Human Dimensions of Ecosystem Analysis: Enriching the LTER Perspective

Incorporation of Socioeconomic Perspectives

Regionalization of LTER Research

Addition of Urban LTER Sites

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Outline of Presentation

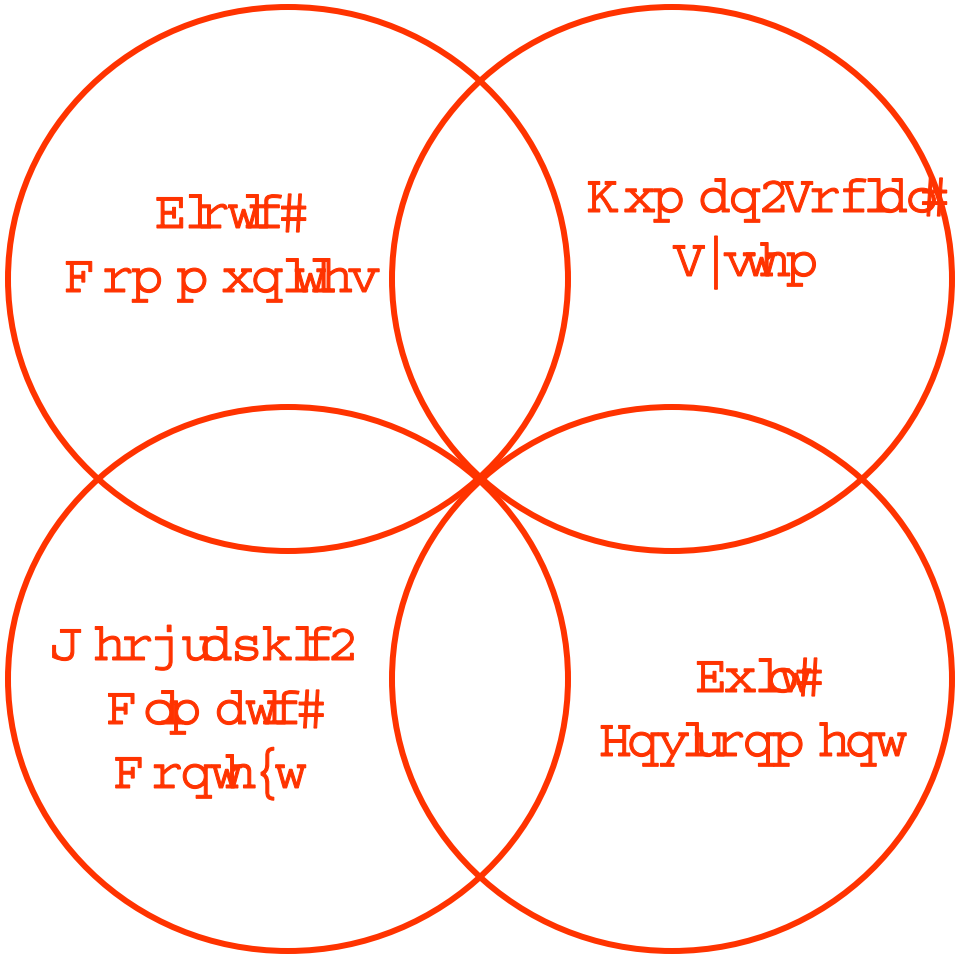
- Definition of the issue
- Enriching the LTER perspective
- Case studies from LTER research
- Strategies for achieving objectives
- Needed resources

Importance and Urgency

- Recognition that ecosystems do not work in isolation from human activities
- Special section of *Science* devoted to human domination of ecosystems
- Joint letter to *Science* urging ecologists to become engaged in pressing issues

Intellectual Challenge

- The conduct of science has evolved into disciplines based on subject matter
- Each set of disciplines has developed their own terminology, measurement techniques, and experimental designs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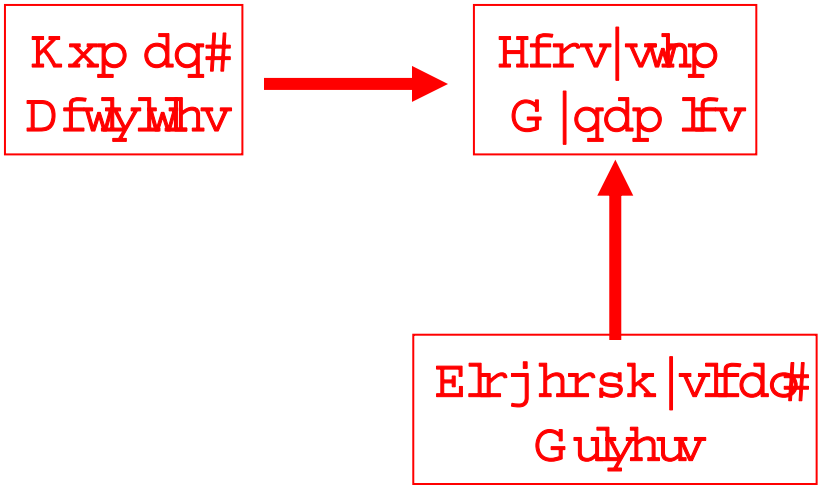
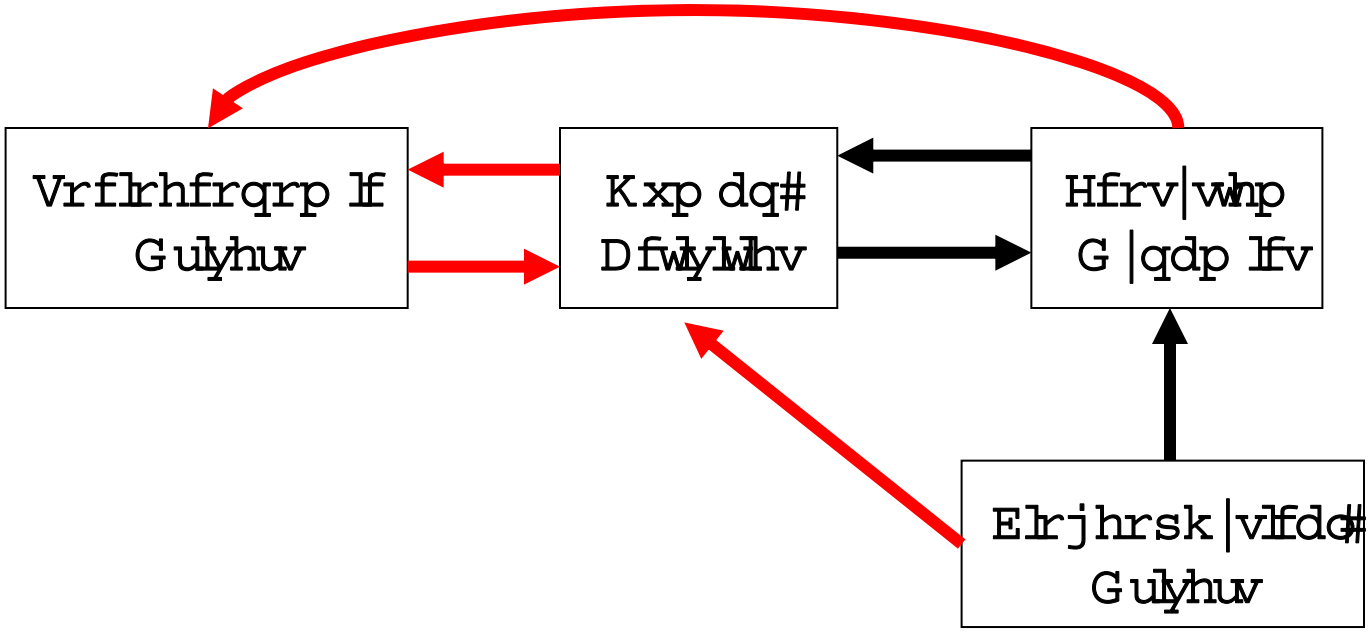
Recognition of the Problem

