**Significance statement**

Anthropogenic climate change is increasingly affecting species phenology. When organisms remain inactive during part of the year, the phenology of emergence from the resting period is often driven by temperature. In the case of a consumer and a resource, the synchrony of their respective emergence is fundamental to the persistence of their interaction. Since species may react differently to the same temperature regime, and temperature regimes differ across latitude, climate change may lead to a shift in species phenology that affect the synchrony/mismatch between consumers and resources. Recent studies have pointed to significant shifts in species phenology in recent decades (Post et al. 2001; Parmesan and Yohe 2003), particularly the timing of spring events at mid-high latitudes (Parmesan 2006; Cohen et al. 2018), and more importantly significant changes in phenological synchrony between species (see Kharouba et al. 2018). However, these observed patterns are difficult to explain mechanistically. In this study, we propose a general theoretical model that determines the duration of the resting period according to temperature, and its effects on synchrony between phenological stages of two interacting species. We then illustrate our approach using the spruce budworm – balsam fir system in Eastern Canada (a major defoliator of the boreal forest) as a case study. The model leads to general conclusions on species synchrony/mismatch under climate change. It can be parameterized for a large number of species showing a resting period in their life cycle. The model provides a mechanistic understanding of the effects of a change in temperature regime on the phenological mismatch between species. Hence, this study provides a novel approach to explain temporal patterns (i.e., species emergence date from their resting period) and spatial patterns (i.e., species phenology across latitudes). We believe that it would be of great interest for the journal *Ecography*.