



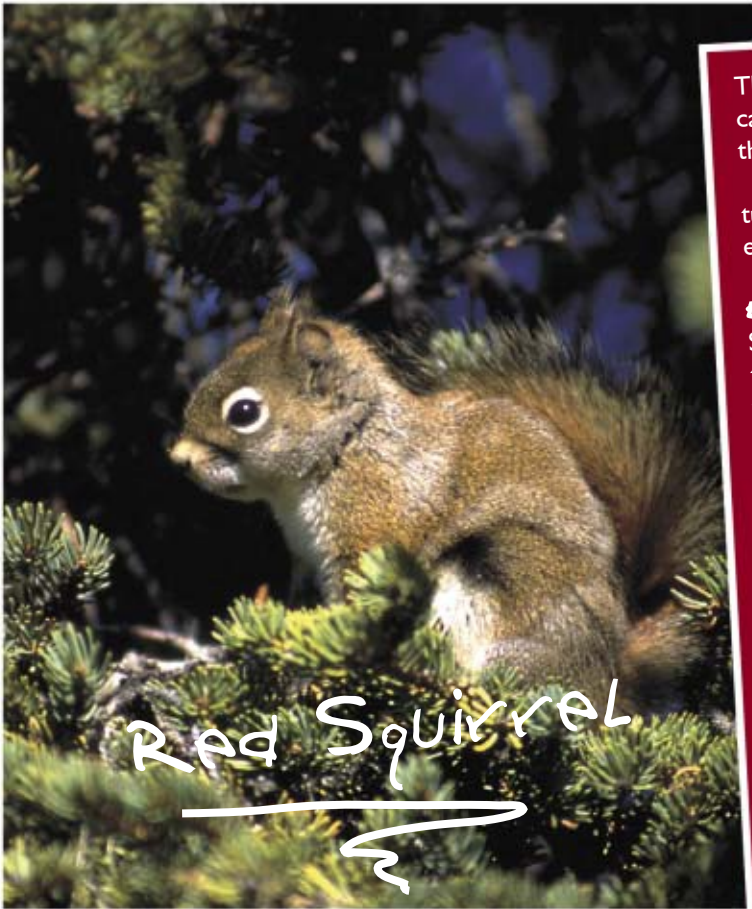
Global Warming

EVOLVING RESPONSES

by JUDE ISABELLA

Nature is How Animals are Responding to Global Warming !!!

Elk, birds, wolf, bears, Corbis; Otter: Photos.com; Squirrel: T. Karels; Others: Photodisc



Red Squirrel

The heat is on. The world is a warmer place—call it global warming, call it climate change, just don't call it an urban legend. Temperatures this century are 0.6° C higher on average than in the past. While a few scientists still argue the point of why Earth's temperature is climbing the global thermometer, other scientists ask a different question. What are the plants and animals doing while we argue?

Early Squirrels Get the Cone
Southwest Yukon—cold, right? Sure, but in the last 27 years spring temperatures rose by about 2° C. You still can't grow bananas, but the spruce trees love it—they're budding earlier and tossing out seed cones like there's no tomorrow. What more could a seed-eating red squirrel want? To be born earlier too. Which is just what's happening, says Dr. Andrew McAdam, a University of Alberta biologist.

Dr. McAdam studies natural selection in red squirrels near Kluane Lake, Yukon. He's part of a team that has kept tabs on these dashing—have you ever seen a relaxed squirrel?—rodents for 15 years. "The surprising thing we found was very consistent and strong selection favouring earlier breeding...[it] was the clue that led us to investigate the influence of climate changes on this population," Dr. McAdam says.

Red squirrel moms are genetically programmed to give birth earlier in the season to give their offspring a headstart. This is risky, if it's too cold. "It's very cold in early spring," confirms Dr. McAdam, who often finds himself wearing snowshoes when spying on squirrels in March. "Breed too early and you spend all your energy keeping warm. Breed too late and you don't have much food left to



raise your kids.” But warmer weather, and more spruce cones both favour the pups first out of the starting blocks. “First come, first served,” Dr. McAdam quips.

These pups are bigger and more independent when fall comes—handy when defending their territory. The genetic bottom line is that after four generations and 10 years, today’s squirrels give birth 18 days earlier in the year than their great-great-great- (you get the picture) grandmothers did.

Mid-Lat Crisis

Notice where the red squirrels live. Southeast Yukon. Geographically speaking, that’s mid-latitude and that’s where scientists expect to see the greatest biological response to climate change, says Dr. Andrew Weaver, a University of Victoria climatologist.

“Earlier spring blooming occurs in the middle latitudes,” Dr. Weaver explains. “The red squirrels in the Yukon—middle latitudes. The pine beetle [infestation] in northern British Columbia (forests) is also a good indication of warmer weather. You need really cold winters to kill them off. We haven’t had those in a while.” And again, we’re talking middle latitudes.

