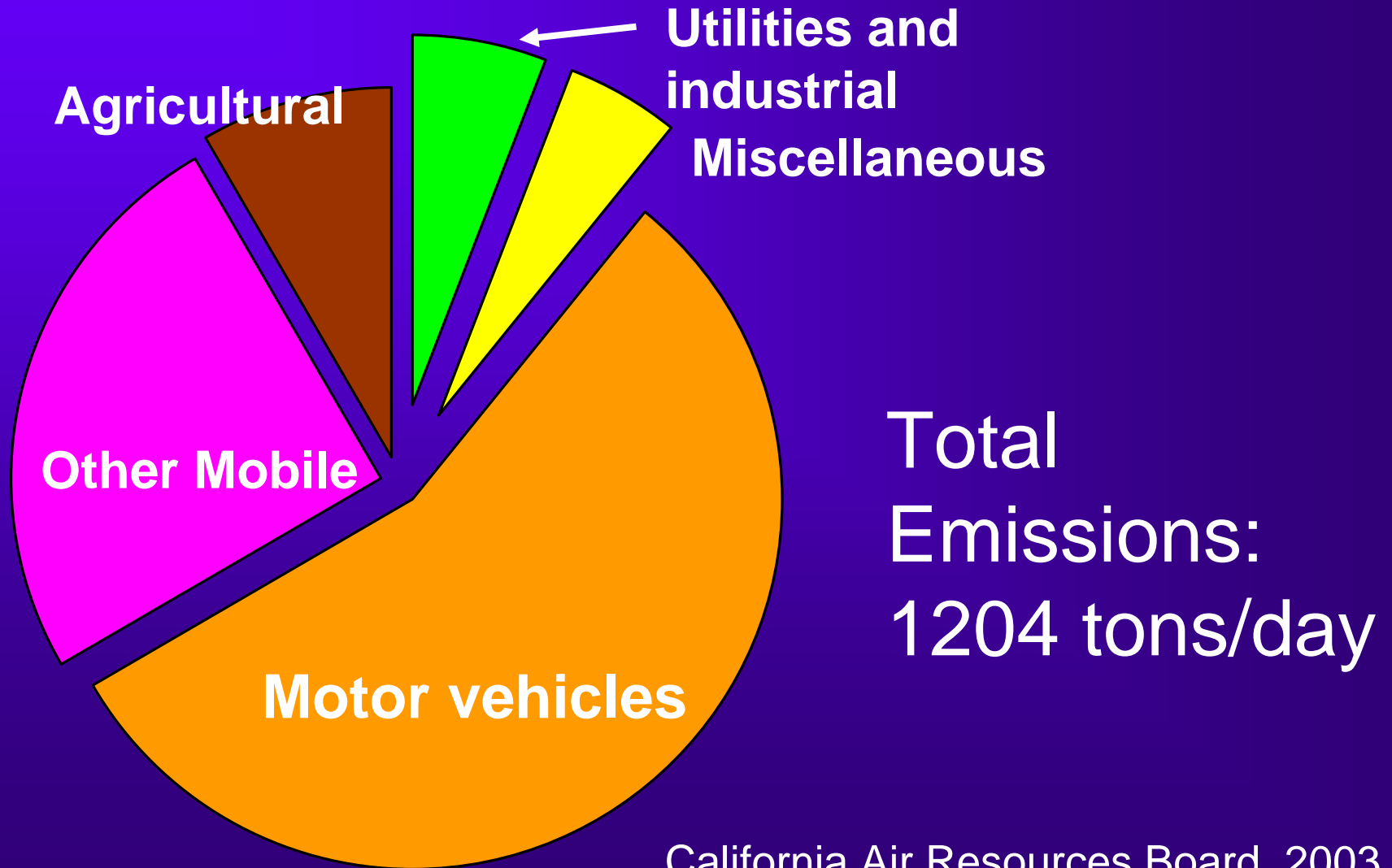


# Effects of nitrogen additions on insects of pine and oak

Michele Eatough Jones

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# Sources of Atmospheric N in S. California





- **High nitrogen inputs**
  - Increase plant growth
  - Increase nutrient status of foliage
- **Ozone**
  - Decrease plant growth rates
  - Change patterns of carbon allocation

# Effects on Ponderosa Pine

- Extremely ozone sensitive
  - decreased growth
  - decreased root mass
  - needle loss
- Increased foliar nitrogen