- Processes and controls crosscut these domains
- Processes and controls work at differing scales of time and space
- Solutions to big problems require multidisciplinary, multiscalar approach

Standard LTER Programs



Augmented or Urban LTER Programs



Drivers of Human Activities

- Creation and maintenance of institutions and organizations
- Flows of information and knowledge
- Incorporation of culturally based attitudes, values, and perceptions

Patterns of Behavior to be Measured

- Land-use management
- Designed environment
- Economic systems
- Demographic patterns
- Power hierarchies

LTER Response

- KBS established as agricultural LTER
- CWT and NTL as regionally augmented LTERs
- BES and CAP as urban LTERs
- 1998 CC meeting on socioeconomic studies

LTERs in Action

- Formative stage of research
- Diversity of topics
- Response from scientists
- Response from communities

Agroecosystems at Kellogg Biological Station (KBS)

- How values, attitudes, past practice, knowledge, and profit motivation affect land management
- Attention is placed on soil management, decisions about crops, tillage, irrigation, and pest management

Farm Operator's Decision-Making: Micro Level

- Imperatives of culture of local community
- Incentives provided by agricultural institutions
- Constraints imposed by social organization

Farm Operator's Decision-Making: Macro Level

- Changes in property rights
- World views that consider resources as unlimited
- Sustainability requiring conservation ethic
- Shifting social trends

Result

- Increasing conflict over public or private control over the environment, its resources, and their management.

Qualitatively New Types of Questions at North Temperate Lakes (NTL)

- Requiring the integration of natural and social sciences
- Requiring a regional understanding of processes

Human Influences

- What economic values do people attach to lake ecosystem services?
- What is the phosphorus budget for the watersheds surrounding the lakes?
- How do farmer behaviors affect soil phosphorus content?

Throughout the Upper Midwest

- Do lakes behave similarly across decadal or longer time scales?
- What are the effects of prolonged drought on lakes?
- Has the timing of ice cover changed over long time scales?

Studies Involving Sources of Phosphorus Delivered in Lake Mendota

- Excessive agrarian use to reduce risk
- Increase in soil phosphorus retention
- Release during conversion of farms to residential development
- Release during extreme climatic events

Historic Land-Use Patterns in the Coweeta Regional Study (CWT)

- Expanded ecological analysis to cover parts of three states
- Relation of decreasing agriculture to ecosystem function
- Legacy effects of former land use
- Immigration of new rural gentry

Legacies are defined as the cumulative outcome of human activities at moments in history that affect opportunities for current and future generations.

Land-Use Models to Predict Future Conditions

- Topography and road networks direct population diffusion
- Exurban residential development increases forest cover and nutrient loads from septic systems
- Agrarian legacy of diminished richness of herbaceous species, but not weedy species

Land-Use History and Stream Ecology

- Forested streams have higher species diversity of invertebrates than agricultural streams
- The reverse is true for fishes
- However, fish in one forested stream were found to be similar to pasture stream (40 years ago the region was farmed, and stream conditions have not yet regenerated)

Community Involvement in the Baltimore Ecological Study (BES)

- Watersheds as the stage to examine interactions
- 300 years of human settlement and land management has conditioned the system
- Hydrologists, ecologists, and social scientists working together
- Involvement of public agencies, nonprofit organizations, and community groups

People Function as "Ecological Agents"

- Directly and indirectly affect the water quality of watershed
- Act at different scales of households, neighborhoods, and municipalities
- Develop hydrological-ecological-social watershed model for managers and planners

Differing Investments in Green Infrastructure Among Neighborhoods

- Related to city's power structure
- Related to grassroots involvement
- Impact on ecosystem functioning
- Impact on economic valuation

