Estimating the contribution of cattle grazing to wildfire fuels reduction

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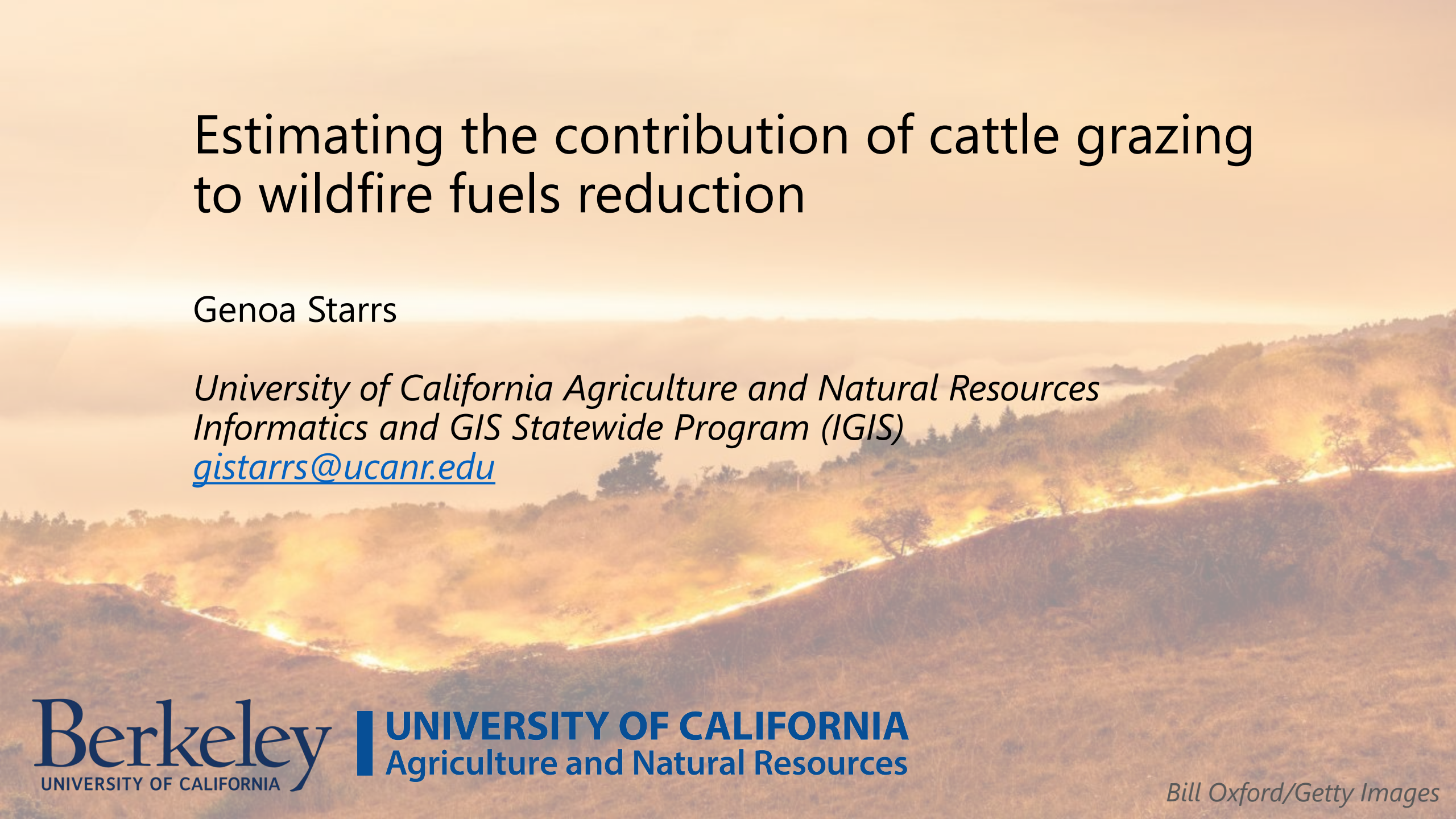

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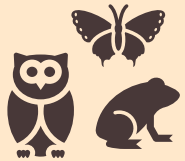
	Service	Components
	Food production	Livestock convert vegetation into food consumable by people.
	Pollinator forage	Supporting pollinators (forb composition/access, open space)
	Wildlife habitat	Stock ponds, shorter grass height, vegetation composition. Benefits to checkerspot butterfly, rangeland bird species, amphibians.
	Water cycling	Grass-dominated landscapes provide increased water yield (additional water stored) compared to shrub-encroached landscapes.
	Fuel reduction	Grazing is utilized to reduce fine fuels and remove/limit the extent of shrubs. Targeted/contract grazing used to reduce brush height in wildland urban interface.
	Recreation	Grazing used to maintain vegetation height and “viewsheds” in recreation areas.

