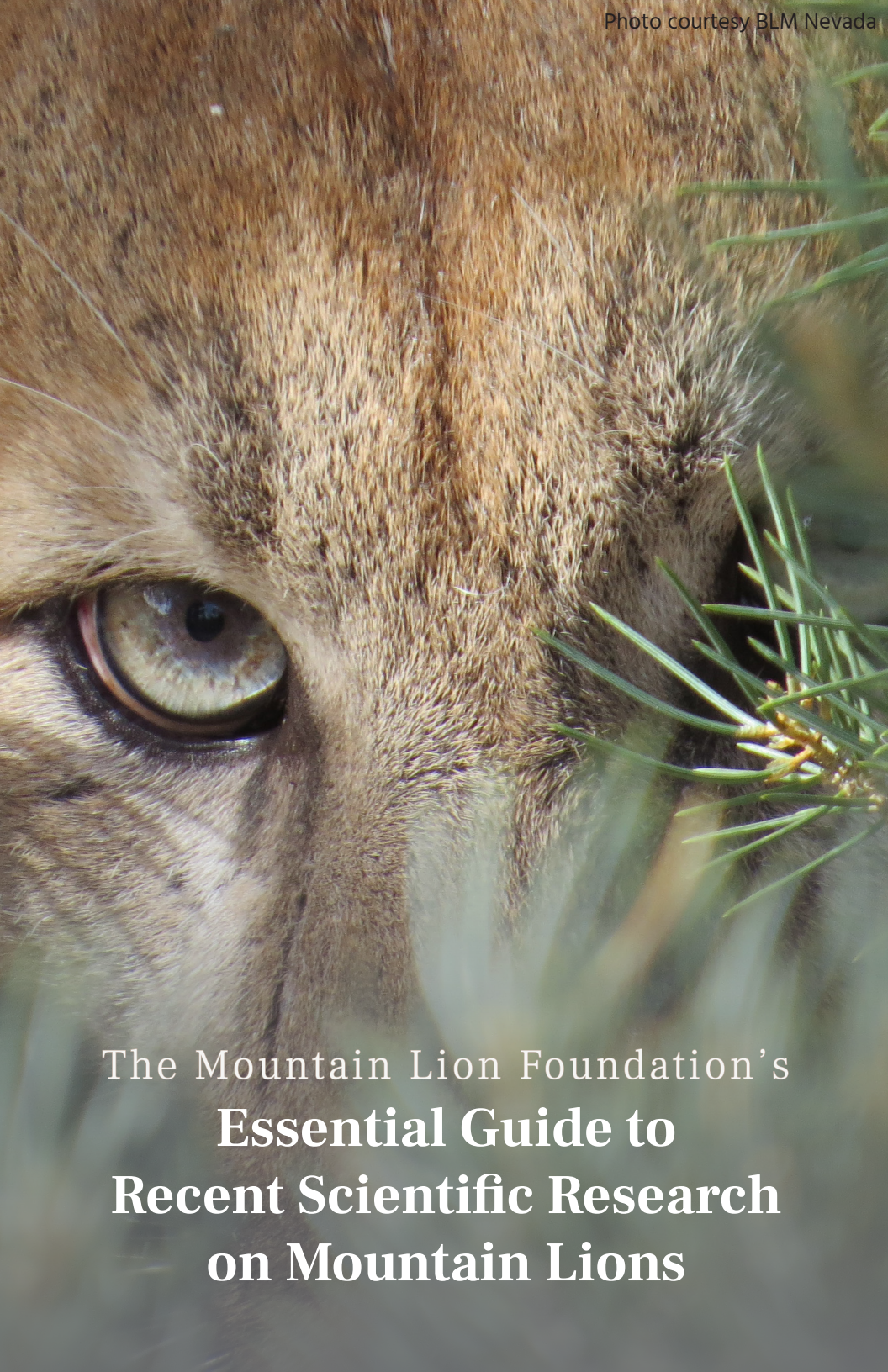

Photo courtesy BLM Nevada

The Mountain Lion Foundation's

Essential Guide to Recent Scientific Research on Mountain Lions

MOUNTAIN LION FOUNDATION

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Photo courtesy USFWS Mountain Prairie

People have been living alongside mountain lions in the Americas for tens of thousands of years. These mysterious animals inspire many important questions, even among the scientists who spend their days with them. To answer the most frequently asked questions by journalists, policymakers, and community members, the Mountain Lion Foundation's scientific staff studied peer-reviewed research and consulted with the field's top researchers.

