**The Art of Making Hay**

**As scientists have learned from the pika, collecting and storing food for winter can be a surprisingly complicated chore**

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One afternoon high in the Elk Mountains of Colorado 16 years ago, the late-summer stillness was broken by a shrill "eeek," followed by the mad rush of a small ball of fur to a columbine plant. The perpetrator was a pika, a small high-altitude mammal that must literally make hay while the sun shines, storing vegetation for winter feeding. After cutting a columbine stalk with its teeth, the pika gripped the plant between its jaws and ran to add it to a hay pile. In general, the animal's actions were not surprising; I had seen the same sight over and over again during thousands of hours of field work as a professor of zoology at Arizona State University.

But as I watched, a scientific question formed that has intrigued me ever since. Earlier in the season, I had seen pikas eat the columbine's flowers but ignore the rest of the plant. Why, I wondered from my rock perch, with binoculars and clipboard in hand, do foraging pikas run right by some wildflowers at one point in the season--even plants right next to their hay piles--and then come back and select the same plants later on?

I am not the only researcher to ask questions about pika foraging. Unlike the marmot, another small mountain mammal with a whistlelike call, the pika doesn't hibernate. The marmot is a rodent, while the pika is the smallest of the lagomorphs--a taxonomic group that includes rabbits. Because pikas have distinct territories and always return from foraging to nearly the same spot, they are ideal subjects for studies of adaptive and behavioral choice.

For example, in the early 1990s, then graduate student Denise Dearing went shopping in the scientific literature for a model animal to study food perishability and diet selection--and came up with the pika. Her main question: Don't the pikas' hay piles rot as they sit in one place for more than half a year? If not, why not?

In another example, in the late 1980s, graduate student Alexie McKechnie watched from atop 9,000-foot-high Niwot Ridge near Boulder, Colorado, as a pika stole from its neighbor's hay pile. Never before had such behavior been reported among pikas. "The pikas that stole did it repeatedly," she recalls. "They were like habitual offenders. And others never stole at all." How common, she asked, was such thievery, and what purposes did it serve?

At the heart of all such questions posed by researchers have been dilemmas the pikas face themselves. Clearly, their choices, instinctual or not, are complex: "Do I eat or make hay for winter? What plants should I harvest? How do I collect enough vegetation while not getting nailed by a golden eagle or a coyote?"

While pikas spend most of their surface-active time in quiet repose--sitting on prominent spots within their territories, in broken-rock piles called talus--they can shift into high gear when they begin to forage. They dash back and forth between the talus and the meadows where they forage, returning each time to their hay piles near the center of their territories. In the meadows, the animals literally mow down plants, turning their heads to the side to bite off stems as close to the ground as possible. Sometimes the animals' antics can cause a lone researcher on a mountaintop to lose all objectivity and dissolve in solitary laughter. I have seen pikas harvest and carry off 4-foot-tall stalks of mountain bluebells, only to have their scampering retreat across the talus abruptly halted as the long stems wedge between rocks.

Pikas engage in two distinctly different types of foraging behavior: haying (collecting food for storage) and grazing (eating on the spot). Males and females defend individual territories of about equal size on the talus. The adjoining meadows usually contain a smorgasbord of different plants. Each time a pika leaves the safety of the talus to forage on the meadow, it makes the decision whether to graze or to hay. This decision, in turn, affects the distance the animal travels and the type of vegetation it harvests.

I found some answers to my questions about pika foraging in the early 1980s with the help of then graduate students Barbara Ivins and Nancy Huntly. Working high in the Elk Mountains of Colorado, we studied more than 10,000 bouts of pika foraging.

One of our findings was that the animals divide their trips about equally between grazing and haying. For grazing, pikas almost always stay within six feet of the talus, creating a zone on the edge of the meadow as carefully trimmed as a golf green. But for haying, the animals seem more adventuresome, collecting plants as far as 60 feet away from the talus. We also found that haymakers tend to harvest stalks, leaves and blossoms, while grazers tend to munch on grasses.

