

A FOREST SURVEY IN GUATEMALA*

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SINCE Guatemala is little known to most "Norte Americanos," or "Yanqui's," as we are called in Central America, I will assume that many are as much in the dark about the country as I was when I received orders to go there. In fact, I knew it only as a small country located somewhere in Central America, and populated chiefly with volcanoes, Indians, and bananas.

A map of the Americas shows that, while it actually is indeed a small country, nevertheless it is large by Central American standards. The map also shows that it is about 900 miles due south of New Orleans. Its area of 40,000 square miles is equal to about four tenths of Oregon, or almost exactly the area of Ohio. It lies at the landward end of the Yucatan Peninsula, and is bordered on the north and west by Mexico, on the east by British Honduras and the Caribbean Sea, and on the south by Honduras, El Salvador, and the Pacific Ocean.

In this small country is packed a population twice as great as that of Oregon, but more than a third of the area is virtually uninhabited. The greater portion of the population is descended from the Maya Indians, who are known to have developed a flourishing civilization in Guatemala at least twenty-five hundred years ago. They are known to have had, two thousand years ago, a better calendar than what we use today, a readily decipherable written language, a mathematical system utilizing the zero, and even observatories for determining the equinoxes and solstices of the sun. The Mayas reached their greatest heights and numbers in what is now the Department of El Petén; and it is concerning this department that I will speak.

Guatemala is comprised of three major physiographical units: the narrow alluvial coastal plain of the south coast; the high, mountainous, actively volcanic central core; and the great, undulating limestone plain which occupies the Department of Petén and extends northward and eastward over the Yucatan Peninsula. The coastal lowlands are intensively cultivated, the principal crop being bananas. In addition, every available square foot of the central highlands is cultivated for corn, coffee, black beans, gourds, squashes and other vegetables. The areas not devoted to crops are covered by several species of pines, a true fir, and cypress, among other things.

Ninety-four per cent of El Petén is covered by dense tropical forests yielding an enormous variety of hardwood logs, chicle for the chewing gum industry, and a small quantity of slash pine, crocodile skins, and other minor products.

The Mayan word "Petén" means lake; therefore the modern name, El Petén, means The Lake. It has two seasons only; the dry season extends from February to May, when rain is almost unknown; and the wet season, from June to January, during which some eighty to one hundred inches of rain pour down. Across the great limestone plain, only 300 to 800 feet above sea-level, occur numerous faults, with a trend from southeast to northwest. These faults form gentle *cuestas*, the steep faces of which face southward against the general drainage pattern of the region. These *cuestas* plus the periodic rainfall are responsible for the extensive *bajos*, a local phenomenon of great significance in the interpretation of forests from photographs and in their exploitation on the ground. Because of the limestone bedrock, there is almost no regular surface drainage pattern. During the rainy season, the excess water

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moves northward against the faces of the *cuestas*, forming great, shallow lakes or saturated areas. During the dry season, these bodies of water are lost through percolation and evaporation, but seldom through surface drainage, because the lowest spot is nearly always at the center. The soil then becomes extremely dry to the extent that we have the phenomenon of a xerophytic forest association occurring on areas which are submerged a large portion of the year.

The *bajos* are quite important from three standpoints. They are striking and easy to identify on photographs of any scale; their forests have no economic value and therefore are to be avoided in any plan for exploitation or survey; and they are absolutely impossible to negotiate by any means throughout the greater part of the year. The person planning the exploitation of forest resources must carefully plan his road systems to avoid these *bajos*.

All of the preceding is merely background material to give an idea of the country which it was desired to survey. When I boarded the plane for Guatemala, I knew less of what was expected of me than you do now. Upon my arrival, I also learned that no one connected with the project had any ideas on the subject. I found that a general survey of the forest resources of the entire country and recommendations for their exploitation and conservation were desired. The program was under the direction of the Inter-American Institute of Agricultural Sciences and was being financed jointly by that organization and the Departamento de Fomento of the Instituto de Fomento de la Produccion, or INFOP, of the Guatemalan government. The actual work on the survey was to be conducted by a forester experienced in the tropics, a doctor of plant ecology, and myself, with such unskilled help as we could obtain.

At this point I was greatly disheartened to learn that the director of the project was exceedingly hostile to the plan of utilizing aerial photographs in the study, and firmly believed that the project would have prospered fully as well if I had been elsewhere. I am gratified that before I left the country he presented me with a letter of appreciation for a job which he had become convinced could be accomplished only through the use of photographs and photo-interpretation techniques.

At the first conference it was decided that I should attempt the survey of El Petén where the field work was to be accomplished by the forester; and the director himself would undertake the survey of the rest of the country. This decision was prompted by three considerations: El Petén was the only area adequately covered by photography; it was too inaccessible to be even superficially examined on the ground in the time allowed us; and the director felt the possibility of development of Petén to be so remote that I could do less damage pattering around up there with my photographs than anywhere else in the country.

