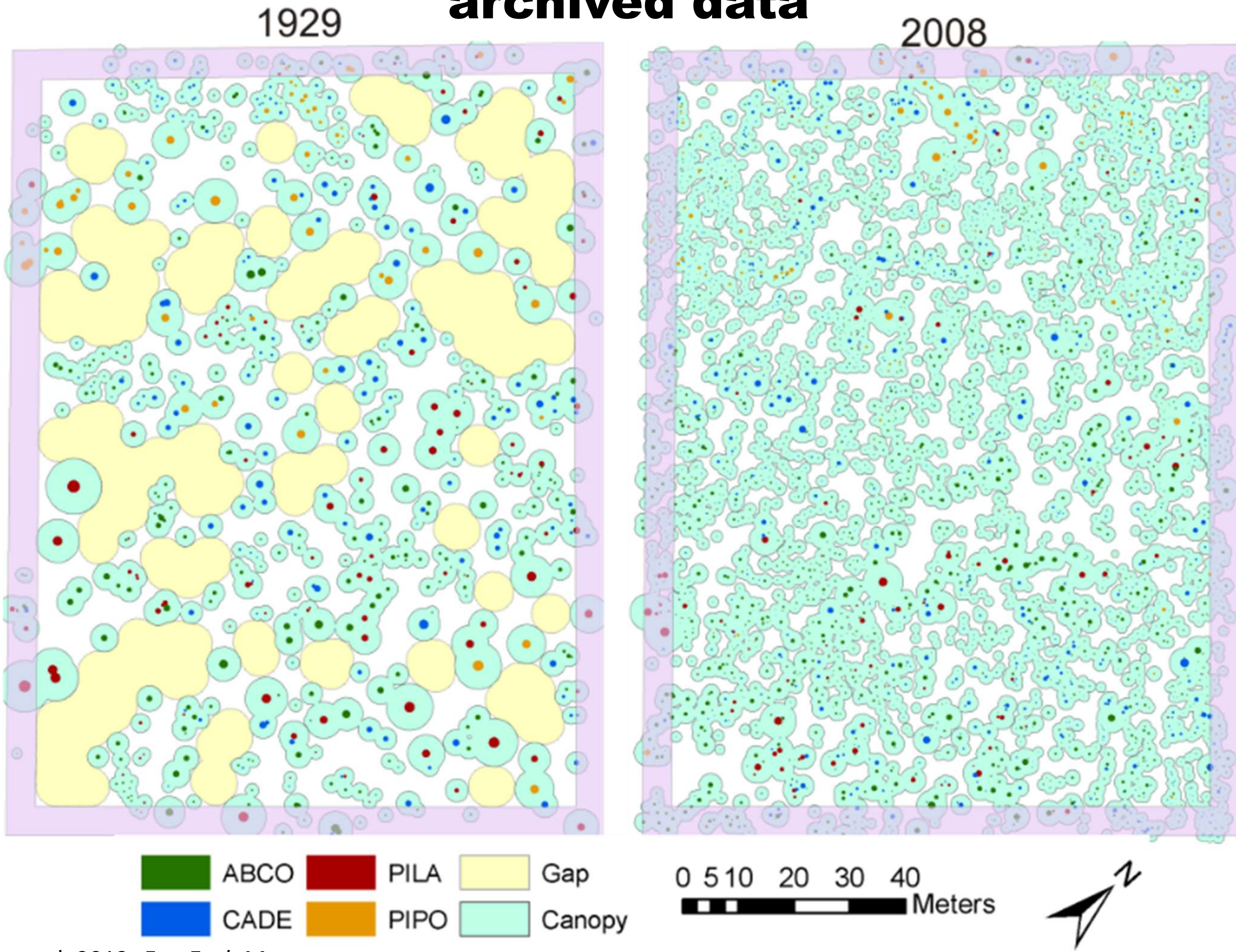
Wildfire, forest management, and sensitive wildlife: lessons from the Sierra Nevada

Legacy of past management in California's forests:

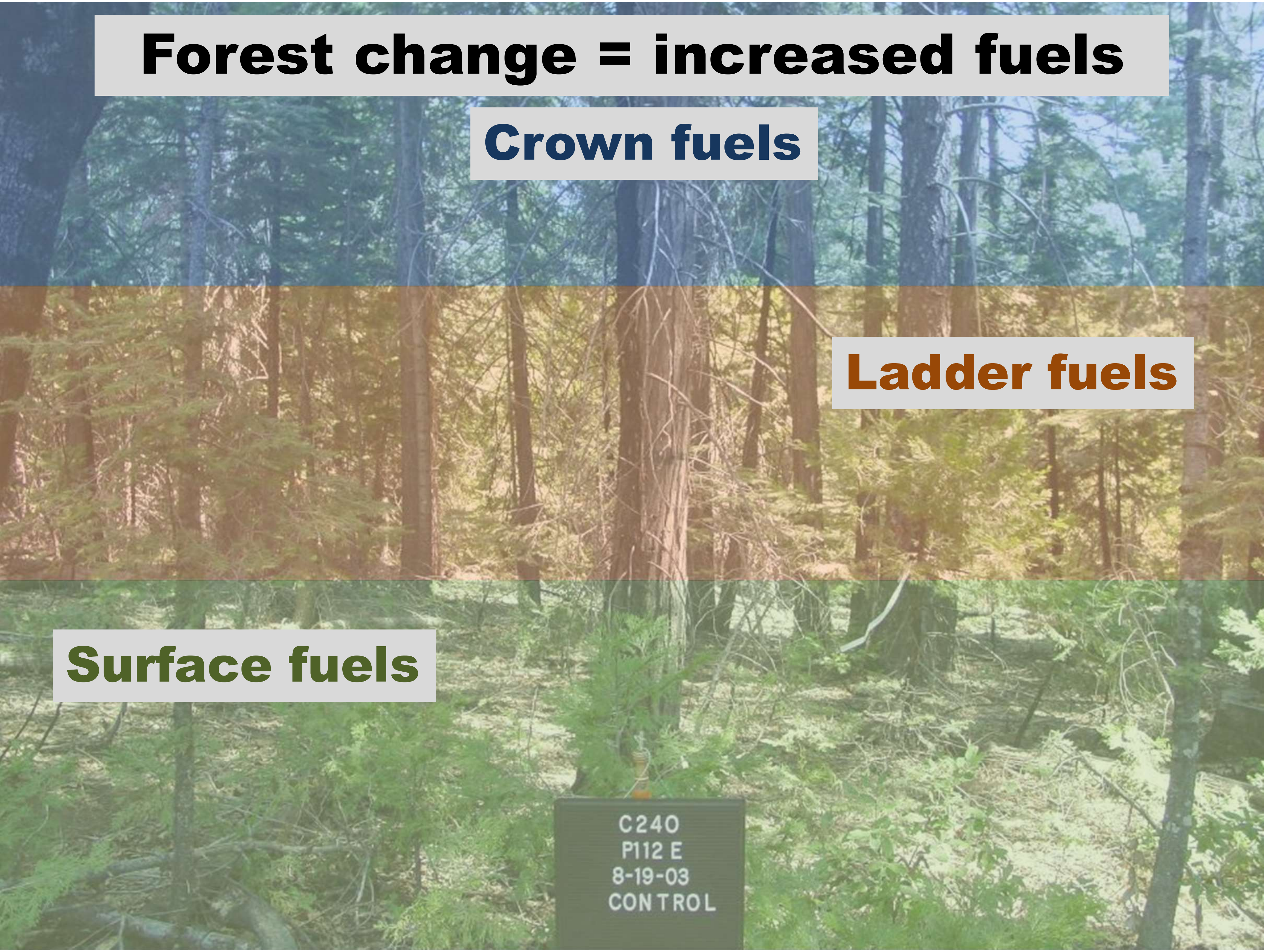
– **Eliminating fire from *fire-maintained* forests**
  - Fire suppression
  - Fire exclusion (removing intentional burning)
  - Grazing
– **Timber harvesting**
  - Overstory removal
  - Even-aged harvests

Historical forest structure and composition: archived data



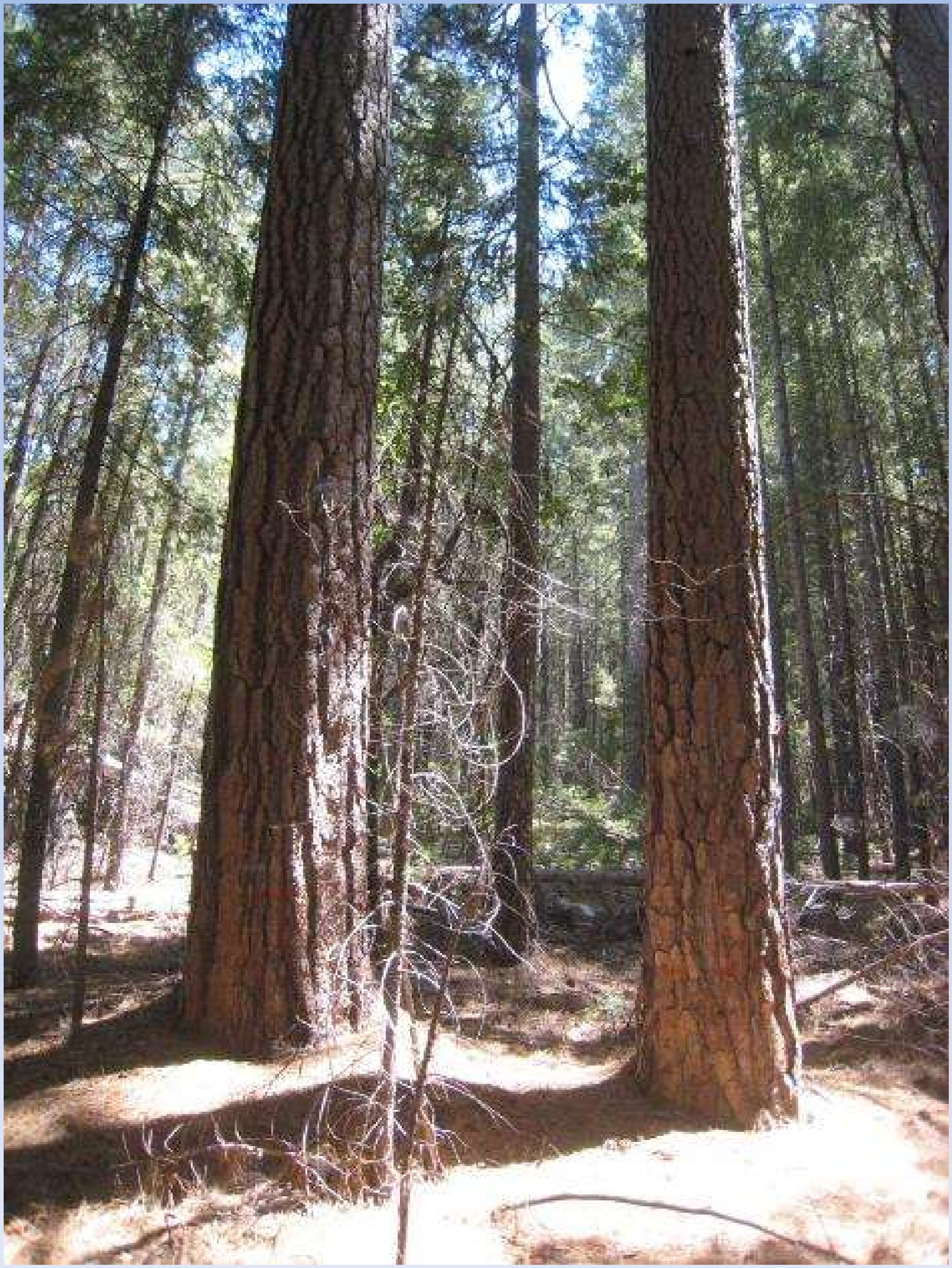
Lydersen et al. 2013, *For. Ecol. Manage.*

Forest change = increased fuels



Field plot within Rim Fire (Stan. NF – 2013)

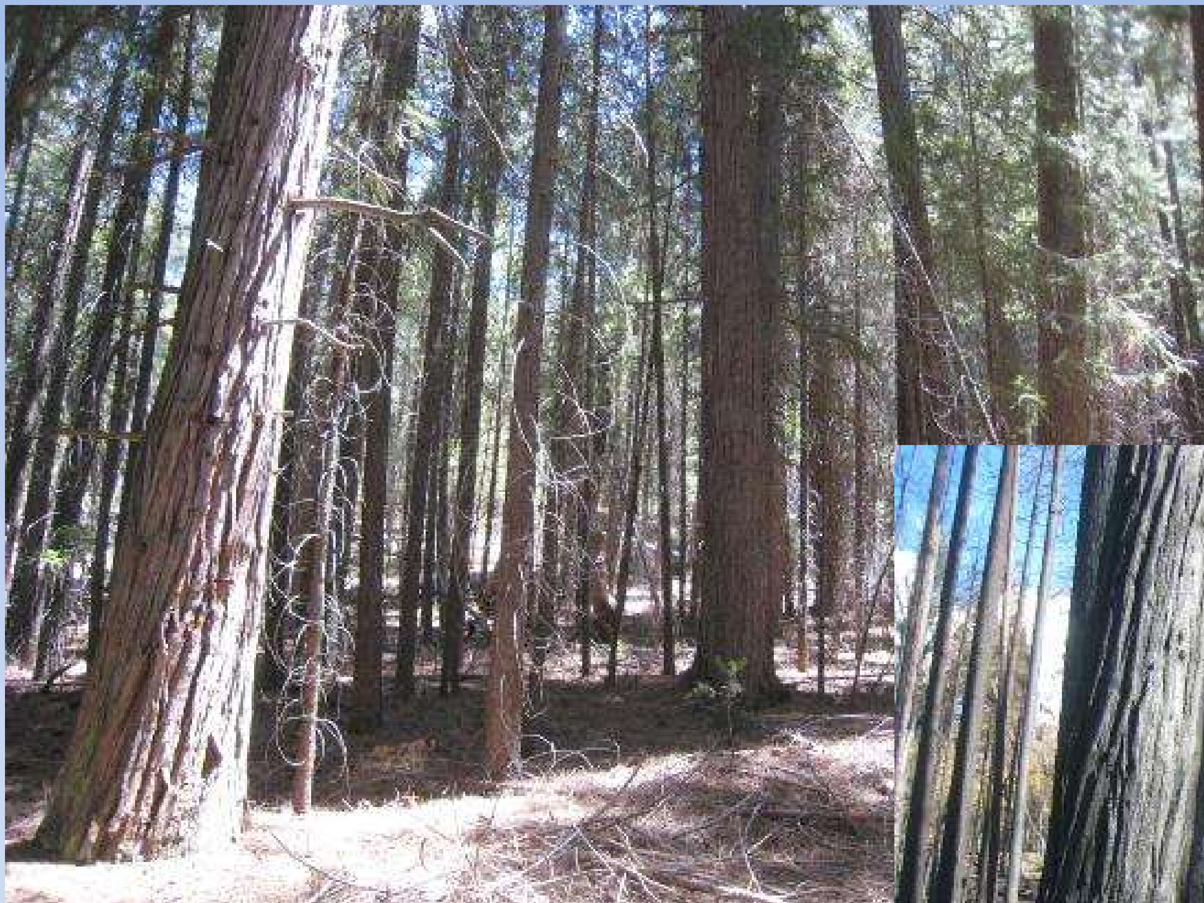
Pre-fire (15-Jul-2013)



