

Drought and Bark Beetles: Status Report and Plan for Research

By

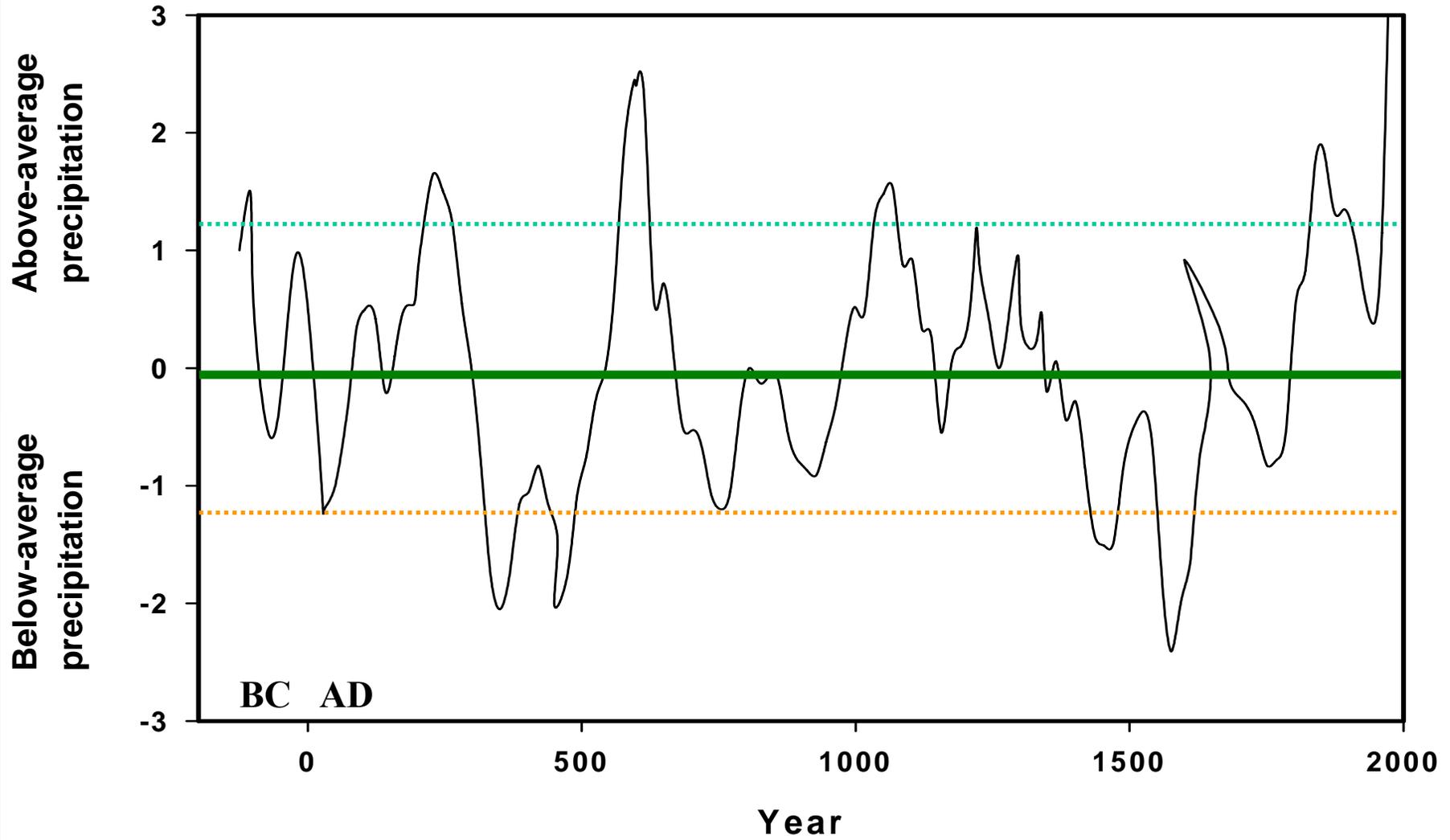
**Michael R. Wagner ^[1], Monica Gaylord ^[1],
Thomas E. Kolb ^[1], and Joel D. McMillin ^[2]**

[1] Northern Arizona University School of Forestry, Flagstaff, AZ

[2] US Forest Service, Forest Health Protection, Flagstaff, AZ

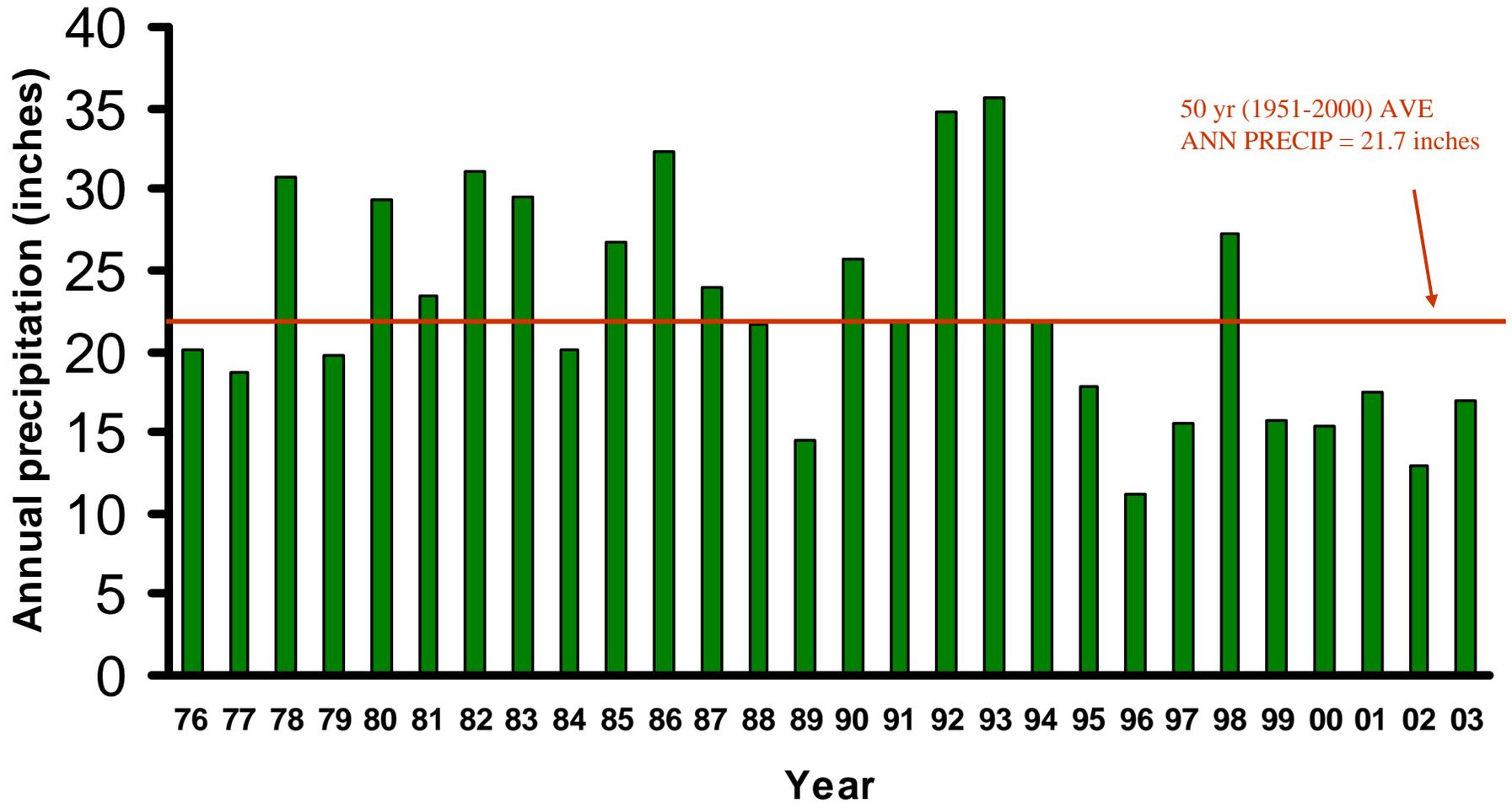
Outline

- **Current Drought**
- **Bark Beetles (BB)**
- **Drought/BB Impacts**
- **Drought or BB?**
- **Current Research**
- **Future Research Needs**