Not only that, I've noticed that pikas seem remarkably cautious and even jumpy when feeding, yet almost foolhardy when haying--even in the same locale! So far, that's an unscientific observation; some day I'd like to be able to quantify it.

How can we explain pikas' selective foraging? They normally graze on grasses because they are a renewable resource; just ask anyone who has to mow a lawn repeatedly. Also, because pikas are at a high risk of being snatched by predators, such as weasels, pine martens and raptors, every time they venture into the open meadow, they have every reason to stay close to the jumbled talus where they can easily detect and evade most pursuers. While pikas are haying, however, it is cost effective for them to carry as large a load as possible--and they can find a much larger number of plants to harvest further out in the meadow.

Pikas collect the best selection of plants that is available as close to their hay pile as possible, and probably because the selection can vary greatly, they do not always select the same plants for their hay piles. Hay piles of neighbors in the same talus can be different, to say nothing of differences in hay piles from different locations throughout the geographic range of the species in the intermountain West.

Still, despite the differences in hay piles, all pikas seem to follow general rules: The animals tend to prefer some plants, not harvest others at all and select plants in a definite sequence through a season. Apparently, pikas select for nutritional value, harvesting plants with relatively high caloric, protein or fat content.

In my work with Ivins and Huntly, we also discovered the answer to my columbine mystery. During the flowering season, the plant protects its leaves and stems with poisonous chemicals, but later in the summer it stores the toxins in its root system. That way, the plant doesn't have to go to the effort to remanufacture them in the spring--when the seasonal growth once again is vulnerable to haying pikas.

Researchers have long known that though some pika hay piles can be spotted easily, many are hard to find. The animals often tuck their loads under large overhanging rocks or sometimes make huge bushel piles of hay right on the talus surface. Other pikas wedge their hay between rocks, so very little of even a large hay pile is visible on the surface. Incidentally, the attractive tale told by turn-of-the-century naturalist Ernest Thompson Seton (and often repeated in natural-history accounts) that pikas dry their hay on the rocks before storing it is false.

What is true, however, is that the hay piles can rot. In a fascinating new discovery, researcher Dearing recently found that pikas choose some plants that inhibit bacterial growth and act as a hay-pile preservative. Working on Niwot Ridge, Dearing discovered that pikas preferentially hayed alpine avens, a species toxic to pikas! In an apparent win-win situation, the animals harvest the plants to preserve their hay piles. They then consume the avens later, after the toxic chemicals degrade.

Also on Niwot Ridge, researcher McKechnie was finding that some of the area's pikas were practiced thieves--a discovery later confirmed by other researchers. She found that though only a few pikas robbed hay piles, many of the thieves were repeat offenders, stealing hay year after year (pikas can live up to six years of age). They generally waited until the owner of a hay pile was absent before robbing. When owners returned early and caught thieves in the act, they reacted violently, chasing and even grappling with the intruders. While overall thievery makes up less than 4 percent of foraging trips, some pikas make a living off their fellows. The stealing cuts down on search time and exposure to predators, as well as ensuring pre-selection of plants, so it remains a mystery why pikas rob from one another at some sites but apparently not at others.

Hay piles are not only critical for pikas' winter survival, they also enable the pikas to reproduce when meadows are still snow-covered. Births of litters--usually triplets--tend to occure as snow melts and a flush of growth transforms high alpine meadows into hayfields. The new food, along with stored fat, helps mothers ensure that their young are weaned successfully, leaving both adults and their offspring with as much time as possible to gather new hay piles to sustain them through the next long, hard winter.

And now we know that to survive the harsh alpine winters, pikas must be able to harvest both nutritious plants and plants that help preserve hay piles. Some pikas have even learned that there are severe consequences to taking the easy way out and robbing their neighbors--although, as in all societies, there are those who try.

Arizona State University zoologist Andrew Smith, a leading authority on pikas, has written extensively about the animals in the scientific literature.

- See more at: http://mobile.nwf.org/Home/News-and-Magazines/National-Wildlife/Animals/Archives/1997/The-Art-of-Making-Hay.aspx#sthash.3csjaeuV.dpuf