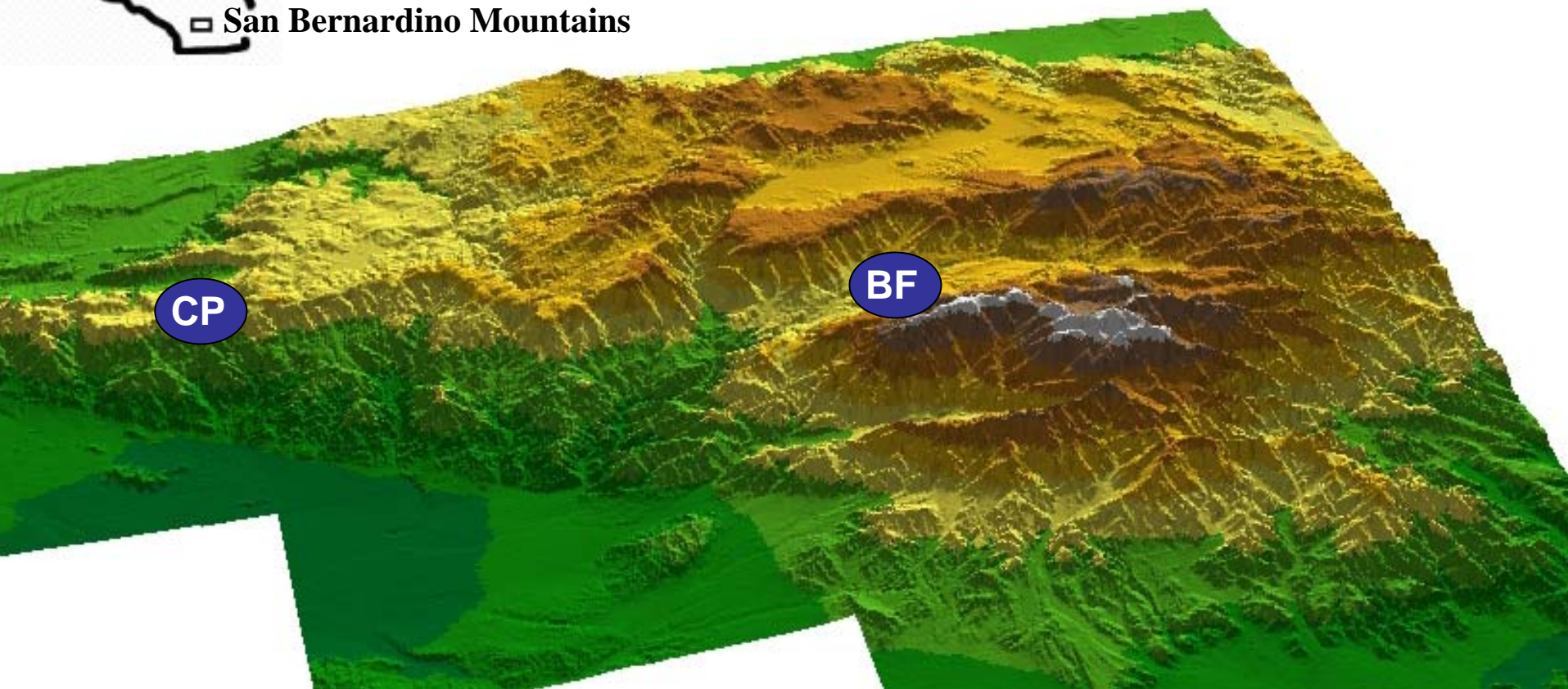


western pine beetle  
*Dendroctonus*  
*brevicomis*

mountain pine beetle  
*D. ponderosae*



San Bernardino Mountains



Map courtesy of the Atmospheric Deposition Group  
USDA Pacific Southwest Research Station

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	BF	CP
Ozone, summer peak (ppb)	91.3	101.6
N deposition: under pine kg/ha/yr	18	194
stand total	8	82
Elevation (m)	1900	1600
Annual precipitation (mm)	534	994

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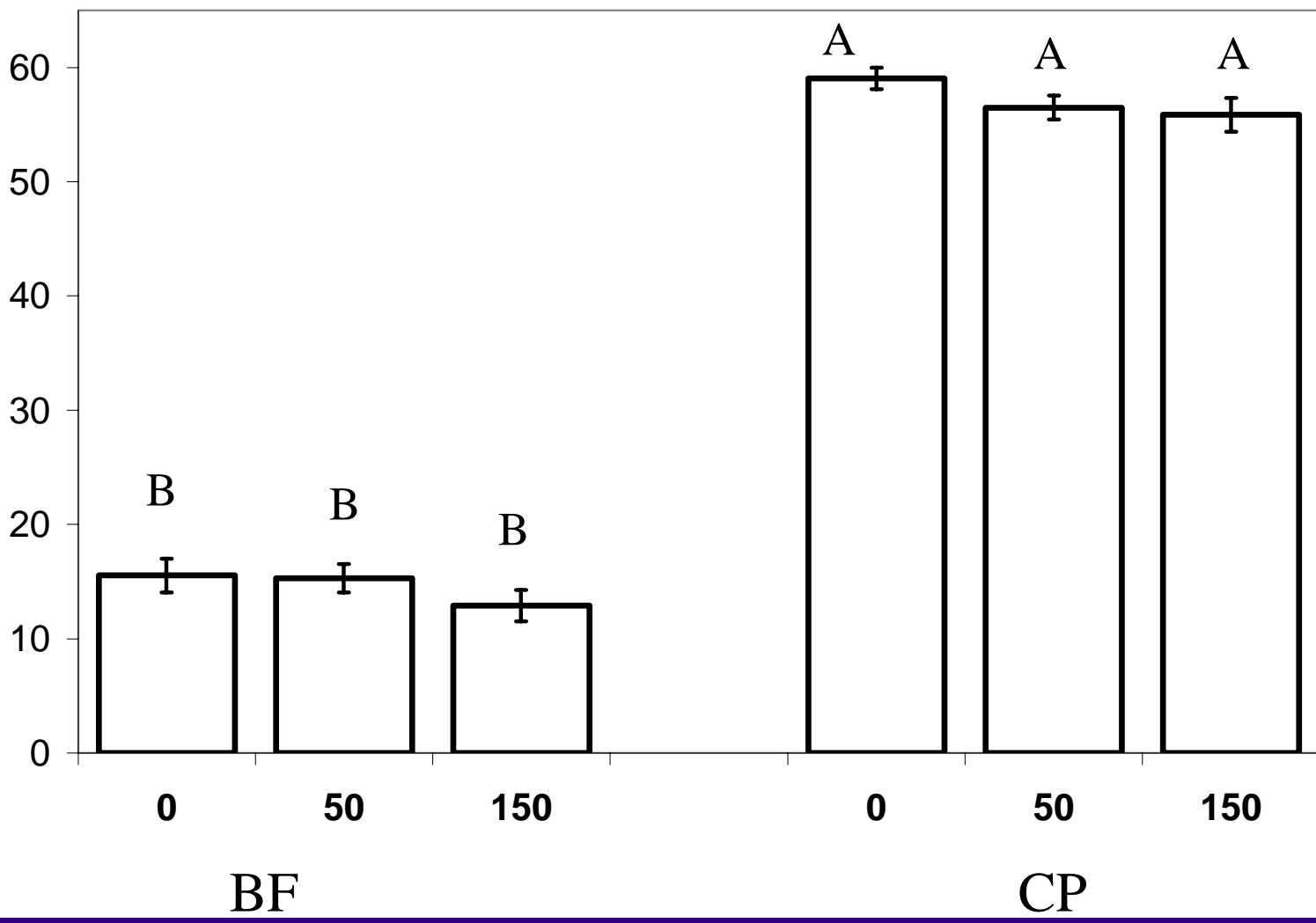
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	Total estimated N	
<b>N added</b>	<b>BF</b>	<b>CP</b>
<b>kg/ha/yr</b>	<b>Low pollution</b>	<b>High pollution</b>
<b>0</b>	<b>8</b>	<b>82</b>
<b>50</b>	<b>58</b>	<b>132</b>
<b>150</b>	<b>158</b>	<b>232</b>

