Austria, Northern Italy and the Czech Republic. The distribution of *P. kuehnelti* should therefore be regarded as boreo-alpine.

Key words: Oribatid mite, *Provertex kuehnelti,* boreo-alpine, Norway, Fennoscandia.

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† While working on this manuscript, Torstein Solhøy passed away unexpectedly. He inspired us to undertake the present study and contributed many comments and suggestions. We dedicate this publication to the memory of this outstanding person.

Introduction

The implemented pit fall trap sampling is part of our long-term alpine ecosystem research project (LTAER) in Norway (for further information sees e.g. Löffler 2003, 2005, 2007, Pape *et al*. 2009, Finch & Löffler 2010, Wundram *et al*. 2010). Here, we present our findings on *Provertex kuehnelti* Mihelčič, 1959, a species new to Fennoscandia. Altogether seven individuals of *P. kuehnelti* were found: **MRI**, Geiranger: Dalsnibba (UTM 32VL 409969.09 6879489.67) 15 July–12 August 2009, leg. N. Hein.

Provertex kuehnelti was originally described as *Provertex kühnelti* (regarding the correct name spelling see International Code of Zoological Nomenclature 2000: Chapter 7: Formation and treatment of names, Article 32.5.2.1.) from Eastern Tyrol, Austrian Alps (Mihelčič, 1959). A detailed re-description based on the type specimen and additional material is given by Krisper & Schuster (2009). Mihelčič (1966) describes *P. kuehnelti* as a saxicole species that prefers warm and dry habitats.

Material & Methods

Due to the north-south extension of the Scandinavian Mountains Norway is divided into an oceanic and a continental part (Figure 1). Our research area "Geiranger" (Møre og Romsdal) is located in the western, inner-fjord area. The oceanic, western part of Norway is characterized by relatively high precipitation of around 1.500–2.000mm (Moen 1999). According to Moen (1999) the area around Geiranger is part of O1 the „slightly oceanic section". Above the treeline, around 840m.a.s.l. the alpine environment covers an altitudinal low to middle alpine gradient up to the highest peak here: Mt. Dalsnibba, 1497m.a.s.l. The transition zone between the low and middle alpine belt is situated around 1150m.a.s.l.

Vegetation analysis was implemented with a frequency method. The frequency of a single species was determined by getting presence/absence data of four single 1m² plots. Each plot was divided into 25 equally sized squares; the frequency was then determined by simply counting the squares in which a certain species occurred and consequently calculating the presence in percentages (Kratochwil & Schwabe 2001). Air and soil temperatures were measured at three different heights (+100cm and +15cm above, and -15cm below ground level); while soil moisture was measured at the depth of -15cm below ground level with the help of HOBO data loggers (Onset Corp., USA). For temperature measurements HOBO S-TMB-M002 sensors with an accuracy < ± 0.2°C were used. For soil moisture measurements, a HOBO S-SMA-M005 sensor with an accuracy of ±4% was used. The climatological results displayed in this paper are those from 1 January–31 December 2010, giving hourly mean temperatures and soil moisture values, respectively. To describe the overall habitat conditions including the minimum and maximum of a single variable during one year, we chose to discuss our findings with the climatological data from 2010. Three pitfall traps with saturated salt solution as a preservative and Agepon© as a detergent were installed at the sampling site during the snow free period from 21 May–23 September. Pitfall traps were emptied on biweekly basis and their content was transferred to 70% ethanol for preservation.

