

Mapping Pinyon and Juniper Mortality in the Colorado Plateau using Landsat Imagery

Al Kirschbaum – Oregon State University
Warren Cohen – U.S. Forest Service
Robert Kennedy – U.S. Forest Service
Neil Cobb – Northern Arizona University
Michael Clifford – Northern Arizona University



Laboratory for Applications of Remote Sensing in Ecology

A collaborative research lab supported by the USFS Pacific Northwest Research Station,
Oregon State University, and external funding.

OSU Oregon State University

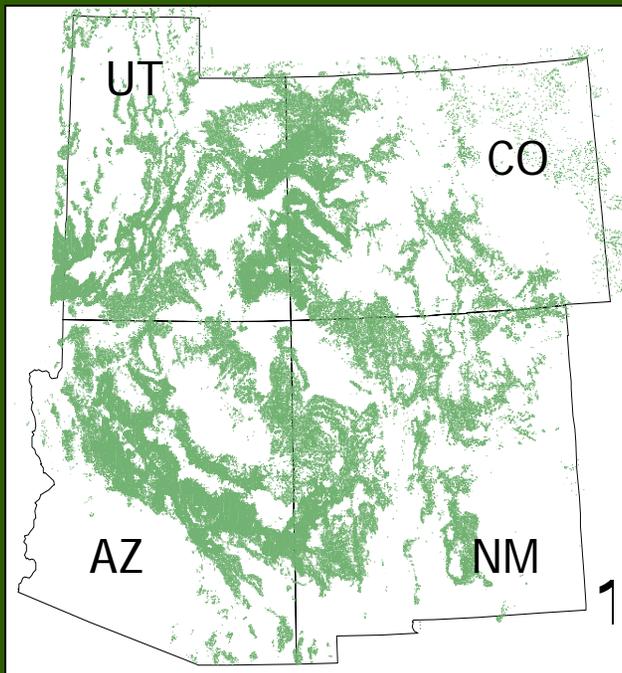


NORTHERN ARIZONA UNIVERSITY
College of Engineering & Natural Sciences



Overview

- Pinyon-juniper (PJ) ecosystem
 - ~14.5 million ha in 10 states

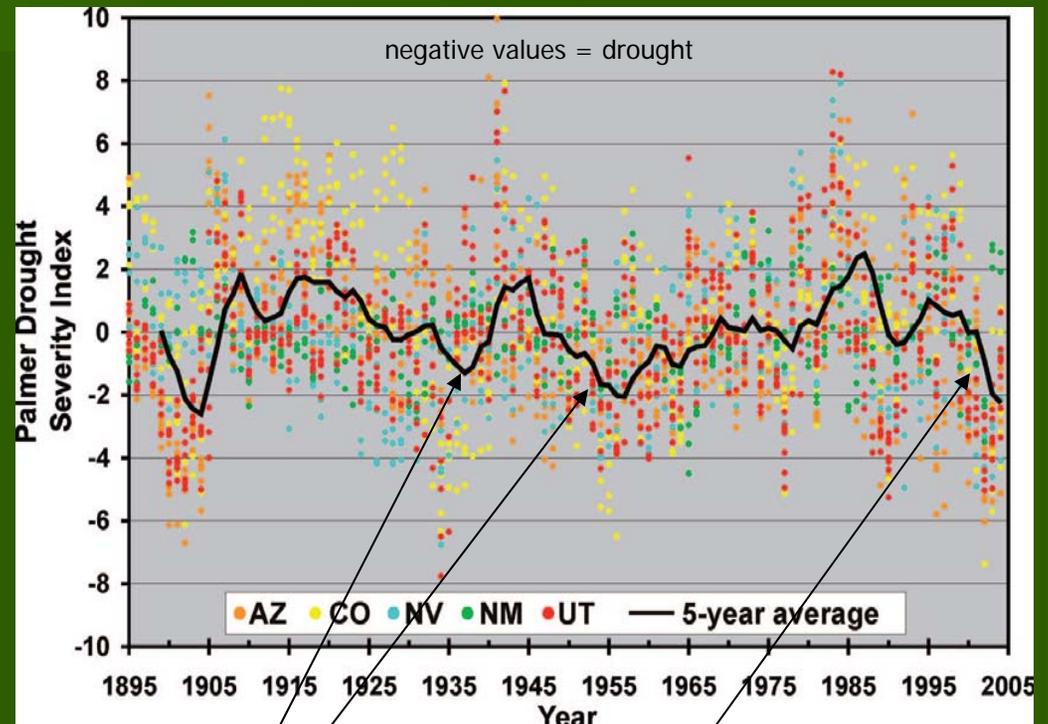


Overview

- Long-term severe drought in southwest region of U.S.
- Drought-induced mortality in PJ woodlands



