BREN SCHOOL
ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Group Project Brief

Project Members:
Sarah Antonelli | Kristen Boysen
Charlie Piechowski | Michael Smith
Geoff Willard

Faculty Adviser: Dr. Ben Halpern

WOLVES IN CALIFORNIA

An Analysis of Wolf-Livestock Conflict Hotspots & Conflict Reduction Strategies in Northern California

SIGNIFICANCE

European-American colonization of California led to a period of ecological disruption. Settlers responded to the wild dangers of the frontier by exterminating large predators. In 1924, the state's last known gray wolf (*Canis lupus*) was killed and collected in Lassen County. Soon wolves were gone from the entire American West.

In 1995-1996 scientists translocated 66 wolves from Canada to Yellowstone National Park and central Idaho. With Endangered Species Act protections, this population has grown to almost 2000 wolves, and has spread throughout the Northern Rockies and into the Pacific Northwest (right).

Current Gray Wolf Range

In summer 2015, wildlife cameras near California's Mount Shasta photographed the state's first wolf pack in almost a century. This protected Shasta Pack was soon implicated in the deaths of two local cows. Wolf attacks can cause death, injury, or stress to livestock. Such wolf-livestock conflicts are controversial problems for other states, and could become a regular problem in California. This project engaged with the issue by mapping locations in the state that are likely to see gray wolf re-colonization and wolf-livestock conflicts, and by surveying ranchers in Northern California to determine regionally feasible conflict reduction strategies.

PROJECT OBJECTIVES

1. Identify potential wolf-livestock conflict hotspots in California through spatial analyses of human land use and predicted wolf habitat.
2. Develop recommendations for the implementation of conflict reduction strategies in Northern California, through the distribution of a survey to the region's livestock producers.

Objective 1: Identifying Conflict Hotspots

Species Distribution Modeling

We used three different species distribution model methodologies to identify the state's suitable wolf habitat.

1. Logistic Regression
2. Maximum Entropy (Maxent)
3. An overlay method previously applied to Oregon

Each method applied a different analysis of input variables (e.g., forest cover, prey density, human impact). These variables tend to support or discourage wolf habitat selection, to varying degrees.

Method Spotlight: Logistic Regression

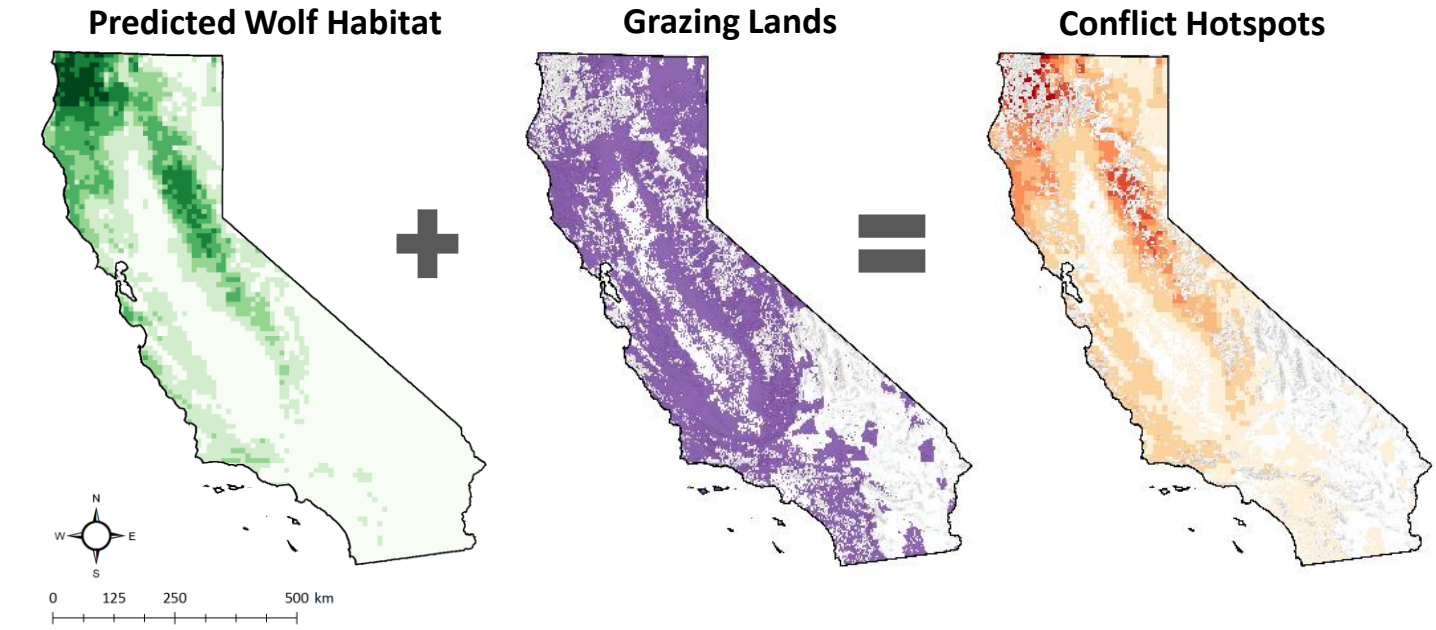
We applied a method of statistical analysis known as logistic regression to understand relationships between known wolf pack locations in Oregon and associated environmental variables. This helped identify significant habitat predictor variables (prey density and percent forest cover), which then informed the construction of our model. We tested the model in Oregon (it performed well) and applied it to California to reveal habitat favorability.