(Grissno-Mayer et al. 1997; Wagner et al. 2000)

Annual Precipitation in Flagstaff, AZ (1976-2003)



Pine Bark Beetles in Arizona

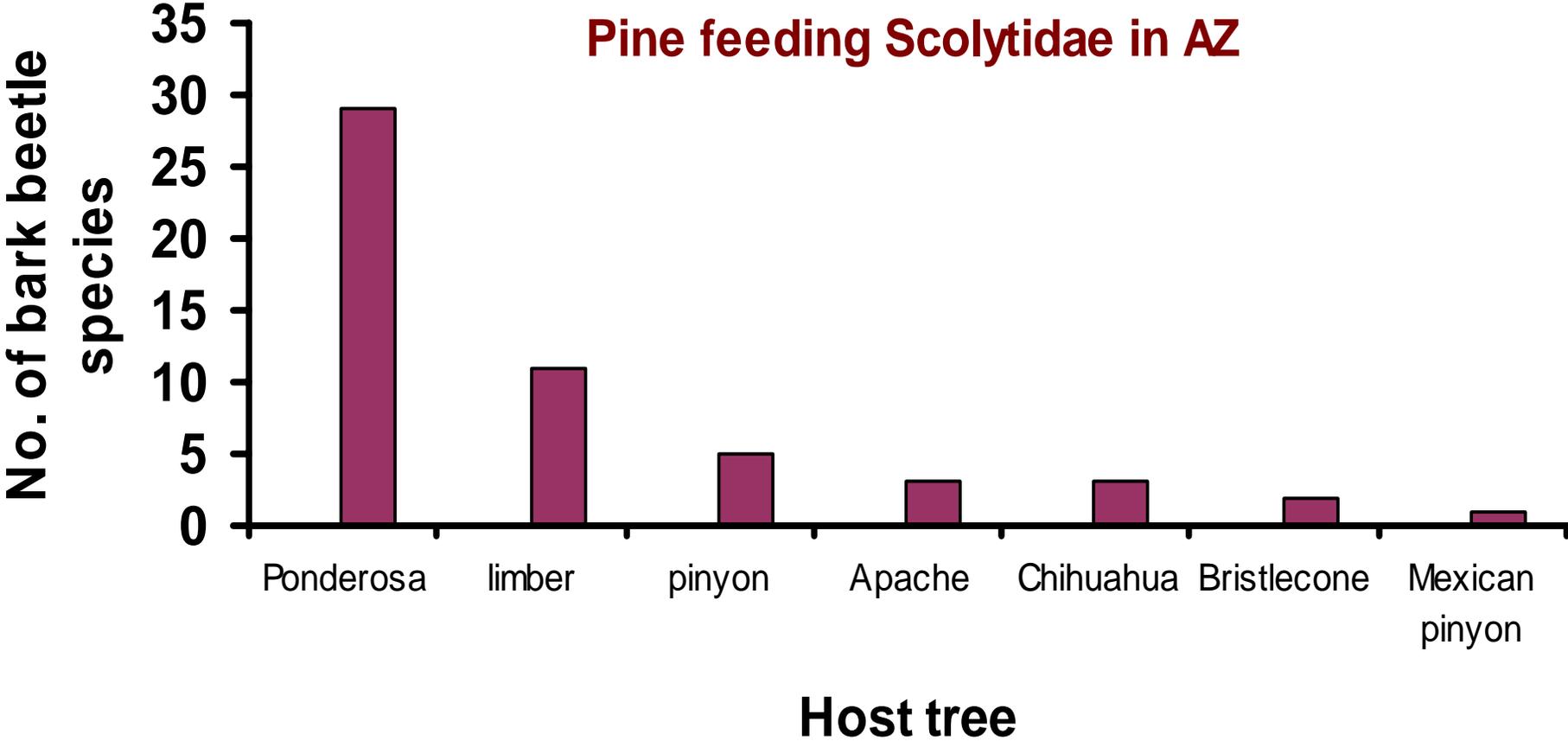
Most important

- Pine engraver beetles (*Ips*)
-11 species in AZ
- Western pine beetle
- Roundheaded pine beetle
- Mountain pine beetle
- Southern and Mexican pine beetle (Chiricahua Mts.)
- Larger Mexican pine beetle
- Red turpentine beetle

