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Science FINDINGS

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"Science affects the way we think together."
Lewis Thomas

Seeking Ground Less Traveled: Elk Responses to Recreation

Leslie Naylor

A female elk wearing a telemetry collar in the Starkey Experimental Forest and Range, Oregon. The collar enabled scientists to track the animal's movements in response to different types of recreation by volunteers wearing GPS units while riding all-terrain vehicles, mountain bikes, horses, or on foot.

IN SUMMARY

Recreating on public land is increasingly popular in the Pacific Northwest. Recreation management requires balancing opportunities for people to enjoy the outdoors with mitigating the effects on wildlife and other natural resources. Recreation and wildlife managers grappling with these issues asked Forest Service scientists to quantify the impacts of motorized and nonmotorized recreation on elk. Elk are highly valued for hunting and viewing by the public, and as large herbivores, they play a critical role in many ecosystems of the Intermountain West.

A large fenced area within the Starkey Experimental Forest and Range in eastern Oregon provided a unique setting for assessing how a wide-ranging species like elk respond to four types of recreation. Real-time data recorded by telemetry units worn by people and elk alike allowed scientists to establish a cause-effect relationship between human movements and activities and elk responses. Scientists found that elk avoided areas where humans were recreating. This avoidance resulted in habitat compression. All-terrain vehicle use was most disruptive to elk, followed by mountain biking, hiking, and horseback riding. When exposed to these activities, elk spent more time moving rather than feeding and resting.

Land managers can use this information to assess tradeoffs between multiple, and often competing, land uses. When combined with planning efforts that include stakeholder engagement, it may offer a clearer path forward.

"These days, unplugged places are getting hard to find."
— Richard Louv, writer

Whether we work at a computer, play video games, or watch movies, too much time glued to a screen can affect our physical and mental health. Now more than ever, time spent in nature offers a powerful antidote to this hallmark of modern American life.

Recreating on public land is an increasingly popular way to recharge. In 2016, 891 million visits were made to national forest, national parks, and other federal lands. As the population increases, this number is expected to rise. This presents a conundrum for public land managers because recreation can take a toll on the land and the wildlife it supports. With growth comes change, and land managers are grappling with how to ensure that outdoor recreation is viable for people and the wildlife and natural resources they enjoy.

That's why findings from a study led by Mike Wisdom on the effects of different types of recreation on elk are particularly relevant. Publications based on data collected at the USDA Forest Service's Starkey Experimental Forest and Range near La Grande, Oregon, from 2002 through 2004 show how motorized and non-motorized types of recreation––all-terrain vehicle (ATV) use, mountain biking, horseback riding and hiking––affect elk. Elk

are highly valued by people for wildlife viewing and for hunting and, as one of the nation's largest herbivores, play a critical role in many ecosystems of the Intermountain West.

Wisdom is a research wildlife biologist with the Forest Service's Pacific Northwest Research Station. He worked on this project closely with Bruce Johnson, a retired wildlife researcher with the Oregon Department of Fish and Wildlife.

Their findings provide quantitative evidence about the effects of recreation on elk. In short: hunted populations of elk generally don't care to be around people, especially people on ATVs and mountain bikes, even during non-hunting seasons.

"We were able to document a cause-effect relationship between the four types of recreation and elk responses," Wisdom says. "The data from that study were so diverse and rich that our first publication in 2004 was just the beginning." Together with collaborators, the researchers subsequently developed new evaluation methods and hypotheses regarding elk responses to real-time interactions with recreationists.

The researchers suspected that the presence of recreationists would disrupt elks' daily activities. Specifically, they hypothesized that the elk spend more time running and less time feeding. For female elk, these energetic costs can reduce body fat needed to successfully rear a calf. They also suspected that elk avoided recreationists at distances that allowed the animals to remain hidden from human view. In open, dry forests of the Interior West, these distances could be quite long.

Further analysis revealed how the avoidance efforts of the elk affect the animals' daily activities of foraging, running, and resting, which can have long-term effects on health and reproductive capacity. The data also revealed that elk do tend to move to stay out of human sight.

The study continues to provide insights that are helping resource managers find ways to balance the ecological and social dimensions of recreation management.

Where the Elk Roam and the Humans Play

Mountain bike and ATV sales are on the rise, especially near urban centers like Portland and Seattle where economic growth has been strong. The number of adults using motorized off-road vehicles is projected to increase by 20 percent by 2030, while the number of adults hunting on federal land, for example, is projected to increase by 12 percent, according to Forest Service research on recreation trends.