Scientific research on mountain lion biology, social interactions, ecology, management, and coexistence has grown rapidly in recent years. Advances in genetics, GPS tracking technology, trail cameras, and other tools for research have opened new windows into these elusive animals' behavior. This has expanded and deepened our existing knowledge of how mountain lions hunt, mate, rear their young, interact with other species, and disperse across the landscape as they mature.

In some cases, new research has upended longstanding beliefs about the species. Recent studies, for instance, have revealed that mountain lions are not nearly as solitary as they have long been believed. While mountain lions are still understood to be solitary hunters, we now know that they sometimes share food and socialize, cultivating complex social networks.

We hope you find this Guide useful and informative. It is a living document, which means that we update it regularly to reflect new research and address new topics. If you don't find your question answered, please contact us at mountainlion.org for an immediate response, and we can also consider including your question in the next edition of the Guide. For full citations and additional studies that have advanced our collective understanding of lions, see **Citations and Further Reading** at the end.

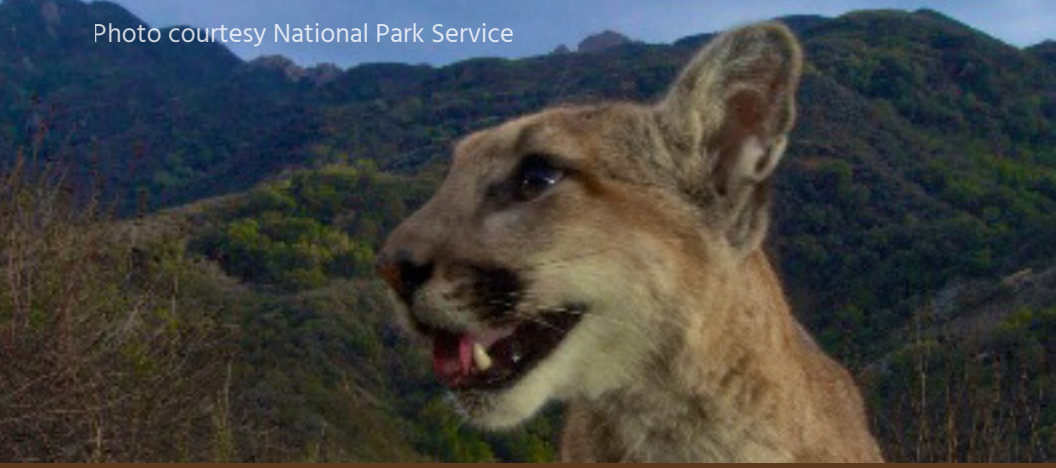


Photo courtesy National Park Service

What makes mountain lions so important to wild lands?

Read the research: Barry et al. 2019; LaBarge et al. 2022; Peziol et al. 2023; Ripple and Beschta 2006

Our summary: As LaBarge et al. (2022) show, mountain lions have "what may be the most diverse set of biotic relationships documented for any species in the world." This is partly a reflection of their wide geographic range. (Their wide range also explains why they have more common names than any other species.) But it also reflects their role as a keystone species throughout their range, affecting everything from carrion beetles and other insects that rely on cached carcasses (Barry et al. 2019) to an array of larger scavengers, as well as improved soil quality from the carcasses from mountain lions' prey (Peziol et al. 2023). Scientists use terms like keystone species, ecological brokers, and ecosystem architects to refer to species, like mountain lions, that are especially important to ecosystem health and to the wellbeing of other species around them.

Mountain lions have been part of the American landscape for hundreds of thousands of years. They continue to evolve in parallel and live in balance with elk and deer in North America, and with llamas, alpacas, and vicuñas in South America. Lions are critically important, and the removal of mountain lions from the eastern United States disrupted the natural regulation of ecosystems there. Finding ways for people to live in harmony with mountain lions and other wildlife will improve the lives of wildlife and people.

