Urban Crossroads: Integration of Earth, Life, and Social Sciences in the City

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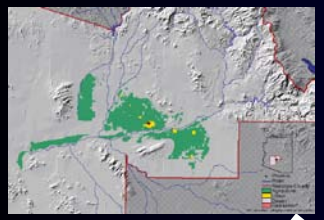
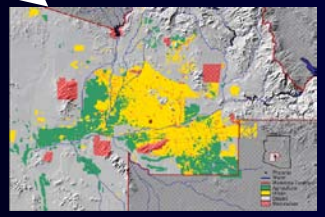
CAP LTER
Central Arizona-Phoenix
Long-Term Ecological Research

land use &
cover change





altered biogeochemical
cycles

People
& cities

altered
hydrology

climate change

biodiversity loss

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The imperatives of urban ecology

- Changing the culture
  - Bias favors “pristine” ecosystems
  - Humans separate from nature
- Studying cities as ecosystems
- Developing new approaches to incorporate humans into models of (urban) ecosystems
- Modifying ecological theory to fit highly modified systems

Urban ecosystems demand an interdisciplinary approach

- Land-cover change – remote sensing, geography
- Legacies – archaeology, historical ecology
- Intense human modifications, extensive built structure – engineering, geology
- Individual and societal decisions – social sciences
- Design of nature – planning, landscape architecture, engineering, sociology
- and more….

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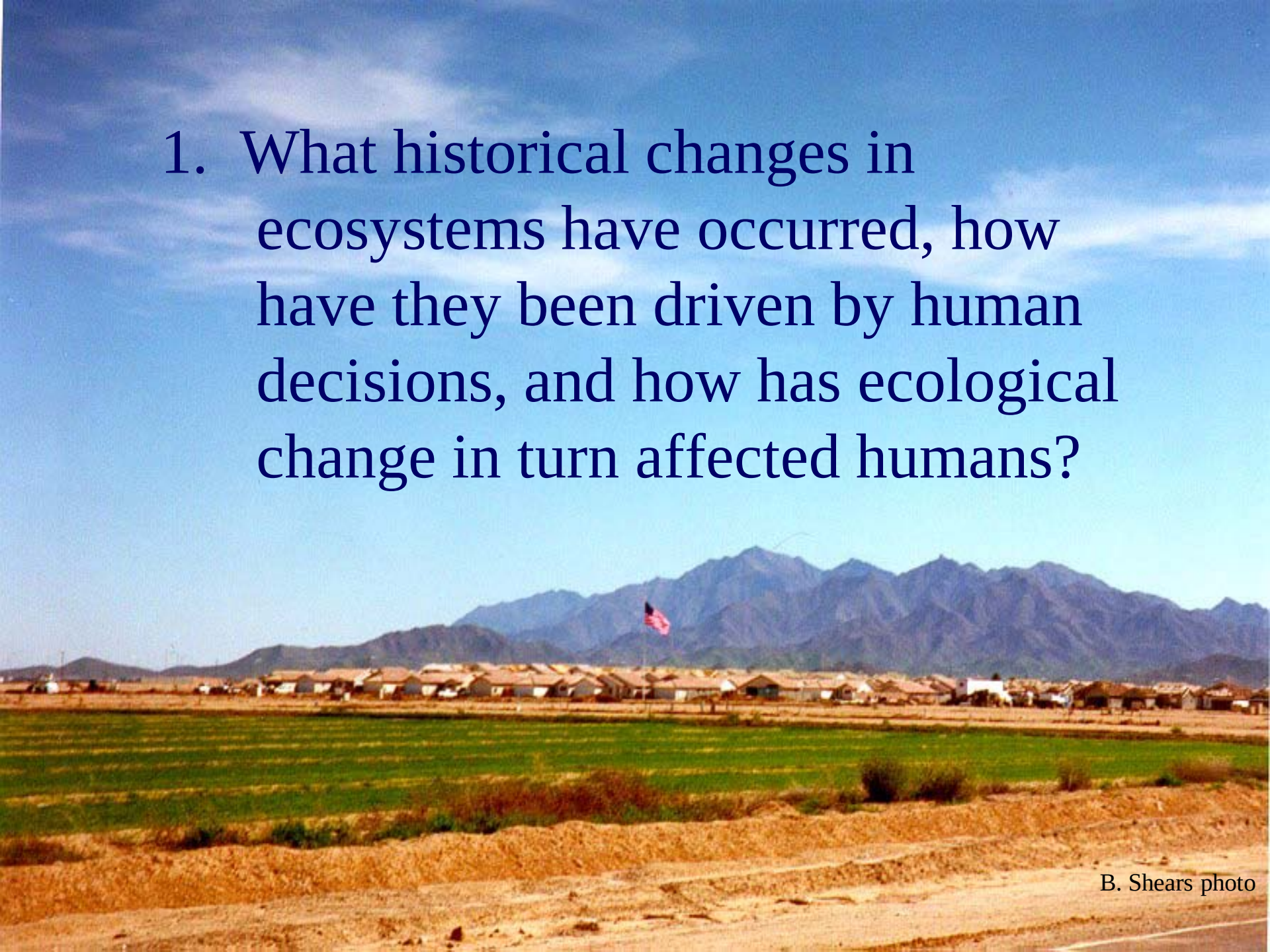
Opportunity for a new kind of training

