

Cameras for Conservation: Direct Compensation as Motivation for Living with Wildlife



The Center for
Growth and Opportunity
at Utah State University



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Authors:

Laura Huggins^a

Olivia Hansen^b

Harrison Naftel^c

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Policy Paper

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^a Laura Huggins is the President of Elevate Environmental Solutions and a Research Fellow at PERC

^b Olivia Hansen was a Summer Research Intern at the Center for Growth and Opportunity at Utah State University

^c Harrison Naftel was a Summer Research Intern at the Center for Growth and Opportunity at Utah State University

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Introduction

The simple camera trap—an automated digital device that takes a photo whenever an animal triggers a motion sensor—is playing an increasingly important role in species conservation. The camera trap is revolutionizing wildlife research by allowing scientists to collect evidence of rarely seen species with relatively little expense and minimal disturbance to both wildlife and landowners. Researchers are using cameras to document wildlife presence, abundance, and population changes.

Beyond benefiting science, camera systems are enabling conservation organizations to directly reward private landowners for hosting threatened species on their land by providing a payment per image of a live animal. Wildlife that was once seen as a liability to many ranchers is now becoming an asset. Some species, particularly predators, have historically been viewed by ranching communities as a threat to livestock. Yet the same communities responsible for reducing these species' numbers in the past can play a key role in successful species restoration in areas such as the Northern Great Plains.

Legislation protecting wildlife in the United States, including the Endangered Species Act, has typically been void of strategies that reward people for living with wildlife on their property. In fact, efforts to preserve species often impose a negative consequence such as restrictions on the ability to farm or harvest timber on private land. Many policymakers and conservationists recognize that the old approach of penalizing landowners that have threatened species on their land is not a productive path toward long-term species survival. Today, a few environmental organizations are aiming to offset the direct costs of wildlife to ranchers' livelihoods. Examples of this approach include paying for fence repair and compensating ranchers for the forage a herd of elk consumed that cattle did not get access to.

Although conservation payments from environmental groups to ranchers are becoming more common, compensation for predators is more complicated. Opposition to predators results from both economic losses as well as entrenched cultural values.¹ Cameras for Conservation programs are designed to address social norms with private landowners by first providing them with benefits, such as cash rewards, for living with wildlife. The hope is that when these initial individuals have a consistently positive benefit associated with carnivores, word will begin to spread within the community and more people will want to try out the program. As more community members participate in camera programs, experience the direct benefits of the program, and see actual data on predators' behaviors, social norms should begin to change.

The success of the camera programs thus far has been measured more in terms of improving social acceptance of wildlife than in terms of actual conservation. The idea is that once the programs spur a conversion of social norms, individuals will be more receptive to living with wildlife, associated communities will expand their social carrying capacity for wildlife (which is often well below the biological carrying capacity), and eventually species will increase. If this hypothesis is correct, it suggests that camera trapping systems run by local nongovernmental entities could be an effective approach used in association with the Endangered Species Act and other legislation aiming to conserve wildlife.

This paper begins with three case studies. In one study in Belize and another in Mexico, camera traps were used to increase threatened jaguar populations and other feline populations, including ocelots and cougars. A third case study, which author Laura Huggins helped design, involves an organization based in Montana. This program was informed by the experiments in Belize and Mexico and expanded to include 13 species and an extensive camera system. The final sections of this paper turn to challenges with these models as well as to policy-related questions such as these: Can these systems be scaled? If so, might camera trapping become a viable program to include in the portfolio of national strategies for habitat and species conservation? The paper concludes that Cameras for Conservation programs may be a more

¹ Amy J. Dickman, Ewan A. Macdonald, and David W. Macdonald, "A review of financial instruments to pay for predator conservation and encourage human–carnivore coexistence," *PNAS* (August 23, 2011) 108 (34) 13937–13944; <https://doi.org/10.1073/pnas.1012972108>.

people-friendly, cost-effective, and species-productive approach to wildlife conservation than some of the methods currently employed at the federal and state levels in the United States.

Background

Jaguars are often associated with Latin American jungles. Historically, however, they roamed across the American Southwest; there are reports of sightings from California to Louisiana in the early 1800s. As the western United States was settled, jaguar populations began to drop because of habitat loss from farming and ranching, as well as because of hunting and trapping by hunters who were paid a bounty by the federal government in the early 1900s.² The last-seen female jaguar in the United States was reported in Arizona in 1963.³ In 1972, the US Fish and Wildlife Service officially listed the jaguar as endangered under the Endangered Species Conservation Act.⁴

Over the past quarter of a century, only a handful of male jaguars have made the border crossing into the United States.⁵ Thanks to images collected by camera traps, scientists discovered that a young male jaguar (named El Jefe by local schoolchildren) was living in the Santa Rita Mountains in Arizona. Since 2013, El Jefe, whose name means “the boss,” has been photographed by motion-detecting cameras more than 100 times.⁶ El Jefe has not been seen on a camera since 2017, but jaguars are notoriously elusive and scientists still hold out some hope for his return.

Jaguars and their habitat have legal protection under the Endangered Species Act. In 2010, the US Fish and Wildlife Service was sued by the conservation group Defenders of Wildlife to create a species recovery plan and establish critical habitat for jaguars.⁷ The federal government has since designated an area that includes the Santa Rita Mountains as critical habitat for the species’ recovery in the United States.

Although the jaguar population remains sparse, private organizations are making some progress conserving this large cat, and, importantly, changing negative public sentiment built up over a century as a result of real and perceived threats from predation. One way groups are working to protect jaguars is by collecting camera trap images and allocating rewards associated with those images to landowners willing to live with wildlife. According to Jessica Moreno, a biologist with Sky Island Alliance (an environmental organization based in Tucson, Arizona), “In some ways . . . people working for [nongovernmental organizations] have an easier time working on behalf of jaguars because they can move forward with less politics, red tape and bureaucracy” than government agencies.⁸ Although relatively new, Cameras for Conservation programs are proving to be fairly simple, inexpensive, and effective: it might be time to scale up these camera trap systems.

Case Studies

The cases explored here are the first organizations that have connected camera trap images directly to reward payments (and documented it publicly) as a tool for wildlife conservation. The test study in Belize contributed a great deal toward early camera trapping research with rare cats. The Northern Jaguar Project in Mexico worked with landowners to establish a new system of rewards for images of live jaguars and other wild felines. Finally, American Prairie Reserve learned from these organizations when it created its

2 Marit Alanen, “Conserving Arizona’s Resident Jaguars,” US Fish and Wildlife Service, April 20, 2015, <https://www.fws.gov/endangered/news/episodes/bu-spring2015/story2/index.html>.

3 Richard Grant, “The Return of the Great American Jaguar,” *Smithsonian Magazine*, October 2016.

4 Alanen, “Conserving Arizona’s Resident Jaguars.”

5 US Fish and Wildlife Service, “Service and Binational Team Complete ESA Recovery Plan for America’s Largest Wild Cat,” press release, April 24, 2019, <https://www.fws.gov/news/ShowNews.cfm?ref=-service-and-binational-team-complete-esa-recovery-plan-for-america%E2%80%99s-ID=36399>.

6 Marina Koren, “The Lonely Jaguar of the United States,” *Atlantic*, February 3, 2016, <https://www.theatlantic.com/national/archive/2016/02/one-is-the-loneliest-number/459828/>.

7 Katherine Harmon, “U.S. Jaguar Habitat Designation Delayed,” *Scientific American*, November 4, 2010, <https://www.scientificamerican.com/article/jaguar-habitat-designation/>.

