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Opinion



The Wild Side

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Where Tasty Morsels Fear to Tread



Uwe Gerig/Deutsche Press Agency, via Corbis A full-grown brown bear at the private 'Libearty' bear reservation in the Carpathians near Zarnesti, Romania.

I've just come back from the predator capital of Europe: Romania. The forests and mountains there are home to most of Europe's remaining bears and lynx and wolves, oh my! (I didn't see any of them, but I did see evidence of bears — scat, and a fresh pawprint.)

In honor of these animals, I thought I'd declare October to be Predator Appreciation Month. For although such beasts are not, these days, a problem for most of us humans, predators remain a powerful force in the lives of many of our fellow creatures.

It's not just that they kill. They also change what their potential victims get up to. In short, they create a landscape of fear.

I imagine this as a place of shadows, where your heart beats fast, you are listening and alert, and forever glancing over your shoulder. In places where predators roam, the landscape of fear is as real as the physical landscape. But rather than being made of mountains and valleys, forests and grasslands, it's smells, sounds and adrenaline.

Some time ago, I saw a clear example of how predators can change things. A friend of mine had a fish tank containing one big fish (about a foot long) and seven or eight much smaller fish (each about an inch). The small fish always went around together, in a tight school. Then, one day, after a long and pampered existence, the big fish died. As soon as his body was taken out of the tank, the little fish stopped schooling. You could almost hear them gurgling with relief.

Schools, herds, flocks — these are common anti-predator measures. The great evolutionary biologist, the late W. D. Hamilton, called the phenomenon “the selfish herd,” arguing that herds form when each animal tries to put itself into the middle of a group.

But being in a herd doesn't just improve the chance that someone else will get eaten instead of you if a predator pounces. Each animal in a herd can spend less time looking over its shoulder, because other animals are also keeping a look-out. This means that everyone can spend more time doing other things — like eating, snoozing or impressing potential mates.

However, the landscape of fear not only changes what animals do. It also changes where they go. Vervet monkeys — small African monkeys — will, if they're not careful, find themselves being caught and feasted on by any of several predators, including baboons, leopards and eagles. Thus, the monkeys tend to stay away from places where baboons or leopards are known to dwell, even if there's good food there. (Eagles don't affect the monkeys' whereabouts, probably because they don't live locally, but rather, fly in from afar.) Indeed, one recent study found that the risk of meeting a baboon or a leopard is more important than food in determining where the monkeys hang out.

And monkeys are hardly the only example. At a more humble level, bumblebees avoid flowers that tend to harbor spiders. Grasshoppers, too, avoid spiders by switching the food that they eat when spiders are out and about. Impala — small African antelopes — stay away from places where lions are likely to lurk. And in Wyoming's Grand Teton National Park, baby moose are often killed by brown bears. So you might expect that mother moose would prefer to give birth in places that brown bears avoid — like roads. Sure enough, in bear-rich areas, pregnant moose tend to give birth on or near roads. (In contrast, non-pregnant females, or females that lost a pregnancy, don't hang out near roads — which shows that it's not just that moose like tarmac.)

A fear landscape has several knock-on effects. Animals that can't go where they like to get food tend to grow more slowly, and reproduce less. For instance, grasshoppers that have to take measures to avoid spiders grow more slowly and lay fewer eggs than grasshoppers in spider-free zones. In areas of Yellowstone where wolves are abundant, female elk give birth to fewer young. Birds that perceive their breeding area to be full of animals that will eat their eggs or young may skip breeding altogether, or lay fewer eggs than usual. In other words, predators keep prey numbers down simply by being scary.

And that's not all. By restricting where other animals go, predators can have a profound effect on plants, too. Often this means that plants that would normally be eaten have a chance to grow. In Yellowstone National Park, for example, elk like to nibble on young willow trees. Before wolves were reintroduced in the mid-1990s, these trees didn't have a chance to grow. Now they do — in the places that elk perceive as dangerous.

In one of his most beautiful and insightful pieces of writing, Charles Darwin predicted exactly this kind of effect. (Note that his “humble-bee” is our “bumblebee.”)

I have very little doubt, that if the whole genus of humble-bees became extinct or very rare in England, the heartsease and red clover would become very rare, or wholly disappear. The number of humble-bees in any district depends in a great degree on the number of field-mice, which destroy their combs and nests; and Mr H. Newman, who has long attended to the habits of humble-bees believes that ‘more than two-thirds of them are thus destroyed all over England.’ Now the number of mice is largely dependent, as every one knows, on the number of cats... Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district!

