UNIVERSITY OF MICHIGAN
MUSEUM OF ZOOLOGY
MISCELLANEOUS PUBLICATIONS NO. 29

A CONTRIBUTION TO A KNOWLEDGE OF THE HERPETOLOGY OF A PORTION OF THE SAVANNA REGION OF CENTRAL PETÉN, GUATEMALA

BY
L. C. STUART
WITH A BRIEF ACCOUNT OF THE FLORA BY C. L. LUNDELL

ANN ARBOR, MICHIGAN
UNIVERSITY OF MICHIGAN PRESS
October 1, 1935

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FREDERICK M. GAIGE
Director of the Museum of Zoology

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INTRODUCTION

The third of the University of Michigan-Carnegie Institution of Washington expeditions detailed to study the biology of the Mayan area of Middle America was directed to the savanna region of central Petén, Guatemala, during the winter and spring of 1933. The savannas proper lie to the south of Laguna de Petén and extend in a broken chain from a little west of La Libertad to east of Santa Ana (see map). East of this they are replaced by "pine ridges" which reach southward to Dolores and northward into British Honduras. My companion on the expedition was Mr. C. L. Lundell of the University of Michigan Herbarium.

We left El Cayo, British Honduras, on March 20, 1933, and returned there on June 22, 1933. The actual time spent in the savanna region extended from March 27 to June 15. During that time our headquarters were at La Libertad. For the purpose of making comparative studies, three trips were made to the high bush areas to the north and south of the savannas to which our main studies were limited, and in the center of which La Libertad is located.[1]

The first of these trips was to Santa Teresa on the Arroyo Subín where we stayed from April 10 to April 13. The second was to San Andrés on the north shore of Laguna Petén where we remained from May 1 to May 3; the third carried us to Zotz for two days, May 17–18.

Unfortunately the season of 1933 was climatically unusual for the region. Extreme drought extended from the end of January until the latter part of May, during which time no rain fell. As a result the area became very dry, and during May extensive fires swept through both the savannas and high bush. Consequently the collections from the bush were meager, and it is doubtful if a fair sample was made of the savanna fauna. Inasmuch as it was necessary for the expedition to leave soon after the wet season had begun, when the fauna of that season was only beginning to emerge, few of these forms were collected.

[1] For a further account of the trip see L. C. Stuart, "The 1933 Expedition to Petén, Guatemala," *Annual Report, Dir. Mus. Zool. to the Board of Regents, 1933–34* (1935): in press; and "A journey to El Petén, Guatemala," *Michigan Alumnus*, 40, 16, 1934: 281–282, 290, 2 figs.

In a recent paper[2] I have noted the herpetological fauna known to occur in Petén and have added to that list species occurring in more recent collections. The reported fauna of Petén as a whole is as follows:

Oedipus platydactylus (Cuvier) = ? *Oedipus mexicanus* (Duméril and Bibron)
**Oedipus yucatanus* (Peters)
Rhinophrynus dorsalis Duméril and Bibron
Bufo marinus (Linnaeus)
Bufo valliceps Wiegmann
Leptodactylus labialis (Cope)
Eleutherodactylus rhodopis (Cope)
Hyla baudinii Duméril and Bibron
Hyla loquax Gaige and Stuart
Hypopachus inguinalis Cope
Microhyla elegans (Boulenger)
Rana pipiens Schreber
Thecadactylus rapicaudus (Houttuyn)
Sphaerodactylus glaucus Cope
Sphaerodactylus lineolatus Lichtenstein
Coleonyx elegans Gray
Anolis aureolus Cope
Anolis biporcatus (Wiegmann)
Anolis ruthveni Stuart
Anolis tropidonotus Peters
Anolis u. ustus Cope
Corythophanes cristatus (Merrem)
Basiliscus vittatus Wiegmann
Ctenosaura similis (Gray)
Sceloporus t. serrifer Cope
Sceloporus variabilis Wiegmann
**Gerrhonotus moreletii* Bocourt
**Gerrhonotus auritus* Cope
**Lepidophyma flavomaculatum* Duméril
Ameiva festiva (Lichtenstein)
Ameiva undulata (Wiegmann)
Cnemidophorus d. cozumelus Gadow
Mabuya agilis (Raddi)
Leiolopisma assatum (Cope)
Eumeces schwartzei Fischer
Constrictor c. imperator (Daudin)
**Storeria dekayi* (Holbrook)
**Dendrophidion dendrophis* (Schlegel)
Drymobius margaritiferus (Schlegel)
Eudryas b. melanolomus (Cope) × *E. b. laevis* (Fischer)
Coluber ortenburgeri Stuart
Spilotes p. mexicanus (Laurenti)
Drymarchon c. melanurus (Duméril and Bibron)
Lampropeltis p. polyzona Cope
Leptophis mexicanus Duméril and Bibron
Leptophis o. occidentalis (Günther)
Adelphicos quadrivirgatus Jan
Xenodon colubrinus Günther
Tropidodipsas sartorii Cope
Imantodes cenchoa (Linnaeus)
Leptodeira a. polysticta Günther
Leptodeira y. malleisi Dunn and Stuart
**Conophis lineatus* (Duméril and Bibron)
Oxybelis fulgidus (Daudin)
Coniophanes imperialis (Baird and Girard)
**Hydrocalamus quinquevittatus* (Duméril and Bibron)
**Tantilla moesta* (Günther)
Stenorhina degenhardtii (Berthold)
Micrurus affinis alienus Werner
Bothrops atrox (Linnaeus)
**Bothrops lansbergii* (Schlegel)
**Staurotypus triporcatus* (Wiegmann)
Kinosternon leucostomum Duméril
Dermatemys mawii Gray
Geoemyda areolata (Duméril)
Crocodylus moreletii Duméril

* I have not seen these forms from Petén.

Many of the above were not taken by the expedition; but to the preceding list the following species are added in this paper:

Leptodactylus melanotus (Hallowell)
Triprion petesatus (Cope)
Hyla culex Dunn and Emlen
Hyla underwoodi Boulenger
Hyla venulosa (Laurenti)
Hylella picta Günther
Rana palmipes Spix
Anolis capito Peters
Anolis copei Bocourt
Anolis sericeus Hallowell
Corythophanes hernandezii (Wiegmann)
Sceloporus chrysostictus Cope
Cnemidophorus gularis Baird and Girard
Masticophis mentovarius (Duméril and Bibron)
Phrynonax p. poecilonotus (Günther)
Ficimia olivacea Gray
Ninia sebae (Duméril and Bibron)
Sibon sibon (Linnaeus)
Oxybelis acuminatus (Wied)
Coniophanes piceivitus Cope
Bothrops nummifera (Rüppell)
Crotalus t. durissus (Cope)
Kinosternon berendtianum Cope
Kinosternon cruentatum Duméril
Pseudemys ornata (Gray)

[2] "A Contribution to a Knowledge of the Herpetological Fauna of El Petén, Guatemala," *Occ. Papers Mus. Zool., Univ. Mich.*, 292, 1934: 1–18.

The collections contain what appear to be four species new to science. These are *Coluber ortenburgeri* Stuart,[3] *Leptodeira y. malleisi* Dunn and Stuart,[4] *Anolis ruthveni* Stuart,[5] and *Hyla loquax* Gaige and Stuart.[6]

The material described in the following annotated list includes everything collected by the expedition, with the exception of a few specimens already reported upon,[7] which could be contained logically in a study of the savanna, and might be summarized as follows:

Group	Genera	Species	Specimens
Amphibia			
Caudata	1	1	3
Salientia	9	16	516
Reptilia			
Squamata			
Sauria	11	23	462
Serpentes	22	26	98
Testudinata	4	6	98
Loricata	1	1	2
Total	48	73	1179

In the above list there are forty specimens from the vicinity of La Libertad including several species not collected by the expedition, which were taken by Harry Malleis, an American collector, and presented after his death by Mr. O. A. Taintor, of La Libertad.

The remainder of the material was taken from five localities: La Libertad, Santa Teresa, Zotz, San Andrés, and Ramate. The last locality was examined and explored only briefly, but the specimens from there fit very nicely into this study. In discussing the geographical aspects of the savannas, I have drawn freely from the material included in my earlier report.[8]

Acknowledgments.—Many persons have aided in the collecting and study of the material here presented, and I wish to express my appreciation for the help which I have received. I am indebted primarily to Mr. F. M.

[3] L. C. Stuart, "Studies on Neotropical Colubrinae. IV. An Apparently New Species of *Coluber* from Guatemala," *op. cit.*, 284, 1934: 1–4.

[4] E. R. Dunn and L. C. Stuart, "A New Race of *Leptodeira* from Northern Central America," *Occ. Papers Mus. Zool., Univ. Mich.*, 313, 1935: 1–3.

[5] L. C. Stuart, "A New *Anolis* from Northern Central America," *op. cit.*, 310, 1935: 1–4.

[6] H. T. Gaige and L. C. Stuart, "A New *Hyla* from Guatemala," *Occ. Papers Mus. Zool., Univ. Mich.*, 281, 1934: 1–3.

[7] L. C. Stuart, *op. cit.*, 292.

[8] *Ibid.*

Gaige, Dr. Alexander G. Ruthven, and the authorities of the Carnegie Institution of Washington, for making the trip to Petén possible. For the many courtesies received during the course of the trip, I wish to thank Mr. A. O. Taylor, of Belize, British Honduras, Mr. P. W. Shufeldt, formerly of Belize, Mr. C. E. Hopun, of El Cayo, British Honduras, and Mr. Rubén Alvarado, of Flores, Guatemala. I am especially indebted to Mr. O. A. Taintor our genial and helpful host at La Libertad for aid and advice during our stay there. To Mr. C. L. Lundell of the University of Michigan, my companion on the expedition, I owe my thanks not only for collecting many specimens and for aiding in the study of the region but also for attending to the details of travel throughout our journey. Mr. O. P. Ricketson of the Carnegie Institution of Washington obtained many courtesies for us. Financial aid for studying material was received from the Faculty Research Fund of the University of Michigan.

