Effects of climate change on the pine processionary moth range expansion: observations and predictions

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Climate change has already affected many plant and animal species. Their geographical range expanded or retracted depending on climatic tolerance, dispersal capabilities and response to environmental changes. During the last decades, the pine processionary moth (PPM), *Thaumetopoea pityocampa*, expanded northwards and upwards in Europe together with a significant increase in the mean minimum temperature in winter (Battisti *et al*. 2005). To determine the role of climate warming in this expansion, we conducted field and lab experiments, and we developed a predictive model using a climate scenario for the future.

We evidenced temperature as the driving factor of feeding activity of PPM larvae. To allow larval feeding, temperature inside the nest during the day should reach at least 9°C, and then air temperature during the following night should be above 0°C (Battisti *et al*. 2005). Understanding the mechanisms governing larval feeding activity is of particular interest because it may explain a large part of larval survival during winter.

Based on these results, we reconstructed PPM feeding activity in the past. We showed that although Paris and its close surrounding region was already favourable to the survival of PPM larvae in the 1990s, an unfavourable area located ca 50-70 km south of Paris prevented PPM expansion towards Paris until the 2000s, but then disappeared with the increase in winter temperatures (Robinet *et al*. 2007). By another way, a local population was discovered in eastern Paris, showing that human-mediated dispersal may exist.

Then, we described explicitly the expansion dynamics using a diffusion model coupled with an indicator of the feeding activity. We reconstructed successfully the range expansion in the southern Paris Basin since the 1980s. Under moderate hypotheses (IPCC climate scenario B2 and flying capability of 3 km), model predictions suggested a colonization of downtown Paris by 2025 (Robinet 2006). 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 resulted in population collapse in the Paris Basin whereas range significantly expanded to higher elevations in the Italian Alps.

References:

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