Why are my neighbors seeing more mountain lions lately? How common are encounters with lions?

Read the research: Benson et al. 2021; Bolas et al. 2024; Elbroch et al. 2022; Kertson and Keren 2022; Riley, Sikich, and Benson 2021

Our summary: Mountain lion populations are very elusive and challenging to count, and their densities can vary locally in response to many factors. Generally, their populations in the western United States are holding steady, with approximately 30,000–50,000 adults across 16 states. In some of the western US, some people believe that mountain lion populations are increasing, or that they are coming closer to towns. It can be difficult to track the size of mountain lion populations, but current evidence suggests that mountain lion populations are not increasing. In fact, Elbroch et al. (2022) found that mountain lion populations are generally stable or declining, in states with breeding populations, though one measure suggested population growth. Even a declining local population could have specific areas where the population is increasing. In states at the eastern edge of mountain lions' current range, they may be establishing new breeding areas as they recover from the overhunting which historically eradicated them in the East. The Dakotas and Nebraska, for instance, have seen the return of breeding populations in recent decades.

Regardless of these broad trends and even if a local population were growing, mountain lions tend strongly to avoid people. In Washington state, Kertson and Keren (2022) used collars with GPS locators to track lion movements, and they found that mountain lions generally steer clear of people and towns. While lions passed through human developments to get from one wild area to another, they avoided humans as much as possible, even when the lion population in neighboring wilderness grew. This is consistent with results from research on pumas in the Los Angeles hills (Benson et al. 2021; Bolas et al. 2024; Riley, Sikich, and Benson 2021) and many other observations throughout the West. So, where does the idea of increasing populations come from?

There are many factors driving this perception. As suburbs and other developments expand, a growing number of people live along the wildland-urban interface, making them more likely to encounter wildlife. In recent years, the rapidly growing use of phone cameras, trail cameras, home surveillance cameras, and doorbell cameras such as "Ring cams" has made it easier

to observe wildlife and detect the presence of mountain lions. Additionally, social media has made sharing and verifying those images of mountain lions more common than ever before. In almost every case, we are likely seeing an uptick in human detections and awareness of mountain lions, rather than a change in mountain lion behavior or an increase in local lion population sizes. In other words, the lions have likely been there all along, and now we're finally seeing them. These changes can make it seem like mountain lions are more abundant or active than they have been in the past.

Finally, young male mountain lions can disperse over long distances as they leave the area they were raised in, seeking a new territory to call their own. These young males may move quickly through unsuitable areas, and they may be sighted during their travels in areas where there is not actually a breeding population. Verified sightings in midwestern states, for example, are almost always these dispersing males.

In-person mountain lion sightings remain uncommon even for hikers, lumberjacks, and others who spend time deep in the woods, and mountain lion attacks on humans are extremely rare. There have been only 28 or 29 fatal attacks in all of the US and Canada in the last 150 years. For comparison, according to the encyclopedia Britannica, on average about 27 people die from lightning strikes in the US every year. People living alongside mountain lions can appreciate sightings as an opportunity for excitement, not fear.

Most mountain lions almost never interact with pets or livestock, focusing their attention instead on the ungulate prey they evolved to hunt.

Photo courtesy Roy Dunn

What tools should I use to reduce the risks to my livestock and pets in mountain lion country?

Read the research: Ohrens, Bonacic, and Treves 2019; Smith et al. 2017; Treves et al. 2024

Our summary: Keeping livestock or pets near wilderness includes the risk of losing some to wild carnivores, including raccoons, bears, hawks, feral cats and dogs, coyotes, and cougars. Luckily, there is an array of time-tested tools that researchers have confirmed as effective against these risks. It is important to note that preventing conflict through animal husbandry practices and the use of non-lethal deterrents is far more effective than trying to prevent conflict by punishing wildlife after they have attacked unprotected or inadequately protected livestock.