Post-fire (25-Sep-2013)

Field plot within Rim Fire

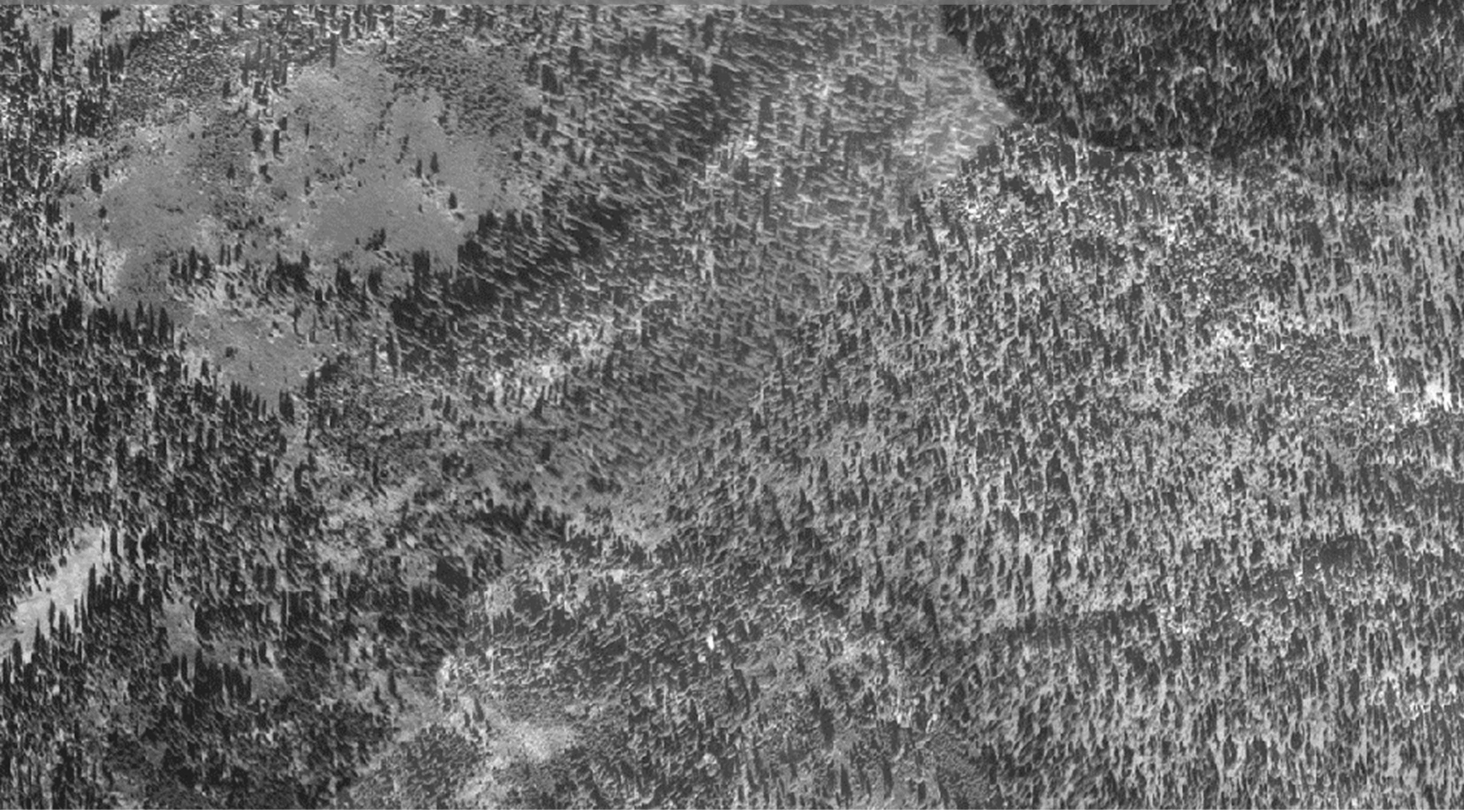
Pre-fire (15-Jul-2013)



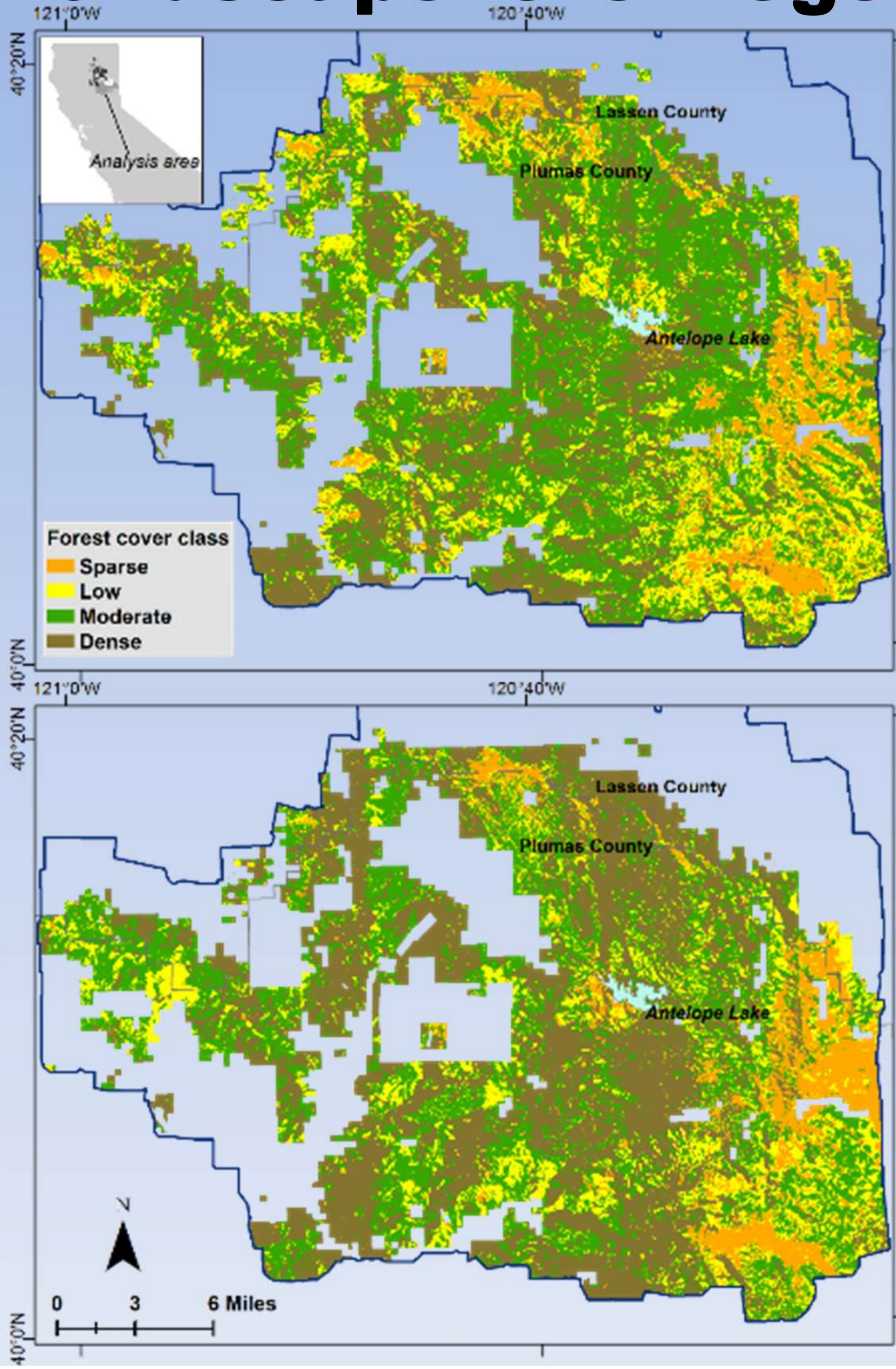
Post-fire (25-Sep-2013)

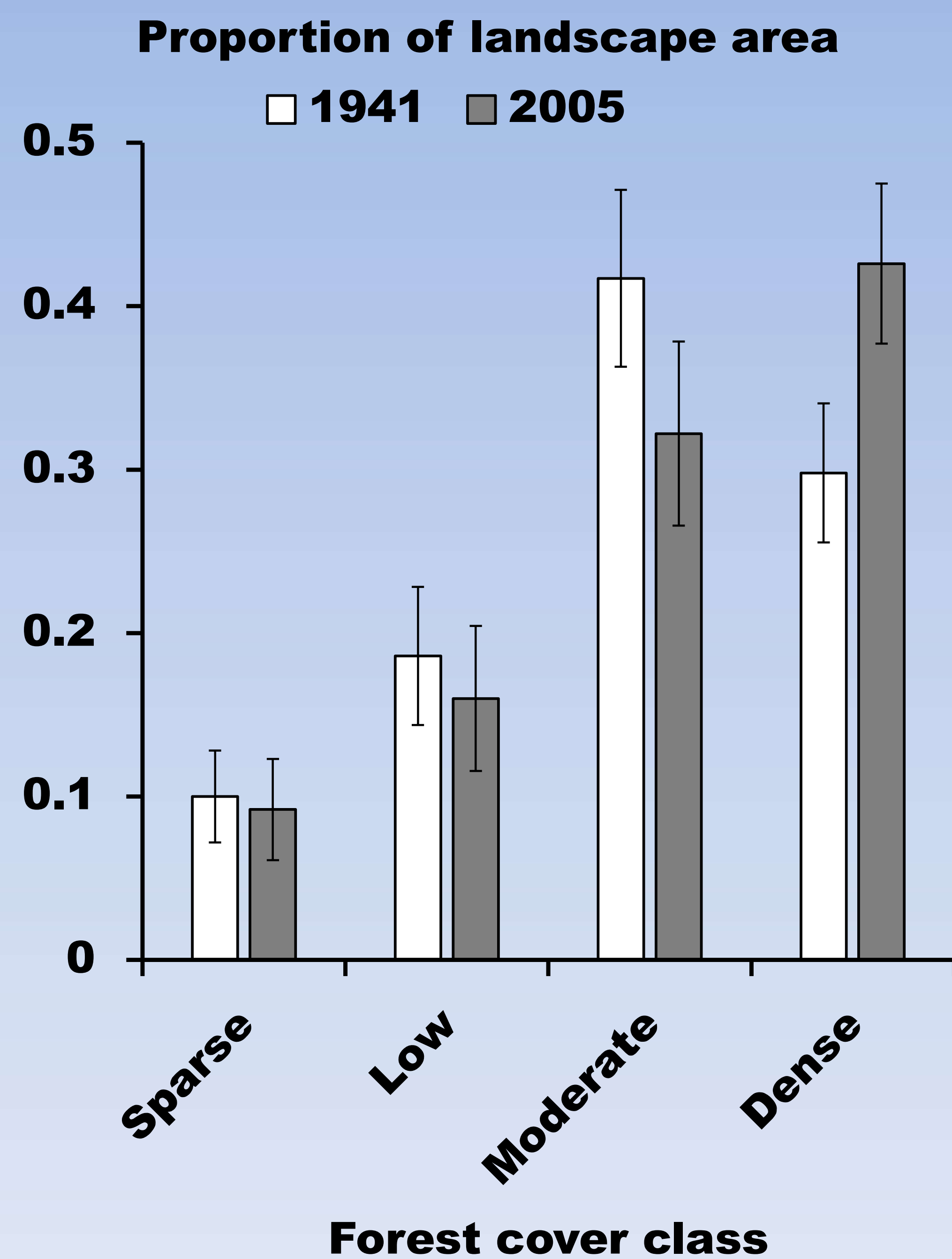
Landscape level vegetation change: Plumas NF

- 1941 aerial photos, wall-to-wall >250,000 ac
- Classified "segment" (polygons) into one of four forest cover classes, both 1941 and 2005
- Compared occurrence across time periods



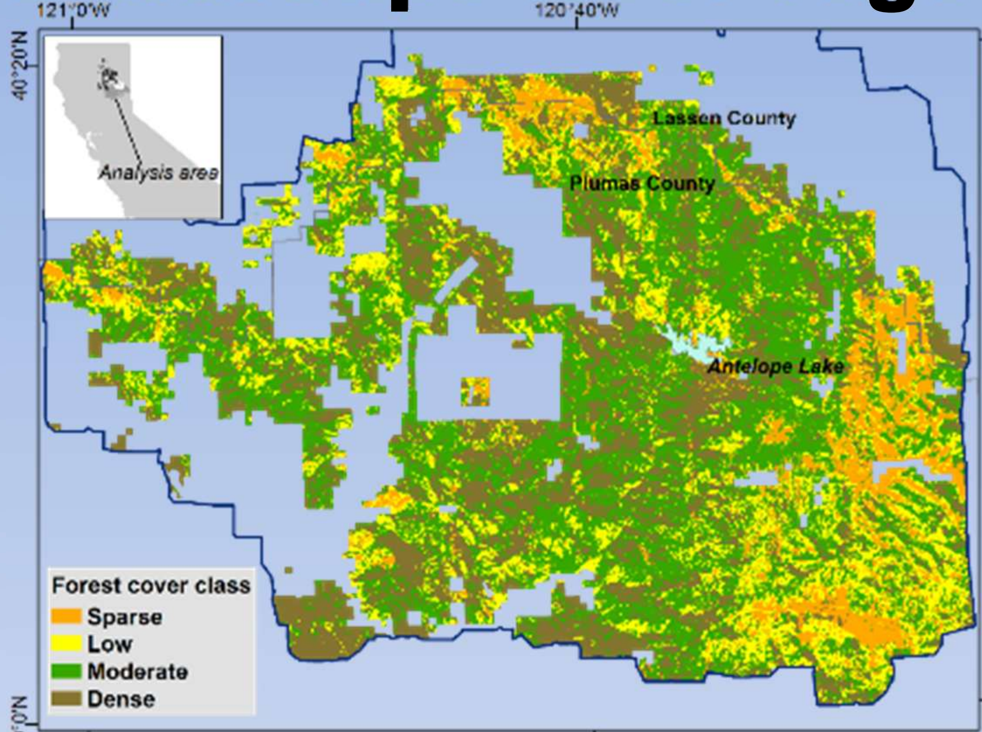
Landscape level vegetation change: Plumas NF