For aid and helpful suggestions in my study of the material, I wish to express my thanks first to Mrs. F. M. Gaige, of the Museum of Zoology, University of Michigan. Practically all the amphibians collected were identified and commented upon by her, and in addition I had access to her manuscript on the herpetology of Yucatan which is in press. Dr. N. E. Hartweg also of the Museum of Zoology identified the turtles. To Dr. Doris Cochran and Dr. Leonhard Stejneger of the United States National Museum, to Dr. Thomas Barbour of the Museum of Comparative Zoology, Harvard University, to Dr. E. R. Dunn of Haverford College, and to Mr. K. P. Schmidt of the Field Museum of Natural History, I wish to express my thanks for the loan of material and aid in determinations. I wish further to thank Mr. W. H. Parker of the British Museum (Natural History) for comparing specimens with types contained in that institution.

For suggestions and aid received in compiling and organizing my data, I wish to thank Dr. L. R. Dice, Dr. C. L. Hubbs, Dr. J. Van Tyne, and Dr. Adolph Murie, of the Museum of Zoology; Dr. E. C. Case, of the Museum of Paleontology; Dr. M. W. Senstius and Dr. I. D. Scott of the Department of Geology; and Dr. P. E. James of the Department of Geography, all of the University of Michigan. The included map was first published and discussed by Murie[9] whose paper includes an account of the previously noted "pine ridges" east, and of the high bush north of the savannas.

[9] Adolph Murie, "Mammals from Guatemala and British Honduras," *Univ. Mich. Mus. Zool., Misc. Publications*, 26, 1935: 1–30, 1 pl., 1 map.

After Murie's paper had gone to press new data necessitated the redrafting of the map. To the information secured from Mr. O. A. Taintor and Mr. P. W. Shufeldt and the bases already noted by Murie, additions have been made from the notes of Dr. C. L. Hubbs, lately returned from Petén, and from maps of the Guatemalan government (Claudio Urrútia, "Mapa de la República de Guatemala," 1 : 400,000, 1924, L. Friederich-

DESCRIPTION OF REGION

Petén is the northernmost department of Guatemala. It stretches from the mountains of Alta Vera Paz on the south to the border of Yucatan and Campeche on the north; its east-west extension is from British Honduras to the Río Usumacinta. This region, comprising about 40,000 square kilometers, and for the most part, less than 500 meters in altitude, is almost completely covered with high rain forest. Though much of the region is well drained, the northern portion is low and often swampy, covered by water during the wet season, and containing hundreds of lakes, the largest of which is Laguna Petén. The savanna region under discussion is of local extent, as has been noted, and is fairly accurately delimited on the map.

The heavy forest which covers most of the area and its general inaccessibility have not been favorable to scientific investigation. Geologically it is practically unknown, and biologically it has remained almost virgin territory. For this reason any description of it must of necessity be brief and very incomplete. Inasmuch as little collecting was done at Santa Teresa, Zotz, San Andrés, and Ramate, it seems hardly worthwhile to describe these localities in any detail. Since the expedition was directed to study only the savannas, a description of localities in the high bush is omitted, and the following notes refer only to the La Libertad savannas. Plate I shows the conditions existing in the high bush near Santa Teresa.

Geology

The only direct statements to be found on the geology of Petén have been based on the works of Sapper.[10] The best summation of our knowledge is to be found in Sorre.[11] Geologically the Petén belongs to the Yucatan Peninsula. It is believed that tertiary and quarternary deposits cover the whole of the peninsula east of the mountains of Chiapas and southward as far as the Río Pasión. Invading these deposits is a long tongue of Cretaceous limestone which extends from the mountains of Chiapas to the southeast into central Petén.[12] It is interesting to note that the limits of the savanna region coincide with the most eastern extension of these Cretaceous beds. As the entire area between La Libertad and the Río Usumacinta is unknown, it is not improbable that the arm of Cretaceous deposits is less extensive

sen and Co., Hamburg) and the Carnegie Institution of Washington (G. C. Shattuck, "The Peninsula of Yucatan," *Carn. Inst. Wash., Publication*, 431, 1933: Plate I, Map I, "The Peninsula of Yucatan," *ca.* 1: 1,562,500).

[10] K. Sapper, "Grundzuge der physikalischen Geographie von Guatemala," *Petermann's Mitteil.*, 113, 1894: 1–59, 4 karten; and "Ueber Gebirgsbau und Boden des nordlichen Mittelamerika," *ibid.*, 127, 1899: 1–119, 3 karten.

[11] M. Sorre, "Mexique Amerique Centrale," *Geographie Universelle*, 14, 1928: 99–100.

[12] K. Sapper, *op. cit.*, 1899: Taf. 2.

than is supposed and may be limited to a local dome upon which the savannas are located. Such a condition might easily account for their presence on a purely edaphic basis.

Structurally Petén represents a flattened lowland surrounded on the west, south, and east by the mountains of Chiapas, the mountains of Alta Vera Paz, and the Cockscombs of British Honduras. The foldings which formed these ranges have left almost undisturbed the tertiary and quaternary deposits of the region to the north. There are, however, feeble traces of these foldings in Petén which are evident as a series of east-west flexures. Three flexures are visible between Yucatan and Laguna Petén, a fourth appears as the Cretaceous outcroppings running through La Libertad, and still farther south is a fifth which is evident as a line of hills extending from Petetbaxtun through Yaxha to Benque Viejo. These flexures inclose elongate depressions, as those through which the Río San Pedro de Mártir and Río Pasión flow and as the one in which Laguna Petén lies. It is on one of these low domes that the savannas lie. The doming is readily evident when Sapper's cross section of the area is examined.[13] The following altitudes read from north to south over a distance of about 50 kilometers:

San Benito (south shore of Laguna Petén)	90 meters
Cimarrón (near north edge of savannas)	180 meters
La Libertad (center of savannas)	170 meters
"Boca del Monte" (south edge of savannas)	120 meters
Arroyo Subín	90 meters

Physiographically the savannas are very similar to other tropical, limestone, savanna regions which have been described. Certain portions of Puerto Rico, in particular, are very similar in appearance to the savannas of Petén. In the region of La Libertad the savannas are low and remarkably level plains covered by a clay soil of unknown depth. Rising from the plains are small, conical, limestone hills averaging about 300 feet in elevation and displaying no regularity in arrangement (Pl. II, Figs. 1 and 2). The hills are covered with bush and by a very thin layer of soil mantle. Scattered over the plain at irregular intervals are shallow depressions, rarely over six feet in depth, and of varying size. The smaller ones (Pl. III, Fig. 2) are marked by the presence of islands of bush; the larger ones which may contain water throughout the year are referred to as *aguadas* (Pl. IV). On the savannas I saw only two depressions of any great depth, one in La Libertad which was about 100 feet in diameter and about thirty feet deep, and the other of considerably greater extent to the west of La Libertad. Most of these depressions are gently sloping, though occasional steep-sided ones are found; they correspond to dolines as described by Sanders.[14]

[13] K. Sapper, *op. cit.*, 1899: Taf. 3.

There is little doubt that this is a karst development similar to that which is known to occur in the limestone regions of Puerto Rico;[15] in fact the topographic aspect of the two regions is identical. It appears that the limestone which once covered this region was not uniform in composition but contained local beds of very resistant material. Under drier climatic conditions formerly prevailing throughout the area (to be discussed later), vegetation was scanty, and the karst cycle was begun and carried to completion as outlined by Sanders.[16] The purer limestones were dissolved and broken down to the deep clays now present, while the more resistant beds remained to form the characteristic limestone hills. An examination of the soils lends support to this theory of the origin of the physiographic forms.

The presence of dolines following the final stage of the cycle may possibly be accounted for by a rejuvenation resulting from uplift which would cause further solution of the underlying bed rock. That this is a region of karst development is very probable when it is noted that drainage is more or less complete in the absence of surface streams. Inasmuch as the karst topography is well-developed in the northern part of the peninsula,[17] the explanation may logically be applied to the development of the land forms of the savanna region of Petén.

Soil

A number of soil samples from the savannas were turned over to Professor M. W. Senstius of the Department of Geology, University of Michigan, for study. A complete report on the material will be published by Dr. Senstius at a later date, but he has very kindly furnished me with the following information.

In general the savanna soils are stiff clays which increase in clay content in direct proportion to depth. At two feet depth the clay content is about eighty per cent. The relationship of clay content and depth indicates that the soils, which are more or less uniform over the entire savanna region and are continuous vertically to an unknown depth, have originated in place and are not the result of deposition. Wells in the region over thirty feet deep, with no indications of bed rock, were noted.

Dr. Senstius believes that the soils, similar to those developed under Mediterranean climatic conditions, and known as *terra rossa,* may well

[14] E. M. Sanders, "The Cycle of Erosion in a Karst Region (after Cvijic)," *Geographical Review,* 11, 4, 1921: 599–600.

[15] The New York Academy of Sciences for the past twenty years has been publishing a very full account of the geology of Puerto Rico and the Virgin Islands.

