Nature on Trail »

Watching Foxes

Scientists are studying the evolutionary history of North American red foxes

Tom Kogut

Come with me on a hike to track an elusive wild canid. You won't have to go far. In fact, it might just be a stroll in your own backyard, in Bellevue, Seattle or Auburn.

But you will have to step back about 15,000 years, to the time when glaciers were beginning to recede near the end of the last ice age. Your sea-level backyard will look more or less like Paradise or Sunrise or any number of alpine areas in the Cascade Range do now, only with the occasional bison, mastodon and woolly mammoth.

Megafauna aside, many of our smaller mammals lived then as they do now. Just as in today's world, you'd have to be lucky to spot them because these creatures' survival depended on not being seen. On that hillside destined to become Queen Anne, nose to the ground, moving at an easy lope ... a wolverine. And darting in and out of scattered and stunted conifer trees, leaping up, digging through snow tunnels in search of a pocket gopher ... a red fox.

The red fox is superbly adapted to life in cold, snowy habitats. When glaciers covered the land, its habitat was widespread, and alpine species roamed into the lowlands of the Puget Sound basin and beyond. What became of these species at the end of the last ice age is an intriguing story with important implications for today's rapidly changing climate.

A team of scientists studying the evolutionary history of North American red foxes is just beginning to unravel this story. Led by Dr. Keith Aubry, a research wildlife biologist at the U.S. Forest Service's Pacific Northwest Research Station in Olympia, these scientists have used a combination of natural history data and field observations; skull measurements of museum specimens; fossil, archaeological and historical records; and modern molecular genetic analysis to reveal a fascinating history.

The story begins about 300,000 years ago, during the Pleistocene epoch, a time when cold, glaciated periods alternated with warm interglacials. During the height of the glaciations, two enormous ice sheets blanketed northern North America, one on either side of the Rockies, extending through the Yukon and British Columbia and into Washington state. So much water was frozen into the ice sheets that the sea level dropped by as much as 300 feet, draining a shallow sea that lay between Siberia and Alaska, and turning it into an ice-free land mass—Beringia. At this time, the progenitors of today's red foxes colonized North America from Asia, and their range expanded southward into the contiguous United States during the warm interglacials.

Sylvia Feder

Sylvia once traveled to the Arctic to learn more about Inuit dogs. Today she's a musher with her own team.

For this article on wild canids, Sylvia worked with Dr. Keith Aubry to share the latest research.

Nature Nugget »


Ralph Radford

If you've ever seen a pika bounding across a talus slope, you know these little creatures are perfectly adorable. What you may not have noticed, however, is that these small mammals (*Ochotona princeps*) also employ extremely advanced foraging techniques.

Pikas do not hibernate, and therefore have to store stockpiles of food for the winter. The perplexing part is that the food they store for winter is not the same food they eat during the summer! In summer, they eat plants which are easily digestible, varying their diet based on what is available in the area and how easy it is to harvest. In their winter food caches, however, they tend to collect an array of plants that are much higher in *phenolics*.

Phenolics are compounds found in many plants which exhibit some toxicity when consumed by herbivorous mammals. When plants high in phenolics are left sitting after harvesting, the levels of phenolics decrease over time. Plants higher in phenolics also decompose more slowly, and lose fewer nutrients while stored in winter food caches. The plant making up 91 to 96 percent of the total phenolics in a pika's winter diet is alpine avens (*Geum rossii)*.

By storing and eating a plant that is otherwise difficult to digest, pikas are able to eat a wider variety of the plants near their homes and can survive off of a more diverse plant population. Now, it is unclear whether pikas tend to store plants like alpine avens during winter just to broaden their diet, or if they are also interested in the preservative effect of the phenolics. One plausible explanation: it could be both. It makes sense for pikas to store plants that they cannot eat during summer and use easily digestible foods for immediate summer consumption. It's also an added bonus that the foods they store last longer and do not have as much nutrient decay over the winter as their summer foods would.

—Jaal Mann

About these fox images

Tom Kogut is a retired wildlife biologist turned professional photographer. For 35 years, he has traveled around the globe, including frequent trips to India, Nepal and Bhutan, to photograph wildlife, landcapes and indigenous cultures. He currently lives in Packwood in the shadow of Mount Rainier.

Then, 100,000 years ago, the climate cooled again, the glaciers returned, and the red foxes that had migrated into the contiguous United States thousands of years earlier were left south of the margin of glacial ice. Physically separated from other populations located north of the glaciers in Alaska and Asia, this population of foxes began to diverge into genetically unique subspecies that were adapted to the cold, snowy, subarctic environment.

When the climate warmed and the ice retreated as the last ice age came to a close about 10,000 years ago, this isolated population of red foxes followed their primary habitat up in elevation into the modern analogues of their ice-age domains, the alpine meadows and subalpine parklands of the Western mountains.