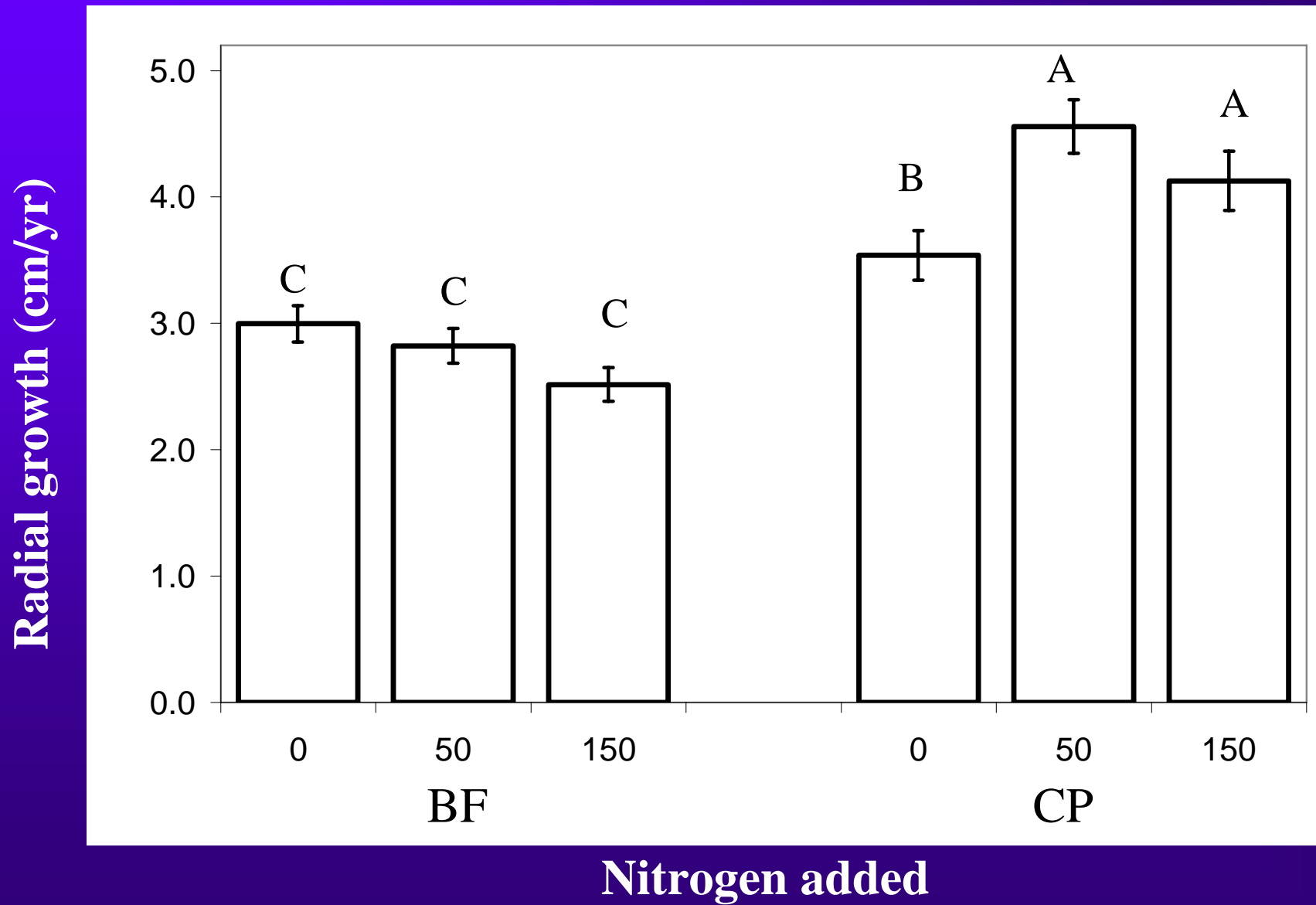
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**Ozone injury index**



