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Climate Change and Extinctions at the Edge

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Climate and land use changes are considered the main threats to the survival and persistence of species in their natural habitat. As mentioned in a previous post, some species will adjust to changes in climate and shift their range, or modify their phenology to persist under significantly altered conditions. Others, however, will go the way of the Dodo and Carolina Parakeet, forever gone except in paintings and museums. Preventing this dire consequence of climate change has been the focus of many efforts in the conservation community.

A lesser known and more subtle consequence of climate change is that local colonies at the southern edge of a North American species' distribution may become extirpated as temperatures rise. A likely example was recently published. The Coral Hairstreak (*Satyrium titus*) is a small butterfly (size of your thumbnail) that is recognized by a series of conspicuous coral-red spots on their wings. It occurs widely in North America and is a common summer visitor at the flowers of Orange Milkweed. Colonies of this species were recently discovered in south-central New Mexico (Sacramento Mountains) at the northeastern edge of the Sky Islands region. They are at the southern edge of the Coral Hairstreak's distribution, geographically isolated from the rest of the species. These Sacramento Mountain Coral Hairstreaks have evolved distinct traits, for which reason they were described as a new subspecies in 2010. This subspecies is precariously restricted to only two mountaintops, where it is adapted to local conditions. As New Mexican Dick Holland, the scientist who authored the paper describing these butterflies, wrote, "a very tiny increase in global temperature shall push this taxon into thin air, and give it no place to live."

One might wonder "so what if a local colony of an otherwise common species disappears?" Well, other than the obvious loss of local diversity – which is recognized by the Endangered Species Act when it allows the listing of subspecies – extirpated populations at the edge of their distributions may be biologically more significant than is apparent at first thought. The late Ernst Mayr, a noted evolutionary biologist, proposed the "founder effect" more than half a century ago. It basically states that colonies at the periphery have the capacity to evolve rapidly when they become isolated. These isolates are likely to go extinct eventually (think of the amplified extinction rate of birds on small peripheral islands), but occasionally, an isolated population will evolve new, evolutionarily significant, adaptations. A classic example of the founder effect might be the marine iguanas in the Galapagos Islands – they evolved major adaptations to the marine environment, unlike iguanas in other parts of the world. Regardless of occasional academic disagreements with Mayr's proposal, significant novel traits can evolve in colonies at the periphery.

So, when distinct isolated colonies of species at the southern edge of their distribution – such as the Sky Island subspecies of the Coral Hairstreak – go extinct as a consequence of climate change, the detrimental effect will be the loss of essential combinations from the "genetic toolbox" that species use to survive in an ever-changing world. More importantly, though, a potential source of major novel "founder effect" adaptations – the kinds of changes on which evolutionary revolutions are based – is also being snuffed out.

So, when you wonder "so what if a local colony of an otherwise common species disappears?" the reasons that it matters may be subtle, but the evolutionary consequences may be oh so pernicious.

This post was written by:
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