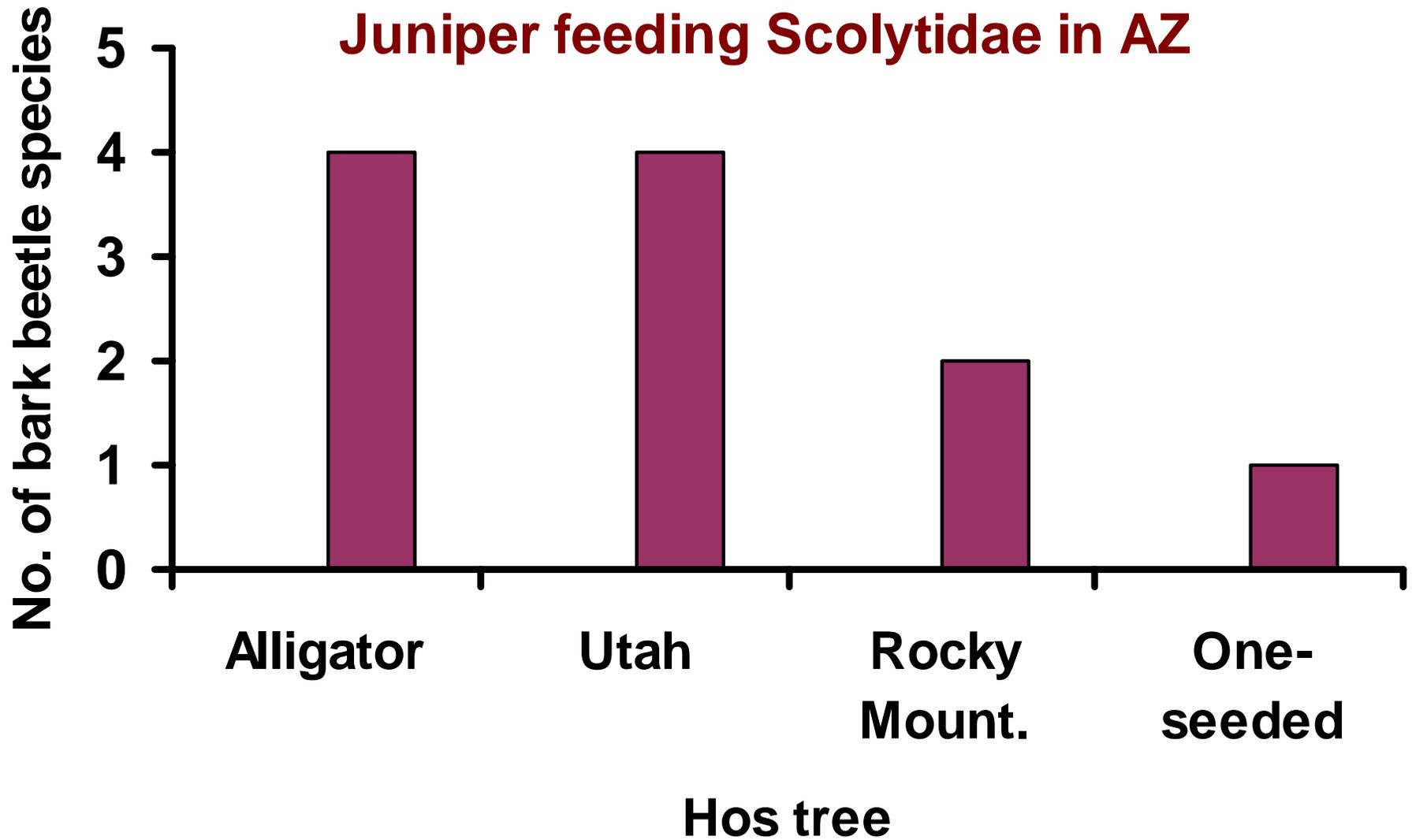


Least important

Pine feeding Scolytidae in AZ



Juniper feeding Scolytidae in AZ



Ponderosa Pine Bark Beetles

Genus	No. of species, %		Available life history information		
			Yes	No	Partial
<i>Ips</i>	12	41.4%	3	6	3
<i>Dendroctonus</i>	6	20.7%	6	0	0
<i>Pityophthorus</i>	4	13.8%	0	4	0
<i>Pityogenes</i>	2	6.9%	0	1	1
<i>Carphoborus</i>	1	3.4%	0	1	0
<i>Hylastes</i>	1	3.4%	0	0	1
<i>Hylurgops</i>	1	3.4%	1	0	0
<i>Pityoborus</i>	1	3.4%	0	1	0
<i>Pityokteines</i>	1	3.4%	0	1	0
	9	29*	10	14	5

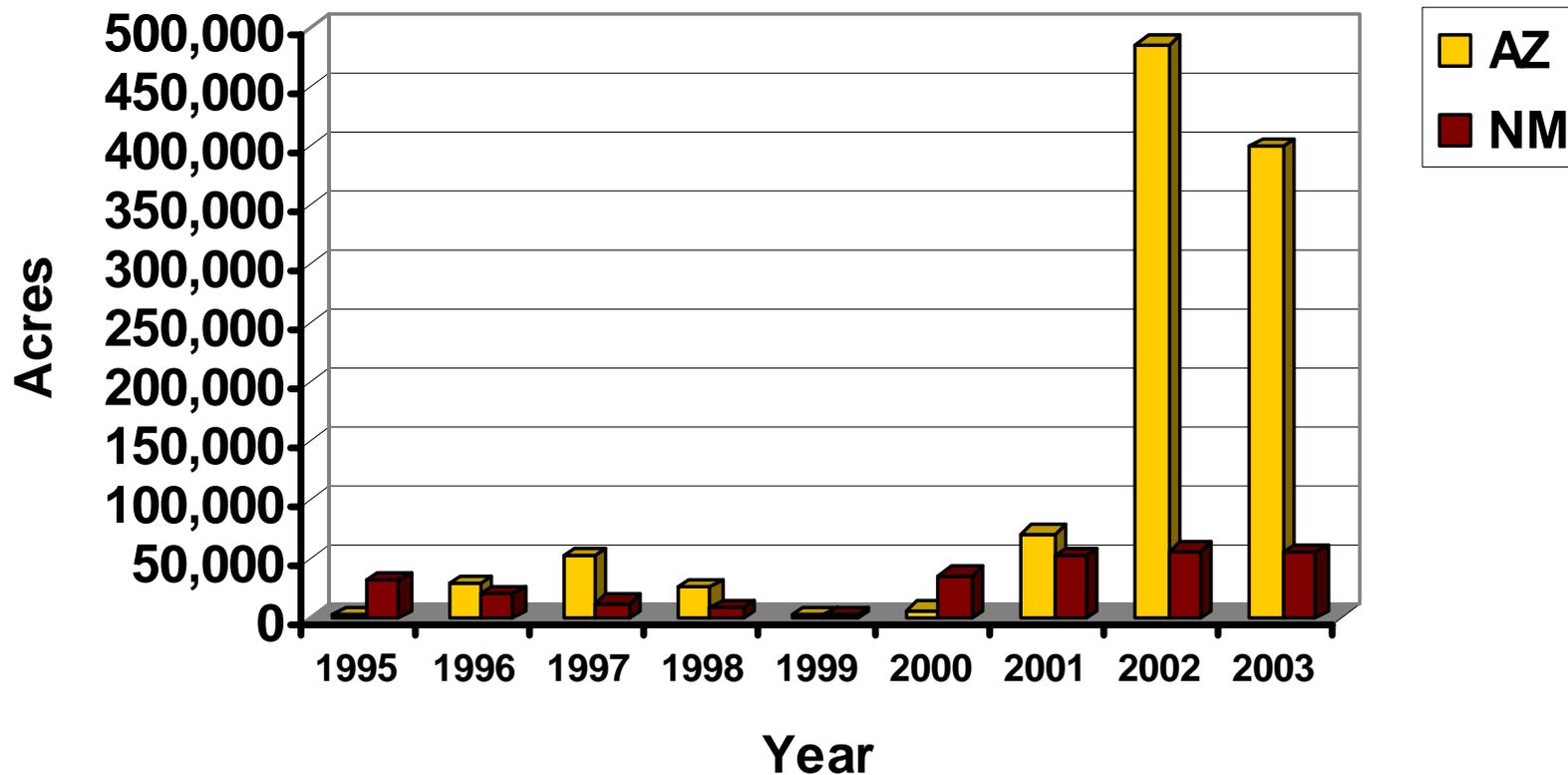
(* potentially 5 additional species to be verified)

Feeding Guild for Ponderosa Pine Bark Beetles

Genus	Species	Twigs	Small branches	Trunks and Large branches	Roots
<i>Ips</i>	12	0	0	12	0
<i>Dendroctonus</i>	6	0	0	6	0
<i>Pityophthorus</i>	4	4	0	0	0
<i>Pityogenes</i>	2	0	0	2	0
<i>Carphoborus</i>	1	x	x	0	0
<i>Hylastes</i>	1	0	0	1	x
<i>Hylurgops</i>	1	0	0	1	x
<i>Pityoborus</i>	1	x	x	0	0
<i>Pityokteines</i>	1	0	0	1	0
9	29*	6	2	23	2