**Nitrogen added**



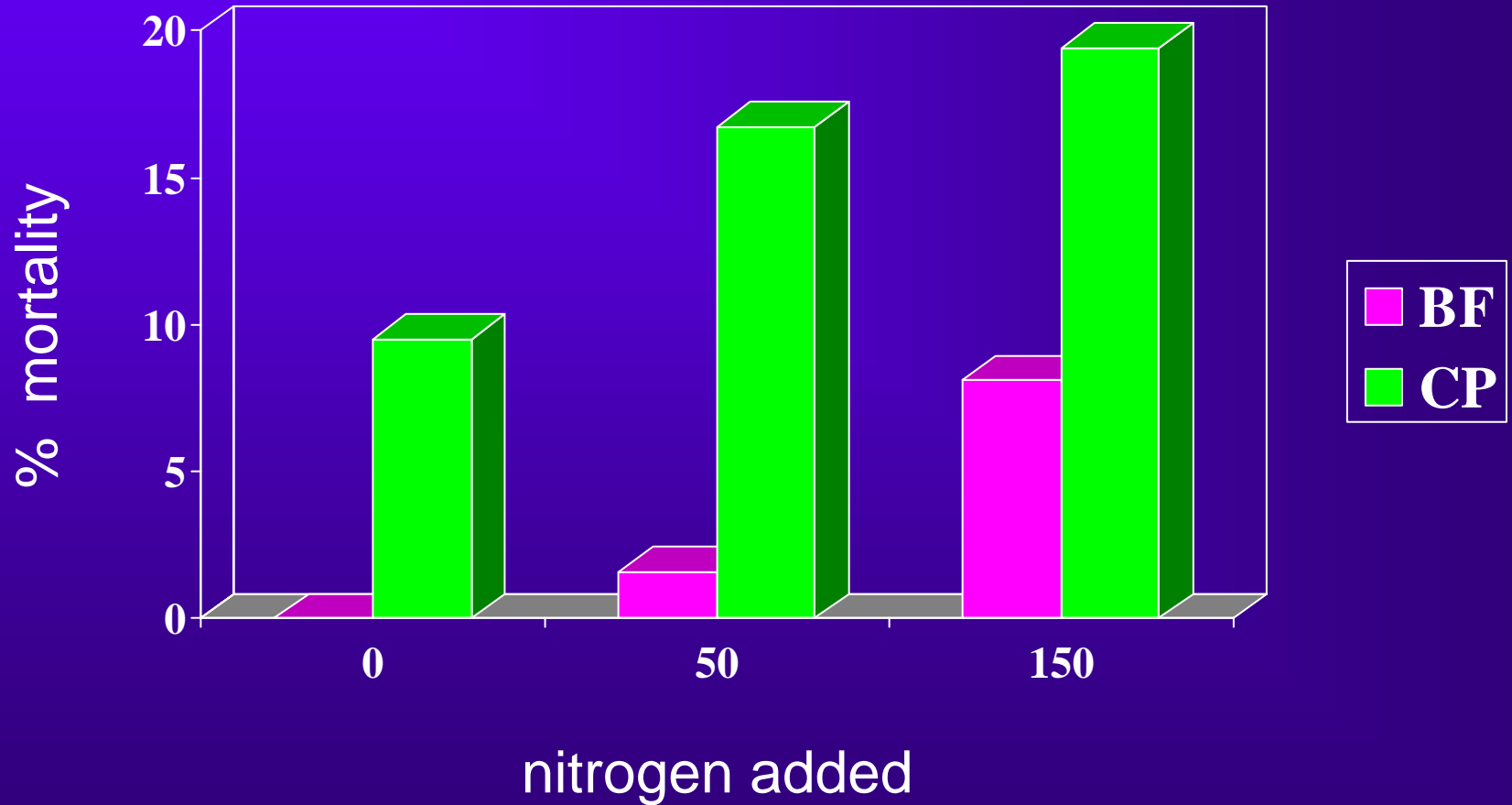


- 2 sites
- 3 levels of N
- 60 trees

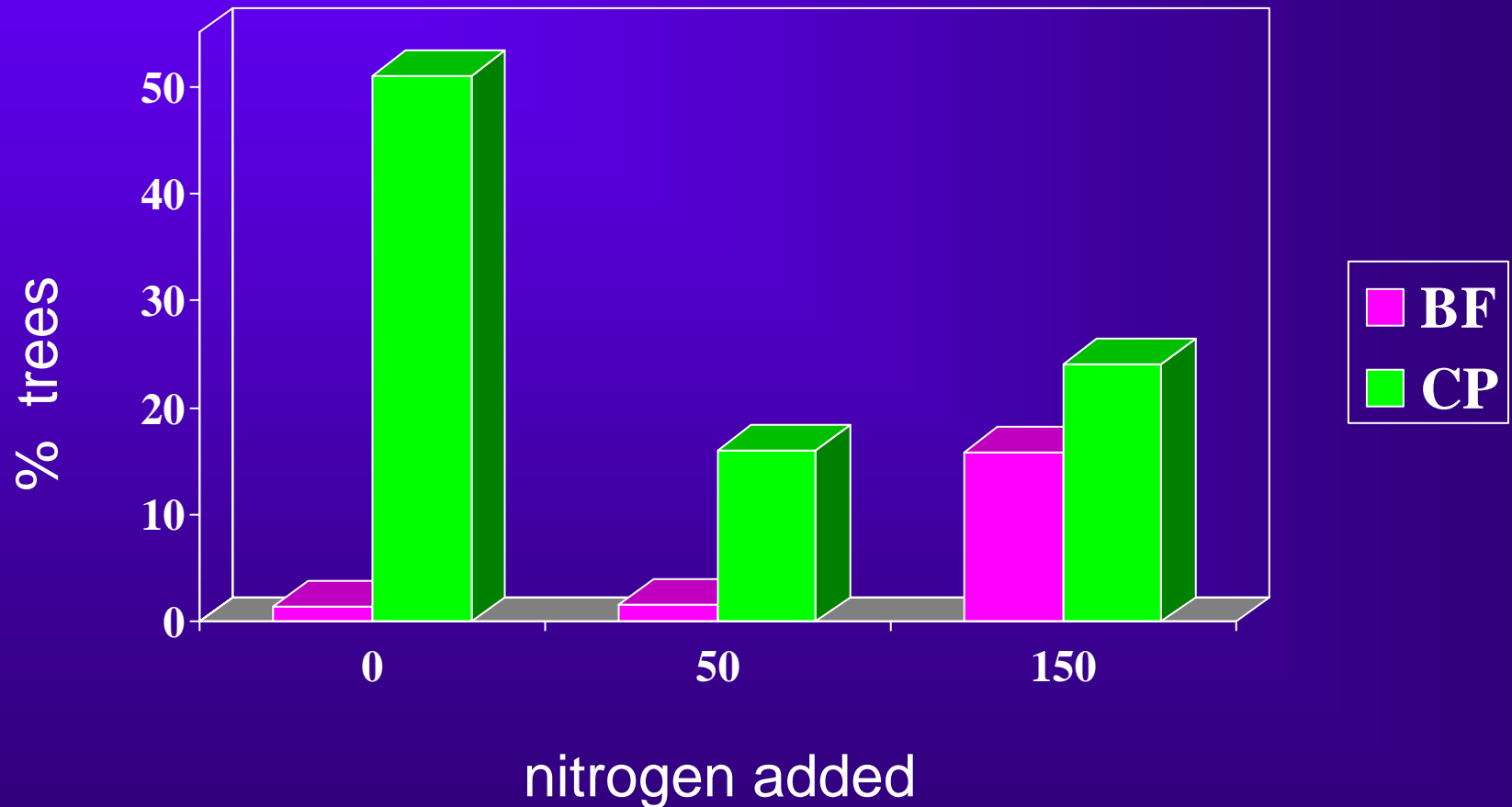




# Tree Mortality



# Trees with beetle activity



# Stepwise logistic regression

			Wald's $\chi^2$	p
Mortality	BF	N added	4.55	0.03
	CP			
Activity	BF	N added	12.16	<0.01
	CP	Growth	8.28	<0.01
		Ozone injury	4.47	0.03

# Summary

- **Low pollution site:**
  - Nitrogen additions
    - increased tree mortality
    - increased beetle activity
- **High pollution site:**
  - Higher tree mortality & beetle activity
  - Activity high on control plots
    - lower growth rate
    - slightly higher ozone injury



# Effects on vegetation

- California black oak
  - Moderately ozone sensitive
    - decreased growth
    - increased litterfall
  - Increased foliar nitrogen