[16] *Loc. cit.*

[17] L. J. Cole, "The Caverns and People of Northern Yucatan," *Bull. Amer. Geog. Soc.,* 42, 1910: 321–336.

have been derived from limestone, and that the true *terra rossa* type at greater depths represents the condition which once prevailed throughout the region. The characteristic red color is evident at depths greater than about six inches, but the surface soils, due to an accumulation of organic material, are chocolate brown in color. It is believed that in the past a more arid climate, resulting in a scanty floral covering, allowed the *terra rossa* soils to develop. Subsequently a more humid climate, such as exists today, developed, which produced vegetation of greater luxuriance. As a result the accumulation of organic material changed the color of the surface soils from red to chocolate brown.

That this cycle of development has occurred is evident when it is noted that on the forest-covered limestone hills, the soils which are now developing are not the *terra rossa* type characteristic of hot, arid climates but, rather, chocolate brown *rendzina* soils which are typically developed from limestone in humid regions.

Climate

The climate of central Petén is marked by uniformly high temperatures and a markedly seasonal rainfall. The Yucatan Peninsula as a whole is characterized by the same climatic type, but becomes progressively drier from south to north until on the north coast semi-desert conditions prevail. The following temperature and rainfall statistics are for El Paso de los Caballos, a village on the Río San Pedro de Mártir about 25 kilometers northwest of La Libertad.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Temp.* °C.	23.0	20.1	26.1	28.9	28.3	27.5	26.6	26.9	27.0	26.9	24.17	25.2	26.0
R. F. mm.	41	55	21	31	107	269	180	130	265	233	152	136	1620

* Temperature records 1925–1929; rainfall records 1924–1929. From K. Sapper, "Klimakunde von Mittelamerika," *Hand. Klimat.*, 2, H, 1932: 63, Tab. 1.

It is to be noted that the rainy season extends from May to December and that the dry season includes the months from January through April. During the latter period there is generally at least one rain per month. In 1933, unusual climatic conditions prevailed. From January until the middle of May no measurable amount of rain fell, although a "trace" was recorded in April. The following are the rainfall and temperature records taken during our stay at La Libertad:

	Rainfall mm.	Temperature °C.
April	T	29.7
May	360.0	28.5
June (first half)	193.5	26.4

The highest daily average temperature recorded was 32.8° C. on May 5, and the lowest 24.5° C. on April 16. The highest daily precipitation was 90 mm. on June 1. For the most part the rain falls in the late afternoon and early evening; the days are generally clear. During the height of the rainy season, however, it may rain steadily for several days, a condition known to the English-speaking inhabitants as a "norther." Following a rainy period the weather may remain clear for a week or more. Thus, from May 19 to June 1 rain fell each day and totalled for the period 446.5 mm.; from June 2 through June 8, there was not enough precipitation to be recorded.

The unusual drought of the 1933 season, accompanied by high temperatures, resulted in conditions wholly unsuitable for herpetological life, so that only a very few of the commoner species were to be found. During May extensive fires, the worst on record since about 1910, swept across the savannas and burned large areas of bush.

Flora[18]

On the basis of the extent of the sapodilla forest, the Yucatan Peninsula has been delimited floristically to include the region south to Lake Petén. The savanna country under consideration lies at the base of this area.

The northern section of the Yucatan Peninsula is dry and covered with secondary growth perpetuated as such largely by *milpa* rotation and destruction by fire. The bush is mostly scrubby, being thicketlike over large areas, but sometimes reaching a height of ten to twenty meters in outlying undisturbed sections.

South of the northern cut-over country lies the great sapodilla forest which ranges in height from twenty to fifty meters with the most luxuriant phase occurring in northern Petén. Except in the somewhat dry forest of the south central and northeastern regions, the vegetation is that of the rain forest with epiphytes, palms, strangler figs, and other characteristic types.

The savanna country of central Petén may be considered as a transition area between the northern sapodilla forest country, and the little known forest region to the south along the Arroyo Subín and the Río Pasión. The bush areas of the savanna country are entirely of secondary growth, called "*acahual*"[19] locally. The characteristic climax forest species of the region

[18] This discussion of the vegetation of the savanna region was written by Mr. C. L. Lundell whose complete report will appear at a later date. For a further account of the flora of the Yucatan Peninsula see his, "Preliminary Sketch of the Phytogeography of the Yucatan Peninsula," *Carn. Inst. Wash., Publication,* 436, 1934: 253–321, Fig. 1.

[19] In discussing the ecology of the fauna I have outlined the communities recognized. There is considerable difference between the floral and faunal habitats, and in the follow-

north of Laguna Petén are in the savanna limited largely to a few small trees at the top of the limestone hills. Excluding the agricultural areas and inhabited clearings, there are five major ecological zones: (1) the grassy savannas, (2) the tension zone of scrubby pioneer species lying on the forest margin, (3) the high forest of the deep clay flatlands, (4) the scrub forest on the limestone hills, and (5) the high forest of the narrow limestone valleys between the hills.

The broad expanses of open savanna[20] support a vegetation dominated by short grasses (Pl. II, Figs. 1 and 2) among which the most common are *Trachypogon montufari* (HBK.) Nees, *Leptocoryphium lanatum* (HBK.) Nees, *Paspalum plicatulum* Michx., *Andropogon condensatus* HBK., other species of the latter genus, and other perennials, chiefly legumes, which, having woody underground stems, are adapted to the fire conditions. During the dry season fire sweeps the grasslands leaving only small patches undisturbed so that the savannas seem almost barren until the beginning of the rainy season. When the rains start late in May, the open country becomes green with grasses, and flowers appear almost over night.

Scattered through the open savannas are various low, scrubby trees (Pl. II, Fig. 2 and Pl. III, Fig. 1), chiefly the *nanze, Byrsonima crassifolia* (L) HBK., the *saha, Curatella americana* L., and the *cocoyol* palm, *Acrocomia mexicana* Karw. These may clump together, but they do not shade out the grasses and other low growth.

The vegetation of the forest margin which I designate as the tension zone[21] is sub-xerophytic in nature, being composed largely of shrubs and scrubby trees which form a thicketlike growth with species of bullhorn *Acacia* and bromeliads as typical forms. The growth is low and open enough on the outer margin for grasses to enter the zone. During the dry season most of these plants lose a large portion of their leaves, and fires sweep through, clearing out much of the lower growth. From the open savanna grasslands to the bush, the first stage is shrubby and is dominated usually by *Conostegia xalapensis* (Bonpl.) DC., *Vismia ferruginea* HBK., *Miconia* spp., *Acacia* spp., and bromeliads. The *cocoyol* palm, savanna trees, chiefly the *nanze* and the *saha,* are intermingled here. In the next stage there are taller species of which *Miconia argentea* (Sw.) DC., *Metopium Brownei* (Jacq.) Urban, *Randia* spp., *Inga* spp., *Cecropia* spp., *Acacia* spp., and the woody vines, *Davilla Kunthii* St. Hil., *Tetracera volubilis* L., and *Cnestidium* sp. are most common. The tallest stage of the tension zone which intergrades into the high forest typified by *Xylopia frutescens* Aubl., *Bursera Simaruba*

ing footnotes I have correlated the two. The term "*acahual*" is used by me in a more restricted sense. L. C. S.

[20] I refer to this formation as the "Grassland Community." L. C. S.

[21] This formation represents the "*Acahual* Community." L. C. S.

(L.) Sarg., and species of the Araliaceae (Pl. IV, Fig. 1). The tension zone may be only a few meters broad or it may cover a half kilometer, as found in the Santa Cruz bush west of La Libertad.

Throughout, the open country is dotted with "wooded islands" which range in size from small clumps of trees and shrubs to those covering many acres. The larger generally surround shallow *aguadas*. In the smaller "islands" the species are confined to the pioneer or marginal scrub types, whereas the larger ones support the flatland high forest.

The tension zone species predominate on the smaller "wooded islands,"[22] making an intertwined clump with some trees in the center consisting of such species as *Bursera Simaruba* (L.) Sarg., *Simaruba glauca* DC., *Spondias Mombin* L., *Cecropia* spp., and *Ficus* spp. (Pl. II, Fig. 2 and Pl. III, Figs. 1 and 2). If the wooded area is large, such as the Monte Chicbul south of La Libertad, the tension zone intergrades into the high flatland forest (Pl. IV, Fig. 1) which often approaches a sub-climax stage.[23] This flatland high forest is dominated by such trees as *Matayba oppositifolia* (A. Rich.) Britton, *Casearia javitensis* HBK., *Zanthoxylum procerum* Donn. Smith, *Terminalia* sp., and the mahogany, *Swietenia macrophylla* King. The undergrowth is characterized by the shrubs, *Mouriria parvifolia* Benth., *Alibertia edulis* (L. Rich.) A. Rich., and a lower layer of species of *Piper* and *Psychotria*. Around the *aguadas,* which occur near the centers of these areas, there is a marginal growth of such plants as *Vismia ferruginea* HBK., *Miconia* sp., *Inga* spp., and *Acacia* spp., much the same as in the outer tension zone except that the shrubby stage is not as pronounced.

The limestone hills which break up the savanna region are covered with a thin mantle of black calcareous soil, and their plant covering is of a calciphile type most nearly approaching that on the same soils in the forested limestone area north of Laguna Petén.[24] The low bush of the hills varies floristically to a high degree, yet there are dominant types which characterize the habitat. The hill tops and steeper slopes are generally dominated by small, gnarled trees of such species as *Hirtella americana* L., *Protium copal* (Schl. and Cham.) Engl., *Clusia* spp., *Rondeletia belizensis* Standl., and *Bursera Simaruba* (L.) Sarg. The lower slopes are characterized by *Eugenia capuli* (Schl. and Cham.) Berg., *Hirtella americana* L., *Protium copal* (Schl. and Cham.) Engl., *Swartzia Lundellii* Standl., and *Plumeria acutifolia* Poir (Pl. II, Fig. 1 and Pl. IV, Fig. 2). The narrow valleys between the limestone hills support high secondary forest characterized by giant trees of the Leguminosae such as *Enterolobium cyclocarpum* (Jacq.)