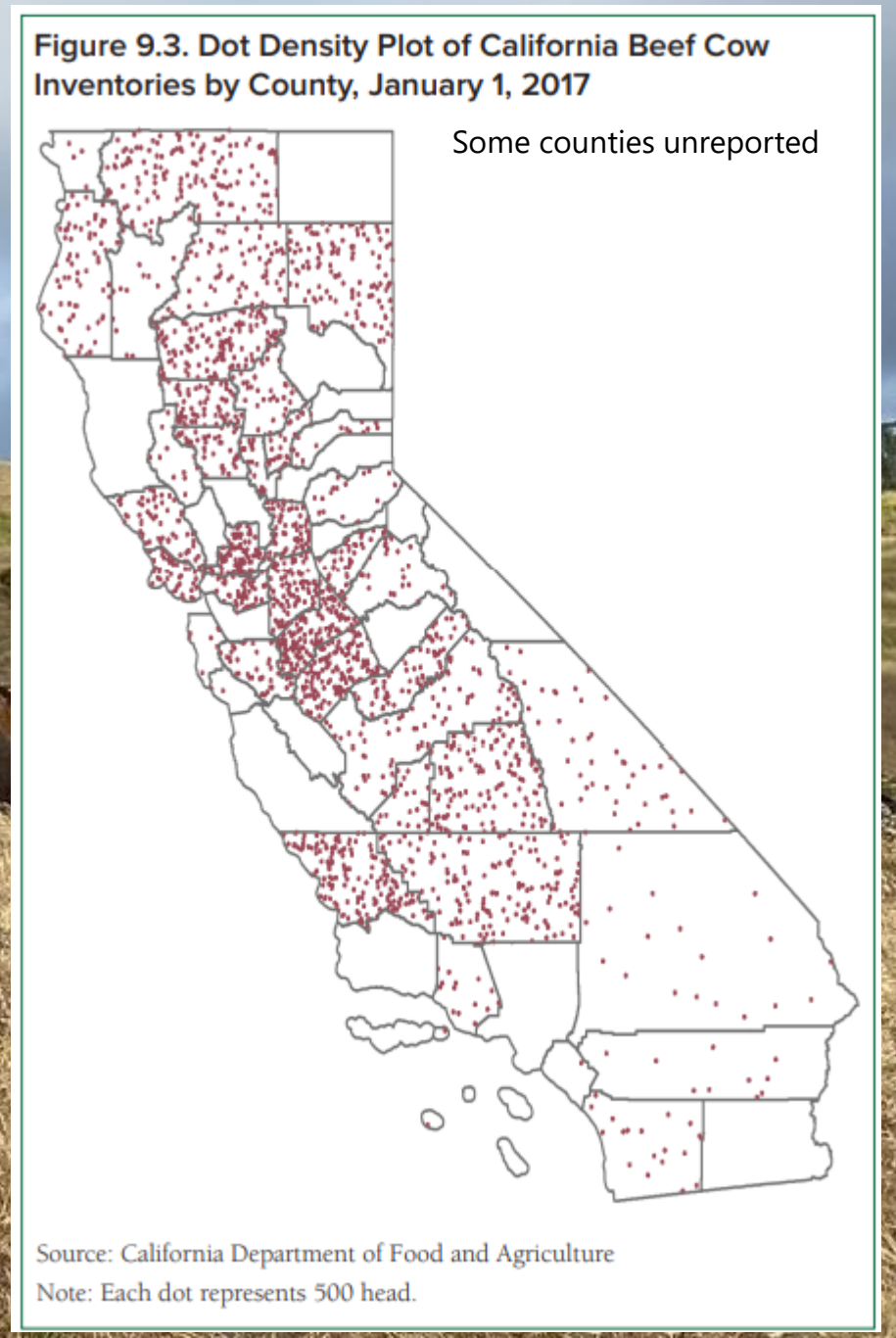
Grazing for fuel management

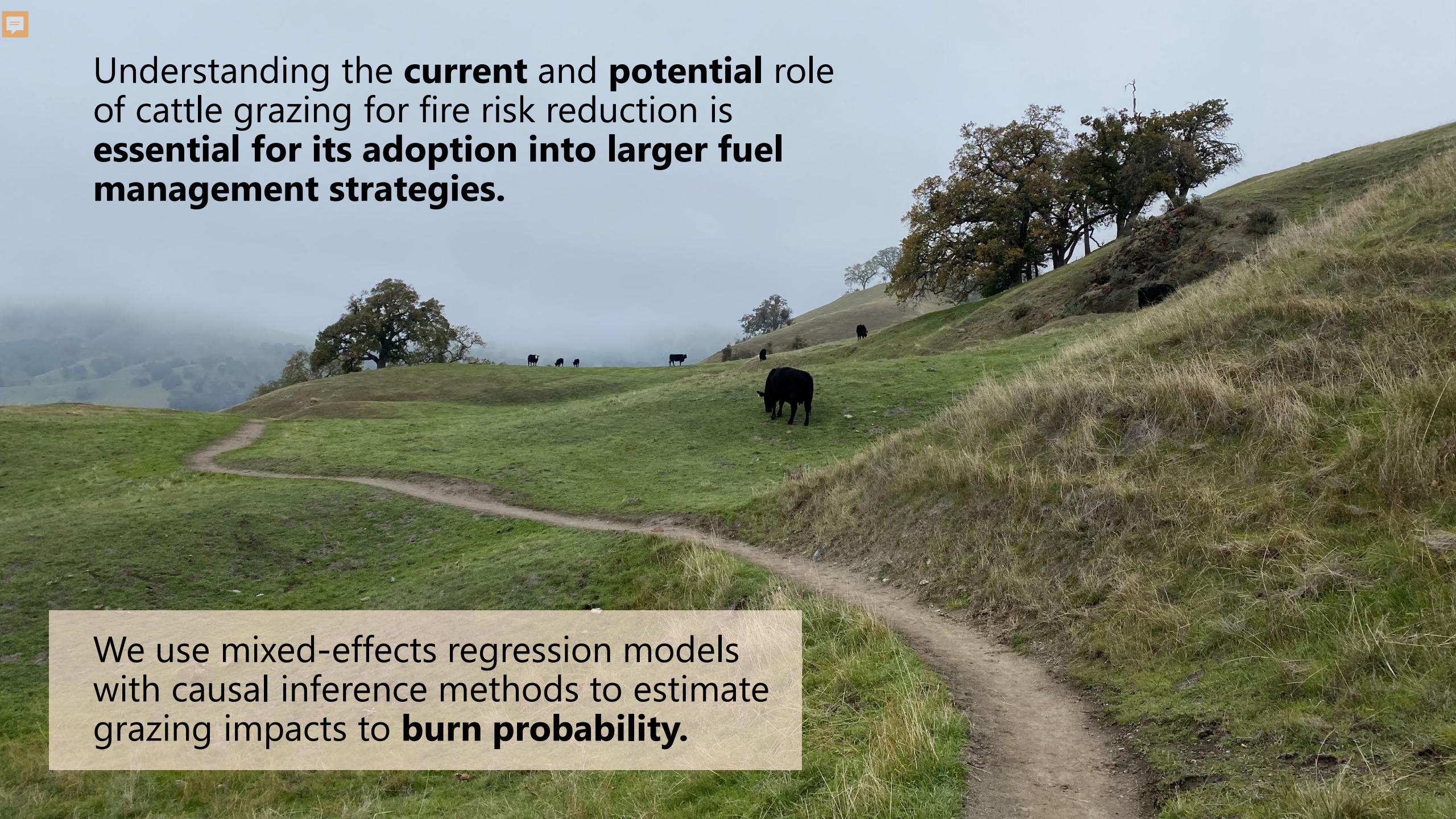
Cattle grazing already occurs over approximately **one-third** of California (Saitone 2020).

Cattle grazing removed approximately **11.6 billion pounds of non-woody plant material** from California in 2017 (Ratcliff et al. 2022).

Cattle grazing in the North Bay and Central Coast of California **reduced annual burn probability by 0.8—3.6 percentage points** (Siegel et al. 2022).

Cattle grazing influences fire behavior through the **removal of fine fuels** and long-term alterations to **vegetation structure and species composition**.



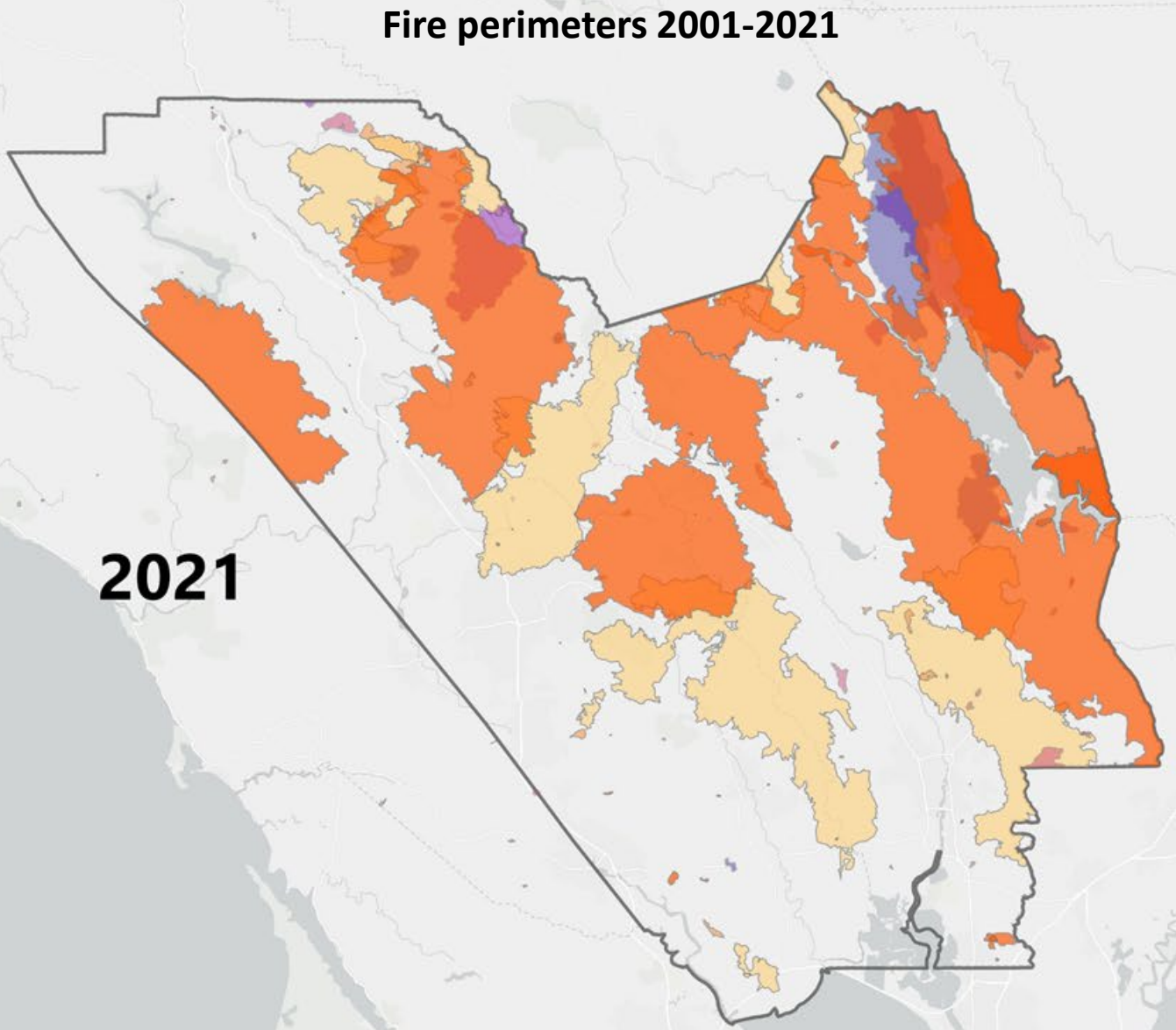


Understanding the **current** and **potential** role of cattle grazing for fire risk reduction is **essential for its adoption into larger fuel management strategies.**

We use mixed-effects regression models with causal inference methods to estimate grazing impacts to **burn probability.**

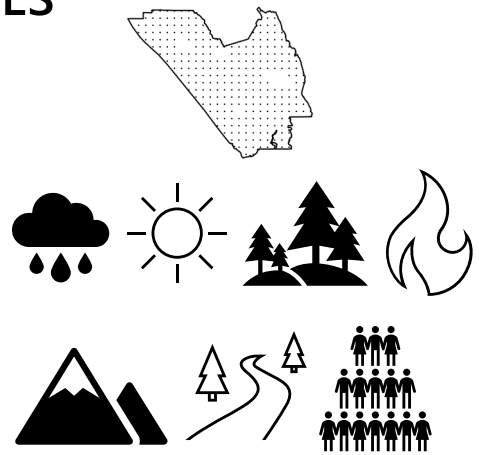
Study Area

- Rangelands of Napa and Sonoma (minus coast redwood region)
- 2001-2017



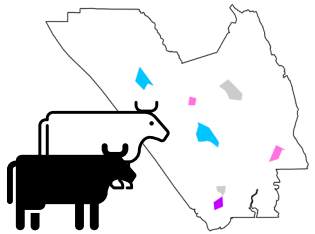
1. ASSEMBLE COVARIATES

- Sampled points at 200m x 200m in grazeable areas
- Annually variable 2001-2017
  - Seasonal/Annual Climate
  - Percent Vegetation Cover
  - Burn Status
- Fixed 2001-2017
  - Topography
  - Census



2. FILTER AND ADD GRAZING SURVEY DATA

Covariates and grazing data for areas of **known** grazing duration, extent, and intensity.



