



Wolves fear humans but learn quickly about us

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“Fear makes the wolf bigger than he is” (German proverb)

Humans have feared wolves for hundreds, if not thousands, of years—as evidenced by our cautionary fairy and folk tales about wolves (e.g., ref. 1) and a remarkably impactful history of wolf persecution. Wolves not only compete with us for food and may hunt our livestock, but they can, and have, killed humans. This is not to be alarmist—these days wolf attacks are *extremely* rare [many are the result of rabid wolves (2)], even in areas with high wolf densities. Moreover, because humans and our livestock make up almost all of the Earth’s mammalian biomass (3); objectively, they have limited impact. Rather, I note this to acknowledge there is a history of selection for humans to respond negatively and fearfully to wolves. This fear has led to wolf eradication around much of the world. Lazzaroni et al. (4) have brought new insights to how free-living wolves modify their wariness around people, knowledge that will be essential if we are to better manage our coexistence with expanding wolf populations.

In many places, where wolves formerly were found, humans have lived for nearly a century without them. This has changed, in part, because public opinion about wolves has changed and because current wildlife managers recognize that wolves are an important top predator that may (either directly or indirectly) shape their ecosystems by driving trophic cascades (5). While controversial and more complex than often portrayed (6), wolves (and other large carnivores) eat natural prey and this reduces their populations compared to wolf-free times. Cascades may also be driven in part by the fear wolves create in their natural prey which modifies prey movement. Together, this impacts how wolf prey use their habitat. Wolf recovery has seemingly driven the recovery of riparian vegetation and aspen sapling recovery in forests that were previously grazed by ungulates in areas with no recent history of wolf predation. Recovered vegetation has associated effects on a variety of other species that use this habitat (but see ref. 6 for the complexities of this brief overview). In addition, wolves keep other carnivore populations in check because wolves, like many other carnivores, compete with and may dominate smaller species, in part by engaging in intraguild predation. For instance, in North America, wolf recovery is associated with coyote population declines (7).

As populations of wolves are recovered by both translocations and restrictions on their hunting, wolf ranges are increasing. This is, in many places, leading them to expand into more densely occupied human areas—including urban areas (8). Because human–wolf interactions are so important for their ultimate coexistence, it is essential to better understand how wolves respond to humans and whether and how this may vary along a gradient of human density/use intensity. In this spectacularly clear and compelling paper that reports the results from a remarkably large sample size of

free-living wolves, the authors show us how human disturbance influences wolf risk assessment.

Some studies suggest that humans are perceived by many species as a “superpredator,” (e.g., ref. 9). Prior work has suggested that wolves avoid areas around humans may avoid them in part by shifting their activity patterns (10). However, animals may also become more tolerant to humans where they coexist (11), and in some cases be attracted to humans (12). The authors contrasted a “colonization hypothesis”—where animals become more tolerant and colonize human-occupied areas, to a “dangerous niche hypothesis”—characterized by increased caution toward novelty. Thus, it is an empirical question as to how wolves respond to people specifically as a function of increased exposure to humans (13).

In Europe, where this study was conducted, wolves have recolonized much of their prior range, which has put many wolves into contact with humans. Indeed, as the authors noted, wolves have shifted their diets from natural prey to now include human pets and human refuse—activities that create direct human–wolf conflicts (14).

Lazzaroni et al. (4) studied wolves in Central Italy and were able to create a remarkable dataset of 185 individually recognized wild wolves to which they gave two behavioral tests. These wolves lived in 44 different locations (including sites around Pisa and Florence) that could be classified using a Human Footprint Index (HFI)—which characterizes human activity in an area. Central Italy has wolves living along a broad gradient of human activity!

At each location, they established motion-sensitive cameras that wolves triggered when nearby. At one camera, and over the course of two months, they sequentially exposed wolves to a novel object that was changed after a month to quantify habituation and to see how they responded to the second novel object. Such cognitive tests may reveal the degree of caution as well as plasticity. At the second camera, and two months after the first experiment, they were exposed to motion triggered acoustic playbacks of humans talking, or control playbacks of bird song. They exhaustively scored these videos (must-see samples can be found in the [SI Appendix](#)).

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Their results were clear. Wolves living in areas with higher HFIs were immediately less fearful of a novel object, but they also were more cautious to the second object than wolves living in more wild areas with low HFIs. The effects of urbanization, however, were not uniform because wolves always responded more fearfully to human voices than their control bird song, regardless of the degree of human activity. But, interestingly, for those individuals that responded to both novel objects and playbacks, the authors found that individuals were more responsive to human voices but also that they habituated to them as they heard them repeatedly over time in a way that was similar to how they habituated to the first novel object.

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Taken together, Lazzaroni et al. (4) were unable to fully reject either initial hypothesis. Rather, animals living in urban areas may be more sensitive and cautious around a variety of novel stimuli while simultaneously becoming more tolerant to them over time. Given a long history of persecution, wolves “wisely” respond to humans and novel objects with caution. Given that continued caution is costly, they habituate to stimuli over time.

Wolves are highly social and live in complex societies. Their analysis showed that wolves encountering the novel object with another individual were less scared than those encountering it alone—evidence in support of the widely reported group size effects whereby increased group size is associated with a reduced risk of predation and therefore a reduced

perception of predation risk (15). Future studies could see if the strength of wolf social bonds could explain this as well and thus test the “social security” hypothesis (16).

What does all of this mean for better managing our coexistence with wolves? Wolves are smart and learn quickly, and this creates a real challenge for developing nonlethal deterrents which they almost certainly will habituate to. Fortunately, in many places, livestock are not vulnerable all year long and deterrence may be effectively focused toward the times when they are most vulnerable. Integrative management that combines managing the natural prey community, habitat, and the behavior of humans, wolves, and livestock, will ultimately be essential. One size will not fit all and adapting methods for the specific location will be needed.

However, viewed from a socioecological framework, all of the burden for change should not necessarily be placed on wolves. Modifying human behavior [e.g., night penning (17)] may be important, and new technology may also help. For instance, it is possible to identify and track carnivore movement acoustically with remotely deployed microphones to localize the carnivores or their prey (18), and it is possible using GPS collars to create virtual fences and manage livestock movement remotely. By concentrating livestock, they can be more easily defended and dense populations of livestock may permit the animals to protect themselves against wolves (19).

As to protecting pets, humans may have to modify how they are fed and where they sleep—wolves do not hunt inside our homes! Keeping pets indoors and removing food that may attract other carnivores will also help manage other wildlife–human conflicts. Such changes, while potentially challenging to implement, will be essential if we value large carnivores, like wolves, having the ability to exert their important role in nature.

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