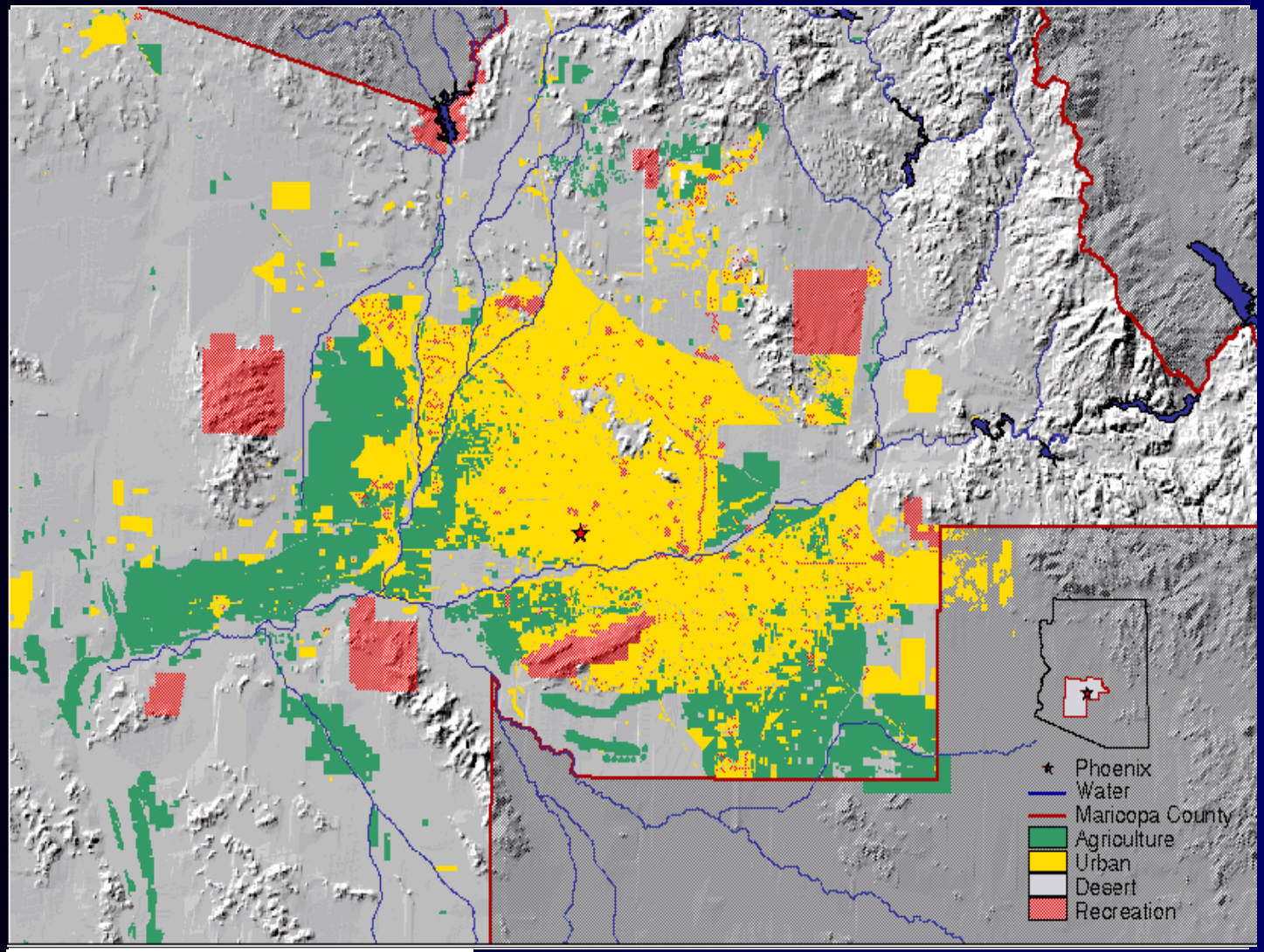
- Interdisciplinary research
- Policy and management relevance
- Collaboration

1. What historical changes in ecosystems have occurred, how have they been driven by human decisions, and how has ecological change in turn affected humans?



B. Shears photo

Central Arizona - Phoenix Historic Land Use 1912-1995



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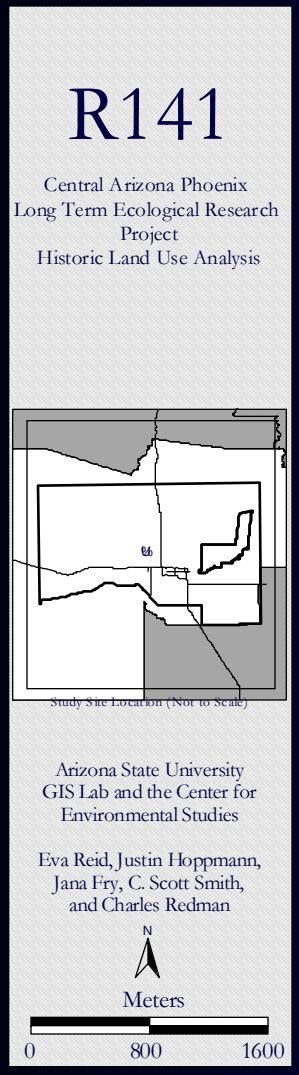
Central Arizona – Phoenix Long-Term Ecological Research