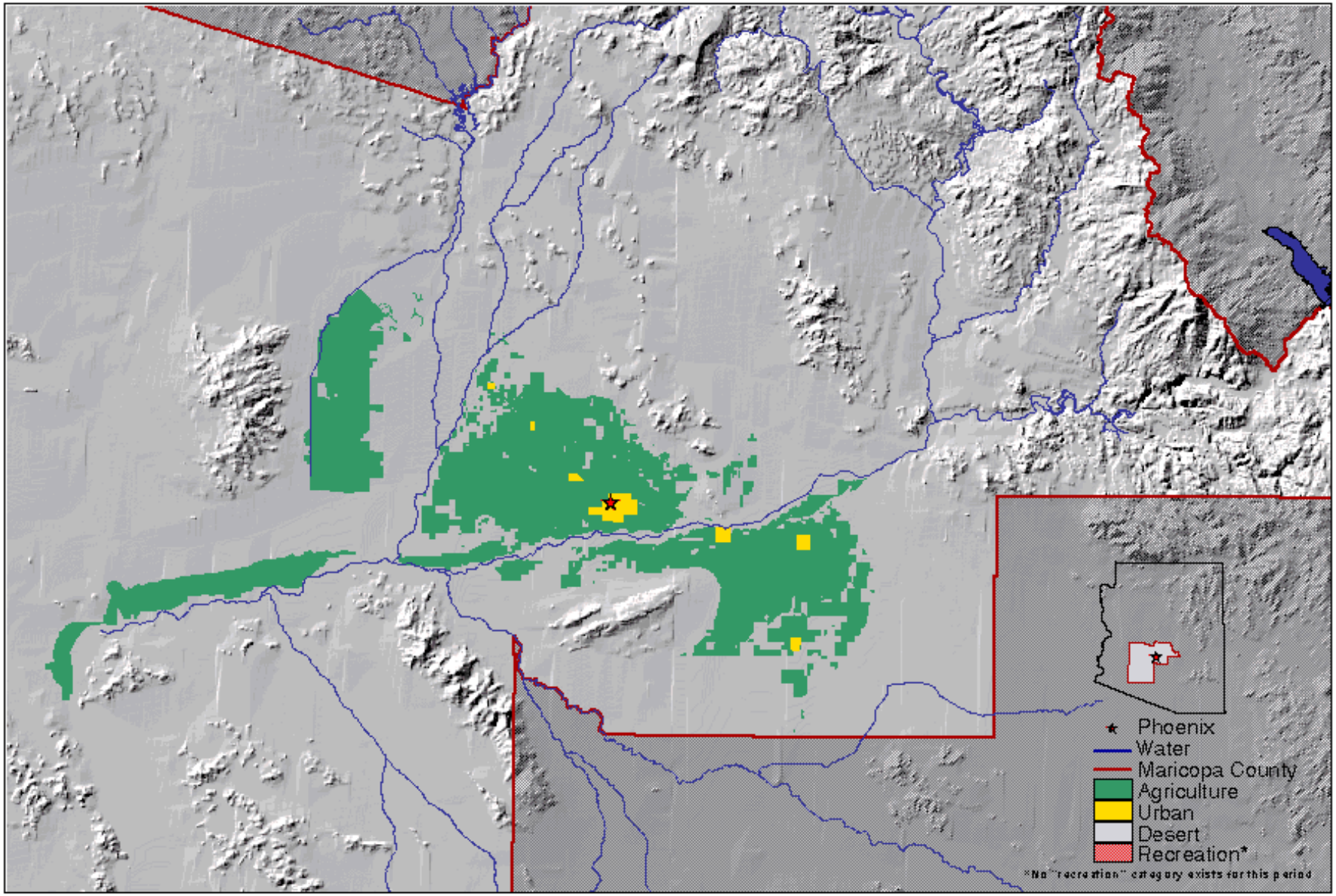
Community Engagement

- Involve local community in every aspect of research
- Participatory involvement with citizen action groups
- BES field station in inner-city neighborhood

Urban Growth in Central Arizona - Phoenix (CAP)

- How do changing land-use patterns affect ecosystem function and vice versa?
- Ecology in the city as well as ecology of the city
- Socioeconomic processes help define system parameters

Central Arizona Phoenix Historic Landuse - 1912



Source: Central Arizona-Phoenix Long Term Ecological Research Historic Landuse Phase I Report, 1998

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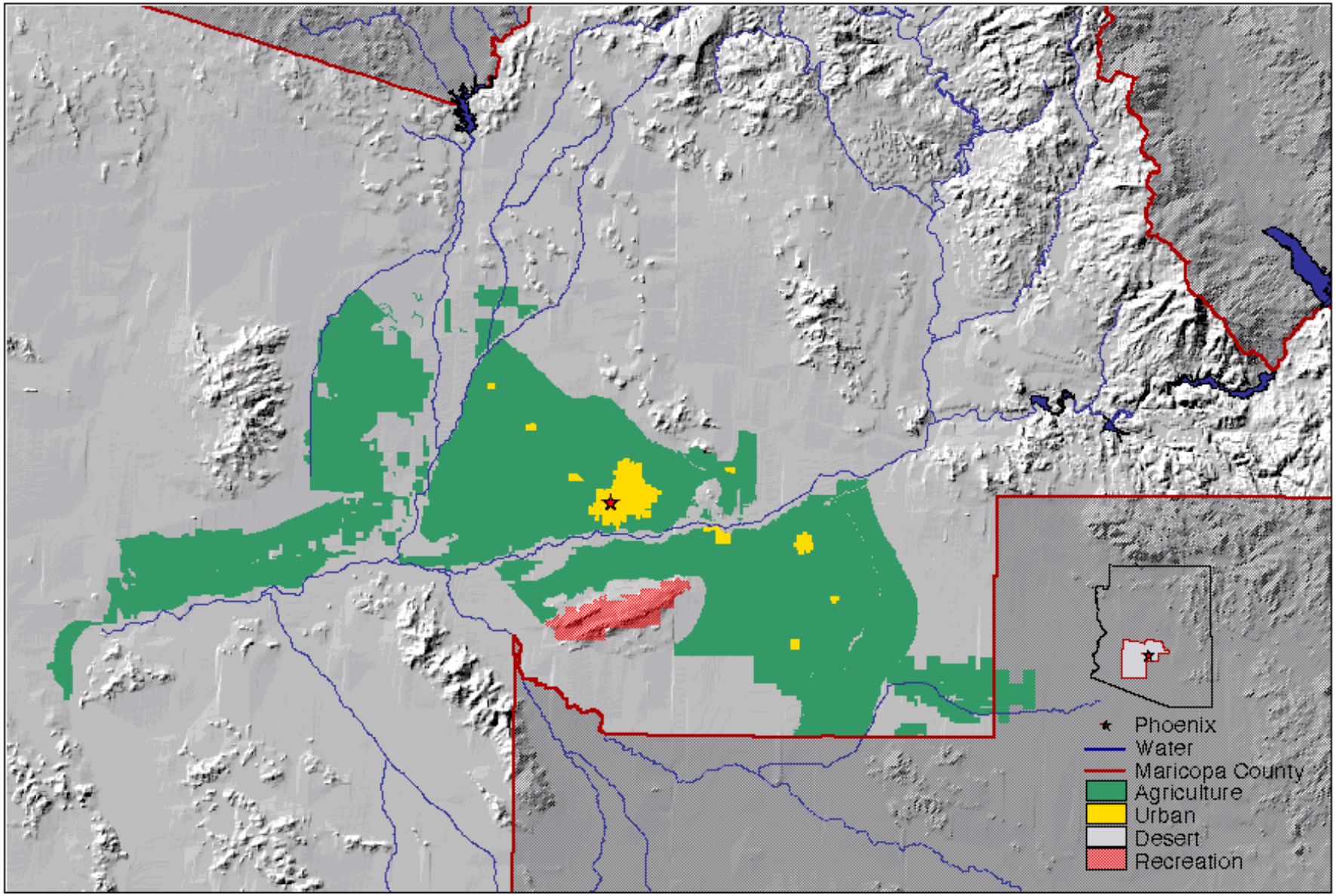
Central Arizona Phoenix Historic Landuse - 1934