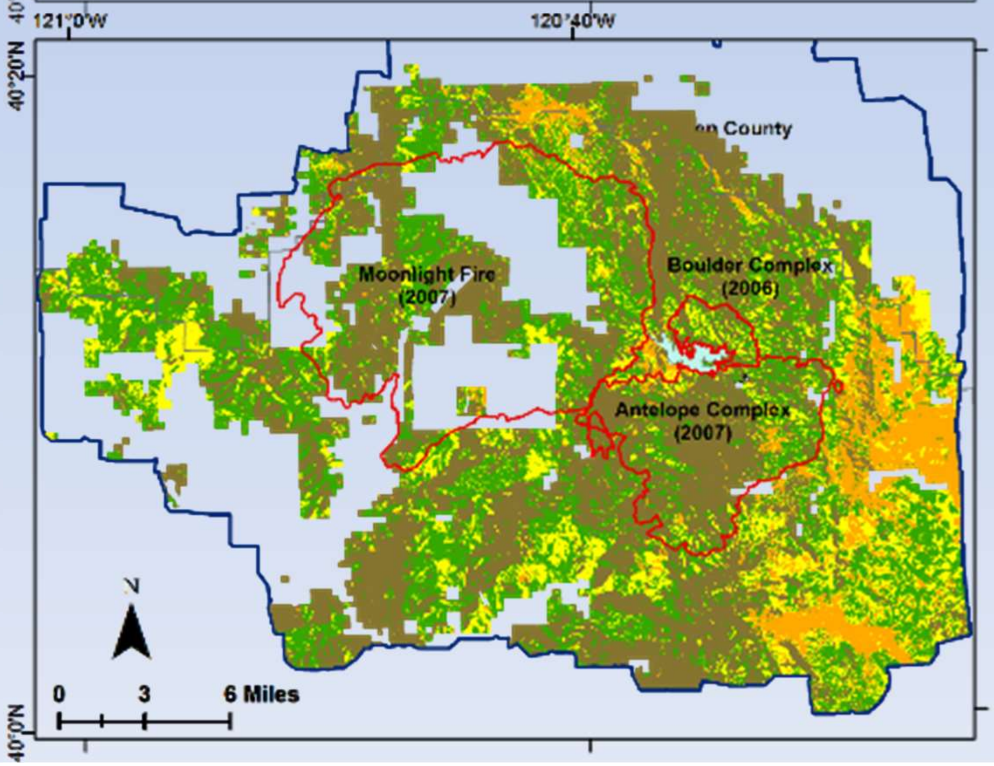


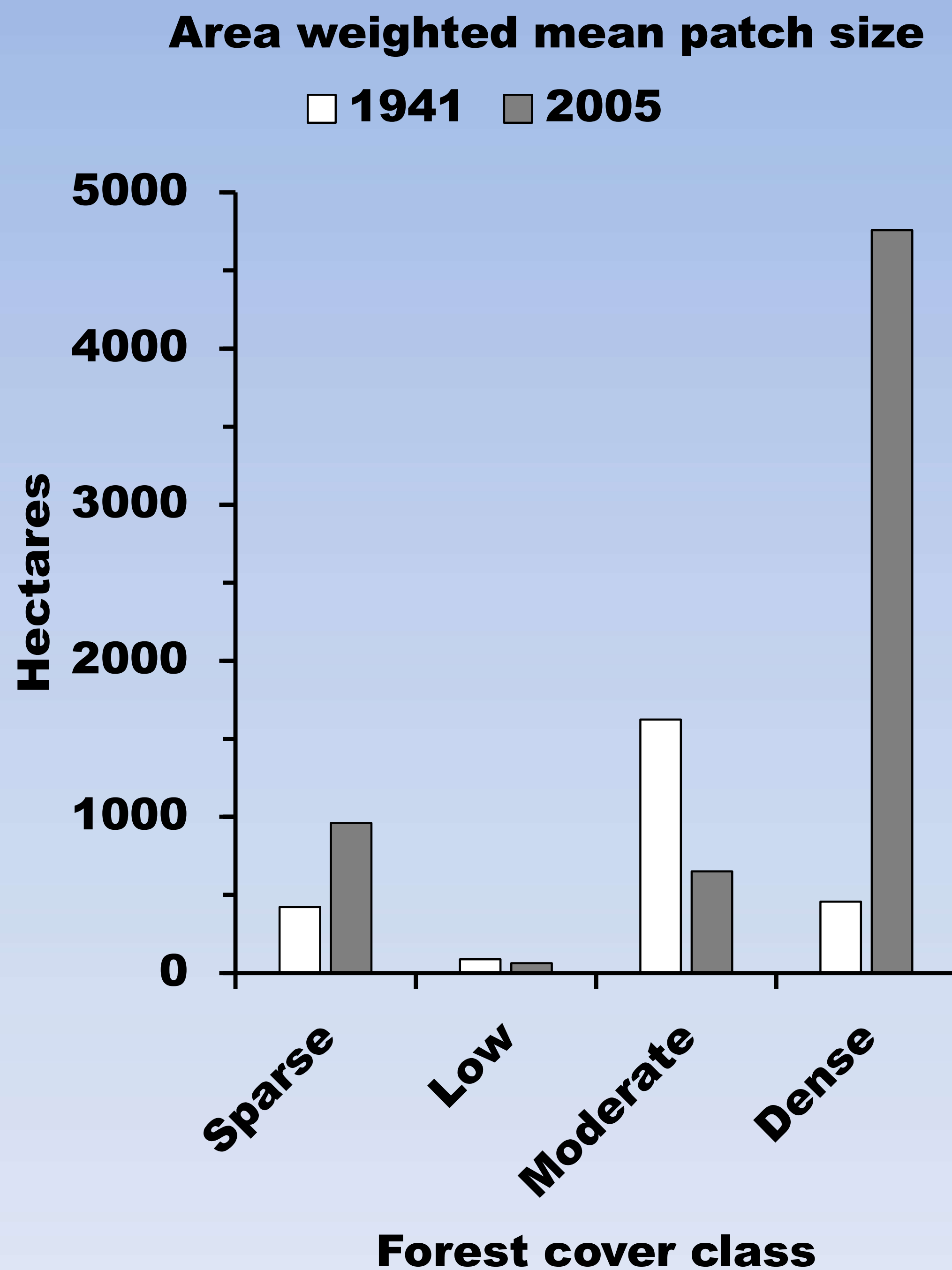


Lydersen & Collins 2018, *Ecosystems*

Landscape level vegetation change: Plumas NF

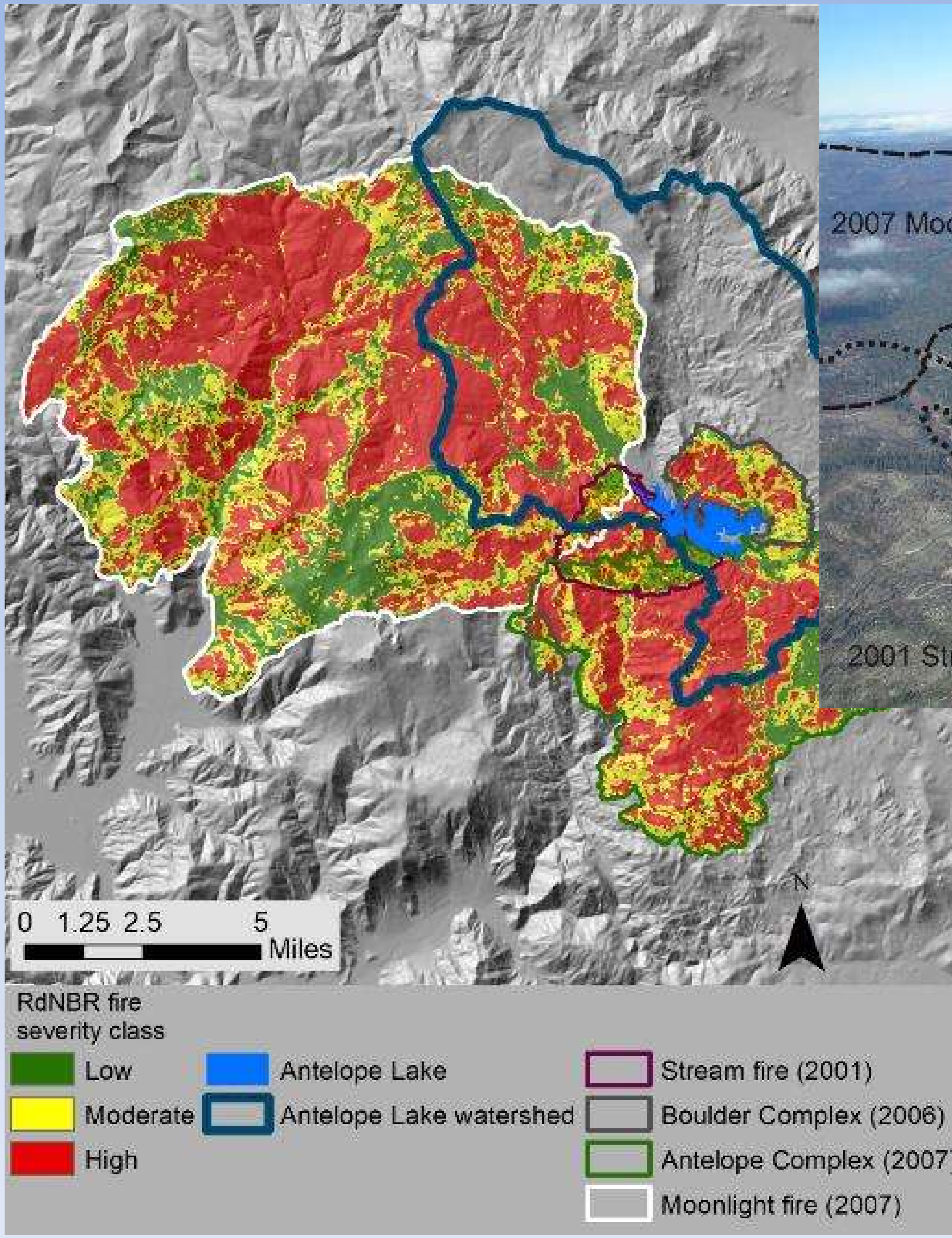


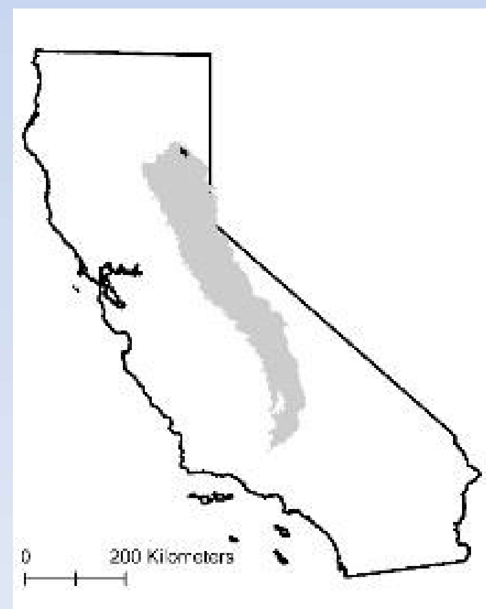




Lydersen & Collins 2018, *Ecosystems*

N. Sierra Nevada fires (2001-2007)

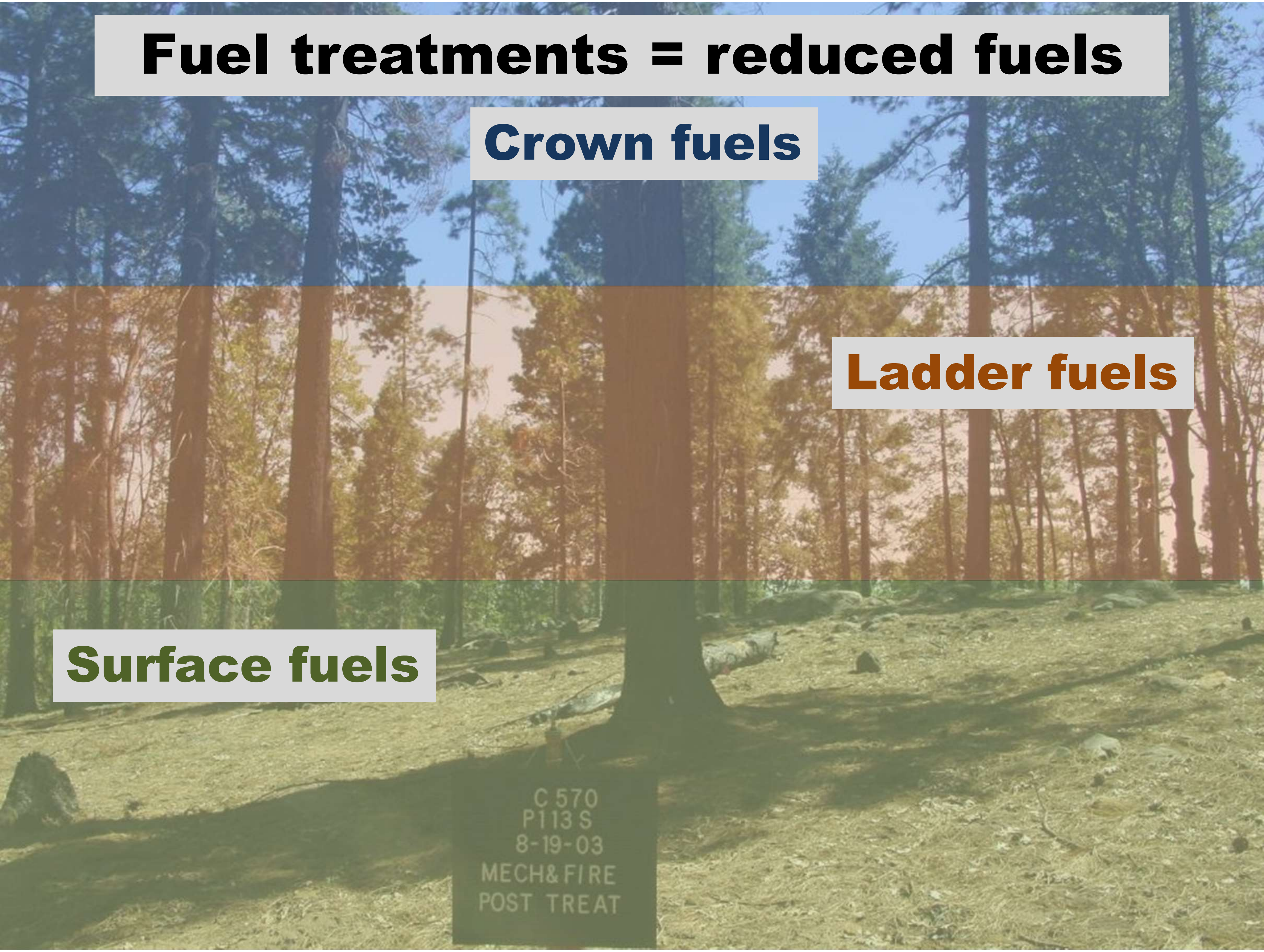


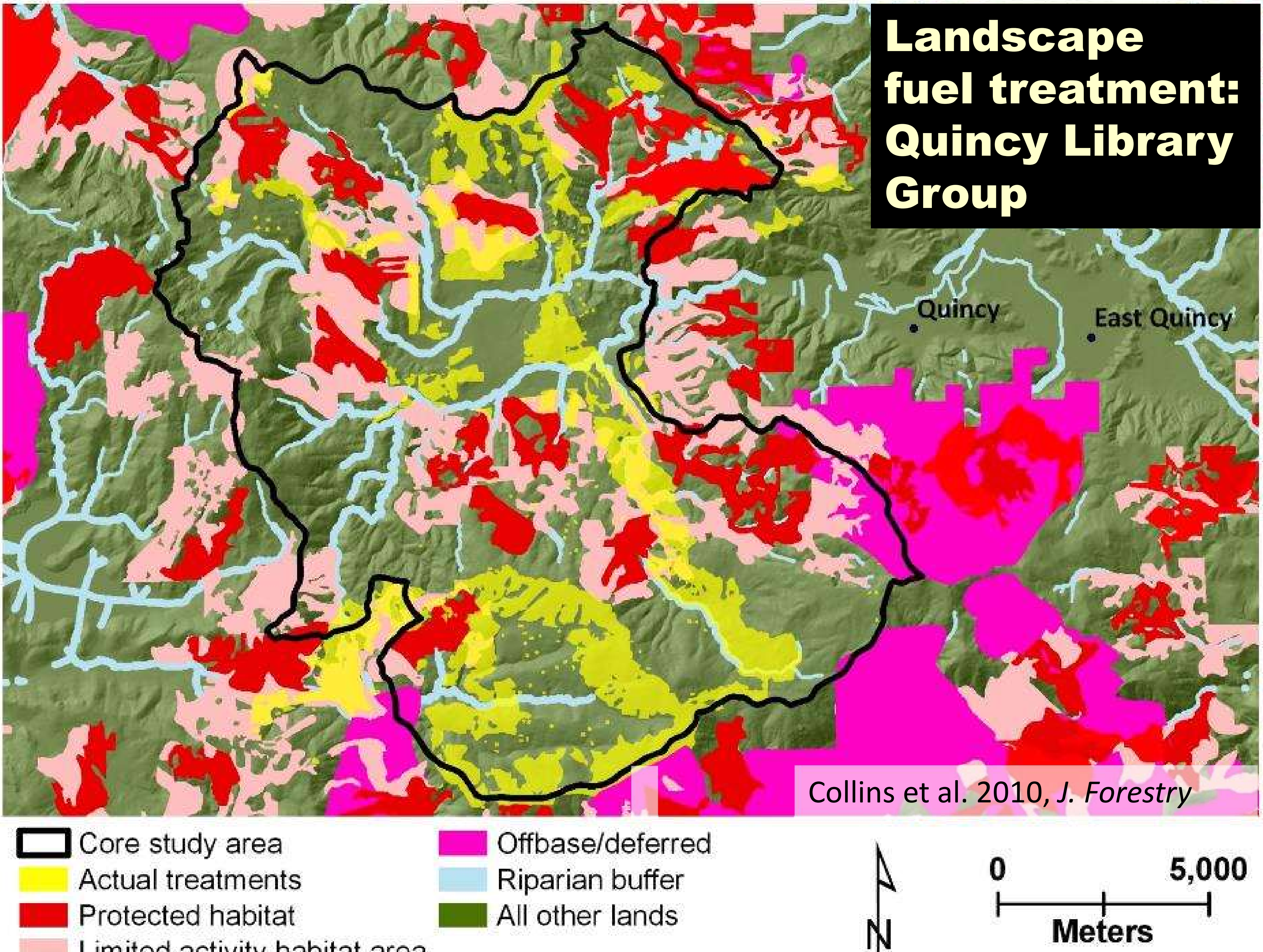


Fuel treatment: thinning (mechanical)

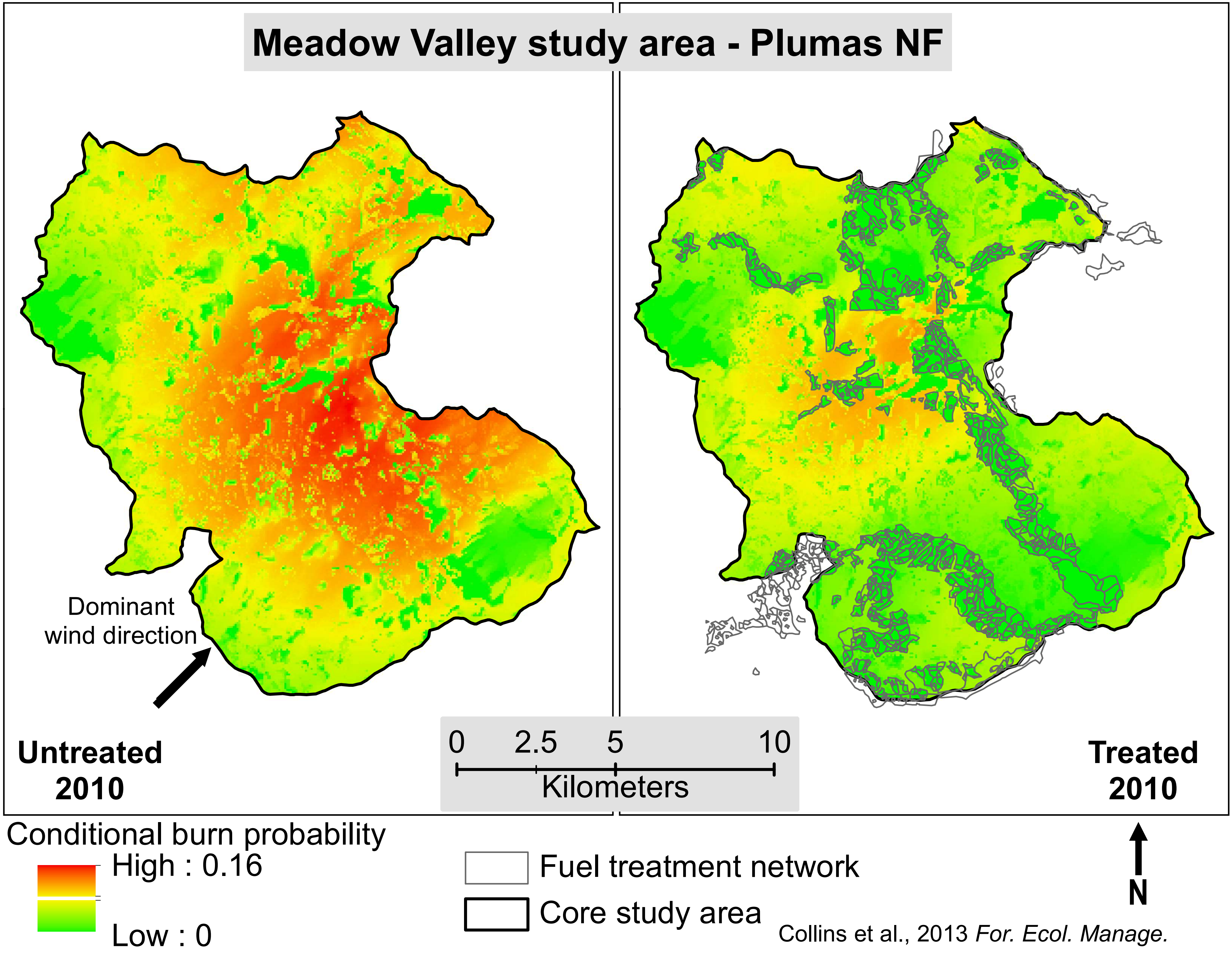
Fuel treatment: prescribed fire

Fuel treatments = reduced fuels