Tools like protected enclosures, flashing lights, noisemakers, range riders, and livestock guardian dogs are all standard tools for livestock owners to prevent losses. Some of these methods are new, while others are ancient. Ranchers in the Americas and Europe have long found ways to use tools to ensure their livestock can live safely alongside wild carnivores. In recent years, researchers have begun systematically testing these techniques to find which are most effective. Ohrens, Bonacic, and Treves (2019), for instance, found that flashing lights can be an effective tool for deterring predation on livestock by mountain lions and other carnivores.

Drawing on research showing that mountain lions avoid humans, Smith et al. (2017) tested whether recordings of human voices were effective at scaring away mountain lions. The experiment showed that human voices, unlike recordings of frogs, tended to chase mountain lions away from a cached kill. Ranchers have often observed that a simple AM radio, tuned to a talk station, can be effective at keeping livestock safe from mountain lions. The growing body of evidence supporting the effectiveness of wildlife deterrents will give ranchers, hikers, and others additional confidence that these field-proven techniques can be

Photo courtesy Gowan Batist

effective at protecting themselves and their animals.

Rigorous scientific research on tools and techniques that allow people and livestock to coexist safely on the landscape with carnivores is challenging. Different techniques and strategies may be effective with one carnivore species but not another. Certain methods may work better or worse based on environmental variations, for instance working differently in forests compared to arid scrublands. Results are also dependent on the type of livestock species being protected and at what scale a rancher operates.

All of these factors have resulted in a scarcity of "gold standard" studies, though Treves et al (2024) found a growing body of high-quality experimental studies. As a result, much of coexistence practice relies on personal and traditional ecological knowledge of the land, the animals being protected, and the wildlife dynamics of the area for effective management. The Mountain Lion Foundation website offers guidance on techniques livestock owners can use to pre-empt conflict at https://mountainlion.org/coexistence, and our staff is available to offer customized guidance for specific situations.

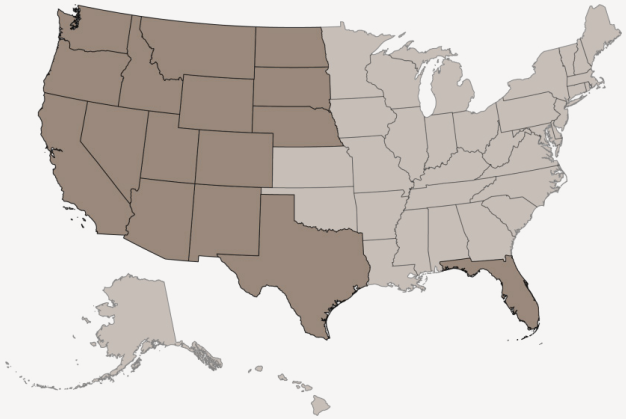
What happens when hunting mountain lions is outlawed? What are the impacts on people, pets, and livestock?

Read the research: Dellinger et al. 2021; Elbroch et al 2017; Elbroch and Treves 2023; Laundré and Papouchis 2020; Lennox et al. 2018; Peebles et al. 2013; Teichman, Cristescu, and Darimont 2016.

Our summary: Mountain lions are subject to legal hunting seasons in all but two US states with breeding populations. All but two states with legal mountain lion hunts allow them to be chased by teams of hounds and killed by the hunter once the hounds tree them.* Most states have forbidden trapping as a means of killing mountain lions.

In the last two decades, research has challenged the longstanding assumption that hunting (recreational or professional) is a necessary or even effective tool to mitigate the risk of dangerous encounters between mountain lions and people, pets, or livestock. Laundré and Papouchis (2020) assembled a large dataset comparing California with various other states, finding that California, where mountain lion hunting was outlawed in the 1970s, has a significantly lower number of problematic encounters per capita than almost every state with high hunting rates. (More research is needed on this topic, since the method of comparing encounters per capita between states has some limitations.) Their analysis also found no substantial difference in the health of deer and elk populations in California compared to other states. Other researchers, working with datasets from state wildlife agencies in the US and Canada, have found that not only does killing mountain lions not reduce risks to people and livestock, but it may cause increased rates of problematic encounters in subsequent years (Dellinger et al. 2021; Peebles et al. 2013, Teichman et al. 2016).