Drought Severity Index

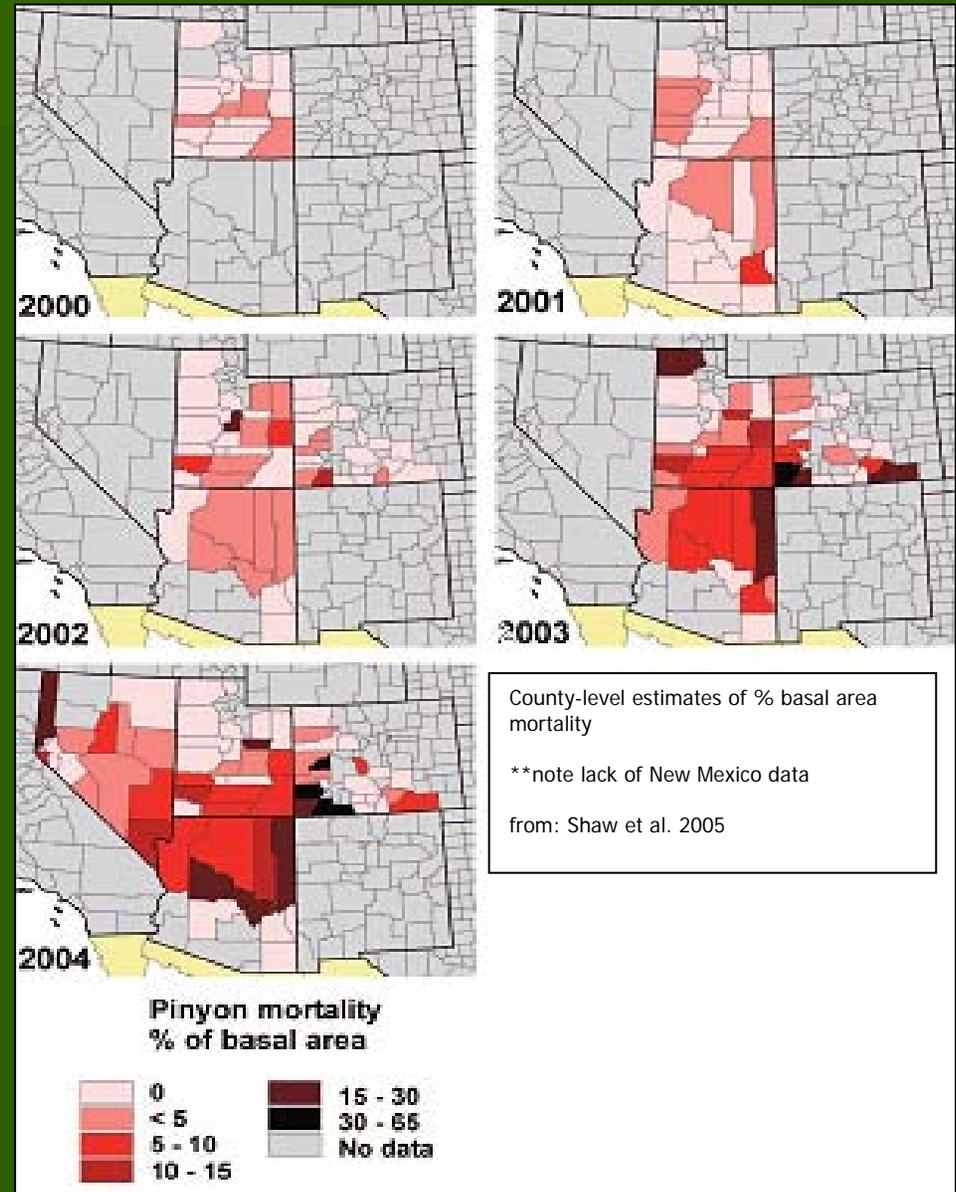


Past droughts

Current drought

Previous studies

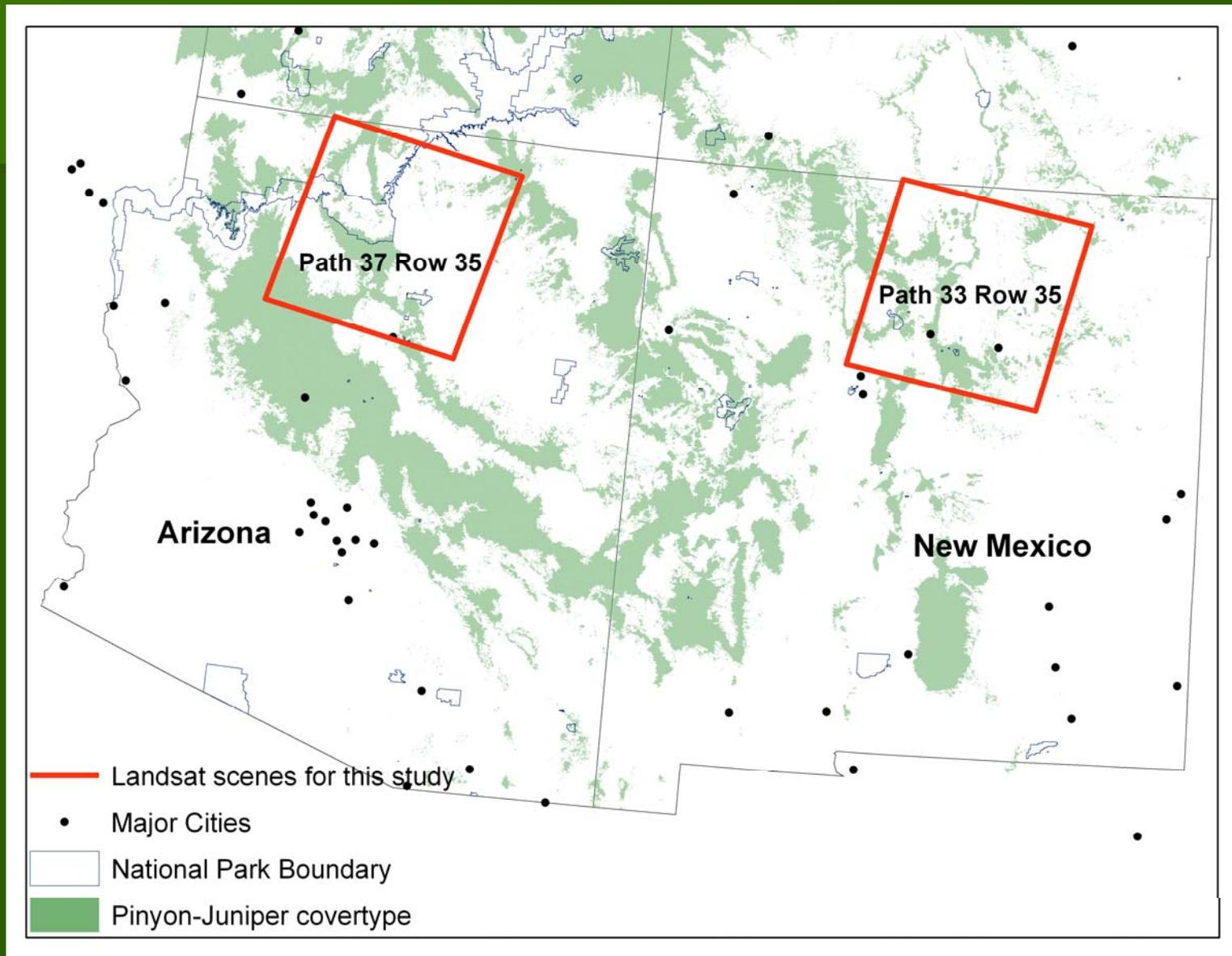
- Shaw et al. 2005
 - used FIA data to map % basal area mortality
 - county-level estimates for 3 states (UT, CO, AZ)
- Breashears et al. 2005
 - NDVI



Objectives

- Develop Landsat-based map of PJ mortality for each year of drought (1998-present)
- Determine influence of slope, elevation and meteorological variables on PJ mortality

Study area



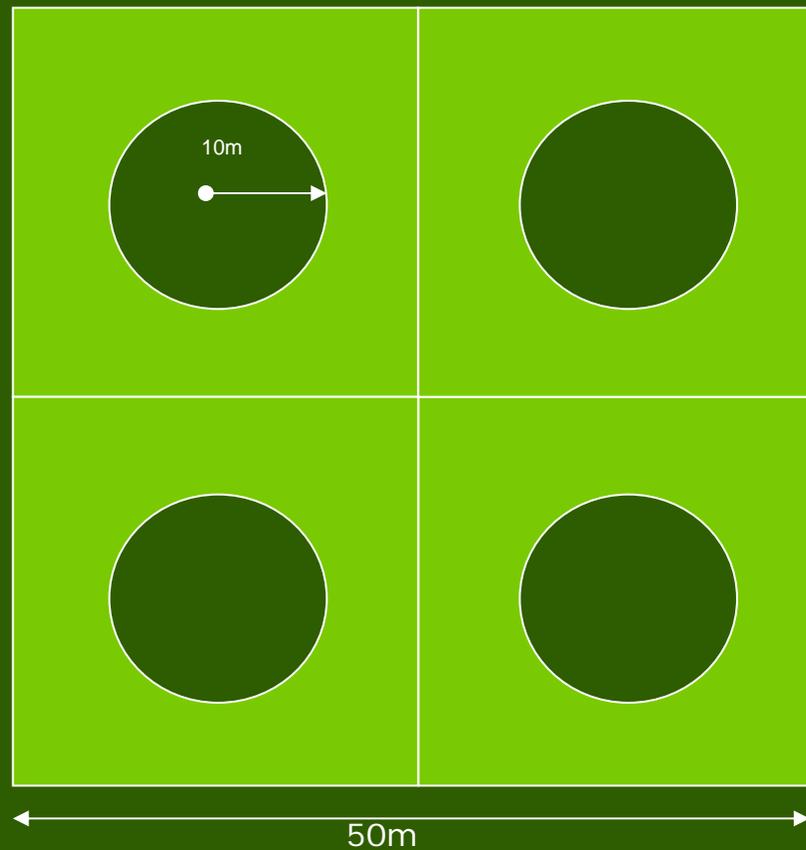
Examples of PJ mortality



Plot design

Plot : 4 Landsat pixels

Subplot : 10m fixed radius plot within each pixel



Measurements

Field (n=51)

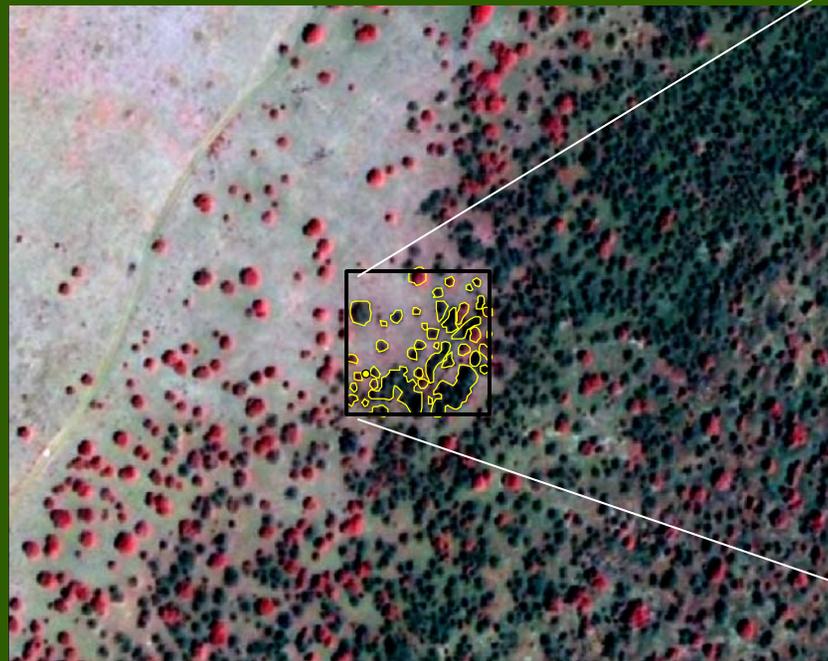
- crown area of each tree within 10m radius subplot
- tree status
- percent ground cover of grass, rock, soil, shrub
- GPS position



Measurements

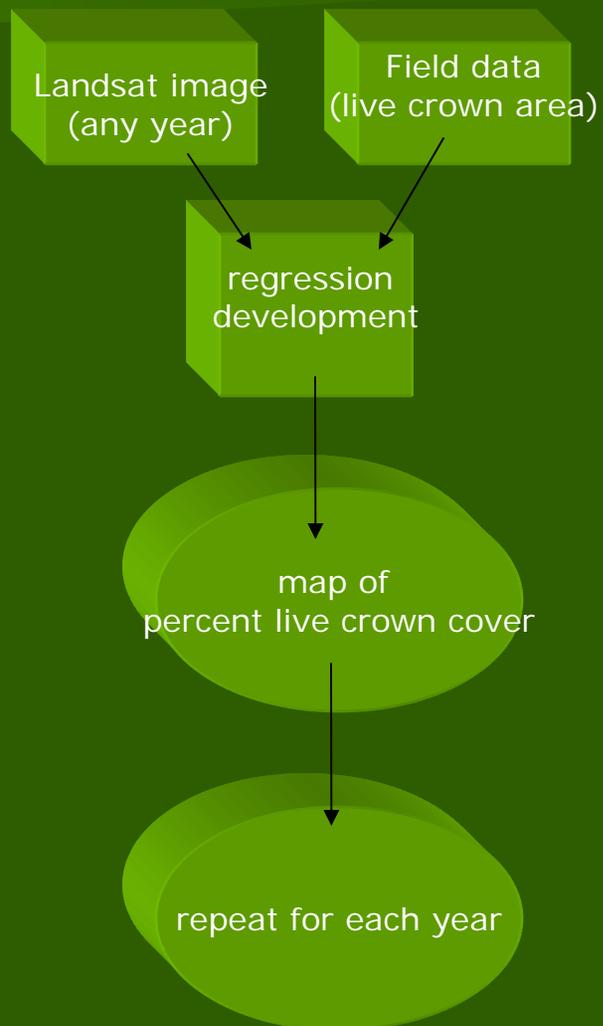
Quickbird imagery (n=100)