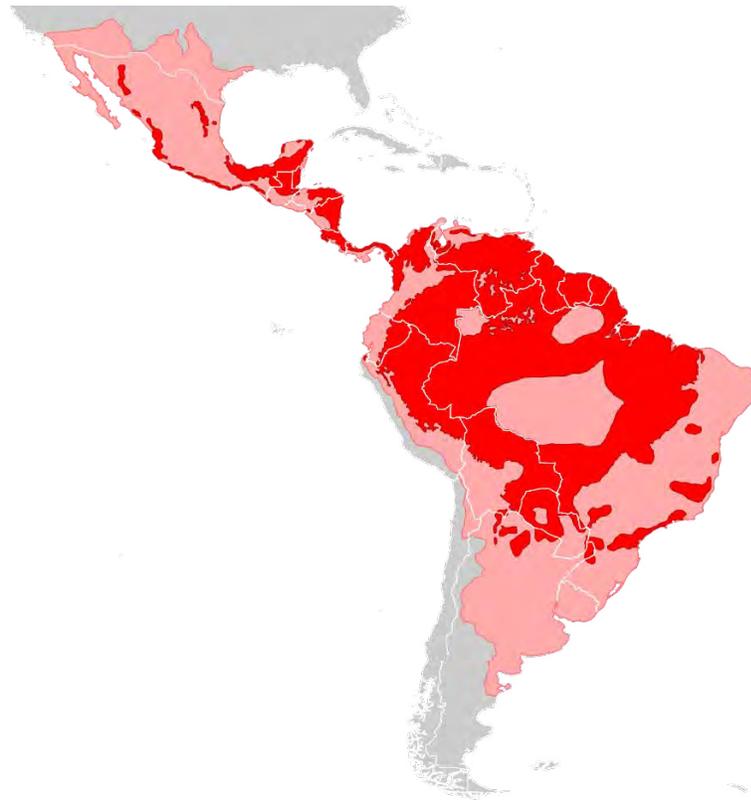
8 Quoted in Richard Mahler, “The Tenuous Fate of the Southwest’s Last Jaguar,” *High Country News*, May 30, 2016.

Wild Sky program, which uses extensive camera trapping to compensate ranchers who live with various species, ranging from mountain lions and wolves to swift foxes and black-footed ferrets.

New River Region Study—Belize

Panthera onca, the jaguar, historically ranged across much of the Americas, from modern-day Arizona to Argentina (see figure 1 for a habitat map). Over time, deforestation caused by logging and clearing land for agriculture, along with the resulting increased competition for prey animals, led to a decline in the jaguar's population. Today, jaguars occupy about 33 percent of their historic range in Central America,⁹ and, according to the International Union for Conservation of Nature, about 50 percent of their total historic range.

Figure 1. Historic and Current Range of Jaguars



Note: Pink marks historic range. Red represents current range.

Source: US Fish and Wildlife Service, "Jaguars," accessed December 15, 2020, <https://www.fws.gov/international/jaguars.html>; image originally from International Union for Conservation of Nature, *The IUCN Red List of Threatened Species*. Creative Commons.

Although loss of habitat was historically the primary cause of the jaguar's population decline, conflict with humans is currently the biggest threat to jaguars.¹⁰ As humans encroach on the jaguar's habitat, the availability of natural prey decreases, forcing jaguars to supplement their diet with cattle and other livestock. Some ranchers react by killing jaguars, paying up to a US\$500 bounty for problematic cats.¹¹ This reaction is understandable. Jaguars in the Pantanal wetlands of Brazil, for example, predate on an average of 3 to

9 Wendell G. Swank and James G. Teer, "Status of the Jaguar—1987," *Oryx* 23, no. 1 (January 1987): 14–21, <https://doi.org/10.1017/S0030605300022547>.

10 Rafael Hoogesteijn, "Understanding the Beef between Jaguars and Cows," *Panthera*, December 14, 2017, <https://www.journeyofthejaguar.org/entry/understanding-beef-jaguars-cows/>; Swank and Teer, "Status of the Jaguar."

11 Venetia S. Briggs-Gonzales and Frank J. Mazzotti, "Camera Trapping Wild Cats with Landowners in Northern Belize," *Caribbean Naturalist* 17 (2014): 1–13.

5 percent of each rancher's herd; profit margins are small for cattle operations and the loss of even a few calves is significant.¹² There is also a preexisting cultural distaste for jaguars stemming from often-exaggerated stories passed along for many years about the danger jaguars pose to livestock.¹³

Range and free movement are important to the sustainability of jaguar populations.¹⁴ Recent studies have shown that the animal's genetic makeup is similar across Central and South American jaguar populations, meaning individuals travel between groups. Jaguars therefore require both large and interconnected groups to maintain genetic health within the population.¹⁵

Panthera, a conservation group devoted to wild cats, attempts to unite different jaguar populations through its Jaguar Corridor Initiative. As part of this program, Panthera was one of the first entities to consider incentive-based conservation programs. Panthera and a handful of other organizations, including the Lamanai Field Research Center, are testing camera trapping programs as one of their reward-based approaches.

A study conducted by Venetia Briggs-Gonzales and Frank J. Mazzotti in the New River Lagoon area of Belize, with help from the Lamanai Field Research Center, looked at the effects of camera trap incentives on protecting wild cat populations. In 2010, cameras were set up along trails and logging roads. Landowners serviced the camera traps on a regular basis, retrieving memory cards every two weeks and changing batteries once a month. Memory cards were turned in at the research center on the first and third Saturdays of each month, at which time the landowners also received payouts for images: approximately US\$125 for each individual jaguar and US\$50 for any successive capture of the same individual. Wild cat prey images also garnered a payout of US\$5 each.¹⁶ In total, US\$2,025 was distributed over a 57-day operating period to 6 of the 13 landowners participating in the study (there were no qualifying images from cameras on the other 7 ranches during the study period). This means that those who received compensation averaged US\$337 each—a substantial sum in Belize.¹⁷

Briggs-Gonzales and Mazzotti found that animal activity levels in pastureland were significantly lower than those in farmland, which was contrary to local beliefs. Big cats seem to prefer their natural prey and spend more time hunting small and medium-sized mammals in corn fields than hunting livestock. Local farmers were pleased to learn about this finding and surprised that jaguars were actually helping them deal with small “vermin” rather than eating their crops.¹⁸

In 2012, the same researchers conducted a survey of households in the study area to determine the effects of the camera trap program. One hundred twelve households participated in door-to-door interviews about their personal interactions with and attitudes regarding wild cats. Respondents were placed on an “intent to kill” scale on the basis of their answers. The findings were somewhat mixed; economic variables and experiences of depredation had no significant correlation with participants' intent to kill score. This is likely explained by the fact that locals in this region are wealthier than in other developing areas and do not suffer as much economic loss from livestock predation as others. Participants in the camera trap program, meanwhile, did have lower intent to kill scores after the program concluded.¹⁹

12 Hoogesteijn, “Understanding the Beef between Jaguars and Cows.”

13 Jennifer Rebecca Kelly, “A Sociocultural Perspective: Human Conflict with Jaguars and Pumas in Costa Rica,” *Conservation and Society* 17 (2019): 355–365.

14 Włodzimierz Jędrzejewski et al., “Estimating Large Carnivore Populations at Global Scale Based on Spatial Predictions of Density and Distribution—Application to the Jaguar (*Panthera onca*),” *PLOS ONE* 13, no. 3 (March 2018): e0194719, <https://doi.org/10.1371/journal.pone.0194719>.