The polar regions and the tropics are another story. “The polar regions have the greatest natural variability, so it’s hard to attribute the changes there to climate change. And the tropics are very complex. El Niño strongly affects any signal [of climate change],” Dr. Weaver says.

One concrete sign of polar warming, however, is melting permafrost. Dr. Terry Root, a Stanford University biologist, studies biological responses to warming. She points out that regions like Alaska are already hit hard by warming trends. “Due to permafrost melting, many buildings are beginning to look like Leaning Towers of Alaska,” she says. But it’s more than a human habitat problem.

For years, biologists working in the field—like Dr. McAdam in the middle of squirrel country—have noticed that animals and plants are already responding to warmer weather.

What kind of picture emerges if you look at all their studies at once? Dr. Root wondered.



Studying the Studies

About 15 years ago, Dr. Root was approached by a biologist with some incredible data.

“Every year she recorded on what day she saw the first bird of all the different species that migrate to the [Upper Peninsula of Michigan],” Dr. Root explains. “Her husband threw away her records from 1945 to 1964, but she had records from 1965 to 1994.”

An undergraduate student typed up the results. What emerged was a clear picture—birds returned 21 days earlier in the spring of 1994 than in 1965. “And there were four different birds that in 1964 were migrants but by 1994 they were residents—they had expanded their ranges,” Dr. Root says. “That got me to really start working on how the warming the globe has

already experienced is influencing animals, then I branched into plants.”

In January, Dr. Root published a meta-analysis—a study of the studies. Her team combed through 143 studies, which involved 1473 species of plants and animals globally. From mollusks to mammals, from grasses to trees, the biologists discovered that about 1200 species—81 percent of the number showing change—experienced biological changes in a way that suggested they were responding to warming. Spring time events—blooming, egg laying, and arousal from hibernation, for example—now happen about 5.1 days earlier per decade on average. The most extreme examples, Dr. Root says, are zooplankton in the North Pacific Ocean reproducing 22 days earlier per decade and the seabird *Uria aalge*





Industry

hatching young 24 days earlier per decade. And remember, species are also on the move.

Moving On Up

A few years ago, Dr. Camille Parmesan, a University of Texas ecologist, reported a large-scale shift in the range of 35 non-migratory species of butterflies. Dr. Parmesan's work took her all over Europe looking for, and reading old studies about, butterflies.

With help from colleagues, she found that 63 percent of the species shifted their range to the north by 35 to 240 kilometres this century. Only three percent shifted south. Like Dr. Root's team, Dr. Parmesan's team decided to do a meta-analysis that included more than 1700 species. (Hey, great minds think alike!)

Dr. Parmesan's meta-analysis was also published in January. The study showed that ranges moved an average of 6.1 kilometres per decade toward the poles.

Dr. Parmesan also looked at long-term "phenological" trends (living organisms' response to seasonal and climatic changes to



Corbis, Photodisc, Corbis

Corbis (2)



their environment) and noticed that spring events—bird nesting, plant flowering—occurred 2.3 days earlier per decade.

Adaptation or Extinction

Okay, so what does all this mean? Dr. Weaver spends most of his time in the past, building computer models that scientists hope will give us more clues to the consequences of climate change, including warming trends.

"We have some examples 135,000 years ago, of fossil remains of hippos in Northern Europe," Dr. Weaver says. "Climates of the past have been conducive to animal movement." To make predictions about species, he says, "you have to understand the basic biology of a creature." And even then it's tricky—we've tried to predict salmon migrations for decades but it's still an inexact science. All sorts of factors play a role in adaptation. Dr. Weaver says that for sure CO₂—the main global warming ingredient—fertilizes and enhances plant life. So, the Northern Hemisphere should experience reforestation. "But, that does become dependent on water availability."

Dr. Root points out that first, as trees move north, other habitats, such as the tundra and bogs get squeezed. "Second, species that live in the habitat that the trees provide, may not be able to move with the trees," she says. That tears apart species communities.

Change—A Constant

It's a complicated issue, but scientists know that knowledge is power, and the more they discover, the better chance we have of doing the right thing. That's one reason Dr. McAdam's out there camping with other biologists, amidst the squirrels, with no electricity or running water, from early March until late August each year. (They do go to town and shower once a week!)

"Organisms are continuously evolving to changes in their environment. Climate change represents the greatest environmental change facing most wild animals today," Dr. McAdam says. "I consider our work to be one of the many warning signs that wild animal populations are already being affected."



Corbis, Photos.com

Photodisc, Corbis

Photodisc, Corbis

Corbis, Photodisc