# Methods

**Foliage collected 4 times  
per year 1998-2000**

**10 samples/treatment**

**Insects identified to family  
and morphospecies**

**samples pooled by tree for  
all 3 years**



# Community Structure Analysis

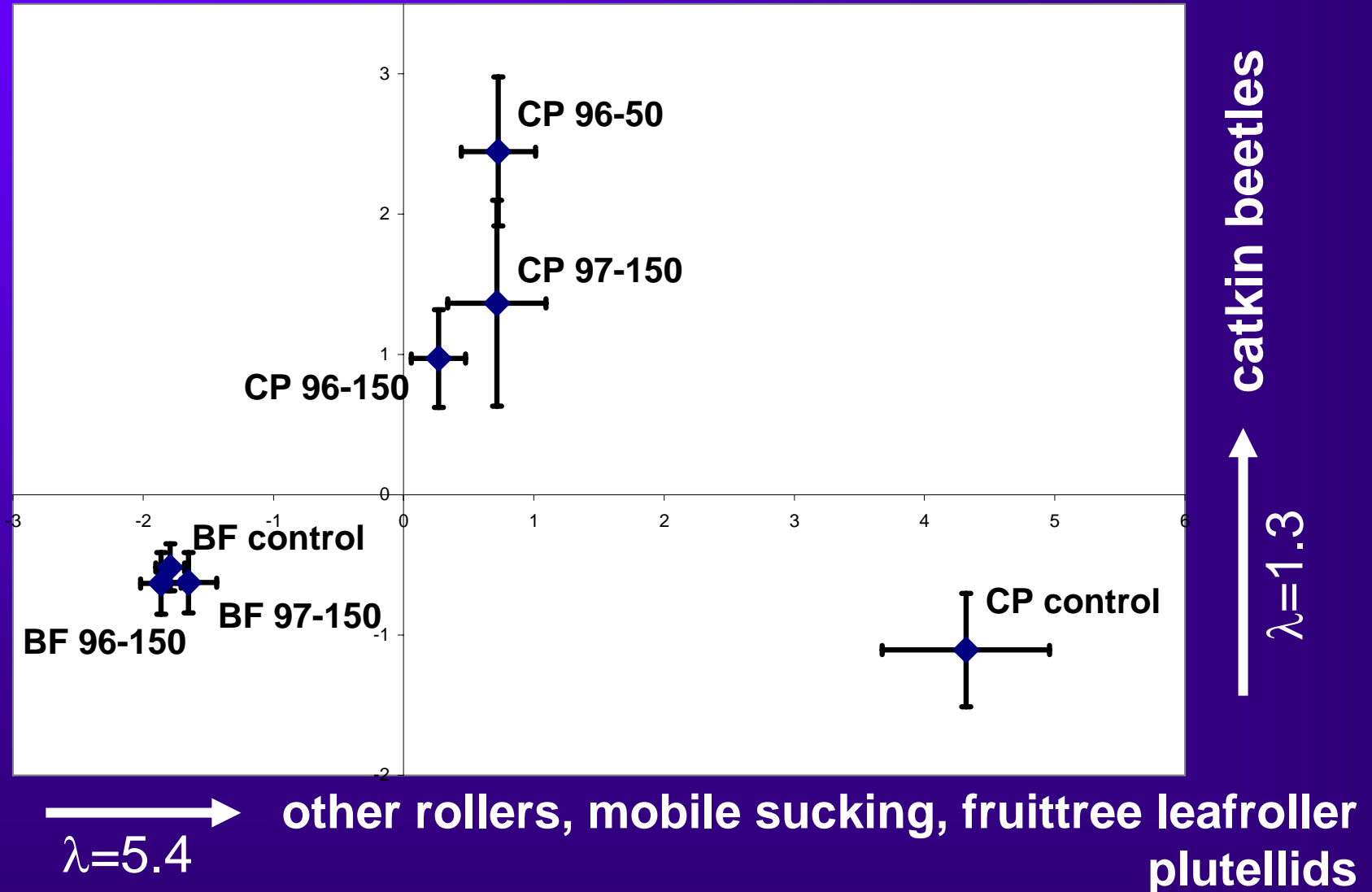
- Discriminant Function Analysis

Most abundant herbivore taxa were represented individually

Less abundant taxa grouped by family or feeding guild

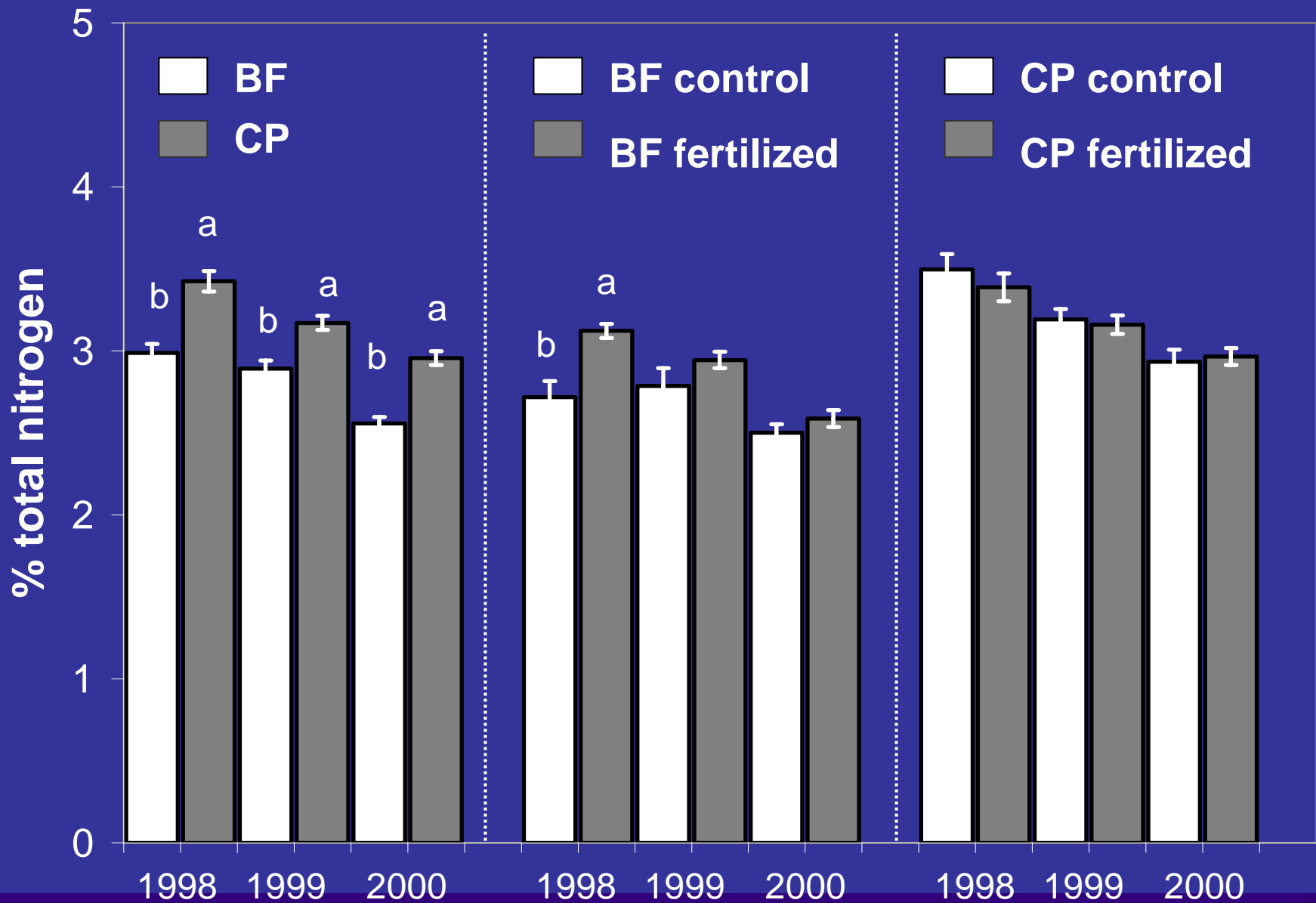
Each axis on DF graphs is a combination of all herbivore groups