15 Jared J. Watkins, *Jaguars of the Pantanal* (New York: Panthera, n.d.), accessed December 15, 2020, https://www.panthera.org/cms/sites/default/files/Panthera_JaguarsOfThePantanal_DigitalAD.pdf.

16 Briggs-Gonzales and Mazzotti, “Camera Trapping Wild Cats,” 5.

17 Briggs-Gonzales and Mazzotti, 8.

18 Briggs-Gonzales and Mazzotti, 8–9.

19 Rebecca G. Harvey, Venetia S. Briggs-Gonzales, and Frank J. Mazzotti, “Conservation Payments in a Social Context: Determinants of Tolerance and Behavioral Intentions towards Wild Cats in Northern Belize,” *Oryx* 51, no. 1 (2017): 730–41, <https://doi.org/10.1017/S0030605316000545>.

The Briggs-Gonzales and Mazzotti study also explored local culture as a factor affecting attitudes toward wild cats. The New River region of Belize is home to many Mennonites, whose traditional religious beliefs often lead them to view nature in a utilitarian light—as something that exists to serve the needs of humans. Non-Mennonite locals had lower intent to kill scores. Overall, survey respondents expressed an appreciation that their concerns about wild cat predation were being taken seriously and many mentioned secondary benefits such as increased awareness of conservation and cat behaviors. Several participants also noted that they were changing their farming practices and were seeing fewer bounties around for wild cat kills.²⁰ The study concluded that economics can have some influence on individuals' decisions regarding wild cat conservation, but local culture and social norms appear to be the driving factor behind attitudes toward wild cats.

Living with Felines—Mexico

The Northern Jaguar Project (NJP) was established in 2003 by a small group of conservationists from Mexico and the southwestern United States. The organization's mission is to restore natural habitat and reduce the effects of cattle ranching on jaguar abundance.²¹ NJP also identifies safe-passage corridors between northern Mexico and the US border, in the hope that more jaguars might migrate to their former habitat in the United States.

In 2008, NJP and Naturalia, a Mexican conservation organization, formed the Northern Jaguar Reserve in Sonora, Mexico (just south of the US border) by buying multiple ranches in the area. One of the organizations' larger purchases was the US\$1.5 million Rancho Zetasora, a 35,000-acre ranch. Today, the Northern Jaguar Reserve encompasses 58,000 acres.²²

The Northern Jaguar Reserve staff understand that the local economy in the area is based on cattle. “We respect that,” said NJP Board President Diana Hadley, “and try to help ranchers and wildlife co-exist.”²³ An alliance between NJP and local ranchers, called *Viviendo con Felinos* (Living with Felines), provides incentives to landowners whose ranches border the reserve and who are willing to live with jaguars. Incentives come in the form of cash rewards for camera trap images of wild cats. Motion-triggered cameras are strategically placed on ranches and monitored monthly by reserve staff. Sixteen ranches surrounding the reserve are currently enrolled in the *Viviendo con Felinos* program—they cover a combined area of 110,000 acres.

The photo compensation system is outlined in an annual contract, which is the same for every rancher. The reward for an image of a living jaguar is 5,000 pesos (about US\$220 as of the December 2020 exchange rate). The original price was set to offset the long-standing bounty for dead jaguars.²⁴ For other threatened felines, the image award amounts for each species are as follows: ocelot, 1,500 pesos; mountain lion, 1,000 pesos; bobcat, 500 pesos.²⁵ As established in the contract, ranchers may receive only one reward per day per specific species. So a rancher might receive two awards for a mother and kitten, but only one award if the same individual appears multiple times in a single day. If an ocelot, for example, is running back and forth chasing something, this still equates to one award. If the same ocelot shows up the next day on the camera, the rancher will get another award. Rewards are given out up to a monthly cap of 20,000 pesos per ranch.

20 Harvey, Briggs-Gonzales, and Mazzotti, “Conservation Payments.”

21 Carmina E. Gutiérrez-González, Miguel Á. Gómez-Ramírez, and Carlos A. López-González, “Estimation of the Density of the Near Threatened Jaguar *Panthera onca* in Sonora, Mexico, Using Camera Trapping and an Open Population Model,” *Oryx* 46, no. 3 (2012): 431–37, <https://doi.org/10.1017/S003060531100041X>.

22 Carolyn Nistler, “Seeing Spots,” The Property and Environment Research Center, December 15, 2007, <https://www.perc.org/2007/12/15/seeing-spots/>.

23 Diana Hadley, phone interview by Laura Huggins, July 7, 2020.

24 Hadley, phone interview.

25 Hadley, phone interview.

Thanks to funding from individual donors and private foundations along with some government support, US\$45,000 in photo awards was distributed for feline presence in 2018 and the program surpassed 1,000 total photographs of jaguars (see one in figure 2).²⁶ There is a final requirement in the contract that ranchers agree to not hunt, trap, or kill any wildlife species on their properties, including prey species. According to Hadley, many of the ranchers observed that “since they don’t hunt whitetail deer or javelina anymore, predation of their stock animals has greatly decreased.” In fact, she adds, “we do not have any confirmed depredation by a jaguar since we started the program.”²⁷

Figure 2. Jaguar Photographed by Monitoring Camera Near the Northern Jaguar Reserve



Source: Photo courtesy of Northern Jaguar Project.

Early signs look promising for both the ranchers and the jaguar in northern Mexico. On the ranching side, NJP has held two formal assessments of its program, conducted by outside social scientists that involved surveying ranchers in the area. The same survey questions were used in both studies, which were several years apart. Both assessments were generally positive, and the second survey was the more positive of the two, perhaps because NJP had implemented some of the ranchers’ suggestions made during the first assessment. Every participant in the second survey, according to Hadley, was “satisfied overall.”²⁸

Regarding jaguar health, nine different jaguars were photographed in 2018 through the *Viviendo con Felinos* project—three times as many as the year before.²⁹ At the end of 2020, as this report was completed, NJP had collected images of eleven different jaguars.³⁰ Despite positive news in and around the Northern Jaguar Reserve, more than 20 years of studies on jaguar conservation throughout their larger range continue to show a decline.³¹ Human conflicts associated with cattle predation remain a large threat to jaguar survival. For their long-term survival, jaguars require expansive, interconnected areas along with sufficient wild prey; otherwise they may consider cattle as a food source.³²

Because cattle ranching is such an integral part of the Sonoran economy, ranchers and conservationists are getting creative in figuring out ways to expand camera incentive programs beyond the Northern Jaguar

²⁶ “Protecting the World’s Northernmost Jaguars,” Northern Jaguar Project, accessed December 15, 2020, <https://www.northernjaguarproject.org/>.

²⁷ Hadley, phone interview.

²⁸ Hadley, phone interview.

²⁹ “A Great Year for NJP,” Northern Jaguar Project, last modified December 31, 2018, <https://www.northernjaguarproject.org/5761-2/>.

³⁰ “Borderland Jaguars are an Antidote,” The Northern Jaguar Project, last modified December 11, 2020. <https://www.northernjaguarproject.org/borderland-jaguars-are-an-antidote/>.

³¹ Gutiérrez-González, Gómez-Ramírez, and López-González, “Estimation of the Density.”

³² Agustin Paviolo et al., “A Biodiversity Hotspot Losing Its Top Predator: The Challenge of Jaguar Conservation in the Atlantic Forest of South America,” *Scientific Reports* 6 (2016): 37147, <https://doi.org/10.1038/srep37147>.