[22] I have referred to this formation as the "Wooded Island Community." L. C. S.

[23] This is the "Savanna Forest Community." L. C. S.

[24] As will be noted later, depending on vegetation, the limestone hills may represent either the "*Acahual* Community" or the "Forest Community." L. C. S.

Griseb., *Tipuana Lundellii* Standl., and *Schizolobium parahybum* (Vell.) Blake.

Fauna[25]

While any lengthy discussion of the fauna of the savannas is impossible, to list the more conspicuous forms of life seems worth while. Among the mammals the white-tailed deer (*Odocoileus* sp.), the ocelot (*Felis pardalis* subsp.), the "lion" (*Felis concolor* subsp.), and the collared peccary (*Pecari* sp.) were most abundant. Less common were the armadillos (*Dasypus novemcinctus* subsp.) and the squirrel (*Sciurus yucatanicus* subsp.); the howler monkey (*Alouatta palliata* subsp.) was heard occasionally in the larger patches of bush on the savannas, and the bat (*Molossus* sp.) was not uncommon about the habitations. Cattle and mules have grazed very extensively on the savannas and, to a certain extent, disrupted natural conditions.

On the open savannas the meadow lark, quail, and sparrows were the most common birds, while humming birds, doves, and the Amazona parrot occurred to a lesser extent. The black vulture was abundant in La Libertad and was seen less frequently circling over the savannas.

Among the invertebrates, ants, especially the leaf-cutters (*Atta* sp.), acacia ants (*Pseudomyrma* sp.), and the army ants (*Eciton* sp.), were very numerous. Termites were common throughout the bush areas and around habitations. Following the rains a great variety of dragonflies, leaf hoppers, and grasshoppers emerged. Flies and mosquitoes were surprisingly rare on the savannas during our stay there.

ZOOGEOGRAPHY AND ECOLOGY

In discussing the zoogeography and ecology of the savannas, three geographic scales must be noted: first, the relationships of the fauna of Petén as a whole, second, the relationships existing between the fauna of the savannas and that of the bush, and third, the ecological aspects of the savannas themselves. Admittedly, there is but little data available for anything like a complete discussion of any one of the three units, and my conclusions can be no more than tentative.

Faunal Relationships of Petén

In order to understand the fauna of Petén it is first necessary to investigate that of the surrounding regions. At present we know too little of the

[25] For a further account of the fauna of the Petén region see: Adolph Murie, *op. cit.;* Josselyn Van Tyne, "The Birds of Northern Petén," *Univ. Mich. Mus. Zool., Misc. Publications,* 27: 1935: 1–46, 2 pls., 1 map; Carl L. Hubbs, "Fresh-water Fishes Collected in British Honduras and Guatemala," *Univ. Mich. Mus. Zool., Misc. Publications,* 28, 1935: 1–22, 4 pls., 1 map.

faunas of the mountains of Chiapas, of the highlands of Vera Paz, or of the humid coastal plains of Vera Cruz and Tabasco; but what data exist seem to indicate that the three regions represent definite biotic provinces as defined by Dice.[26] To the north of Petén lies a fourth very distinct area, the Yucatan Province, and with this the Petén fauna is most closely associated both in composition and origin. It is advisable to investigate first the fauna of the former in order to understand the relationships of that of the latter.

A discussion of the geographic aspects of the fauna of any region must, of necessity, be preceded by an investigation of the physical conditions to which that fauna is and has been subjected. It is important, therefore, to review briefly the more salient features which have combined to produce the natural landscape of Yucatan. (Throughout this discussion, "Yucatan" is used in a restricted sense. It does not refer to a political division, but rather to the scrub forest area, the limits of which will be defined later, lying to the north of the high bush of Campeche and Guatemala.)

Inasmuch as my space is too limited to present a complete discussion of the geological history of northern Central America, I have chosen, from various works of Sapper, Heilprin, and Schuchert, only those points which have a direct bearing upon the present study.

1.—An open portal in the Tehuantepec region linking the Pacific Ocean and the Gulf of Mexico during the Upper Miocene and Lower Pliocene.

2.—A low-lying coastal plain in northern Yucatan composed of Pliocene and Post-Pliocene marine deposits which through solution have developed karst topography.

3.—A dome capped with Miocene deposits arising abruptly from the coastal plain at the Sierra de Yucatan and continuing southward into northern Guatemala.

4.—A closed Panamanian-Costa Rican portal during the basal Eocene (pre-Claibornian) or, later and more logically from the standpoint of the herpetofauna, during the Oligocene. This entire question is ably discussed by Schuchert.[27]

The climate of Yucatan has been described by Page and Sapper.[28] The rainfall decreases gradually from central Guatemala northward from about 2500 mm. in southern Petén to less than 500 mm. per year along the northern shore of the peninsula. The temperature is more or less uniform, and the mean annual temperature is everywhere greater than 20° C. An

[26] L. R. Dice, "Biotic Areas and Ecological Habitats for the statement of animal and plant distribution," *Science,* 55, 1422, 1922: 1–4.

[27] Charles Schuchert, "Geological History of the Antillean Region," *Bull. Geol. Soc. America,* 40, 1929: 341–342, in particular p. 341, footnote 2.

[28] J. L. Page, "The Climate of the Yucatan Peninsula," *Carn. Inst. Wash., Publication,* 431, 1933: 409–422. K. Sapper, *loc. cit.*

analysis of the soils secured in central Petén has shown that a more arid climate formerly prevailed. The importance of this will be apparent later.

Coinciding with the decreasing rainfall towards the north is the reduction in the luxuriant forests of central Petén to the scrub bush along the north coast. Lundell[29] has shown that, on the basis of flora, the area north of a line drawn from Cape Catoche to Champoton represents a definite phytogeographic unit which he has designated as "Northern Yucatan." Its vegetation has been adequately described by Bequaert, who refers to it as a "dry forest."[30] Contrasted with the rain forest to the south, it is only to be expected that northern Yucatan would support a fauna quite different in nature from that of the more humid regions of the interior. Indeed, it is in the "dry forest" that the Yucatan herpetological fauna seems to be centered.

This fauna, like that of all Central America, is composed of two major elements, a southern Neotropical and a northern Nearctic. To these have been added an autochthonous Central American element the ancestry of which is to be found on the continents to the north and south but which has developed and dispersed secondarily from northern Central America. On the basis of these three groups, the Yucatan fauna may be arranged in the following categories:

1. Endemic Yucatan Forms
   - A. Forms of Nearctic Origin
   - B. Forms of Neotropical Origin
   - C. Forms of Central American Origin
2. Central American Forms
   - A. Forms of Nearctic Origin
   - B. Forms of Neotropical Origin
   - C. Forms of Central American Origin
3. Widespread Forms
   - A. Forms of Nearctic Origin
   - B. Forms of Neotropical Origin

Exemplifying the endemic Yucatan fauna are:

Nearctic Forms

Ctenosaura defensor — *Terrapene yucatana*
Lampropeltis p. blanchardi

Neotropical Forms

Eleutherodactylus rhodopis — *Eudryas b. melanolomus*
Sphaerodactylus glaucus — *Micrurus a. mayensis*

[29] C. L. Lundell, *op. cit.*: Fig. 1.

[30] J. C. Bequaert, "Botanical Notes from Yucatan," *Carn. Inst. Wash., Publication*, 431, 1933: 505–524.

Central American Forms

Anolis kidderi
Laemanctus alticoronatus
Kinosternon creaseri

Connecting the endemic and the more widespread Central American fauna is a group of species which occupies not only northern Yucatan but invades Petén. Included here are:

Oedipus yucatanus
Triprion petesatus
Anolis aureolus
Sceloporus chrysostictus

In the second category, Central American forms, may be placed:

Nearctic Forms

Sceloporus variabilis
Ctenosaura similis
Masticophis mentovarius
Elaphe flavirufa
Elaphe triaspis
Agkistrodon bilineatus

Neotropical Forms

Ameiva undulata
Phrynonax p. poecilonotus
Spilotes p. mexicanus
Sibynomorphus brevifacies

Central American Forms

Rhinophrynus dorsalis
Anolis biporcatus
Anolis sericeus
Laemanctus serratus
Ficimia olivacea
Kinosternon cruentatum

The third category, consisting of widespread forms which occupy not only Central America but also one or both of the continental blocks to the north and south, contains:

Nearctic Forms

Rana pipiens
Cnemidophorus gularis
Thamnophis s. proximus
Crotalus t. durissus

Neotropical Forms

Hyla venulosa
Constrictor c. imperator
Drymobius margaritiferus
Xenodon colubrinus

It is to be understood that the above is only a partial list, but from the examples cited it seems evident that with further investigation there should be little trouble in placing in these categories most of the species recorded from Yucatan.

Having reviewed briefly the composition of this fauna, I shall now proceed with an investigation of its origin. It has been derived, as noted, from three sources, Nearctica, Neotropica, and Central America. My belief is that the first two alone have been the ancestral homes of the fauna, while the Central American forms represent a composite group derived

primarily from the continental blocks to the north and south and which, through isolation, have differentiated and dispersed secondarily from Central America.