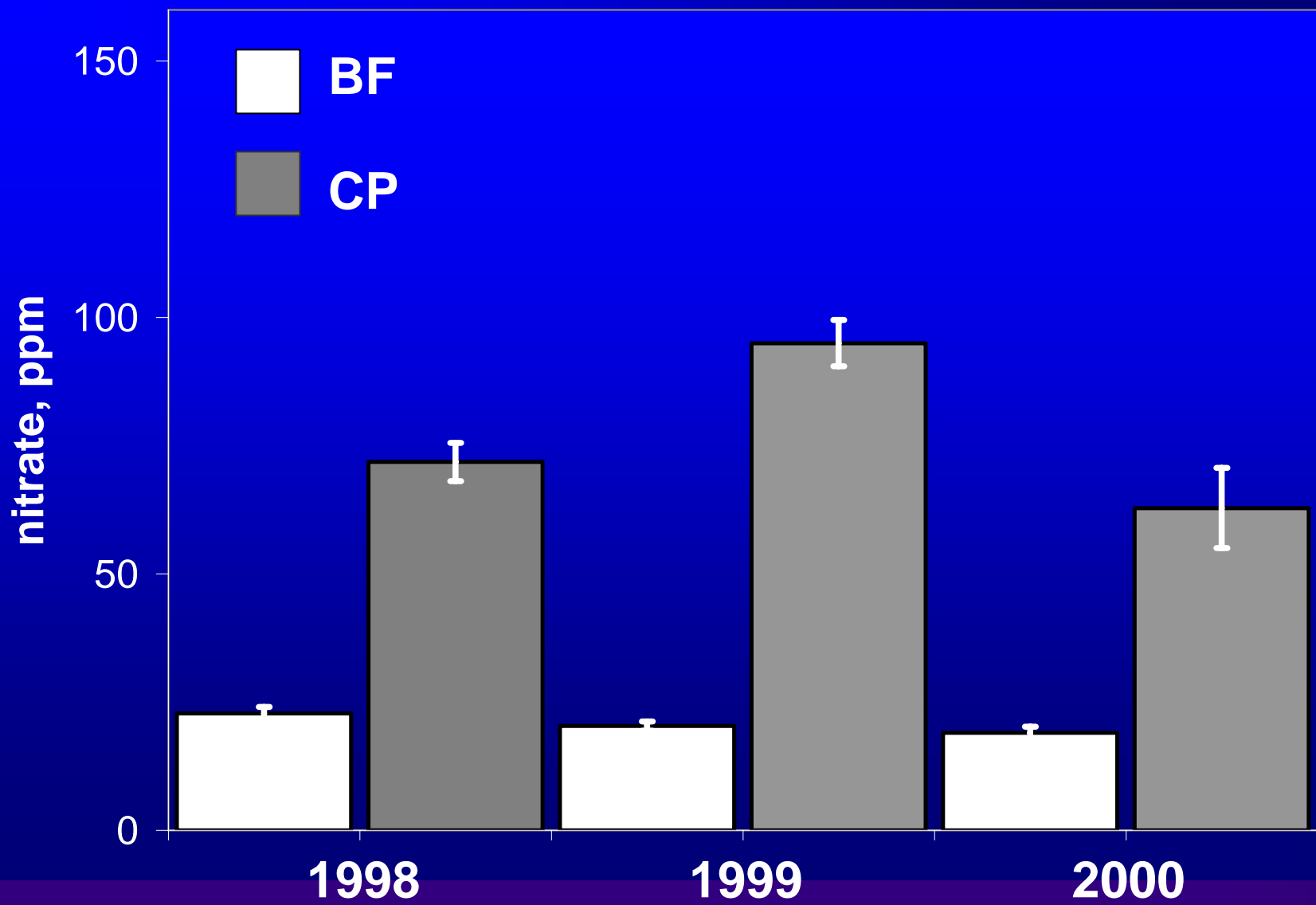
# Oak herbivore communities



# Effect of fertilization on plant N

- Low pollution site:
  - Fertilization did not increase foliar N
- Why?
  - Water limitation
  - Litter layer and nitrogen cycling
  - Ozone drives site differences