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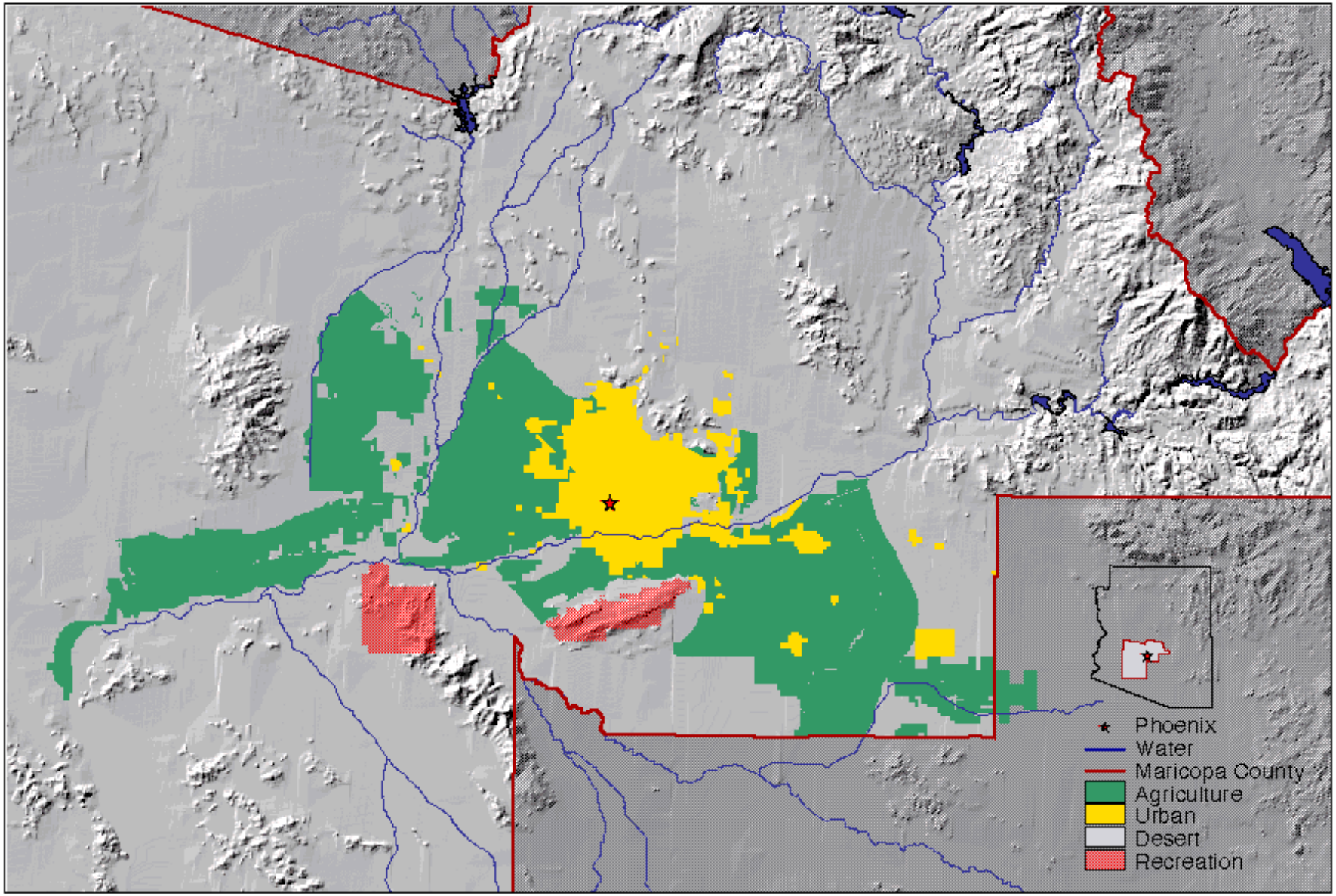
Central Arizona Phoenix Historic Landuse - 1955



Source: Central Arizona-Phoenix Long Term Ecological Research Historic Landuse Phase I Report, 1998

