

Ecology of the Rio Camuy Cave Area, Puerto Rico

By Brother G. Nicholas, F.S.C.*

Almost 3,000,000 people live on the island of Puerto Rico, which has an area of approximately 3,400 square miles. Although originally the inhabitants were concentrated in half a dozen of the larger cities, a combination of population pressure and the development of a road system some 3,000 miles in length within the past 25 years has led to the settlement of practically every available square mile of land on the island. Homes and farms are now found perched on steep hillsides, dotting the tops of mountains, and stringing along the flood plains of river valleys. There are but few localities on the island that do not reflect the impact of man's activities. At present, a few sites retain their pristine appearance. The most famous of these is El Yunque, a tropical rain forest situated in the Sierra de Luquillo on the eastern end of the island. El Yunque is part of the Luquillo Division of the Caribbean National Forest. The other division, Toro Negro, is located in the Cordillera Central and contains some of the highest peaks of the island. These two forests are administered by the U.S. Forest Service. Scattered about the island are ten or so Reservas Forestales, or areas where the cutting of timber and construction of residences is closely supervised by the Puerto Rican government. However, these are not developed for casual visitation.

The Carribbean National Forest preserves two distinctive ecological habitats; the tropical rain forest and the higher montane forest. But until the plan of developing a territorial park in the Rio Camuy valley was proposed, one of the most distinctive ecological habitats on the island was in danger of severe alteration by man. In the northwestern section of Puerto Rico, there exists an area of karst topography, the mogote country, characterized by steeply sloping hills, deep ravines and practically completely subterranean drainage. Notwithstanding the rugged limestone topography the demand for living space was so great that the karst terrain was fast becoming denuded of its foliage as the area was becoming increasingly utilized for agricultural and grazing purposes. With the preservation of that portion of the Rio Camuy Valley now to be included in the territorial park not only will the distinctive terrain be preserved for all future visitors to observe but the opportunity will be afforded for biologists to study an area unique because of the ecological diversity in such a limited geographical area. Fortunately, the equitable climate, heavy rainfall and high mean temperature will allow the rapid recovery to their original condition of those areas of the Rio Camuy Valley that are now occupied by man.

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Preliminary reports on the geology and topography (Gurnee, *et al.*, 1966) and the biology (Nicholas, 1966; 1967) have recently appeared. This report will serve as a summary of the distinctive ecology of the Rio Camuy Valley. It is rare to find such an amazing diversity of living organisms within such a restricted area. Three totally different environmental habitats can be seen (with less obvious transitional zones), all

within an altitudinal variation of less than 100 meters.

On the surface of the mogotes or pepinos is a thicket-type growth interspersed with a number of introduced varieties. Down in the ravines and sinkholes where the relative humidity is higher and the temperature more constant there exists a tropical mesophytic forest. Beyond the wide entrances at the ends of the ravines and bottom of the sinkholes exists the cavernicolous habitat. This exists as a continuum underneath most of the mogotes but for purposes of study the cave habitat has to be entered in different places. Of more difficult access, it can be seen and studied readily only where the sinkholes have penetrated down to the subterranean Rio Camuy. Some dry passages and rooms exist in the Rio Camuy cave system, but most of the known system can be reached only from the river itself.