# Herbivores that distinguished sites

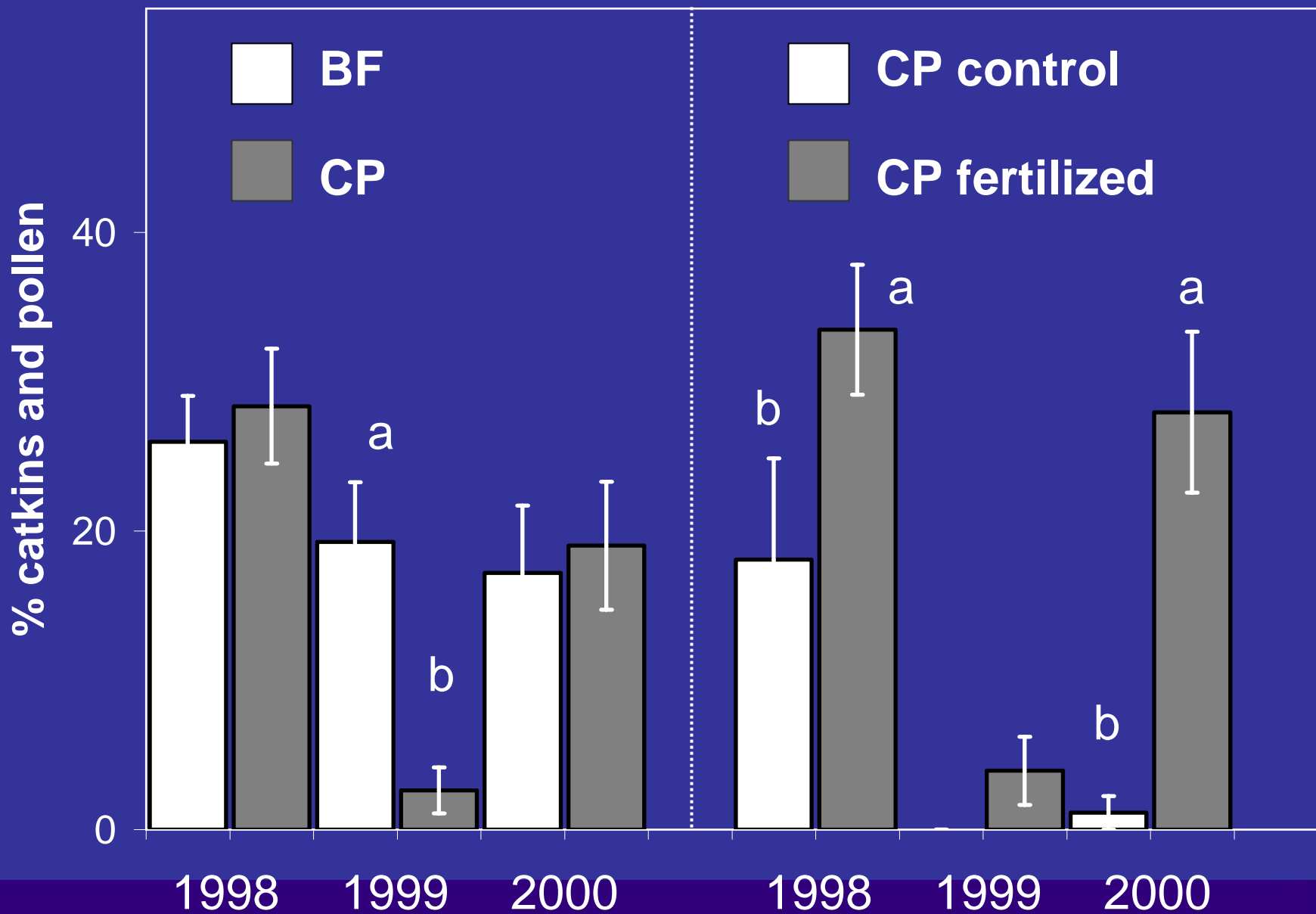
## Associated plant characteristics

Pearson's correlation coefficients  
significant at  $\alpha < 0.05$

Fruittree leafroller	Plutellids	Mobile sucking
Total N		
Nitrate	Nitrate	Nitrate

# Why nitrate?

- Normally a feeding deterrent
- Other components of total N
  - soluble protein
  - amino acids



# Pearson Correlation Coefficients

Catkin beetle with foliage variables

	r	P
% water	-0.15	0.26
Total N	0.25	0.05
% catkins & pollen	0.45	0.0005

# Summary: Oak communities

- Differences between sites
  - Associated with plant nitrogen
- Low pollution site N response: NO
  - expected increased chewing herbivores
- High pollution site N response
  - higher pollen production
  - increased pollen-feeding beetles

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**Mark Poth**

- **UC Riverside:**

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**Richard Redak**

**J. Daniel Hare**

**Edith Allen**

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**Sarah Allen**

**Idara Essien**

**Jocelyn Holt**

**Victor Bebtchouk**

**Katherine Lurhing**

**Linda Bybee**

**Jennifer Charles**

**Clare Casteel**

**Darcy Reed**

**John Kabashima**

**Heather Yaffee**

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