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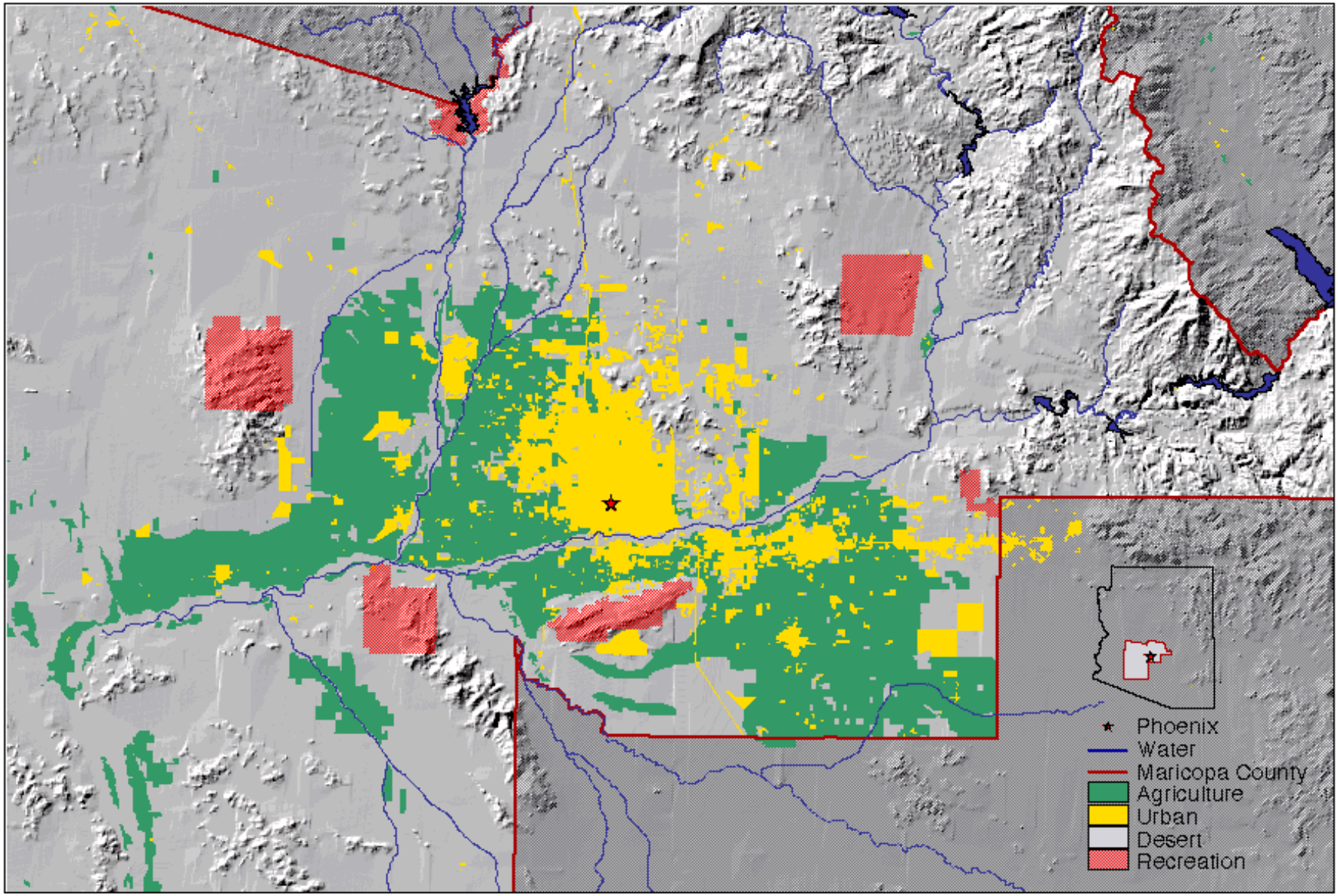
Central Arizona Phoenix Historic Landuse - 1975



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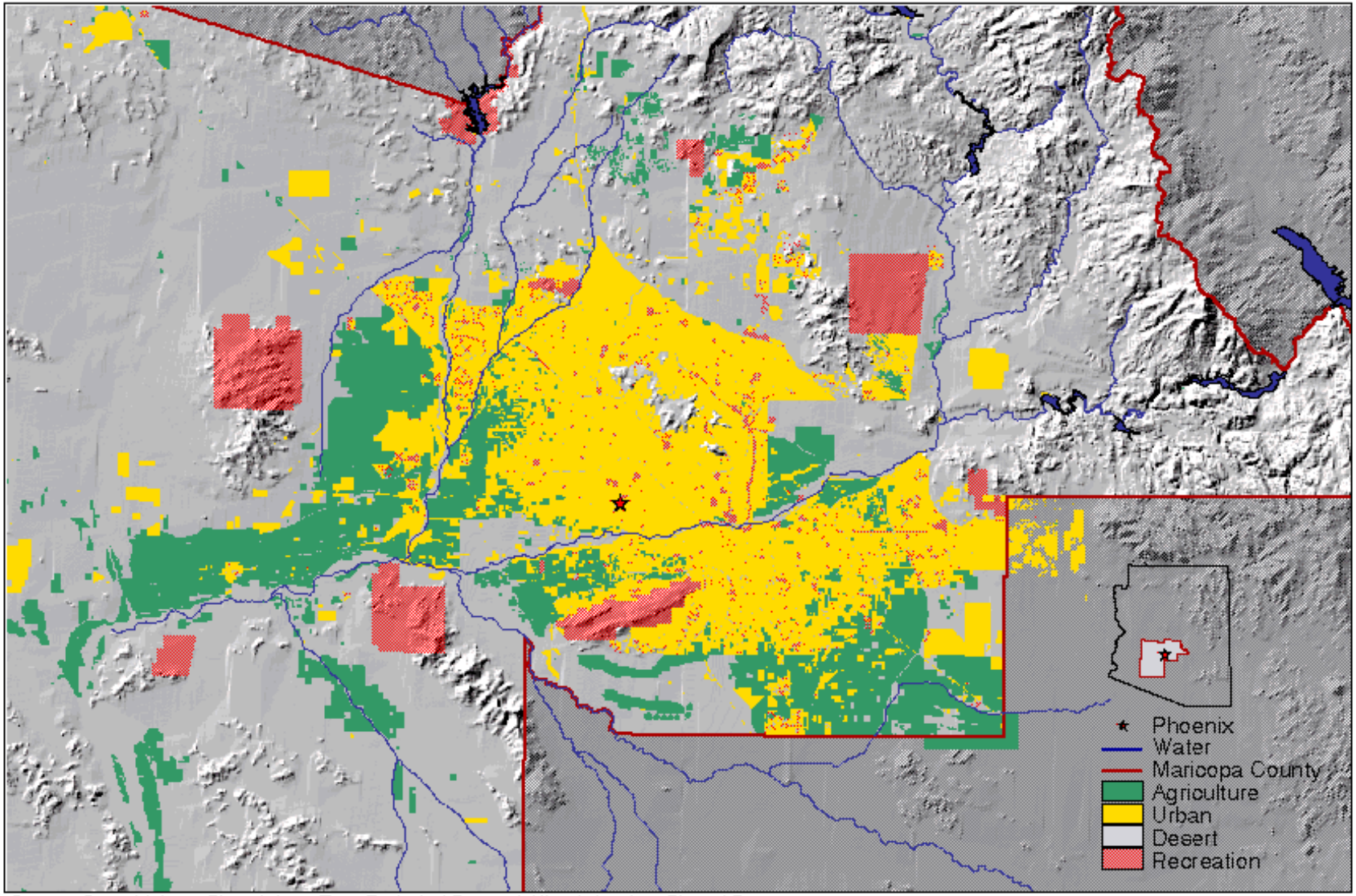
Central Arizona Phoenix Historic Landuse - 1995



Source: Central Arizona-Phoenix Long Term Ecological Research Historic Landuse Phase I Report, 1998

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N W E S

Why Conduct Research on Arthropods in Urban Areas?