As I sit here, thinking about the landscape of fear, I watch a small bird at my bird feeder. It spends more time looking around than it does eating. I try to imagine the world from its point of view — the startles, the alarms, the rustle of wings, the paw of the cat. And although I wish it well, I wouldn't like its predators to disappear. For when predators vanish, our planet becomes a safer, but poorer, place.

Notes:

Estimates for the numbers of bears (Ursus arctos), lynx (Lynx lynx), and wolves (Canis lupis) in Central Europe are given by Salvatori, V. et al. 2002. “Hunting legislation in the Carpathian Mountains: implications for the conservation and management of large carnivores.” Wildlife Biology 8: 3-10. Romania comes out top with around 5,000 bears, 2,000 lynx and 3,000 wolves — considerably more than any of its neighbors. For comparison, Sweden (home to the other major European bear population) has around 1,000 bears — see Waits, L. et al. 2000. “Nuclear DNA microsatellite analysis of genetic diversity and gene flow in the Scandinavian brown bear (Ursus arctos).” Molecular Ecology 9: 421-431.

The literature on predation and its effects is gigantic; my treatment is necessarily brief. Apologies if I have left out anyone's favorite examples or studies.

As far as I can tell, the term "landscape of fear" was first used by Laundré, J. W., Hernández, L. and Altendorf, K. B. 2001. "Wolves, elk, and bison: reestablishing the "landscape of fear" in Yellowstone National Park, USA." Canadian Journal of Zoology 79: 1401-1409.

Hamilton's paper on the selfish herd can be found in Hamilton, W. D. 1996. "Narrow Roads of Gene Land. Volume I: Evolution of Social Behaviour." W. H. Freeman. See pages 229-252. This is one of Hamilton's most delightful papers; his commentary on the work is also interesting. It's generally agreed that individuals in larger groups spend less time looking around; however, the reason for this is much debated. The lead-contender is the "many-eyes" hypothesis — because others are looking around, you don't have to. For other possibilities see, for example, Roberts, G. 1996. "Why individual vigilance declines as group size increases." Animal Behaviour 51: 1077-1086.

For vervet monkeys and fear, see Willems, E. P. and Hill, R. A. 2009. "Predator-specific landscapes of fear and resource distribution: effects on spatial range use." Ecology 90: 546-555. For bumblebees avoiding flowers they suspect of harboring spiders, see Ings, T. C. and Chittka, L. 2009. "Predator crypsis enhances behaviourally mediated indirect effects on plants by altering bumblebee foraging preferences." Proceedings of the Royal Society of London B 276: 2031-2036. For grasshoppers altering their behavior in the presence of spiders, see Beckerman, A. P., Uriarte, M. and Schmitz, O. J. 1997. "Experimental evidence for a behavior-mediated trophic cascade in a terrestrial food chain." Proceedings of the National Academy of Sciences USA 94: 10735-10738.

For impala (and other animals) avoiding likely lion habitat, see Valeix, M. et al. 2009. "Behavioral adjustments of African herbivores to predation risk by lions: spatiotemporal variations influence habitat use." Ecology 90: 23-30. For baby moose being killed by bears, and for moose giving birth near roads, see Berger, J. 2007. "Fear, human shields and the redistribution of prey and predators in protected areas." Biology Letters 3: 620-623.

*For grasshoppers growing more slowly and reproducing less in the presence of spiders, see Danner B. J., Joern A. 2004. "Development, growth, and egg production of *Ageneotettix deorum* (Orthoptera : Acrididae) in response to spider predation risk and elevated resource quality." Ecological Entomology 29: 1-11. For elk being affected by the mere presence of wolves, see Creel, S. et al. 2007. "Predation risk affects reproductive physiology and demography of elk." Science 315: 960. For a review of the landscape of fear and its influence on birds, see Lima, S. L. 2009. "Predators and the breeding bird: behavioral and reproductive flexibility under the risk of predation." Biological Reviews 84: 485-513.*

For a general overview of how predators can influence prey numbers just by being scary, see Preisser, E. L., Bolnick, D. I. and Benard, M. F. 2005. "Scared to death? The effects of intimidation and consumption in predator-prey interactions." Ecology 86: 501-509. For elk, wolves, and willow, see Ripple, W. J. and Beschta, R. L. 2004. "Wolves and the ecology of fear: can predation risk structure ecosystems?" BioScience 54: 755-766. For Darwin on humble-bees

and cats, see pages 74-75 of Darwin, C. 1964. "On the Origin of Species: A Facsimile of the First Edition." Harvard University Press. The passage I quote is one of my favorites.

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