At this conference three objectives were decided upon for the study of Petén. First was the determination of total areas of various classes of forested and non-forested lands. Second, the determination and map location of forested areas not considered merchantable because of topography. Third, the determination of areas possibly suited for agriculture. Because of the vast area which it was desired to study in a stringently limited period of time and with an absolute minimum of personnel, it was found necessary to keep the study of Petén broadly generalized. In addition, because of the small scale of existing photography and the absence of opportunity for advance correlation of field observations with photo observations, it was impossible to make definite stand analyses on a basis of species. Partial delineation of vegetation on existing maps and a study of the photographs led to the setting up of the following types:

1. High forest, subdivided into
 - a. Lowland high forest
 - b. Upland high forest
2. Low forest, consisting of
 - a. Bajos
 - b. Hillcap forest
 - c. Old agricultural lands
3. Pine forest
4. Savanna
5. Other, consisting of
 - a. Water areas
 - b. Swamps
 - c. Non-forested other than savannas

For the study, the following information and equipment, including that which I carried to Guatemala was available:

File copies of photographs of a scale of 1/40,000 made in 1938-1939 for the Shell Oil Company of Guatemala by Fairchild Aerial Surveys. I extend my most sincere compliments to that photographic crew for an outstanding job of flying, in an area virtually without landmarks and of which there were only the most rudimentary sketch maps. Considering the circumstances, it certainly did a magnificent job.

Copies of 134 ten-minute quadrangles of a planimetric map of Petén at 1/40,000 scale made from the above photographs. This map showed a partial delineation of some vegetative classes and some major physiographic features.

For photogrammetric equipment, a contour finder, a pocket stereoscope, a parallax wedge and micrometer wedge, a sketchmaster, and a dot templet.

Botanical literature pertaining to Petén was intensively studied in order to become familiar with the vegetative associations to be found on various sites identifiable on the photographs. The most valuable were *The Vegetation of Petén*, by C. L. Lundell; *Phytogeographical Reconnaissance*, paper no. 1, *Botany of the Mayan Era*, by H. H. Bartlett; and *Botanical Research in the Chiclé Industry*, by F. E. Egler.

It was necessary first to interpret the photographs and to delineate the forest and non-forest types on the base maps. Preliminary study consisted of observations to attempt to correlate the photographic images with the various associations described by Lundell. These observations included notes on the tones and textures of various timbered and non-timbered areas and measurements on the photographs of total heights and average crown diameters of dominant and co-dominant trees, as well as counts of numbers of visible crowns per four hectares (or 10 acres) under various site conditions.

The second step consisted of checking, correction, and completion of the delineation of vegetation on the Shell Oil Company map, so that area measurements could be made. Calculation of areas was accomplished by means of dot counting in the manner practiced by the U. S. Forest Service in its regional surveys.

Two areas—Lacanton and the area surrounding the agricultural colony at Poptún—were desired for more intimate study than the rest of Petén. Utilizing the Shell Oil Company map as a base, detailed type mapping was undertaken, necessary topographic information added, and complete planimetry delineated. This last step was not as arduous as might be supposed, because even as late as 1949 there were in all Petén only about 50 miles of roads considered passable with trucks or jeeps.

I will present only two examples from the seven types or associations described in the report to INFOP. These broad associations were identified by photographic appearance and the ecological factors of soil conditions, moisture conditions, elevation, and history.

1. The *Zapotal*, or "broken ridge," described by Lundell and Bartlett. The zapotal is the upland high forest previously referred to. It covers a major portion of Petén, occurring virtually everywhere on the upper slopes and rolling plateau lands. Its name is derived from the presence of the zapote tree. This yields the chicle, which until recently was the base for all good chewing gums. It is characterized by full stocking of trees approximately 70 feet tall, except on drier sites, where it degenerates to hillcap forest. Tree crowns vary greatly in diameter and color (tone on the photographs) giving a mottled appearance. Its defining characteristics are: dense, closed canopy; strongly mottled tone; coarse texture; uniform height but irregular surface; and presence on well-drained shallow-soiled calcareous uplands.
2. The *Corozal* or *Caobal*. The distinction in name varies with the proportion of corozo palm and caoba (mahogany), and has never been defined in precise terms. The caobal is the lowland high forest referred to previously, and is the one sought because of its mahogany. It covers a large, but by no means major portion of Petén and is restricted to rich, better-drained alluvial soils in broad river valleys and the narrow valleys of the plateaus and upland hills. It presents the darkest photographic image of all Petén types and is definitely a two-storied forest, the upper story consisting of great broad-crowned trees which rise far above the lower canopy. These crowns reach a maximum of 120 feet in diameter and approximately 120 feet in height, and they almost never average more than one per acre. The defining characteristics of the caobal are: very dark tone; two-storied canopy; isolated trees of great height and crown diameter; and presence on broad better-drained alluvial soils and alluvial slopes.

The report which was submitted to INFOP gave, in considerably greater detail than herein given, the *objectives* of the study, the *information and equipment available* for the study, the *procedure*, a *presentation of statistical data*, a *detailed discussion* of 128 ten-minute quadrangles, *conclusions*, and *recommendations* for future surveys.

Time does not permit discussion of the field work performed by the forester, but I must make clear that this study was not accomplished without field checks and research. The forester was almost constantly in the jungle during the study, being flown by the Guatemalan Air Force to isolated landing strips in Petén whence he would set out into the bush accompanied only by an Indian *chiclero*, or chicle hunter, and a string of pack mules. His job was to check the validity of the type mapping and to study both exceptional and typical areas which I had previously selected on the photographs. Whatever value this project may have for the Guatemalan government will be principally due to his efforts.

I have mentioned previously the stringent limitation on both time and personnel. The survey of El Petén was accomplished by two professional grade persons aided by two unskilled laborers; and the summary of data in the report to INFOP shows that a total of 35,561 square kilometers, or 13,780 square miles was surveyed in two months and nine days, including travel time from Portland to Guatemala and return.