- digitized live and dead crowns on 100 additional plots



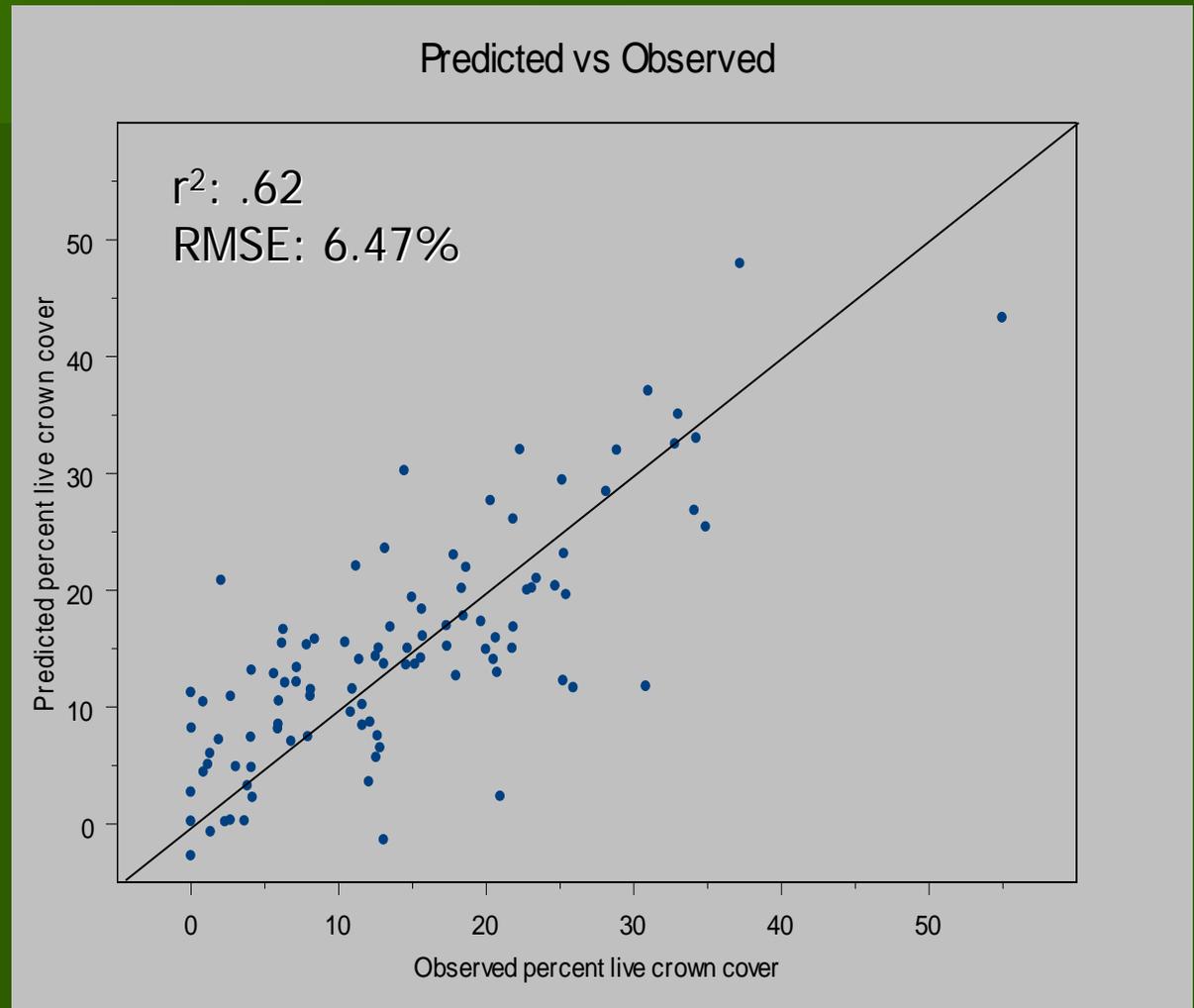
Modeling approaches

State



State model

- 100 points used for model development
 - combined TC bands into one variable (CCA)
 - bands chosen: greenness and wetness



2006

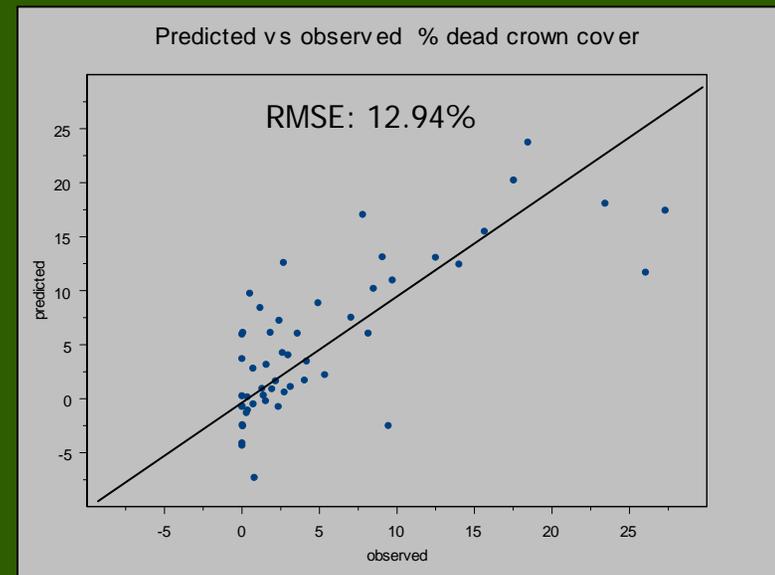
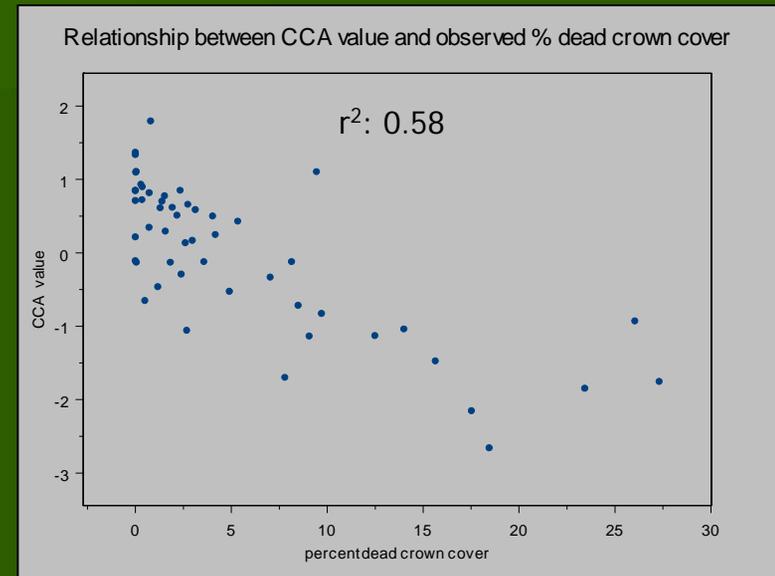


