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DEVASTATION OF YUCATECAN FORESTS, WITH NOTES ON INSECT ABUNDANCE AND FORMATION OF LOCAL CLIMATES

EDUARDO C. WELLING

Mérida, Yucatán, Mexico

Yucatec is a term which can be applied to aspects of the whole of the Yucatán Peninsula, including parts of southern Mexico, British Honduras, and Guatemala. The peninsula is a district subregion, not only biologically, but geologically and in climate as well. It was once covered with forest from east coast to west and from north to south. This forest was not of the same character before human inhabitation as at present. Apparently the vegetation had been greatly disrupted about 1,000 years ago, and in recent times has staged a major recovery by returning mostly to a climax state. I will comment below on general life sub-zones of the peninsula, their present condition, and probable past history.

The area now occupied by the Yucatán Peninsula was once under a shallow sea. The peninsula was formed mostly by calcareous deposits of marine life. This formation, including emergence from the sea, took place in the northern part of the peninsula, which is remarkably flat, in Pliocene and early Pleistocene times of the late Tertiary and early Quaternary. The southern, undulating portion was formed much earlier, during the Eocene and Oligocene.

The vegetation can be roughly divided into three major zones. The first of these is the thorn forest zone, both evergreen and deciduous, which dominates almost all of the state of Yucatán and the central and northern parts of Campeche. This area has an average yearly rainfall of about 75 cm (30 inches), decreasing from east to west. The trees attain an approximate maximum height of 12 to 15 meters in the climax state. The second zone is the subequatorial or transitional zone which contains different forest types, with an approximate maximum height of 20 to 30 meters in the climax state. This area has from 125 to 200 cm (50–75 inches) of rainfall yearly, and extends over all of Quintana Roo, northern British Honduras, southern Campeche, and certain parts of northern El Petén. The third is the true equatorial zone which flourishes

in central and southern British Honduras and central and southern Petén. Here the rainfall is from 200 to 500 cm (80–200 inches) yearly, and climax forests reach a height of 50 to 70 meters.

Rainfall and average overall height of the forests diminish from south to north. It may be of some significance that this corresponds with the fact that southern portions of the peninsula have been upraised from the sea for a longer time, thereby allowing for the more thorough breakdown of the limestone and the formation of a richer soil. Another possible factor for development of a magnificent forest cover in the south is the proximity to the great mountain ranges of Chiapas and Guatemala, and the distance from the sea. Low coastal areas in the Gulf of Mexico area are usually devoid of luxuriant vegetation where they extend far from mountains.

Both human and natural destructive forces have been influential in greatly decimating the natural forest cover. During the height of the Mayan civilization 800 to 2,000 years ago, it is estimated that there were two million people on the peninsula. Today, with an approximate population of 900,000 in the north that cannot grow the corn it needs, and 100,000 in the south, the peninsula is less densely populated than in the past. It is my belief that impoverishment of the soil due to agriculture was one of the greatest factors contributing to the downfall of the ancient civilization. When the great Mayan migrations from the south arrived on the peninsula the people found a virgin soil to work; later the soil could not sustain two million people. With the decline of abundance of food, the population began to dwindle. Large areas were abandoned and consequently reverted to climax forest, most of which was not disturbed again until the last 100 or 200 years. Subsequent to the Mayan civilization, the bulk of the population has been concentrated in northern Campeche and Yucatán. The soil is now failing again and migrations are taking place into southern Campeche and Quintana Roo. The dispersal of people and the effect of cultivation on the land in centuries past has been a much more complicated process.

With the bulk of the Mayan populace residing in Yucatán and northern Campeche, which is the territory occupied by the thorn forest, this forest has suffered greatly. Virgin or climax stands are almost nonexistent, especially in western Yucatán. However, fortunately the area has a limestone subsoil or base, and following destruction, such as by fire, the same trees and shrubs spring up the following year. On a non-limestone base thick grasses frequently cover the soil immediately after destruction of the forest, thus creating great difficulties for the reestablishment of primitive forest species. Therefore, there is no great difficulty collecting insects peculiar to the thorn forest, along with other

wide-ranging unspecialized species in the subregion, even if the primary forest has been completely exploited and destroyed, as the larval food-plants of the phytophagous insect fauna can be found everywhere in varying stages of development. This is most fortunate since otherwise a greater poverty of insects would exist than there does at present.

The presence of some rather local forms gives evidence that the thorn forest in certain areas is natural, not artificially caused. As examples I give *Papilio rogeri* Boisduval, a curious and unusually stable population of *Chlosyne lacinia* Geyer, and *Anaea tehuana* Hall. Except for the first-mentioned species, these are found in only limited spots in the southern area.

The great impoverishment of the western part of Yucatán is partially due to the extensive planting of henequen (*Agave* sp.) for fiber industries. Rains from the east frequently cease to advance on approaching the cleared area, which has to be continually cut and clean; whereas the rains develop again further west of Mérida, where no henequen has been planted. This has produced a "local climate" of extreme heat and dryness in the environs of Mérida. Here certain insects are scarce and appear much later than in the eastern parts of the thorn forests, and the number of species is greatly reduced. For example, in nearly 10 years, I have never seen *Morpho peleides* Koll. or *Caligo memnon* Feld. in the western part of the state, while they are always found in the eastern part.

