

Baltimore Ecosystem Study (BES)

The Baltimore Ecosystem Study (BES) investigates metropolitan Baltimore as an ecological system. The program brings together biological, physical, and social scientists to collect new data and synthesize existing information on how both the ecological and built components of Baltimore work. We also seek to understand how Baltimore's ecosystems change over long time periods.

The ecological knowledge we create helps support educational and community-based activities. Interactions between the project and the Baltimore community are an important part of our project.



Site Characteristics: The Baltimore Ecosystem Study conducts research and educational activities in Baltimore City and Baltimore County, Maryland. The project focuses on several watersheds to organize research both spatially and functionally. The Gwynns Falls Watershed includes agricultural lands, recently suburbanized areas, established suburbs, and dense urban areas having residential, commercial and open spaces. In addition, a reference area has been established in a forested catchment of the Gunpowder drainage in Oregon Ridge County Park in Baltimore County. Research on stream restoration is centered in the Minebank Run catchment. A study of the ecological effects of residential neighborhood greening and restoration takes place in the storm drain catchment in Baltimore City labeled Watershed 263.

The Gwynns Falls watershed, centered on 76°30', 39°15' and encompassing 17,150 hectares, drains into the Chesapeake Bay. It contains 16 sub-watersheds, which range in size from 465 hectares to 1,855 hectares. The watershed's resident population in 1990 was approximately 356,000 people with the downstream sub-watersheds of the Gwynns Falls being the most densely populated. During the period 1950 - 2000, total population and population density changed significantly in the Baltimore region because of movement of residents from the City into the County. Baltimore City's total population declined from a high of approximately 1.4 to 0.65 million. In the case of the Gwynns Falls watershed, total resident population declined yet the percentage of urban areas increased. In 1990, the downstream Gwynns Falls sub-watersheds contained predominantly residential / commercial / industrial areas (90.4%) and the upstream sub-watersheds contained primarily agricultural / forested / open space areas (90.8%). The socioeconomic characteristics of residents in the watershed vary as well. For instance, the



average median family income in 1990 was \$18,598 in the lower sub-watersheds and \$49,133 in the upper sub-watersheds.

The vegetation of the watershed has changed from predominantly forest before it was settled by Europeans to primarily herbaceous today. There are no original stands of forest in the Baltimore area. After European settlement, farmers cultivated most of the land. In the early 20th century, forested areas were located primarily on steep slopes and non-arable lands and held almost exclusively by farmers. Hardwoods (96%) were pre-dominant in the forests of Baltimore County in 1929 and consisted mainly of three basic forest types: a ridge type, dominated by chestnut oak (*Quercus prinus*) and scarlet oak (*Quercus coccinea*); a slope type, with scarlet oak, black oak (*Quercus velutina*) and white oak (*Quercus alba*) transitioning to red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*) and hickory (*Carya ovata*) on the lower slopes; and a bottom type consisting mainly of red maple (*Acer rubrum*), ash (*Fraxinus pennsylvanica*), elm (*Ulmus americana*), birch (*Betula nigra*) and sycamore (*Platanus occidentalis*).

Landsat TM data indicates that in 1992 only 18.9% of the Gwynns Falls watershed was forested. Research underway documents a decline in forest cover as suburban spread continues. Average annual precipitation is 109 cm./yr. and stream discharge is 38 cm./yr. Maximum evapotranspiration occurs during July, and groundwater reservoirs are recharged primarily between mid-September and March.

Research Focus: Urban ecological studies have had a long history, but they have not been a component of mainstream ecology until recently. The growing interest of ecologists in urban systems provides an opportunity to articulate integrative frameworks, and identify research tools and approaches that can help achieve a broader ecological understanding of urban systems. BES uses several frameworks to support comparative and quantitative urban studies: (i) spatial patch dynamics of biophysical and social factors; (ii) the watershed as an integrative tool; and (iii) the human ecosystem framework. These frameworks build on empirical research investigating urban biota, nutrient and energy budgets, ecological footprints of cities, as well as biotic classifications aimed at urban planning. These frameworks bring together perspectives, measurements, and models from biophysical and social sciences. These frameworks support our investigations of (i) the structure and change of the urban ecosystem; (ii) the fluxes of matter, energy, capital, and population in the metropolis; and (iii) how ecological information affects the quality of the local and regional environments.