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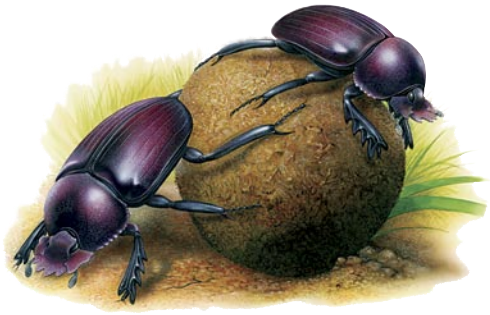

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Expansion of pine processionary moth in Europe: patterns and predictive model

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Introduction: Many species are already affected by the warming up of climate. Their distribution is expanding or retracting depending on climatic tolerance, dispersal capabilities and response to environmental changes. During the last decades, the pine processionary moth, *Thaumetopoea pityocampa*, has expanded northwards and upwards in Europe. We investigated the role of climate warming in this expansion and developed a predictive model with regard to climatic scenarios for the future.

Methods: Experimental studies have been carried out to determine the effects of low temperatures on the survival of larvae during the cold period, and climatic thresholds for development. A reaction- diffusion model relying on these thresholds has been developed. The effects of climatic anomalies have also been considered.

Results: We found close relationships between the increase in winter temperatures and feeding activity and survival of larvae. By including these relationships into a diffusion model, we successfully reconstructed the range expansion in the southern Paris Basin since the early 1990s. Under moderate hypotheses for average winter warming during the next 50 years (+3°C), model predictions suggest a colonization of downtown Paris by 2025. However, climatic anomalies such as the heat wave which occurred in August 2003 in Western Europe are likely to modulate such expansions because of contrasting effects: extremely high temperatures in the Italian Alps enhanced the range expansion in higher elevations whereas processionary populations collapsed at the same time in the Paris Basin.

Conclusions: In the future, the impact of climatic anomalies should be explored and included in predictive models. Because of its northwards expansion, this forest insect is likely to become an urban pest, causing serious troubles to public health due to its urticating properties.