The Butterfly Effect

Minda Berbeco

In 2010, University of California, Davis professor Arthur Shapiro wrote a startling article for the *News of the Lepidopterists’ Society*. He revealed that as a “butterfly guru”, he had always “pooh-poohed” the notion that butterflies were disappearing, noting that populations will decline in response to disruptive factors such as development, but some losses were reversible.

“I regarded such losses as regrettable, but inevitable,” he wrote in the article, but then went on to confess, “Now I know better. I don't think butterflies are in trouble. I know it” (Shapiro 2010).

When Shapiro started collecting data on butterflies in northern California over 40 years ago, he had no idea how important his surveys would be today.

“I guess I was ahead of my time when setting this thing up back when I did,” Shapiro said in a recent interview.

He originally devised a five-year butterfly monitoring study over a transect running over 120 miles from the San Francisco Bay all the way up to the Sierra Mountains in northern California. Butterflies in particular are ideal subjects for studying environmental effects on biological organisms over large regions due to their prevalence, distribution, and size.

As it happened, the data ended up being extremely interesting, and after Shapiro received tenure he decided to keep his data collection going.

“I ended up some thirty years later sitting on a huge mountain of data with no precedent in North America.”

This work resulted in a study published in *Proceedings of the National Academy of Sciences* in which he and his colleagues found profound impacts of both climate and land-use change on butterflies in Northern California (Forister and others 2010).

Shapiro and his colleagues expected that all butterfly species would move up in elevation in response to warming temperatures to seek a more suitable climate. They found, though, that habitat loss in the lower elevations reduced the population of ruderal (“weedy” or non-specialist) butterflies, which resulted in fewer of these butterflies being available to move up in elevation. Meanwhile, the nonruderal species (the specialists) living in the undisturbed mid-elevation range were able to move upslope in response to climate, as predicted.

Northern California is not the only place where these shifts in butterfly species are being observed. “We have lots of studies pointing in the same direction,” Shapiro said, with stud-
ies from Massachusetts to Britain demonstrating similar species movement in response to climate change (Breed and others 2012; Franco and others 2006).

Shapiro quipped that “if I could come back in 300 years, the butterfly fauna of the central valley might look sort of like the butterfly fauna of San Diego,” where the average annual temperature is approximately 4°F warmer.

Though all of this spells calamity for species responding to the combined pressures of habitat destruction and climate change, Shapiro says that it is not all bad news. “We are losing things, and depending on the availability of necessary resources, like host plants, we are gaining things.”

Shapiro points to the example of the Gulf Fritillary, a non-native subtropical species whose larvae feed exclusively on passion flowers, an ornamental garden plant. In the past, cold winters have kept this animal from establishing itself in northern California, but recent warm winters have allowed this butterfly to survive and spread across the Sacramento region. “If the warming trend means we are less likely to have extreme freeze conditions, maybe [this butterfly species] will persist longer.”

Overall, though, Shapiro reports finding a net loss of species at most of his sites, with such a large population crash at his lowest elevation sites that he has been able to start individual animal counts, instead of just recording species richness.

“Removal of butterflies is extremely sad for people,” Shapiro said. “It has aesthetic and perhaps moral resonance.”

More importantly, though, this type of research demonstrates how humans are a force of nature, altering both the landscape and climate. Shapiro’s study is part of a growing body of research demonstrating human impacts on both climate and biological systems.

“If we are interested in conservation,” Shapiro said, “we have to try to understand what the forces are that put species … in peril. By teasing out the factors most likely to account for the trends we observed, we hope to gain insight into the processes that work so we can take action.”

Shapiro’s research demonstrates that anthropogenic climate change and habitat loss have started to transform our natural world. As more data continue to demonstrate these trends, the arguments for action will become undeniable.

References

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Minda Berbeco received her PhD in biology from Tufts University in 2011 specializing in the effects of climate change on terrestrial systems. She joined NCSE in the fall of 2012 as a Programs and Policy Director in NCSE’s new global climate change program.

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