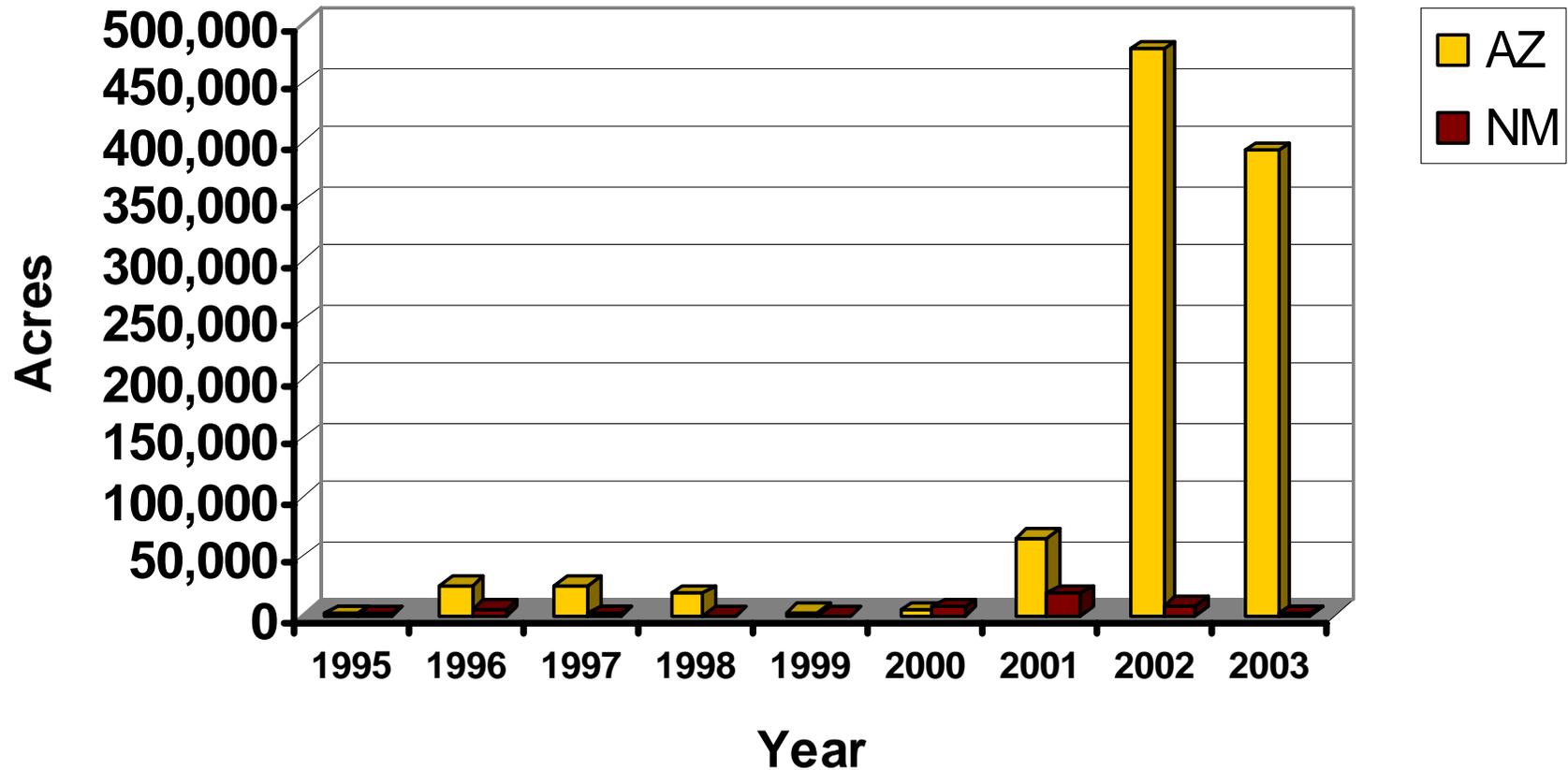
X: feeding on both tissue types; * Potentially 5 additional species to be verified

Ponderosa pine mortality caused by *Dendroctonus* and *Ips* spp. complex in AZ and NM, 1995-2003



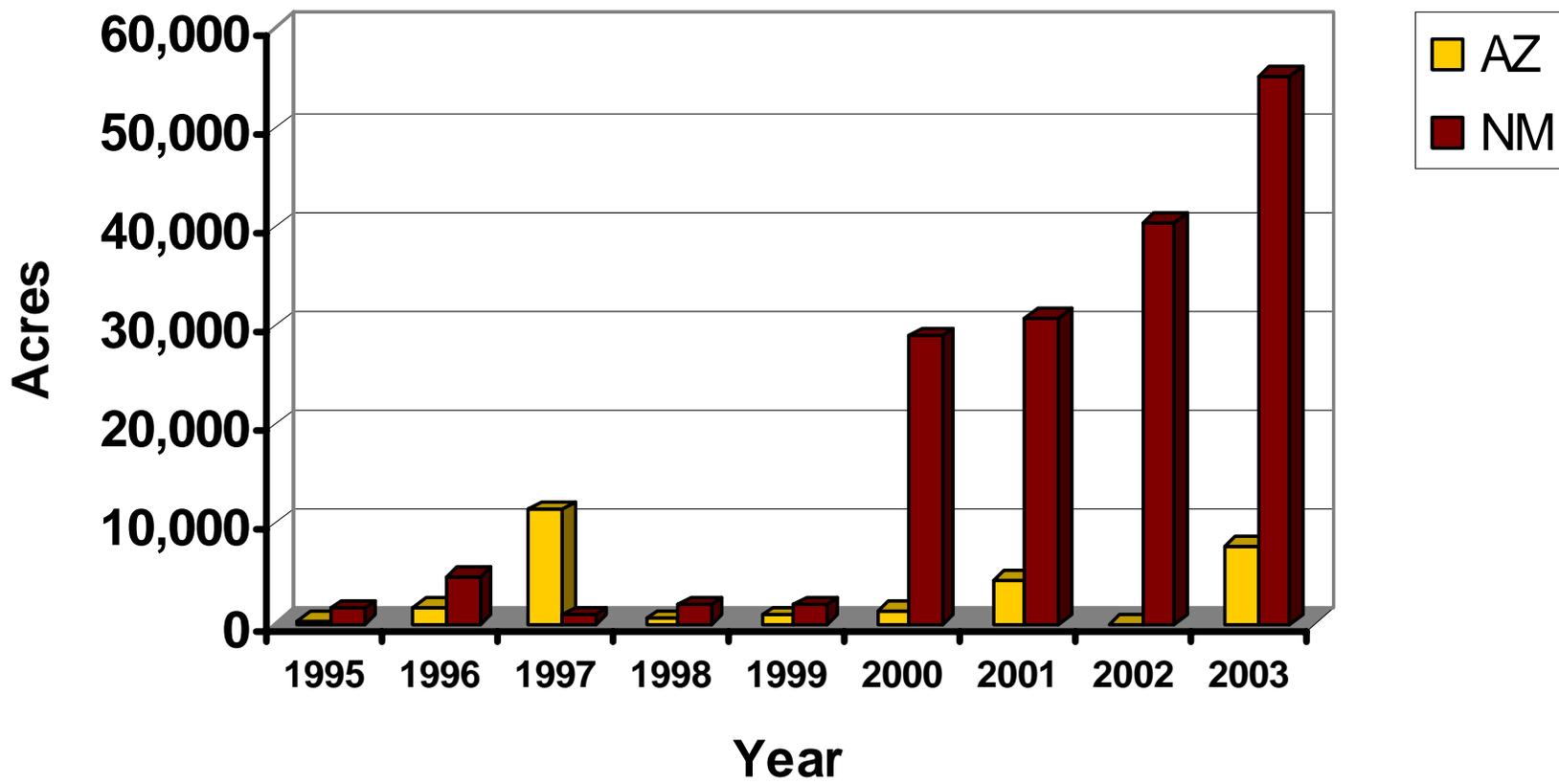
(Sources: Forest Insect and Disease Conditions in the SW Region, 1995-2003)