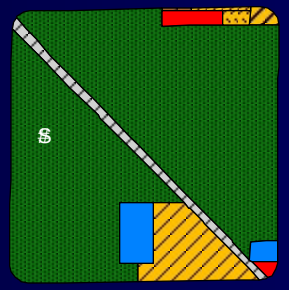
1912 1934 1955 1975 1995

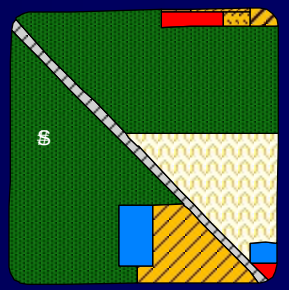
10 km

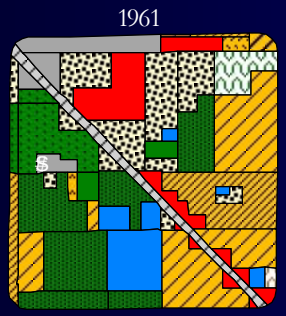
Knowles-Yanez et al. 1999

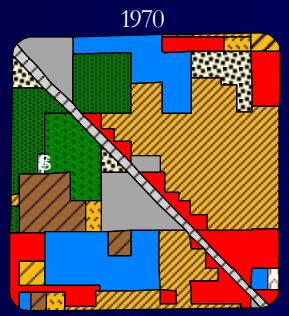
Analysis of historical land-use change

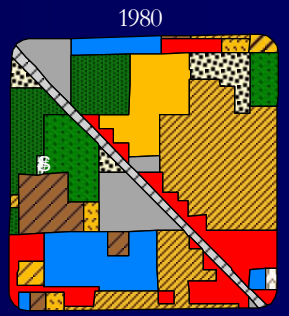


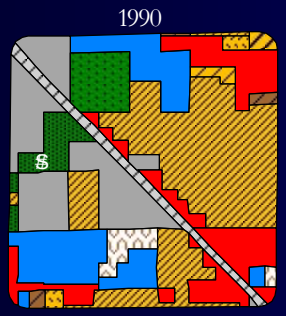


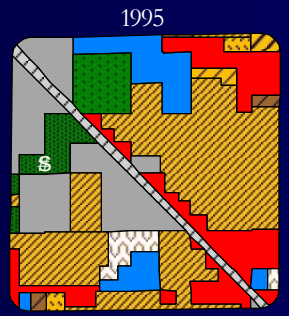


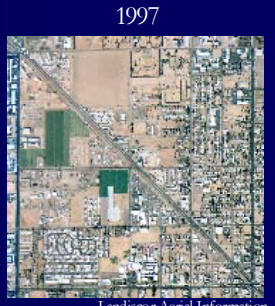








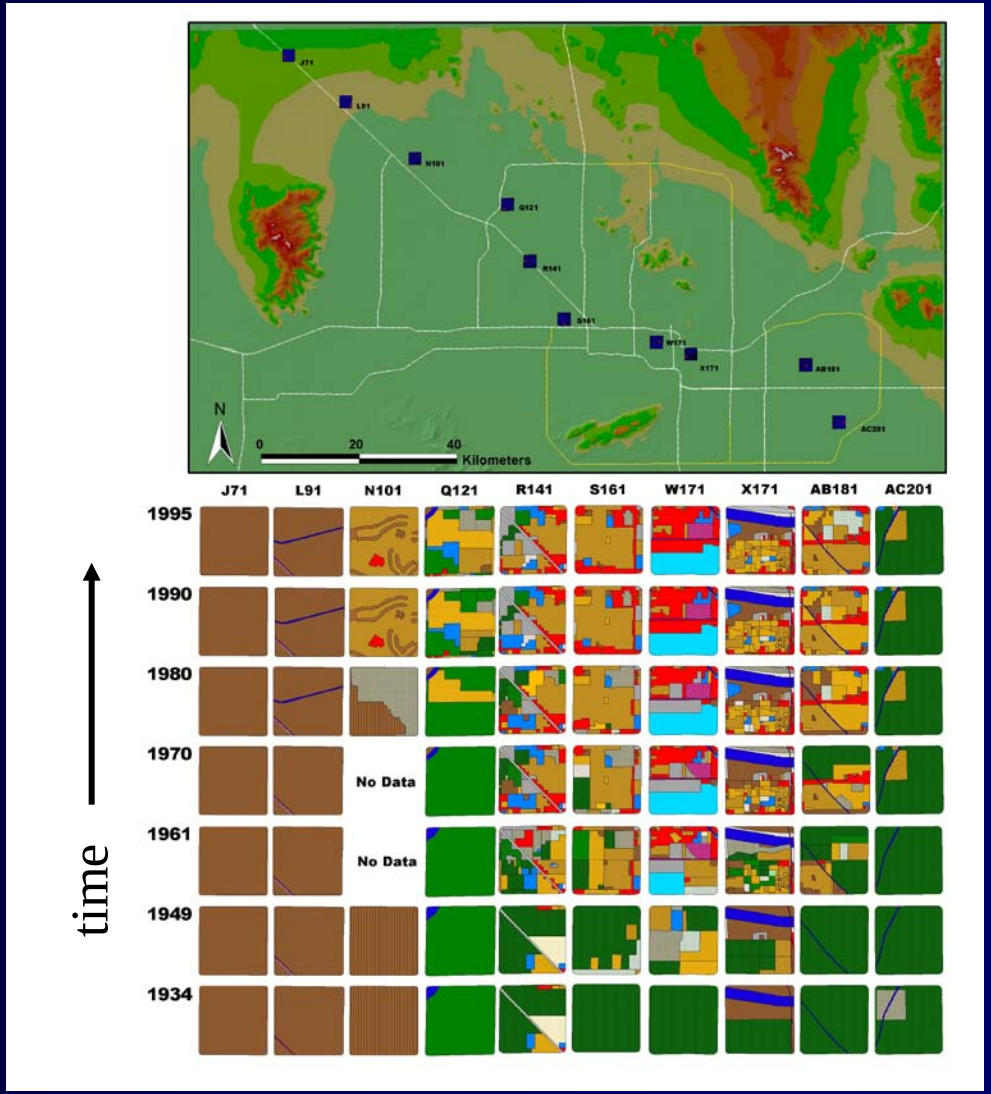




J Fry et al. unpublished

Analysis of historical land-use change

- Trajectories of Land Use along Urban Gradient



J Fry et al., unpublished

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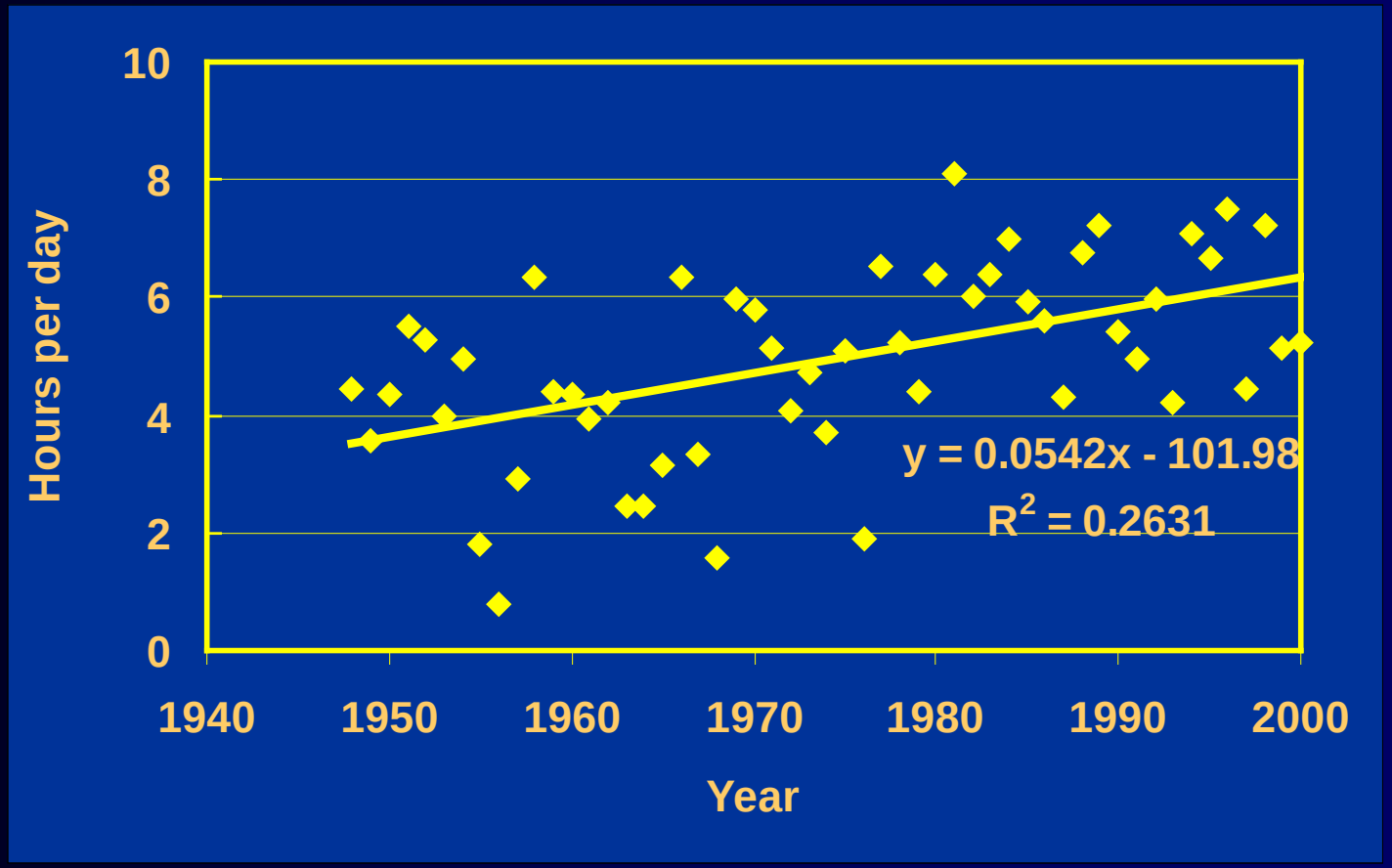
J Fry et al. unpublished