Today, montane red foxes are found at high elevations in the Cascade Range, Sierra Nevada and Rocky Mountains. Washington's montane red fox, known scientifically as *Vulpes vulpes cascadensis*, the Cascade red fox, is genetically distinct from all other montane red fox populations and represents an irreplaceable reservoir of genetic diversity.

The Cascade red fox is smaller than other red fox subspecies, and despite its name, it is rarely cherry red in color. It is more common in the dark (black and cross) color phases and, in the red phase, it is more yellowish-red in color with gray grizzling on the back.

Cascade red foxes occupy alpine meadows and subalpine parklands near tree line, giving birth to pups in earthen dens at the forest edge. They do not migrate or hibernate during winter, but remain active in what are often extreme weather conditions. Like most red foxes, they are opportunistic in their diet, but likely feed most heavily on small mammals. They appear to specialize on the northern pocket gopher, which is common in alpine meadows and also remains active during the winter.

And for thousands of years, the Cascade red fox has lived this quiet existence in relative obscurity in the high mountains.

Yes, there are red foxes that live at low elevations, and you may have seen them while hiking in rural or even semiurban areas, but data analyzed by Dr. Aubry and his colleagues show that those red foxes are not native to Washington. These lowland foxes are descendants of nonnative foxes that escaped or were released from fur farms in the early to mid-1900s. While they are quite at home in newly disturbed habitats ranging from suburban parks to golf courses, these red foxes do not venture up into the alpine zone.

What keeps the montane foxes in the moun-

tains and the lowland foxes in the lowlands? As adaptable and mobile as foxes are, scientists suspect that significant differences in their physiological adaptations must account for the distinct habitat preferences of each group. Proving that hunch is another matter. Natural history studies have been difficult to undertake, largely due to a lack of adequate funding and little interest in the species from conservationists.

And yet a better understanding of the Cascade foxes' physiological traits will be crucial, because as the climate warms, the Cascade foxes' cold, alpine homeland is predicted to recede farther up the mountains. With increased fragmentation of their alpine and subalpine homeland, their range could shrink to small, isolated habitat "islands." One more commonly studied alpine species, the pika, is already showing increased extinction in some populations, thought to be due to climate warming. Coyotes and domestic dogs are also a potential threat to foxes due to competition and spread of disease.

Cascade red foxes are extraordinarily hard to observe. Dr Aubry, who has spent several years studying them, has seen only one in the wild. If you do see a fox on a high-elevation hike, consider yourself very fortunate. Photo by Jocelyn Akins.

For these reasons, and because of its unique genetic characteristics, the Cascade red fox was recently designated by the Washington Department of Fish and Wildlife as a "candidate" species for potential listing as sensitive, threatened or endangered in the state. Hopefully, this designation will spur new surveys and ecological field studies that will help to fill our many significant knowledge gaps about this relic of the ice ages.♦

Tom Kogut

Hints for Hikers

If you are lucky enough to see a red fox at elevations above 3,000 feet in the Cascade Range, do your best to take a photograph that documents your observation. The distribution and natural history of these foxes are very poorly understood. Sighting reports and other anecdotal observations are of limited scientific value.

In the unlikely event that you come across a road-killed fox, take a photograph of the carcass, record the location as precisely as you can, and immediately notify Dr. Aubry or local biologists.

In some areas of Mount Rainier National Park, especially near Longmire and Paradise, Cascade red foxes have become habituated to humans and are commonly encountered in or near the parking lots. Please, DO NOT FEED THESE FOXES (or any other animals for that matter). Feeding foxes habituates them to humans, exposes them to predation or being roadkilled, and encourages them to congregate and den in areas where their pups may have reduced chances of survival.

Dr. Aubry welcomes any observations, photos or other input you may have on the Cascade red fox in the high country. Reach him by email at kaubry@fs.fed.us.

Further Reading

You can learn more about Dr. Aubry's work on North American red foxes in a recent issue of *Science Findings*. The article "Tracing the Fox Family Tree: The North American Red Fox has a Diverse Ancestry Forged During Successive Ice Ages"can be found at www.treesearch.fs.fed.us/pubs/37702. *Science Findings* is published by the PNW Research Station and geared toward nontechnical readers.

Or, for more adventurous readers, these are the technical papers that provide the scientific basis for these research findings:

Aubry, K.B., M.J. Statham, B.N. Sacks, J.D. Perrine, and S.M. Wisely. 2009. Phylogeography Of The North American Red Fox: Vicariance in Pleistocene Forest Refugia. *Molecular Ecology* 18:2668-2686.

Sacks, B.N., M.J. Statham, J.D. Perrine, S.M. Wisely, and K.B. Aubry. 2010. North American Montane Red Foxes: Expansion, Fragmentation, and the Origin of the Sacramento Valley Red Fox. *Conservation Genetics* 11:1523-1539.

Statham, M.J., B.N. Sacks, K.B. Aubry, J.D. Perrine, and S.M. Wisely. 2012. The Origin of Recently Established Red Fox Populations in The United States: Translocations or Natural Range Expansions? *Journal of Mammalogy* (forthcoming).