Ponderosa pine mortality caused by *Ips* beetles in AZ and NM, 1995-2003



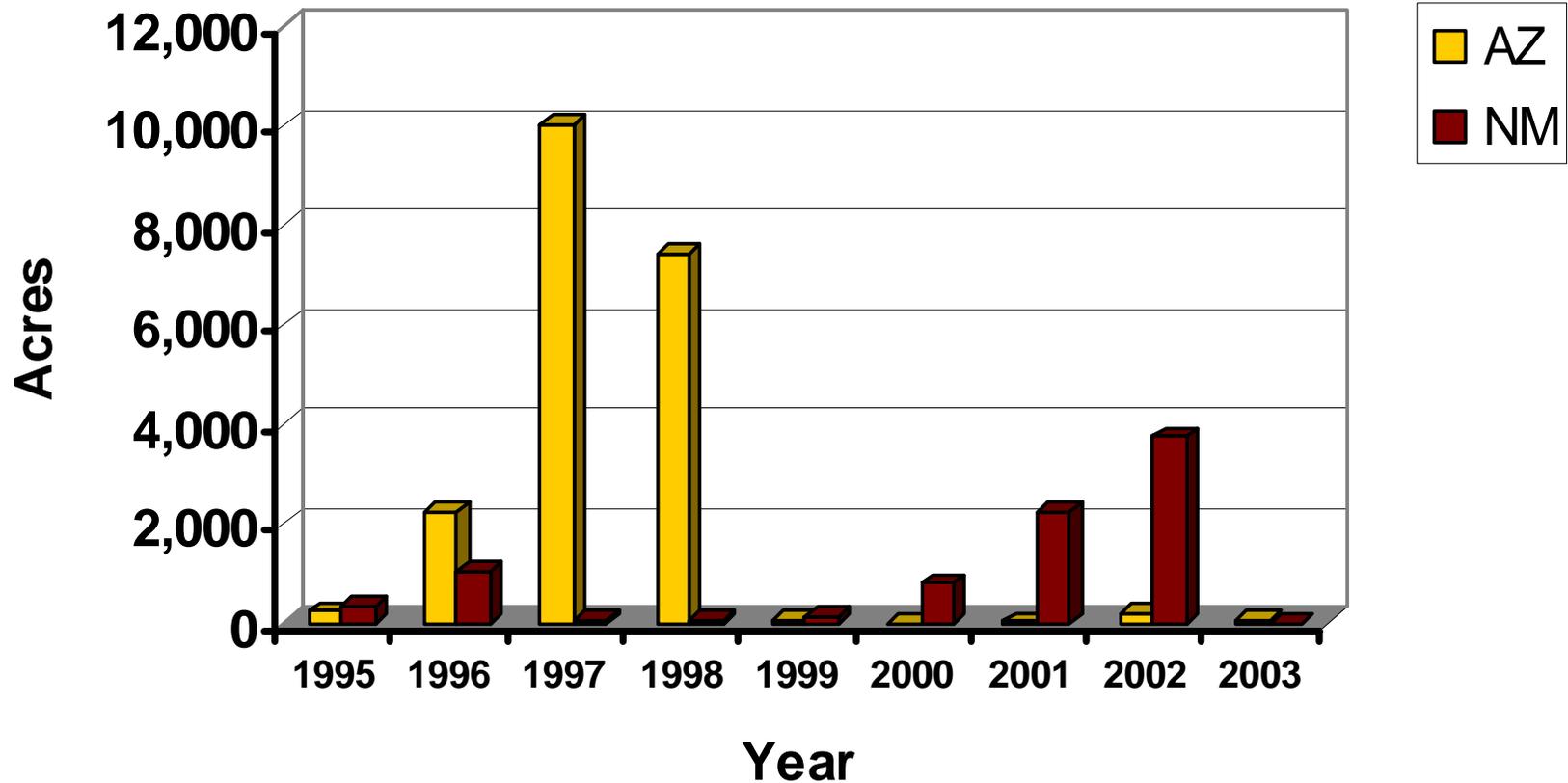
(Sources: Forest Insect and Disease Conditions in the SW Region, 1995-2003)

Ponderosa pine mortality caused by Western pine beetles in AZ and NM, 1995-2003



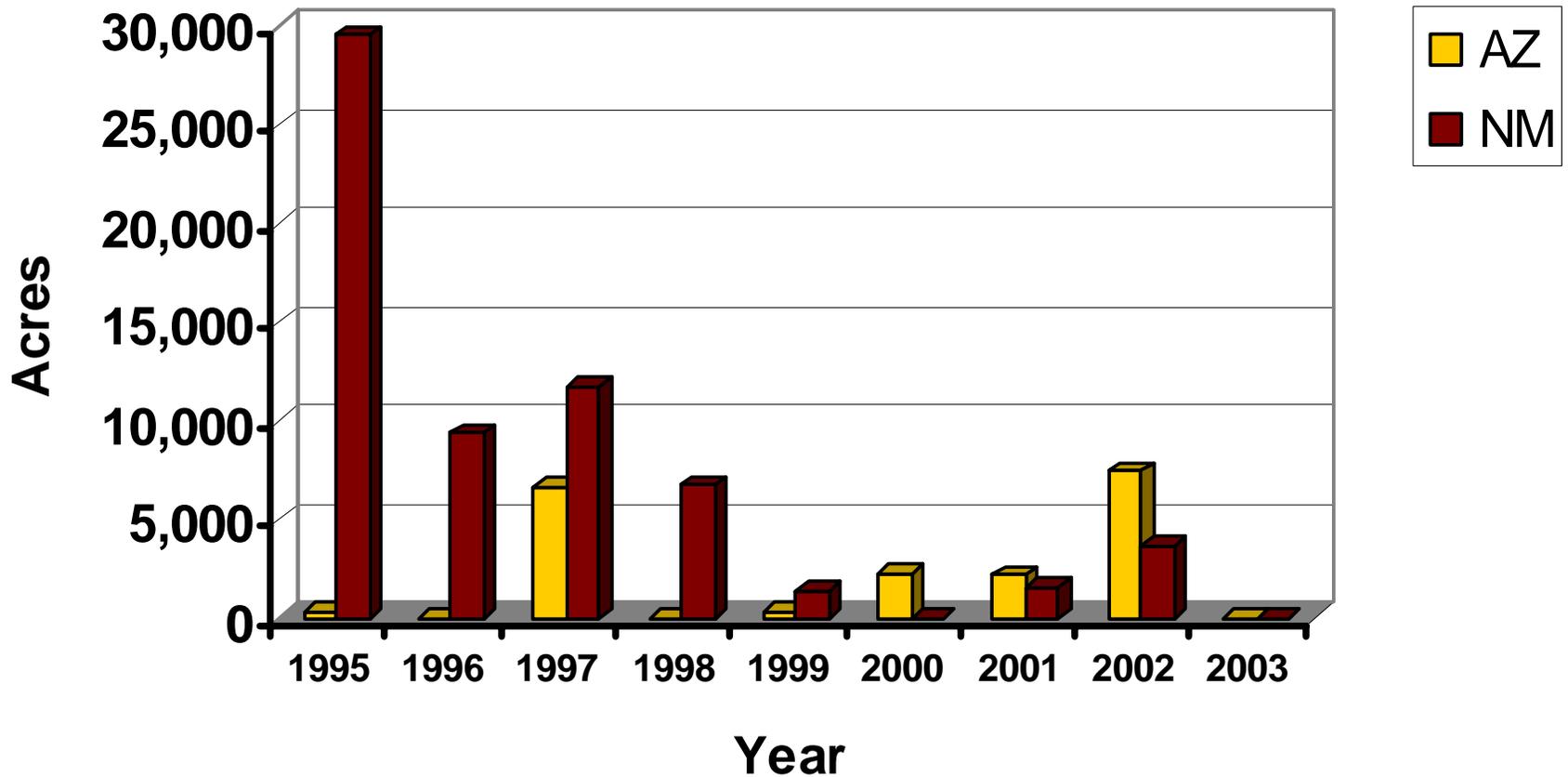
(Sources: Forest Insect and Disease Conditions in the SW Region, 1995-2003)