3. MODEL SPECIFICATION

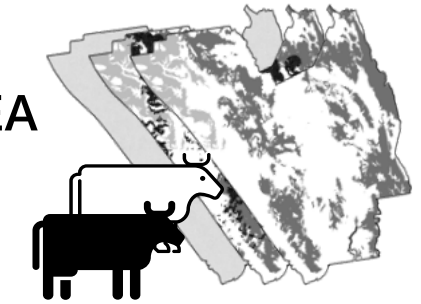
Fit **shrub model** and **burn model** using real-world data for 2001-2017 (1. and 2.)

SHRUB MODEL
How do grazing and covariates influence percent shrub cover?

BURN MODEL
How do grazing and covariates influence burn probability?

4. ADD GRAZING SCENARIOS TO COVARIATES OVER FULL STUDY AREA

Grazing attributes for whole study area developed to test impact of different **extents, locations,** and **intensities** of grazing.



5. UPDATE SHRUB COVER

Use shrub model to update shrub cover data for **alternative** grazing scenarios, use known shrub cover data for **baseline** scenario.

SHRUB MODEL
How do grazing and covariates influence percent shrub cover?

6. ESTIMATE OVER STUDY AREA

Use "predict" function with burn model on data for entire study area to estimate burn probabilities.

BURN MODEL
How do grazing and covariates influence burn probability?

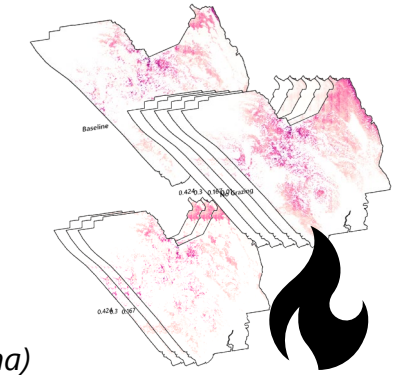
7. CALCULATE AVERAGE ANNUAL BURN PROBABILITY

for each point averaged over 2001-2017

1 Baseline Scenario
(0.41 and 0.14 AUY per G ha[1])

5 Full Extent Scenarios
(No grazing, 0.02, 0.41, 0.74, and 1.05 AUY per G ha)

3 Priority Scenarios
(0.41, 0.74, and 1.05 AUY per G ha)

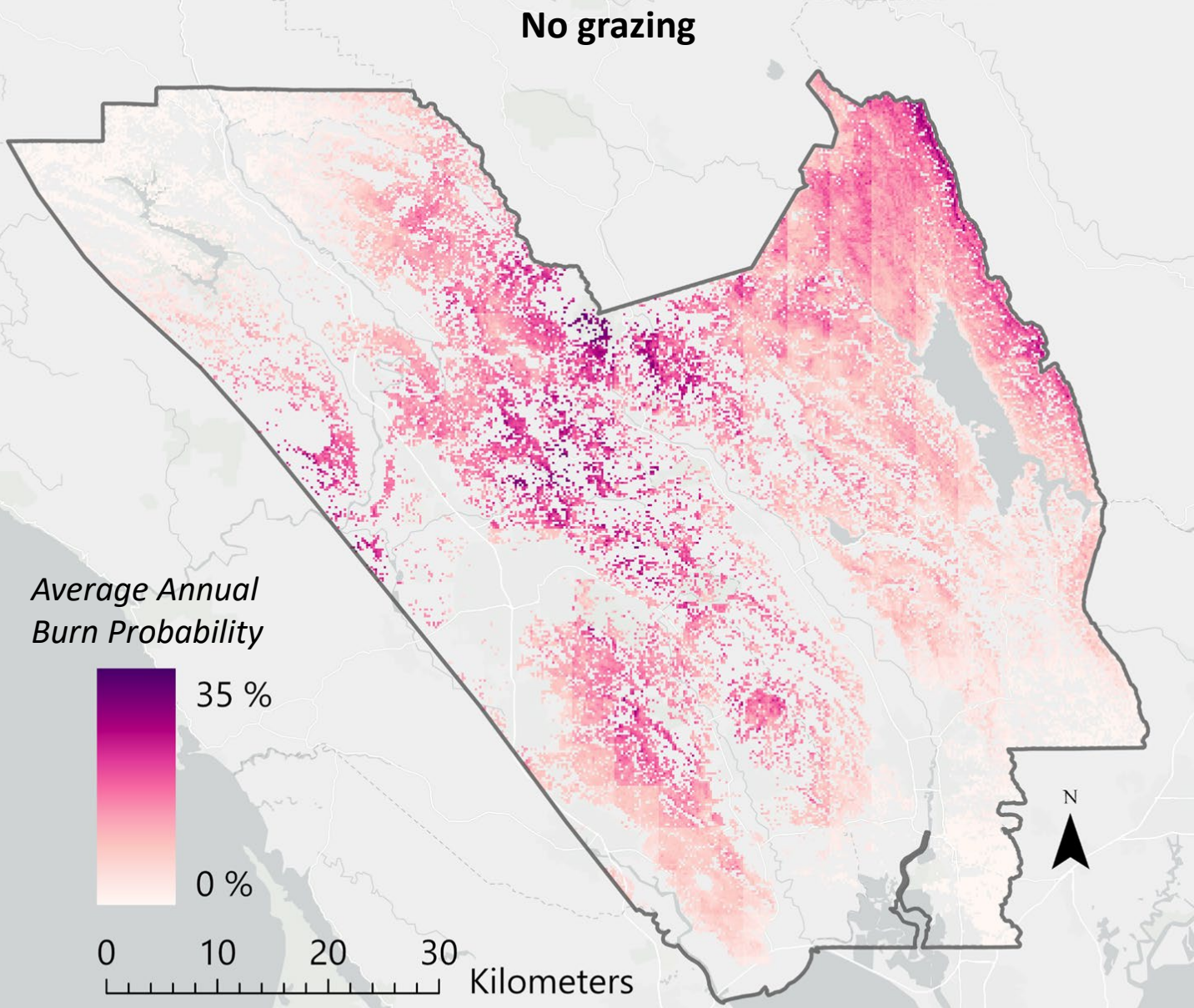


[1] *Animal unit year per grazed ha*

What impact is cattle grazing is having on fire risk?