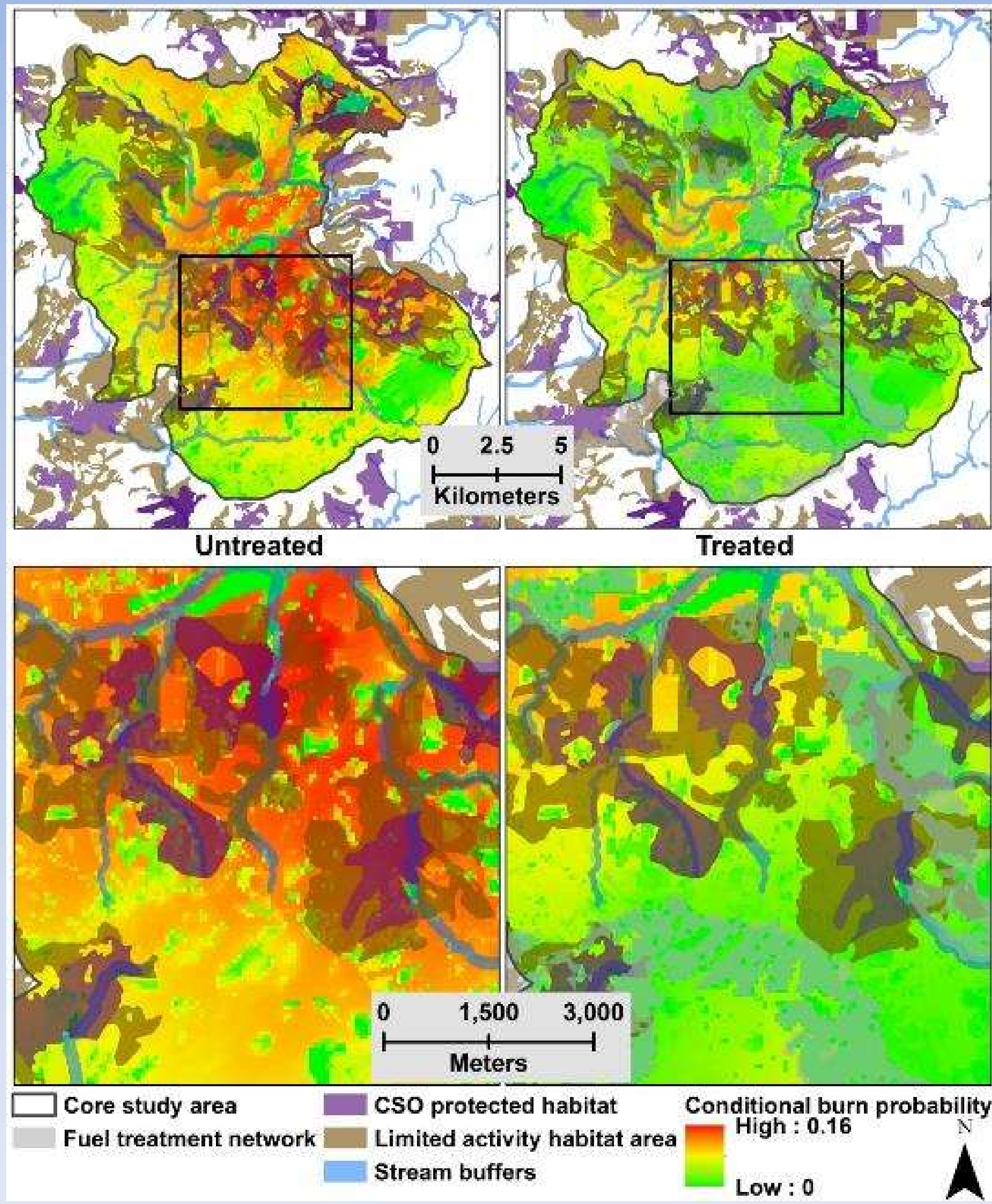




Landscape fuel treatment: Quincy Library Group
Quincy
East Quincy
Collins et al. 2010, *J. Forestry*
Core study area
Actual treatments
Protected habitat
Limited activity habitat area
Offbase/deferred
Riparian buffer
All other lands
N
0
5,000
Meters

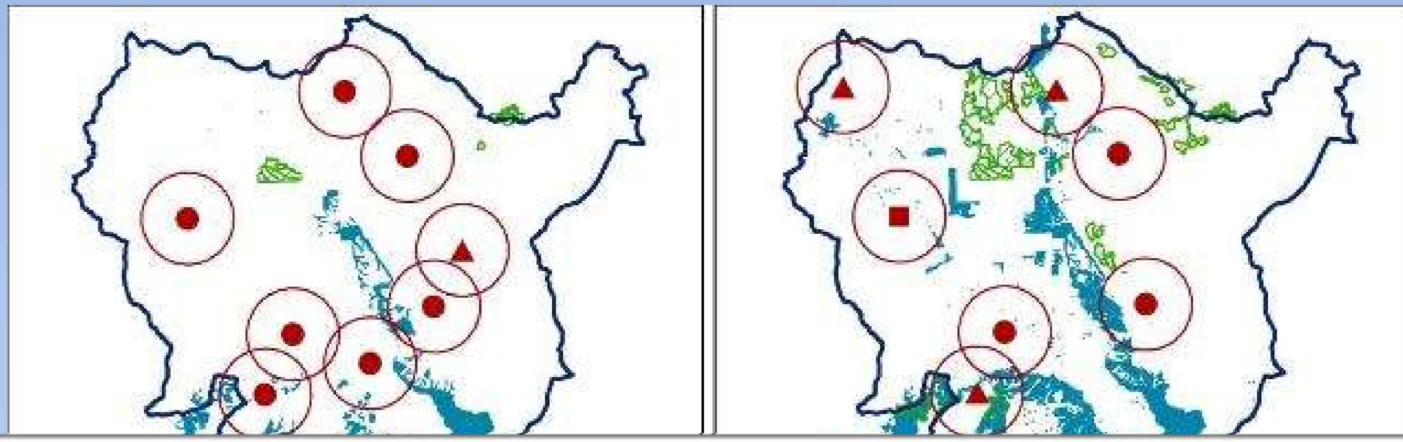

Meadow Valley study area - Plumas NF
Dominant wind direction
Untreated 2010
Treated 2010
0 2.5 5 10
Kilometers
Conditional burn probability
High : 0.16
Low : 0
Fuel treatment network
Core study area
N
Collins et al., 2013 For. Ecol. Manage.