Model	Variables Included	Coef.	p-value	AIC Score
All Variables	% Forest Cover	1.65	0.002**	353.15
	Prey Density	1.40	<0.001**	
	Human Density	1.91×10^{-4}	0.364	
	Road Density	1.15×10^{-4}	0.254	
	Land Ownership	3.00×10^{-2}	0.944	
Selected Model	% Forest Cover	1.61	<0.001**	349.76
	Prey Density	1.52	<0.001**	

** indicates statistical significance

The logistic regression model's results (lower left) show a gradient of favorable wolf habitat across California; darker greens indicate more suitable habitat. Each model highlighted similar areas of favorable habitat in northwestern California and the Sierra Nevada foothills. We opted to use the logistic regression model to identify conflict hotspots (below) because its results could be statistically validated and the method had been used in other parts of the country. The model performed well when tested according to success criteria thresholds set forth by other published gray wolf species distribution models applied to the Western US.

Identifying Conflict Hotspots



To identify wolf-livestock conflict zones in California, we overlaid predicted wolf habitat (left, in green) with a map of potential grazing lands in the state (center, in purple). We retained all overlap locations and the habitat favorability gradient. This produced a map (right) showing the locations in California that are most at-risk of experiencing wolf-livestock interactions; darker reds indicate greater conflict risk.

Objective 2: Feasibility of Conflict Reduction

Region of Interest

Our survey focused on the seven northern counties of California: Del Norte, Humboldt, Trinity, Siskiyou, Shasta, Modoc, and Lassen counties. Agriculture, especially livestock production, makes up a large part of their economies. They are close to the Oregon border and likely to be affected by growing wolf populations before the rest of California.

Survey Development

We developed a survey for distribution to livestock producers in the seven counties listed above, to understand their perspectives and priorities. The survey elicited information on general attitudes towards wolves and the feasibility of various conflict reduction strategies.

The survey asked about nonlethal conflict reduction strategies currently used throughout the West:


