RANGE EXPANSION OF THE PINE PROCESSIONARY MOTH IN EUROPE II: ACTIVITY AND SURVIVAL OF *THAUMETOPOEA PITYOCAMPA* (LEP.: THAUMETOPOEIDAE) DURING THE WINTER MONTHS IN AN ALPINE VALLEY

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Abstract

The larvae of the pine processionary moth, *Thaumetopoea pityocampa* (Den. & Schiff.) (Lep.: Thaumetopoeidae) feed on needles of various pine species and other conifers; in many Mediterranean countries the species has permanent pest status. The socio-economic impact of *T. pityocampa* is of particular importance due to the urticating hairs of the caterpillars that cause severe contact dermatitis in humans and warm-blooded animals. In recent decades, an expansion of the range of *T. pityocampa* has been observed—both, northwards, such as in the Paris Basin in France, and altitudinal, such as in the Venosta valley in northern Italy. Winter temperature may be the thriving force behind range expansion since *T. processionea* hibernates in the larval stage without entering diapause. Larvae live gregariously in conspicuous silk nests that are left during the night for feeding, when conditions are favourable. Thus, temperature limits larval survival directly through low, lethal temperatures and indirectly through starvation during long periods of sub-lethal temperatures.

The Venosta valley (Province Bozen/Bolzano) stretches in east-west direction; *T. pityocampa* has been occurring at outbreak levels in the secondary *Pinus nigra* stands on the south-facing slope (from 750 to 1250 m elevation) over the last years. The mixed *P. sylvestris* stands on the north-facing slope sustained only very low population densities. Comparison with records of previous surveys carried out by the local forest service showed that the upper limit of *T. pityocampa* has risen from 1150 m in 1975 to 1380 m elevation in 2004.

We recorded climate data during the winter season 2002/03 and 2003/04. Air and larval nest temperature as well as insolation were measured on both, north and south slope at different altidudes. A topoclimatic model was developed for the study area illustrating big differences in temperature on north and south exposed sites, particularly with regard to high temperatures that were favourable for larval feeding during winter. From experiments under laboratory conditions, we estimated threshold temperatures for the nocturnal larval feeding activity. No feeding occurred when night temperatures were kept at -3 °C; larvae fed at night temperatures of 3 °C when they had been activated during photophase by temperatures of 9 °C or 12 °C. Larval nests contributed to a significant increase of daytime temperatures under sunny conditions; depending on nest size and number of larvae inhabiting the nest, temperatures were up to 5 °C higher than air temperatures. Nests had, however, no positive effect on temperature during dark hours. The freezing temperatures of larvae (according to super cooling point measurements) and their starving ability was evaluated under laboratory conditions. Larvae showed no particular adaptation to winter temperatures (freezing occurred at -8 to -11 °C) but 70-80% were able to survive at least 6 weeks without feeding at -5 °C or 0 °C. When kept at night temperatures of -10 °C survival was reduced to 10-30%.

Based on climate data recorded in the field, we calculated the number of hours of potential feeding induction at our study sites in Venosta assuming the threshold of night temperature above 0 °C plus day temperature above 9 °C as revealed in the laboratory experiments. In the period from December 3, 2002, to March 4, 2003, 97 h of potentially induced feeding occurred at the lower study site (elevation 750 m) and 106 h at the upper site (1100 m) on the north-facing slope. Markedly more hours of potentially induced feeding were recorded on the south-facing slope: 476 h at the lower (900 m) and still 265 h at the upper site (1450 m). Based on the topoclimatic model, we extrapolated the potential feeding induction for the whole Venosta study area to highlight areas of favourable climate for the overwintering *T. pityocampa* larvae.