Den site selection of alpine predators in relation to altered snow conditions

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Introduction

With climate change both snow structure and the duration of snow cover might change, possibly impacting placement of den sites in arctic fox (*Alopex lagopus*) and wolverine (*Gulo gulo*), and affecting their ability to breed successfully. Wolverines and arctic foxes have a circumpolar distribution where they inhabit the arctic and subarctic region (Landa et al. 2000; Hersteinsson & Macdonald 1992); in addition wolverine distribution seems to coincide with the snow covered areas in May (Aubry et al. 2007; Copeland et al. 2010). The wolverine is the only non-hibernating large carnivore of the northern hemisphere giving birth in winter (March) whereas the arctic fox gives birth early spring (May). Natal den sites of wolverines are generally located on steep mountain sides with snow tunnels reaching down to crevasses under rocks, fallen logs or along overhangs (May 2007; Magoun & Copeland 1998). Conversely, den sites in arctic foxes and red foxes are associated with underground dens with shallow snow cover (Prestrud 1992). Herewith we investigated whether den site selection in wolverines and arctic foxes can be related to snow cover during winter and spring. In addition, temperature and humidity loggers (WatchDog 100 T/RH, Spectrum Technologies, Inc.) have been placed at known wolverine and arctic fox den sites in order to relate the placement of den sites to snow cover and exposure on a micro-scale.

Methods

We estimated the start and end of the snow-covered period for each den site that had a data logger using broken-line regression with two nodes. Broken-line regression essentially fits three separate lines through the data. Before and after the first and second node, respectively, a linear relationship was assumed. For relative humidity the log-likelihood function of the broken-line regression was optimized for a linear function in-between the two nodes. For temperature, the log-likelihood was optimized for a quadratic function in-between the two nodes. From the best fit, the locations of the two nodes signify the start and end date of the snow-covered period. The optimization was carried out preferably on both parameters simultaneously; however in some cases one of the parameters (especially temperature) did not render a stable fit. Then the dates were adjusted using only one parameter.

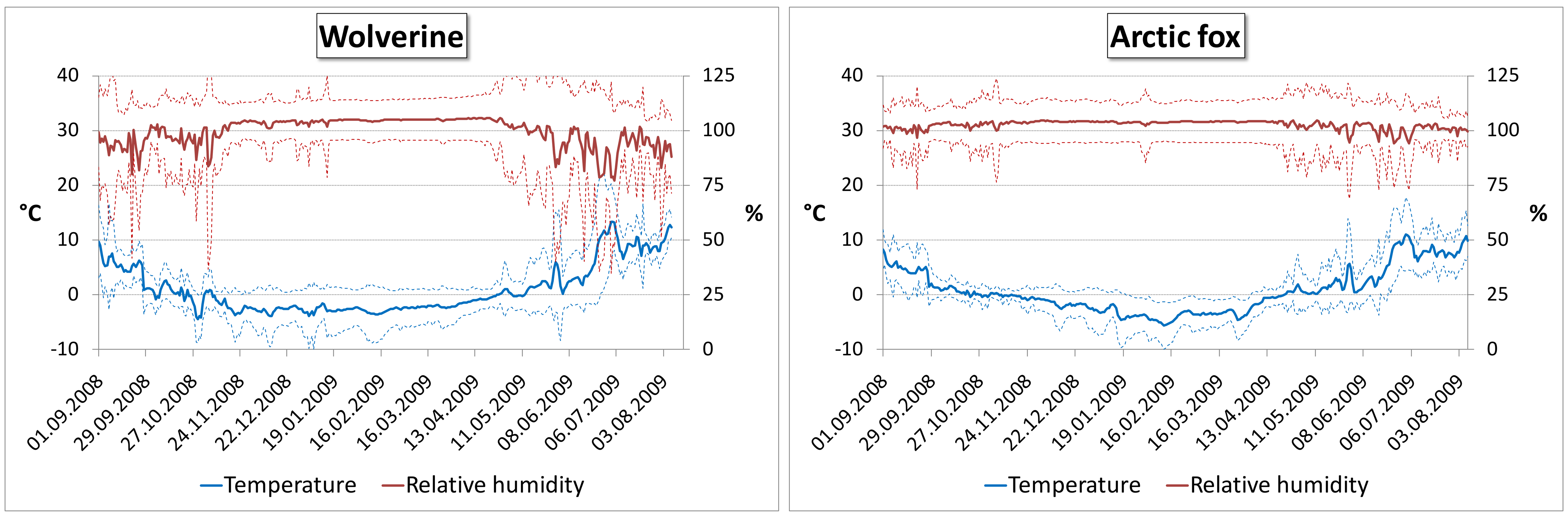

Figure 1. *Average fluctuations in temperature and relative humidity (± 95% C.I.) for wolverine (n=11) and arctic fox (n=12) den sites in central-Norway.*

