

Luquillo Experimental Forest (LUQ)

The 11,330-ha Luquillo Experimental Forest (LEF) is a tropical forest and the only experimental forest with the same boundary as a National Forest--the Caribbean National Forest (CNF). In 1956, the CNF was designated an experimental forest. Research in this forest dates back over 100 years, being one of the most intensively studied tropical forests in the world. The forest was designated the Luquillo Biosphere Reserve in 1976, and a Long-Term Ecological Research site by the National Science Foundation in 1988. The LEF harbors the largest area of primary forests in Puerto Rico--recently designated as wilderness by the US Congress--and the most pristine rivers in the island, including several wild and scenic rivers.

Site Description and Characteristics The LEF is a core of igneous and volcanic rocks with an age of about 146 million years, together with layers of uplifted sedimentary and metamorphosed rocks. It is located within the geographic tropics at latitude 18°N. In the Holdridge life zone system, the LEF is classified as subtropical moist to subtropical rain forest. Along the 1,000 m elevation gradient (100 m to 1075 m asl) in the forest, mean annual temperature ranges from 25 °C to 19 °C and rainfall from about 2,000 to about 5,000 mm/yr. The average rainfall for the forest as a whole is 3880 mm/yr. The climate is subtropical maritime and is moderated by steady trade winds, which maintain air temperatures relatively constant year-round--the annual temperature variation within a climate station is only 3.0 to 3.5 °C. The lapse rate is 5.58 °C. Rainfall intensity varies at all temporal scales from diurnal to decadal. While all months receive in excess of 100 mm, there is a period of lower rainfall between February and April and peaks of rainfall in September. Storms and hurricanes are climatic events that dramatically change forest conditions (Pictures). For example, winds normally range from 8 to 18 km/h but exceed 200 km/h during category 5 hurricanes. Rainfall can exceed 400 mm/day during storms and low-pressure systems. These events trigger numerous landslides. Droughts (<100 mm/month) recur on decadal scales, but natural fires do not occur in the LEF.

There are four soil associations representing 19 soil series in the LEF. The principal orders are Ultisols and Inceptisols, which respectively occupy 50 and 20 percent of the total forest area, and small areas with ultisols and other soil types such as oxisols. Dominant soils are deep, highly weathered and leached clays with low pH, and base saturation less than 35 percent at 1.25 m. Soil oxygen decreases with increasing elevation from 21 percent in aerated soils to anaerobic soils in cloud forests.

The vegetation of the LEF is evergreen broadleaf tropical forest. The 240 tree species in the forest form different forest types with different species composition, structural development, and dominance with elevation. The forest also harbors 16 amphibian species, 18 reptile species, 16 mammal species, about 150 resident and migratory bird species, and over 350 mushroom species. The number of species in groups of organisms such as micro fungi, bacteria, nematodes, arthropods, and other soil groups are unknown but well exceed the number of tree species. The biodiversity of the LEF includes 98 rare and endangered plant species and 23 endemic plant species. The cloud condensation level occurs above 600 m elevation, where soils are saturated, and forested wetlands constitute the forest cover. Increased elevation is associated with decreasing forest height, decreasing tree species diversity, increasing species dominance, increasing epiphyte abundance, and increasing tree density.

Numerous databases are compiled at the LEF, including: maps of geology, soils,

vegetation, disturbance history; seven sets of aerial photography since 1936; air temperature, precipitation since 1909; solar radiation, wind speed and direction, relative humidity; NADP precipitation since 1984; chemical composition of precipitation, dryfall, cloudwater, bulk soil, soil solution, throughfall, stemflow, streamwater, plant tissue, animal tissue, fungal tissue; vegetation composition, above- and below-ground biomass, tree growth/mortality, litterfall, litter decomposition, wood decomposition, mycorrhizal associations, phenology; population records and biomass of terrestrial and aquatic fauna. Many long-term data records can be found in (<http://luq.lternet.edu>).

Research Focus Studies include the gamut from plantation forestry, reforestation, land rehabilitation, tree growth, ecosystem structure and function, wildlife ecology, hydrology, and geomorphology. After Hurricane Hugo in 1989, the research program expanded into disturbance ecology, spatial modeling of ecosystem attributes, climate change, and landscape ecology.

Disturbance ecological research focuses on both natural (hurricanes, landslides, drought, and excessive rain) and anthropogenic (land use/land cover change) disturbances. Observed

changes in the cloud condensation level have led to studies of climate change in relation to land cover change outside the LEF. The LTER program also addresses land-water interactions with the goal of understanding the role of terrestrial vegetation and land cover on stream functioning, migration of stream fauna, and the capacity of streams to deliver ecological services to lowland urban populations.

The LEF offers unlimited opportunities for research in tropical forestry and related fields. Programs such as those of the USDA Forest Service, National Science Foundation, US Geological Survey, and the University of Puerto Rico welcome research collaboration in all fields of the natural sciences. Particular priority is given to those that support the mission of these institutions.



View of the Luquillo Experimental Forest before and after Hurricane Hugo in 1989.