No grazing

9.9% average annual burn probability



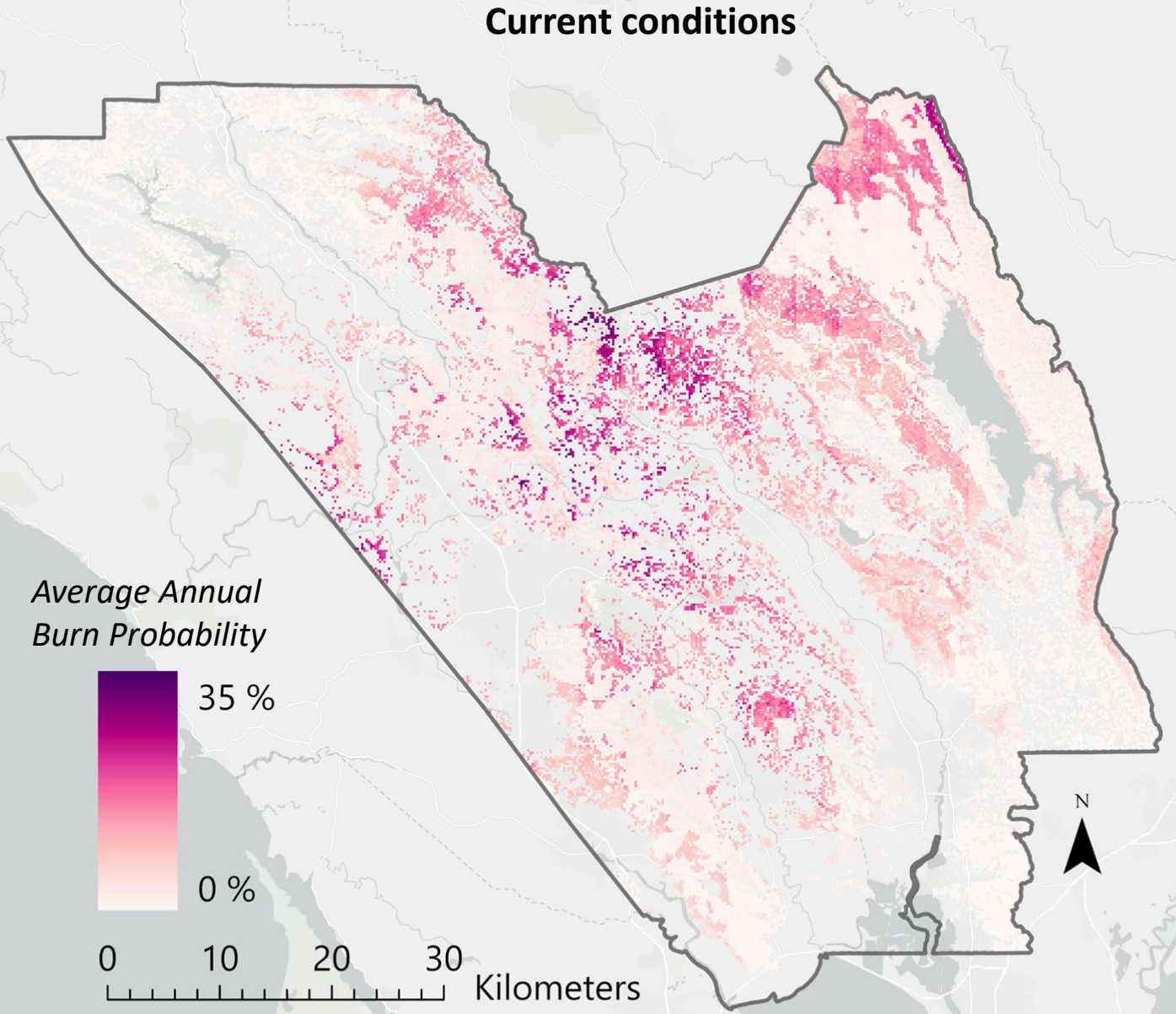
What impact is cattle grazing is having on fire risk?

No grazing

9.9% average annual burn probability

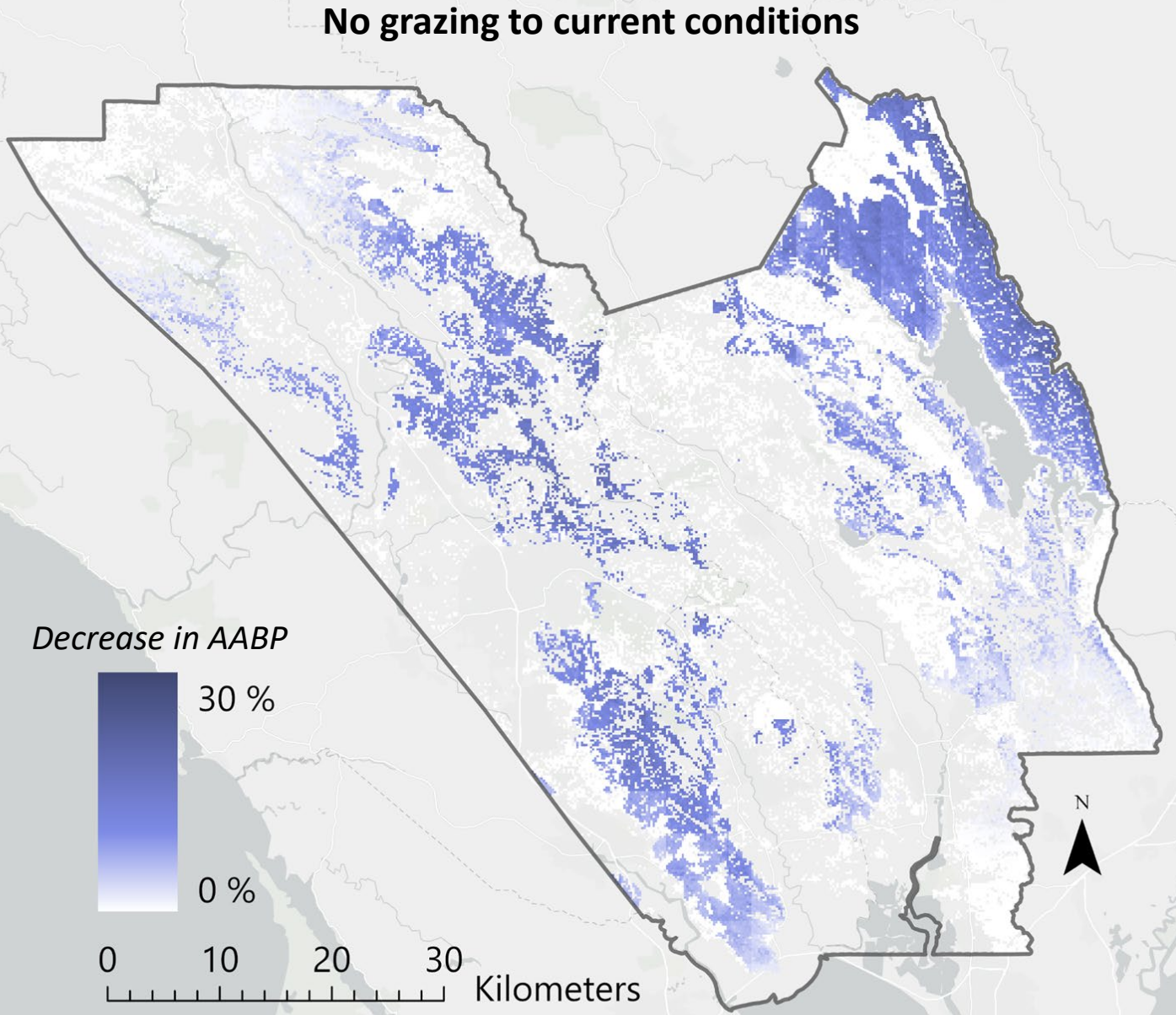
Current grazing

5.4% average annual burn probability



What impact is cattle grazing is having on fire risk?

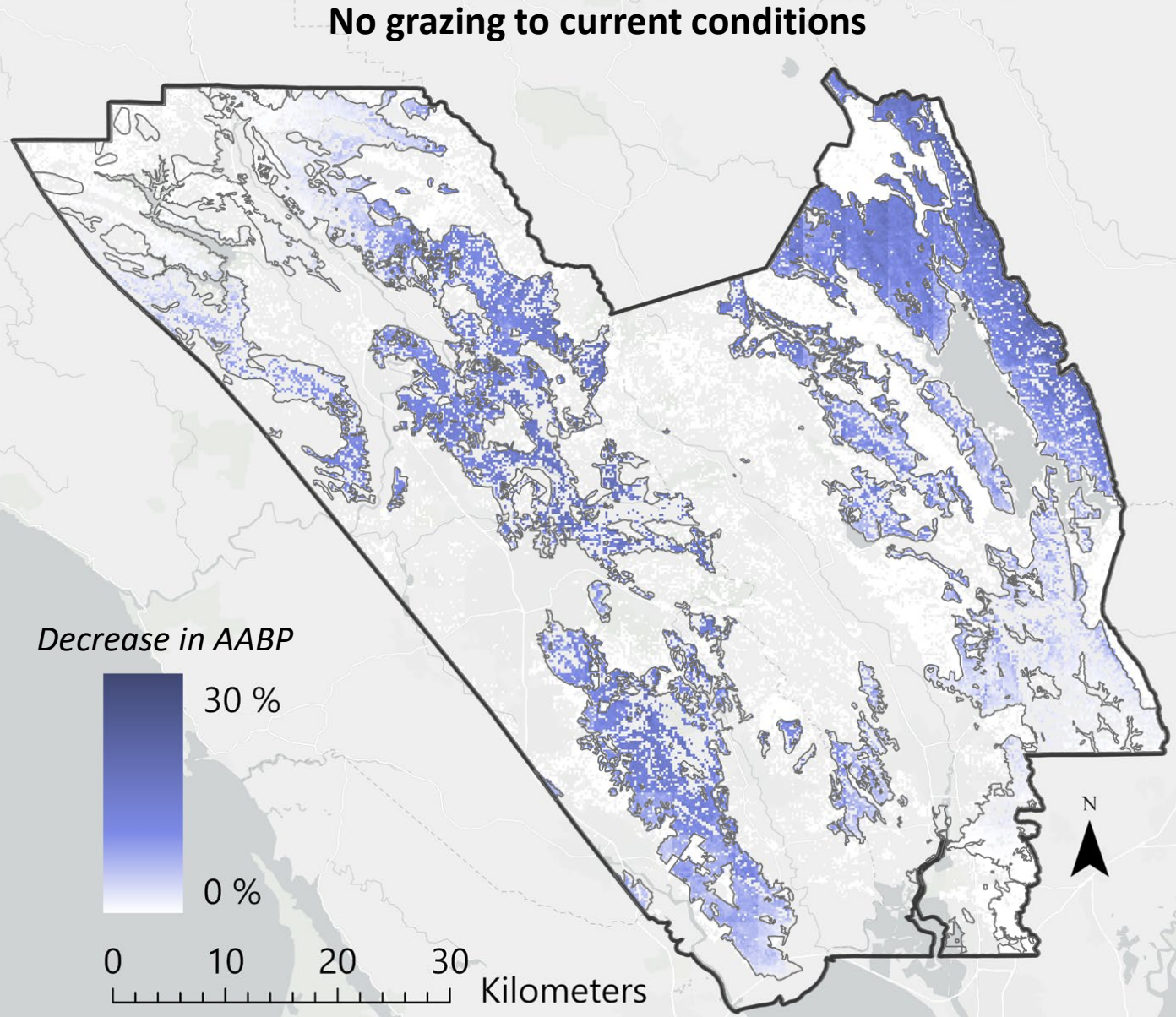
Existing cattle grazing in the study area reduced average annual burn probability over the entire study area by **45% (from 9.9% to 5.4%).**