Why might killing lions result in higher rates of problematic encounters? The reasons for this pattern are still being studied, but multiple explanations have been offered to explain them. One is known as the "troubled teen" hypothesis. This rests on the observation that many unwanted encounters with mountain lions involve young, inexperienced males dispersing into an area as they seek an adult home range. When mountain lion populations are heavily hunted, territories from older mountain lions are left empty and dispersing males quickly fill the vacancies. As a result, high levels of hunting can lead to mountain lion populations that are made up of higher proportions of young males compared to unhunted populations.



* Breeding populations of mountain lions currently exist in Arizona, California, Colorado, Florida, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. Recreational hunting of lions is illegal at the state level in California and at the federal level in Florida. Recreational hunting of lions with hounds is illegal in Oregon and Washington.

The death of an established adult mountain lion, whether it was killed legally by a hunter, illegally by a poacher, by wildlife agency personnel, or law enforcement, opens up that mountain lion's territory on the landscape, and thus creates room for younger, more conflict-prone individuals to take up residence in larger numbers. In turn, this increases rates of unwanted encounters with people and livestock.

Another proposed explanation for the observed pattern centers on the impacts of killing female lions with dependent young. Females spend around three quarters of their life pregnant or raising their young, and the young stay with their mothers for up to two years. If the mother is killed, these kittens and young lions may struggle to hunt for deer and other wildlife. Hunger and inexperience may drive these young animals to attempt to attack livestock or come too close to people in towns or on trails. Under normal circumstances, their mother teaches those young animals to hunt and navigate human-altered landscapes. However, if a female with dependent young is killed, their learning is disrupted, which can produce more unwanted encounters.

The increase in mountain lion conflict in areas with more lion hunting may be explained by a mix of these factors: desperate acts by starving orphans and disruption to the social and territorial structures of the lions. Social structures are important: We know now that lions, though solitary when hunting, will sometimes share food and develop communities with social interactions (Elbroch et al. 2017). Reducing or eliminating hunting and emphasizing non-lethal deterrence and coexistence-focused animal husbandry techniques are very likely the best ways to avert problematic encounters.

How can we avoid overhunting mountain lions?

Read the research: Beausoleil et al. 2013; Beausoleil et al. 2021; Cooley et al. 2009; Elbroch et al. 2022; Elbroch and Harveson 2022; Logan 2019; Murphy et al. 2022; Robinson and DeSimone 2011.

Our summary: Basic ecological theory, the history of wildlife in North America, and more recent research all suggest that hunting is not necessary to "manage" or "control" mountain lion populations. Nonetheless, all states with breeding populations of mountain lions permit recreational hunting, except Florida (where the population is federally listed as endangered) and California (where voters outlawed recreational hunting). For much of US history, the management of mountain lions has been the responsibility of individual states, largely due to historical and bureaucratic reasons. The states' primary policy tool has typically been adjusting hunting regulations. As a result, policy is usually driven by a desire to provide a recreational hunting opportunity for the tiny fraction of hunters who pursue mountain lions. Sometimes policy proceeds on the false premise that more killing will reduce risks to people or livestock, or on the equally false idea that killing mountain lions will lead to higher deer or elk populations. Some researchers have focused on identifying the levels of hunting that are the most and least damaging to mountain lion populations and their ecosystems, along with policy frameworks to reduce negative impacts from hunting.

Beausoleil et al. (2013) conducted extensive research in Washington and other western states to develop a framework for science-based management of mountain lion hunting. The principles they proposed have since been incorporated into policy in Washington, and similar policies have been adopted in other states. A key finding that shaped the policy is that maintaining mountain lion mortality at or below the species' intrinsic growth rate is crucial for preserving cougar social behaviors, promoting older age structures, and ensuring stable populations. In Washington, the intrinsic growth rate was estimated at 14 percent, ± 2 percent. Other mountain lion populaions across North America have shown comparable growth rates, ranging from 11 to 17 percent (Logan and Sweanor, 2001; Robinson