Attractant Removal


Range Riders


Change Calving


Guard Dogs


Alarm & Scare

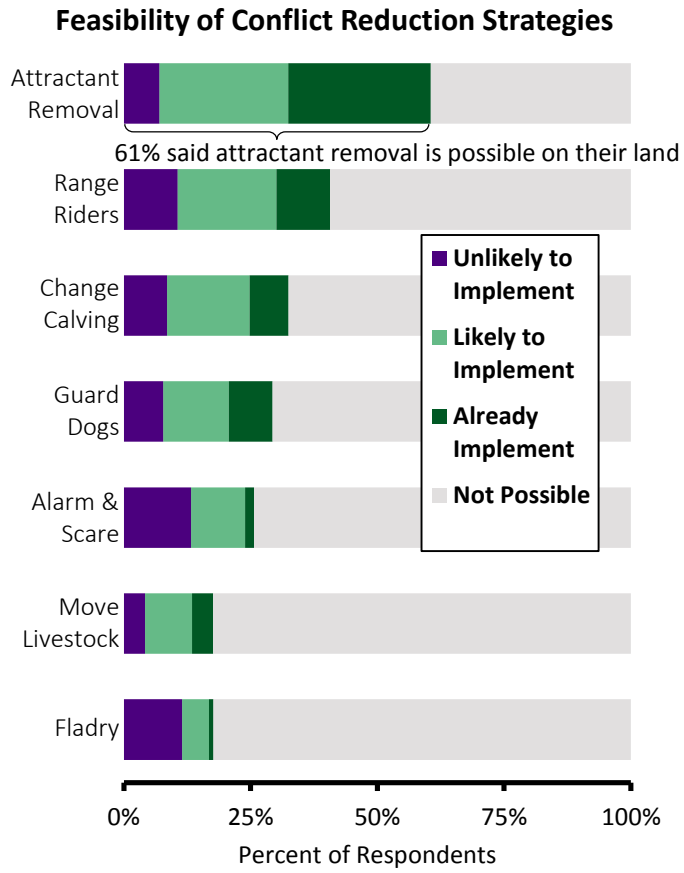

Move Livestock


Fladry

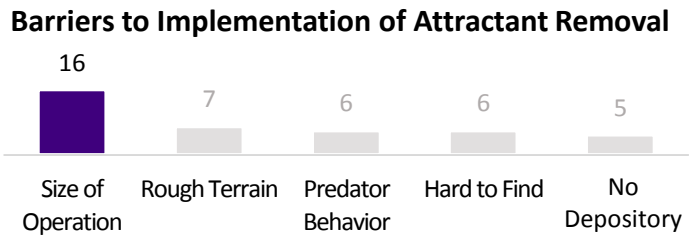
We mailed surveys to 570 livestock producers and received responses from 21.7% of this group.

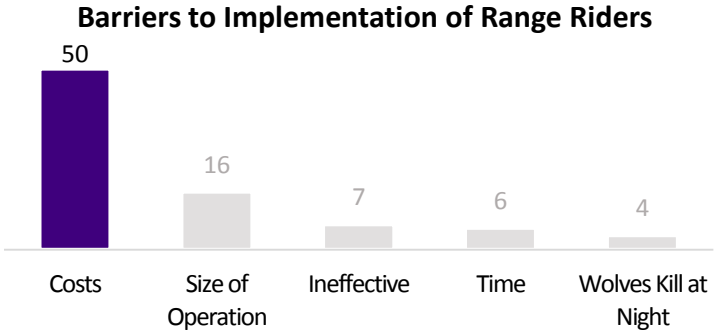
Feasibility and Likelihood of Implementation

We queried respondents on their familiarity with each conflict reduction strategy, as well as the feasibility of the strategy on their operation and the likelihood they would implement each strategy.



Responses indicated that attractant removal and range riding are the most feasible local strategies. These also ranked highest in a cross-strategy comparison. Concerns regarding these two strategies that respondents expressed (below) can be surmounted through cost-sharing programs.



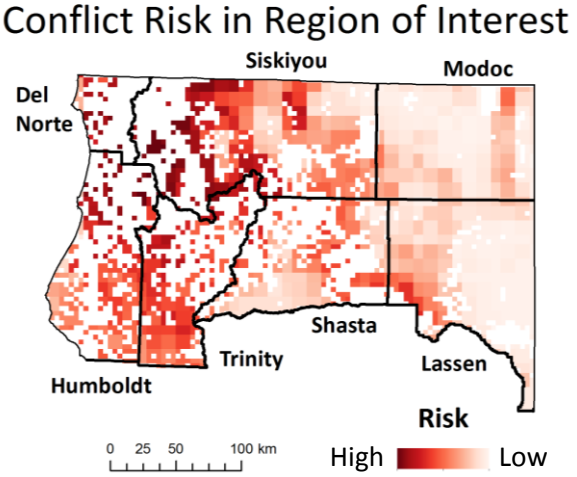


Conclusions and Recommendations

Our selected species distribution model predicted more than 50,000km^2 of potential gray wolf habitat in California. This habitat includes the National Forest lands in the northwestern part of the state, forests in the southern Cascades, sections of the Sierra Nevada's western foothills, as well as the coastal and mountainous parts of Mendocino County.

1) Large portions of favorable wolf habitat exist on livestock grazing land. These sites are at risk of wolf-livestock conflicts.

Much of Northern California is operated as private rangeland, and many public lands are leased for grazing. There is thus extensive overlap between the predicted wolf habitat and these grazing lands. Specific hotspots are located in western Siskiyou and Shasta Counties, eastern Humboldt County, most of Trinity County, the southern Cascades, and the northern Sierra foothills.



2) Attractant removal and range riders are the most feasible conflict reduction strategies for Northern California grazing land.

These two strategies ranked as the most preferred and the most feasible in our survey analysis. The barriers to implementation for these two strategies could be overcome with cost-sharing programs implemented by regional conservation nonprofits or the state. Other states have implemented programs that help livestock producers use these strategies, and California should look to these as successful examples of conflict reduction.

All seven strategies are now used by different livestock producers in Northern California to protect livestock from predators. Each strategy should thus be considered a potentially effective method to reduce conflicts, and regional livestock producers should consider which is best for each operation's unique needs.

Acknowledgments

We are thankful for the many people who supported this project. Special thanks to our client, Defenders of Wildlife, especially Pamela Flick and Charlotte Weaver. Thanks also to Dr. Ben Halpern and the many experts who donated their time and guidance, including Matt Barnes, Dr. Stewart Breck, Dr. Frank Casey, Dr. Frank Davis, Ian McCullough, Bre Owens, and Tiffany Russell.