

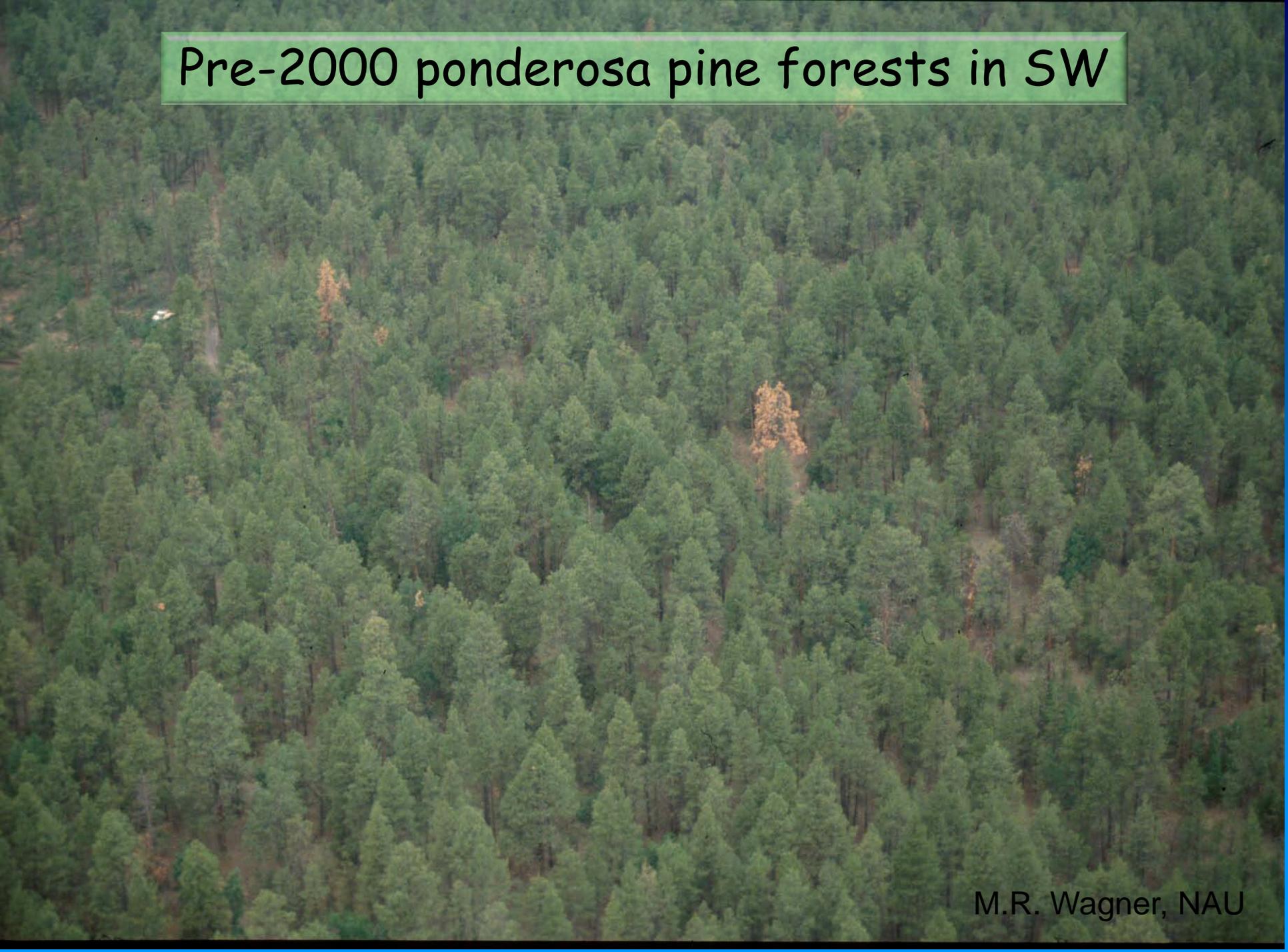


Impacts & patterns of recent bark beetle outbreaks in the Southwest

Joel McMillin

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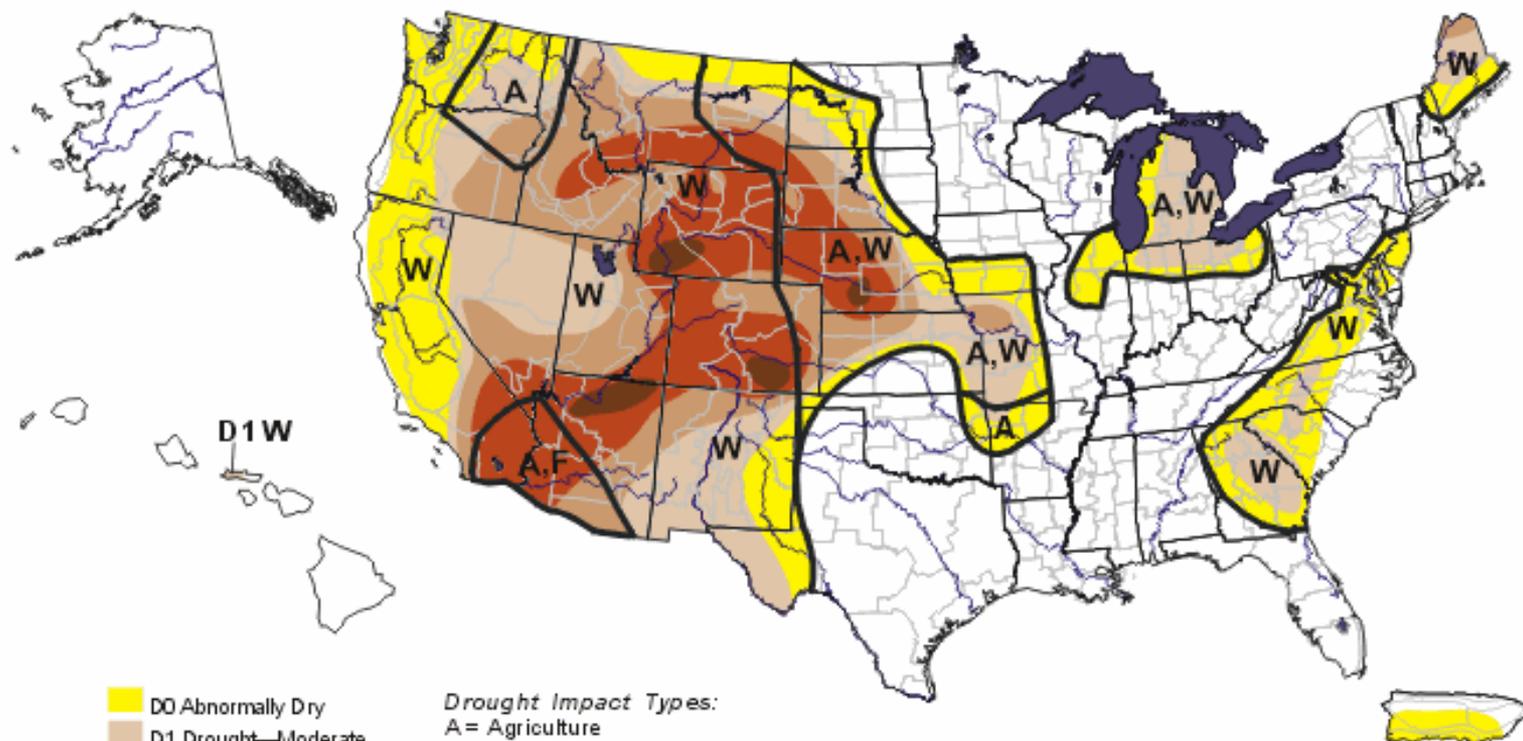
Pre-2000 ponderosa pine forests in SW



U.S. Drought Monitor

November 19, 2002

Valid 7 a.m. EST



-  D0 Abnormally Dry
-  D1 Drought—Moderate
-  D2 Drought—Severe
-  D3 Drought—Extreme
-  D4 Drought—Exceptional

Drought Impact Types:

- A = Agriculture
- W = Water (Hydrological)
- F = Fire danger (Wildfires)
-  Delineates dominant impacts
- (No type = All 3 impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>