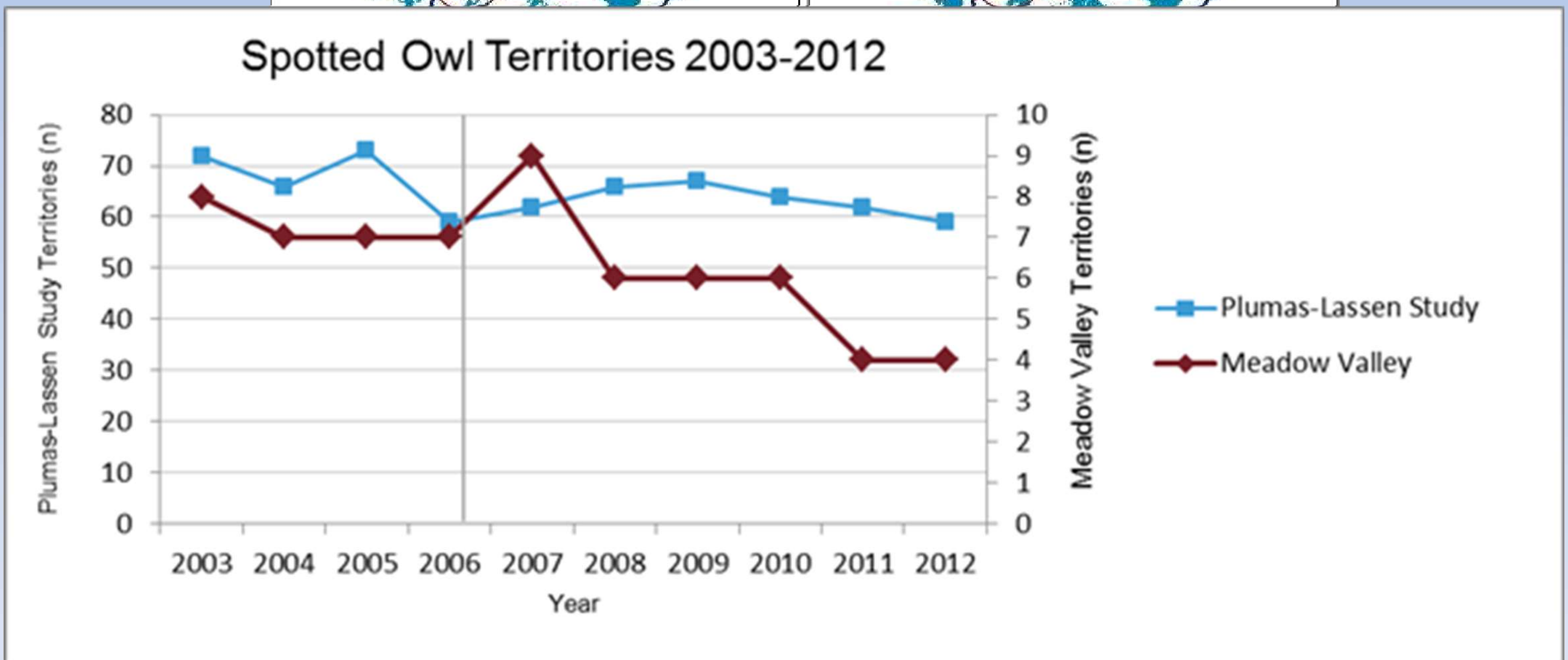
Hazardous fire potential in protected areas



Stephens et al. 2014, *Bioscience*

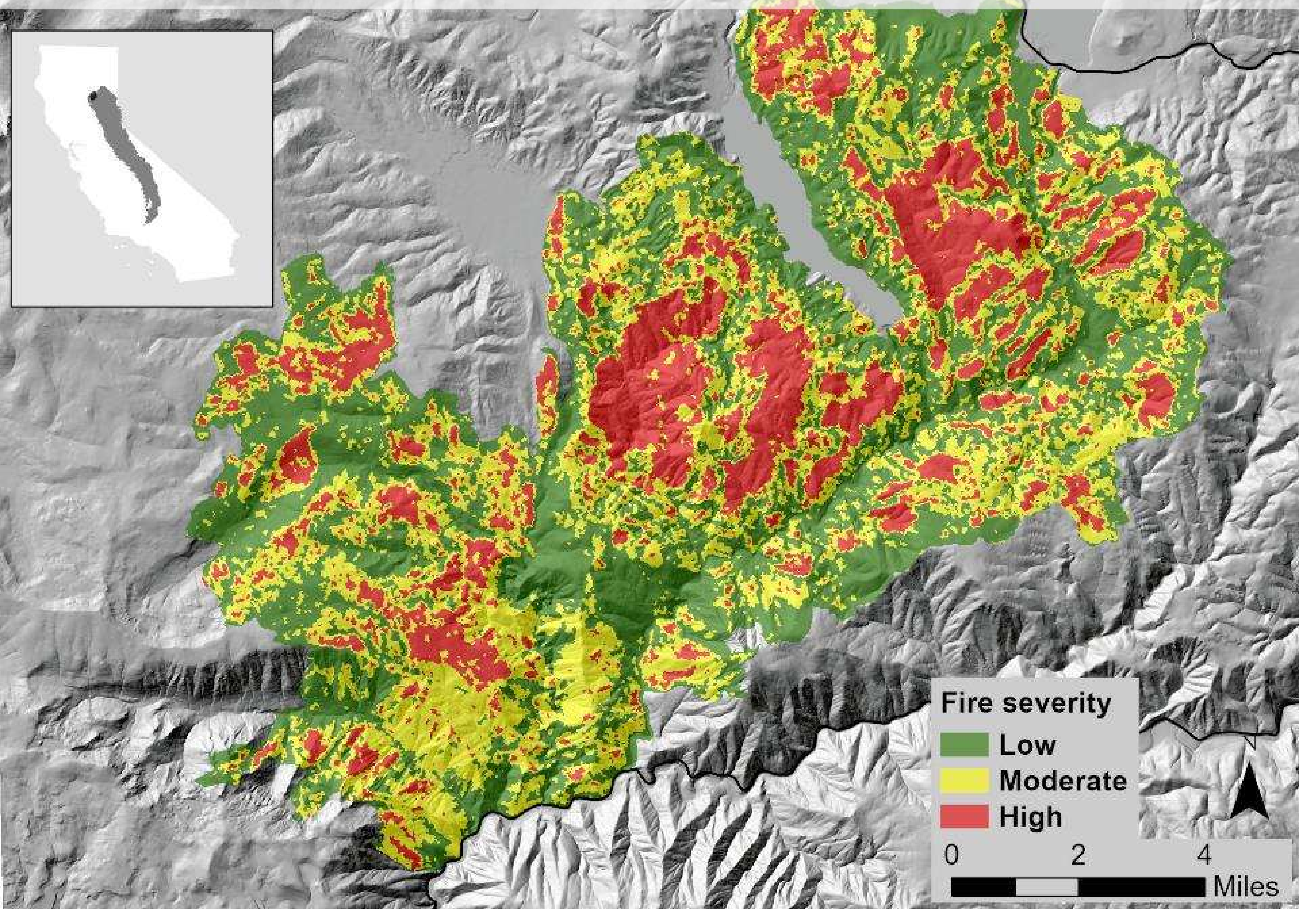
Fuel treatment impacts on Ca. spotted owls



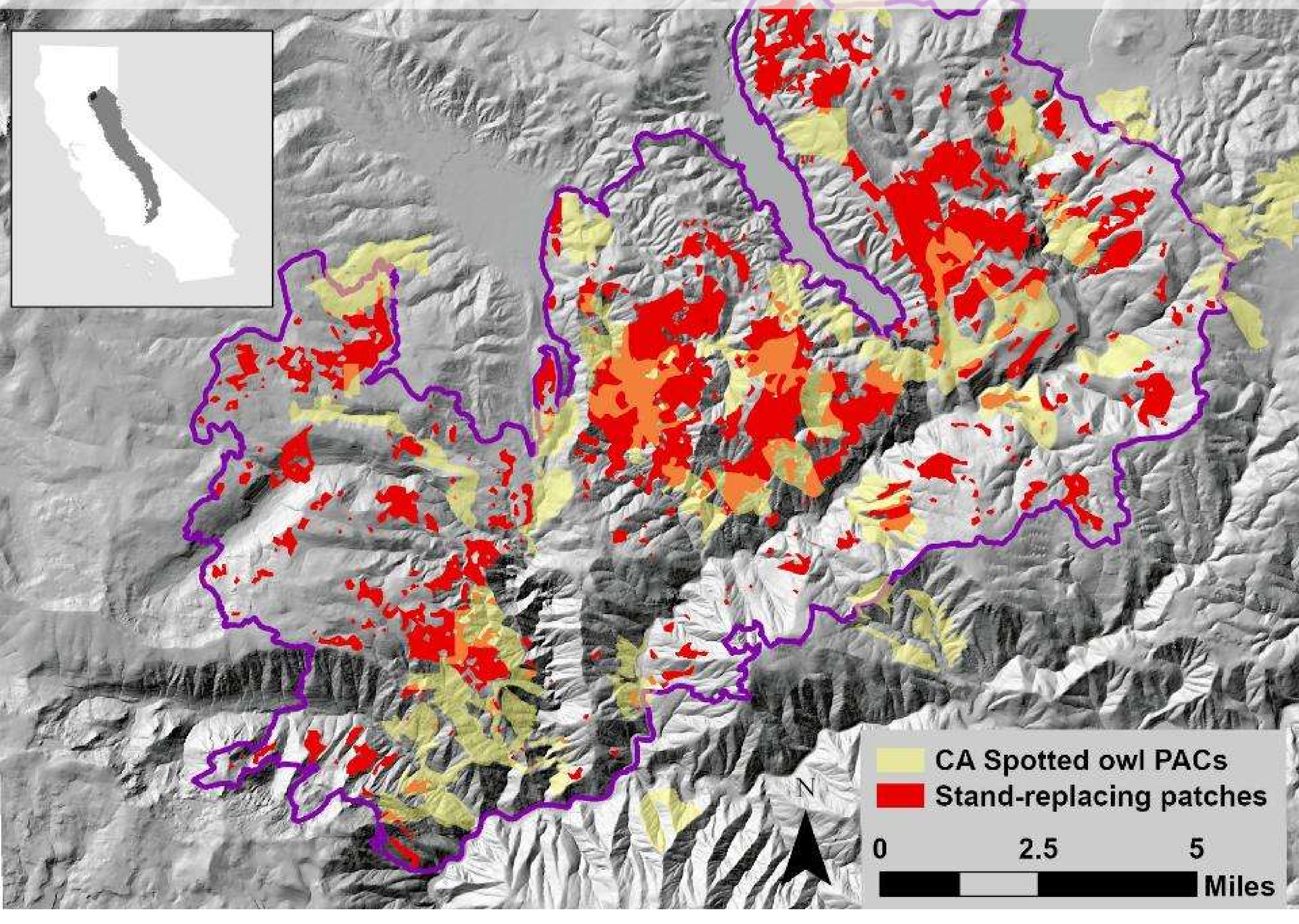


Stephens et al. 2014, *Bioscience*

Chips Fire (2012): Plumas NF



Chips Fire (2012): Plumas NF



Historical variability in fire effects

Show and Kotok (1924):

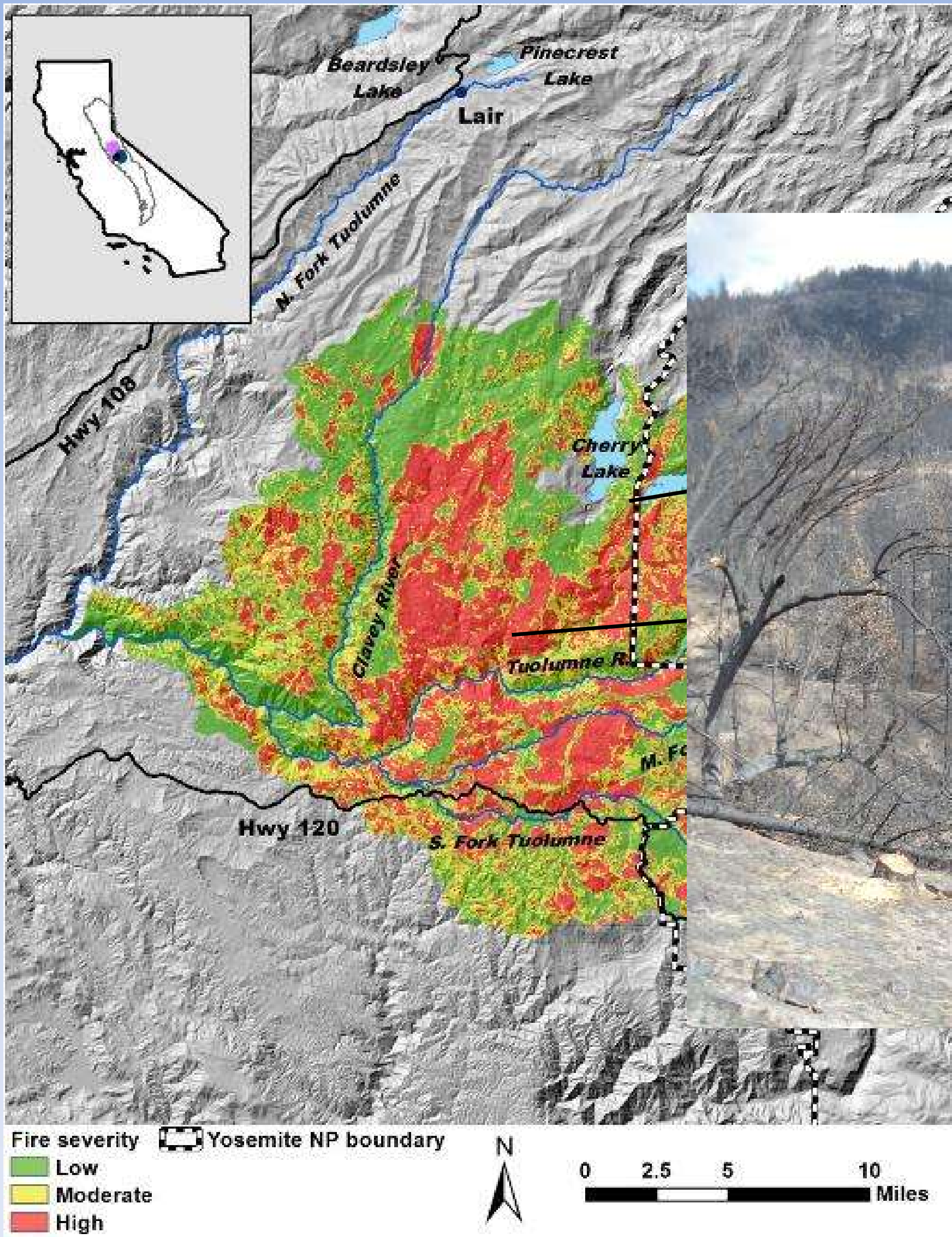
“Extensive crown fires...are almost unknown to the California pine region*.”

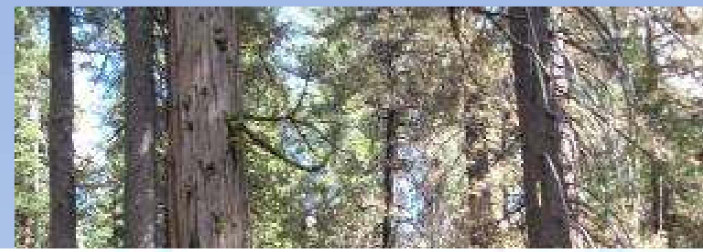
But...