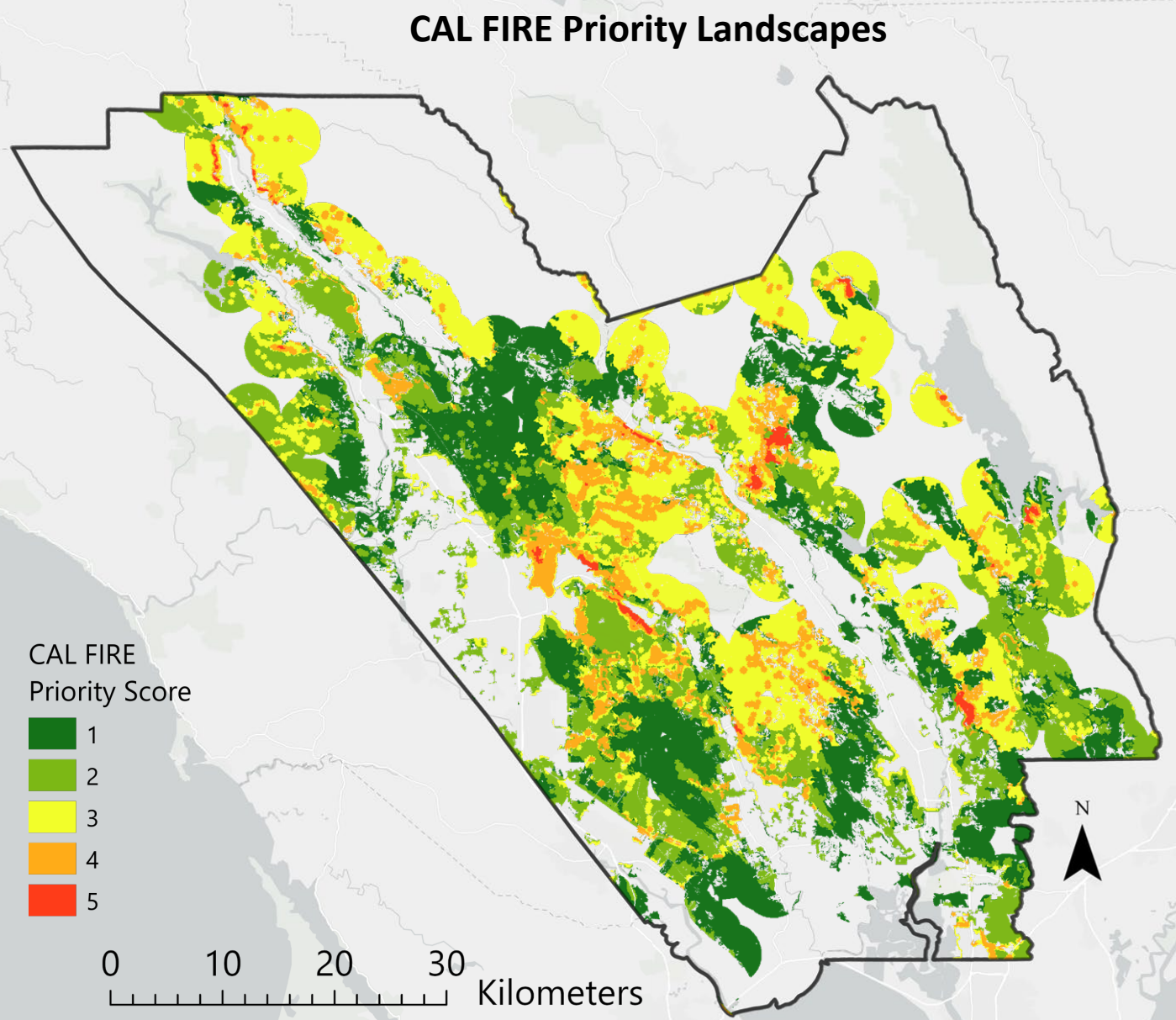
What impact is cattle grazing is having on fire risk?

Existing cattle grazing in the study area reduced average annual burn probability over the entire study area by 45% (from 9.9% to 5.4%).

Within grazed lands, this is an average annual burn probability decrease of **88% (from 9.2% to 1.1%) directly attributable to grazing.**

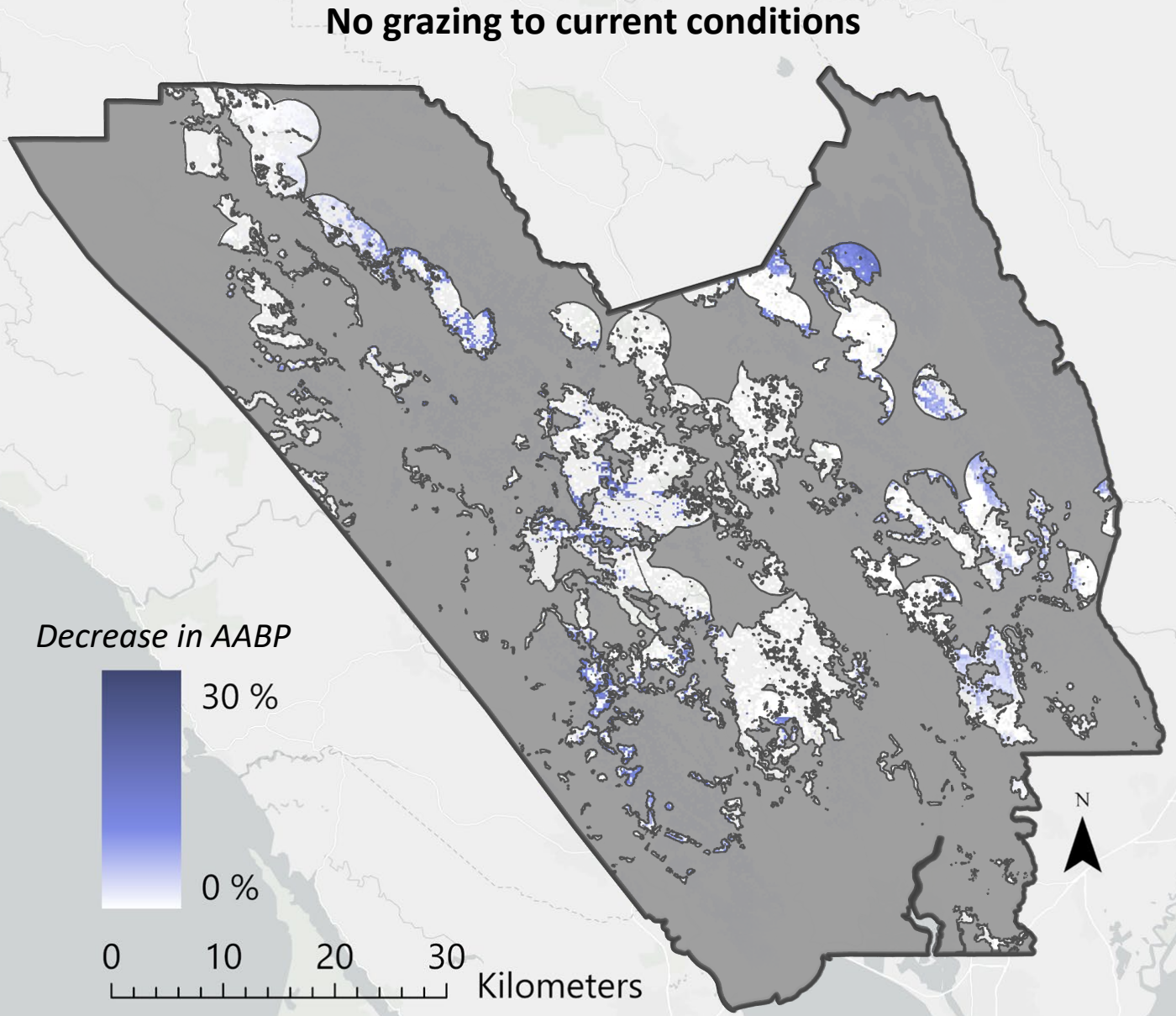


What does this mean for high-risk high-priority areas?