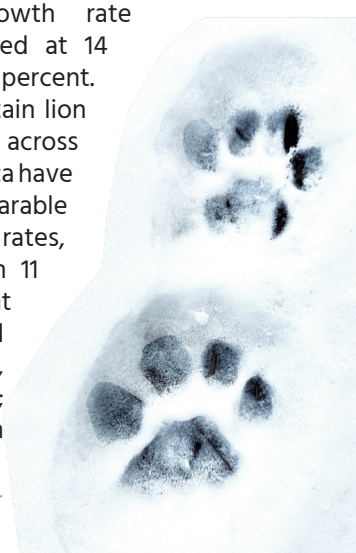


Photo courtesy Paula von Weiler

and Desimone, 2011). (The intrinsic growth rate of a species refers to how fast the species would grow if there were no outside factors limiting it, such as hunting or unusual disease. For mountain lions, an area's lion population will grow to a certain point, and then stabilize once long-term adult territories are established.)

Subsequent research has supported these findings and shown that this approach to mountain lion hunting can be an effective way to reduce conflict and maintain healthy ecosystems (Beausoleil et al. 2021). Given the high mobility of mountain lions, it can be difficult to detect overhunting without the sort of detailed fieldwork and careful regulation that the Beausoleil framework recommends. Even in the face of high hunting rates, population numbers can sometimes seem high because of immigration of young dispersers, but the population does not compensate for high hunting mortality with additional reproduction or higher survival rates of cubs (Cooley et al. 2009; Logan 2019).

In Texas, the only state where mountain lion hunting and trapping are largely unregulated, scientists and others are pushing for implementation of proactive management approaches (Elbroch and Harveson 2022), and wildlife management agencies in other states have adopted many of these same principles. Unfortunately, states vary widely in what data they gather on mountain lion populations and how they regulate hunting of the species. This makes it difficult to assess the overall health of mountain lion populations in the face of widespread hunting (Elbroch et al. 2022; Murphy et al. 2022).

Another management strategy for mountain lions has hinged on source-sink dynamics. Due to mountain lions' wide dispersal patterns, certain areas can be overhunted — a sink population — but maintain stable numbers. This can occur if there is a nearby source population of dispersing mountain lions that experiences low mortality levels to bolster the sink population's numbers. This management strategy has been widely accepted across the West as evidence for the resilience of mountain lion populations. However, this approach is limited in that it primarily focuses on managing the demographic numbers of mountain lions without preserving age structure, social behavior, or aiming to reduce human-wildlife conflict. Furthermore, the success of this management strategy relies on connectivity between habitat patches, but maintaining such connectivity is outside the scope of the policymakers regulating hunting, and it is rarely addressed in updates to hunting regulation reforms. The challenge of managing source-sink dynamics shows why so many attempts to reduce mountain lion populations through hunting fail, and why they often fail to reduce conflict as well.

What are the biggest threats to mountain lions?

Read the research: Benson et al. 2019; Blakey et al. 2022; Gustafson et al. 2019; Huffmeyer et al. 2022; Riley et al. 2007; Road Ecology Center 2023; Wultsch et al. 2023; Zeller et al. 2023

Our summary: Mountain lions were extirpated from over half their range within the United States in the 19th and 20th centuries, due to hunting, trapping, and poisoning, and encouraged by widespread bounties. Even today, human activities are the leading cause of mountain lion mortality across the US.

This includes hunting, which is prohibited in California and restricted in Florida due to their federal Endangered Species Act listing. In Colorado, for instance, over 500 lions are legally killed every year during the hunting season. Mountain lions face significant risks well beyond the direct effects of overhunting.

In Florida, which contains the only remaining mountain lion population in the East and was one of the first species listed under the Endangered Species Act, low genetic diversity, continued habitat loss, and deaths from car strikes have hindered recovery of the population. Over time, genetic isolation can result in local extinction of a population. Research in Washington state (Wultsch et al. 2023; Zeller et al. 2023) has documented low genetic diversity in mountain lion populations isolated by major highways, and in southern California, Huffmeyer et al. (2022) noted physical signs of inbreeding, including tail kinks and sperm deformity.

