An early spring drives butterfly population declines

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Early snow melt in the Colorado Rocky Mountains initiates two chains of events resulting in population decline in the mormon fritillary butterfly, *Speyeria mormonia*. One effect of snow melt date was readily detectable, but the second, cryptic effect required an understanding of the butterfly's biology.

"This suggests that predicting effects of climate change on organisms' population sizes will be difficult in some cases due to lack of knowledge of the species' biology," noted Dr. Carol Boggs, professor in the department of biology at Stanford University and lead author on the study.

The study results are published early online in the journal Ecology Letters.

An initial understanding of the butterfly's life cycle and the factors determining egg production aided the research. Butterflies lay eggs (and then die) in the first summer; the caterpillars over-winter without eating and develop into adults in the second summer. In the laboratory, the amount of nectar a female ate determined the number of eggs she laid. This suggested that flower availability might be important to changes in population size.

Using long-term data on date of snow melt, butterfly population sizes, and flower numbers at the Rocky Mountain Biological Laboratory (RMBL) - located at 9,500 feet in the Colorado Rocky Mountains -

researchers uncovered multiple effects of a single weather event, the date of snow melt, on change in population size of *Speyeria mormonia* butterflies. Early snow melt in the first year leads to lower availability of the butterfly's preferred flower species, due to exposure of newly developing plants to early-season frosts that kill flower buds. The researchers showed that reduced flower (nectar) availability per butterfly adversely affected butterfly population growth rate. Early snow melt in the second year of the butterfly life cycle worsened this impact, probably through direct killing of caterpillars during early-season frosts. The combined effects of snow melt in the two consecutive years explained more than four-fifths of the observed variation in population growth rate. "It is very unusual for research to uncover such a simple mechanism that can explain almost all of the variation in growth rate of an insect population", said Dr. David Inouye, professor of biology at the University of Maryland and co-author of the study.

"One climate parameter can have multiple effects on an organism's population growth," Dr. Boggs stated. "This was not previously recognized for species such as butterflies that live for only one year. We already can predict that this coming summer will be a difficult one for the butterflies, because the very low snowpack in the mountains this winter makes it likely that there will be significant frost damage."

"Long-term studies such as ours are important to understanding the 'ecology of place' and the effects of weather and possible climate change on population numbers," commented Dr. Inouye. "Research of this nature is critical to assessing the broader effects of weather on an ever-changing earth, and field stations such as RMBL, by facilitating longer-term, longitudinal studies, are an invaluable asset in this regard."

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