Summertime Human Comfort in Metro Phoenix

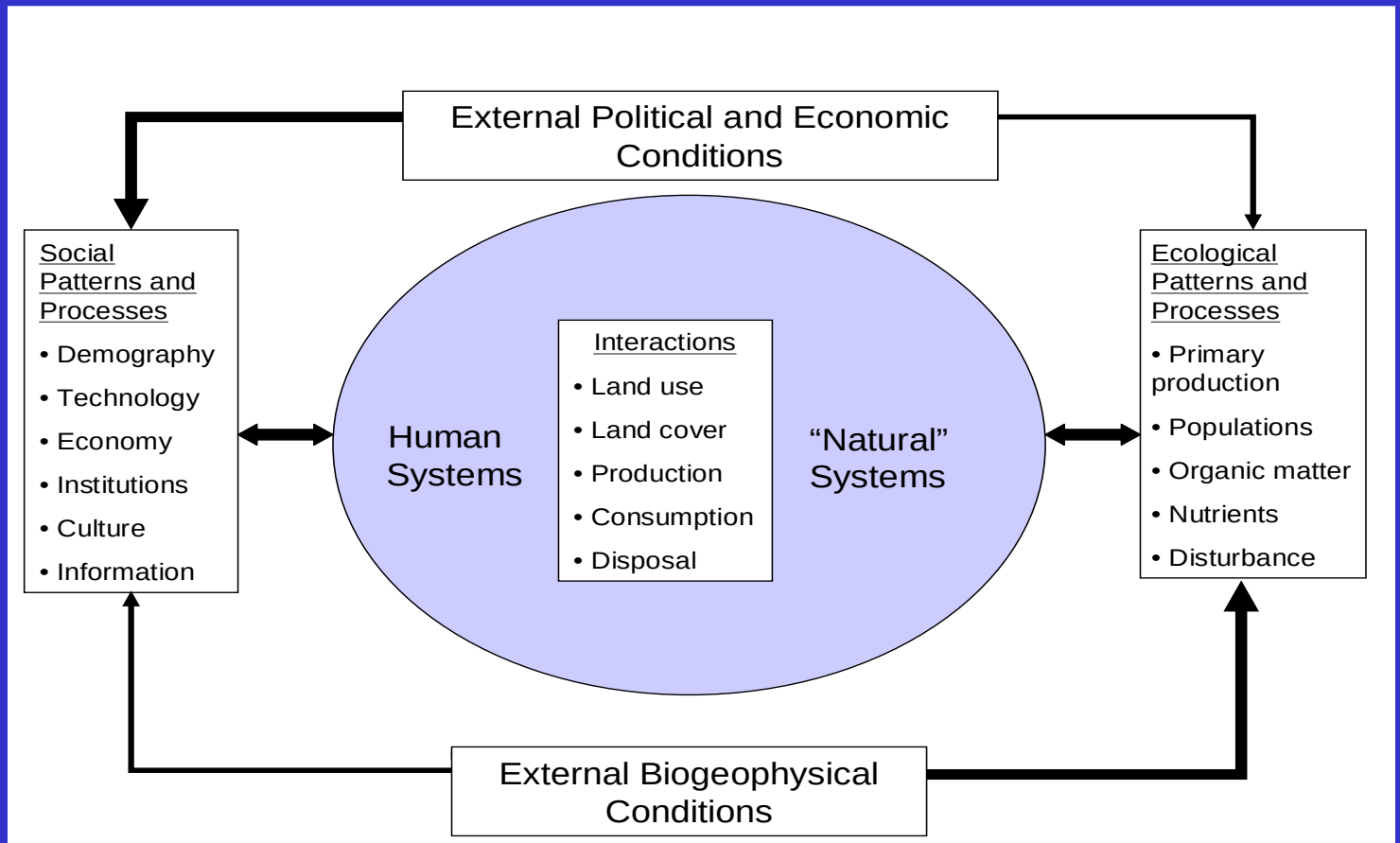
Hours per day with effective temp >100 F at Sky Harbor Airport



1940-2000

Baker et al. unpublished

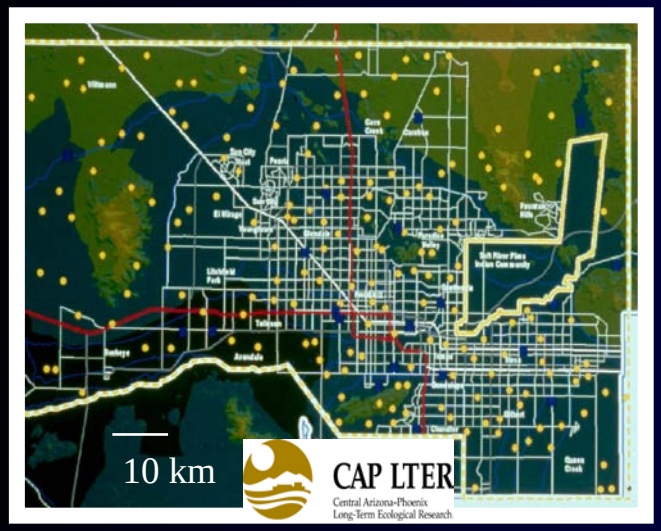
Human dimensions of ecological change:
toward a more complete human ecosystem model