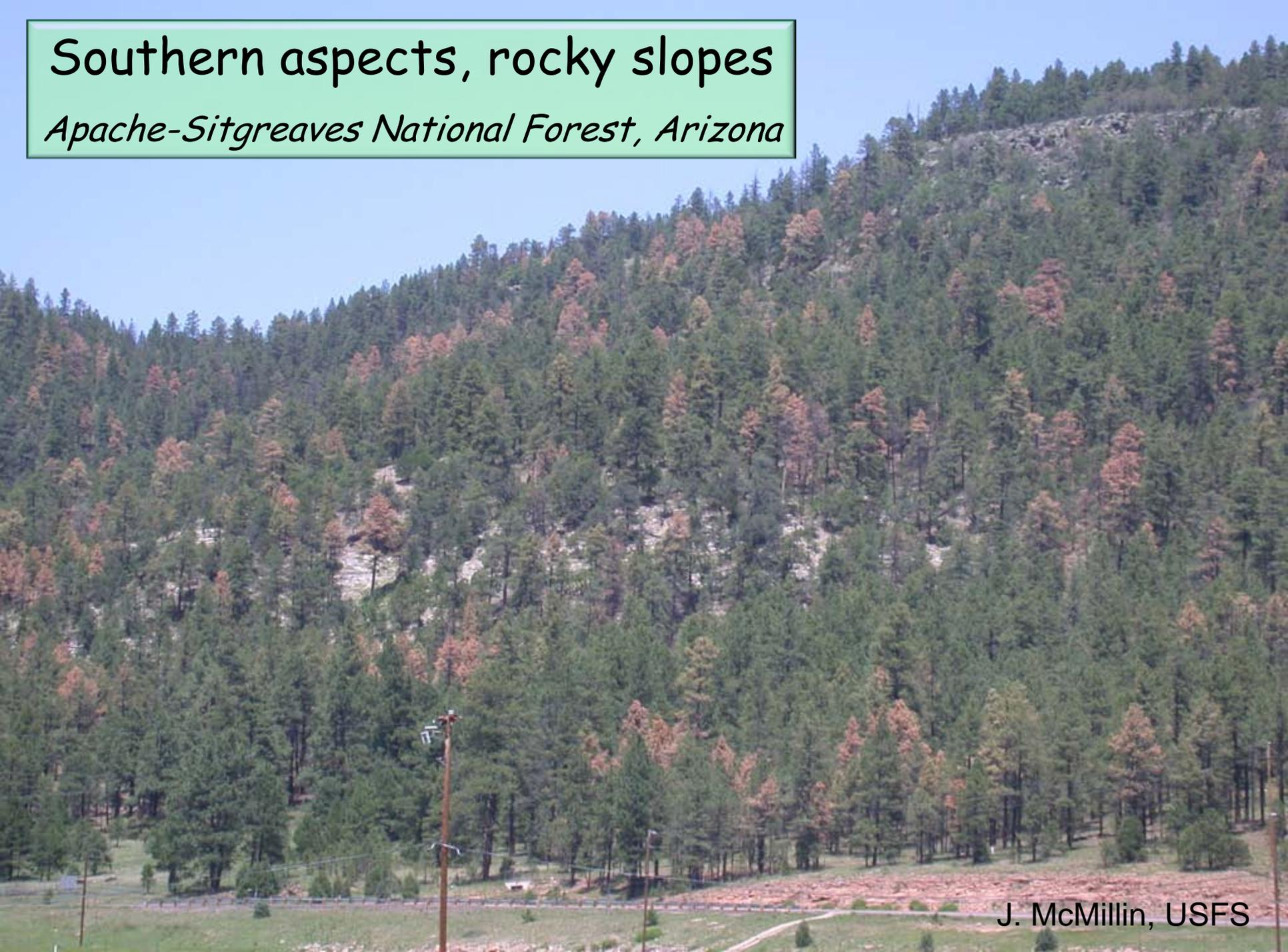


Released Thursday, November 21, 2002

Author: Richard Heim/Karin Gleason, NCDC

Southern aspects, rocky slopes

Apache-Sitgreaves National Forest, Arizona



J. McMillin, USFS

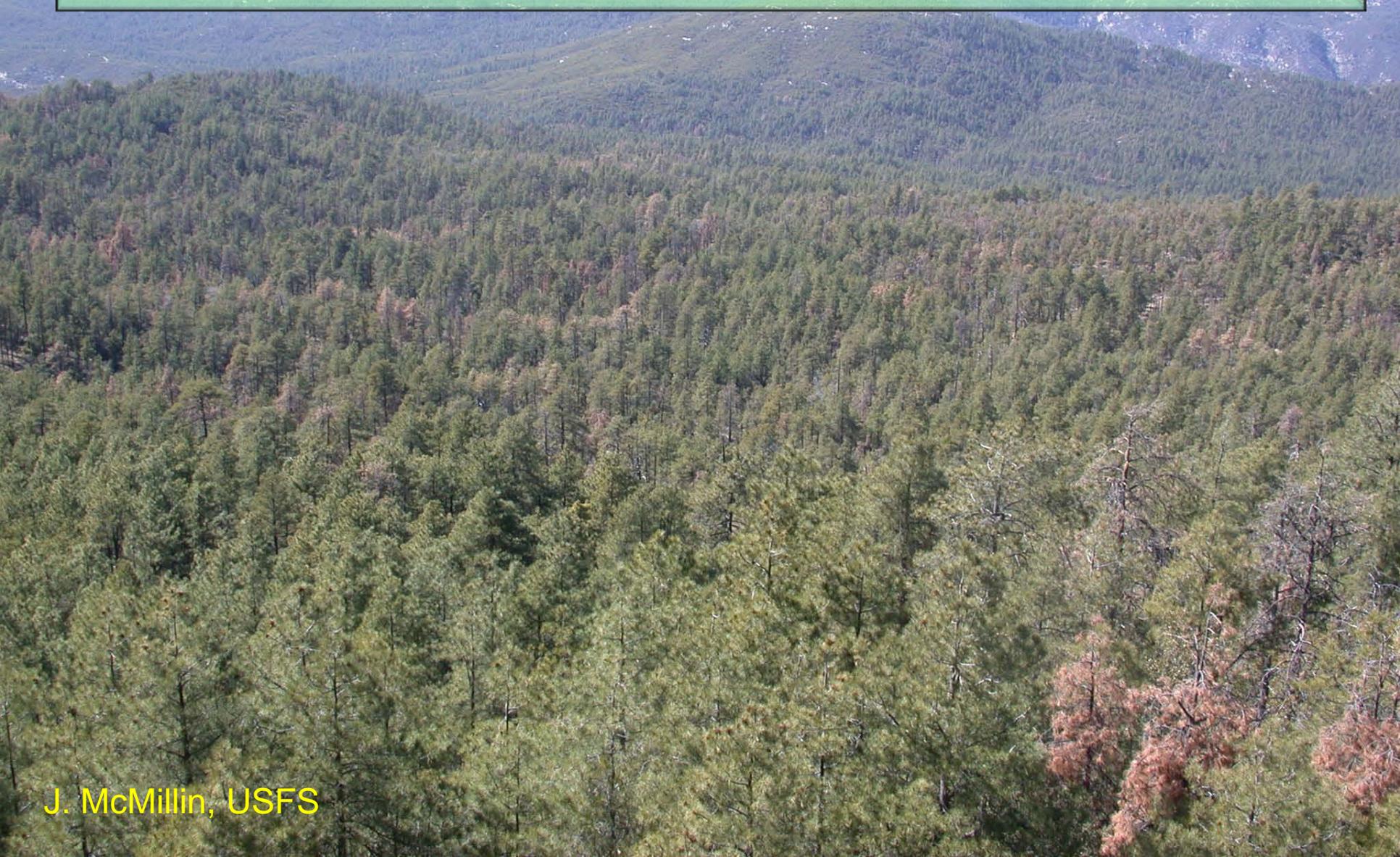
Ponderosa pine - piñon/juniper transition zones

Coconino National Forest, Arizona



Poor site quality/high stand density

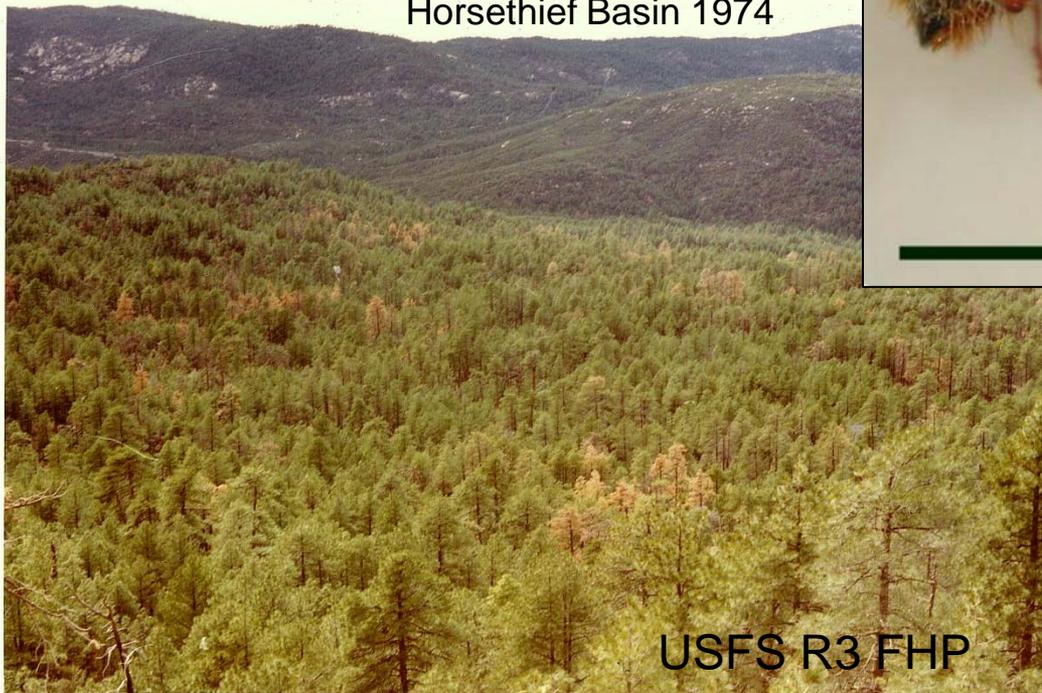
March 6, 2002 Horsethief Basin - *Prescott National Forest, AZ*