Roads pose a significant risk to mountain lion survival: a study in California found that two mountain lions die from car strikes in an average week in the Golden State alone (Road Ecology Center 2023). Major road crossings are planned, or in construction, to address these genetic bottlenecks and allow cougars and other wildlife to safely cross major roadways. In most areas, as in Southern California, even more extensive road crossings would be necessary to restore adequate connectivity. Further study on the effects of these barriers and the best ways to remedy the loss of genetic diversity they cause is urgently needed. Road crossings are crucial tools, but they can only reduce the harm already caused by road-building, habitat fragmentation, and development in mountain lion habitat.

There are other important threats to cougar survival as well. Riley et al. (2007) and subsequent researchers have shown that exposure to

rodenticides can cause serious health problems for mountain lions, including death from mange. Exceptional wildfires, especially in the increasing drought and heat resulting from human-caused climate change, drive out mountain lions and disrupt their populations and their prey availability (Blakey et al. 2022).

Photo courtesy National Park Service

Do mountain lions mainly kill sick deer? What is the impact of lions on Chronic Wasting Disease?

Read the research: Baune et al. 2021; Krumm et al. 2010; Miller et al. 2008; Wild et al. 2011

Our summary: Some carnivores have been found to select out the very weakest or least evolutionarily fit members of their prey species. Mountain lion predation, which focuses more on ambushing prey, is not as strongly selective in that sense, compared to carnivores that rely more on chasing their prey. Nonetheless, there is some initial evidence that mountain lions may select, to a modest extent, deer and elk infected with an emerging pathogen called

Chronic Wasting Disease. Chronic Wasting Disease is a relatively new disease in deer and elk, currently found in 33 US states and in Canada. State wildlife agencies are working hard to control its spread, as it can devastate populations of key game species, including white-tailed deer, mule deer, and elk. It is spread by a prion — a malformed protein like that which causes mad cow disease — not by a bacterium or virus, and it is not preventable or treatable by vaccines or antibiotics. There is not yet decisive evidence that the prion can infect humans, but some preliminary medical reports have suggested such transmission may be possible.

Krumm et al. (2010) and Miller et al. (2008) showed that mountain lions, unlike human hunters, are more likely to kill deer infected by the prion-caused Chronic Wasting Disease. Researchers have also found that mountain lion digestive systems are efficient at destroying the deadly disease agent (Baune et al. 2021), and some research suggests that this predation could be sufficient to eradicate the disease (Wild et al. 2011). These findings should be considered preliminary, and more research is needed on this important topic.

How did mountain lions persist in parts of the US when wolves, bears, and other apex carnivores were wiped out in the late 19th and early 20th centuries? And how do adaptability and traveling long distances continue to benefit lions' survival?

Read the research: Hawley et al. 2016; LaRue and Nielsen 2016; Stoner et al. 2008

Our summary: From the time that Europeans first arrived in the Americas, wolves, bears, coyotes, and mountain lions were targeted by bounties and other policies that were explicitly intended to eradicate the species. Lions are highly adaptable and are found in a wide variety of habitats, from forests to deserts

and at a wide range of elevations and climatic regimes. They are well-camouflaged, secretive, quick to hide, and often nocturnal, all of which makes them harder to find and kill. Furthermore, they occur at low densities and can reproduce at any time of the year. All of these traits helped mountain lions persist in some of the most remote areas of the western US. When bounty programs were reversed in the 1960s, mountain lion populations slowly rebounded, and by the late 1990s, small breeding populations had returned to the Dakotas and western Nebraska.

The species has also survived thanks to its extraordinary ability to disperse over long distances. Hawley et al. (2016) showed that a mountain lion found as roadkill in Connecticut had spent 2 years traveling nearly 2,000 miles (at least 2700 km) from the Black Hills of South Dakota. This remarkable journey took the young male through Wisconsin and Ontario, across hundreds of roads, streams, and rivers, into New York state, and from there to Connecticut. The fact that this record-setting journey went through so many different habitat types highlights the adaptability of mountain lions, a key feature in their survival through the era of bounty hunting that extirpated wolves from nearly all the continental United States, sent grizzly bears into endangered status, and drove black bears out of much of their historic range.