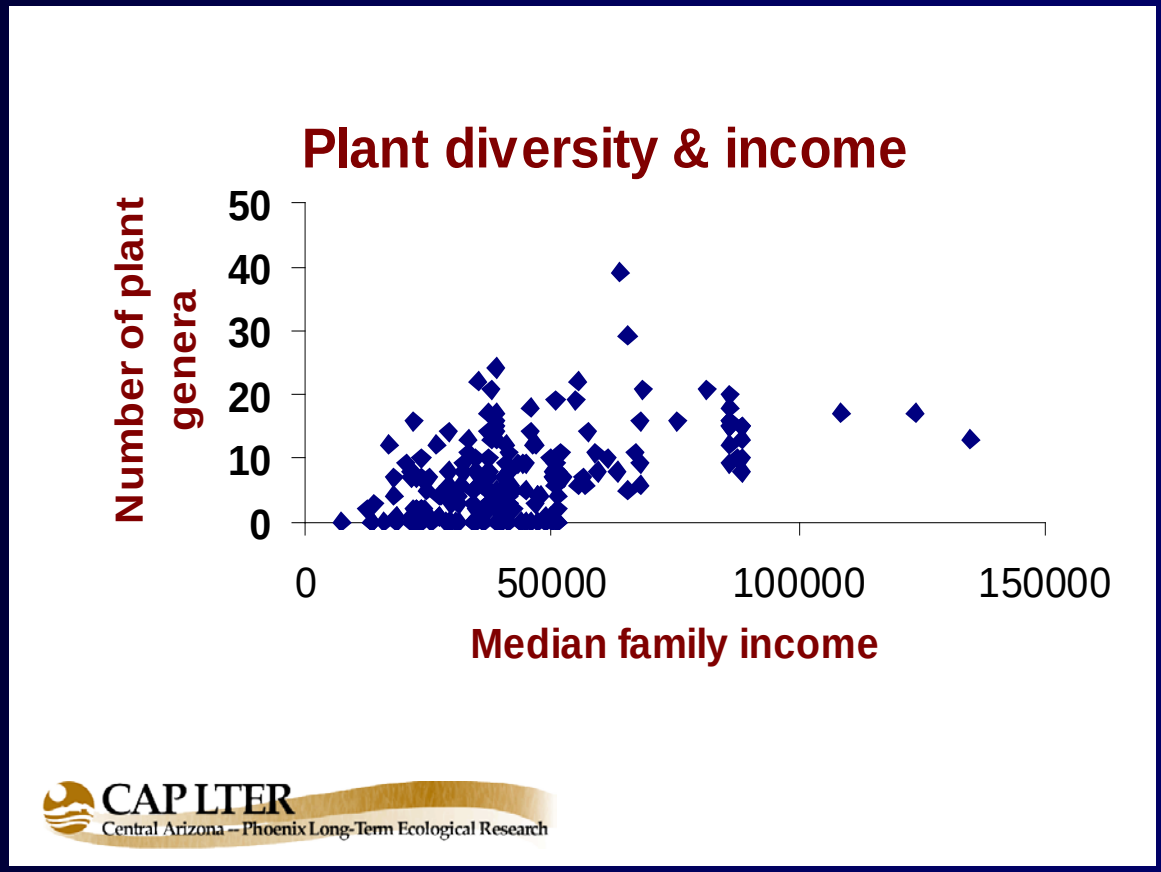
CL Redman et al. unpublished

2. How do human activities and behavior affect biodiversity in urban areas?

Plant Diversity: The Luxury Effect



Diane Hope et al., ms
in preparation.



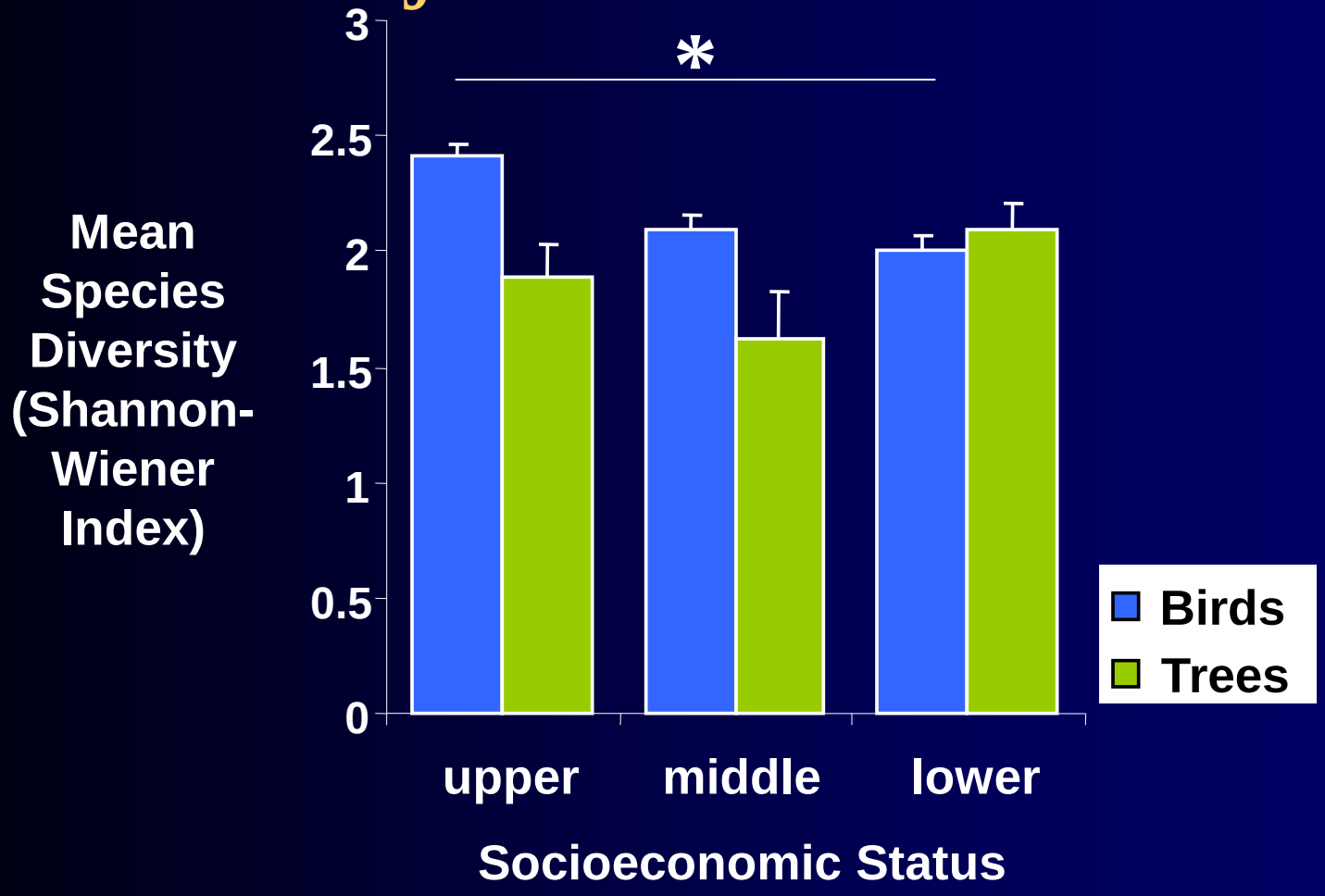
Plant diversity highest in plots located
in wealthier neighborhoods