Ponderosa pine mortality caused by Mountain pine beetles in AZ and NM, 1995-2003



(Sources: Forest Insect and Disease Conditions in the SW Region, 1995-2003)

Ponderosa pine mortality caused by Roundheaded pine beetles in AZ and NM, 1995-2003

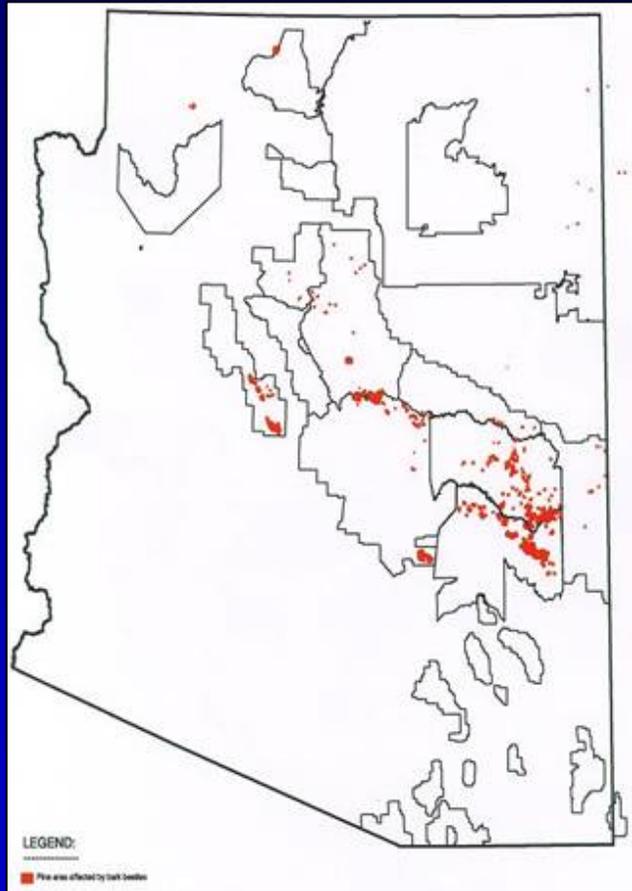


(Sources: Forest Insect and Disease Conditions in the SW Region, 1995-2003)

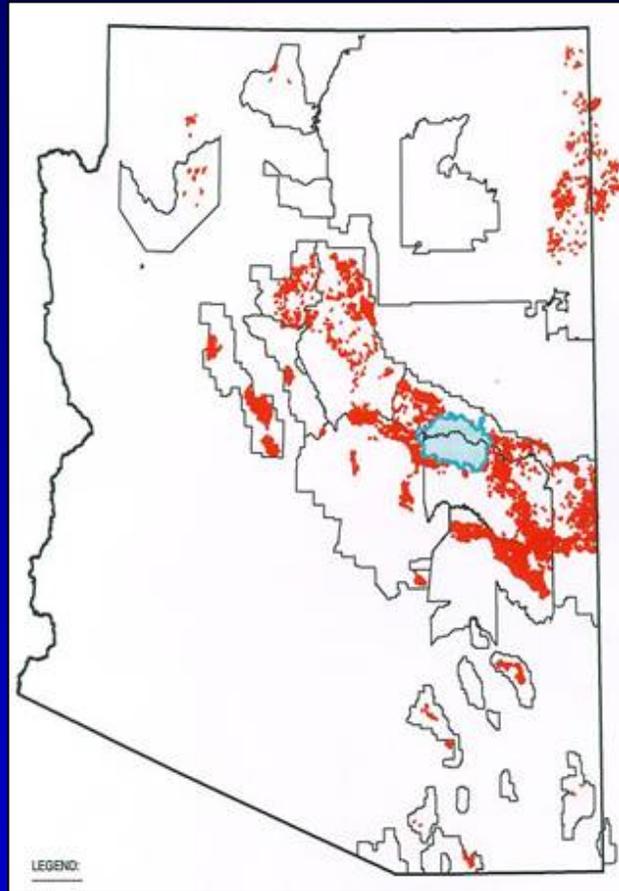
The meaning of acres of bark beetle mortality

- **Area of bark beetle activity**
- **Intensity of mortality varies with activity polygon**
- **Qualitative decision made during aerial survey**
- **Same acre can have mortality over several years**
- **Number of dead trees estimated**

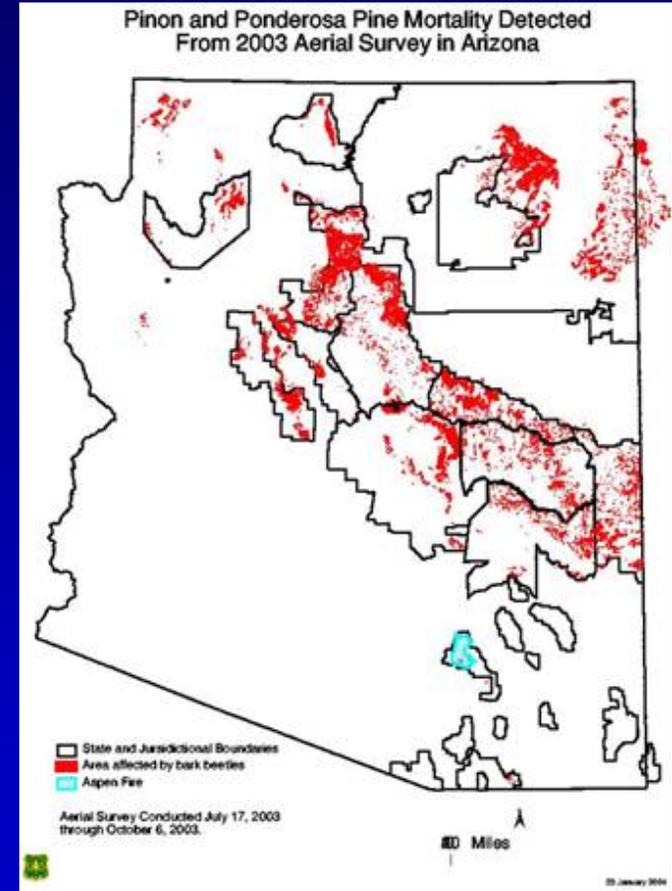
Pinon and ponderosa pine mortality detected from aerial survey in Arizona, 2001-2003