- Provide snapshot of overall biodiversity
- Short generation times mean they respond quickly to changes in land use
- Represent spectrum of trophic levels
- Relatively easy to sample
- Ecologically, economically, and sociologically important

Two CAP LTER Research Projects Dealing with Arthropods

- Long-term arthropod monitoring
- Influence of urban land use on abundance of scorpions

Monitoring Study

- Long-term assessment of arthropod richness, abundance, distribution, and turnover in different types of urban land use

Monitoring Methods: Pitfall Trapping

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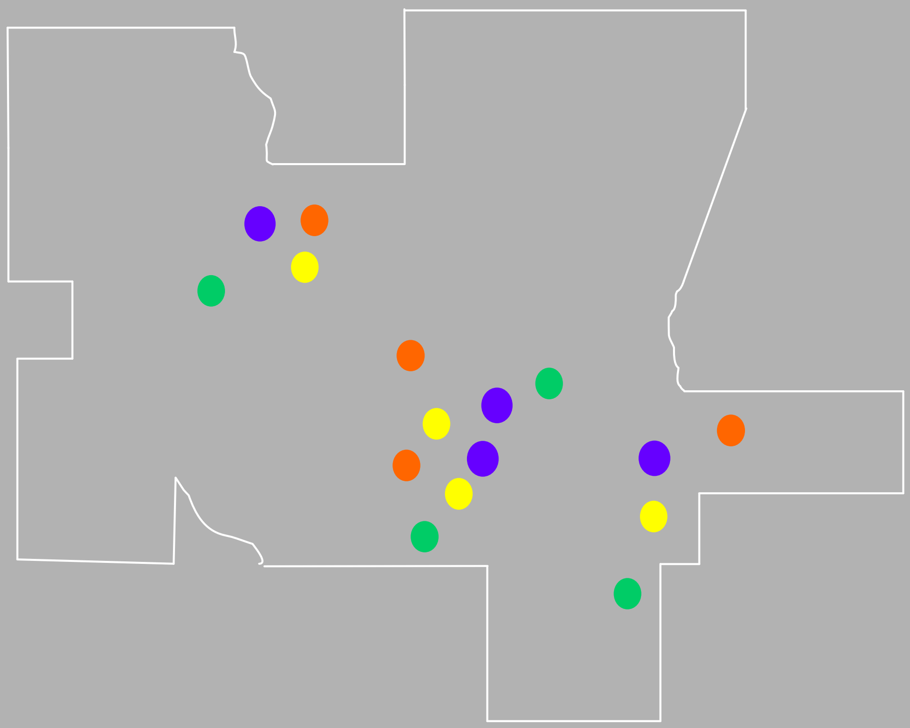

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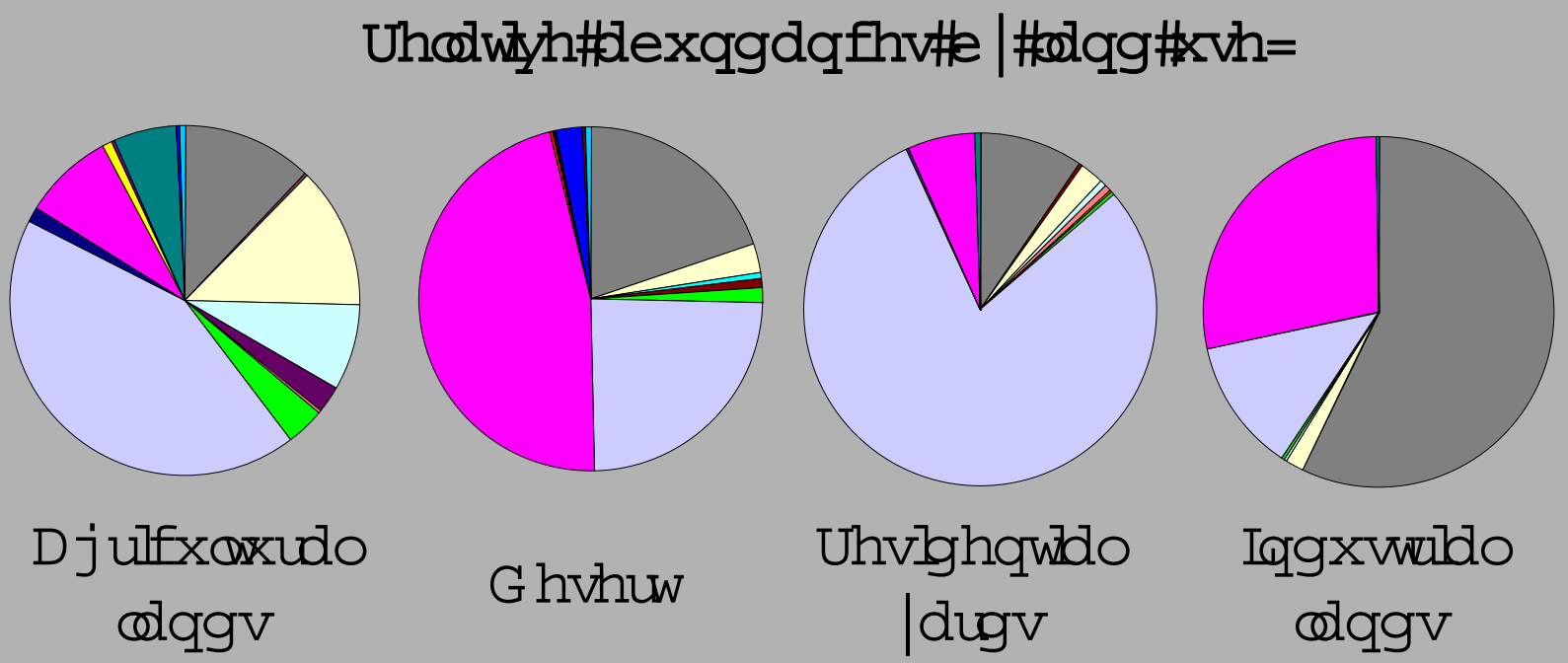
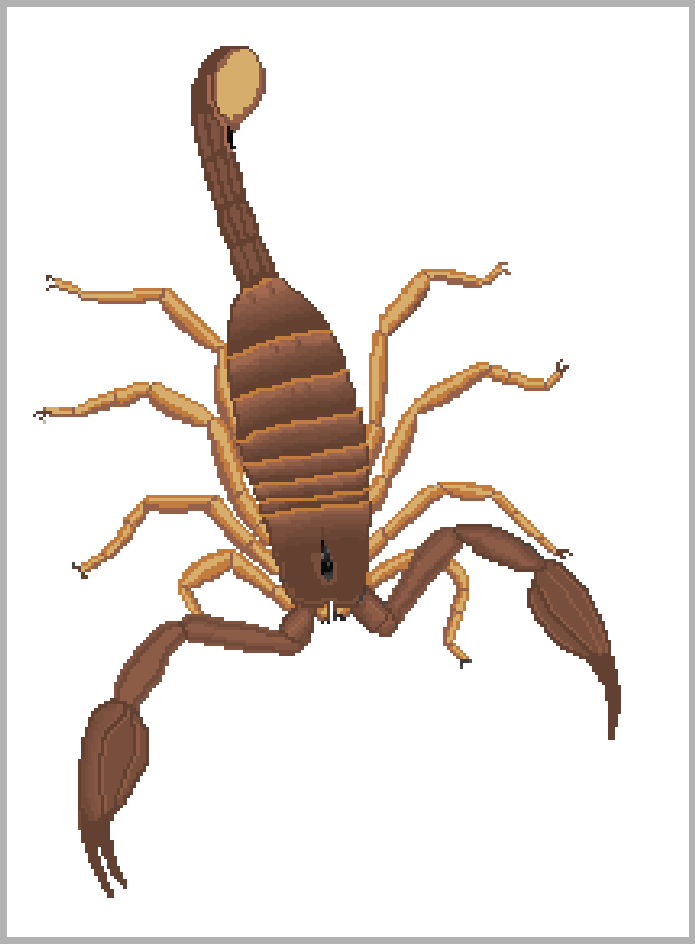
Preliminary Monitoring Results