The Nearctic element has been divided by Dunn[31] into two groups, a recent "Boreal" element which does not enter Central America, and a later "Old Northern" fauna. The latter he has subdivided into an ancient southeastern mesic fauna and a more recent southwestern xeric one. The southeastern fauna has been shown to have persisted in the humid region of Central America, particularly in the northern part. I suggest that it has not only persisted but has, from this region, dispersed secondarily. It is conceivable that during the late Miocene and early Pliocene, when the Tehuantepec portal was open, this fauna was barred from dispersal through Central and South America, and that once the portal was closed the element which persisted in humid southern Mexico dispersed secondarily from that region. This is certainly indicated in the case of *Geoemyda, Kinosternon,* and *Oedipus.* Thus this portion of the Nearctic fauna would fall into the categories which I have previously designated as "Central American forms." The only true "Nearctic forms" in the Yucatan fauna are representatives of the southwestern xeric element such as *Cnemidophorus, Sceloporus, Thamnophis, Lampropeltis, Masticophis,* and others previously mentioned. These are all recent entrants into Yucatan from the north.

From the observed distribution of living forms it appears that the Neotropical fauna in Yucatan has paralleled the Nearctic fauna in its history. Two elements of different ages seem to be present.

It is possible that the ancestors of the older element containing such genera as *Laemanctus, Rhadinaea, Coniophanes,* and possibly the anoles, entered Central America from South America either during the early Eocene or during the doubtful Oligocene period of Panamanian-Costa Rican emergence. There they became isolated during the Oligocene and Miocene or during the Miocene alone when the Costa Rican portal was open. As they dispersed northward their progress was ultimately blocked by the Tehuantepec portal which opened during the Miocene. They or their descendants then underwent considerable differentiation, dispersing secondarily once land connections made it possible. This element would, then, not be strictly Neotropical but rather Central American, being comparable to the southeastern Nearctic fauna already discussed.

Entering Yucatan at a more recent date (Post-Miocene) are such genera as *Sphaerodactylus, Ameiva, Constrictor,* and *Xenodon.* I do not suggest that these had their entire history in South America, but that they sprang from northern ancestors which became isolated in South America during

[31] E. R. Dunn, "The Herpetological Fauna of the Americas," *Copeia,* 3, 1931: 106–119.

the Eocene-Miocene as noted by Dunn[32] in the case of the Iguanidae, and from there dispersed northward.

The elements comprising the Yucatan fauna are summarized as follows:

1.—A very recent Nearctic element derived from Southwestern North America which entered Central America after Mid-Pliocene.

2.—A recent Neotropical element which entered Central America after Mid-Miocene.

3.—An ancient autochthonous Central American element whose ancestors were derived from South America before the Oligocene and from North America prior to Mid-Miocene.

It is to be noted that the Neotropical elements in Yucatan are in the ratio of about two to one over the Nearctic elements. This is to be explained on the basis of the fact that the former have had a geological period longer to enter the region and by the fact that the humid rain forests of Vera Cruz and Tabasco may have acted as a distinct barrier to the Nearctic element which originated on the arid plateaus of southwestern North America.

There remains to be considered the more recent history of the endemic Yucatan fauna, which amounts to about twenty-five per cent. At least three explanations may be offered to account for its origin, and it is not at all improbable that all three processes have worked both separately and collectively.

The first explanation of endemism in Yucatan is by origin *in situ*. I am of the opinion that this fits the majority of the species. It is only to be expected that a species of wide distribution through tropical forests would differentiate in such an area of comparative aridity. Among the forms which appear to have changed *in situ* are:

Oedipus yucatanus
Eleutherodactylus laticeps
Laemanctus alticoronatus
Ctenosaura defensor
Eudryas b. melanolomus
Sibynomorphus brevifacies
Micrurus a. mayensis
Kinosternon creaseri

It is to be noted that all species which belong to this group are restricted, so far as we know, to the arid northern coastal plain already delimited and may be said to be strictly endemic.

There is a second explanation for the origin of the endemic or pseud-endemic Yucatan fauna. These forms are not confined to northern Yucatan, but invade northern Petén. Here may be placed:

Triprion petesatus
Sphaerodactylus glaucus
Anolis aureolus
Sceloporus chrysostictus

I suggest that such forms as these had their inception on the higher land of the Miocene age in the center of the peninsula during inundation of the northern coastal plain. Here, possibly on an island, under the more arid

[32] *Ibid.*: 115.

conditions (as evidenced by the soils) they differentiated. At the close of the Pliocene they moved northward to the arid, newly emerged coastal plain rather than southward into the humid basal portion of the peninsula which was climatically foreign to them.

The third possibility for the origin of endemism lies in the fact that some forms appear to represent primitive relicts which have persisted in a peninsular position. *Lampropeltis p. blanchardi,* for instance, is more closely related to the primitive *Lampropeltis t. annulata* than to the adjacent *Lampropeltis p. polyzona.* Similarly *Leptodeira y. yucatanensis* occurs not only in northern Yucatan but also on Cozumel Island despite the fact that *Leptodeira y. malleisi* is on the adjacent mainland. From this we may assume that we are dealing with a primitive type discontinuously distributed in peripheral positions. From available data it appears that *Thamnophis s. proximus* is of a degenerate nature in Yucatan and Costa Rica; both are peripheral positions of the form's entire range. It is not improbable that this is a primitive condition.

Before leaving the Yucatan fauna it should be noted that northern Yucatan is distinct not only because of its high degree of endemism but also because of its lack of certain species which are widespread through Central America. Most conspicuous of these are:

Rana palmipes
Cnemidophorus, deppii group
Ameiva festiva
Leiolopisma assatum
Bothrops atrox

For the most part the fauna of Petén is composed of the same elements which comprise that of Yucatan. There is first the pseud-endemic fauna of Yucatan, which extends southward into the *zapote* forest region. Here are such forms as *Triprion petesatus, Sphaerodactylus glaucus,* and *Eumeces schwartzei.* Secondly, there are the Central American forms listed; and thirdly, there are the widespread forms also noted. In addition to the three major categories, there is a small endemic fauna, in which I should place:

Anolis ruthveni
Cnemidophorus d. cozumelus
Coluber ortenburgeri
Leptodeira y. malleisi
Micrurus affinis alienus
Kinosternon berendtianum

It would appear from this that there is a separate biotic province, but such, I believe, is not the case. This area, in which the *zapote* tree is the dominant feature, includes all or most of Campeche, all of Petén, and British Honduras. To the north it shades into the Yucatan Province, to the west into the Vera Cruz-Tabasco forest and the mountains of Chiapas, and to the south into the mountains of Alta Vera Paz. It is true that the region may represent a minor zoogeographic area, but it is certainly not to be considered comparable with the surrounding provinces. I am inclined to

treat it as an intergrading area. With Yucatan it shares the species already mentioned; affinities with Vera Cruz and Tabasco are found in such forms as:

Oedipus mexicanus
Microhyla elegans
Hylella picta
Pseudemys elegans
Kinosternon leucostomum

Of Chiapas and Vera Paz too little is known to make any generalizations, but the *Eudryas* of the *zapote* forest is a distinct intergrade between *Eudryas b. laevis* of Vera Paz and *Eudryas b. melanolomus* of Yucatan. It is possible, moreover, that the conglomerate fauna, different in nature from the surrounding assemblages, coupled with the endemic forms (amounting to seven per cent) may entitle the area to provincial rank, but in the face of insufficient data, I believe it is best to consider it as a transition belt.

The origin of the widespread species has already been noted in the discussion on Yucatan. The endemic fauna has, in all probability, arisen *in situ*. This is evident when it is noted that these forms are not only few in number but are only slightly differentiated from species occurring in adjacent areas.

In summing up the relationships of the Petén fauna it may be said that it contains an assemblage of species, derived from the adjacent areas, upon which has been superimposed a small endemic fauna. Its origin as a whole has already been summarized under the discussion of that of Yucatan.

Savanna—Forest Relationships

The fauna of the region of Petén under discussion might be grouped under three heads: forms restricted to the forest, forms restricted to the savannas, and forms common to both forest and savannas. A complete analysis of all species is at present impossible, since knowledge of the region as a whole is still very incomplete, and because I know very little concerning the distribution of the wet season fauna. What little data are at hand seem to me of extreme importance; conclusions from them will be presented as suggestion rather than as fact.

From my own observations and the material collected by Malleis and already reported upon,[33] it would appear that forms restricted to the forest include:

Eleutherodactylus rhodopis
Rana palmipes
Thecadactylus rapicaudus
Anolis capito
Anolis humilis
Anolis sericeus
Anolis ruthveni
Sceloporus t. serrifer
Ameiva festiva
Cnemidophorus d. cozumelus
Mabuya agilis
Eumeces schwartzei
Tropidodipsas sartorii
Oxybelis fulgidus
Coniophanes piceivitis
Bothrops nummifera

[33] L. C. Stuart, *op. cit.*, 292.

Because so little is known of the bush fauna, it is impossible to state that many types known only from the savannas do not occur in the bush. I feel, however, that the following may be referred to the savanna habitat:

Leptodactylus labialis
Anolis u. ustus
Sceloporus chrysostictus
Ameiva undulata
Cnemidophorus gularis
Coniophanes imperialis

The third group of forms, common to both forest and savannas, comprises by far the majority of the species inhabiting the region.

Bufo marinus
Bufo valliceps
Leptodactylus melanotus
Hyla baudinii
Hyla loquax
Rana pipiens
Sphaerodactylus glaucus
Coleonyx elegans
Anolis aureolus
Anolis biporcatus
Anolis copei
Corythophanes cristatus
Basiliscus vittatus
Ctenosaura similis
Sceloporus variabilis
Leiolopisma assatum
Constrictor c. imperator
Drymobius margaritiferus
Drymarchon c. melanurus
Leptophis mexicanus
Leptophis o. occidentalis
Imantodes cenchoa
Micrurus affinis alienus
Bothrops atrox
Geoemyda areolata
Crocodylus moreletii

In analyzing the fauna of the savannas, with relation to the forest, the following points are to be noted:

1. No species have been developed there.
2. Few species (to be considered later) are limited to the open savannas.
3. As a unit they are occupied by only a few restricted forms.
4. Their fauna as a whole is poorer than that of the forest.