“...no large fires occur without a certain amount of heat-killing”

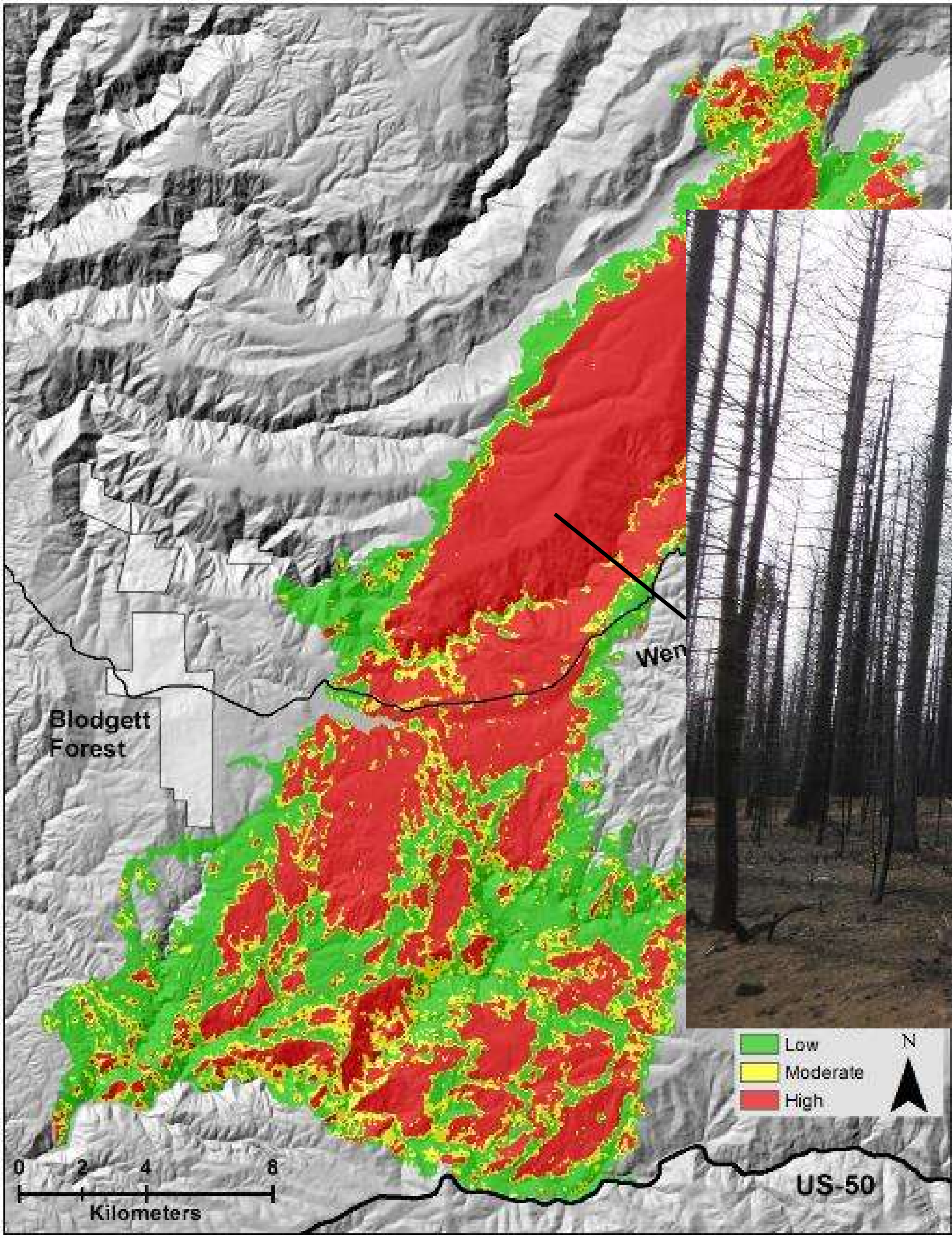
“This loss... represents the complete... wiping out of <u>small patches</u> of the stand”

Rim Fire (2013)

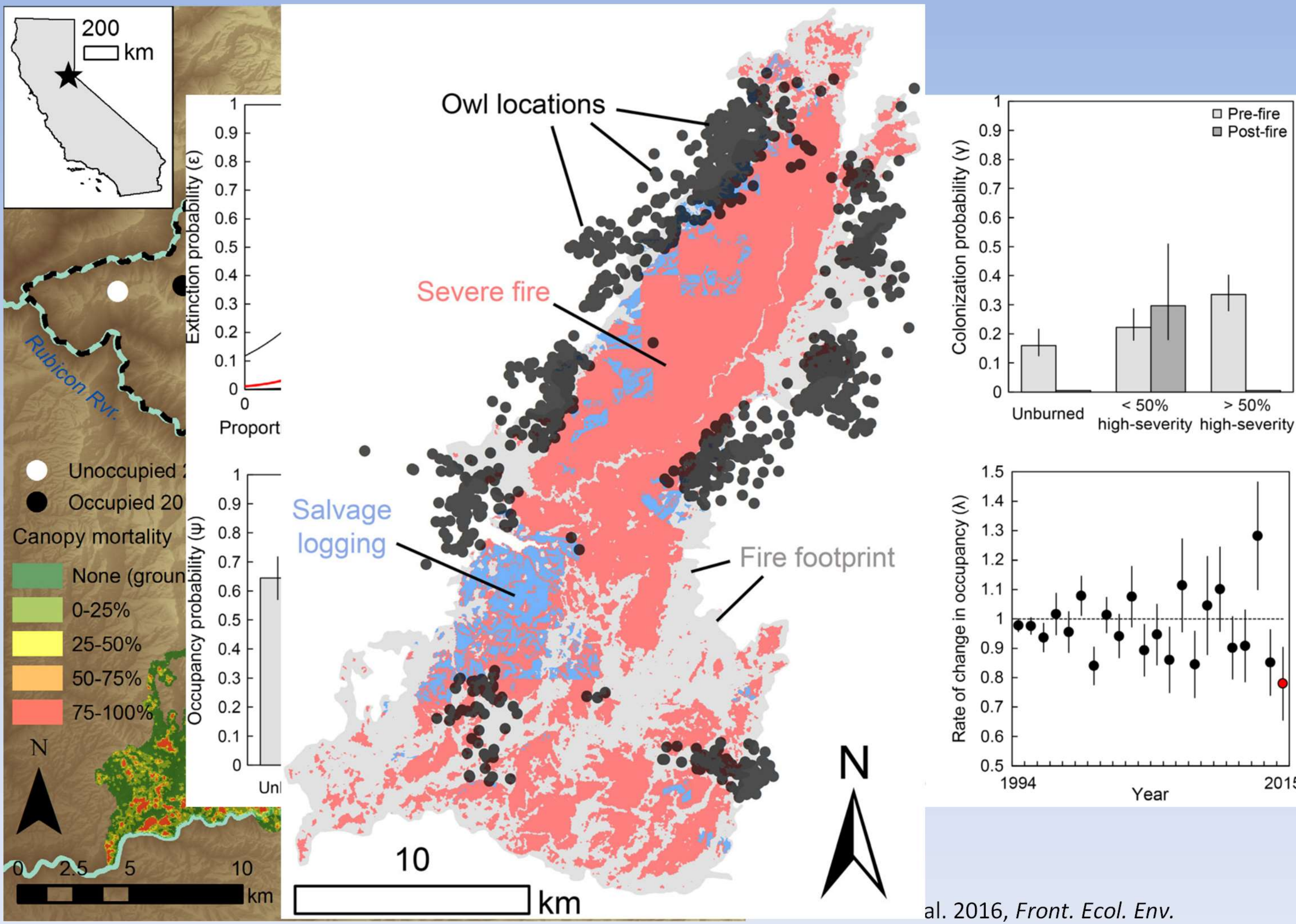




King Fire (2014)



“Megafire” effects on CA spotted owls

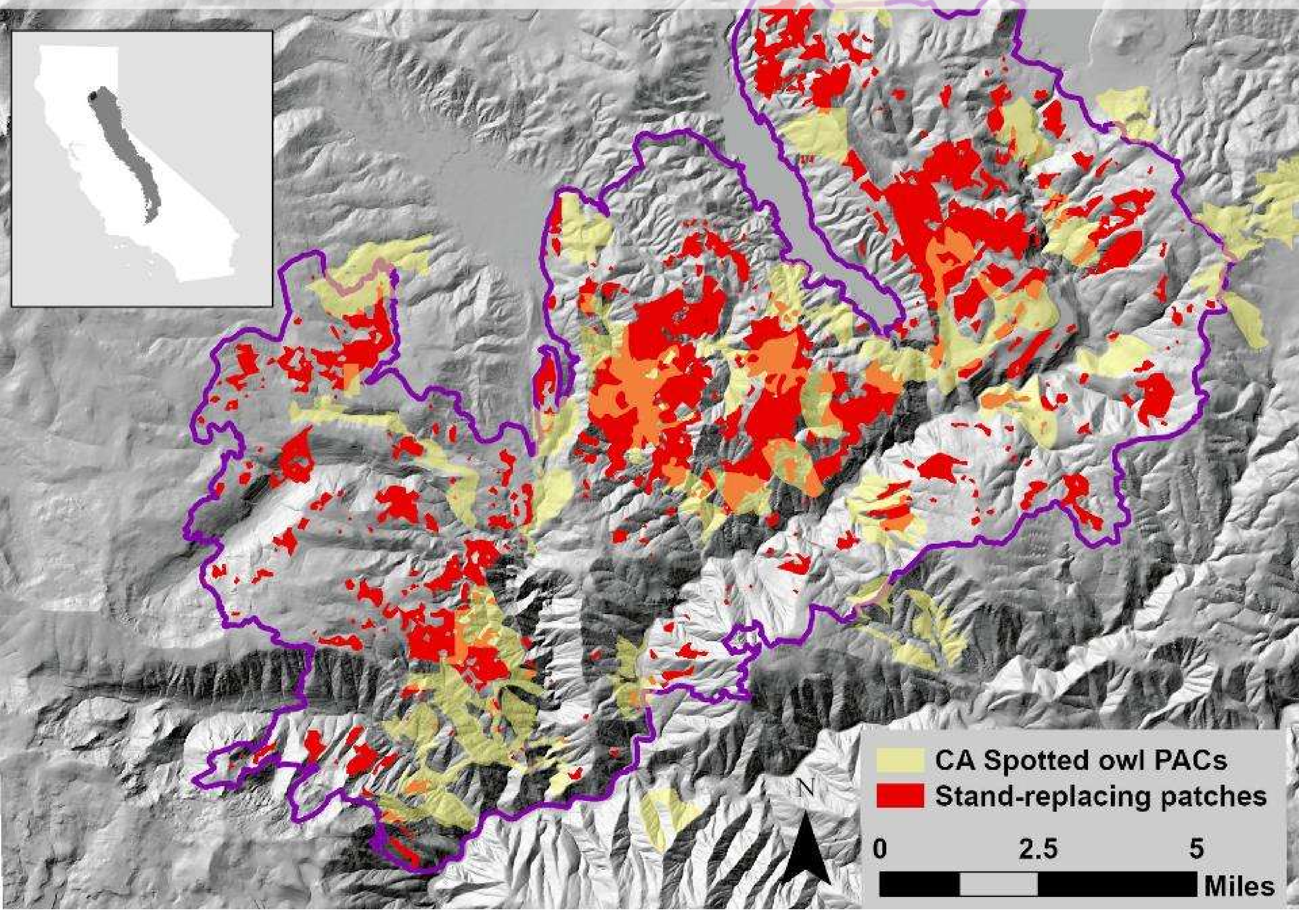


al. 2016, *Front. Ecol. Env.*

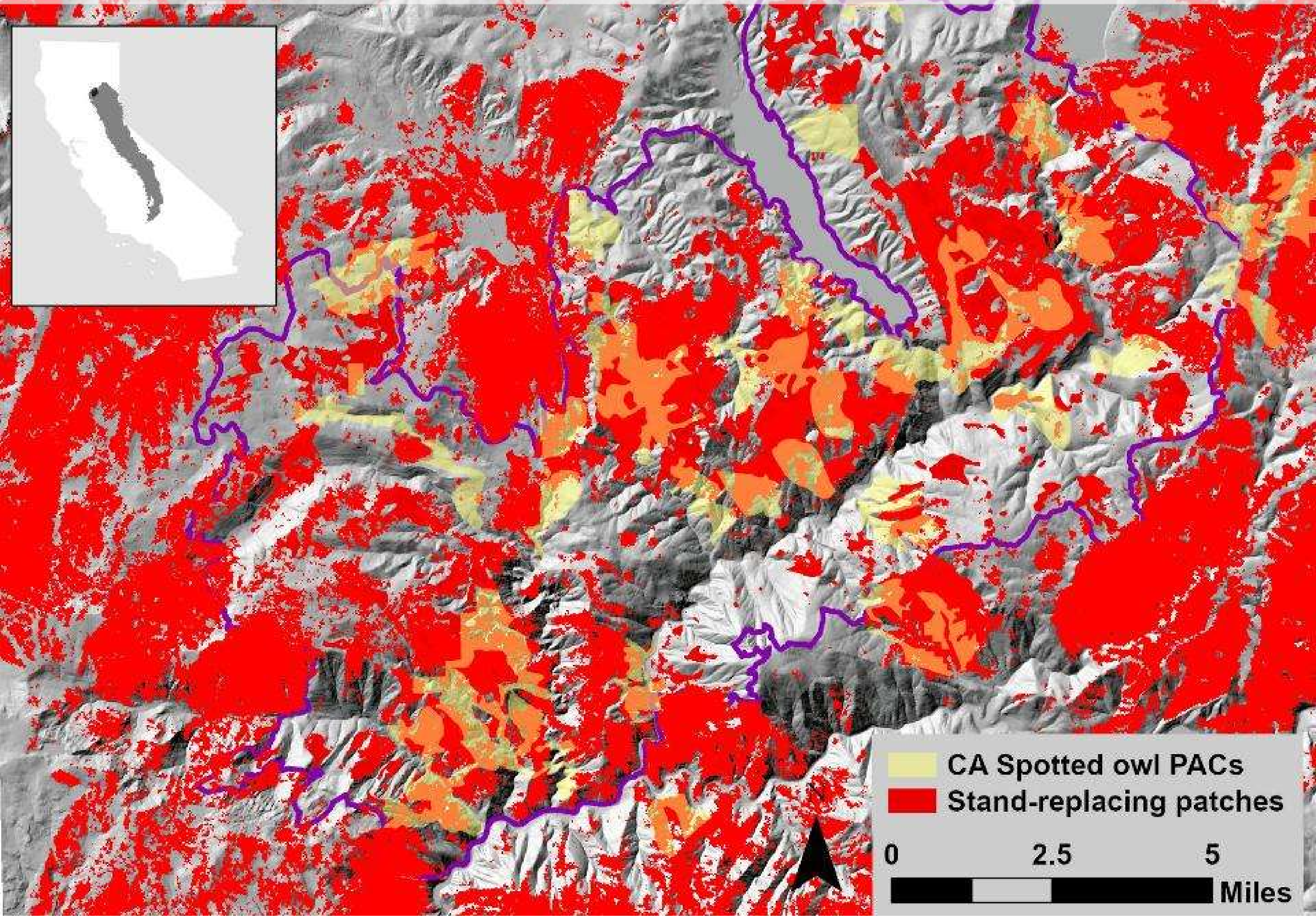
Ten years after stand-replacing fire: Plumas NF