August 21, 2002 Horsethief Basin - *Prescott National Forest*



Horsethief Basin 1974



USFS R3 FHP

74
APR

Arizona fivespined ips, *Ips lecontei*

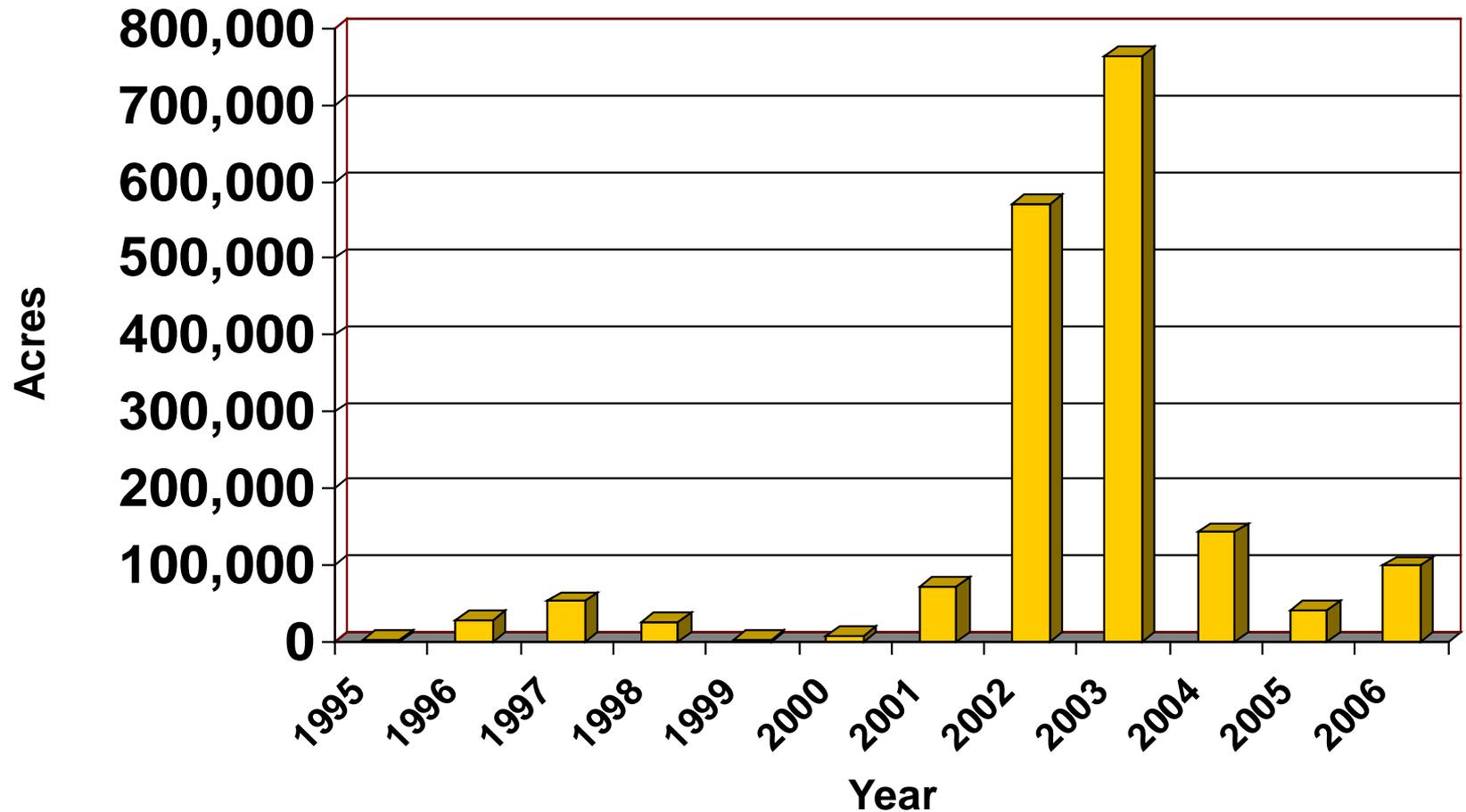


5 mm

J. Schalau

J. McMillin, USFS

Acres impacted of ponderosa pine by bark beetles in Arizona, 1995-2006

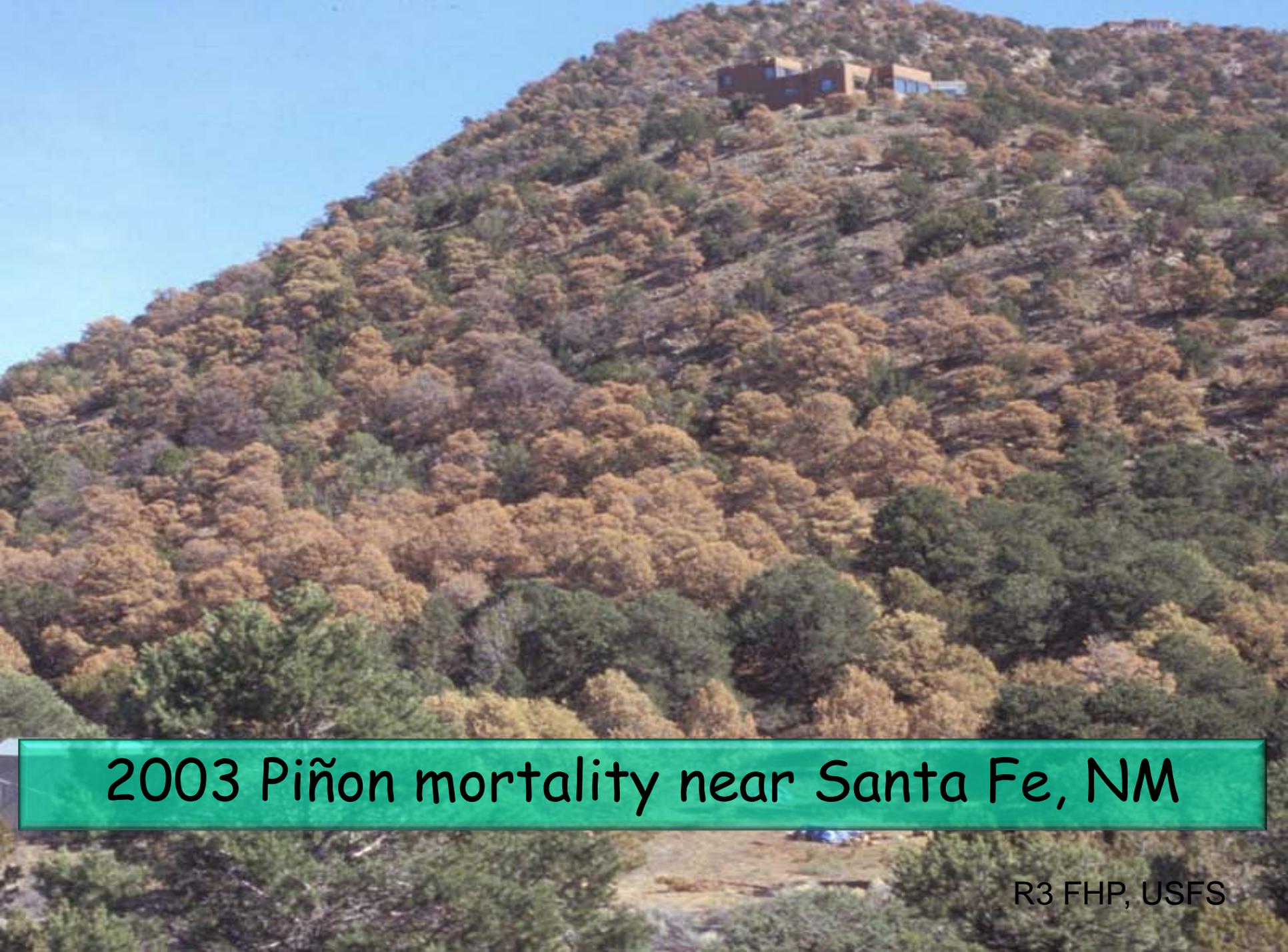


USFS FHP Region 3

2003 Piñon mortality Coconino NF, AZ

7,127 pinyon ips collected in 1 trap in 1 week





2003 Piñon mortality near Santa Fe, NM

20

2004 Twig beetle damage
Laguna Hansen, Baja California

ge on

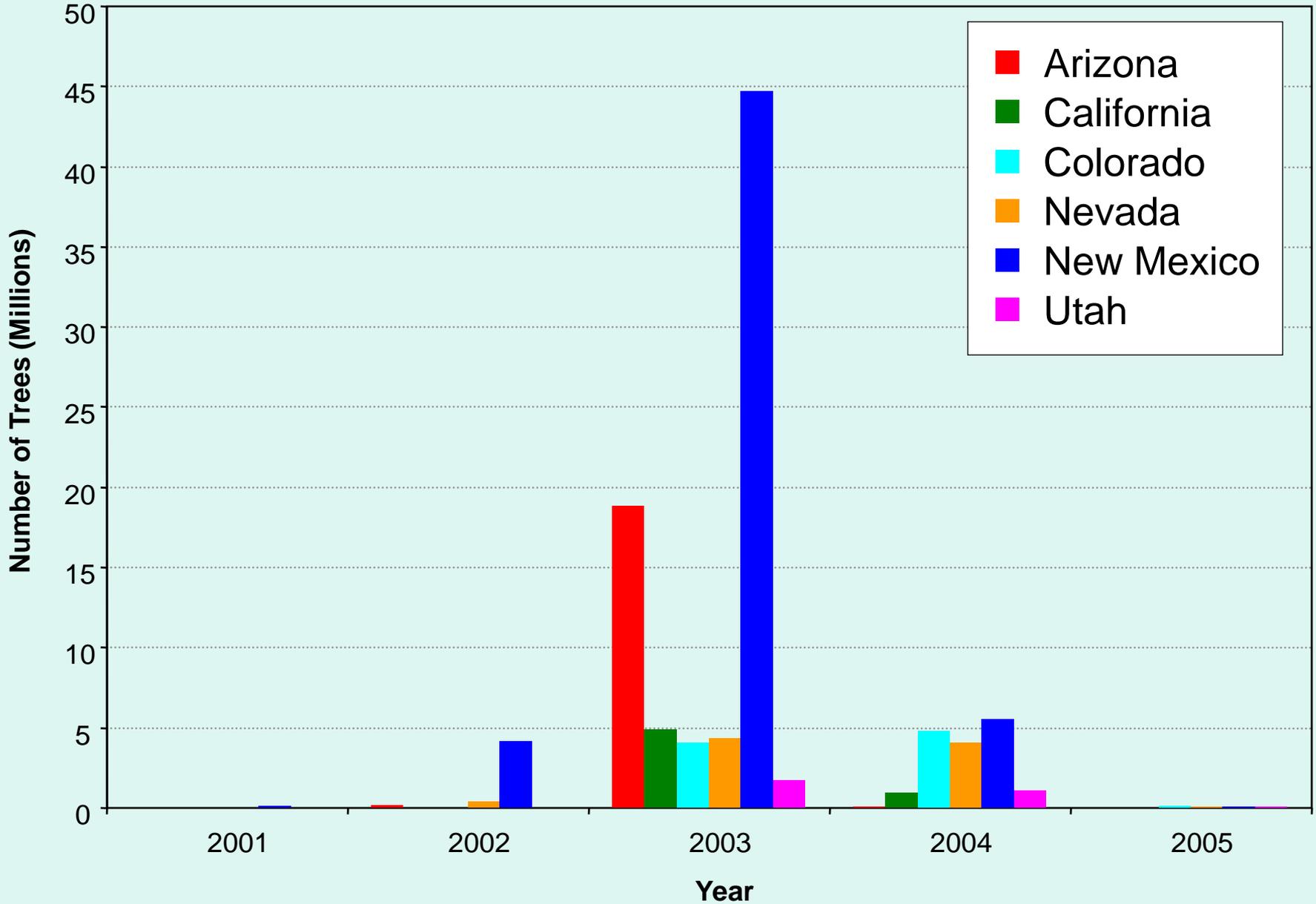


J. McMillin, USFS

T. DeGomez, UA

Piñon Mortality 2001 - 2005

Estimated Number of Trees from FHP Aerial Detection Surveys