Parks Project

- 16 neighborhood parks in 3 different neighborhood types
  - Low income, black and hispanic
  - Middle income, white and hispanic
  - High income, predominantly white

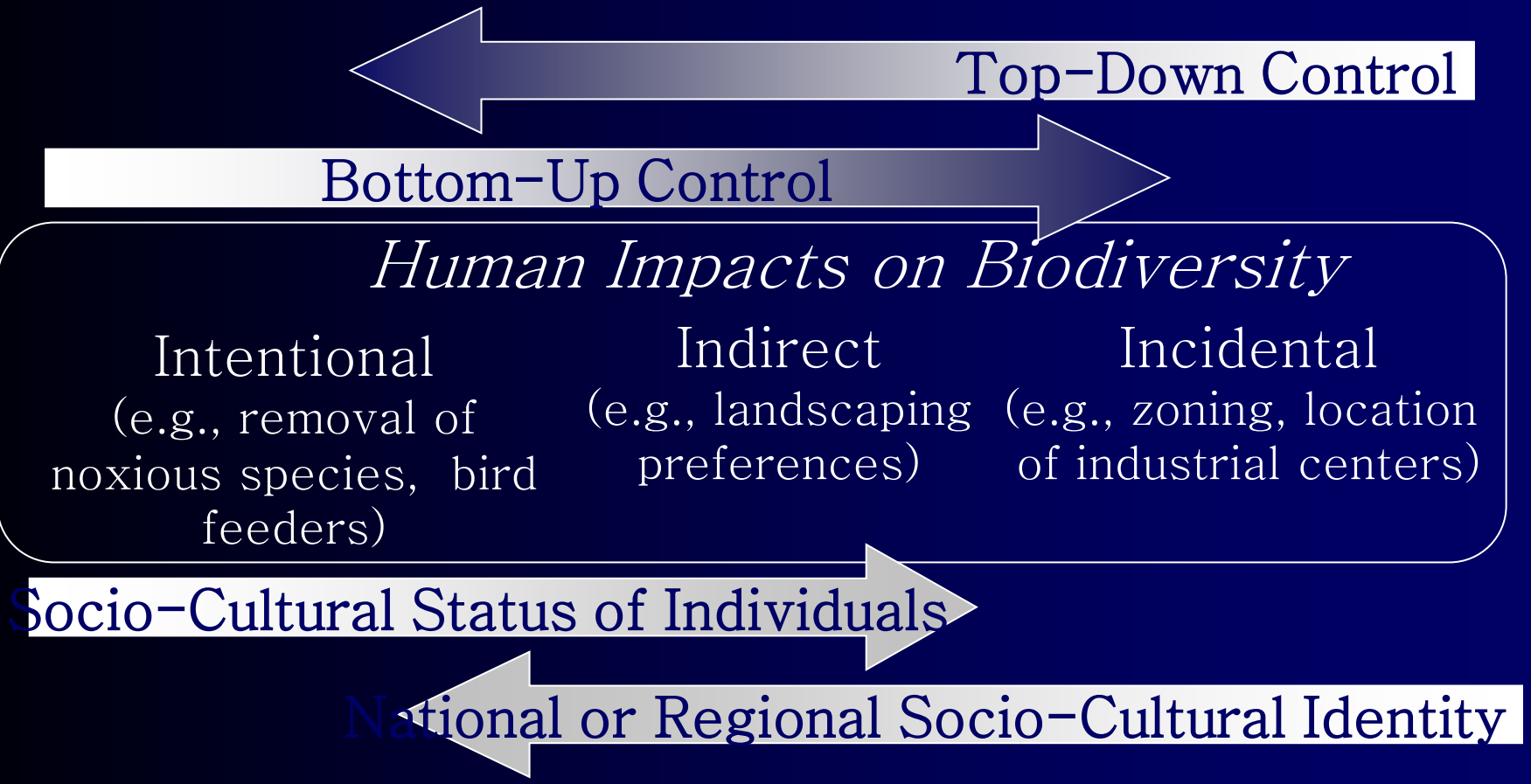
Parks Project

Note: Bird species diversity is from Dec. 2000, but a similar pattern occurs in Mar. 2001 as well.



A. Kinzig, P. Warren, & C. Martin, unpublished data

2. Human Impacts on Biodiversity



A. Kinzig

3. Human modifications: do we need to modify our ecological models?

- Chemical modifications
  - Enhanced N, C deposition
  - Addition of novel compounds and pollutants
- Hydrologic modifications
  - Land cover changes
  - Manipulation of water source, amount
  - Simplification of flowpaths