Reserve area and to implement other approaches for living with jaguars. In 2010, many of the ranchers inhabiting the surrounding area of the Northern Jaguar Reserve formed their own group, known as *Rancheros Amigos de la Reserva del Jaguar del Norte* (Rancher Friends of the Northern Jaguar Reserve).³³ The group promotes ecotours, wildlife-friendly ranching practices, and participation in *Viviendo con Felinos*, highlighting ranchers' commitment to preserving the jaguar species.

In addition to the camera reward program, NJP is using a myriad of strategies to protect jaguar habitat. The organization is cooperating with the Mexican government, which formally protects jaguars, by sharing data and collaborating on some conservation management tools, such as controlled burns and water restoration projects. Ground tactics for NJP include building protective corrals for cattle, installing water tanks to keep cattle away from key areas, and fencing off riparian areas that wild cats frequent to keep cattle out.

More important for NJP is the fact that the approaches the group is using are building community trust in the Northern Jaguar Reserve's conservation efforts and a genuine appreciation for wild cats.³⁴ The organization hosts many community meetings with ranchers and residents who live around the reserve to discuss conservation strategies. It also runs popular eco-camps and an eco-guardian club for students. A favorite event is the annual *Viviendo con Felinos Fiesta* (see figure 3) and photography exhibit, which falls on International Jaguar Day. Hundreds of community members gather to honor participating ranchers and see the awards for the year's best camera trap photos. NJP reports a noticeable sense of pride and appreciation that is developing in the community and parents come to staff with comments such as "bless you for all that you have done."³⁵

Figure 3. Viviendo con Felinos Fiesta, 2019



Source: Photo courtesy of Northern Jaguar Project.

33 Hadley, phone interview.

34 Hadley, phone interview.

35 "Celebrating Living with Cats," Northern Jaguar Project, November 29, 2019, <https://www.northernjaguarproject.org/celebrating-living-with-cats-on-international-jaguar-day/>.

Unfortunately, a study using thirteen years of camera trap data (from 2000 to 2012) did not detect changes in the density of the broader jaguar population across the Northern Jaguar Reserve. The report suggested that longer term monitoring and higher quality cameras would allow for more precise estimation.³⁶ Time will tell, but recent data coming from the Northern Jaguar Reserve look promising and NJP's Megan Southern reports that the organization is in the process of compiling a brief that outlines some positive findings.³⁷

The alternative to these private conservation efforts is to rely solely on the government. Unfortunately, the Mexican government may not be in a position to fund many conservation efforts. A 2016 study by the National Institute of Statistics and Geography found that the cost of environmental degradation in Mexico was five times greater than the allotment of money for environmental protection.³⁸ Yet, in 2019, the government slashed its parks and reserve budget by 75 percent.³⁹

Mexico's General Wildlife Law is similar to the US Endangered Species Act. Its primary goals are prevention of extinction and promotion of species' recovery to the point where the law's protection is no longer needed. Although the Mexican government officially listed species as threatened, extinct, and endangered in 1994, few species have recovered. Researcher Alejandro Olivera lists the jaguar as one of the species least adequately protected by the Mexican government.⁴⁰ By promoting groups such as NJP and its proactive camera trapping system, the government may be able to help both the cattle industry and the jaguar population.

Through a multifaceted approach involving camera trapping, community engagement, money-conscious land management practices, and the establishment of continuous corridors for jaguars, NJP is creating positive change for cattle ranches and cat survival. Hadley declared that "if these magnificent animals are ever to reoccupy appropriate habitat north of the border, the stepping-stones in the jaguar corridor are essential."⁴¹ Perhaps more importantly, NJP is providing a template for other conservationists to learn from.

Wild Sky—Montana

Wild Sky is a collaboration between American Prairie Reserve (APR) and ranchers that are living and operating in key wildlife corridors in central Montana. APR is stitching together three million acres of private and public lands, including the one-million-acre Charles M. Russell National Wildlife Refuge (see figure 4). Unlike how national parks are created through government action such as eminent domain, APR is connecting large swaths of fragmented public lands through the strategic purchase of private lands (depicted in blue in the figure) situated between public parcels.⁴² The nonprofit organization purchased its first property in northeastern Montana in 2005. Today, the reserve has raised more than \$160 million to acquire 30 properties, which form a combined habitat base of 420,000 acres. Hundreds of cattle ranches surround the reserve and accommodate an estimated 500,000 head of cattle.

36 Carmina Gutierrez-Gonzalez, Miguel A. Gomez-Ramirez, Carlos A. Lopez-Gonzalez, Paul F. Doherty Jr., "Are private reserves effective for jaguar conservation?" *PLoS ONE* (2015) 10 (9) e0137541; <https://doi.org/10.1371/journal.pone.0137541>

37 Megan Southern, email correspondence with Laura Huggins and Kyran Kunkel, May 19, 2020.

38 "Finanzas para la biodiversidad," Biodiversity Finance Initiative, accessed December 15, 2020, <https://www.biodiversityfinance.net/mexico>.

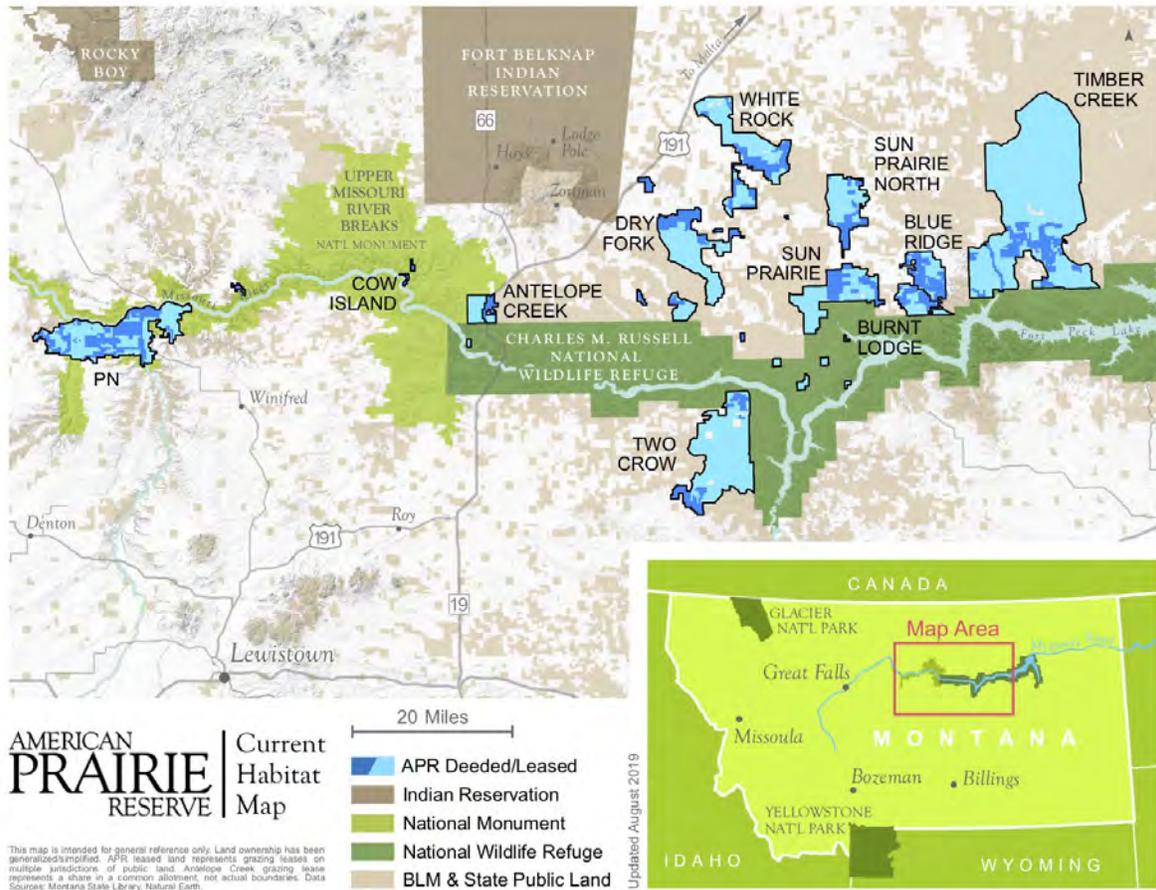
39 Oscar Lopez and Christine Murray, "Party' ahead for illegal loggers? Mexico's national parks in doubt with cuts," Reuters, accessed June 11, 2020, <https://www.reuters.com/article/us-mexico-forest-budget-trfn/party-ahead-for-illegal-loggers-mexicos-national-parks-in-doubt-with-cuts-idUSKBN23I31H>.