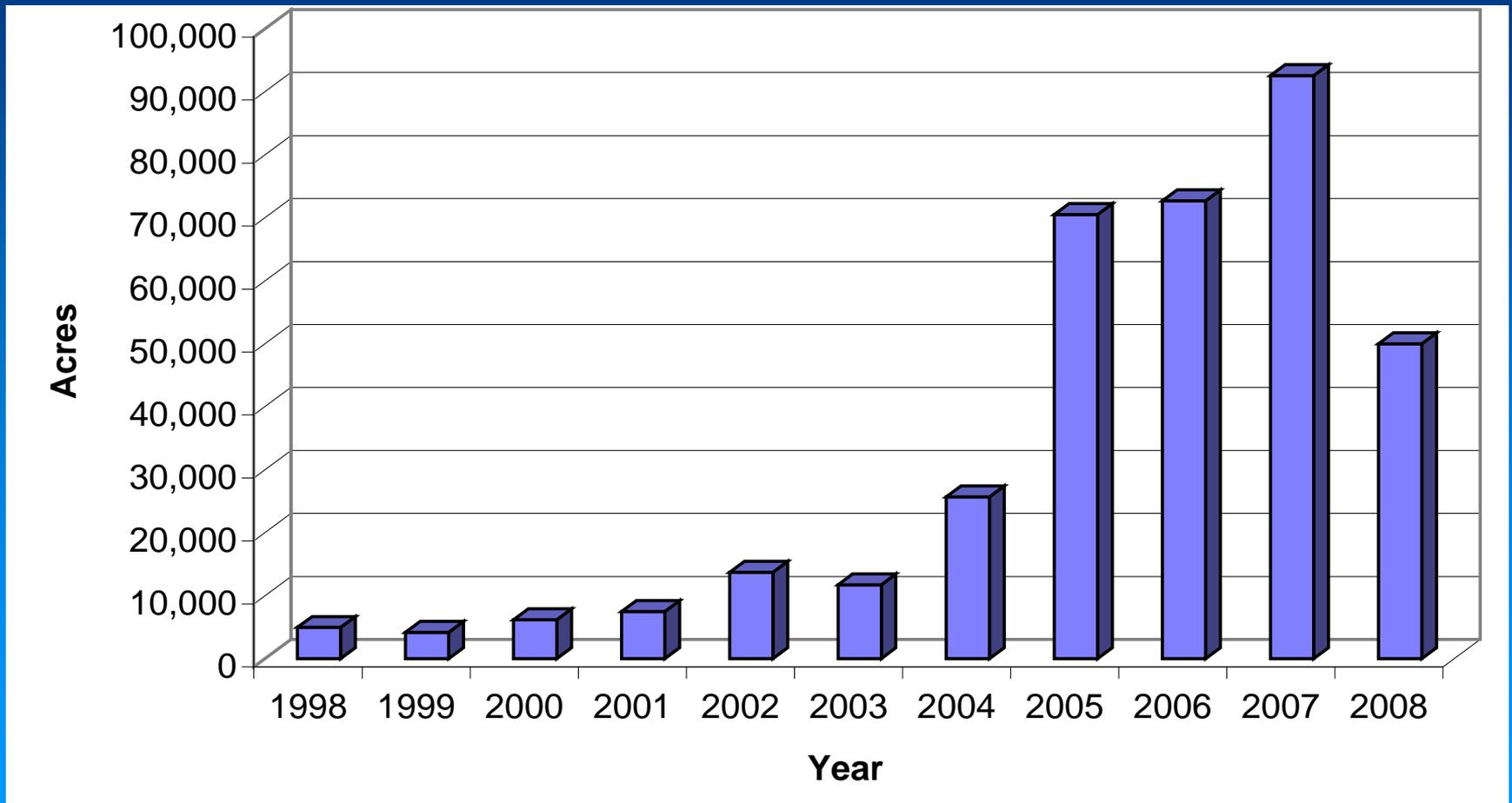


An aerial photograph of a forest in the Apache-Sitgreaves National Forest, Arizona. The forest is a mix of green and brown, indicating mortality. A large green box with a black border is overlaid at the top, containing the title and location. The background shows a dense forest of conifers, with many trees appearing dead or dormant, showing brown and tan colors. The foreground shows the branches and needles of a living pine tree.

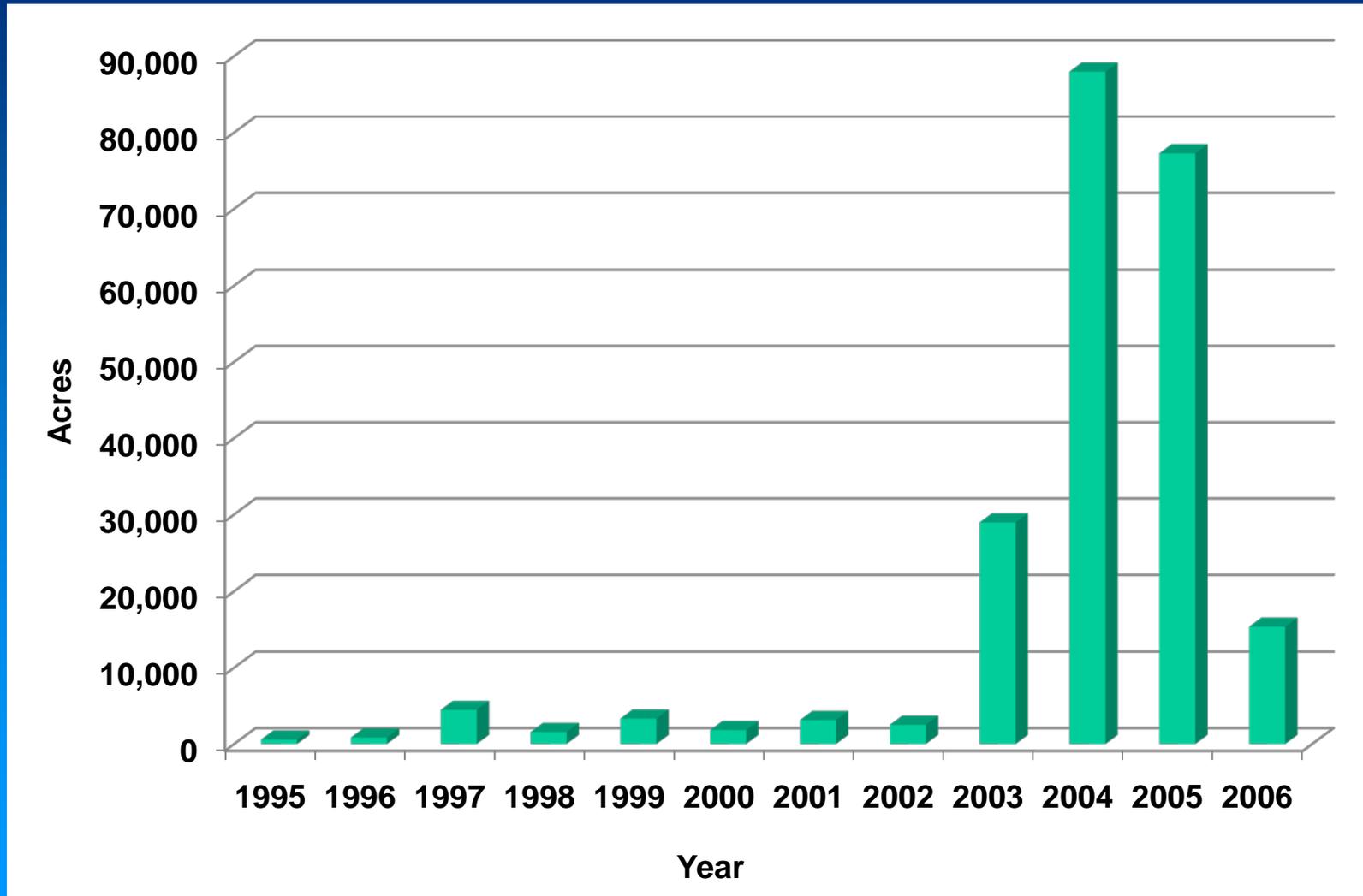
Mixed conifer mortality - 2004

Apache-Sitgreaves National Forest, Arizona

Recent true fir bark beetle activity in AZ & NM



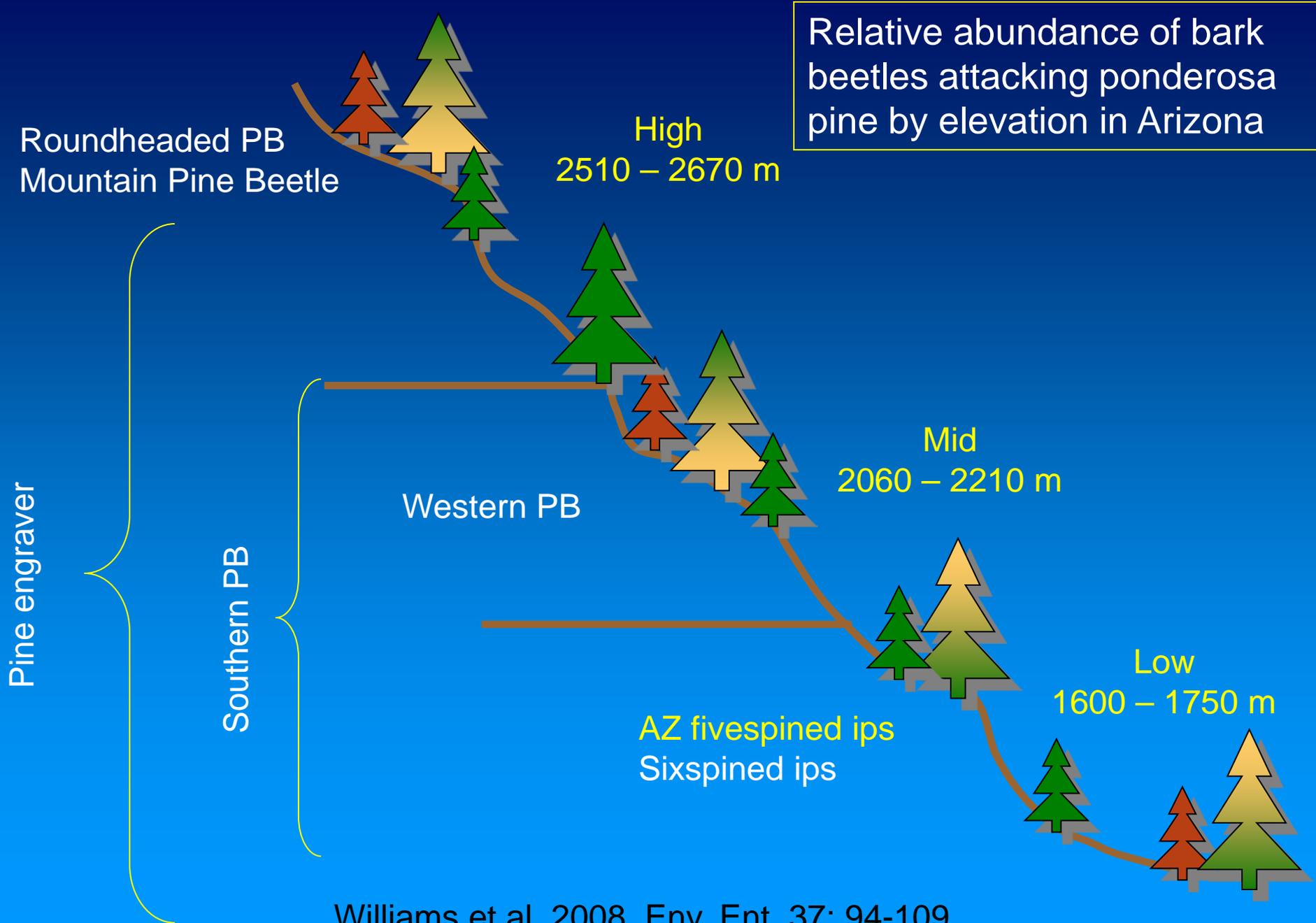
Recent Douglas-fir beetle activity in AZ & NM