What does this mean for high-risk high-priority areas?

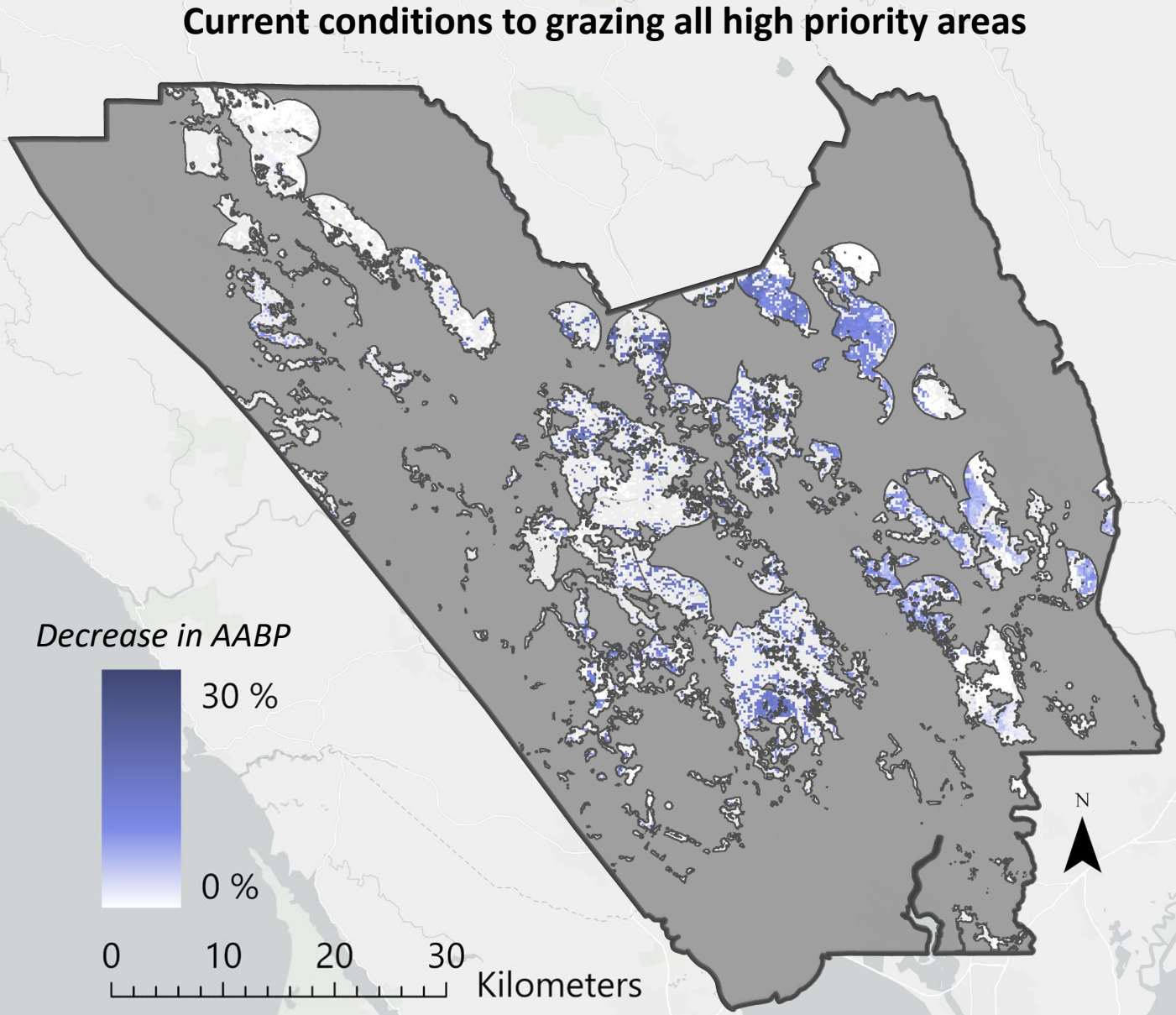
Current grazing in high priority landscapes reduced their burn probability by **28% (from 10.6% to 7.6%).**



What does this mean for high-risk high-priority areas?

Current grazing in high priority landscapes reduced their burn probability by 28% (from 10.6% to 7.6%).

Extending grazing to all rangelands in high priority landscapes reduced their burn probability by **82% (from 7.6% to 1.4%).**



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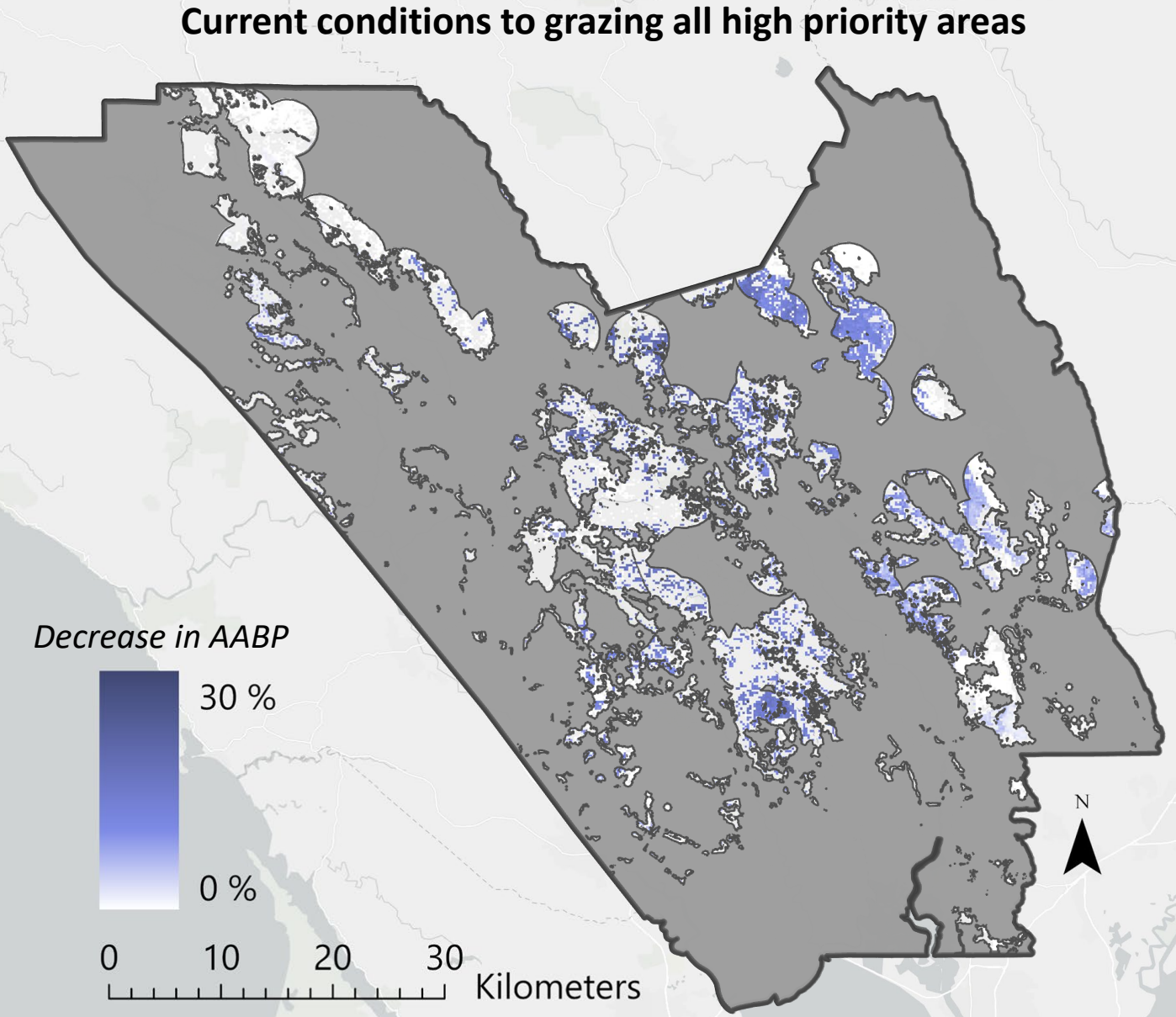
Current grazing in high priority landscapes reduced their burn probability by 28% (from 10.6% to 7.6%).

