Camouflage is one of nature’s most marvelous adaptations. It’s everywhere, hiding creatures in plain sight. Cryptic coats cloak insects, snakes, birds, mammals, lizards—really, species from any animal group you could imagine. Why?

Because, in nature, where every animal kills something to survive, camouflage makes the difference between life and death. Deep study of animal camouflage by naturalists and artists in the late 1800s led to principles that revolutionized military camouflage patterns by World War I. In turn, hunters and nature watchers ever since have benefited from the rich tapestry of commercial camouflage patterns, ranging from “real-tree” brown to “winter-white” patterns.

But unlike humans who have to buy separate brown or white camouflage patterns to fit the occasion, some animals carry a full set of different coat colors in their genes. At least twenty species worldwide undergo seasonal molts where their hair turns from brown in summer to white in winter to match the predictable seasonal passing of snow, making them some of nature’s most charismatic creatures: Arctic foxes, weasels, hares, and some lemming and hamster species to name a few. Here in the Crown of the Continent, snowshoe hares, white-tailed jackrabbits, and three species of weasels, all undergo seasonal color molts.

I have been studying snowshoe hares continuously since 1998. My questions at the beginning were both basic—understanding the controls on numerical changes and population fluctuations of wild animal species—and also very applied, because the hare is the nearly sole prey of the Canada lynx, a species listed as federally threatened in 2000. My students and I live-trapped, radio-collared, and observed...
I’ll bet 50 bucks they say yes.

The duration of winter is shorter now, on average, than in the past. In a reverberating “ah-ha!” moment. Pouring out of emerging findings from the field of climate science and climatology labs from around the world (including Steve Running’s at the University of Montana) came clear evidence that the duration of seasonal snow cover is decreasing fast. And the thing is, you don’t need to believe in any climate model to know this is true. Just go anywhere in the world with seasonal snow (Montana, Maine, Mongolia, Alberta, Scotland, Italy), find a person who has spent a lifetime observing the seasons (perhaps a hunter, birdwatcher, logger, or skier), and ask them if the duration of winter is shorter now, on average, than when they were young. I’ll bet 50 bucks they say yes.

With the realization of the globally shortening snow duration, I dug into what was known about seasonal coat color. Lab studies had shown the timing of the coat color molt was, like migration, hibernation, and other seasonal (phenological) traits, driven by changing day length. This makes sense, as day length is a reliable cue, long term, of the comings and goings of snow. Over time, snow has come early or late in different years, but on average, the shortening days of fall indicate that snow will soon arrive, and the lengthening days of spring herald the coming thaw.

What does it mean if the timing of the molt is set by photoperiod, but snow duration is rapidly decreasing? Will coat color mismatch increase in the future? Does mismatch make animals easy targets for predators, and could it lead to the eventual decline of a species? Do animals have tricks (we call it “plasticity”) up their furry sleeves that help them deal with mismatch, perhaps by adjusting molt timing year to year or behaving in ways to minimize mismatch or its consequences? Could natural selection change the timing of the molt, prompting “evolutionary rescue” that decreases mismatch fast enough to prevent species declines? In the end, will climate change be likely to send snowshoe hares, or for that matter, any species facing climate change?

Therefore, my research team is throwing everything, including the kitchen sink, at answering the question of whether or not wild animals can locally adapt to rapid climate change. Over the past six years, we have radio-collared more than 300 snowshoe hares so we can find their locations once per week. If they’re dead, we figure out who killed them, and where. If they’re alive, we record their coat color so we can quantify the timing and speed of the coat color change, and we record snow around each hare to quantify the mismatch between the hare and the ground. We also measure behaviors to test whether or not hares can perceive their own mismatch and act to decrease the chance of becoming someone’s next meal.

Out in the field with my graduate students Marketa Zimova and Alex Kumar and dozens of hard-core field helpers and collaborators, we’ve already learned a lot. The fall molt to white starts with the ears and lower abdomen, then spreads through the body, with the face and back the last to turn white; spring molt is roughly five weeks longer.

When hares are mismatched, they are indeed more vulnerable to being killed by raptors, lynx, bobcats, foxes, coyotes, and marten that prey on them. Our field
studies show that for every week a hare is mismatched, it is seven percent more likely to be killed than other individuals who are matched against their background. As to whether hares can perceive that they are mismatched and then take actions (like hide, flee, or pick a spot to be better matched), they don’t seem to know what’s going on. What happens when we put the cost of mismatch up against the rigorous, locally down-scaled climate change projections of shortened winters in the future? Assuming the color molt timing stays as it is now, over the next 50 to 100 years, the number of days that white hares will be mismatched on a snowless background will be four to eight times more than it is now, and that mismatch will be deadly.

But wait...we also found that within hare populations, individuals are remarkably variable in their coat color timing and rate of molt—some start earlier, or later than others. This is exactly what you would expect: because snow has always differed in when it comes and goes each year, an inconstancy in coat color timing has allowed the persistence of these populations through those long and short winters. And the within-population variability is mirrored across populations, where we find that molt timing is shaped to local snow conditions like Seeley Lake versus Gardiner.

Could evolution rescue species from the rapidly shifting conditions of climate change by altering the timing of the molt to track reduced snow duration? We are pushing hard to answer this question. In addition to timing of the molt to track reduced snow duration? We are also expanding the project globally, with new coat color change research collaborations underway in the Northeast on weasels, in Scotland and other parts of Europe on mountain hares, and in Sweden on Arctic foxes.

The charismatic poster-child of climate change is mismatched white animals on a brown snowless background. On the one hand, the picture underscores a direct and real consequence of climate change. But on the other, it implies that natural selection may play a powerful role in determining how this story unfolds in the years ahead.

For the good of both humans and non-humans, we clearly must continue to address the underlying causes of climate change. However the potential role of natural selection implies very real steps that could be taken in the meantime to foster evolutionary rescue. Adaptive evolutionary change requires populations to be relatively large, with connectivity across the landscape with other populations, and with reduced stressors coming from other factors (such as land use change, invasive species, and habitat fragmentation). While we fill in the details of the science behind this story, we can say for sure that any actions taken to foster evolutionary response by maintaining large, connected populations will increase the chance for wild animals to persist in the face of rapid climate change. That’s the hands-on, hopeful story that the hares have told me.

I, Scott Mills is a professor in the Program in Global Environmental Change, within the Department of Forestry and Environmental Resources and the Program in Fisheries, Wildlife and Conservation Biology at North Carolina State University. He began his extensive research on snowshoe hares and other animals in the Crown of the Continent while he was a professor in the Wildlife Biology Program at the University of Montana, where he taught for 15 years.

Montana and Washington hares undergoing their normal color molts, allowing us to tease out key questions regarding genetic inheritance, ability for animals to adjust behaviors or molt, and other questions. We’re also expanding the project globally, with new coat color change research collaborations underway in the Northeast on weasels, in Scotland and other parts of Europe on mountain hares, and in Sweden on Arctic foxes.

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