2021 Dixie Fire reburning 2007 Moonlight Fire: Plumas NF

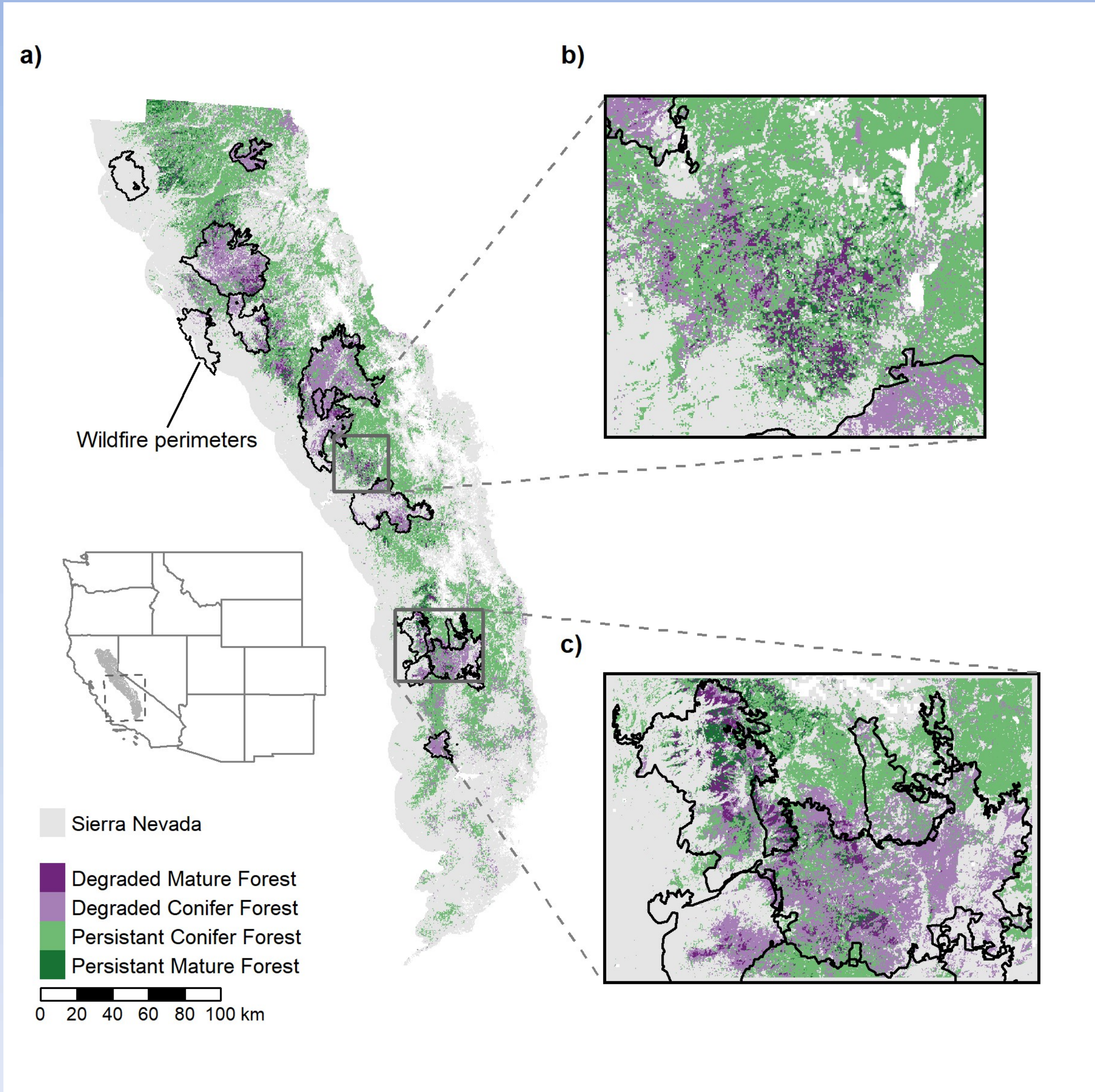
Chips Fire (2012): Plumas NF



Chips Fire (2012) + Dixie (2021): Plumas NF

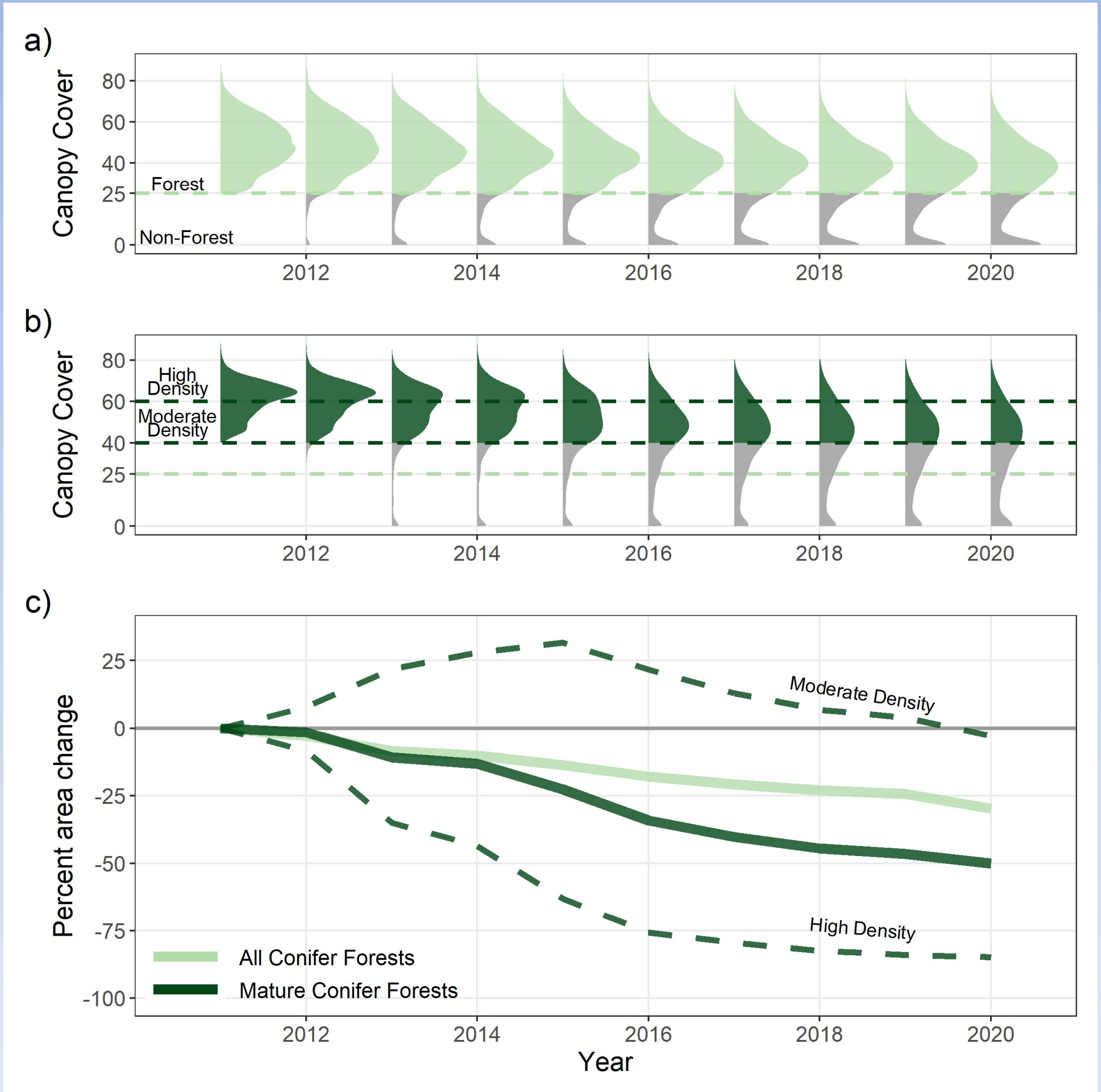


Change in mature forest habitat: 2011-2020



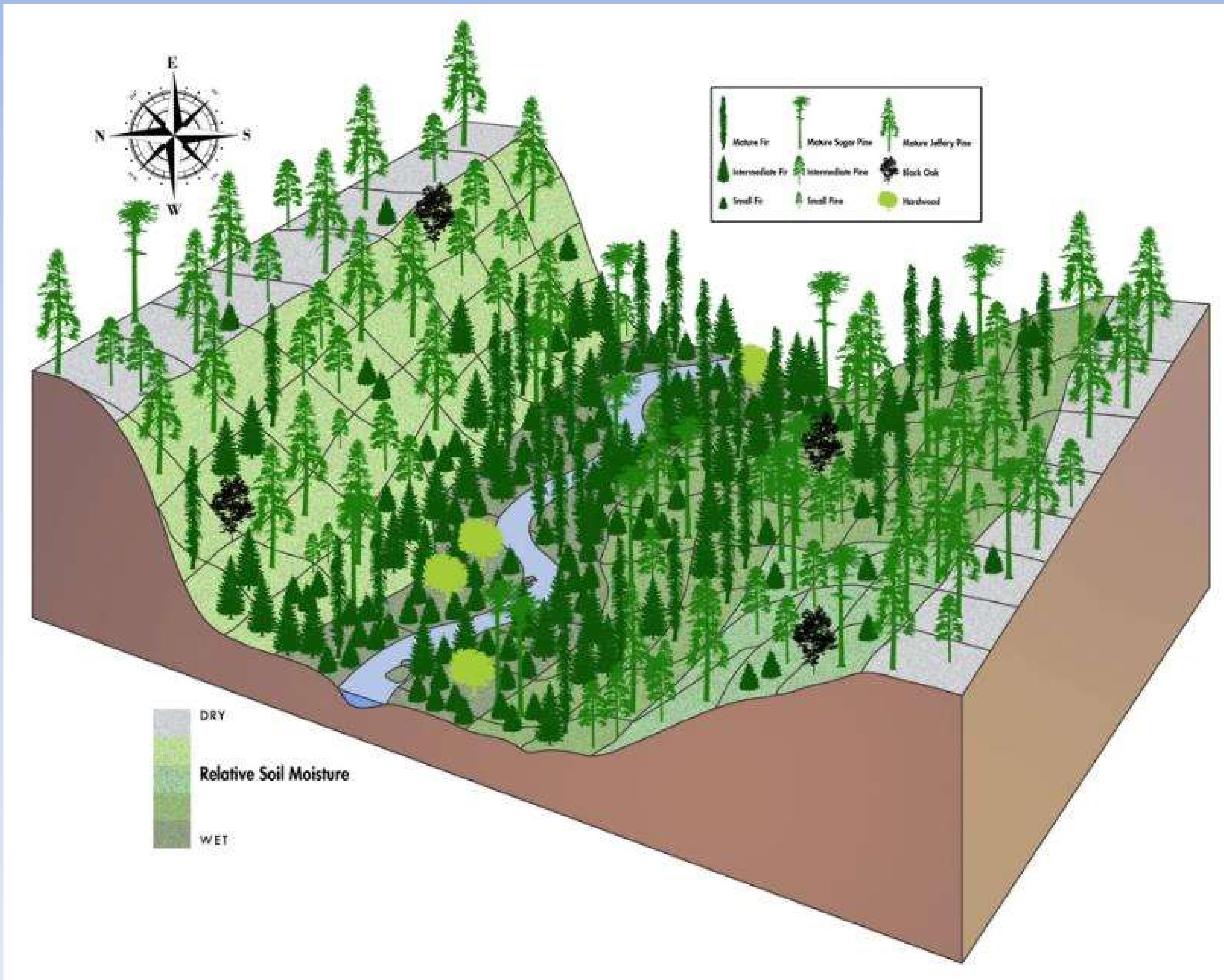
Steel et al. 2023, Ecol. Appl.

Change in mature forest habitat: 2011-2020

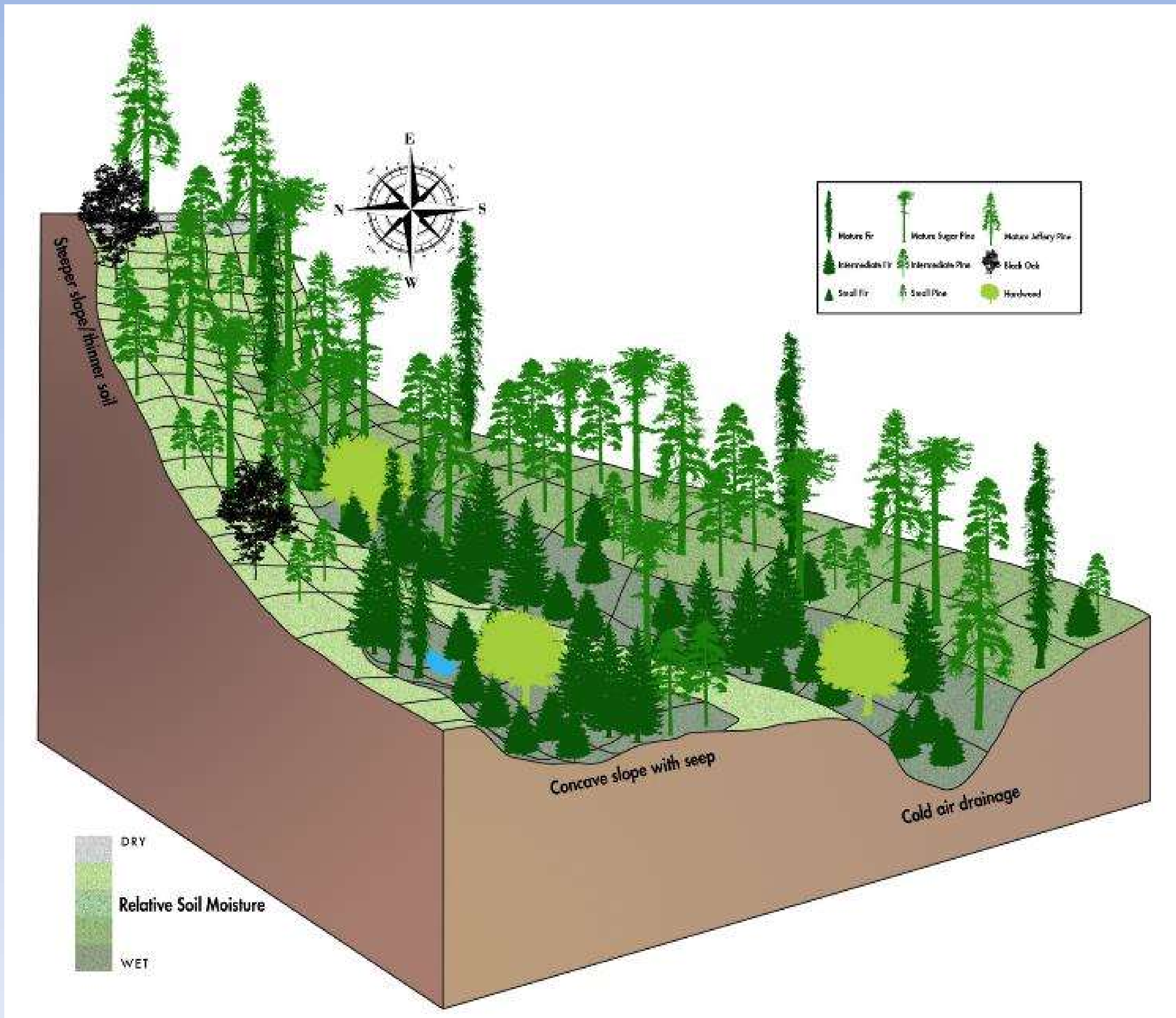


Steel et al. 2023, Ecol. Appl.