Conclusions

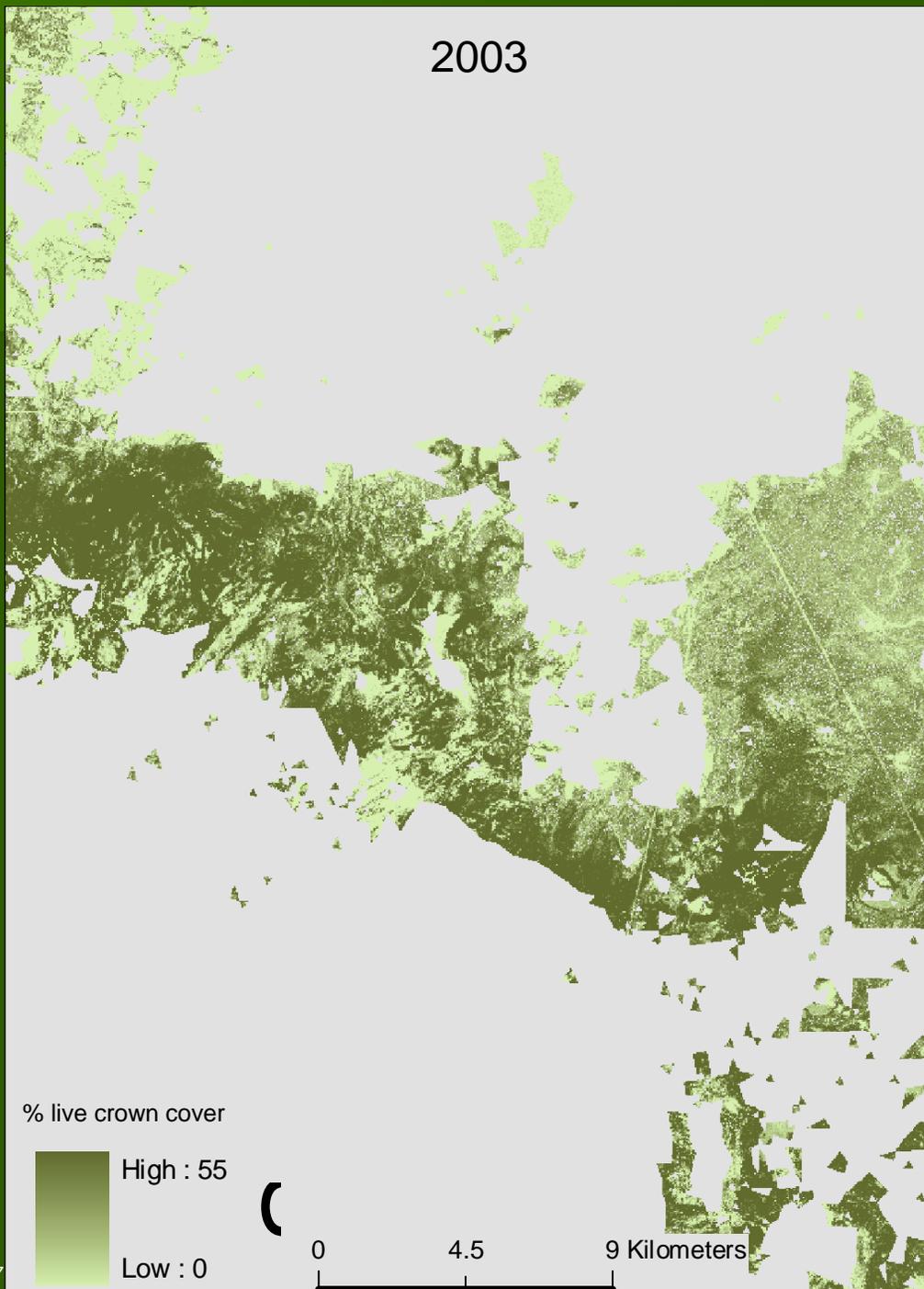
- Landsat can effectively map low percent cover in arid environment
- Demonstrates long-term monitoring with Landsat-type sensor
- Future work will look at contributions of environmental and geographic variables on mortality variation

Dynamic model

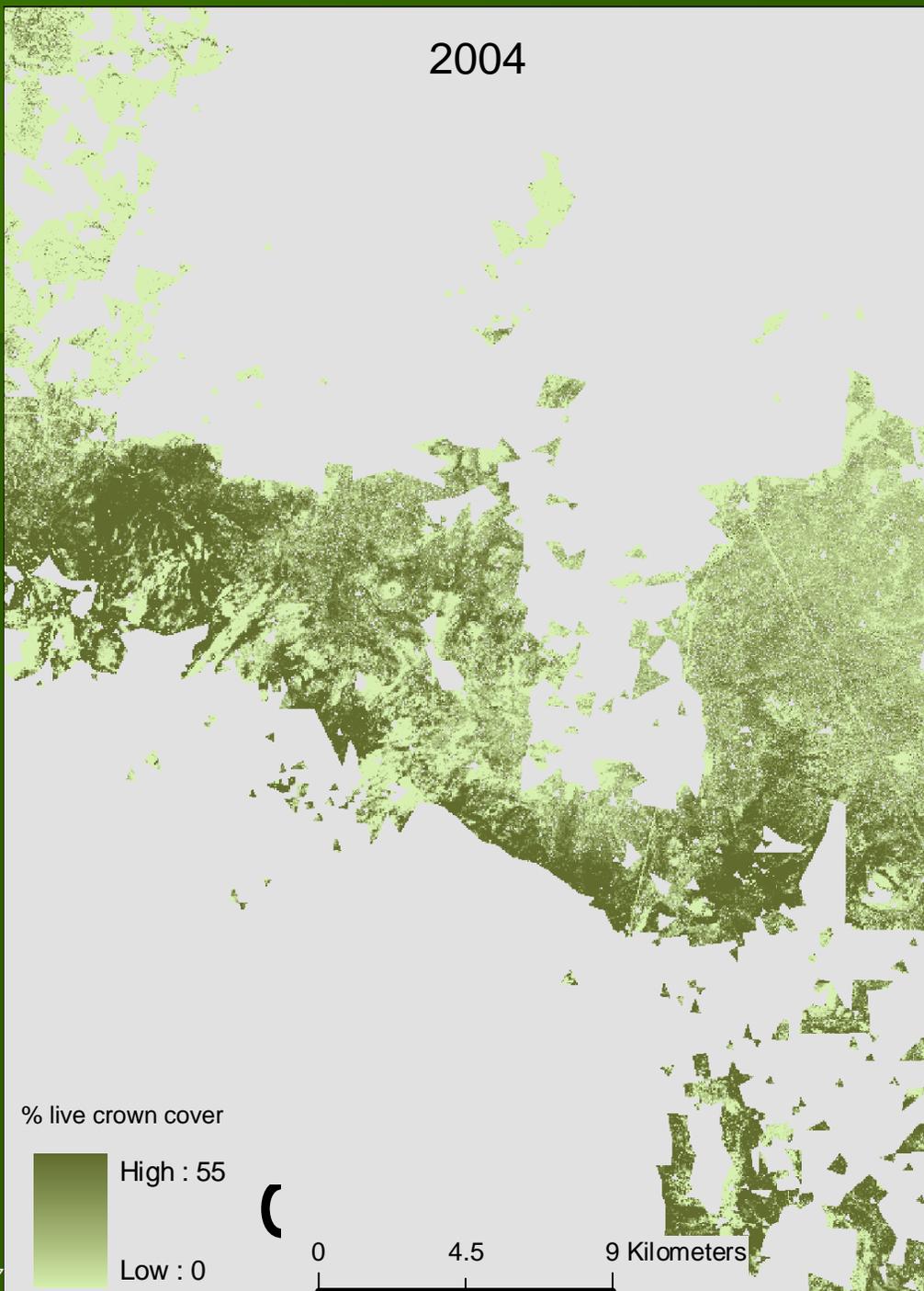
- n=51
 - transformed TC bands into a single CCA index
 - bands chosen: greenness and wetness
- leave-one-out model validation