"You look at the highways and you see more people pulling enclosed trailers with recreation equipment," Johnson says. "People with disposable income are buying bigger and fancier toys, whether it's a better mountain bike or a better ATV."

Too much computer time may drive us to seek refuge in nature, but Johnson says that technology also makes it easier for people to get outside and recreate––think new off-road vehicle designs and electric mountain bikes.

"This is really important because they become advocates for recreating in open spaces," Johnson says.

At the same time, with more people recreating on public land, the pressure is on to make sure that strategies for managing land use, and the natural resources that attract the recreation in the first place, are effective.

"Probably one of the most controversial topics on a national level is recreation management on public lands, especially in relation to management of roads and trails for motorized use," Wisdom says.

Wisdom, who has three decades of wildlife management and research experience, recalls when off-road vehicles once roamed just about anywhere on national forest lands, leaving in their wake a proliferation of rogue trails that caused soil erosion, degraded water quality, and disturbed wildlife. To address these problems, in 2005, the Forest Service implemented the Travel Management Rule; it requires designating roads, trails, and off-road areas for motor vehicles to use and prohibits their use outside those areas.

"That process really generated a lot of controversy," Wisdom says.

Today, agencies are under pressure to accommodate more ATV riders and mountain bikers, while also providing recreation opportunities to a growing number of hikers and horseback riders. All such uses are increasing on public lands. In response, many public land managers find themselves in a hotbed of debate.

Part of the challenge is that research on the impacts of motorized and nonmotorized recreation on wildlife is largely observational. Several stakeholder groups had begun to ask Wisdom if it was possible to quantify the effects of these different forms of trail-based recreation on wildlife. For trail planning, the Oregon Department of Parks and Recreation, which collects sales tax on all-terrain vehicles to develop trails, was particularly interested in the results.

KEY FINDINGS

- Elk avoided people and trails associated with all-terrain vehicle (ATV) use, mountain biking, hiking, and horseback riding. Avoidance was strongest in response to ATV use, followed by mountain biking, and was less strong in response to hiking and horseback riding.
- In response to these recreation activities, elk moved to areas where they were less likely to encounter recreationists. Increased movement and flight added energetic costs and decreased foraging times, which can affect animal health and diminish their ability to reproduce.
- Elk stayed hidden from human view as part of avoidance. Extensive forest thinning increased the field of view and, therefore, the distances that elk maintained from recreationists.

Purpose of PNW Science Findings

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Rhonda Mazza, editor; rhonda.mazza@usda.gov

Jason Blake, layout; jason.p.blake@usda.gov

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The scientists working at Starkey knew that quantifying elk responses to human activities in a cause-effect manner would require experimental research with controls and replication. But how could they design a study to assess the impacts on a free-ranging species like elk? How could they control for both humans and elk?

The short answer: a big enclosure and technology to monitor both recreationists and elk.

A Giant Outdoor Laboratory

In 1987, a 25,000-acre portion of the Starkey Experimental Forest and Range was enclosed with 8-foot-high elk-proof fencing for long-term, landscape-scale ungulate research. The fencing is important not only for managing elk and deer but also people. The enclosure was the brainchild of Jack Ward Thomas, then a scientist for the Pacific Northwest Research Station who later became Chief of the Forest Service. Since its establishment, more than 80 studies have made use of the opportunities provided by the enclosure, resulting in more than 400 scientific publications.

"One of the things about the Starkey Experimental Forest and Range is that we have complete control over the human activities that go on there," Wisdom says.

The study took place in a smaller portion of the experimental forest: A 3,600-acre fenced area where earlier commercial timber harvests resulted in a mosaic of open and closed forests interspersed with grasslands. The mixed-confer forest typical of the eastern Oregon is dominated by ponderosa pine, Douglas-fir, grand fir, and western larch.

The environment was ideal for studying how elk respond to activities over time and across a large area––the closest thing to real-world conditions but with controls.

"It was a pretty elegant, manipulative experiment that was very clean, with defined treatments and controls," Wisdom says.

The defined treatments were exposure to the four types of recreation and the control periods of no human activity. Five days of exposure to a given recreation activity (treatment) were followed by 9 days of no exposure to human activity (control). This was repeated multiple times for each paired treatment and control from spring through fall for 3 years.