40 Alejandro Olivera, "Mexico's 10 Most Iconic Endangered Species," Center for Biological Diversity, last modified April 2018, <https://www.biologicaldiversity.org/programs/international/mexico/pdfs/English-Top-10-Endangered-Mexico.pdf>.

41 Quoted in Mel White, "Path of the Jaguar," *National Geographic*, last modified March 2009, <https://www.nationalgeographic.com/magazine/2009/03/jaguars/>.

42 American Prairie Reserve website, accessed December 15, 2020, <https://www.americanprairie.org/>.

Figure 4. American Prairie Reserve Project Map



Source: Image courtesy of American Prairie Reserve.

Knowing that conservationists and cowboys have historically clashed, leaders at APR began thinking about a proactive approach the organization might take to avoid conflicts with ranchers. The Wild Sky program started in 2014 to promote wildlife-friendly ranching practices and help avoid battles on the borders between reserve properties and local ranch properties. Wild Sky’s purpose is to create positive outcomes for both ranchers and conservationists—wildlife enthusiasts get more wildlife and ranchers increase their bottom line while diversifying their ranch income. The ultimate goal, according to APR founder Sean Gerrity, is to change hearts and minds and, over time, increase the “social carrying capacity for wildlife.” In other words, the objectives of this program are currently centered more on rancher approval and participation than on collecting or monitoring data on wildlife—although the latter is being done as well.

American Prairie Reserve is learning from other large parks and taking proactive steps ahead of predators including wolves and grizzly bears that are naturally making their way back to the Northern Great Plains. “We can’t be an isolated island out on this prairie landscape,” said Pete Geddes, APR’s vice president, pointing on a map to possible habitat corridors connecting the reserve to Glacier National Park and Yellowstone. “In 10 or 15 years, when these [large carnivores] start to show up, we’d like the region to be prepared.”⁴³ Wild Sky is serving this purpose.

43 Quoted in Aaron Teasdale, “Building an American Serengeti in Montana,” *Sierra*, September 5, 2019, <https://www.sierraclub.org/sierra/2019-5-september-october/feature/building-american-serengeti-montana-american-prairie-reserve>.

Much as in *Viviendo con Felinos*, participating ranchers voluntarily commit to Wild Sky via an annual contract. The agreement consists of a menu of wildlife-friendly ranching practices that have been identified as beneficial to conservation. All ranchers who sign up must agree not to till any new land, but they can choose whether to also participate in voluntary steps based on the Freese Scale for Grassland Biodiversity.⁴⁴ Steps might include installing wildlife-friendly fencing to help establish wildlife connectivity, expanding prairie dog towns to promote improved ecosystem health, preserving sage-grouse breeding areas to protect threatened species, and making ranching practices more carnivore-compatible by refraining from killing species such as coyotes. Upon successful implementation of agreed-upon actions (with third-party verification), APR makes annual payments to participating ranchers. For each step, ranchers are paid a premium of one cent per pound on annual calf sales, a sum that can exceed \$10,000 annually. The program works similarly to a frequent-flier program: the more a rancher signs up for and accomplishes in a year, the more he or she gets rewarded. In this way, Wild Sky creates a situation where both people and wildlife can thrive.

After the first year of the program, ranchers reported that they appreciated most components of the system but that living with predators was hard and might not be worth the basic-level reward. On the basis of rancher feedback, a bonus system was implemented in 2015 to provide additional incentives to ranchers who voluntarily opted to sign up for an expanded “carnivore compatible” option in the contract. The founders of this program, Laura Huggins and Kyran Kunkel, knew about the Northern Jaguar Project’s work with camera trapping and used this knowledge to establish an expanded Cameras for Conservation scheme.

The Wild Sky team looked at the price the Northern Jaguar Project was offering ranchers for images of live jaguars and mountain lions. The team also factored in how much the loss of a calf would cost a rancher in order to try to offset the potential risk of predation. Finally, Huggins and Kunkel knew from extensive meetings with ranchers that the local ranchers were most nervous about wolves, then about bears, then about mountain lions, and so on. Thus, the image prices would need to reflect this local level of concern. On the basis of this limited information, initial prices were set for images of each predator. Three ranchers signed up for the beta year, and scientists installed camera traps on their properties. Success came fast, according to Kunkel: “After about a month of ‘trapping,’ we collected a photo of a mountain lion and a black bear.”⁴⁵ This served as the first documented evidence of black bears near the project area. Huggins, one of the authors of this paper, recalls that this particular rancher [from the ranch where the images were collected] was visiting the APR office the day the first black bear picture came through. He was so excited that he made the rounds within the office showing everyone the picture of “*his* bear.”

Ranchers are not as excited about wolves. Some ranchers remain leery of the predators, even though the Wild Sky team has collected images of wolves mixed in with cattle images, and even though no predation has occurred for several years in a row. Another Wild Sky rancher claimed that he considers wolves to be “killing machines.” He has begrudgingly agreed not to shoot them for another penny per pound. “If a wolf pack would focus on the elk and leave my cows alone, maybe I can learn to live with ‘em.”⁴⁶

Daniel Kinka, who is now running the Wild Sky program, expanded the original bonus system from six predators to include thirteen species (see the current list in the contract excerpt below). The expanded list includes elk, which, according to Kinka, are currently a bigger concern than predators to ranchers in Montana. (Elk can damage fences, eat a great deal of grass, and potentially carry disease.) He adds, “We couldn’t afford to pay for every elk in a picture, of course, so we modified the contract to include a \$50 per

44 American Prairie Reserve, “Freese Scale for Grassland Biodiversity: Background Summary,” accessed December 15, 2020, https://www.americanprairie.org/sites/default/files/APR_Complete_FreeseScale_2014.pdf.

45 Kyran Kunkel, interview by Laura Huggins, Harrison Naftel, and Olivia Hansen, Bozeman, MT, May 24, 2020.

46 Quoted in Teasdale, “Building an American Serengeti in Montana.”

image per day clause for a picture containing any amount of elk.”⁴⁷ Here’s an excerpt from the Wild Sky contract:

Producer agrees to participate in the “Cameras for Conservation” bonus program. Unbaited camera traps are installed and checked regularly for incentives payments for confirmed photos of the following species: coyote (\$25), red fox (\$25), badger (\$50), elk (\$50), bobcat (\$100), bighorn sheep (\$100), cougar (\$250), black bear (\$250), wolf (\$500), grizzly bear (\$500), swift fox (\$500), black-footed ferret (\$500), wolverine (\$500). Confirmed wolf, grizzly bear, or swift fox dens will receive a one-time incentive payment of \$1,000. Payments correspond to no more than one picture of each species per camera per day. In the case that there are multiple individuals of a species in a single frame, the payment will be multiplied by the number of individuals for all carnivore species but not for herding herbivore species (e.g. elk). The maximum annual bonus payout is \$6,000 per ranch per contract year.