2003



2004



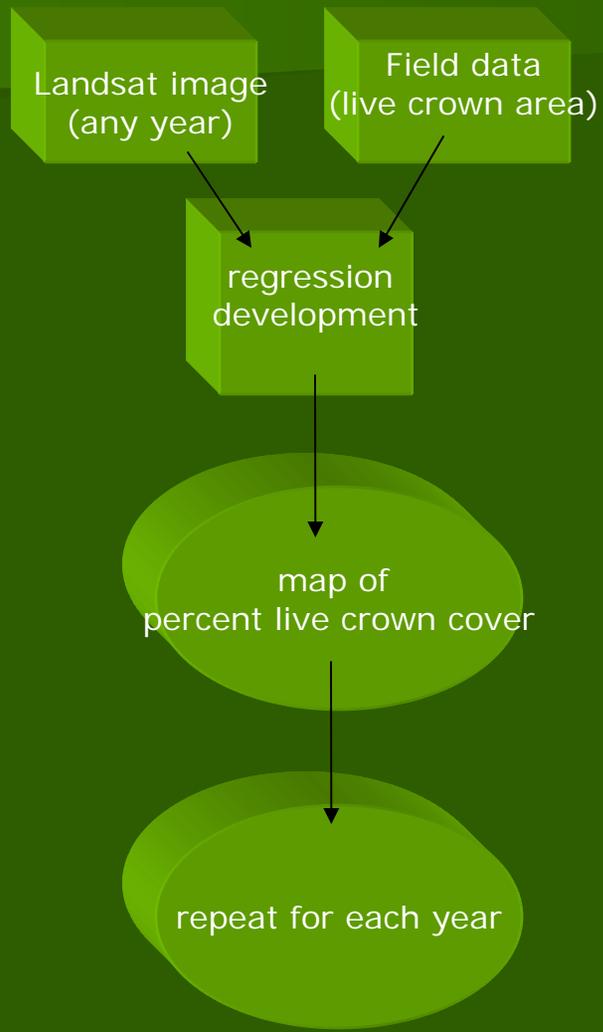
% live crown cover



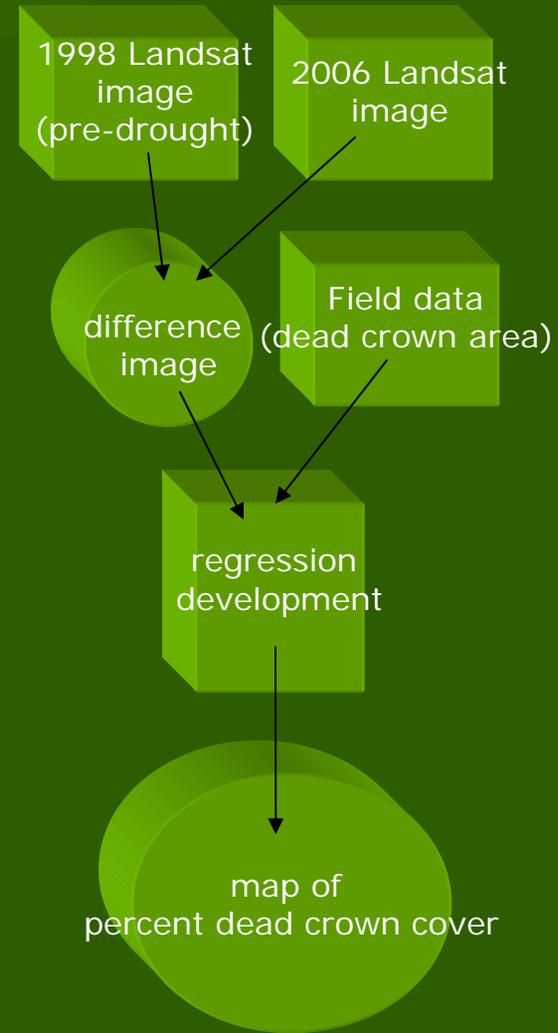
0 4.5 9 Kilometers

Modeling approaches

State

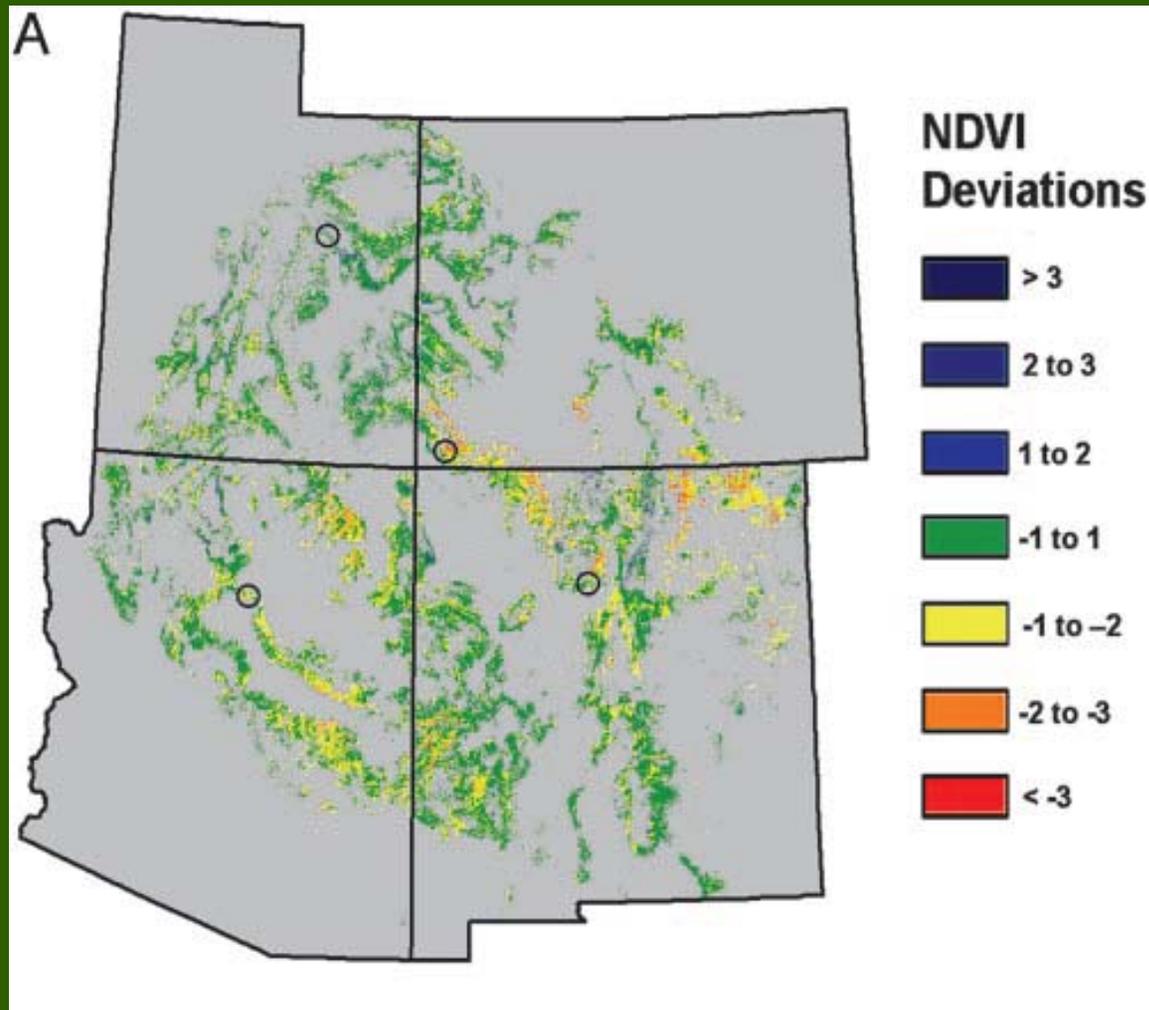


Dynamic

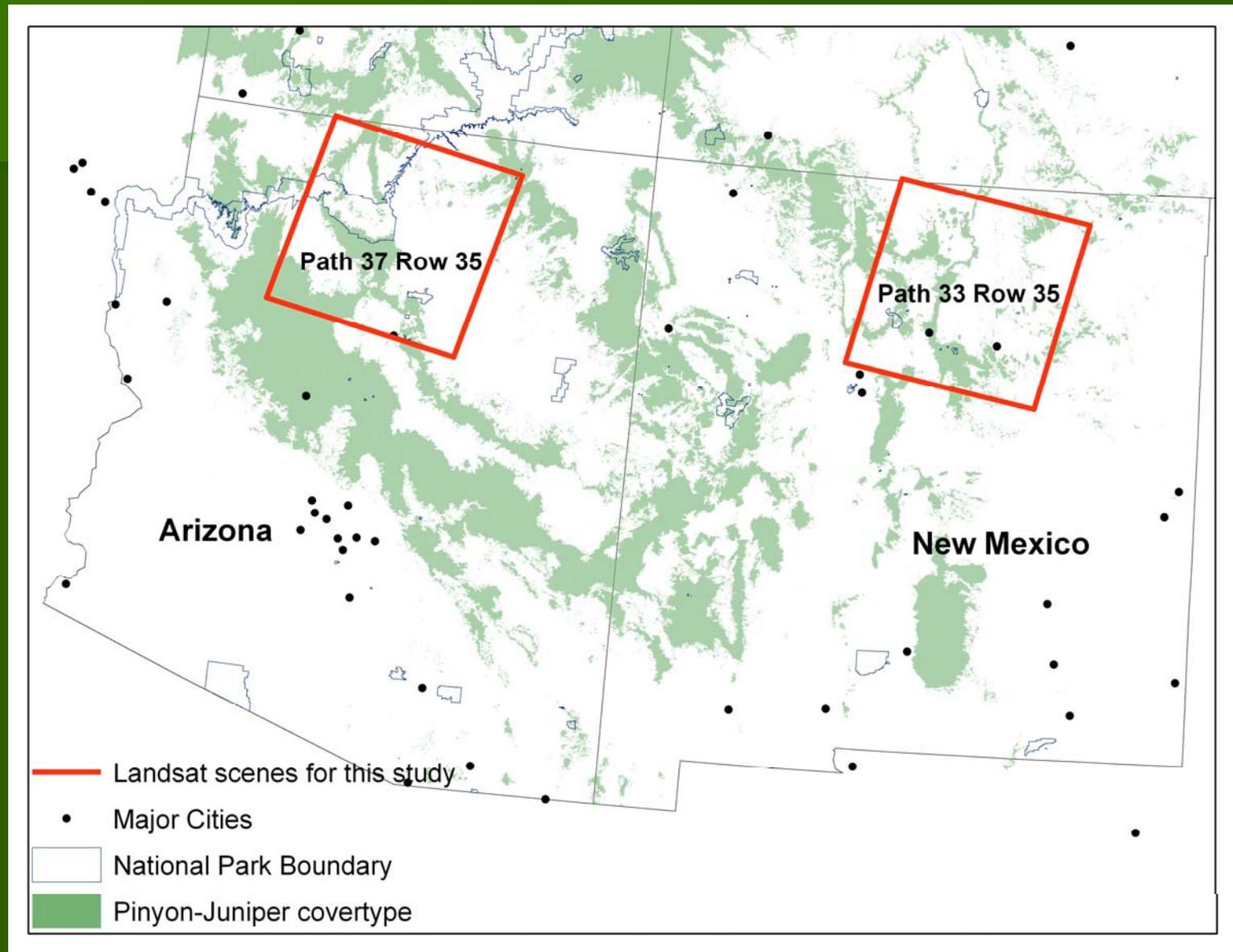


Previous studies

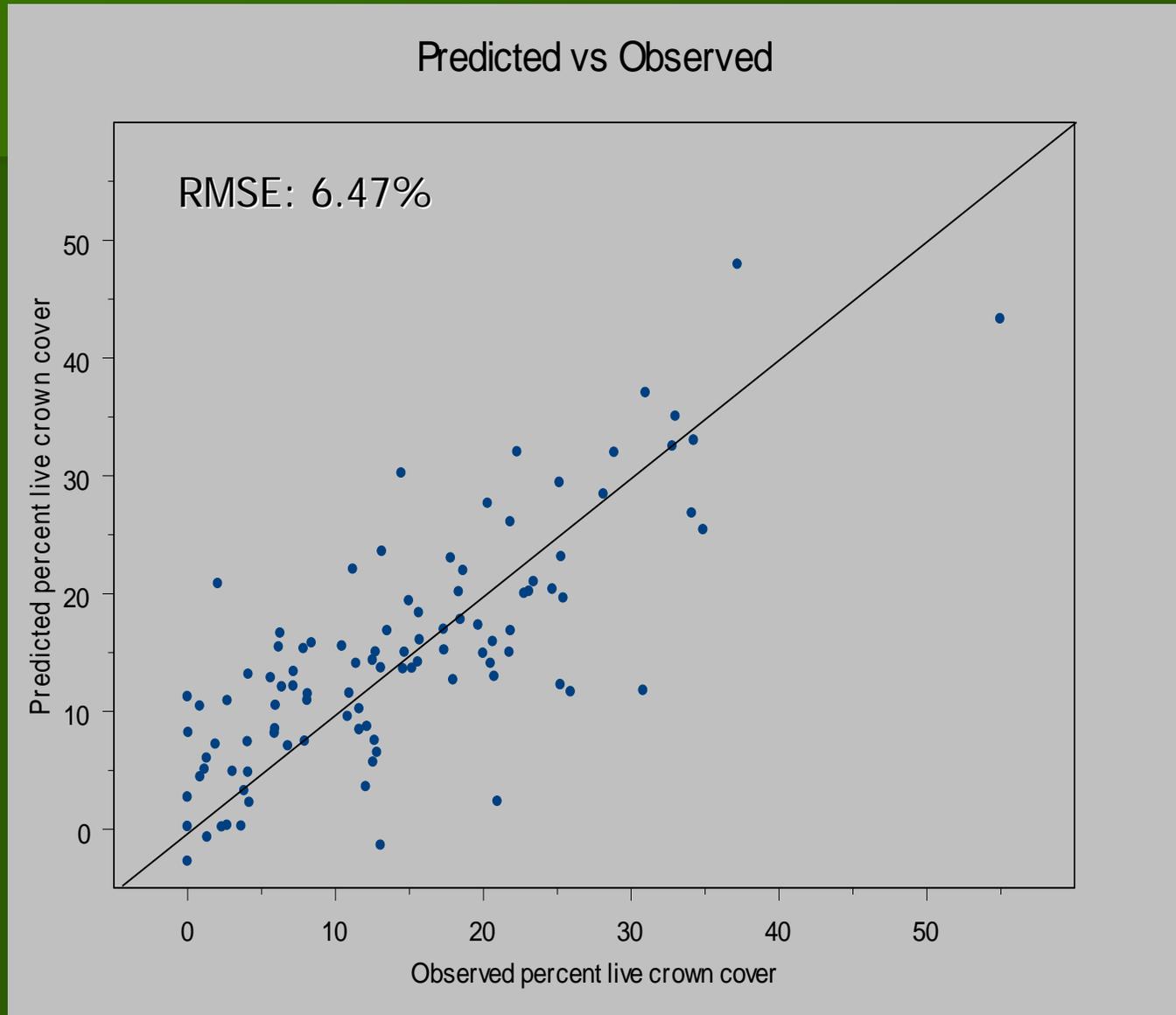
- Breashears et al. 2005
 - used NDVI from AVHRR to map change from pre-drought mean



