

## Conservation Matters:

### Contributions from the Conservation Committee

# **Lepidoptera conservation under a changing climate**

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Climate change is among the most daunting environmental problems faced by the world today. What with sea level rise, droughts, fires, floods, it seems the world is being taken by storm (pun intended).

As a science, climate change is pretty much set on the fact that man-made carbon emissions are the main driver behind a trend in warming temperatures around the globe. The vast majority of climate scientists agree that the world is getting warmer, and that human burning of fossil fuel is behind it. Probably many of you have seen the now (in)famous “hockey stick” graph of rising temperatures, and maybe even followed the so-called “climategate”. One could argue that there is some controversy about what people believe when it comes to climate change, but what is undeniable is that temperatures **are** going up, independently of the reason. Yes it happened before, and much worse. The earth’s climate has fluctuated a lot in the past 2 billion years, and today’s warming is not even close to some of the warming that happened in the past. And we know that, in the past, when temperatures changed, many species disappeared. Are we ready to accept that some of the species roaming the earth now will be gone in 50 or 100 years? Of course not, particularly when it comes to butterflies...

Butterflies and moths provide a vast array of what we call ecosystem services, including pollination. They are also excellent indicators of environmental quality, and have an important aesthetic value, being enjoyed by people around the world. Climate change is likely to affect Lepidoptera in many ways. Most commonly, species will experience changes in range and distribution, and in population sizes. Another way that Lepidoptera may respond to climate change is through phenological changes: species are already shifting range due to climate change, usually moving to higher latitudes or altitudes. Species are already emerging earlier in the spring due to warmer temperatures. There are many instances of disruption of essential interactions with food plants and prey. And other effects of climate change are yet unknown.

Biodiversity is already at a crossroads, with more species in danger of extinction than ever before. Human activities have degraded, destroyed, and fragmented the landscape to a degree that makes it very hard to design conservation plans, simply because connectivity and habitat availability are many times rare if not impossible to detect. Add to that the challenge of climate change, and it may be impossible to design effective conservation plans for many species and habitats, because they will have less capacity to respond due in large part to human threats. It is essential that conservation plans include a climate adaptation component, either from early stages or as a later inclusion.

As an example of the importance of climate adaptation planning, a recent publication (Poiani et al., 2011) asked conservation teams to re-evaluate 20 projects taking into account climate change threats, and the project teams developed 42 adaptation strategies. Out of the 42 adaptation strategies developed, only two were existing, unchanged conservation strategies. That tells us that conservation practices that have worked up until now may not be effective anymore under a different climate scenario. Protected habitat will have to include predicted habitat after species range shifts, as in the case of critical habitat under the Endangered Species Act for the Quino checkerspot. Conservation easements will have to include the same. Managed relocation or reintroduction efforts, if they are to have a chance in succeeding, will have to take into account not only future habitat but also phenological characteristics of relevant interacting species.

When we consider all those concerns, the number of studies addressing butterfly conservation under a changing climate is worrisome. A recent issue of the *Journal of Insect Conservation* was dedicated exclusively to Lepidoptera conservation, but only a small fraction of the papers dealt with climate change. One article (Wilson & Maclean, 2011) did a literature review of all papers published on ISI Web of Science between January 2005 and December 2009 about climate change and/or biodiversity. Only 9 out of 73 papers that showed a link between climate change and declining biodiversity studied insects, 8 of which dealt with Lepidoptera. These papers showed Lepidoptera to be very sensitive to climate change. My own search just last June yielded about 50 papers dealing with various aspects of climate change and Lepidoptera (Table 1). That is certainly not impressive!

**Table 1:** Breakdown of articles found on the ISI Web of Science dealing with Lepidoptera and climate change (CC).

Focus of paper	# of studies
Review article focusing on CC	9
Predictions under CC	15
Effect of CC on single species	11
Effect of CC on assemblage	16
Effects of CC on species interactions	6

I attended the Annual Meeting of the Lepidopterists' Society this past June at Yale University and made a few suggestions to our members that might improve this alarmingly sad state of affairs. The National Phenology Network (<http://www.usanpn.org/>) currently has only 12 Lepidoptera species on its list, so I urged the society to become a partner and increase the number of species in that list. We could bring specialized input to the network, whose capabilities would be of much value to conservationists. I also suggested that we use their publication, *Season Summary*, in a better, more comprehensive way. In addition to range extensions, host plant associations, and population dynamics, I proposed that we make an effort to include consistent, actively sought first sightings of species known for a long time from specific locations. Also, include any changes in host plant association, phenology disruption, or other change in a known pattern that can be related to a warmer climate.

If we are to keep enjoying leps for years to come, we need more climate change-related studies. We need to be aware of climate change-induced changes in butterflies and moths. We may need reintroductions and managed relocation of species whose populations are declining and that have adequate, available habitat that could sustain a viable population under a warmer climate. The time to act is now - otherwise we may lose some of the most beautiful creatures ever to flutter on earth.

### Literature Cited:

Poiani, K. A., Goldman, R. L., Hobson, J., Hoekstra, J. M., & Nelson, K.S. (2011). Redesigning biodiversity conservation projects for climate change: examples from the field. *Biodivers Conserv* 20:185–201.

Wilson, R. J. & I. Maclean, M.D. (2011). Recent evidence for the climate change threat to Lepidoptera and other insects. *Journal of Insect Conservation* 15(1-2): 259-268.

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