The subequatorial zone has a richer insect fauna than that of the thorn forest areas of Yucatán and Campeche. Until recently many widespread species peculiar to more open country such as certain *Papilio*, *Euptoieta*, *Zerene*, and *Phoebis* were practically absent. Upon the recent clearing of patches in the forests by people migrating from northern parts of the peninsula these open-country species have quickly become established. The above is also true for some endemic forms associated with the thorn forest. The same establishment has been noted with certain birds and plants. Exploitation of the forests for lumber has been rather intensive in south central Campeche and southern Quintana Roo. The great hurricane of 1955 that devastated Chetumal, Quintana Roo, and Corozal, British Honduras, and most of the forest in a 100-km radius north and south of these towns and quite the same distance into the interior, was followed by two years of extreme aridity perhaps in part due to the lack of the tall forest which formerly served to cool the air and to induce rain. In 1957 huge fires swept over southern Quintana Roo, and the ground was left completely bare. Several prefire but post-hurricane species of butterflies, like *Eueides aliphera* Godt., *Papilio torquatus* Cram., and some *Euselasia* spp., are now absent there. Thus,

the character of the fauna has changed and the rainfall has declined. Returning to former luxuriance will take a long time.

Central and northern Quintana Roo are still magnificently forested. There has been little human influence on these forests which were fortunate to escape the terrible 1931, 1955, and 1961 hurricanes. The lack of mahogany in the northern part of the territory has also helped them remain mostly unchanged. Here collecting is magnificent in season, and the best collecting can be experienced beginning in late May, in comparison with August in western Yucatán or late June in eastern Yucatán. During the rainy season it may rain in torrents twice daily, in midmorning and all afternoon, in comparison with once daily beginning about 4:00 P.M. in western Yucatán, or once daily about 1:00 or 2:00 P.M. in the eastern part of the same state.

The great equatorial forests present another aspect altogether. These forests appear to be outside the limits of the true Yucatecan life zone, which is characterized by a flora and fauna adapted to the limestone base, because other geological features are clearly seen in some areas where this luxuriant forest exists, especially in southern British Honduras and southeastern Petén. Still, in south central and southwestern Petén, one can find limestone subsoil under meters of fine, rich topsoil. This equatorial zone, of essentially the same character as the wetter forests that spread northward on the Atlantic side of the mountains from the equator, is a zone of frequent streams and rivers, deep soils, an immense yearly rainfall, and a fantastic insect fauna.

The history of natural and human destruction of the forest is not so well documented as in thorn forest areas. Apparently, the Mayans inhabited this region and had destroyed a part of the vegetation with great difficulty. Probably the damage was not as extensive as in the subequatorial or thorn forest zones, as the clearing of the giant tree forests was not as easily done and excessive rainfall in some limited areas may not have been as ideal for growing corn. The English have been exploiting the forests in British Honduras for nearly 300 years, but still, before the terrible 1961 hurricane, there were great stands of mahogany and other forest giants there. Most of the cultivation has been along the rivers, and the interior part of the country is scarcely populated. In British Honduras cultivation is more stable and not so nomadic as in Yucatán, Campeche, and Quintana Roo, where corn is planted after felling the forest, and then abandoned after two years. All this has helped to protect the equatorial forest to a degree. Also of importance is the fact that no species of tree occurs in pure stands, the forest complex being composed of many species in a relatively small area. During lumbering, only certain trees are taken out here and there,

leaving most of the forest intact. Further inland, in El Petén, no way has been found to take fine woods out economically due to the lack of roads and harbors. Some wood has been floated down the Usumacinta River into Mexican territory, but the treacherous nature of the river in the interior prohibits large-scale forestry work there. The lack of other resources in these areas has made large-scale development and opening of this country unfeasible.

Recently, the equatorial forests in central and south central British Honduras have suffered a terrible disaster due to the 1961 hurricane, which laid waste to hundreds of square kilometers of forest. It has been calculated that it will take at least a century for these forests to attain their former magnificence, providing the rainfall does not diminish. Fortunately, most of the forests which were destroyed are on elevated land, where the elevation will help to sustain the usual precipitation. The forests of El Petén and Chikibul Forest on the western side of the Maya Mountains in British Honduras have escaped hurricane damage. Collecting in the damaged area in the Stann Creek Valley of British Honduras has indicated no remarkable reduction in the insect population following the hurricane; however, the bird population has suffered somewhat and I believe many species dependent upon a heavy forest canopy have migrated to the remaining forest country farther west. This may help to explain the continued abundance of insects in the Stann Creek Valley. The wetness of the region has prevented forest fires in that zone and has helped preserve what is left of the forest. Forest fires raged all through the devastated subequatorial forest areas of British Honduras during early 1963 and 1964. It is hard to collect Ithomiids and other shade-loving butterflies there, since they are usually seen in flight, seemingly searching for a shaded place; nevertheless, they are still present, concentrating in places where there are still a few trees left. The local people told me that in 1962, immediately after the hurricane, butterflies and other insects were very abundant, and I hope that this will be the case until the forest has reestablished itself. Collecting in 1964 and early 1965 also afforded excellent results. It is encouraging to see the British Forestry Department making efforts to prevent further destruction to these forested areas.

In spite of the great damage done to peninsular forests, collecting is still superb at most localities in season. I have in my collection about 720 species of butterflies from the Yucatecan area, and suspect that there are at least another 150 within the limits of the peninsula, an area of about 200,000 square kilometers, approximately 80,000 square miles, or the equivalent of the states of New York, New Jersey, and Pennsylvania combined.