Add animal and human tracking technology to this mix and you have a game changer. Telemetry units worn by all of the recreationists and a portion of the elk population (35 of 123) in the study area allowed the scientists to collect response location data in real time. And an accelerometer, essentially a Fitbit calibrated for elk, embedded in their radio collars, captured data about time spent running, resting, or foraging.

U.S. Forest Service

A unique feature of the Starkey Experimental Forest and Range is the 8-foot high fence enclosing 25,000 acres. The fence has enabled many landscape-scale studies involving elk and other wildlife since its installation in 1987.

U.S. Forest Service

The GPS units worn by volunteers, an ATV rider here, recorded information about their location and speed.

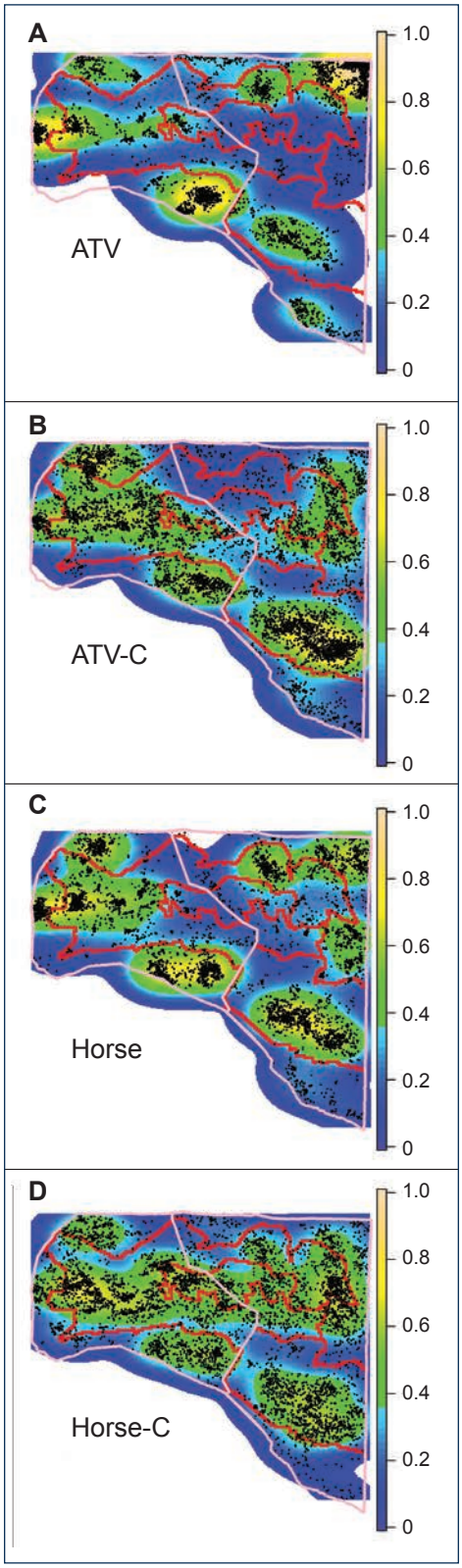
Avoiding Motors, Wheels, Hooves, and Boots

The study results confirmed what the scientists suspected––elk are quite sensitive to the presence of humans. The animals clearly shifted long distances away from recreationists and moved farther out of view as human activities moved along the trails. They avoided not only recreationists but also the trails associated with their activities. Their intolerance (as indicated by the distances they maintained) was highest for ATV riding, followed by mountain biking. To a lesser degree, the elk also avoided hikers and horseback riders.