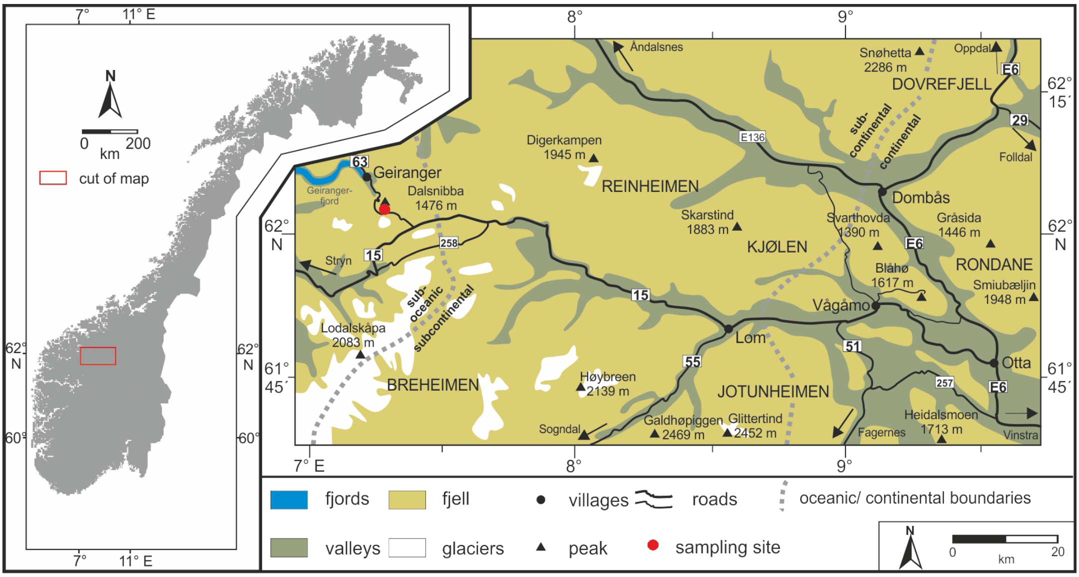

FIGURE 1. Map of Norway with focus on the research site at Dalsnibba near Geiranger (Møre og Romsdal). The sampling site at 62° 4′ 43″ N, 7° 17′ 35″ E where *P. kuehnelti* Mihelčič, 1959 was found is marked with a red dot (after Löffler & Pape 2004).

Habitat description

The sampling site of *P. kuehnelti* is located at a ridge 1333.2m.a.s.l. This elevation is part of the middle alpine belt in the western, oceanic part of Norway (Figure 1). The lichen coverage at this certain site is dense, but there is still some open ground and rocks. A lack of chionophilous species refers to little or no snow cover in winter (Table 1); this is supported by our near-ground climate data (Figure 2). Hourly means of air and soil temperatures and of soil moisture are displayed in Figure 2. The respective mean, minimum and maximum temperatures for 2010 are given in Table 2. The annual mean temperature is below -2°C. Especially the very low soil temperature of -14°C during winter indicates snow free conditions during periods of severe frosts. In addition, the annual temperature amplitudes at the three different heights are pronounced. The highest amplitude is found at +15cm with almost 45K. Here, the vegetation, open ground and rocks are influencing the near-ground air temperatures. At +100cm this influence declines, which results in a lower amplitude of approximately 40K.

The sampling site is located next to the road to the Dalsnibba peak, which is visited by a vast amount of tourists every year during summer. Reindeer grazing is also common in the area (Pape & Löffler 2012). Disturbance of the vegetation resulting in changes of the composition of species can therefore not be ruled out although not traced directly.

TABLE 1. Results of the vegetation analysis at the ridge site. Species frequency (%) is the mean of four different plots each consisting of 25 subplots (=100) measured during 2009. The given growth height is the mean of the highest four individuals of a certain plant group that was present in one of the four vegetation plots. Species are sorted by frequency in descending order.

Species	Frequency (%)	Height (cm)
Shrubs		8
Salix herbacea	63	
Empetrum nigrum ssp. *hermaphroditum*	49	
Phyllodoce caerulea	18	
Grasses		35
Juncus trifidus	89	
Carex bigelowii	49	
Deschampsia flexuosa	10	
Festuca ovina	7	
Poa alpina ssp. *vivipara*	1	
Lichens		6
Cetraria ericetorum	100	
Cladina arbuscula	100	
Cetraria nivalis	86	
Stereocaulon spec.	80	
Cladonia spec.	71	
Cladina rangiferina	45	
Ochrolechia frigida	30	
Thamnolia vermicularis	27	
Cladina uncialis	17	
Cladina stellaris	7	
Cetraria cucculata	3	
Solorina crocea	2	
Mosses		2
Kiaeria starkei	80	
Conostomum tetragonum	39	
other Bryophytes	27	
Herbs		4
Hieracium alpinum	17	
Huperzia selago	7	
Rocks	20	
Open ground	8	

Discussion

The results show that *P. kuehnelti* has to cope with periods of both relatively low/high temperatures and the risk of both desiccation and strong precipitation events. During winter, the prevailing wind speed leads to snow free ridges and snow accumulation in depressions. This can be seen in Figure 2, which reveals long periods (January–April and November–December) with soil temperatures below 0°C. The lack of snow cover during winter results in relatively low temperatures even at -15cm depth.