Patterns of tree mortality in ponderosa pine forests of Arizona



Relative abundance of bark beetles attacking ponderosa pine by elevation in Arizona



Williams et al. 2008. Env. Ent. 37: 94-109

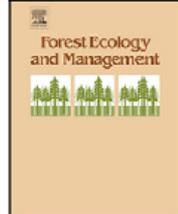


ELSEVIER

Forest Ecology and Management

257: 1353–1362

journal homepage: www.elsevier.com/locate/foreco

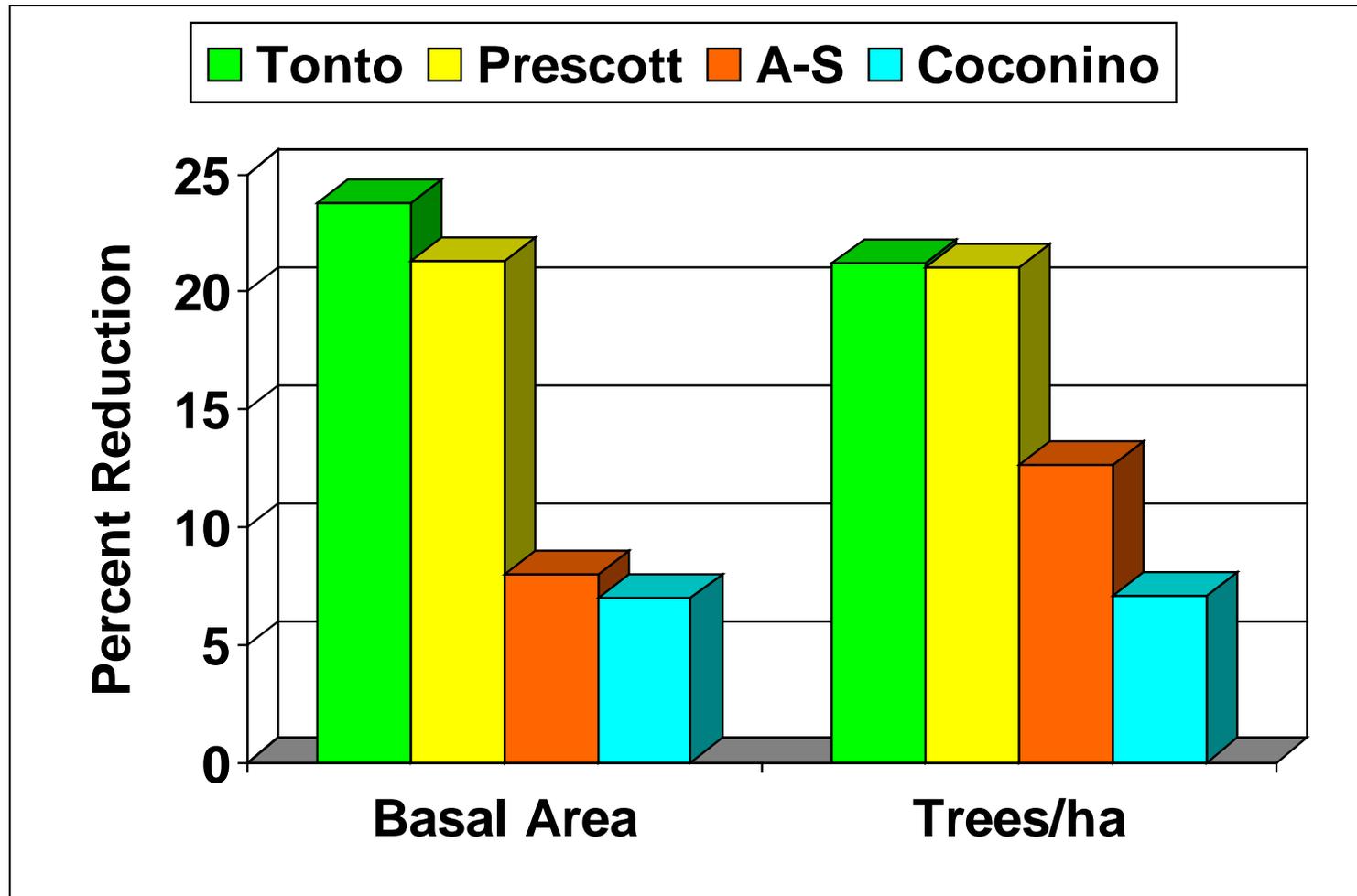


Bark beetle-caused mortality in a drought-affected ponderosa pine landscape in Arizona, USA

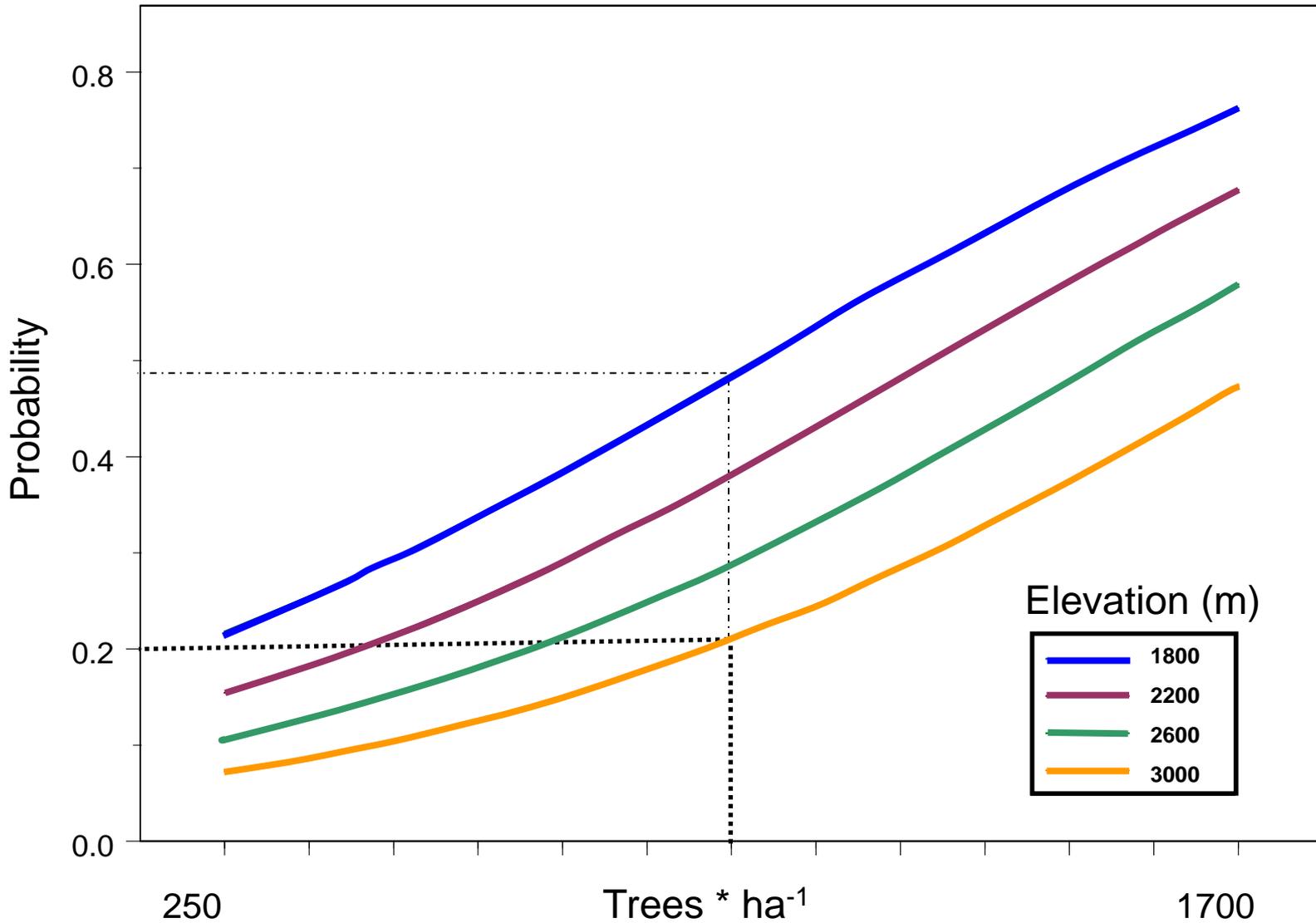
José F. Negrón^{a,*}, Joel D. McMillin^b, John A. Anhold^b, Dave Coulson^c

- FHM EM funded study – objectives:
 - Quantify stand level impacts of bark beetles on ponderosa pine forests in Arizona
 - Determine correlations between stand conditions & site characteristics and pine mortality
- Extensive network of plots (1,100+) distributed across National Forests in Arizona