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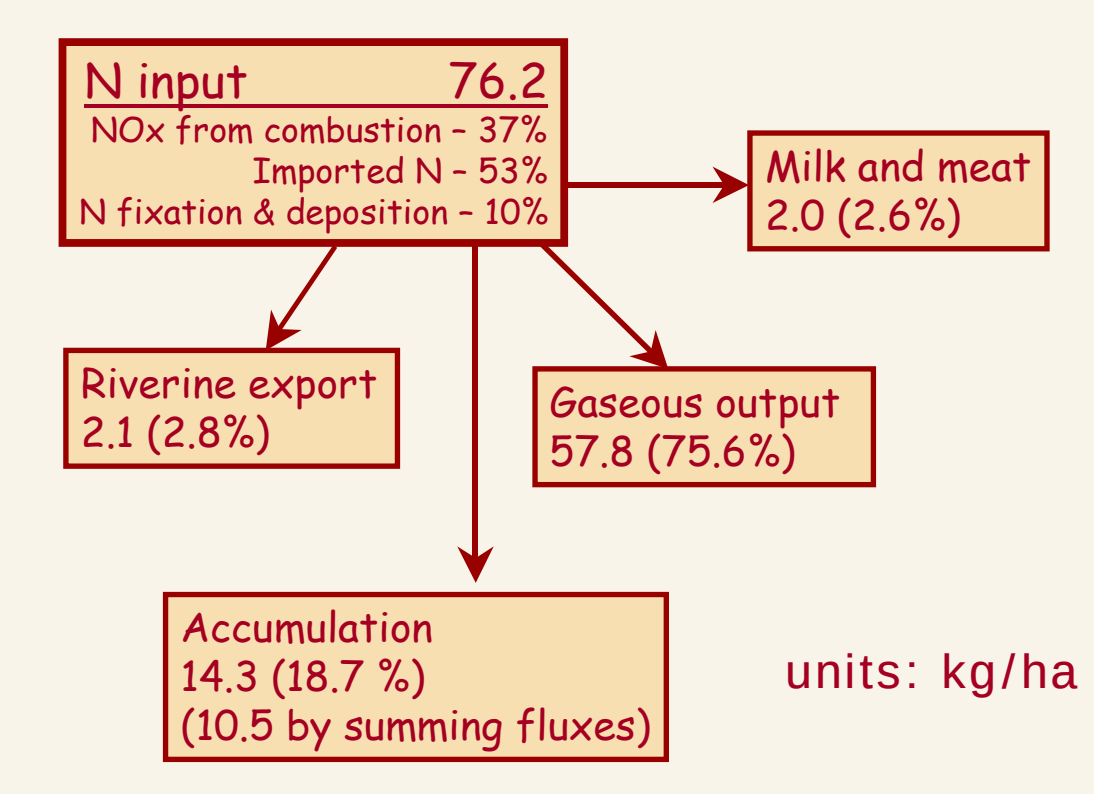
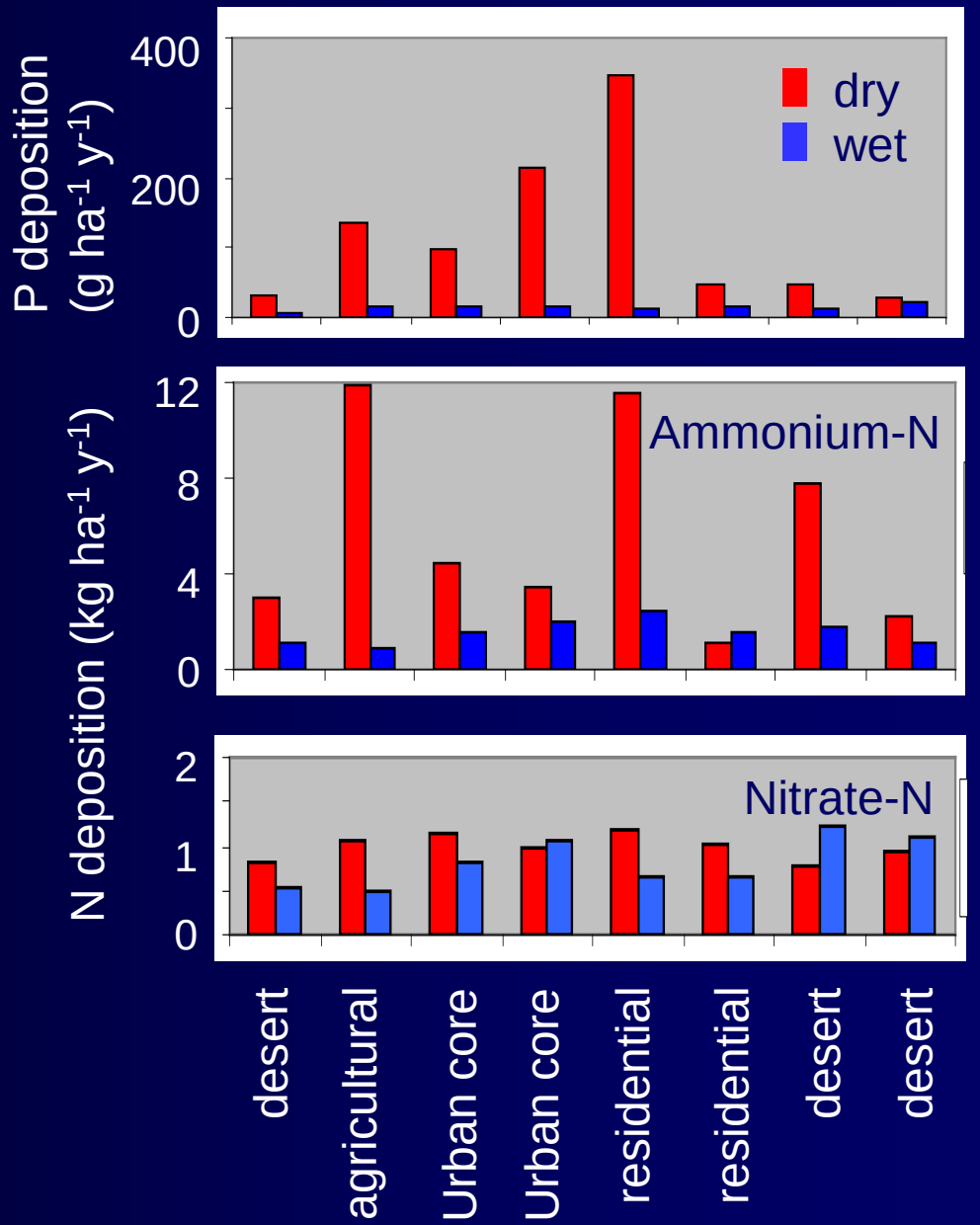
Annual Nitrogen Balance for the CAP Ecosystem