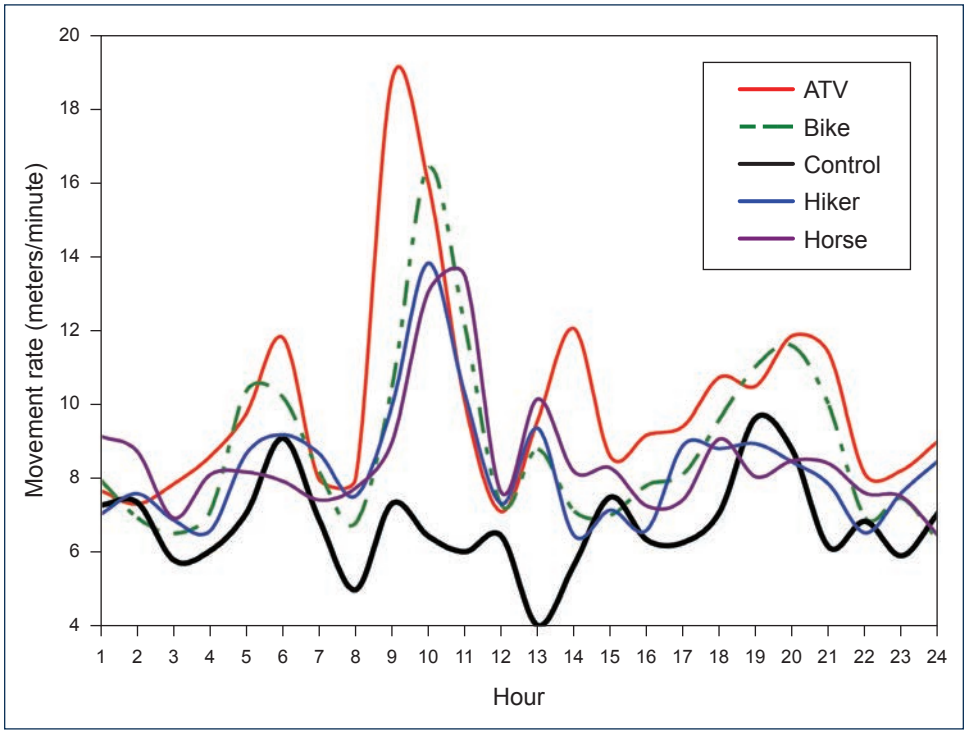
"We saw that their flight response occurred at distances over 1000 meters (3,218 feet) for ATVs and close to that for mountain bikes, and more like 500 to 750 meters (1,640 to 2,460 feet) for horseback riding and hiking," Wisdom says.

The distances elk kept from recreationists (1,830 to 2,880 feet) were two to four times farther than the distances they kept from trails (780 to 1,020 feet) and well beyond 980 feet, the maximum distance from which they could be seen by people.

Some people participating in the study reported that they could see elk from the trails. However, telemetry data revealed that the elk that were



A map of the study area showing locations of 35 elk wearing telemetry collars (black dots) recorded during periods of ATV use and horseback riding (left) compared to periods of no human activities (right). During times of recreation, 44 percent of elk locations were clustered in the 15 percent of the study area that was farthest from trails (red lines) and out of human view. Areas of higher likely use by elk are shown by warmer colors (yellow, then green) and lower likely use by cooler colors (light blue, then dark blue). Adapted from Wisdom et al. 2018.



When exposed to four types of trail-based recreation activities, elk spent more time moving than they did when humans were not present (black line). Elk avoided all types of recreation, particularly ATV use (red), followed by mountain biking (green), hiking (blue) and horseback riding (purple). Adapted from Wisdom et al. 2018.

seen by recreationists represented a small portion of the larger population: most of the elk had retreated far enough to be hidden from view.

"What you see is not what you get in terms of the response of a species like elk that has far more knowledge of human presence than we have of them," Wisdom says.

Interestingly, to be hidden from human view may also mean the reverse is true—that elk could no longer see humans. Most likely, elk use additional sensory cues to maintain their distance. Even if they couldn't see humans, they could easily hear the sound of motors or smell the gasoline of ATVs and the odor of horses.

Habitat Compression

Avoiding motors, wheels, hooves, or feet takes a toll on elk in two ways: increased energy expenditures and decreased access to food sources. Moving more than necessary and not having enough to eat can be detrimental to the viability of elk populations. For example, if females don't put on enough body fat, they may not be able to reproduce.

Output from the elk "Fitbits" showed that the animals spent less time feeding and resting and more time running compared to when there was no human activity. And the amount and quality of forage area available to the animals shrank as they shifted away from recreation trails.

Nearly half (44 percent) of all elk locations detected by telemetry during the recreation activities occurred in the 15 percent of the study area that was farthest from trails. In other words, a large number of elk sought refuge by crowding into a smaller range.

"You've basically reduced what we call carrying capacity, the number of animals that can make a living on the landscape," Wisdom says.

Dane Johnson

A horseback rider and elk. Elk avoidance was less strong in response to hiking and horseback riding, compared to ATV use and mountain biking. Elk also avoided areas where extensive forest thinning resulted in a more open field of vision.

He calls this type of habitat loss "habitat compression;" it creates pressure for elk to seek safer foraging opportunities on private land. It also reduces opportunities for people to take in wildlife on public land––one of the most popular recreation activities.

A Blended Approach

Cheryl Friesen, the Willamette National Forest science liaison, knows well the impact that habitat loss can have on animals. She used to work as a district wildlife biologist.