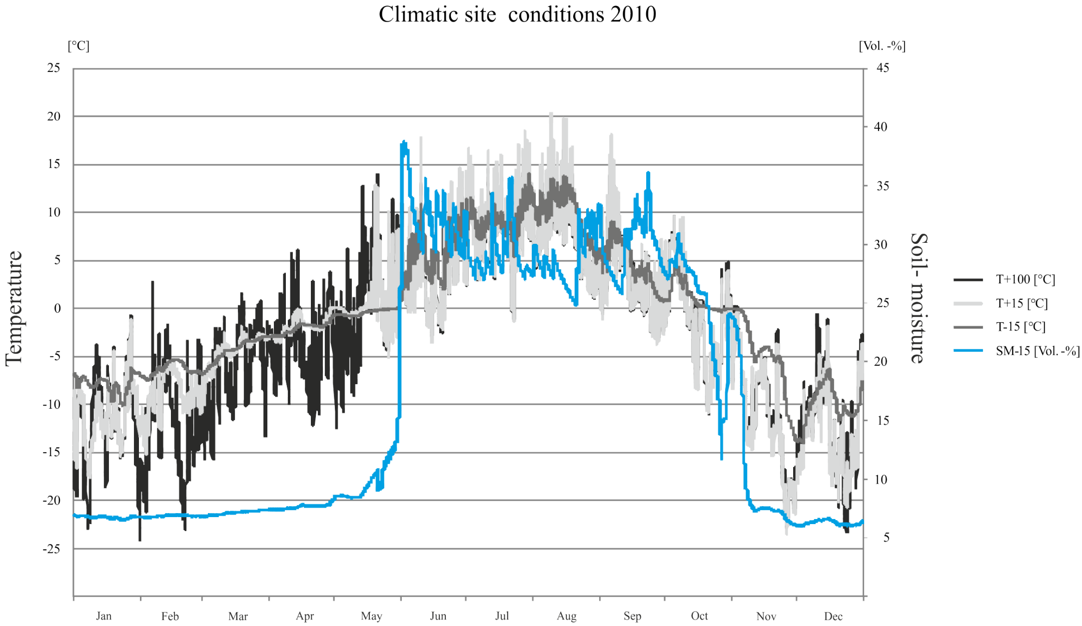

FIGURE 2. Near ground environmental conditions at the research site. Mean hourly air and soil temperatures [°C] as measured at three different heights, 100cm above ground level (T-100), 15cm above ground (T+15), in -15cm depth (T-15) and soil-moisture in -15cm depth (SM-15) [Vol.-%] are shown for the period from 1 January–31 December 2010.

The overwintering conditions at a middle alpine ridge site in this area are severe, with a minimum temperature of -14°C in 2010. Temperatures above 10°C are reached several times during the summer. Temperatures at +15cm often reach more than 15°C. Thus, *P. kuehnelti* has to deal with high annual temperature amplitudes of around 40K. Such amplitudes are well known phenomena in alpine environments (Barry 1992, Löffler *et al.* 2006). It is clear that ridges represent one of the most extreme sites in the alpine environment (Löffler *et al.* 2006). *P. kuehnelti* obviously must have some remarkable adaptation strategies to cope with these severe alpine conditions. The results given here and former findings indicate that *P. kuehnelti* is euryoecious. Schuster (1997) found *P. kuehnelti* in Austria at a southern exposed slope in dry moss and lichen vegetation at the base of the Traunstein, an isolated calcareous mountain on the northern edge of the Alps in Upper Austria. In addition, this species inhabits crevices and in the Austrian Alps it has an altitudinal distribution from 480–2790m.a.s.l. (Krisper & Schuster 2001). Due to these facts, we expect *P. kuehnelti* to inhabit a wider range of alpine habitats in Fennoscandia.

According to Weigmann (2006), this species was known from Austria and the Czech Republic. Mihelčič (1966) reported additional records from xerothermous sites in the Italian Karst near Trieste and Gorizia. Recently, *P. kuehnelti* was also found in the Dolomite Alps (Prov. Bolzano, Northern Italy) on the Sciliar massiv at 2250m.a.s.l. in a cushion plant (Schatz 2008). Our new findings indicate a boreo-alpine distribution for *P. kuehnelti.* Boreo-alpine refers to a disjunctive distribution with a southern and northern areal. Species with a boreo-alpine distribution usually populate high elevation sites in the southern or middle European mountains. In the northern area these species usually populate the lowlands, even though some boreo-alpine species may occur at high elevation sites in both the southern and the northern areal (Holdhaus 1912). The statement of Subías (2004) concerning distribution of *P. kuehnelti* in Central and South Europe ("Europa centromeridional") is not correct. No records from South Europe are known; probably this statement refers to the findings in the Northern Italian Alps.

TABLE 2. Annual mean temperatures for 2010 at the research site giving average annual means, minimum and maximum temperatures, as calculated from the hourly means. *Values for soil moisture were derived from those from the non-frozen period. We chose a temperature threshold of 0.5°C at -15cm depth to define this period (31 May–16 October 2010).

	T+100[°C]	T+15[°C]	T-15[°C]	SM-15[Vol.%]
min	-24.0	-23.4	-14.0	17.1
mean	-2.7	-2.0	-0.4	29.7
max	16.8	20.3	14.0	38.7

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