Extending grazing to all rangelands in high priority landscapes reduced their burn probability by 82% (from 7.6% to 1.4%).

If that was the only change, it would reduce burn probability over the whole study area by **23% (from 5.4% to 4.2%).**



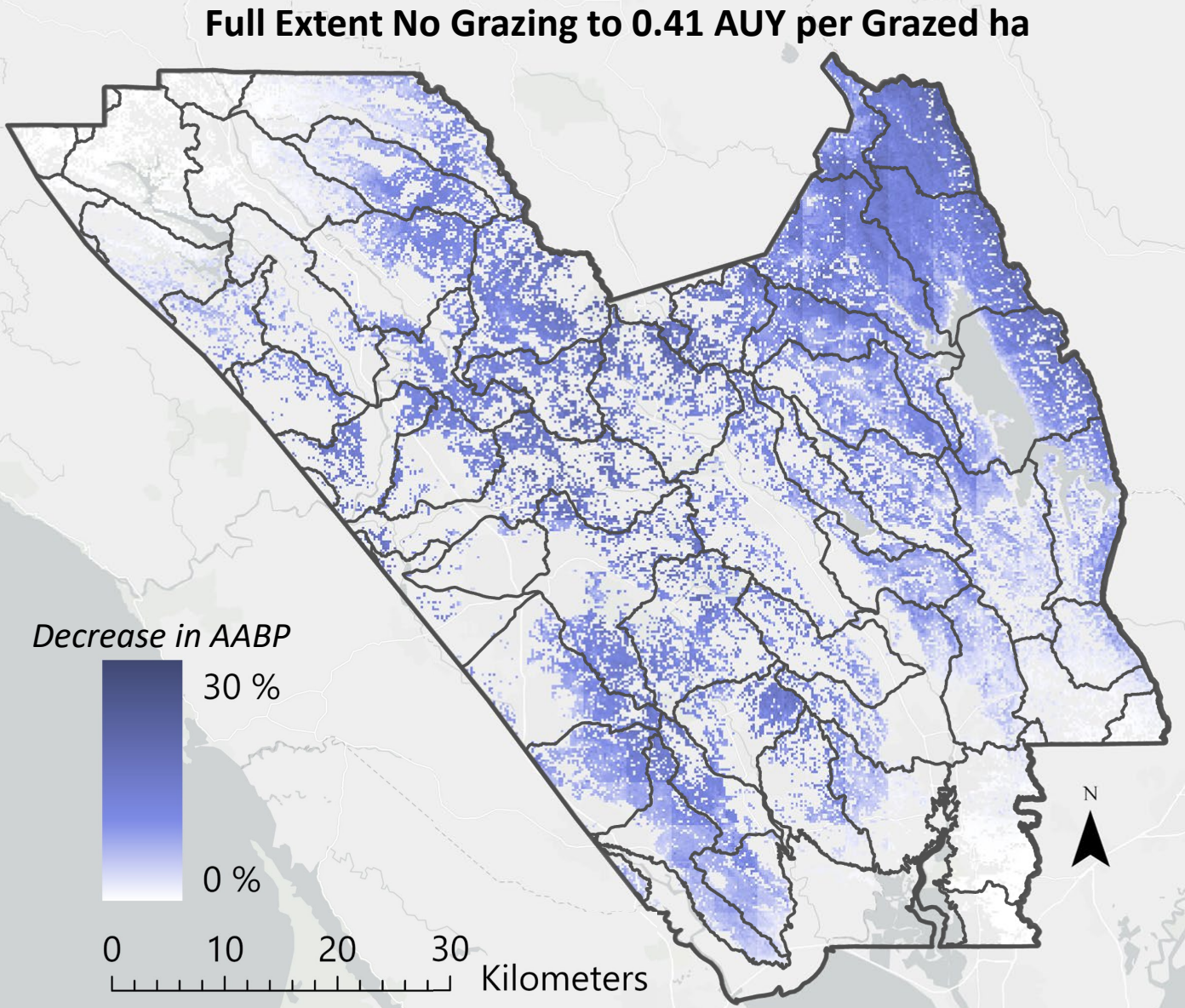
Key Treatment Units

Hypothetical treatment unit:

HUC12

Grazing efficiency:

Decrease in AABP going from no grazing to grazed at customary level (0.17 AUY per grazed ac).



Key Treatment Units

Hypothetical treatment unit:

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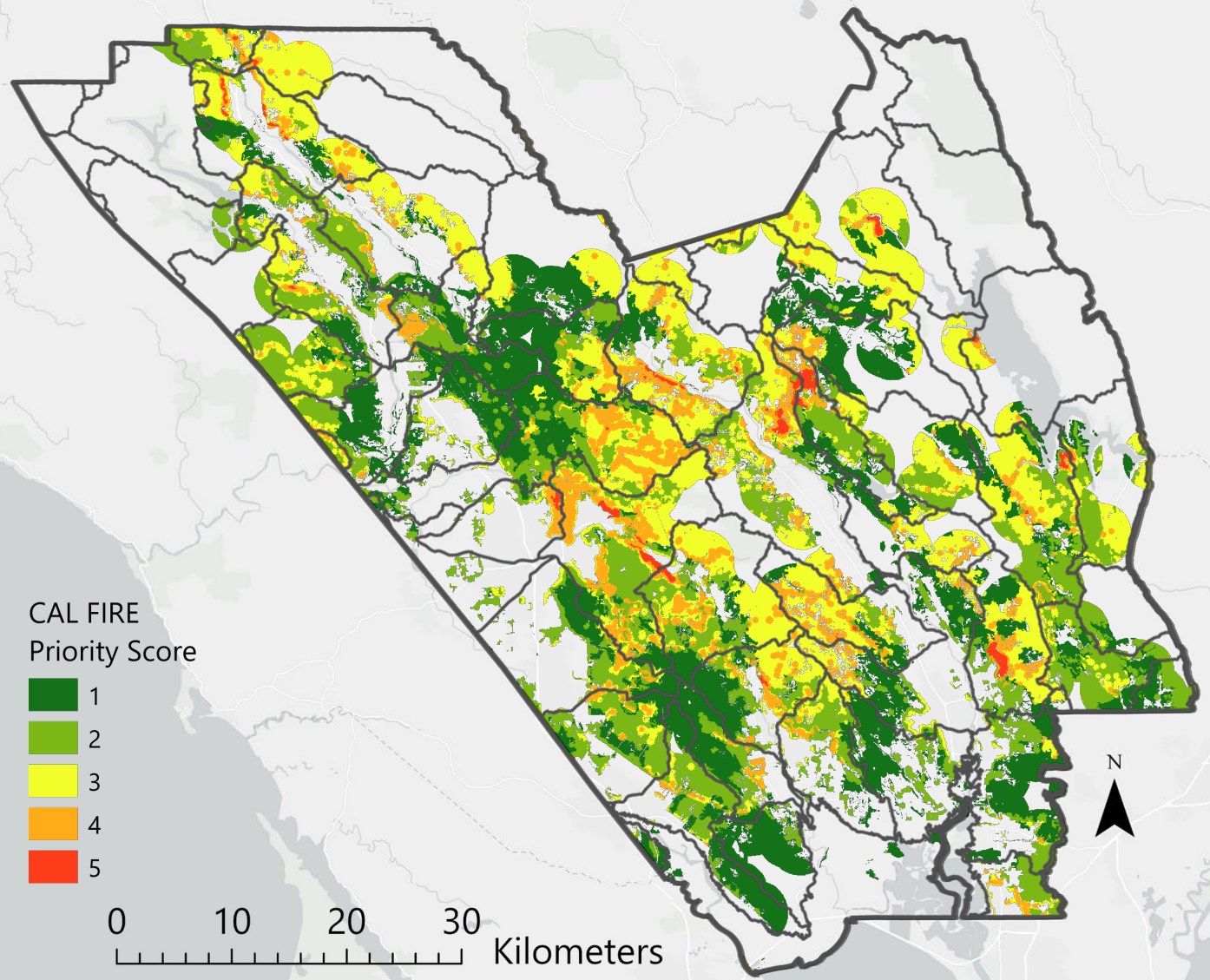
Priority landscape score



