Functional Ecology

BRITISH ECOLOGICAL SOCIETY

Photoperiod at the larval stage sets the timing of entire annual program in an herbivorous insect

Lucia Salis, Erik van den Hoorn, Domien G.M. Beersma, Roelof A. Hut & Marcel E. Visser

In seasonal environments, decisions such as when to reproduce or when to move from one place to another have a large impact on the survival and fitness of many organisms. In insects, the timing of transitions from one life stage to another (e.g. from pupae to adults) is often regulated by environmental cues such as photoperiod and temperature. In this research, we studied the effect of photoperiod on the timing of pupation and adult emergence, and its fitness consequences, in a lepidopteran species, the winter moth. In this species, adults lay eggs in early winter (November-December). The eggs hatch in early spring and the caterpillars feed on fresh oak leaves until pupation. The timing of hatching of the eggs varies substantially from year to year depending on temperature. However, there is not large variation in the timing of adult emergence. Using long-term data (from 1995 until 2014) and a laboratory experiment we show that winter moths can adjust the duration of their pupal development depending on the photoperiod experienced as caterpillars. In the experiment winter moth caterpillars were subjected to photoperiods that mimicked early (EP) and late (LP) hatching respectively. Interestingly, timing of pupation was not affected by photoperiodic treatments while timing of adult emergence was different among

Image provided by authors.

treatments: caterpillars experiencing EP had extended pupal development compared to the control group, while the opposite was true for those experiencing LP. Regulation of development by such a photoperiod-sensitive mechanism will help maintain the synchronization of annual timing with calendar date in the face of changing environmental cues such as increasing temperatures.