With respect to the first point, so far as its known, no species or subspecies has arisen on the savannas. Secondly, as will be noted later, the fauna of the savannas is, for the most part, confined to the small patches of bush occurring in these areas. Few forms actually inhabit the open grasslands. Thirdly, as has been pointed out, only a few forms are restricted to the savanna area, and the majority of these are represented by other species of the same genus in the forest. Series of this type are:

Savanna Species	Forest Species
Anolis sericeus	*Anolis u. ustus*
Ameiva undulata	*Ameiva festiva*
Cnemidophorus gularis	*Cnemidophorus d. cozumelus*
Coniophanes imperialis	*Coniophanes piceivitus*

Fourthly, the small fauna restricted to the savannas as compared with the numerous species limited to the bush, results in the conclusion that the

fauna of the former, with the exception of the few typical forms, is little more than an impoverished forest fauna.

The importance of these facts is at once apparent in comparing the Petén savannas with those of Vera Cruz as studied by Ruthven.[34] In the latter region floral and faunal conditions were found to be similar to those of the Petén savannas with the exception that the savanna fauna of Vera Cruz appears to be more impoverished than that of the grasslands of Petén. On the basis of the poor fauna Ruthven concluded[35] that the Vera Cruz savannas represent old artificial clearings. Inasmuch as a similar condition exists in Petén, except that the fauna appears to be better established, it seems logical to assume that the Petén grasslands are likewise of relatively recent age but older than those of Vera Cruz. Unfortunately it is difficult to determine the age of such regions since no data exist concerning the rate at which a new habitat is populated. Thus at Uaxactun there exists a very recent clearing in which was discovered such a savanna type as *Ameiva undulata*. Certainly each village clearing produces savanna-like habitats which appear to be rapidly colonized by savanna species. If we are to assume that the savannas are relicts, indicatory of a former arid climate, it would be expected that they would contain relict species or at least types found in the arid peninsular region of northern Yucatan, which is definitely not the case.

Ecology of the Savannas

In making an ecological study of the herpetological fauna of any region, numerous and varied problems arise. Most important of these is in the marked differences in the seasonal activity of different species. Some are active throughout the year, others are to be found only during the wet or dry season, and still others appear during but a few days of one season. It is, therefore, difficult to describe with any completeness the fauna of any community unless a year-round study is made. In the following discussion I have included all species found in any one habitat at any time and have judged their abundance on the basis of the greatest observed activity.

Another problem at once apparent to one studying the ecology of a group, is that of the methods of expressing abundance. Incorrectly, it might be assumed that the species most abundant in a collection is the most

[34] A. G. Ruthven, "The Amphibians and Reptiles Collected by the University of Michigan-Walker Expedition in Southern Vera Cruz, Mexico," *Zool. Jahr.*, 33, 4, 1912: 295–322, Taf. 6–11; and "The Local Distribution of the Reptile-Amphibian Fauna in Southern Vera Cruz and its bearing on the origin of the Savannahs," *Ann. Ass. Amer. Geog.*, 2, 1913: 41–48, Pls. XIII–XVI.

[35] *Op. cit.*, 1912: 302–303.

abundant in the locality from whence it was derived. Such large forms as *Basiliscus vittatus* are rarely collected after a fair series is secured, but *Anolis biporcatus,* a smaller form, will be taken in larger numbers; yet the latter species was found to be less common than the former on the savannas. To list the actual number of individuals collected is often misleading. Although ecologists have employed a number of different terms to indicate abundance these are not suited to the following discussion. I have used, therefore, two terms, "common" and "rare"; forms restricted to a single community are marked with an asterisk (*).

A third problem deals with the occurrence of many species only under edificarian conditions which make it impossible to place them in any natural community. Other forms occur in too small numbers to secure adequate information concerning their habits. Although sixty-two species were secured on the savannas, enough satisfactory information exists to discuss but fifty-three.

The fourth problem deals with the method of defining the various habitats and communities. Seasonal change has a profound effect upon the herpetological fauna. It might seem strange to find *Hyla baudinii* in the middle of a grassland during the dry season, yet, once the rains of the wet season have formed temporary pools on the savannas, this species becomes very abundant about them. Again, one habitat may combine with its own features those of another. The water accumulating in the depressions in a forested island results in the latter habitat assuming the rôle of an aquatic condition in addition to its own characters. Finally, the fact that lizards and snakes have, as a whole, excellent powers of locomotion and a wide range of tolerance, results in a certain amount of difficulty in blocking out areas in which the sum total of the environmental features are of sufficient magnitude to effect the fauna, and in defining these areas as separate entities.

As a result of these complexities the following list of habitats and their fauna can be, at best, no more than arbitrary. The communities (with reference to the herpetological fauna) which seemed to exist on the savannas at the time of my studies are:

Aquatic Habitat
- *Aguada* Community
- Savanna Pool Community

Aquatic Margin Habitat = *Aguada* Margin Community

Terrestrial Habitats
- Grassland Community
- *Acahual* Community
- Wooded Island Community
- Savanna Forest Community

The subdivision of habitats, into communities is used for convenience rather than to designate units of rank and importance. Thus the *Aguada* Community is of the same importance as the *Aguada* Margin Community despite the fact that it is a secondary division in the above outline.

The *Aguada* Community is the most frequent of the aquatic habitats. Although it is possible to subdivide it into a Permanent and a Temporary *Aguada* Community, no sharp line can be drawn between the two because of varying climatic conditions, and too few data are at hand to discuss them individually. This community is rather extensively distributed over the savannas. As a whole the *aguadas* are rarely over a few hundred yards in diameter and, for the most part, are less than five feet in depth. The majority are surrounded by the Forest Community (Pl. IV, Fig. 1), but a few lie on the open grasslands with very little or no bush about them (Pl. IV, Fig. 2). All contain very turbid water, and the bottom material varies from a firm clay to a very soft mud several feet in depth. Mules and cattle have trampled the immediate shores bare around nearly all of the *aguadas* (Pl. IV, Fig. 2). A few contain patches of sedges and have grass covered shores, but this condition appears to have little effect on the fauna. The following is a list of the fauna of the community:

Common:

Rhinophrynus dorsalis
Bufo marinus
Bufo valliceps
Leptodactylus labialis
Leptodactylus melanotus
Triprion petesatus
Hyla baudinii
Hyla culex
Hyla loquax
Hyla underwoodi
Hyla venulosa
Hylella picta
Hypopachus inguinalis
Rana pipiens
Kinosternon berendtianum
Kinosternon cruentatum
Pseudemys ornata
Crocodylus moreletii

Rare:

**Dermatemys mawii*

The very temporary Savanna Pool Community occurs on the open savannas in small depressions following heavy rains. As several amphibians breed in these pools, they constitute an important community. Included under this heading are the small depressions which mark the presence of the wooded islands (Pl. III, Fig. 2). These, like the savanna pools, are temporary but important as breeding places for amphibians. The fauna, that of an impoverished *Aguada* Community, includes:

Common:

Bufo marinus
Bufo valliceps
Leptodactylus labialis
Leptodactylus melanotus
Hyla baudinii
Hyla venulosa
Hypopachus inguinalis
Rana pipiens

It should be noted that temporary *aguadas* have a larger fauna than permanent ones. *Triprion petesatus, Leptodactylus labialis, Leptodactylus melanotus,* and *Hypopachus inguinalis* were found only about the temporary *aguadas.*

The *Aguada* Margin Community represents only a narrow strip surrounding the *aguadas.* For the most part it is devoid of vegetation; occasionally it supports a dense growth of sedges. Where bush surrounds the *aguadas* it breaks off sharply at the forest edge. The fauna consists of all the animals listed under the *Aguada* Community in addition to several terrestrial species.

Common:

Rhinophrynus dorsalis
Bufo marinus
Bufo valliceps
Leptodactylus labialis
Leptodactylus melanotus
Triprion petesatus
Hyla baudinii
Hyla culex
Hyla loquax
Hyla underwoodi
Hyla venulosa
Hylella picta
Hypopachus inguinalis
Rana pipiens
Basiliscus vittatus
Drymobius margaritiferus
**Leptodeira a. polysticta*
**Leptodeira y. malleisi*
Stenorhina degenhardtii
Kinosternon berendtianum
Kinosternon cruentatum
Crocodylus moreletii

Rare:

Pseudemys ornata

The Grassland Community is the most extensive of the terrestrial habitats. It is represented by the level plains covered with grass and low flowering plants, and broken by the small wooded islands and clumps of bush (Pl. II, Figs. 1 and 2 and Pl. III, Fig. 1). The whole area is extensively grazed, and, during the dry season, is almost entirely swept by fires. It is inhabited by a small fauna which contains a few exclusive forms. Some of the species common on the wooded islands occasionally wander out on the open savannas.