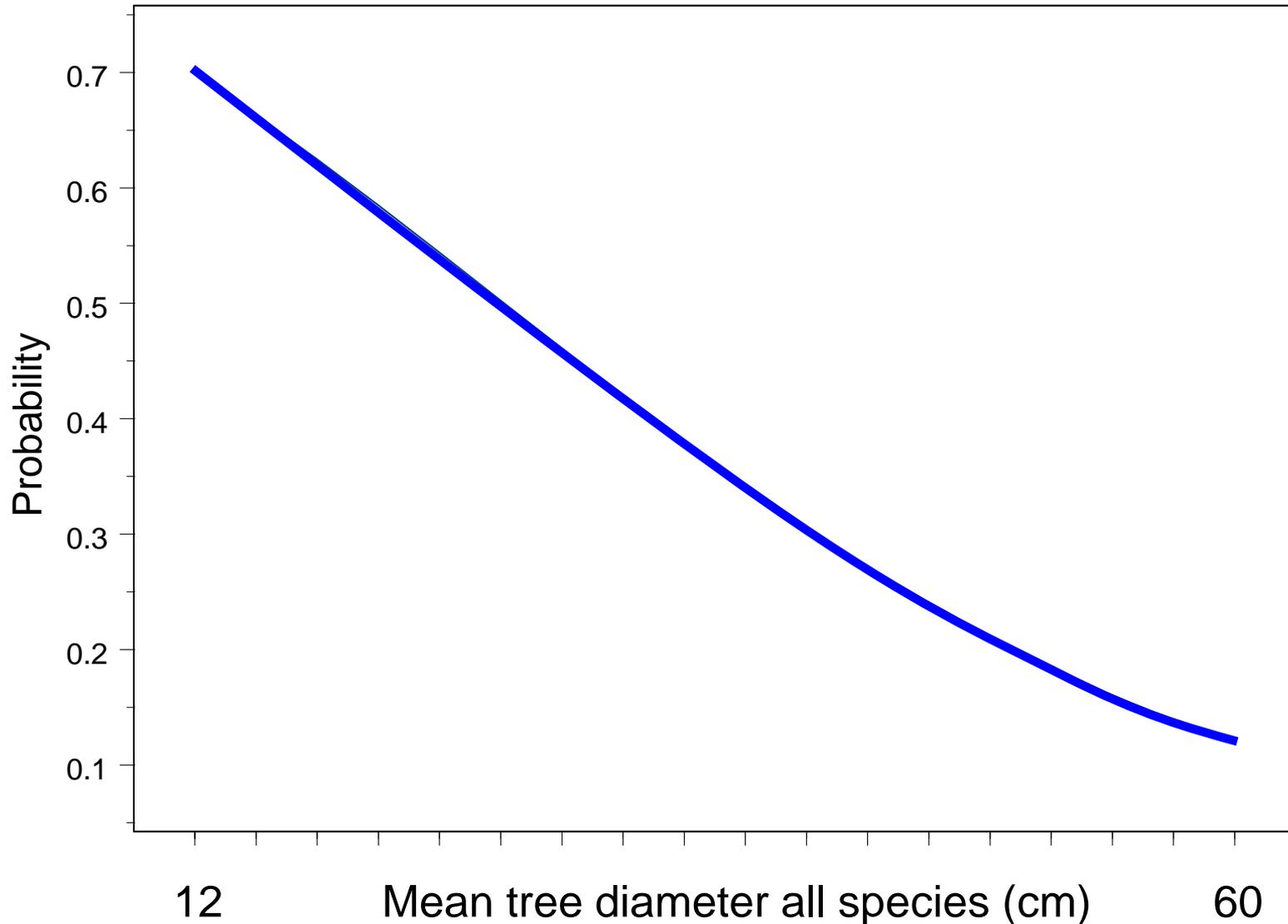
Bark beetle impacts to ponderosa pine by National Forests in Arizona



Probability of ponderosa pine mortality by elevation and trees/hectare



Probability of ponderosa pine mortality by mean tree diameter (Prescott NF)



Selection of dwarf mistletoe-infected ponderosa pine by *Ips* during drought



Tonto National Forest

Live

<1.6

Dead

>4.4

Average DMR

Kenaley et al. 2006. WNAN 63: 279 - 284

Mortality Associated with a Bark Beetle Outbreak in Dwarf Mistletoe-Infested Ponderosa Pine Stands in Arizona

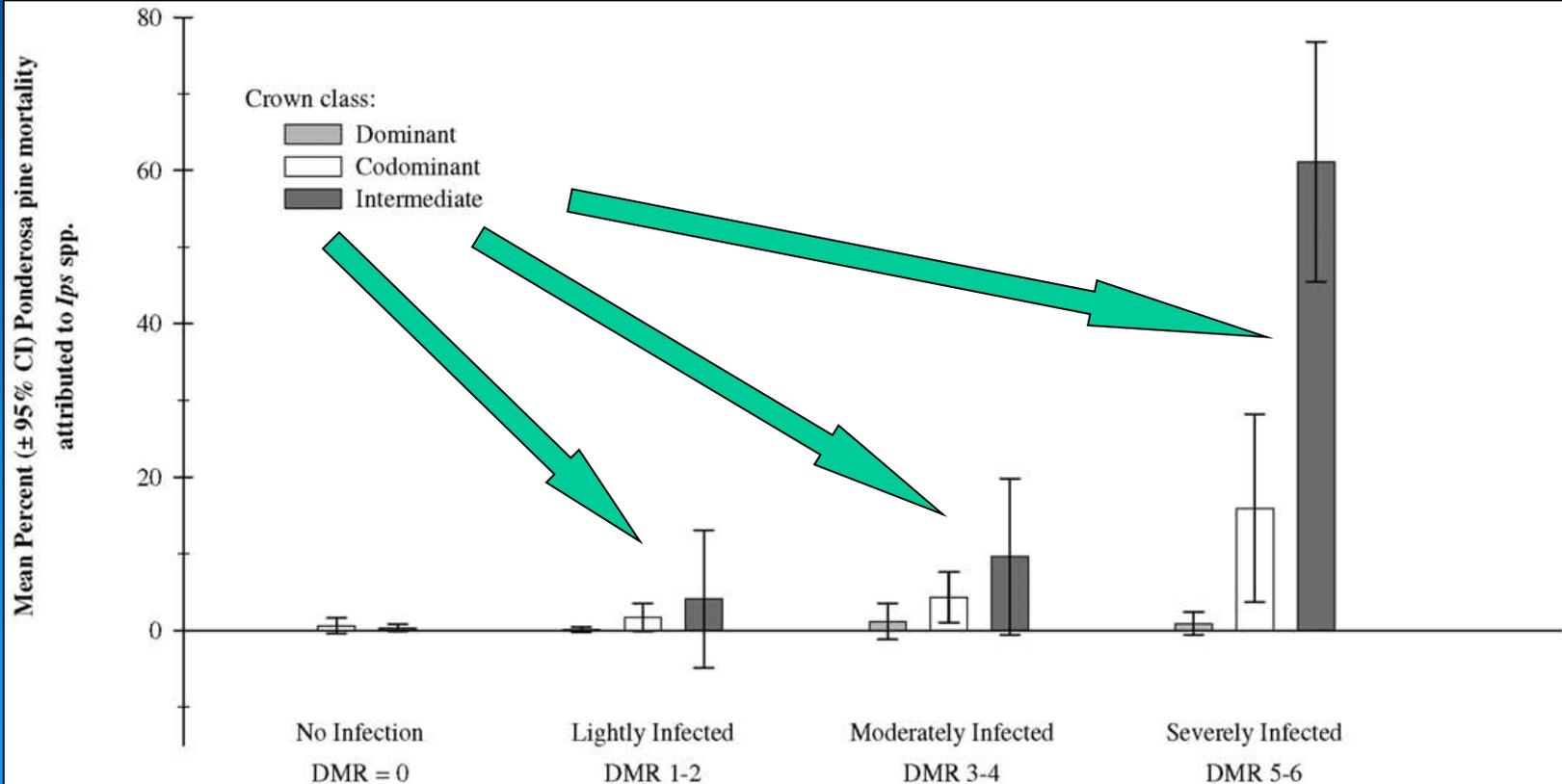
WJAF 23: 113-120 (2008)

Shawn Kenaley, Robert Mathiasen, and E. James Harner

ABSTRACT

Ponderosa pine (*Pinus ponderosa* Douglas ex C. Lawson var. *scopulorum* Engelm.) mortality was evaluated from a 2002 bark beetle outbreak in areas infested with southwestern dwarf mistletoe (*Arceuthobium vaginatum* [Willd.] Presl subsp. *cryptopodum* [Engelm.] Hawksw. & Wiers) in a total of nine study sites in northern Arizona. Ponderosa pine mortality attributable to bark beetles (*Ips* and *Dendroctonus* spp., Scolytidae) was systematically sampled, and stand attributes, such as basal area, tree density, dwarf mistletoe severity, and site indices were recorded. Ponderosa pine mortality was predominately attributed to *Ips* spp. Although the prolonged drought likely was the inciting factor responsible for the *Ips* spp. outbreak, results suggested a strong relationship between ponderosa pine mortality and the interaction between crown class and dwarf mistletoe rating class. Ponderosa pines severely infected with dwarf mistletoe and in the intermediate crown class are at the greatest risk of *Ips* spp. attack during outbreak years in northern Arizona.

Keywords: *Arceuthobium vaginatum*, ponderosa pine, *Ips* spp., dwarf mistletoe rating



Hazard rating for western pine beetle

<u>% PP</u>			<u>Ave. PP DBH</u>			<u>Basal Area (ft²/ac)</u>	
>85	(3)		>12	(3)		>120	(3)
50-85	(2)	+	8-12	(2)	+	80-120	(2)
<50	(1)		<8	(1)		<80	(1)

<u>Composite Stand Hazard Values</u>	<u>Hazard Rating</u>
8 – 9	High
5 – 7	Moderate
3 – 4	Low

Hazard rating for *Ips* beetles during drought?