Key Treatment Units

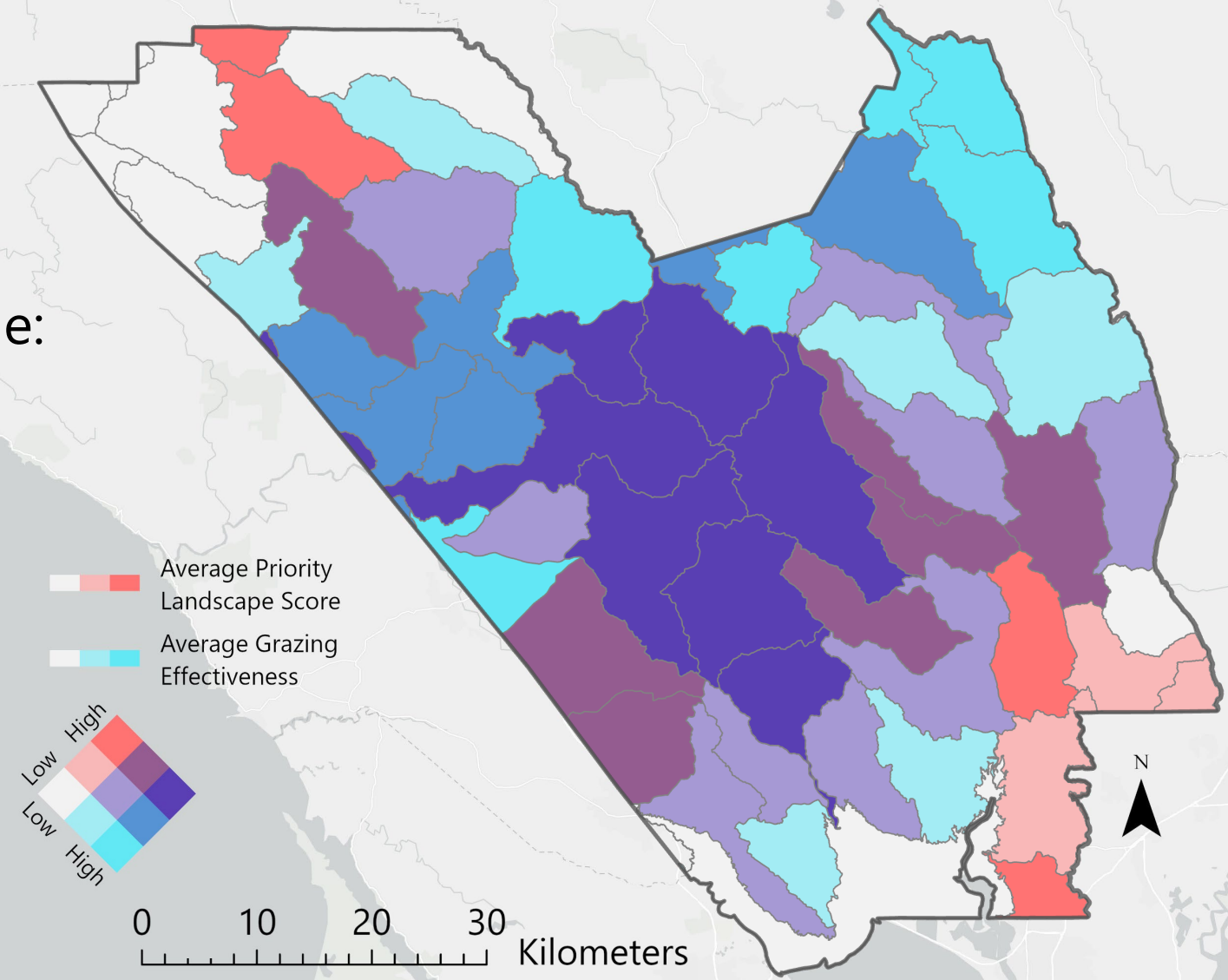
Within these key units:

37% of rangelands grazed at baseline:

11.3% average annual burn probability

Extend grazing to 100% of rangelands:

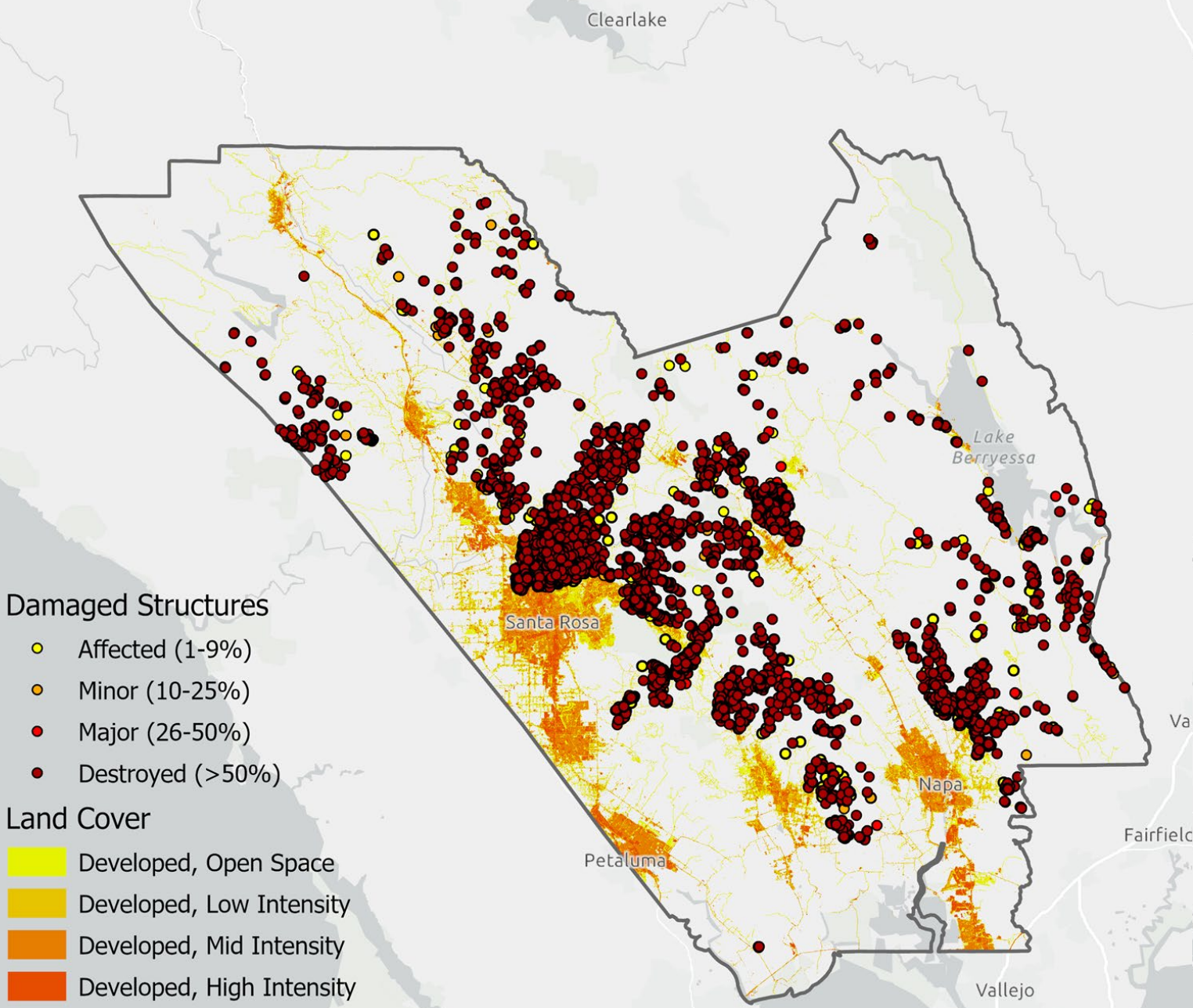
2.9% average annual burn probability



Is there a way to get this into dollars?

Yes and no…

- Direct Measurement
- Willingness to pay
- Avoided loss
- Substitution cost



CAL FIRE Damage Inspection Report 2013-2022
NLCD 2001


“Good fences make good neighbors.”
Working Land Urban Interface

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Starrs, G. I., Siegel, K. J., Larson, S., and V. Butsic. *In review.* Quantifying landscape-scale impacts of cattle grazing on burn probability in Napa and Sonoma counties, California

Key points

Under current grazing conditions, cattle grazing reduces overall average annual burn probability by **45%** (from 9.9% to 5.4%) when compared to the scenario without grazing.

Extending production-level grazing into high priority areas could decrease wildfire risk to communities in the WUI, with an average annual burn probability decrease of **82% (6.3 percentage points)** in high priority landscapes, and a **23%** (from 5.4% to 4.2%) decrease over the entire study area.

Grazing effectiveness at decreasing burn probability varied over the study area. In combination with additional considerations, this can be leveraged to identify areas best suited to the use of cattle as a fuel treatment.

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