Preliminary results

1) Wolverine dens are placed in such way that a very stable temperature and humidity arises when the den site is covered by snow which was less prominent for arctic fox dens, especially for temperature (Fig. 1).
2) The snow-covered period for wolverines encompassed 194 days (12.11.2008 - 25.5.2009, ± 7 days SE, n = 11). For arctic fox the snow-covered period encompassed 213 days (08.10.2008 - 09.5.2009, ± 7 days SE, n = 12).
3) Arctic fox den sites were on average snow-covered earlier than wolverine den sites (t = 2.93, P = 0.008).
4) Arctic fox den sites overtaken by red fox were earlier free of snow relative to those not overtaken (t = 2.87, P = 0.017).

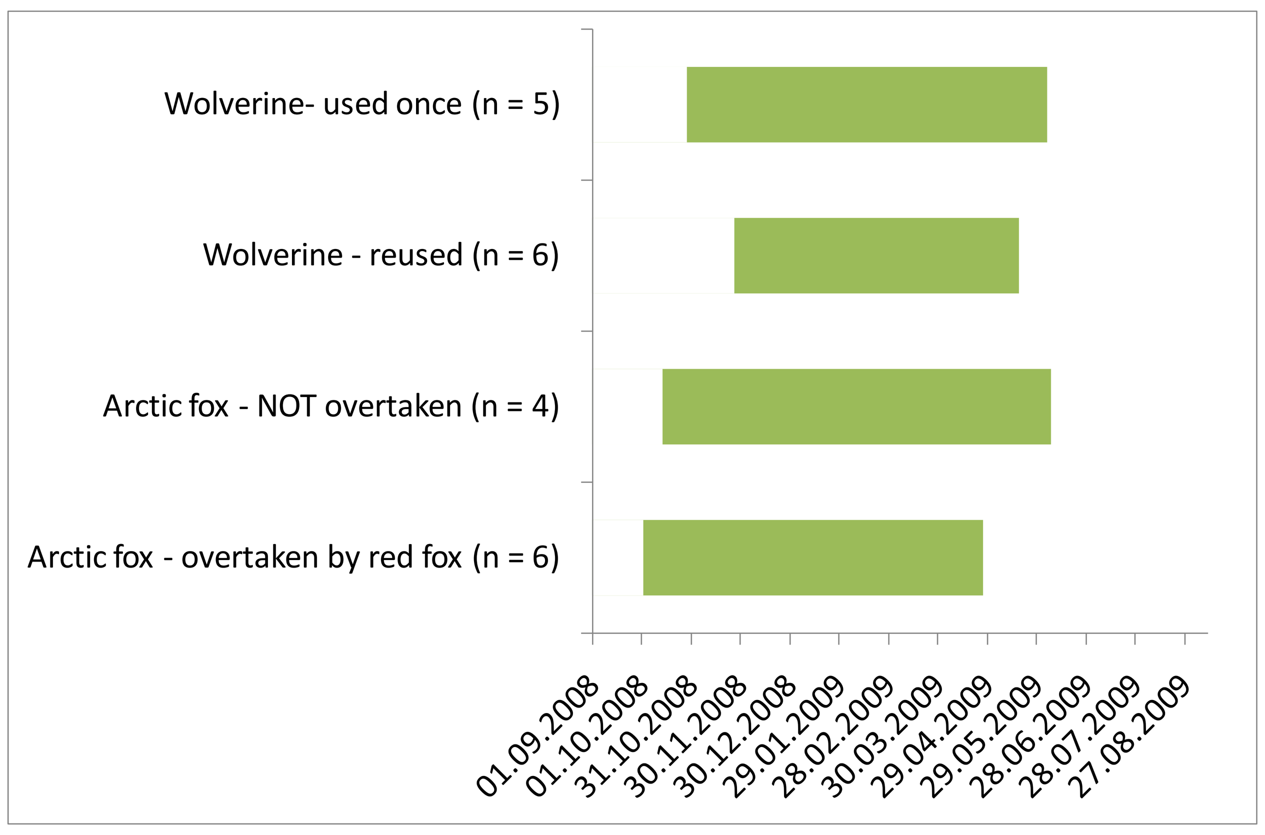

Figure 2. *Onset and duration of the snow-covered period for wolverine and arctic fox den sites in central-Norway.*

References

Landa et al. 2000; Hersteinsson & Macdonald 1992; Aubry et al. 2007; Copeland et al. 2010; May 2007; Magoun & Copeland 1998; Prestrud 1992