"I've put in my share of nature trails and viewing platforms, but that was site-by-site management," she says. "The idea of managing recreation use at a landscape scale and understanding the tradeoffs and the distribution of those uses is becoming more and more important."

Friesen says research like Wisdom's elk study is very useful in this regard. She is glad for the continued production of publications from this study and wants to see that results are effectively used by resource managers. As a science liaison, a rare position in the Forest Service nationwide, she creates opportunities for scientists and land managers to exchange information.

In 2018, she brought together more than 200 scientists and wildlife and recreation managers from throughout the West at a workshop where they could share state-of-the-art information about how recreation affects wildlife populations.

"The challenge we have right now that was clearly articulated in the workshop," Friesen says, "is you have marketing strategies pushing to get everybody out to the woods and people trying to manage the woods going, 'oh my goodness, what do we do with all these people?'"

Most natural resource issues are as much people problems as they are ecological ones, she says.

Wisdom, a keynote speaker at the workshop, summarized effects of recreation on wildlife and discussed new management approaches that integrate human values with wildlife needs. He and Friesen both see value in planning efforts that include what social scientists call human ecology mapping––engaging recreation users to show on maps where they go, what they do there, and why. Understanding how human activities such as motorized recreation, for example, are distributed across a landscape can help planners see where activities might need to be limited, redistributed, or perhaps concentrated, depending on the management goals.

The long-standing conflict between recreation and wildlife is one that Wisdom believes requires an interdisciplinary approach.

"We're trying to blend research on ecological effects with human ecology mapping so that there can be a better dialogue about the value of recreation trails and roads and their ecological impact for wildlife," he says.

Such an approach may not resolve the issue once and for all, but it might lead to productive conversations about opportunities for compromise and ways to manage multiple objectives.

"The hope of the future lies not in curbing the influence of human occupancy—it is already too late for that—but in creating a better understanding of the extent of that influence and a new ethic for its governance."

—Aldo Leopold

LAND MANAGEMENT IMPLICATIONS

- When elk avoid recreation trails and recreationists, their habitat is compressed. This is a form of habitat loss, similar to the well-documented effects of forest roads and traffic on elk and other wildlife.
- Habitat compression on public land can lead elk to move to private land. This reduces elk hunting and viewing opportunities on public land, two of the most popular forms of recreation.
- Stand structure and topography affect the line of sight for both humans and wildlife. Stand treatments that result in visual barriers may benefit wildlife such as elk that are sensitive to human presence.
- Combining information about elk response to trail-based recreation with human ecology mapping and stakeholder engagement may help natural resource managers evaluate tradeoffs and address conflicts between recreation and wildlife management.

For Further Reading

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Writer's Profile

Sylvia Kantor is a science writer and editor based in Seattle, Washington.

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U.S. Department of Agriculture
Pacific Northwest Research Station
1220 SW Third Avenue
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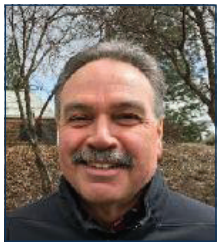

MIKE WISDOM is a research wildlife biologist in La Grande, Oregon, and oversees all research at the nearby Starkey Experimental Forest and Range. He has worked in wildlife management and research for more than 30 years and has served as team leader of the Starkey Ungulate Ecology Team for the past 9 years. He has studied elk and mule deer at Starkey and replicate sites throughout the West. His research has focused on their responses to land uses and human activities, including the effects of roads, traffic, recreation, silviculture, prescribed burning, and cattle grazing on nutrition, habitat use, and population distribution.

Wisdom can be reached at:

USDA Forest Service
Pacific Northwest Research Station
1401 Gekeler Lane
La Grande, OR 97850-3368

Phone: (541) 962-6532
E-mail: michael.wisdom@usda.gov

BRUCE JOHNSON retired from the Oregon Department of Fish and Wildlife, where he was the project leader for wildlife research and worked in collaboration with Forest Service personnel at the Starkey Experimental Forest and Range from 1990 to 2015. His research interests focused on wild ungulates and the abiotic, bottom-up and top-down forces that limit their populations.

Collaborators

Haiganoush Preisler, Pacific Southwest Research Station

Alan Ager, Rocky Mountain Research Station

Robert Anthony (deceased) and Leslie Naylor, Oregon State University

David Brillinger, University of California-Berkeley

Mary Rowland, Pacific Northwest Research Station