Scorpion Study



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Scorpion Study Methods

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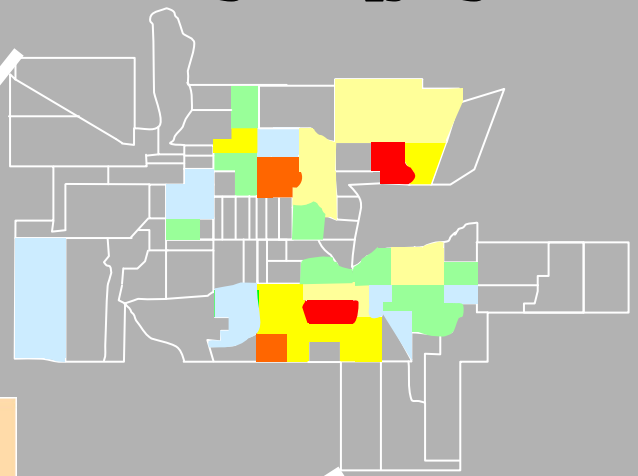

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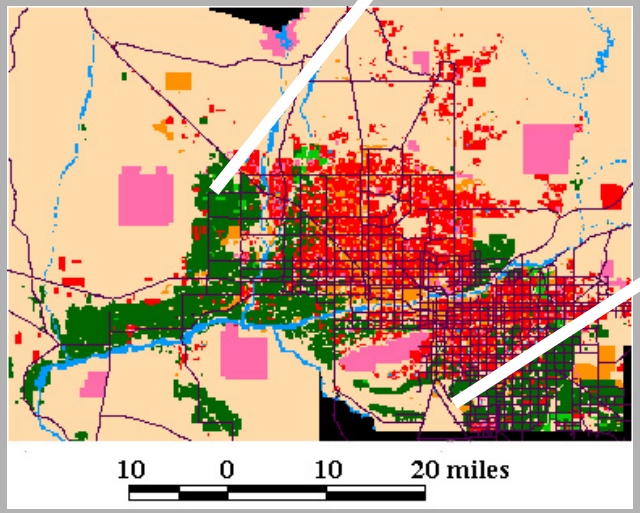

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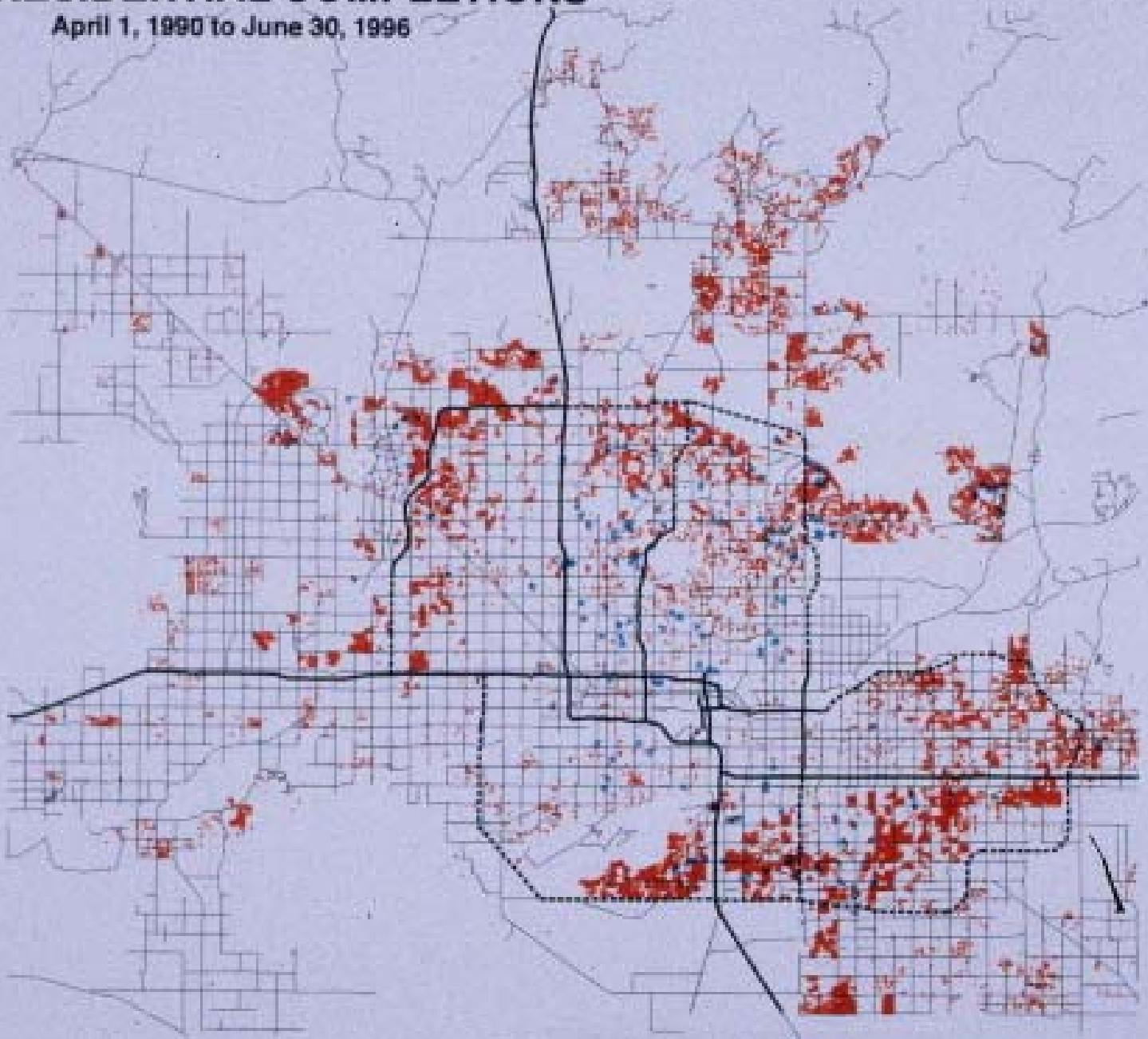
Social Sciences - Urban Fringe Morphology