Common:

**Ctenosaura similis*
**Drymarchon c. melanurus*
Bothrops atrox
Kinosternon berendtianum
Kinosternon cruentatum
Geoemyda areolata
Basiliscus vittatus
Sceloporus variabilis
Ameiva undulata
Cnemidophorus gularis
Drymobius margaritiferus
**Masticophis mentovarius*
**Coluber ortenburgeri*
Leptophis mexicanus
**Crotalus t. durissus*

Rare:

Bufo marinus
Bufo valliceps

The *Acahual* Community, while not supporting a great number of species, is rich in individuals. This community borders the forests and includes

several areas of secondary growth as opposed to the climax forest. As a whole it is very dense, containing, principally, bushes and low shrubs; large trees are almost entirely lacking. The dense growth seems to exclude domestic animals from this community so that natural conditions are less deranged than in other habitats. In combining the features of light and cover which exist singly in the forest and grasslands and, at the same time, being situated in direct proximity to both, the advantages of this community are at once apparent. Shelford has discussed this phase of the problem in some detail and refers to the community as "forest margin."[36]

The following is the fauna of the *Acahual* Community:

Common:

Hyla venulosa
Anolis aureolus
Anolis biporcatus
**Corythophanes cristatus*
Basiliscus vittatus
Sceloporus chrysostictus
Sceloporus variabilis
Ameiva undulata
Cnemidophorus gularis
Geoemyda areolata

Rare:

Bufo marinus
Bufo valliceps
Hyla baudinii
Anolis u. ustus
Corythophanes hernandezii
Drymobius margaritiferus
**Eudryas boddaertii* subsp.
Leptophis occidentalis
Bothrops atrox
Kinosternon berendtianum

The Forested Island Community is of too limited extent to support an exclusive fauna. It appears to combine, to a certain extent, the characters of the *Acahual* and Savanna Forest Communities, and it has an impoverished fauna of the two. The small depressions about which these islands of bush are centered (Pl. III, Fig. 2) add to this community some of the fauna of the savanna pools in the wet season.

Common:

Anolis aureolus
Anolis biporcatus
Anolis u. ustus
Basiliscus vittatus
Sceloporus chrysostictus
Sceloporus variabilis
Ameiva undulata
Cnemidophorus gularis

Rare:

Bufo marinus
Bufo valliceps
Hyla baudinii
Hyla loquax
Hyla venulosa
Sphaerodactylus glaucus
Constrictor c. imperator
Drymobius margaritiferus
Leptophis mexicanus
Stenorhina degenhardtii
Bothrops atrox
Geoemyda areolata

The Savanna Forest Community is found on the savanna lowland, and on the limestone hills. The forest on the latter, however, is often more

[36] V. E. Shelford, "Animal Communities in Temperate America," *Geog. Soc. Chicago, Bull.* 5, 1913: 262–277.

like an *acahual* than the high bush and contains an *acahual* fauna. Despite the fact that the vegetation of the various bush areas differs, the physiognomy is much the same, and the forests may be grouped as a unit except along the edges (Pl. IV, Fig. 1). As a whole the bush is more or less open, containing little undergrowth. Grazing is almost negligible. The following species exist in the Forest Community:

Common:

Bufo marinus
Bufo valliceps
Hyla baudinii
Hyla culex
Hyla venulosa
Sphaerodactylus glaucus
Anolis aureolus
Anolis biporcatus
**Anolis copei*
Anolis u. ustus
Corythophanes hernandezii
Constrictor c. imperator
**Phrynonax p. poecilonotus*
Leptophis mexicanus
**Xenodon colubrinus*
**Coniophanes imperialis*

Rare:

Basiliscus vittatus
**Leiolopisma assatum*
**Leptophis o. occidentalis*
**Lampropeltis p. polyzona*
**Ficimia olivacea*
**Oxybelis acuminatus*
Stenorhina degenhardtii
Bothrops atrox
Kinosternon berendtianum
Geoemyda areolata

The following table summarizes the fauna of these communities (number of exclusive forms in parentheses):

Community	Common	Rare	Total
Aguada	18	1(1)	19(1)
Savanna Pool	8	0	8
Aguada Margin	22(2)	1	23(2)
Grassland	6(2)	11(3)	17(5)
Acahual	10(1)	10(1)	20(2)
Forested Island	8	12	20
Savanna Forest	16(4)	10(5)	26(9)

In the table the terrestrial habitats alone are of any great importance, the aquatic habitats being inhabited, for the most part, by amphibians which are wide-ranging. Among the former, it is important to note that the Savanna Forest Community contains more "exclusive" species than the other three together. Here, too, is found the greatest number of "common" species, while "rare" species form the largest lists in the other terrestrial communities. Likewise, the total number of species is greater in this community. Hence, it may be concluded that forest types dominate in the savanna region as a whole. This, it seems to me, is a rather weighty argument favoring the conclusion that the savannas are of comparatively recent origin.

ACTIVITY OF THE FAUNA

Inasmuch as a portion of both the wet and dry seasons was spent on the savannas, a few notes on the activity of the fauna may not be out of place. Some observations were made on the diurnal activity as well as on the seasonal activity.

The most conspicuous change in activity exists between the wet and dry seasons. Although the extreme conditions of drought may have resulted in special conditions during 1933, it seemed that the tendency was to decrease activity of the dry season forms rather than actually to prohibit it.

The fauna may be divided into the species which are active throughout the year and those active only during the wet season. So far as I was able to observe no species were found which were active only during the dry season.

Most conspicuous of the dry and wet season forms were:

Bufo marinus
Bufo valliceps
Rana pipiens
Anolis aureolus
Anolis biporcatus
Basiliscus vittatus
Sceloporus chrysostictus
Sceloporus variabilis
Ameiva undulata
Cnemidophorus gularis
Drymobius margaritiferus
Stenorhina degenhardtii
Geoemyda areolata

Although I have noted in the annotated list the wet season species, the following were most conspicuous after the first rains:

Triprion petesatus
Hyla loquax
Hyla underwoodi
Leiolopisma assatum
Phrynonax p. poecilonotus
Kinosternon berendtianum
Kinosternon cruentatum

The seasonal activity is complicated by two facts. First, some species which are active throughout the year in the bush were found only during the wet season on the savannas. Thus, while *Leiolopisma assatum* was found only after the first rains on the savannas, Dr. Van Tyne and Dr. Murie took a specimen of it at Uaxactun, Petén, at the height of the dry season in 1931. Secondly, certain species which appear at the beginning of the wet season are active for only a few days and then disappear again; *Triprion petesatus* is one such species.

Following the first rains the wet season fauna emerges rapidly, appears to reach its peak during the first two or three days of activity, and then decreases in numbers. This gradual increase in the fauna and its subsequent decrease is well brought out in Figure 1 which represents the comparative activity found to exist among the amphibians at a temporary *aguada* following the rains. The first night of any activity was that on which water

entered the *aguada*. Following the emergence of the species their subsequent activity shows correlation with the amount of precipitation.

Some little variation was found to exist with reference to the first emergence of a species in different localities. At the temporary *aguada* mentioned above, *Hyla loquax* and *Hyla underwoodi* made their first appearance in small numbers on the night of June 1; at a permanent *aguada* several

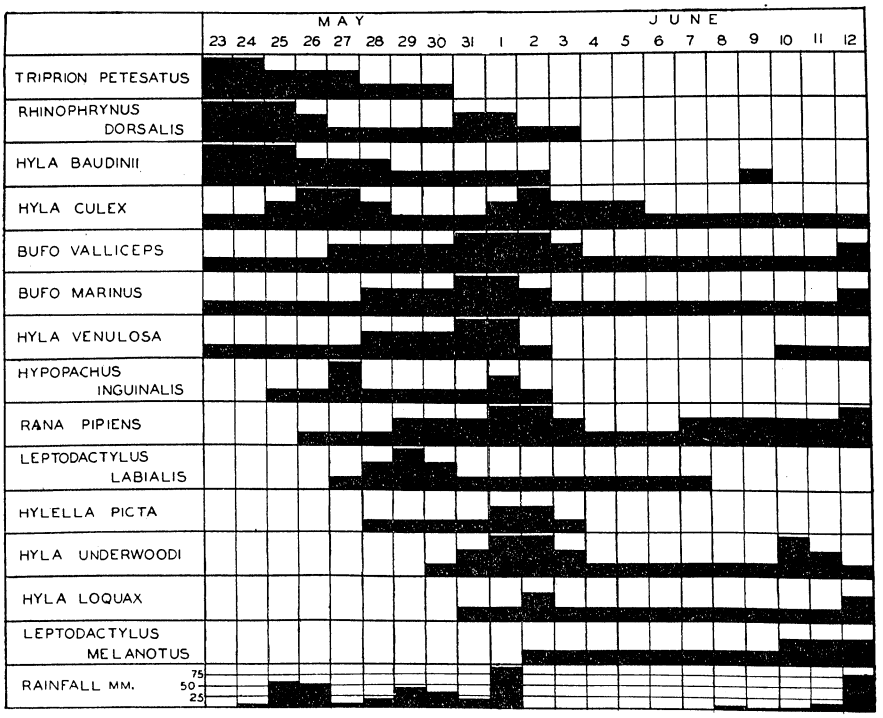


FIG. 1

miles from the former water hole, these species were abundant on the night of May 31.

Yet another point worth noting was the greater abundance of the wet and dry season forms following the first rains. Species which increased conspicuously in numbers following the onset of the wet season were:

All amphibians active during dry season
Drymobius margaritiferus
Leptophis mexicanus
Leptodeira a. polysticta
Leptodeira y. malleisi
Geoemyda areolata

What effect the extreme drought had upon the diurnal activity of the fauna I do not know, but during the dry season I found practically no nocturnal species, and night collecting netted very meager results. Two periods of activity were noted. The first extended from about 8:00 A.M.

until noon and the second from about 4:00 P.M. until sundown. These remained the same for the diurnal fauna both during the dry and wet seasons. During the former the only species which appeared to be nocturnal were:

Bufo marinus
Bufo valliceps
Leptodeira a. polysticta
Leptodeira y. malleisi

Once the rains had begun, the nocturnal fauna increased both in species and individuals, due entirely to the emergence of the amphibians. I found, however, no nocturnal lizards, and the only nocturnal snakes I observed were those listed above. During the first part of the breeding season many of the amphibians, otherwise nocturnal, were active throughout the day. On the first few days of their emergence, *Triprion petesatus, Hyla baudinii,* and *Rhinophrynus dorsalis* were found to be almost as abundant during the day as at night. Several days after the first emergence these species became strictly nocturnal.

