PHOTO: CHRISTOPHER FURLONG/GETTY IMAGES

ANIMAL BEHAVIOR

Mammals responded to reduced road traffic

COVID-19 restrictions in 2020 reduced traffic worldwide and altered animal movement

By **Colleen Cassady St. Clair** *and* **Sage Raymond**

The frequency of animals crossing roadways is important to the conservation of countless species worldwide because roads cause mortality through vehicle collisions, reduce habitat, and limit movement of individuals (*1*). Road avoidance also limits dispersal, which increases isolation, inbreeding, and susceptibility of small populations to local extinction (*2*). Despite the global ubiquity of roads and their long-identified conservation implications (*3*, *4*), it has been difficult to determine whether road avoidance is caused by permanent road infrastructure or the day-to-day presence of vehicles. COVID-19 lockdowns during 2020 have provided an opportunity to answer this question. On page 1059 of this issue, Tucker *et al.* (*5*) report using data from other studies that tracked mammals both before and during COVID-19 lockdowns in 2020. They found that vehicle traffic alone appeared to change animal movement near roads with implications for population persistence and human-wildlife conflict.

Studies of mammals fitted with collars that track an animal's location every few hours using the global positioning system (GPS) are used to answer a range of questions about wildlife biology, conservation, and management (*6*). Tucker *et al.* incorporated data from 43 mammal species around the world and 2300 GPS-collared individ-

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Wild mountain goats roam the streets of Llandudno, Wales, on 31 March 2020, which was attributed to the lack of human activity and traffic owing to the COVID-19 lockdowns.

uals to assess whether the sudden reduction in vehicle traffic in the early COVID-19 lockdowns between 1 February and 28 April 2020 changed the way that animals moved near roads relative to the way that they moved in the same weeks 1 year earlier. The authors analyzed displacement between points (measured at 1-hour and 10-day scales) and proximity to roads for each animal. For each GPS data point, the authors also considered the extent of the adjacent human development (measured with a standardized index of human footprint), the strictness of the lockdown (measured with the Oxford COVID-19 Stringency Index), and between-year changes in the vegetative state of the habitat (measured by satellite imaging). For each animal, they analyzed the average distance traveled on an hourly scale, which could demonstrate fleeing responses, and a 10-day scale, which could demonstrate willingness to explore beyond their usual home ranges.

Tucker *et al.* observed substantial variation among individuals, species, and locations. Some studies have reported more uniform responses among different animals during the COVID-19 lockdowns in 2020, including mountain lions (*Puma concolor*) in California, USA (*7*), birds in Canada and the US (*8*), and Torresian crows (*Corvus orru*) in Australia (*9*), but the variability of the results presented by Tucker *et al.* is more consistent with other studies. For example, a pre–COVID-19 study in 2016 of 14 mammal species in India showed a range of responses to human activity (*10*), and a COVID-19–era study in 2022 of seven other mammal species in Slovenia showed that lockdowns in 2020 reduced roadkill for some species, such as roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*), but increased it for others, especially badgers (*Meles meles*) (*11*). This variability suggests that even an experiment as widely synchronized and globally replicated as the COVID-19 lockdowns in dozens of countries did not affect animal movement in the same way.

However, Tucker *et al.* did find evidence for a few consistent effects. When and where the COVID-19 lockdowns were more strict, there was a 73% increase of the longest movements by individuals at the 10-day scale. This indicates that most animals were exploring more of the landscape when vehicle movement was more limited. However, in areas with greater human density, such as near an urban center, animals showed a 12% decline in the longest movements at the hourly scale during lockdowns. Tucker *et al.* suggested that this is because they were less frequently frightened by aversive stimuli, whether from road traffic or human presence, during the lockdowns and exhibited shorter fleeing distances. Their interpretation that roads caused less fearfulness when they had less traffic is supported by their observation of lesser avoidance of roads—animals were 36% closer to them than before the lockdowns. Changes in longest movements were contingent on the strictness of the lockdowns and human population density, showing that animals are both sensitive and responsive to human activity on and near roads.

Lesser road avoidance by animals during the lockdowns has implications for both wildlife and people that range from beneficial to potentially harmful. Conservation goals might be advanced with the greater movement of sensitive and rare species, such as the urban-avoiding mountain lions in the San Francisco Bay area of California, USA (*7*). However, closer proximity to roads by carnivores might increase the potential for conflict with people in highly populated areas. Proximity of people and wildlife may also affect disease dynamics. Greater sharing of space with people during the COVID-19 pandemic might be the reason that white-tailed deer (*Odocoileus virginianus*) in Ohio, USA, are now frequently infected with at least three lineages of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (*12*), which may produce variants that could evolve and be transmitted to people or livestock (*13*).

The COVID-19 lockdowns created a large unintentional experiment for the study of how human activities affect animal movements, including for species that are threatened, culturally important to people, or associated with human-wildlife conflict. Tucker *et al.* provided a comprehensive answer about the ability of some animals to make use of human-inhabited areas and even expand their habitats when human activity declines. Their results highlight the environmental impact of vehicle activity, which is discussed less often publicly than the effects of emissions, permanent road infrastructure, and habitat loss. This study shows the quantitative impact of vehicle presence on animal behavior, which has been much harder to measure. The authors also show how effectively and quickly some animals can take advantage of decreased traffic, which may offer support for traffic restrictions in protected areas (*14*) as well as greater appreciation for the cognitive flexibility of other species (*15*). ■

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