Baker, L.A., Y. Xu, L. Lauver, D. Hope, and J. Edmonds. 2001. *Ecosystems.*



Typical annual N input for native desert = ~5-15 kg/ha

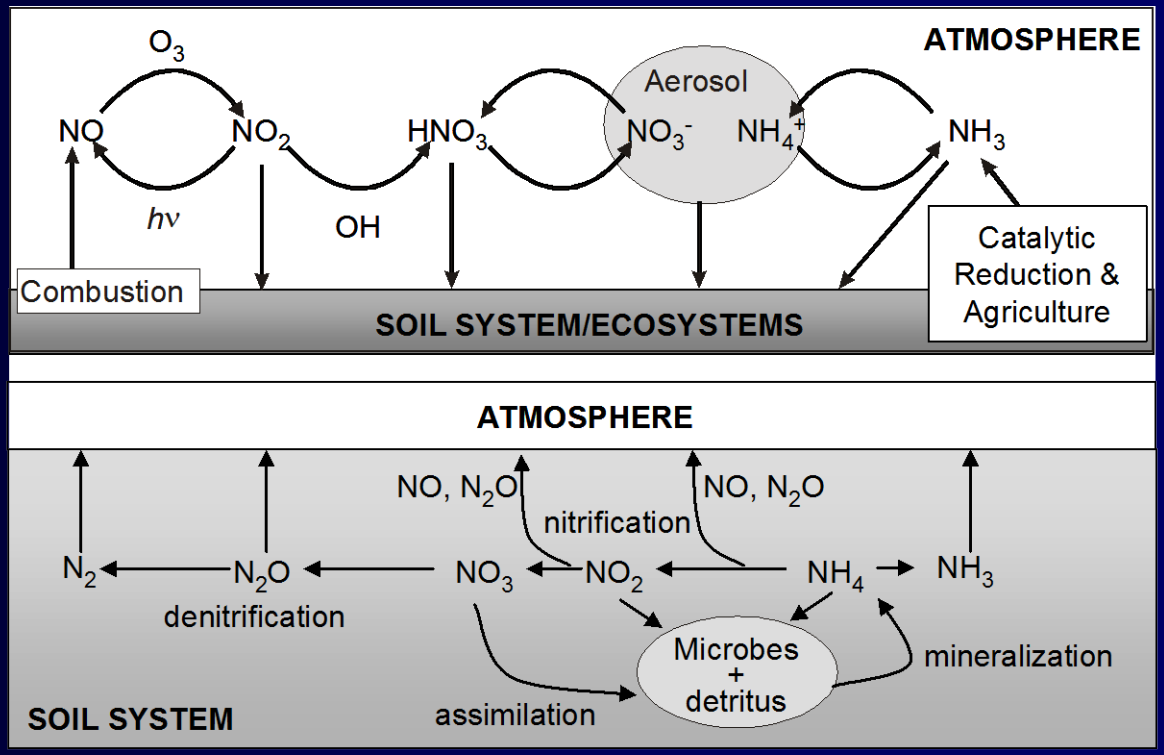
Year 2000 deposition



D. Hope et al. unpublished

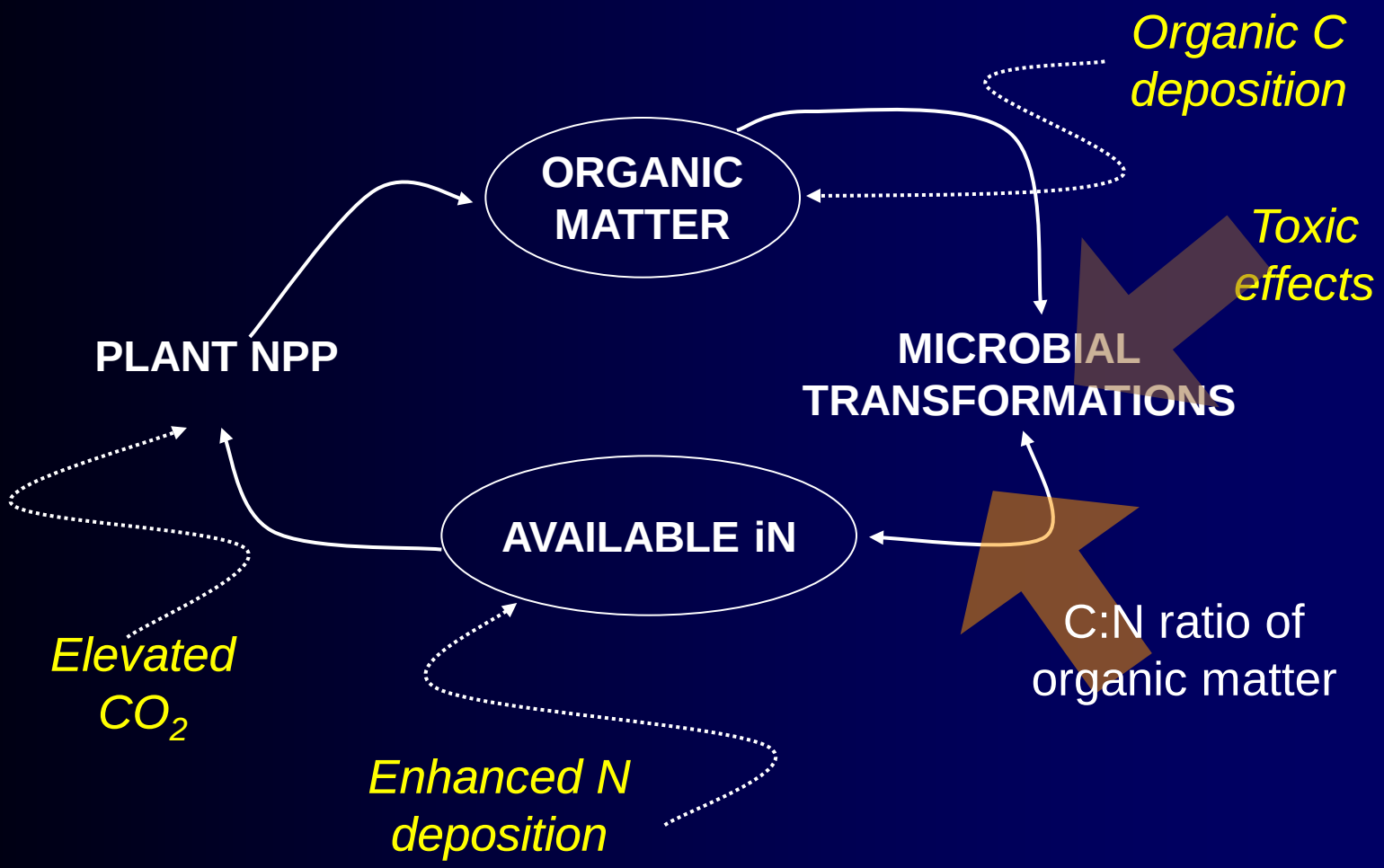
Interdisciplinary collaboration: atmospheric chemists, ecologists, engineers

- Measure all species of N and C in atmosphere
- Model atmospheric transport and deposition
- Measure soil response
- Model ecosystem response
- Combine atmos-pheric and ecosystem models to examine regional responses



JO Allen & NB Grimm

Unique biogeochemical cycles in cities?



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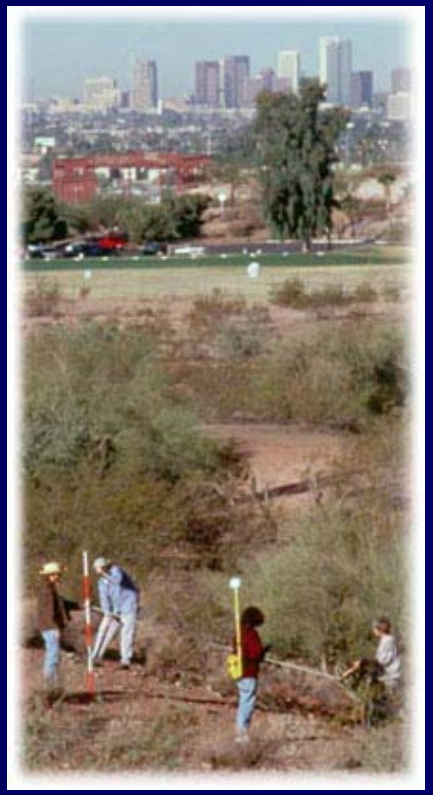
Summary

"Clear opportunities exist for interaction with physical/earth scientists, with environmental engineers, and with social and economic scientists that would greatly expand the range of application of LTER research"

– LTER White Paper



This interaction is essential for understanding the structure and function of urban ecosystems.