Site index or elevation

low	(3)
mid	(2)
high	(1)

+

Ave. PP DBH

<8	(3)
8-12	(2)
>12	(1)

+

Tree density

high	(3)
moderate	(2)
low	(1)

Stand DMR

high	(3)
moderate	(2)
low	(1)

+

=

Stand Hazard

high	(10 - 12)
moderate	(7 - 9)
low	(4 - 6)

Factors associated with pine mortality

Weather &
Climate



Stand & site
Conditions

Bark Beetle
Population

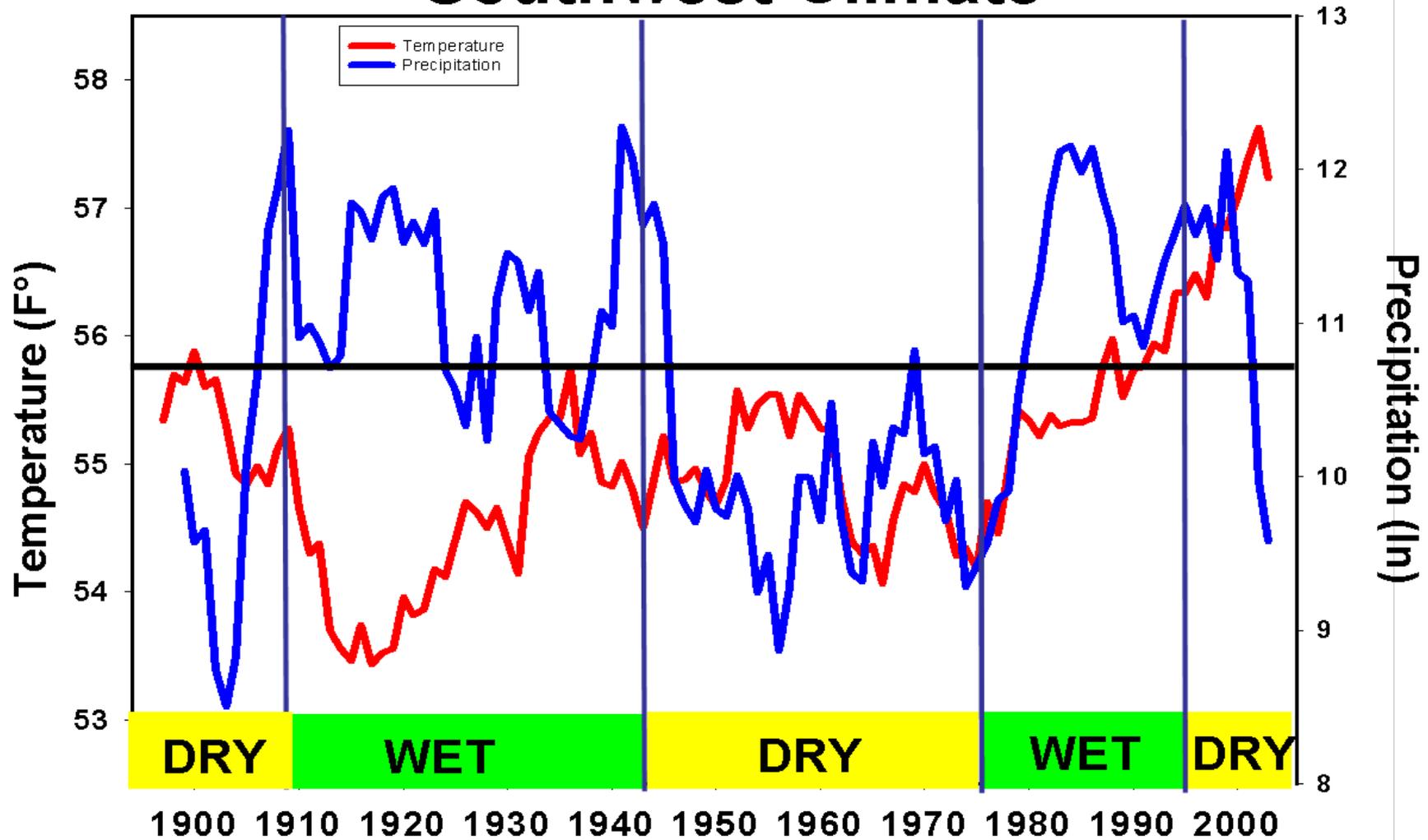
Compared to pre-1900 forests, today's southwestern ponderosa pine forests are:



- Denser (35x)
- more small trees
- fewer large trees

Increased drought impacts & Ips habitat

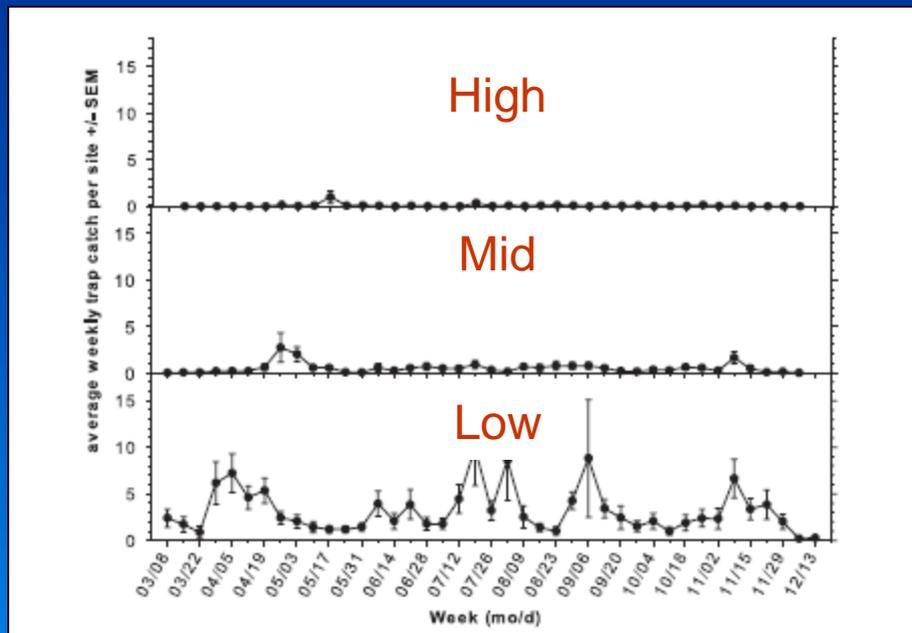
Southwest Climate



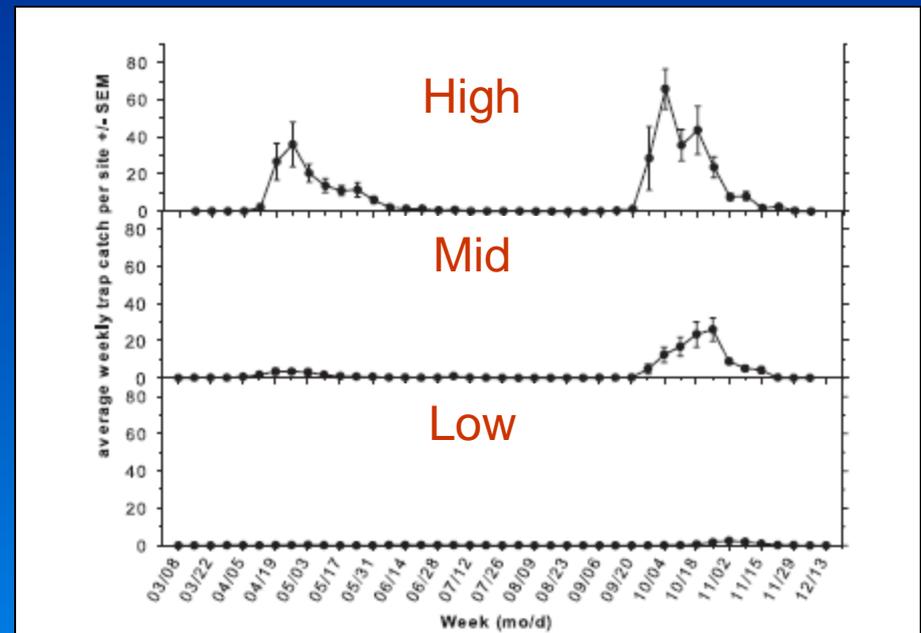
Current drought is considerably warmer than two previous droughts in the last century (N. Cobb and others)

Increased temperatures affect host tree and bark beetles

- Increased host tree stress?
- Increased generations for bark beetles?