- Characterized by:
  - low population density and abundant open space
  - urban fringe is well-defined line
  - leap frog development
- Land consumption rates and land adsorption coefficients vary widely
- Water (availability and quality) is a limiting factor
  - advent of CAP canal water strongly influenced location of new development

RESIDENTIAL COMPLETIONS

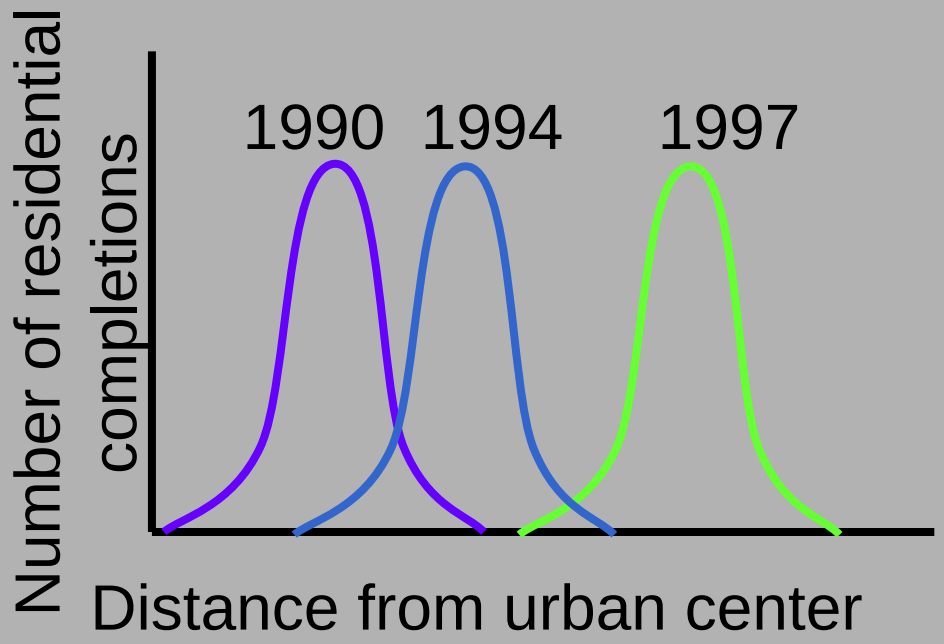
April 1, 1990 to June 30, 1996



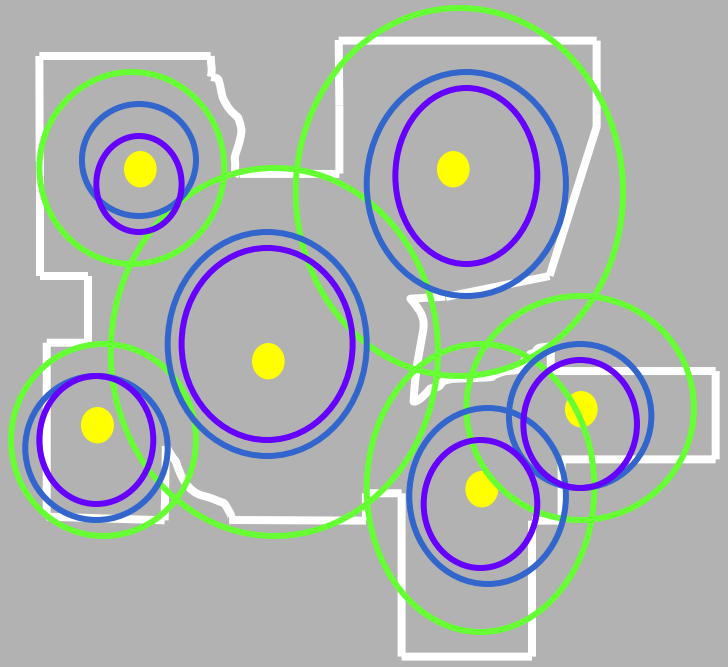
Single Family Completions

Apartment Completions

Urban Fringe Morphology



Urban Fringe Morphology



1998 Madison Coordinating Committee Meeting

- Science session focused on LTER social science initiatives
- Diversity of approaches, enthusiasm over potential
- Working group convened
- Challenge of integration acknowledged
- Standing Committee on Social Science established

Strategies to Achieve Objectives

- Standing committee formed to promote integration
- Collect range of initiatives and opportunities
- Convene workshop to define core areas
- Establish minimal social science capacity
- Identify appropriate range of issues for each site
- Secure partnerships for funding

Needed Resources

- Support for standing committee activities
- Workshop organized by LTER Network
- Expand augmentation grants to more sites
- Underwrite minimal capacity at all sites
- Meet special needs of urban sites
- Consider potential of new sites