Variability in forest structure/composition

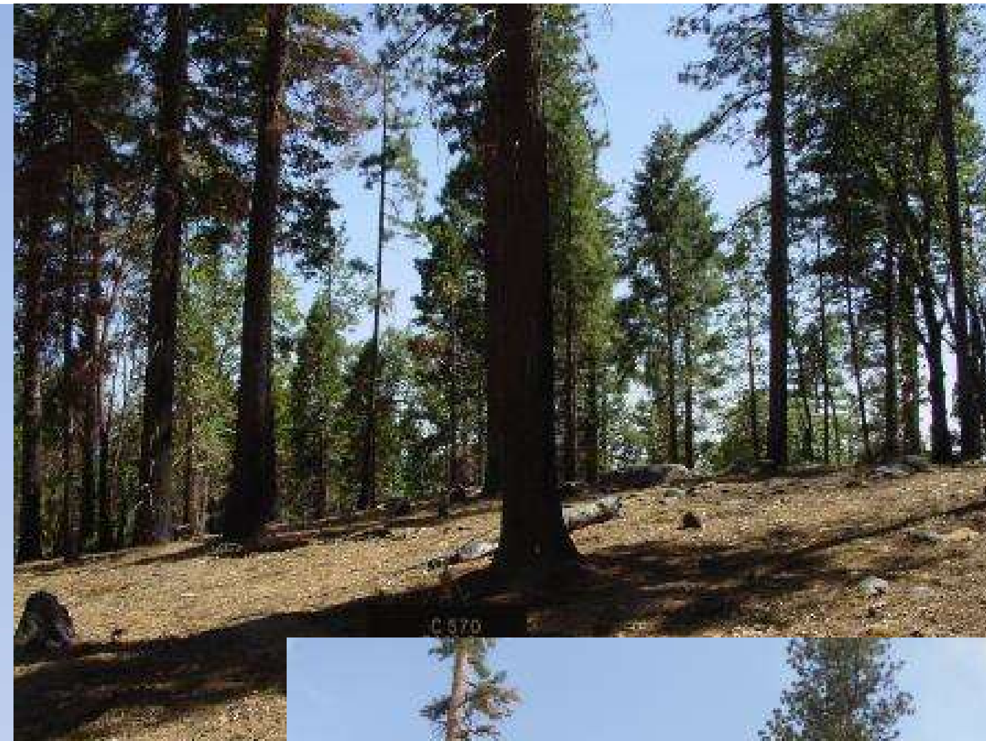


Variability in forest structure/composition



Forest management implications:

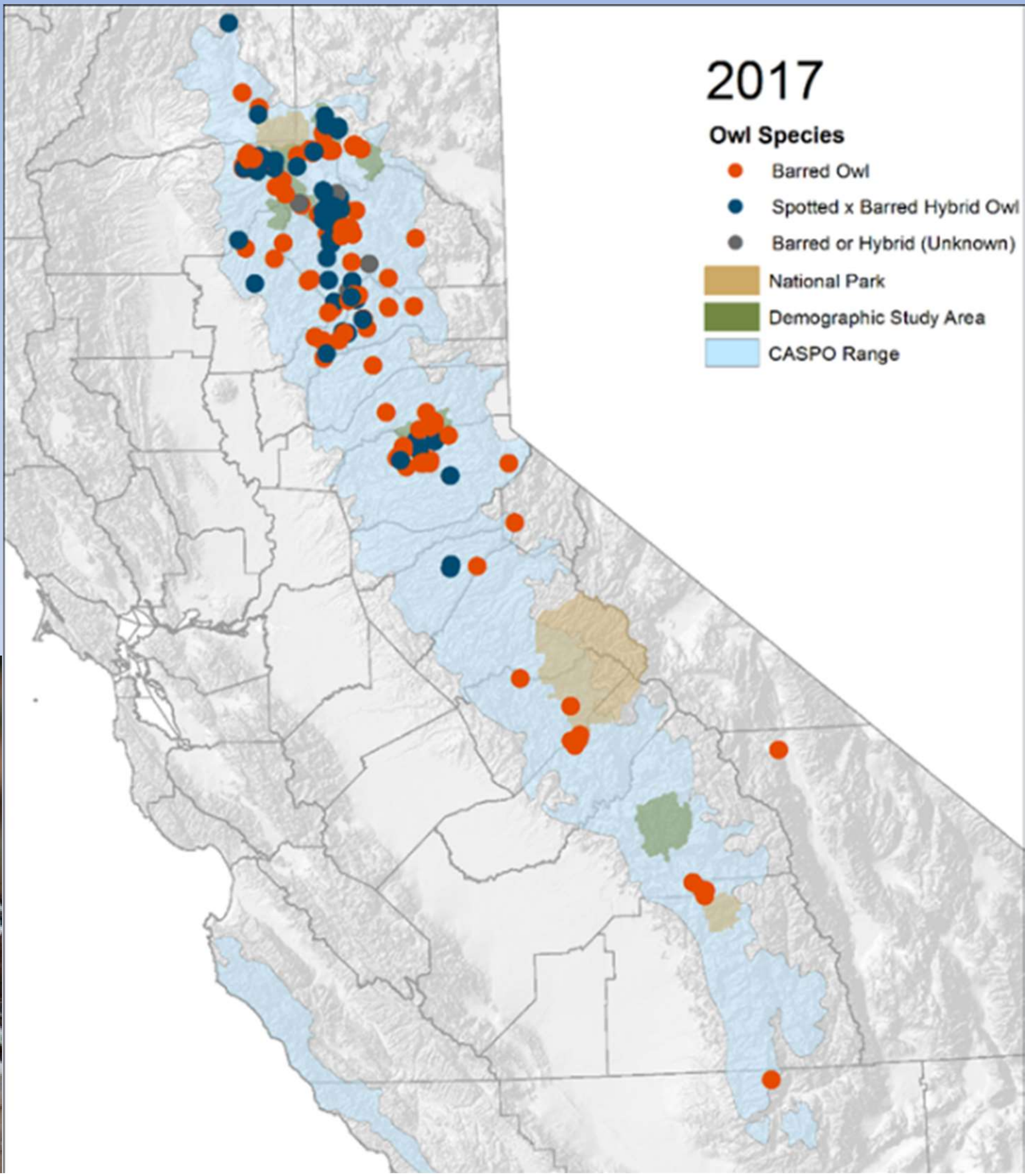
- **Historical forests were generally low density, yet highly variable**
  - ➢ **Maintaining high density, mature forest habitat is UNLIKELY**



- **Forest change = greater vulnerability to fire AND drought-related mortality**
  - ➢ **Vegetation/fuel development following these can lead to long-term forest loss**
- **Large-scale forest restoration is needed**
  - ➢ **A plan for EVERY acre…not just strategic placement**
  - ➢ **Creative and varied silvicultural approaches with fire use**

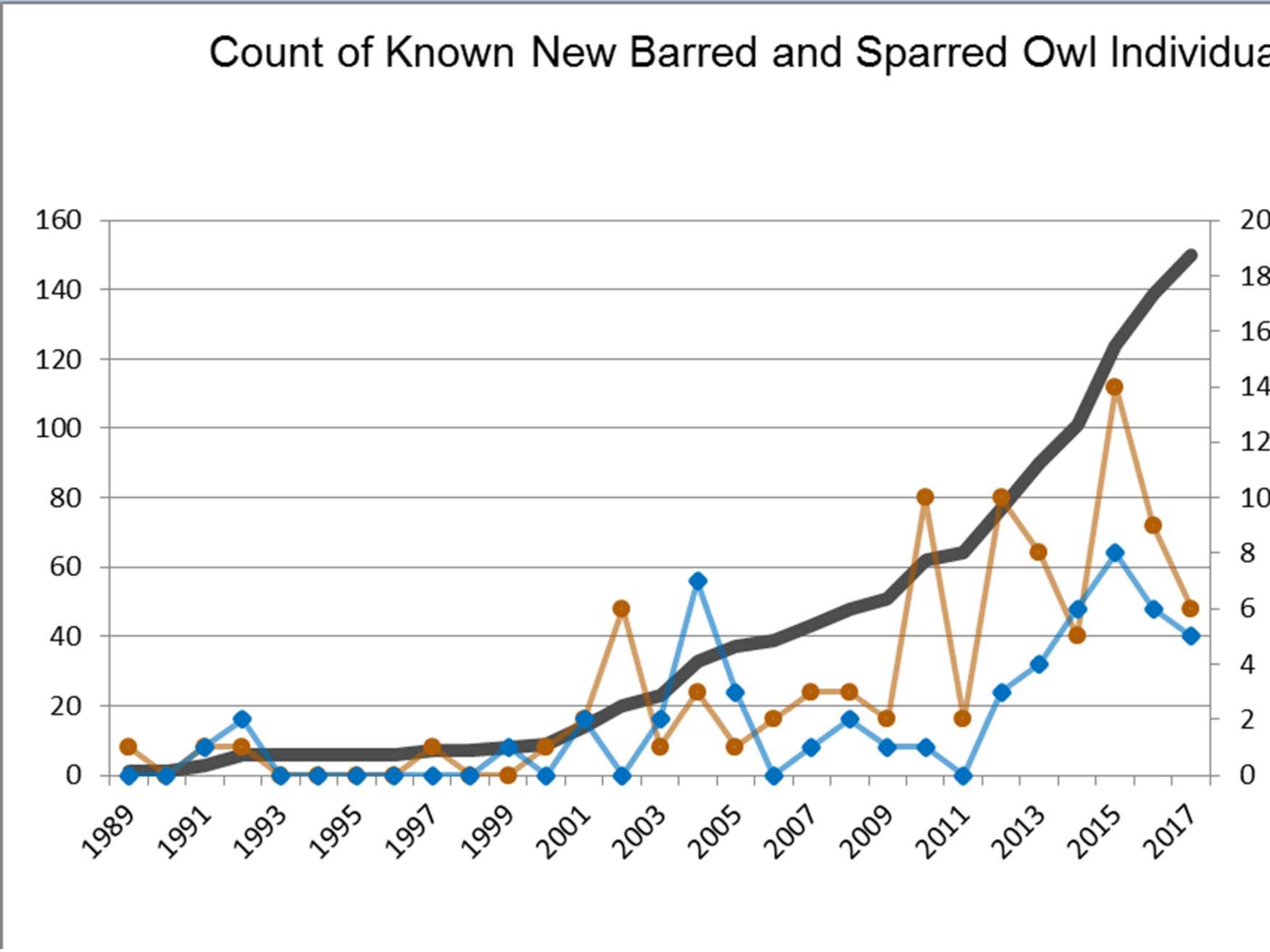
Range Expansion of the Barred Owl

- **Rapid population increase in N. AND NOW C. Sierra Nevada**
- **Transients, dispersers in S. Sierra Nevada**
- **Similar pattern observed in PNW**



Barred owl populations, Sierra Nevada

- **Increasing significant risk factor to CSO.**
- **Future range expansion into central coastal and southern CA**
- **Population control?**



Barred owl populations, Sierra Nevada

THE CONDOR
Ornithological Applications

AmericanOrnithology.org

Volume 122, 2019, pp. 1–10
DOI: 10.1093/condor/duz058

RESEARCH ARTICLE

Early detection of rapid Barred Owl population growth within the range of the California Spotted Owl advises the Precautionary Principle

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Submission Date: June 21, 2019; Editorial Acceptance Date: November 5, 2019; Published January 22, 2020

multiple grid cells. Given the Barred Owl's demonstrated threat to the Northern Spotted Owl, we believe our findings advise the Precautionary Principle, which posits that management actions such as invasive species removal should be taken despite uncertainties about, for example, true rates of population growth if the cost of inaction is high. In this case,

Barred owl populations, Sierra Nevada

Arresting the spread of invasive species in continental systems

Daniel F Hofstadter[1*], Nicholas F Kryshak[1], Connor M Wood[1,2], Brian P Dotters[3], Kevin N Roberts[3], Kevin G Kelly[1], John J Keane[4], Sarah C Sawyer[5], Paula A Shaklee[4], H Anu Kramer[1], RJ Gutiérrez[1,6], and M Zachariah Peery[1]

Invasive species are a primary threat to biodiversity and are challenging to manage once populations become established in previously unoccupied areas. But removing them is further complicated when invasions occur in continental, mixed-ownership systems. We demonstrate a rare conservation success: the regional-scale removal of an invasive predator – the barred owl (*Strix varia*) – to benefit the spotted owl (*Strix occidentalis*) in California. Barred owl site occupancy declined sixfold, from 0.19 to 0.03, following 1 year of removals, and site extinction (0.92) far exceeded colonization (0.02). Spotted owls recolonized 56% of formerly occupied territories within 1 year, contrasting starkly with removals conducted after barred owls achieved high densities in the Pacific Northwest. Our study therefore averted the otherwise likely extirpation of California spotted owls (*Strix occidentalis occidentalis*) by barred owl competition. Collectively, leveraging technological advances in population monitoring, early intervention, targeting defensible biogeographic areas, and fostering public–private partnerships will reduce invasive species-driven extinction of native fauna in continental systems.

Front Ecol Environ 2022; 20(5): 278–284, doi: 10.1002/fee.2458