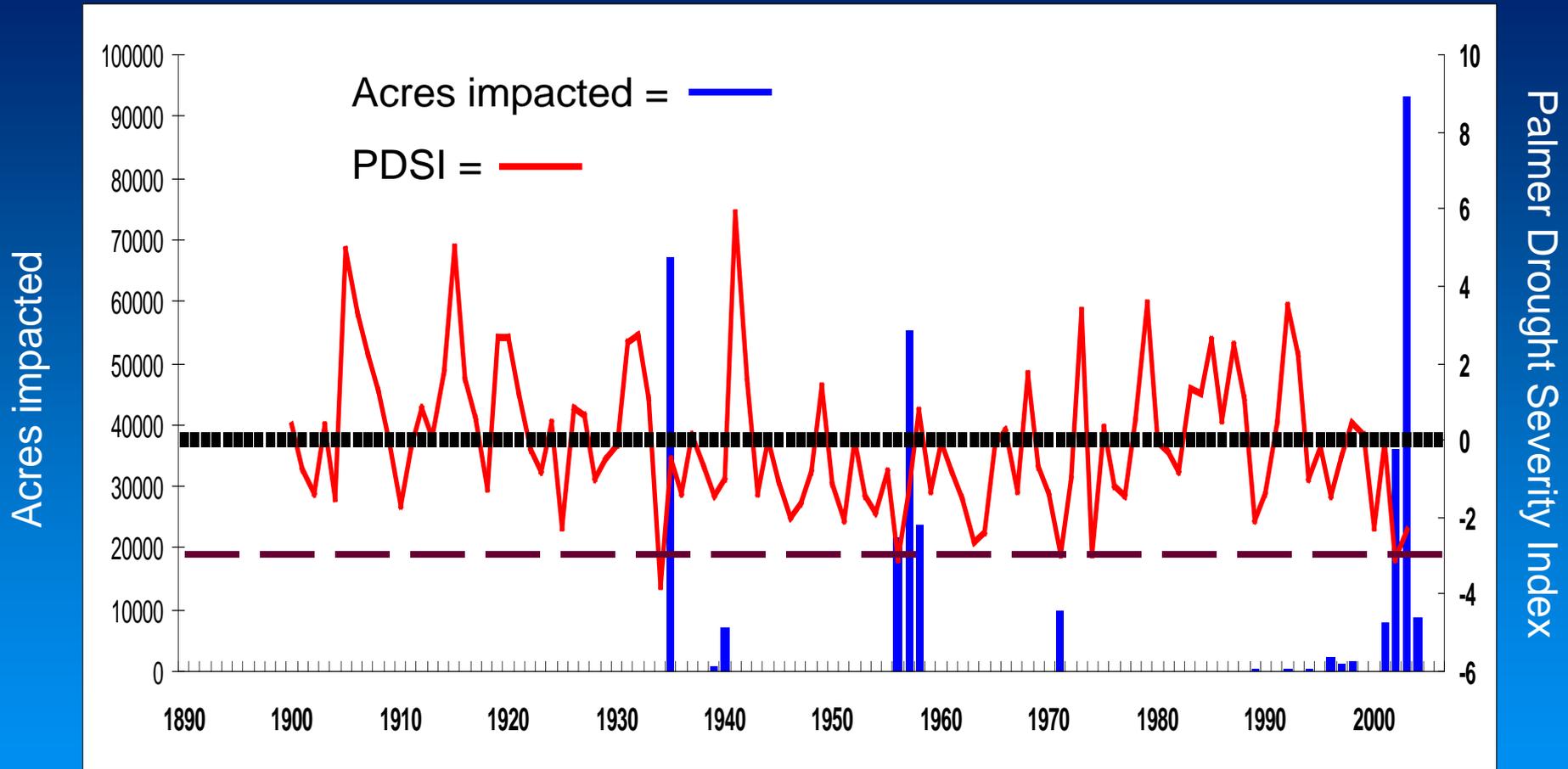


Arizona fivespined ips



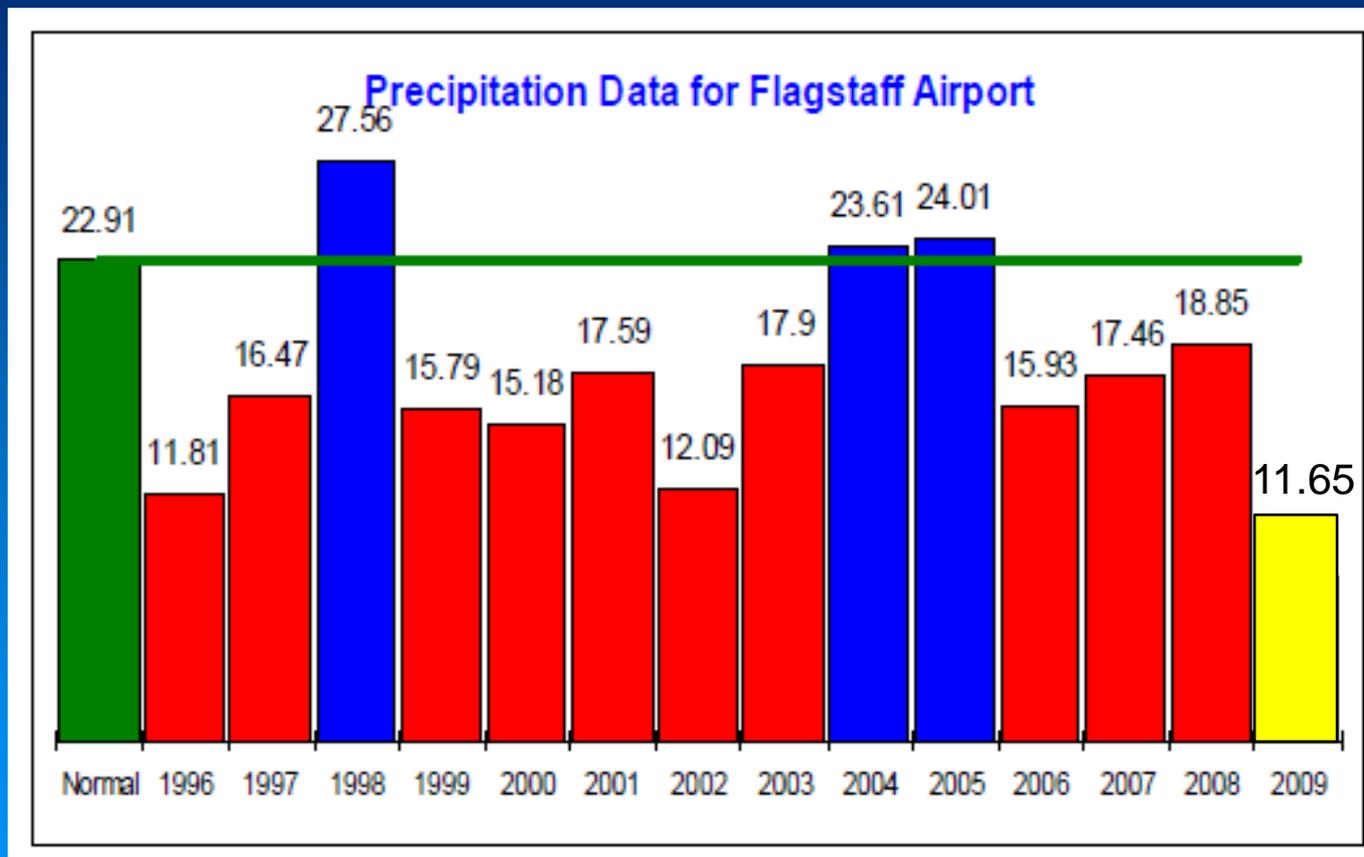
Roundhead pine beetle

Bark beetle activity by PDSI on Prescott NF



PDSI less than -3.0 seems to be threshold for significant beetle activity in pine forests of Arizona

2009 was 4th driest year on record in Flagstaff

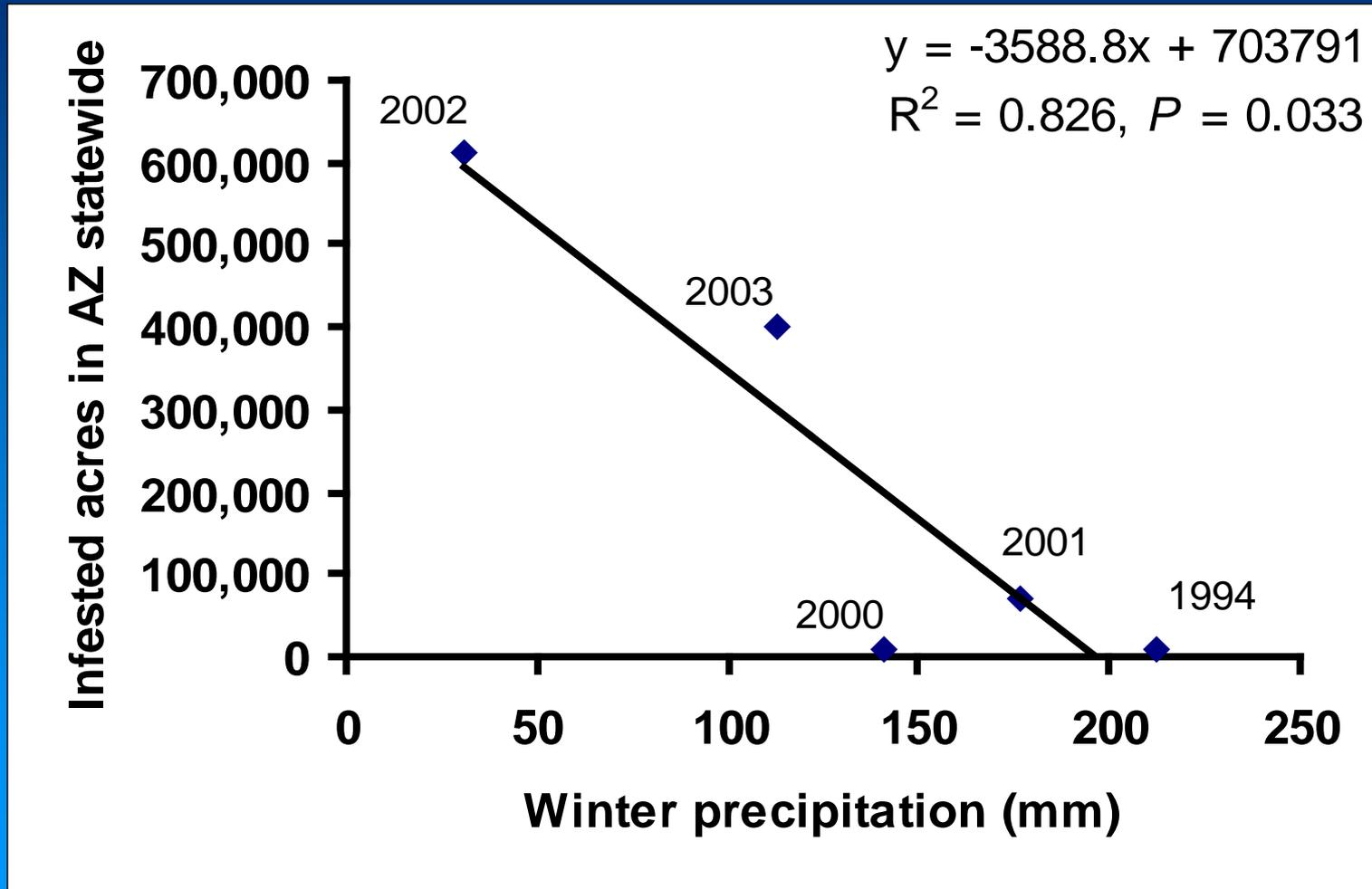


Arizona Drought Monitor Report

3rd largest snow storm last week in Flagstaff



Acres impacted vs. winter precipitation



Courtesy of M.R. Wagner, NAU

Conclusions from Arizona studies

- Pine mortality follows elevational/site quality gradient
- Tree or stand density (tree/ha or SDI) is also important
- Dwarf mistletoe × bark beetle interactions are important
- Implications for forest management

Overall Conclusions

- Outbreaks in the past
 - Bark beetle-caused pine mortality occurred historically (obviously) – drought driven
 - However, magnitude of outbreaks was less due to lower tree and stand density
- Outbreaks in the present
 - Increased probability of landscape level outbreaks with associated high trees/acre killed
 - Increased white fir and Douglas-fir has led to increase of fir engraver & Douglas-fir beetle

Outbreaks in the future?