No doubt the extra payment for the images helps in an area where the average household income sits below the US median household income.⁴⁸ Payments for camera images per year max out at \$6,000, and only a few ranchers have hit this mark—“although some are coming close,” Kinka said. He shared how excited he was to recently come across “an image containing four mountain lions—that’s a \$1,000 payment right there for the rancher!” (see figure 5). The Wild Sky team placed a cap on the annual amount for images per ranch so APR can appropriately budget for the project. “We really had no idea how many images we would receive in the beginning,” Kunkel confirmed, “so we had to make sure we had enough funds to cover payments.”⁴⁹ Ranchers also reported that they like the bonus camera program because they enjoy seeing the images and receiving small payments throughout the year—as opposed to their annual Wild Sky contract, for which they collect an annual payment at the end of the contract term. Huggins elaborated that she thought drip payments throughout the year would serve as a more consistent reminder to ranchers of the value of living with predators. Kinka added, “The bulk of a rancher’s incentive payment comes from their base contract, but what we’re seeing is that the Cameras for Conservation image payments really serve as the sugar that helps the medicine go down.”⁵⁰

Since 2014, the Wild Sky program has paid more than \$250,000 in incentives to a handful of local ranchers (ranging from three ranches in the first year to eight ranches in 2019, covering a combined 100,000 acres). The program is funded by a portfolio of sources, which have included licensing payments from partner beef companies, grants from the National Geographic Society, in-kind support in the form of equipment, and donations from private individuals. Lance Johnson is a Wild Sky rancher who also grazes some of his cattle on one of APR’s properties. Some of his neighbors give him grief for working with a conservation organization, but he appreciates the help. “I think they have an idea and a real lofty goal for the future,” he has said.⁵¹ The Wild Sky program has also supported two of his daughters in the local rodeo circuit.

47 Daniel Kinka, interview by Laura Huggins and Olivia Hansen, American Prairie Reserve, MT, May 26, 2020.

48 “Household Income in Montana,” *Statistical Atlas*, last updated September 4, 2018, <https://statisticalatlas.com/state/Montana/Household-Income>.

49 Kunkel, interview.

50 Kinka, interview.

51 Quoted in Hannah Nordhaus, “Two Visions Collide Amid Push to Restore Montana Plains,” *National Geographic*, February 2020.

Figure 5. Cougar on Wild Sky Ranch Collected from Camera Trap



Source: Camera trap image courtesy of American Prairie Reserve.

Six years after Wild Sky launched, one of the original rancher partners, David Crasco (featured in figure 6), is still participating. He recalled in an interview that when he first met “my ‘Little Buddy’ at APR [his nickname for Laura Huggins], I introduced myself as APR’s biggest enemy. . . . We soon became friends and I decided to try out Wild Sky for one year. It was a good business decision for me so I signed up again.” Beyond the business component, Crasco enjoys attending local events hosted by Wild Sky and appreciates the fact that the program supports rodeos and powwows in the Fort Belknap Indian Community. Other Wild Sky ranchers have been willing to speak to local media ranging from Yellowstone Public Radio to NPR about their experiences with the program. These are considered big wins for APR.

Figure 6. Two Wild Sky Ranchers



Source: Photo courtesy of Laura Huggins.

“People say, ‘Hey, conservation’s GREAT and all, but I can’t afford it,’” Kinka said. “We’re saying, ‘Good point. Here’s money.’ We don’t want to put ranchers out of business. Quite the opposite—they deserve to be paid for doing the right thing.”⁵² Kinka and his predecessors at Wild Sky hope this new approach of incentivizing ranchers to conserve species and habitat on behalf of the public will eventually help lead to the restoration of the Northern Great Plains and inspire new approaches to conservation around the world.

Challenges and Solutions

A challenge with Wild Sky that the program’s founders admitted they did not consider is how much time and resources it would take to regularly collect all the camera cards, which are dispersed across a vast landscape, and then sort through the thousands of images collected. It became apparent that to scale this project, APR would need to hire more people or recruit volunteers to collect the camera cards and sort through images. In retrospect, both Kunkel⁵³ and Kinka⁵⁴ commented that they wished the ranchers’ expectations had been set early on to be responsible for collecting camera cards and swapping out batteries. In 2015, APR partnered with Adventure Scientists, which contracted with citizen scientists to collect and manage images. Still, it was taking too much time to manage images, so the Wild Sky team turned to technology.

In 2017, APR began a fruitful partnership with the Smithsonian Conservation Biology Institute. This partnership started with the Smithsonian Institution granting APR access to its unique eMammal technology. “Camera trappers” use this data management tool to look at pictures, identify animals, and upload

⁵² Quoted in Teasdale, “Building an American Serengeti in Montana.”

⁵³ Kunkel, interview.

⁵⁴ Kinka, interview.

pictures for review and archive at the Smithsonian.⁵⁵ This technology helped lower the time costs involved in managing thousands of images. The APR team is now using a similar system called Wildlife Insights.

The partnership with Smithsonian expanded to include a team of scientists led by project manager Hila Shamon. Their work, in partnership with APR, is part of a long-term restoration initiative for North America's Great Plains. On just one APR property called Sun Prairie, which is about 32,000 acres, Shamon describes collecting 400,000 images from camera traps in a one-month period. This is why eMammal and similar technology is essential, she explains: "But this process is still labor intensive; we need to continue to tap into new technology such as machine learning to automatically sort images."⁵⁶

American Prairie Reserve also partnered with the National Geographic Society on a technology grant that helped make it possible to install a reliable network where there is very limited internet coverage. The resulting LoRa network enables long-range transmissions with low power consumption. What this means for Kinka, Shamon, and the team of scientists is that they can now track animals in real time and further support camera trapping efforts. Kinka was asked what advice he would offer to other scientists looking to advance conservation efforts. He responded, "There are new and emerging technologies . . . that allow us to really push the envelope in ecology and restoration science. . . . I feel as a wildlife manager for American Prairie Reserve that these technologies will mark a fundamental change in our research and ability to help restore iconic species."⁵⁷

New technology may also help solve two additional challenges for Wild Sky—sustainable funding and the ability to scale. Satellite imagery, drones, sound sensors, fence monitors, and so forth are all being tested to help streamline efforts to measure conservation progress on both APR properties and Wild Sky ranches. More specifically, with the bonus Cameras for Conservation program, the Wild Sky team believes the technology is near the point where cameras on a given ranch will be able to flag images of target species and immediately notify the rancher, scientists, and potentially a donor. This type of technology, according to Shamon, would make it relatively easy to create a platform for an adopt-a-ranch or adopt-a-camera funding approach. A donor in New York City, for example, might receive an email notification when a wolf walks by a camera that she signed up to support. The image of the wolf would also serve as a receipt that the donor has paid \$500 to support a rancher who has opted to live with predators.