Study area

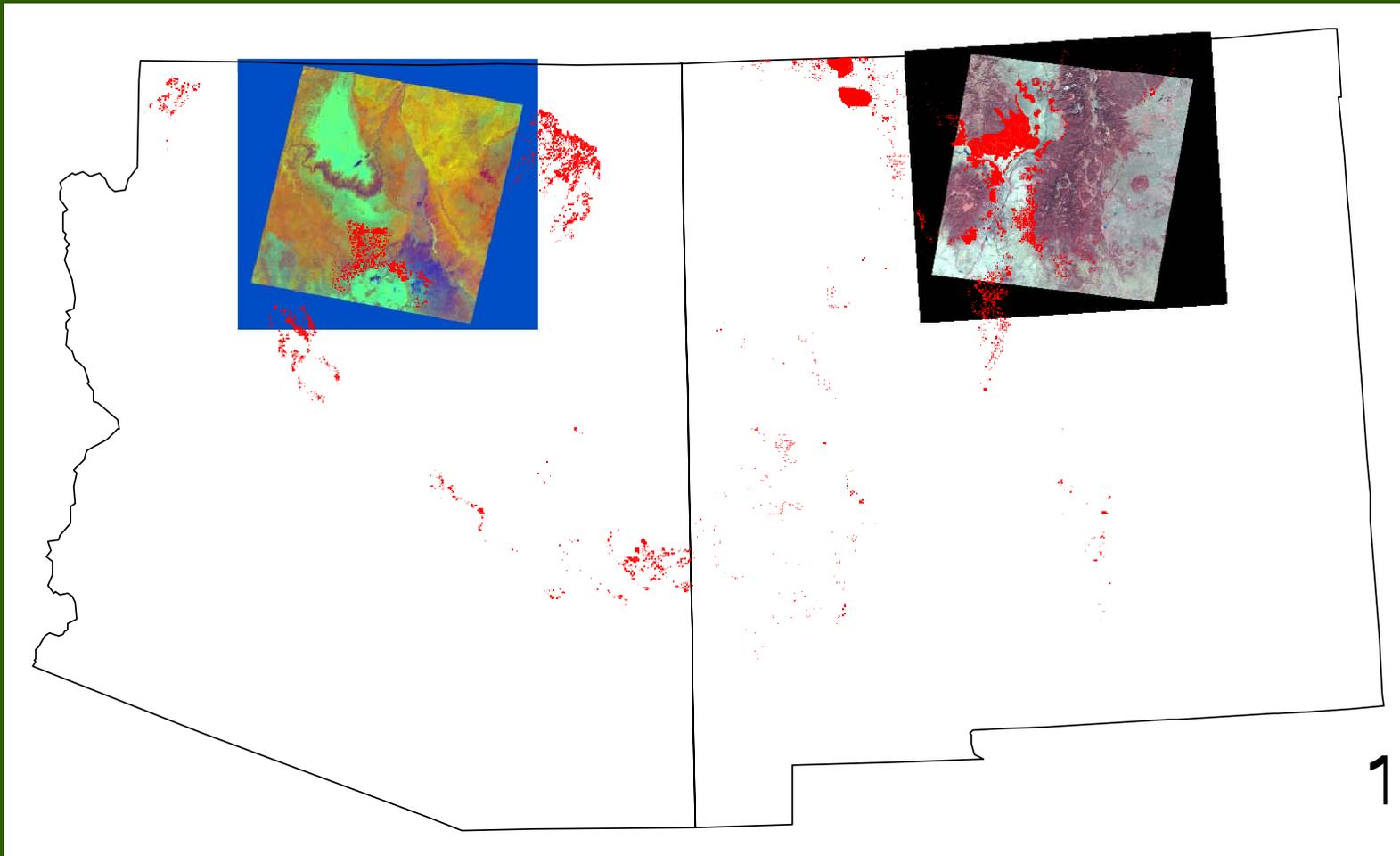


State model

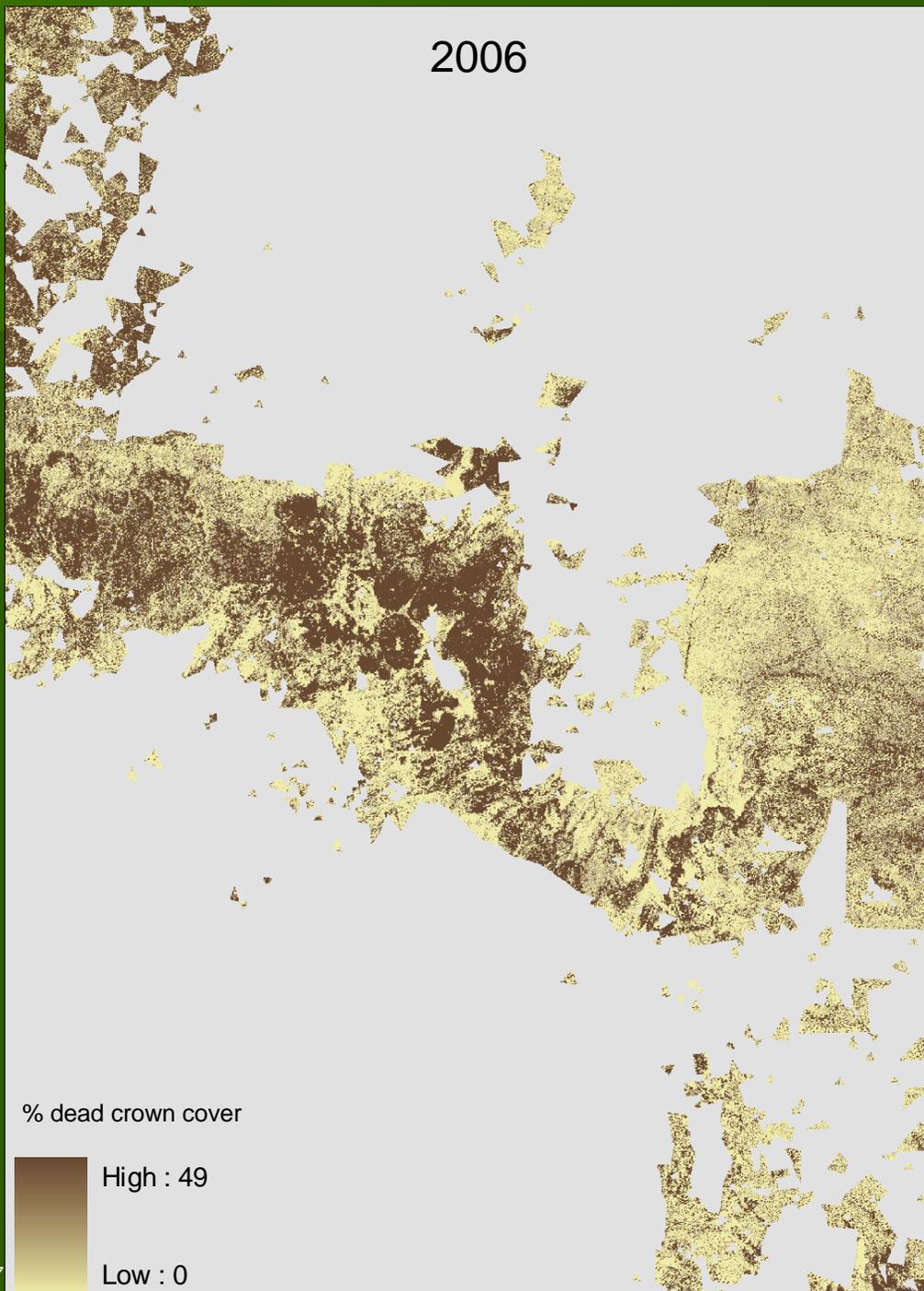


Previous studies

- Forest Health and Monitoring Program (FHM)
 - overflight observations for years 2003 and 2004 for AZ and NM
 - no analysis performed



