Wolves & Livestock Conflicts
A Northern California Analysis

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BRENSCHOOL UC SANTA BARBARA

DEFENDERS OF WILDLIFE

Wolves in California

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.

Scientists translocated 66 wolves from Canada to Yellowstone National Park and central Idaho in 1995-1996. 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.

Current gray wolf range (green)

Photo: California Dept. of Fish & Wildlife

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. In order to coexist with this animal, we must determine where potential conflicts may occur, and how to avoid them.

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.

Photo: Amy Gerber

Recommendations

1. We predict wolf-livestock conflict hotspots in parts of Siskiyou, Shasta, Trinity, and Humboldt counties, as well as substantial parts of the Sierra Nevada's northwestern foothills. Extensive favorable wolf habitat exists throughout the region.

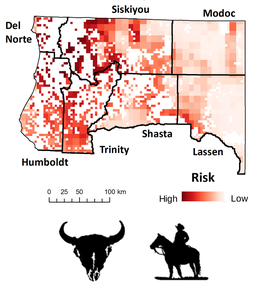
2. Removal of wolf attractants and the use of range rider programs are the most feasible conflict reduction strategies for the region. Each strategy is now used by some livestock producers, thus the toolbox of conflict reduction strategies should be considered to fit each operation's unique needs.

Defenders of Wildlife, its partners, and other stakeholders should:

1) Focus conflict reduction efforts on regions highlighted in our risk map

2) Highlight attractant removal and range riders as the most culturally and logistically feasible conflict reduction strategies.

Conflict Risk in Region of Interest



Feasible conflict reduction strategies

The costs of conflict minimization programs are a significant concern with the rancher and woolgrower communities. The benefits of wolf coexistence will be dispersed, thus the cost burden should also be dispersed rather than placed primarily on a few livestock producers. California can look to successful implementation in other states as frameworks for such programs.

Acknowledgments

We are thankful for the many people who supported this project. We would especially like to thank our client, Defenders of Wildlife, and our primary project advisers, Pamela Flick and Dr. Ben Halpern, as well as the experts who donated their time to provide excellent guidance, including Ian McCullough, Charlotte Weaver, Matt Barnes, Dr. Stewart Breck, Dr. Frank Casey, Dr. Frank Davis, Bre Owens, and Tiffany Russell.

Further Information: This poster and other project information can be found online at www.wolf-livestock.net. Please contact us at loslobos@lists.bren.ucsb.edu.

Species Distribution Modeling

Methods

We performed three different species distribution model methodologies to identify suitable wolf habitat in California.

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, etc.). These variables tend to support (or discourage) wolf habitat selection, to varying degrees.

Method Spotlight: Logistic Regression

We applied logistic regression to understand the relationships between wolf pack locations in Oregon and associated environmental variables. We then identified the most significant predictor variables to inform our model. These were ungulate (wild prey) density and percent forest cover. We tested this model in Oregon and applied it to California to reveal habitat favorability across the state.

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

Selected Environmental Variables

Photos: Adrian Hodge Photography

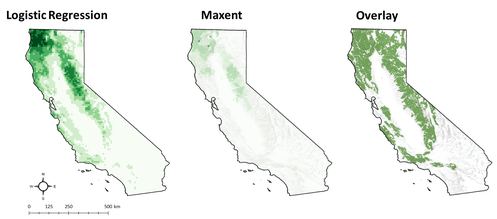
Forest Cover

Photos: R.G. Bremer Photography

Ungulate Density

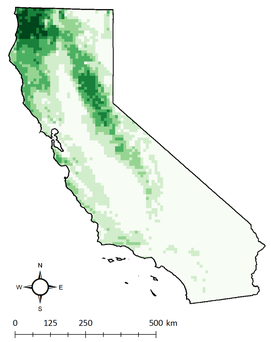
Identifying Wolf-Livestock Conflict Hotspots

Species Distribution Model Results

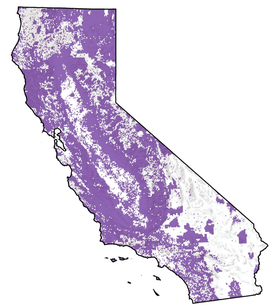


- Logistic regression & Maxent show favorable wolf habitat on a gradient (darker greens indicate greater favorability)
- Overlay shows binary outcome, green=favorable habitat
- Each model selected similar favorable habitat: northwestern California and the Sierra Nevada foothills
- Logistic regression was the model chosen to identify conflict hotspots, due to its ability to be statistically validated

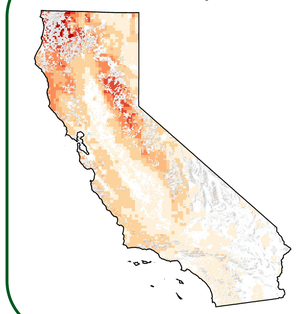
Predicted Wolf Habitat



California Grazing Lands



Conflict Hotspots



To identify wolf-livestock conflict zones in California, we overlaid the results of our logistic regression model (left) 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.

Conflict Reduction Survey

Region of Interest

Our survey focused on the seven northern counties of California.

Survey Development

The survey elicited information on two main topics:
1. General attitudes towards wolves and other predators
2. Familiarity with and feasibility of conflict reduction strategies.

Part 1. General Attitudes

Do large carnivores have an impact on respondents' operations?

What is the current level of tolerance for wolves among respondents?

Part 2. Familiarity and Feasibility

Attractant Removal

Range Riders

Change Calving

Guard Dogs

Alarm & Scare

Move Livestock

Fladry

How *familiar* are you with this strategy?

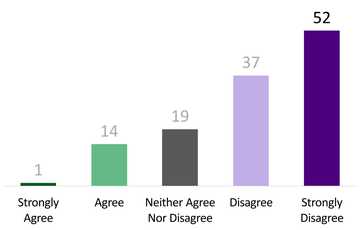
Is it *possible* to implement this strategy on your land?

How *likely* are you to implement this strategy?

Feasibility of Conflict Reduction Strategies

We received survey responses from 124 livestock producers, resulting in a response rate of 21.8%. Many respondents identified a lack of sufficient protection from large carnivores for their livestock.

My livestock currently have enough protection:

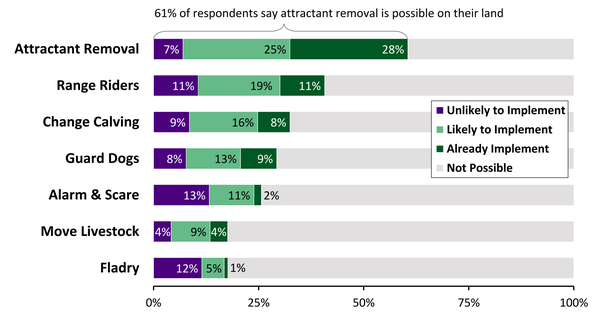


Nearly **50%** of respondents report using direct, lethal control to protect their livestock from predators.

About **73%** of respondents think it should be legal to shoot or kill a wolf in all circumstances.

Given the reported need for additional livestock protection and the relatively low tolerance for wolves, an emphasis on proactive conflict reduction strategies will be essential to avoid both livestock and wolf losses.

Feasibility and Likelihood of Implementation



Respondents identified attractant removal and range riders as the two most feasible conflict reduction strategies. Successful conflict reduction efforts may be maximized if programs emphasize these two strategies and target the reported barriers to implementation (below).

Barriers to Successful Implementation