Despite the importance of emerging technologies, APR scientists are quick to point out that they will always aim to include locals in their conservation efforts. Collection via camera trapping work is relatively easy to do. Citizen scientists can collect large amounts of solid data, "but perhaps more importantly, people love seeing the images and often become connected to the project. In our current plan to reintroduce swift fox near APR, we have a large component that includes middle schools, the local community college, Fort Belknap Indian Community, and 4H groups."⁵⁸ Shamon added, "This is where we get back to the original goal with Wild Sky—changing hearts and minds."⁵⁹

Policy Implications of Cameras for Conservation Programs

The camera trapping reward programs outlined in this paper are part of a new frontier in species conservation. While a combination of approaches will likely be most effective at conserving species, key elements of the original camera trapping programs include (1) creating annual contracts between the producer (rancher) and buyer (conservation organization) that outline the rewards and parameters for images, (2) taking cost-effective actions, (3) recognizing social norms, and (4) establishing stable funding sources.

55 eMammal, accessed December 15, 2020, <https://emammal.si.edu/>.

56 Hila Shamon, interview by Laura Huggins and Olivia Hansen, American Prairie Reserve, MT, May 26, 2020.

57 Daniel Kinka, "From the Field: Meet National Geographic Fellow Daniel Kinka," *National Geographic Society Newsroom*, March 28, 2020, <https://blog.nationalgeographic.org/2020/03/28/from-the-field-meet-national-geographic-fellow-daniel-kinka/>.

58 Shamon, interview.

59 Kinka interview.

Contracting for Proactive Conservation Payments

Conservation payments for camera images create a direct incentive for ranchers to host wildlife on their properties. Payments are also independent of levels of depredation, thereby avoiding moral hazard scenarios. This system, compared to reactive compensation for predation programs, lowers transaction costs for ranchers because they do not have to search for depredated livestock or submit claims for compensation.⁶⁰ Ranchers around the Northern Jaguar Reserve report that the government process for compensation after a kill is so cumbersome and lengthy that they usually don't bother with it. Similarly, ranchers in Montana shared that it can be days before a dead calf is discovered and at that point the kill is likely not worth reporting, because it will be difficult to prove depredation and efforts to collect compensation may take time away from ranch work.

The State of Montana established the Livestock Loss Board in 2007 to help alleviate financial pressures placed on ranchers when wildlife reintroduced or protected by the federal government harm their livestock. The board compensates ranchers following the US Department of Agriculture Wildlife Services guidelines for confirmed or probable loss. In 2019, ranchers were paid a total of \$260,838 in compensation for livestock losses.⁶¹ Although the payments ranged widely for different predators and prey, the average is approximately \$700 per attack. This is significantly less than the value given to most cattle by the US Department of Agriculture.⁶² Many other states have similar compensation schemes. Aside from the below-market payments, applicants for compensation must navigate bureaucratic processes and wait months while their applications are pending. Applicants who wish to contest a decision can plead their case to the Livestock Loss Board.⁶³ These steps can take weeks of effort for less than full compensation, which raises the question: Might the state compensation funds be better spent incentivizing ranchers up front through a proactive camera reward program?

Contracts for proactive compensation, such as in the cases reviewed in this paper, appear to solve many of the problems with loss compensation. Furthermore, a study by Johns Hopkins economist Paul Ferraro and American University economist David Simpson examined the cost effectiveness of direct payment programs and found that direct payments are more cost effective than their indirect counterparts that seek to incentivize commercial activity, such as ecotourism.⁶⁴

There are, however, a few potential downsides to consider before forming contracts. The producer (i.e. rancher or farmer) may incur risks if he or she invests in strategies, such as stream restoration work or installing wildlife-friendly fencing, that do not ultimately lead to more wildlife. Or the benefits of these steps may be outweighed if external forces such as drought or disease reduce the numbers of wildlife and associated images. As the Wild Sky and Northern Jaguar Project teams discovered, these systems can also involve high transaction costs for the buyer. Both groups mentioned that they did not properly account for the time it would take to collect camera cards and sort through images in order to make the payments outlined in the contracts. The Belize program streamlined the image collection process by establishing clear requirements for ranchers to deliver camera cards. This approach might also be beneficial to landowners, who do not necessarily appreciate scientists or volunteers walking around their ranch to collect cards. Regarding the sorting process, the Montana and Mexico programs ended up using volunteer groups and technology to aid with the cataloging. It is important to keep the total costs involved in executing

60 Amy J. Dickman, Ewan A. Macdonald, and David W. Macdonald, "A review of financial instruments to pay for predator conservation and encourage human-carnivore coexistence," *PNAS* (August 23, 2011) 108 (34) 13937-13944; <https://doi.org/10.1073/pnas.1012972108>.

61 "2019 Livestock Loss Statistics," Montana Department of Livestock, accessed June 30, 2020, <http://liv.mt.gov/Attached-Agency-Boards/Livestock-Loss-Board/Livestock-Loss-Statistics-2019>.

62 US Department of Agriculture, "Livestock Indemnity Program," *Fact Sheet*, July 2019, https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdfiles/FactSheets/2019/livestock_indemnity_program-fact_sheet-july_2019.pdf.

63 "Livestock Loss Board," Montana Department of Livestock, accessed December 15, 2020, <http://liv.mt.gov/Attached-Agency-Boards/Livestock-Loss-Board>.

64 Paul J. Ferraro and R. David Simpson, "The Cost-Effectiveness of Conservation Payments," *Land Economics* 78, no. 3 (August 2002): 339-53.

the contracts in mind as transaction costs could undercut the bigger-picture strategy of creating a lasting species conservation model.

Cost-Effective Actions For Conservation

For Cameras for Conservation programs to succeed in the long run, they must be cost effective for the landowner, the conservation group, and—ultimately—government agencies and taxpayers as well. Cost entails more than just money; it includes time as well as other costs such as opportunity costs. Ranchers will not likely sign a contract and allow cameras to be installed on their ranch if they believe the expense of maintaining the cameras and dealing with conservation staff or potential liability issues will be higher than the reward generated from the images and wildlife data.

On the conservation side, both the American Prairie Reserve and the Northern Jaguar Reserve are looking for returns in the form of “increasing social carrying capacity” for predators or threatened species. Given that the Northern Jaguar Reserve’s *Viviendo con Felinos* program has been operating for 15 years and APR’s *Wild Sky* program for 7 years, it appears that the investments have been worthwhile from each organization’s perspective. Interviewees, however, admitted that it can be hard to measure the value of some beneficial changes, such as ranchers forming their own Friends of the Reserve group, as they did in Mexico, or *Wild Sky* ranchers taking schoolchildren on tours of their ranch and allowing media in to share their wildlife-friendly ranching practices with large audiences.

At the federal level, annual costs associated with the Endangered Species Act have been estimated to be in the range of \$1.5 billion (for the basic program) to \$9 billion (including legal fees, anticipated recovery costs, etc.).⁶⁵ Given these costs, states create their own regulations and management regimes to try to keep species off of the federal endangered species list. A recent example is the case of the greater sage-grouse. Estimates of the total economic impact if the bird were to be formally listed depend on which conservation plan the government chooses. Plans calling for the strictest conservation measures could cost approximately \$260 million in lost state and local revenue every year, according to a widely cited study conducted by scholar Lowell Baier.⁶⁶ At even a fraction of this estimate, the economic costs to states are large. Yet unraveling the Endangered Species Act is not a winning political strategy—polls show that most Americans support the law.

There is, however, room to lower some of the costs associated with the Endangered Species Act and other wildlife conservation legislation. People are beginning to recognize and assign value to natural processes such as pollination, water filtration, and carbon sequestration; even just knowing a species exists is a benefit to many individuals. Economists describe this broad set of benefits as *ecosystem services*. Cameras for Conservation programs capture some of this value by putting a price on an image of a species. Much research needs to be done, but one can see how this relatively simple approach that eliminates perverse incentives for landowners while collecting solid scientific data and lowering the need for regulatory oversight and lawsuits offers a supplemental approach to the Endangered Species Act. Camera reward programs could continue to be managed by local nongovernmental organizations with substantial knowledge of local issues and with some alternative funding sources. There may also be opportunities to tie camera programs into federal landowner conservation funding and collaborate with state wildlife agencies to use cameras to work with landowners in more productive ways.

