

Central Arizona–Phoenix Long-Term Ecological Research (CAP)

The National Science Foundation began funding the Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) site in 1997 as one of two urban LTER sites in the US. Located in the central Arizona and the Phoenix metropolitan area, the site encompasses 24 municipalities and surrounding agricultural lands embedded in undeveloped Sonoran Desert. CAP LTER involves over 60 scientists from a range of discipline, including ecologists, geographers, anthropologists, engineers, and sociologists. Human interactions with the environment have been a focus of scientific inquiry of CAP LTER, and the project's institutional home at Arizona State University's Global Institute of Sustainability has stimulated a wealth of transdisciplinary study.



The CAP LTER study area contains some of the fastest-growing municipalities in the US, enabling researchers to study the effects of rapid urbanization on an arid ecosystem. As agriculture and, increasingly, desert lands give way to homes and businesses, natural habitats are severely modified to meet the needs and desires of human inhabitants. These modifications have significant ramifications for native plant and animal species. Water quality and quantity issues are pressing in this growing region, and air quality remains a critical problem due to ozone pollution and high levels of particulate matter, especially PM-10. Other stressors include drought and the urban heat island effect, which has raised nighttime minimum temperatures by 5°C in the central city along with the “misery index” CAP LTER scientists use to measure the impacts of the temperature increase.

Urban ecology research in the CAP LTER study area aims to achieve four main objectives:

1) to advance ecological understanding through development of ecological theory; 2) to understand the structure and function of the urban ecosystem; 3) to develop ecological scenarios that can be used to guide future development of urban environments while sustaining ecological and societal values, and to engage decision makers in this process through deliberate knowledge exchange; and 4) to involve the public in the research effort through dissemination of information via the media, public outreach, and educational initiatives.

Site Description and Characteristics. The CAP study area is in a 6400 km² area situated in a broad, alluvial basin where two major desert tributaries of the Colorado, the Salt and Gila rivers, converge. The basin, dotted with eroded volcanic outcrops and rimmed by mountains, once supported a vast expanse of low-land desert and riparian systems and now houses the nation's fifth-largest city. The study area is in the Basin and Range Physiographic Province at the edge of the Lower Colorado River subdivision of the Sonoran Desert, extending into the

Arizona Upland or Foothills subdivision. Average temperatures range from 12° C in January to 34.2° C in July.

Annual precipitation (180 mm) falls in two distinct seasons: the winter months from November through March, when the area is subjected to occasional storms from the Pacific Ocean, and during July and August, when Arizona experiences intense thunderstorm activity. These precipitation patterns and mild winters have contributed to high biodiversity in desert areas and have fostered the development of a unique vegetation type. Two life forms visually dominate the landscape and distinguish the Sonoran Desert from other North American deserts: small trees belonging to the pea family (Leguminosae) and the large columnar cacti. Widely spaced, low shrubs, primarily creosote (*Larrea*), bursage (*Ambrosia*), and brittle bush (*Encelia*) dominate the undeveloped desert on the valley floor, while a rich and denser saguaro-palo verde (*Carnegie* and *Parkinsonia*) forest covers the foothills.

Humans have long modified the natural landscape in the CAP LTER study area to suit their purposes, beginning with the Hohokam peoples, who built a vast network of irrigation canals in the Salt River Valley. Later, Euro-Americans converted desert land to arable agriculture, using surface water and then groundwater for irrigation. Natural water courses have been altered through dam building and river channelization to reduce flooding and assure water availability. Long-distance water transfer from the Colorado River through the Central Arizona Project Canal has augmented water supplies in the area, facilitating urban growth, which now consists mainly of land conversion from desert to residential land use since agriculture has declined steadily in the region. The availability of water and cultural preferences for mesic landscapes have resulted in native desert vegetation often being replaced with Bermuda grass (*Cynodon*) and irrigated exotics (*Nerium*, *Lantana*, *Rosa*, and *Bougainvillea*) with ramifications for higher trophic levels. There has been a decline in biodiversity among avian and arthropod species in urban areas compared with the desert, and human attempts to mimic desert through xeriscapes and desert landscapes have been unsuccessful in recapturing ecosystem function. Urbanization in this region of over 3.6 million people has also altered characteristics of the remaining desert within and immediately outside of the urban area.



Research Focus. Project researchers are forging new paths in urban ecology through examining the function and structure of the urban ecosystem, the feedbacks between human decisions and ecological processes, and the effects of urbanization on surrounding desert land. Land-use change is viewed as a major driver of ecological patterns and processes, which occur at multiple scales. Research also seeks to understand the responses, both human and ecological, that accompany changes in ecological conditions and multiple feedbacks in the system that lead to further change.

Scientific endeavors at CAP LTER involve short- and long-term monitoring at many sites throughout the study area, long-term experiments, social surveys and the use of remote sensing to build chronologies of land use and land-use change. Although socioecological research is relatively new in the CAP LTER area, researchers are able to mine a wealth of existing, historical data to describe and analyze processes in the urban landscape. In turn, these data and data collected through research feed into models of ecological and human behavior.