Female mountain lions generally don't disperse as far as males, though some have been shown to make remarkable journeys (Stoner et al. 2008). The slower dispersal of females explains the relatively long amount of time that it took even to colonize Nebraska from South Dakota (LaRue and Nielsen 2016).

In areas with breeding populations, mountain lions have home ranges that can cover 100 square miles or more. In the LA area, though, a young mountain lion that managed to cross two freeways to reach Griffith Park managed to make a home in only 9 square miles. That's the smallest home range on record for a male mountain lion. That enormous adaptability has been a key asset in the survival and success of mountain lions in the face of expanding human development.


Photo courtesy Yellowstone National Park

Will mountain lions return to their eastern range? If they did, what benefits would they bring?

Read the research: Gantchoff et al. 2021; Gilbert et al. 2017; Glass et al. 2024; Glick 2014; LaRue et al. 2012; Larue, Nielsen, and Pease 2019; LaRue and Nielsen 2016; 2011; 2008; Laundré 2013; O'Neil, Rahn, and Bump 2014; Smith, Nielsen, and Hellgren 2016; Yovovich et al. 2023

Our summary: Both because of their ecological importance and because of wide public fascination with and appreciation for mountain lions, a large literature exists exploring how and when mountain lions might recover in states where overhunting extirpated them through the 19th and 20th centuries. Yovovich et al. (2023) is a major recent effort to assess where and how mountain lions might return to their eastern range. Like prior research teams (LaRue, Nielsen, Dowling, et al. 2012; Larue, Nielsen, and Pease 2019; LaRue and Nielsen 2016; 2011; 2008; Glick 2014; Gantchoff et al. 2021; Smith, Nielsen, and Hellgren 2016; O'Neil, Rahn, and Bump 2014; Laundré 2013), they found that there are substantial areas in the East with adequate habitat to sustain healthy mountain lion populations. Mountain lions are slowly recovering at the eastward edge of their current range, returning to the Dakotas and Nebraska in recent decades. A simulation study by Glass et al. (2024) concluded that further dispersal between habitat patches is unlikely to lead to full recolonization of the East, and that translocation of females to suitable habitat may be necessary to bring back eastern panthers outside of Florida. In all locations, enhancing habitat connectivity through road crossings, the protection of green spaces along rivers, and setting aside natural areas for corridors will benefit not just lions but all wildlife and the natural systems they support.

Beyond the ecological benefits of that recovery, a return of mountain lions could benefit people in the eastern US directly. In one study, Gilbert et al. (2017) found that the return of mountain lions to South Dakota has reduced traffic accidents to a significant degree; this happens because mountain lions reduce deer overpopulation, which in turn means fewer wildlife collisions. Based on that result, they estimated that reintroduction of mountain lions to the eastern US could prevent over 21,400 human injuries, 155 fatalities, and could save $2.13 billion in avoided costs within 30 years of the species' recovery. More research on this topic would be valuable.

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The Mountain Lion Foundation sends out its sincere appreciation to the many scientists, policy experts, and field researchers who provided feedback on various drafts of this publication. Your input has made the Essential Guide a more robust and valuable tool for its diverse audiences!

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The mission of the Mountain Lion Foundation is to ensure that America's lion survives and flourishes in the wild. Peer-reviewed science, traditional knowledge, the lived experience of local communities, and science-based conservation strategies are crucial to our work protecting mountain lions and their habitat. Given the enormous and complex impacts that humanity has on mountain lions, especially in rural areas and along the urban-wildland interface, we are obligated to practice thoughtful and compassionate stewardship of our wildlife neighbors.

Mountain lions are beloved members of the wilderness and the lore of peoples throughout the Americas. Mountain lions inspire important questions, even among the scientists who spend their days with these mysterious animals. This Guide answers the most frequently asked questions posed by community members, journalists, and policymakers who are eager to learn more about living with lions. To answer these questions, we cite peer-reviewed research, most of which has been published in the last five years.

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