Social Norms Matter

The programs covered in this paper demonstrate that culture plays a major role in how local agricultural producers perceive wildlife. Diana Hadley stressed the point that the “initial contracts and rewards for images with ranchers serve as an important tool to get in the door, but the economics is just the hook to

⁶⁵ Robert Gordon, “Whatever the Cost of the Endangered Species Act, It’s Huge,” Competitive Enterprise Institute, August 21, 2018.

⁶⁶ Lowell E. Baier, *Inside the Equal Access to Justice Act: Environmental Litigation and the Crippling Battle over America’s Lands, Endangered Species, and Their Critical Habitat* (Lanham, MD: Rowman & Littlefield, 2016).

get ranchers started.”⁶⁷ The hard work begins when conservationists get the opportunity to engage with ranchers and begin trying to slowly change attitudes so that people become more accepting of predators and other species that compete with livestock. As more people participate in camera conservation programs, see the data on predators’ behaviors, and experience the direct benefits to communities, social norms start changing. Venetia Briggs-Gonzales (one of the designers of the Belize study) believes this will have a cyclical reinforcement effect.

After more than 15 years during which cameras have been collecting images of jaguars on ranches around the Northern Jaguar Reserve, there has not been one incident of a jaguar killing a calf. Ranchers, according to Hadley, have gained an understanding of where the jaguars live and how they behave. She shared a quotation from a rancher: “I love being part of the program; now I know where jaguars like to go I can keep my cattle away.”⁶⁸ Hadley elaborated that NJP staff are also now seeing ranchers and the local community take pride in the annual *Viviendo con Felinos* Fiesta and that more and more schoolchildren are involved in NJP’s eco-programs. Those who run the camera trap programs hope to ultimately change the conservation culture, or—as the founder of APR said—to increase the social carrying capacity of local people to live with wildlife by incentivizing new behaviors and disproving incorrect beliefs about wildlife.

In his book *Navigating Environmental Attitudes*, Thomas Heberlein outlines three types of solutions for environmental issues: the technological fix, the cognitive fix, and the structural fix. Technological fixes are solutions that use technology; although these can work in a conservation situation, they can be expensive and difficult in areas lacking infrastructure. Cognitive fixes (approaches based on mental reasoning), are difficult to achieve alone, since people do not always respond to new knowledge as quickly and easily as well-meaning conservationists might hope. Instead, Heberlein supports the structural fix, a change in incentives for single, important individuals that can have a compounding effect on other individuals.⁶⁹ Camera trap programs fall in the structural fix category. Not only does this system focus on changing the previously held beliefs of landowners, the program encourages new behaviors with the goal of creating an evolved belief system. In a study on conservation norms, Xiaodong Chen describes the relationship between behavior and beliefs as one of self-reinforcement. The more people sign on to a camera trap or other incentive program, the more the community will develop a social norm of conservation.⁷⁰ New actions can then also be backed up by evidence that debunks incorrect beliefs and reinforces wildlife-friendly activities. Cultural beliefs are difficult to change, yet with the double benefits of knowledge and incentives provided by the camera traps, it is possible to chip away at previously held beliefs to create new ones.

Stable Funding Is Key

Although camera trapping programs are relatively inexpensive compared to other species conservation programs, stable funding sources are imperative in order to ensure that the conservation organization can deliver on its end of the contractual agreements and scale the system. Both the Wild Sky program and the *Viviendo con Felinos* program currently depend on private donations, augmented by other funding sources including licensing agreements, support from foundations, and government grants.

Donor adoption programs, in which supporters or volunteers are linked with a particular location, are fairly common. Adopt-a-Highway programs are one example. Other programs are more in-depth and may serve as a potential model for funding camera images. The Adopt a Stream Foundation began in 1981 as a local-government-funded organization in Washington State. Organizations were quick to sign up to adopt a stream section and keep it clean and healthy. The program grew to become a private nonprofit

67 Hadley, interview.

68 Hadley, interview.

69 Thomas A. Heberlein, *Navigating Environmental Attitudes* (Oxford: Oxford University Press, 2012).

70 Xiaodong Chen et al., “Linking Social Norms to Efficient Conservation Investment in Payments for Ecosystem Services,” *Proceedings of the National Academy of Sciences* 106, no. 28 (2009): 11812–17.

with a wide range of programs focused on stream restoration.⁷¹ Arizona's Game and Fish Department runs a similar program called Adopt-a-Ranch that links conservation organizations with ranch owners. Local organizations, such as the Arizona Elk Society, volunteer to help ranchers install or maintain nature-friendly infrastructure on their land.⁷²

The Wild Sky team is already considering learning from adoption models and modifying them with the help of emerging technology. Daniel Kinka and Kyran Kunkel suggested using a new adopt-a-camera program as a tool tying donors to a specific camera or to all of the cameras on one ranch. Donors could receive information about a ranch and real-time images of wildlife from *their* camera trap. Although the technological infrastructure for a program like this is still in development, an adopt-a-camera program could foster important personal connections between ranchers and individual donors, schools, or corporations. Adoption programs might also help conservation organizations achieve a more diversified and stable source of income to accomplish environmental goals, provide conservationists with volunteer opportunities, and create personal connections between donors, landowners, and threatened species.

Conclusion

Predators such as jaguars, wolves, and grizzly bears have historically been viewed by ranching communities as a threat to livestock. Ironically, the very same communities responsible for effectively reducing these species' numbers over the past century may offer the greatest hope for successful restoration in this century. Camera trapping offers a simple, noninvasive approach to conservation by creating a market for images of wildlife. Images in turn convert predators and other species such as elk from ranch liabilities into assets. The camera programs are also proactive in design, unlike the reactive predator-livestock compensation programs that ranchers do not necessarily appreciate. Finally, image collections also provide valuable information to scientists and conservation groups that want more accurate data and provide opportunities for more donors to support Cameras for Conservation programs.

The authors recognize that funding and scaling camera trap programs for species conservation remains a challenge. If individuals from across the world value the long-term conservation of globally iconic but locally problematic species, they will have to support strategies that outweigh the local costs incurred—and this will require significant investment. Additionally, federal and state governments may consider shifting some funding from low-return wildlife and habitat conservation efforts to augmenting emerging camera trap programs. Encouraging progress is taking place with regard to conservation payments and adopt-a-camera approaches might be a viable funding tool. But compensation for predators remains a challenge as both economic loss and deep-rooted cultural values still often lead to conflict with local producers.

As shown in Belize, Mexico, and Montana, camera reward programs both provide an economic reward and address cultural norms—a path that leads to positive outcomes for both people and threatened wildlife. If positive-sum programs such as Cameras for Conservation continue to be a viable approach for long-term species protection, policymakers may want to consider coupling camera systems managed by local organizations with larger-scale conservation efforts.

71 Tom Murdoch, "Stream Restoration and Environmental Education: The Adopt a Stream Foundation," *Pacific Northwest Reports* 13, no. 1 (Summer 1995): 7–11.

72 "Landowner Relations and Habitat Enhancement Programs," Arizona Game and Fish Department, accessed July 6, 2020, <https://www.azgfd.com/wildlife/landowners/>.