The thicket cover on the mogotes would seem at first more peculiar to an area of extremely limited rainfall. It is the porosity of the limestone with resultant low runoff that produces the typically xerophytic, woody, scrubby vegetation, rather than any lack of rainfall. Isolated trees can be seen rising above the shrubs. The most conspicuous in the Rio Camuy Valley include *Roystonea regia*, the royal palm; *Gaussia attenuata*, the coconut palm usually seen at the summit of the hills; the dense, leafy *Ficus stablii* and *F. laevigata*; and the Caribbean pine, *Pinus caribea*. One of the most conspicuous shrubs is that of the spiny maguay, *Agave sisalana*. The spines of the fronds of this sisal-type plant are so sharp that rows of the maguay make effective cattle barriers and replace barbed wire fences. *Gynenium sagittatum*, a tall, wild sugar cane that is inedible; *Inga laurina*; the guaba; and *Ceiba pentandra* are also common to this habitat. The whole thicket is interlaced with numerous lianas or long vines, such as *Lastacia sorghoidea*, *Acacia riparia* and *Batocypdia unguis*. Found along the edges of the thicket, on the exposed ledges of rock along the ravine, and on the trees themselves are such epiphytes as *Anthurium acule*, *Philodendron kramerii*, several types of vanilla plant, including *Vanilla eggersii*, *V. pompona* and *V. planifolia*, different species of orchids, such as *Cattleya speciosissima* and *C. mendeli*; and *Pitcairnia angustifolia*. Exotics collected or seen near the building used as expedition headquarters during the time of exploration in the Rio Camuy cave system include the Asiatic malanga, *Colocasia esculenta*; the avocado, *Persea americana*; the African tulip, *Spathodea campanulata*; wild begonia, *Begonia obliqua*; the edible guava, *Psidium guajava*; wild eggplant, *Solanum melogena*; the breadfruit, *Artocarpus altius*; and the colorful "lobster claw" *Heliconia rubro-striata*. The thicket vegetation covering the mogotes of Puerto Rico is similar to that found on the mogotes or "guaniguanicos" in the Cordillera de Los Organos of western Cuba (Vic-

torin and Leon, 1942). This similarity extends to the cave fauna of western Cuba as well.

The outcrops of the limestone on the mogotes are heavily eroded into sharp points and edges, deep crevices and rounded pockets that supply ample opportunity for the accumulation of vegetable debris and, in some cases, the gradual development of a thick soil. The soil in the ravines is alkaline usually, but occasionally the CaCO_3 has been leached out or the alkalinity lessened by the accumulation of humus. Sugar cane, *Saccharum officinarum*, is grown in the ravines. Coffee, *Coffea arabica*, is limited in extent, being more conspicuous on the volcanic soils found south of the Rio Camuy Valley toward the center of the island. Among the prominent crops seen in the Rio Camuy Valley are sour orange, *Citrus auranticum*; sweet orange, *C. sinensis*; the banana, *Musa sapientum*; pineapple, *Ananas sativus*; and ginger, *Zingiber zingiber*. Bananas were being cultivated in one of the larger sinks of the Rio Camuy Valley, Tres Pueblos, but grow wild in the ravines and mogotes.

The well-protected, humid ravines with the rich loam, clay soil and abundant water supply are ideal sites for the development of a tropical mesophytic forest. In this habitat the palms, giant bamboo, *Gigantocloa sp.*, broad-leaved evergreens, bromeliads and abundant epiphytes are all suggestive of tropical conditions. Two of the sinkholes, Espiral Sink and the north end of Empalme Ravine, are particularly rich in this type of flora. The contrast is startling between the luxuriant, almost jungle-like mass of vegetation in these sinkholes and the almost barren, dark cave environment just a few feet away. At the base of Espiral Sink and Tres Pueblos Sink, the transitional zone between the two distinctive habitats is not only pronounced but amazingly narrow. In both cases, less than 70 meters separates the tropical mesophytic forest and the cavernicolous habitat. Amid the dense vegetation of the sinkholes can be seen *Bufo marinus*, the large marine toad; *Euleutherodactylus portoricensis*, the ubiquitous tree frog with the distinctive call which gives it the common name of coqui; numerous lizards, snails, moths, butterflies and many other types of insects and myriapoda. The environment at the base of the sinkholes and ravines is the immediate source for much of the nutrient input of the cave ecosystem. The leaf litter and cover in the rich, loamy soil contains numerous types of microfauna contributing directly or indirectly to the trophic equilibrium of the cave.

Within the cave environment the predominant taxa are all faunistic, as opposed to the large number of floral taxa in the forest. Large quantities of organic material in the form of debris and detritus are washed into the Rio Camuy caves and support a fauna more abundant and diverse than that found in the temperate climates.