2006

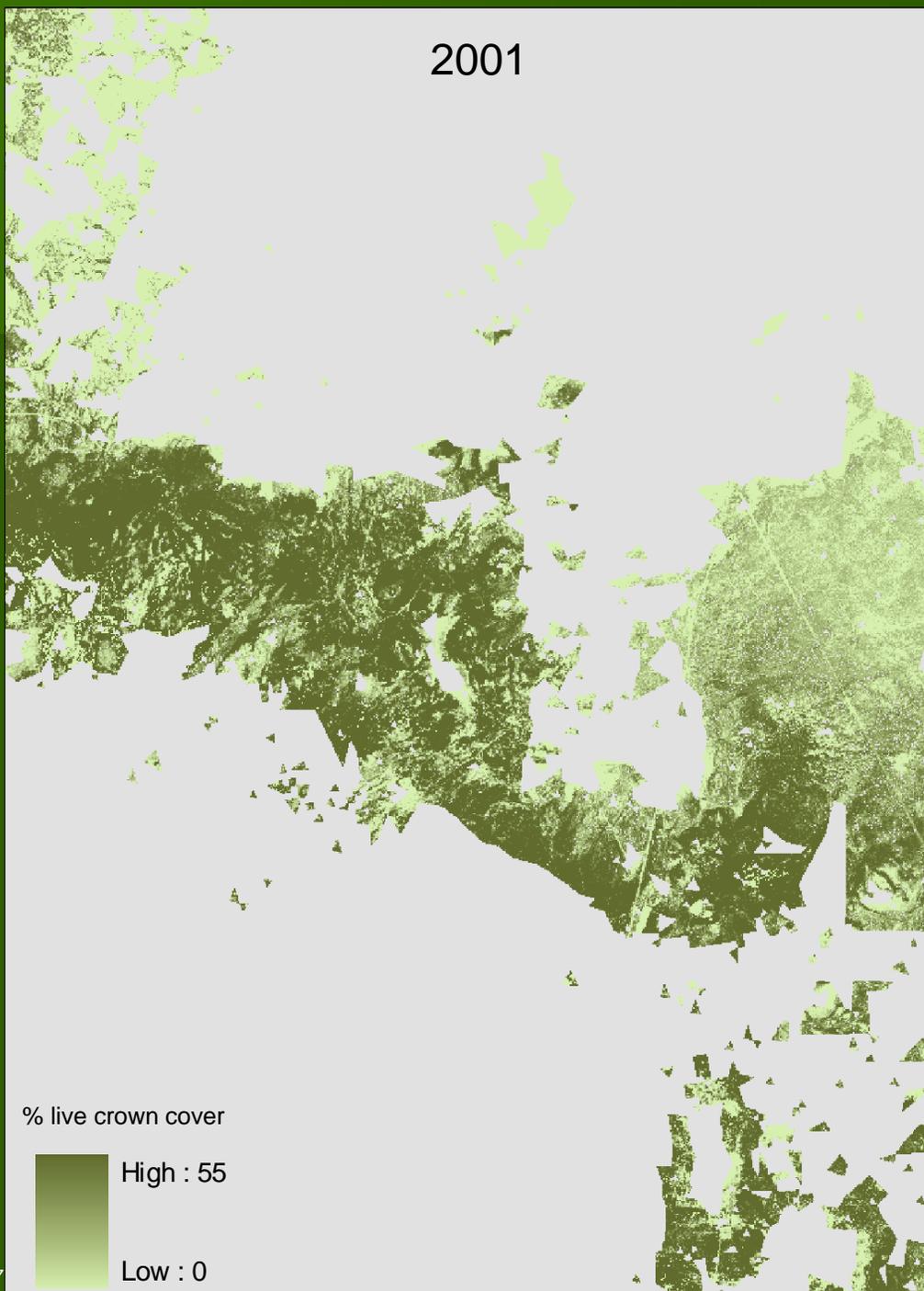


% dead crown cover

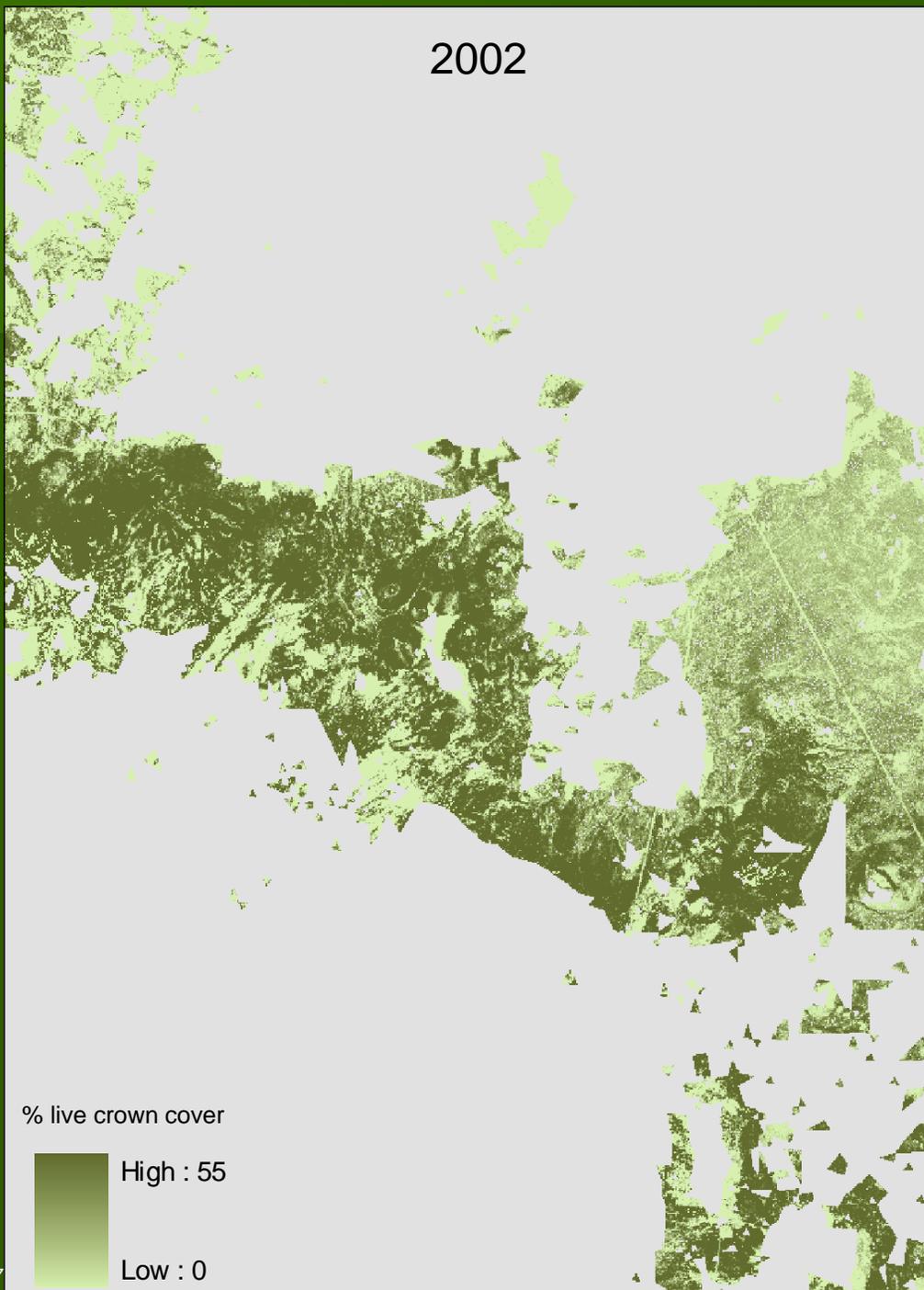
High : 49

Low : 0

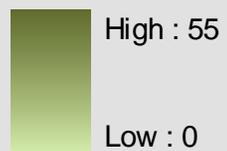
2001



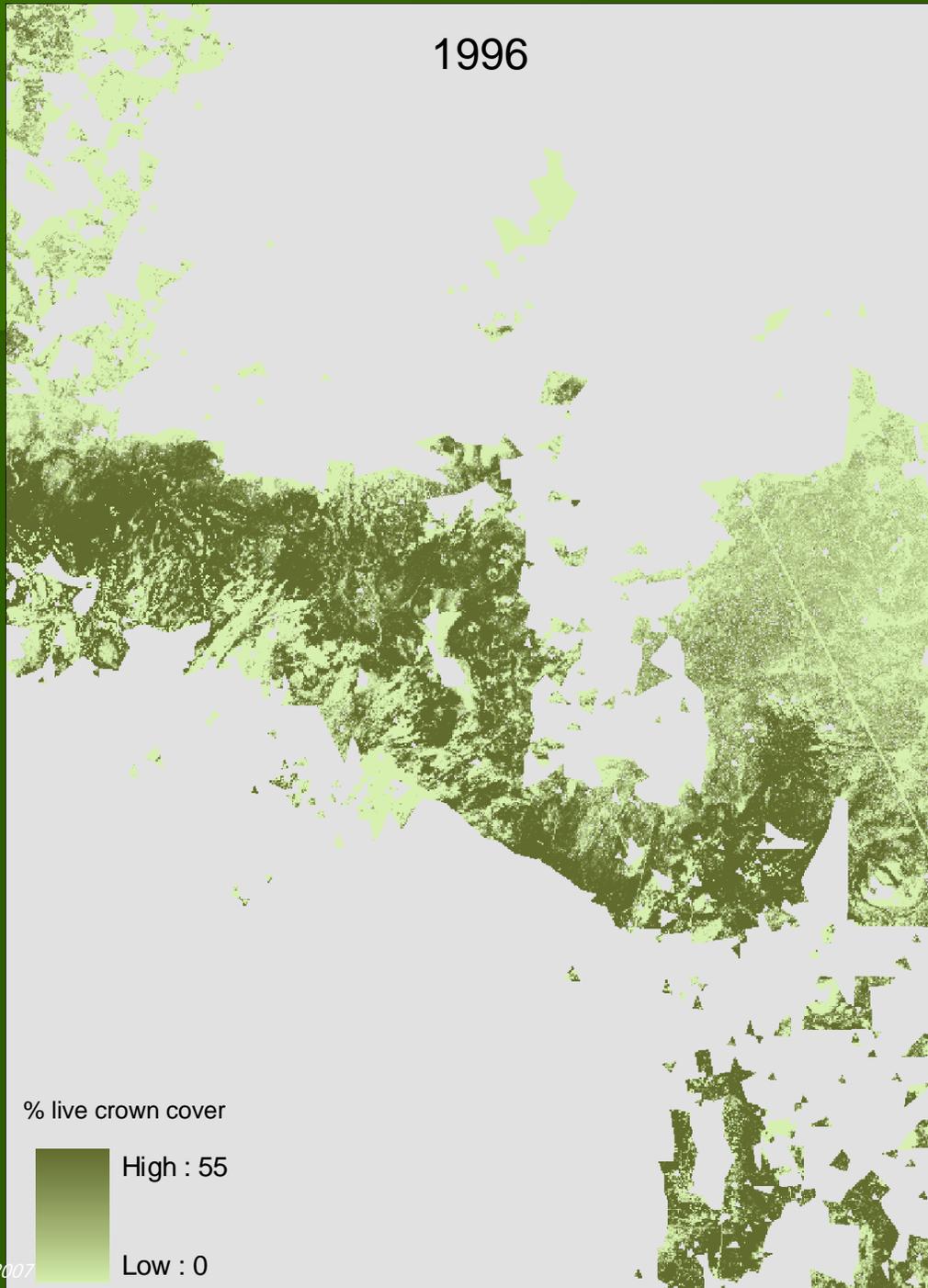
2002



% live crown cover



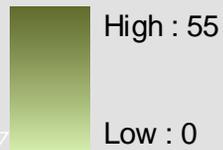