2001



2002



2003









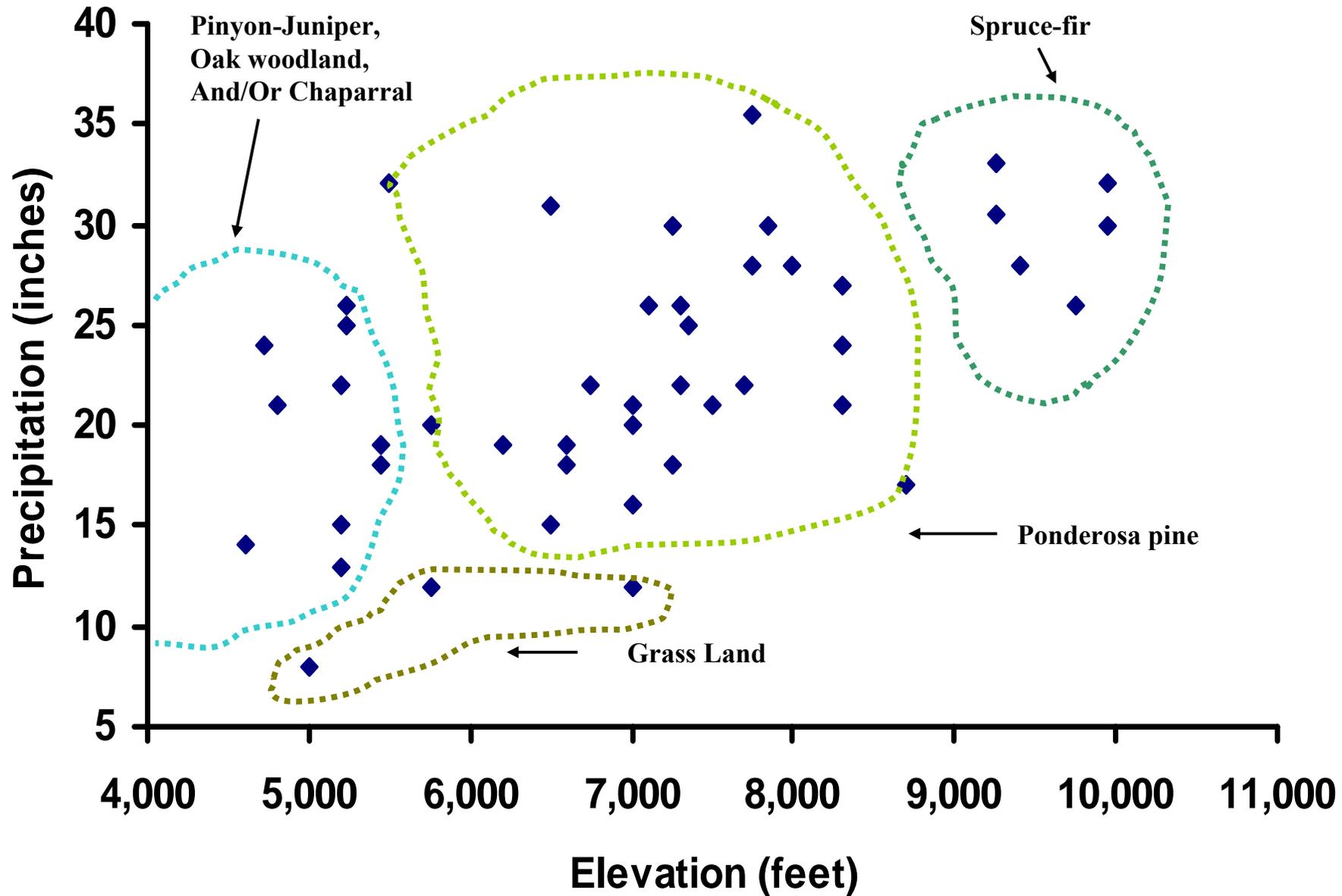






DO NOT
ENTER

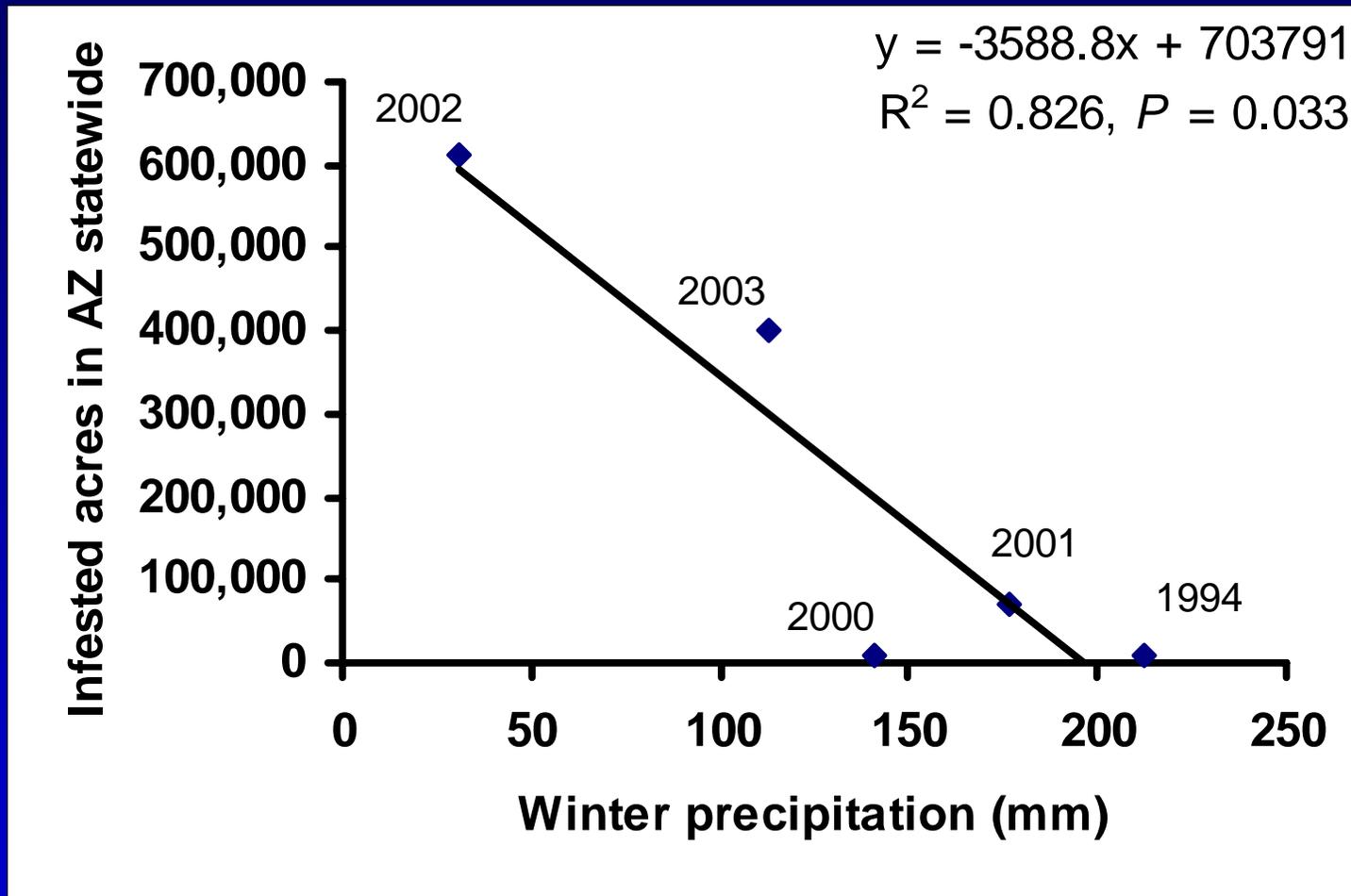




Drought or Bark Beetles?

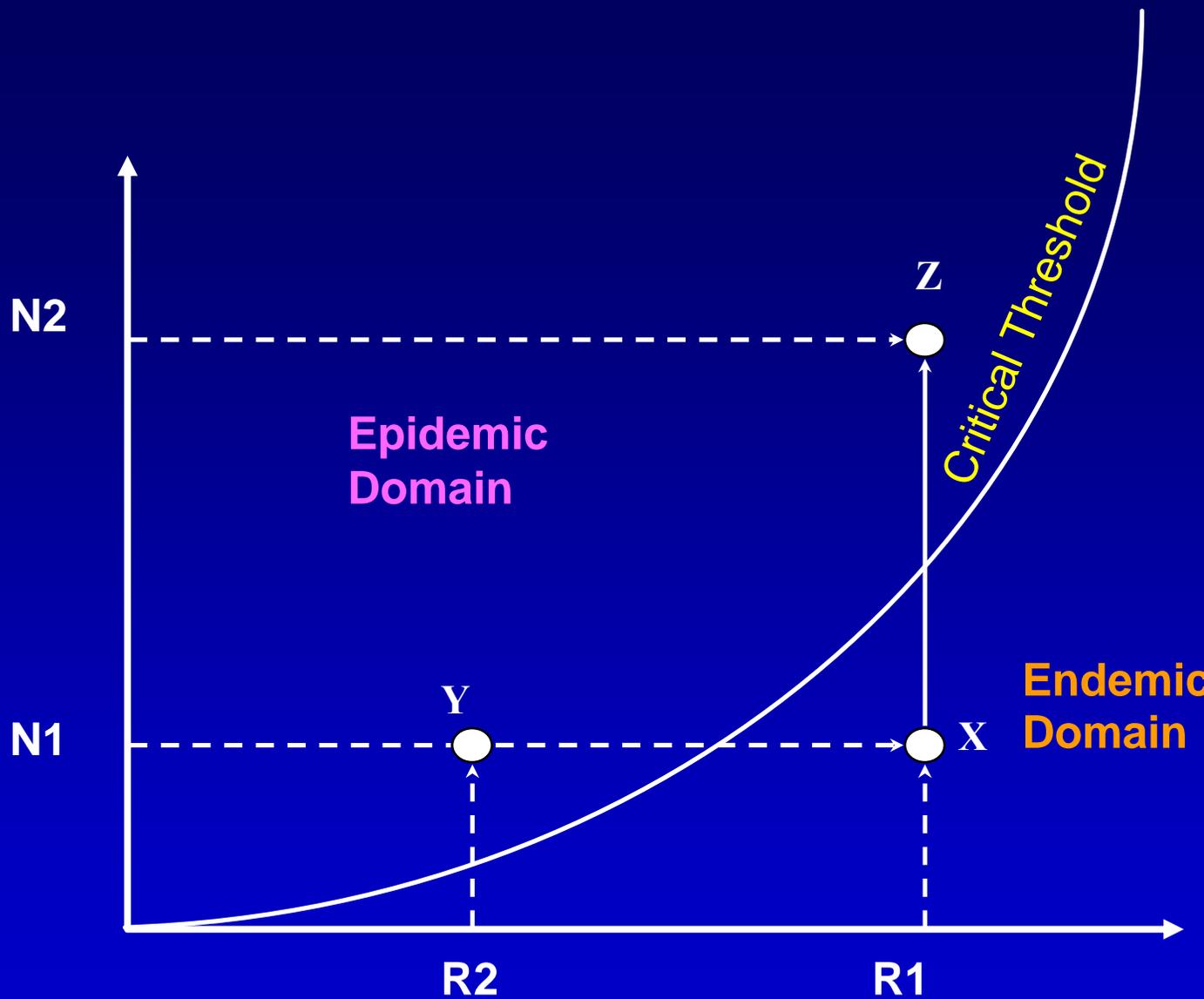
- **Correlation of bark beetles and drought**
- **Anecdotal reports of death w/o bark beetles**
- **Little evidence from skilled necropsy**
- **Rigorous experimental test is lacking**
- **Drought as inciting agent**
- **Conceptual understanding of inciting factors versus sustaining factors**
- **Does it matter?**

Relationship between bark beetle infested acres and winter precipitation (January to April)



(Bark beetle species included the complex of *Dendroctonus brevicomis*, *D. ponderosae*, *D. adjunctus*, and *Ips spp.* on ponderosa pine)

↑
Beetle #'s



Host Resistance →

Does It Matter?

- **Drought can cause direct mortality**
- **Bark beetles can cause direct mortality**
- **Bark beetles require suitable host**
- **Outbreaks can persist after drought ends**
- **Active management (thinning) can reduce the risk of both drought and bark beetle mortality**

Southwest (AZ/NM) Ponderosa Pine Bark Beetle Research

- **≈ 40 Studies (manuscript)**
- **80% in Progress**
- **80% Flagstaff Based (NAU, RMRS, FHP)**
- **≈ 95% Federal Funds**

Ponderosa Pine Bark Beetle Research Topics

- **Stand structure, density, restoration effects**
- **Tree physiology, resistance**
- **Life history, seasonal and elevational patterns**
- **Ecological effects (mistletoe, birds, CWD)**
- **Prevention and tree protection**

Important Research Questions

- **Can stand/landscape scale treatments mitigate bark beetle outbreak?**
- **Are current fuel risk reduction treatments well suited for reducing bark beetle risk?**
- **What will be the combined effect of thinning from below and bark beetles on future forest?**

Important Research Questions (Continued)

- **Which aspects of bark beetle community structure, life history strategy, and natural enemies are most important to population dynamics?**
- **Long-term economic, social, and ecological effects of widespread loss of Arizona forests?**
- **Are current monitoring tools (pheromone, aerial detection) adequate?**

Summary

- ✓ **Unprecedented tree mortality in SW**
- ✓ **Probably drought induced**
- ✓ **Likely related to overstocked forest condition**
- ✓ **Outbreak will continue for several years**
- ✓ **Paucity of basic understanding of all aspects of bark beetles**
- ✓ **Coordinated SW research program needed**