1996



1997



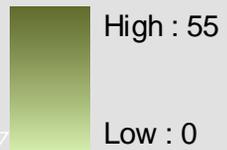
% live crown cover



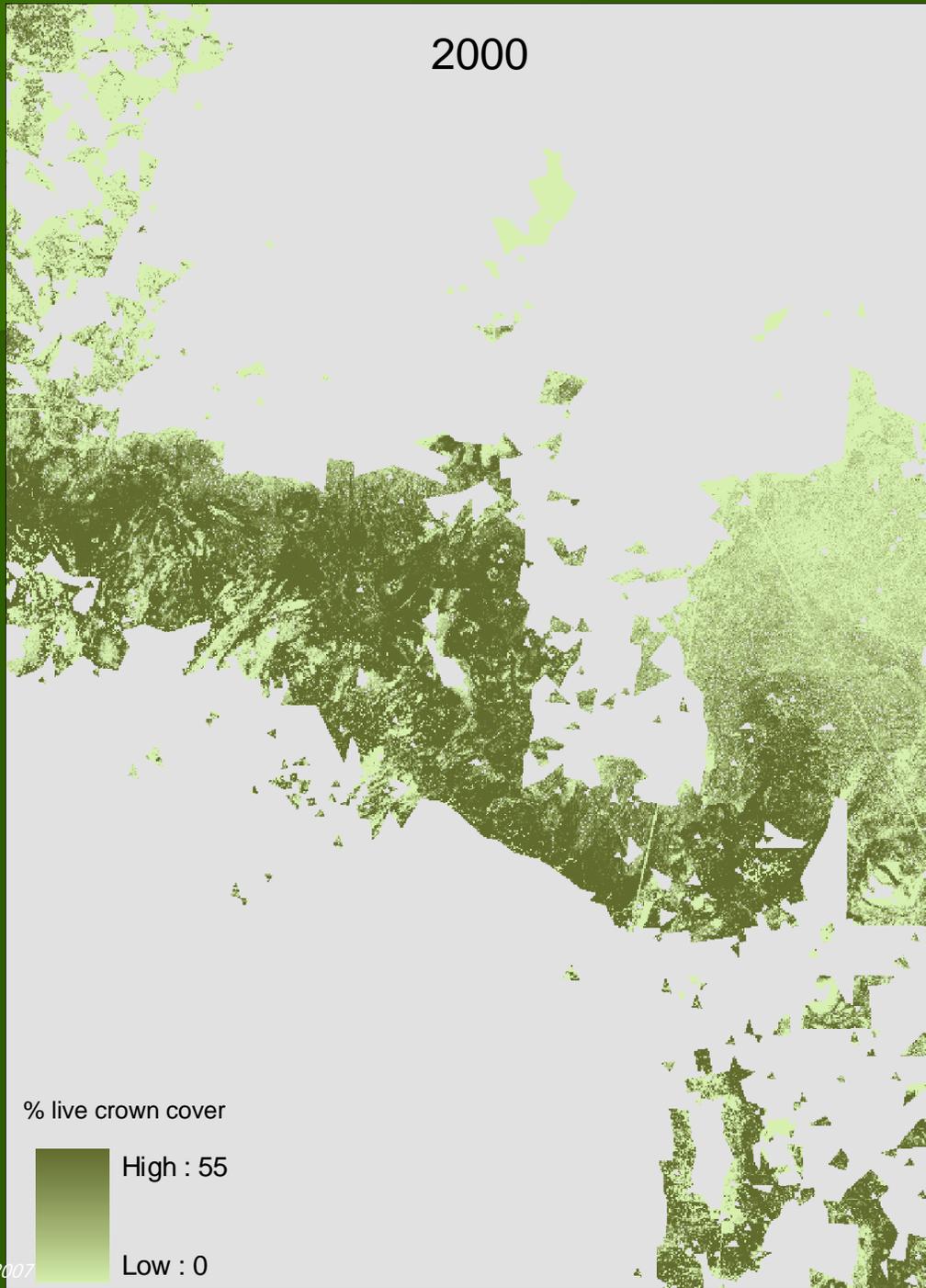
1998



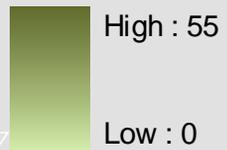
% live crown cover



2000



% live crown cover



State model

- withheld 50 points for model validation
 - RMSE: 6.47%