Only one crepuscular form was taken in the region. This was *Anolis sericeus* which was secured at Santa Teresa. I found this species active only during the last hour or so of daylight, when it was fairly abundant.

ANNOTATED LIST OF SPECIES

AMPHIBIA[37]

Oedipus mexicanus (Duméril and Bibron)

La Libertad, 3.

These three specimens were collected by Malleis and presented to the expedition by Mr. O. A. Taintor. They were said to have been collected at a small *aguada* south of the village. Diligent search in the same locality failed to reveal others. I am indebted to Mr. K. P. Schmidt for the identification of the above specimens.

Rhinophrynus dorsalis Duméril and Bibron

La Libertad, 30.

Although it was not unusual to find this species in the evening during the dry season, it was not common until after the first rains, when it became very abundant. It appeared to be one of the first amphibians in the region to breed, and could be found in the temporary *aguadas* as soon as they began to hold water. Sumichrast[38] states that the copulatory act is "inguinal,"

[37] Except where otherwise stated I have followed Kellogg in amphibian nomenclature: R. Kellogg, "Mexican Tailless Amphibians in the United States National Museum," *U. S. Nat. Mus., Bull.* 160, 1932: 1–224, 24 figs., 1 pl.

[38] F. Sumichrast, "Contribution à l'histoire naturelle du Mexique," *Bull. Soc. Zool. France,* 5, 1880: 187.

and takes place on land and not in water. With the former part of the observation I can agree for in all of the many pairs I observed breeding, copulation was accomplished by the male seizing the female, with its arms, about the groins. It is not uncommon to find copulating pairs with their ventral surfaces in contact.

Although Sumichrast did not observe the copulatory act taking place in water, I found clasping almost completely limited to water, and egg-laying entirely so. The eggs, while laid in a mass, separate and float singly on the surface of the water.

The call of this species is well described by the name applied to it by the natives, "wow." This note is emitted rather abruptly and is guttural. Sumichrast's description of the call is well expressed:

> Leur voix, . . . , est un son gutteral et profond, assez analogue à celui qui accompagne les efforts que fait un homme pour vomir; . . .[39]

Bufo marinus (Linnaeus)

La Libertad, 18, and many juveniles and tadpoles; Ramate, 1; San Andrés, 8.

Generally distributed throughout the region and active during both the wet and dry seasons. Tadpoles and juveniles belonging to this species were collected early in May. At San Andrés at about the same time eggs were seen along the shore of Laguna Petén. From this it would seem that, contrary to the statements of Kellogg[40] the species breeds more or less throughout the year wherever water is available, even during periods of extreme drought.

Bufo valliceps Wiegmann

La Libertad, 42; San Andrés, 6; Zotz, 1.

Like *B. marinus* generally distributed throughout the region and active throughout the year wherever water is available.

Leptodactylus labialis (Cope)

La Libertad, 24.

The status of this species will be discussed by Gaige in a forthcoming paper. The breeding habits of the species are similar to those of *L. albilabris* as recorded by Schmidt.[41] The species, found only around the *aguadas,* was breeding along the edge of several temporarily filled ones soon after the rains began. The eggs are laid in a mass of foam in a shallow excavation five or ten feet above the edge of the water and at the base of some low

[39] *Ibid.:* 186.

[40] *Op. cit.:* 56.

[41] K. P. Schmidt, "Amphibians and Land Reptiles of Porto Rico, With a List of Those Reported from the Virgin Islands," *Scientific Survey of Porto Rico and Virgin Islands, N. Y. Acad. Sci.,* 10, 1, 1928: 41–42.

plant. Although Schmidt found as many as 200 eggs in the nests of *L. albilabris,* I observed no more than about twenty-five in any nest. The rising water soon covered all the nests, but no specimens were found breeding within the water.

During the dry season specimens were found under blocks of mud in the dry *aguadas.* In call and in habitat I was unable to distinguish this species from *L. melanotus.*

Leptodactylus melanotus (Hallowell)

La Libertad, 28; Ramate, 1.

Like *L. labialis* this species was found to be active only during the wet season, though it could be found beneath blocks of mud during the dry season. Its breeding habits are like those described for *L. labialis.* The species, however, was not breeding until almost a week after *L. labialis* made its first appearance.

Eleutherodactylus rhodopis (Cope)

Santa Teresa, 4.

Since the above specimens and another series already reported upon[42] are immature, they are referred for the present to *rhodopis,* although they appear more slender, and the dorsum is much more granular than in the southern specimens available for comparison. From *rugulosus* they differ in proportions, coloration, and in having a distinct canthus; from *laevissimus* they differ in having a larger ear and shorter head, and in coloration.

The specimens secured at Santa Teresa were found in the bush during the day and were hopping about on the forest floor. I do not believe the species inhabits the savannas.

Triprion petesatus (Cope)

La Libertad, 40.

One of the most interesting finds made by the expedition was the discovery of this species, heretofore known only from Yucatan. The specimens do not appear to differ from those taken there. The apparent absence of specimens in many regions may be due to their peculiar habits. I found them only in one locality, an intermittent *aguada,* following the first rains, when they appeared by the hundreds, breeding during the days and nights for about a week, from May 23 to May 30. Thereafter the species completely disappeared, and diligent search failed to reveal its presence.

The species breeds in the water but could be found in holes of trees surrounding the *aguada.* Once in a small hole the species plugs the cavity with its casque-like head, and it is almost impossible to remove a specimen thus protected. I have removed partially digested specimens from the stomach

[42] L. C. Stuart, *op. cit.,* 292: 7.

of a *Leptodeira y. malleisi.* The call of the frog closely resembles that of a domestic duck.

Hyla baudinii Duméril and Bibron

La Libertad, 59.

This species, distributed generally throughout the savannas, was not found during the dry season, but became very abundant following the first rains when every small pool and *aguada* in the region was filled. During the days it was not uncommon in bromeliads. When the species first appeared (May 23 in the vicinity of La Libertad) it was active throughout the day, singing and breeding in the water.

Hyla culex Dunn and Emlen[43]

La Libertad, 81.

This series appears to combine the characters of *Hyla altae* Dunn (type locality, Summit, Panama Canal Zone) and of *Hyla culex* Dunn and Emlen (type locality, Tela, Honduras), lacking only the black bars on the front of the thighs described for the latter species. Because of geographical reasons and the priority of *culex* these specimens have been referred to *H. culex.*

Although not active during the dry season specimens were occasionally found in bromeliads. Following the rains they were abundant in all the *aguadas,* breeding in the water and resting on the floating aquatic plants. Occasionally they could be found among the forest litter near water holes. This species was one of the first to become active following the breaking of the rains about May 20. Its call is quite different from that of *H. altae,* which Dunn describes as a "harsh . . . 'whark' "[44] The call begins with about six high-pitched cheeps, and breaks into a rapid trill of the same tone.

Hyla loquax Gaige and Stuart[45]

La Libertad, 12.

The above specimens include the holotype (No. 75446), and paratypes. This species differs from *H. miotympanum,* apparently its closest relative, in possessing a flatter and broader head, indistinct canthus rostralis, larger ear, smoother throat, and different coloration.

Only one specimen was found during the dry season. It was taken from the top of a high tree in a small patch of bush on the savannas by Mr. C. L. Lundell. At the *aguada* studied most intensively it was one of the last amphibians to make its appearance. The first was seen May 31, in the water

[43] E. R. Dunn, and J. T. Emlen, "Reptiles and Amphibians from Honduras," *Proc. Acad. Nat. Sci. Phila.,* 84, 1932: 24.

[44] E. R. Dunn, "A New Hyla from the Panama Canal Zone," *Occ. Papers Boston Soc. Nat. Hist.,* 8, 1933: 62.

[45] H. T. Gaige, and L. C. Stuart, *op. cit.:* 1.

and among the bushes on the banks of the *aguada*. Its call is very similar to that of *Triprion petesatus*.

Hyla underwoodi Boulenger

La Libertad, 52.

Mr. Parker, who compared one of the above specimens with the type of *underwoodi*, states that differences, such as the slightly greater extent of the webs on the fingers in the type, are "trivial." Our series seems identical with the Museum of Comparative Zoology specimens of *Hyla phlebodes* (= *underwoodi*) from Yucatan and mentioned by Kellogg.[46]

In life the ground color of the head and dorsum is light purplish brown (head somewhat darker than dorsum), finely powdered with a darker purplish brown, and irregularly reticulated with a network of lines of the same color. The upper lip is light, slightly powdered with brown. The sides are immaculate, the ground color of the dorsum ends abruptly at the level of the eye and is marked by a darker line extending from the eye, becoming fainter posteriorly. The dorsal surfaces of the arms are colored like the back, though of a lighter shade, and are faintly powdered or slightly reticulated with a darker color. The thigh is immaculate. The upper surfaces of the tibia and tarsus are colored as the arms, while the upper surfaces of the metatarsi are white, faintly powdered with brown. The lower lips, chin, throat, belly, and the ventral surfaces of the arms and legs are immaculate. Great variation exists in the dorsal pattern, which may consist of two dorso-lateral lines, several dorsal blotches, or a reticulation which in some specimens tends to form a cross.

This species, one of the later ones to appear, was first found near a permanent *aguada* on the night of May 31. It was one of the most abundant of the hylas. It was found breeding in the water; in actions it resembled *H. culex*.

Hyla venulosa (Laurenti)

La Libertad, 31.

A common *Hyla* in the region. It was observed following the first rains both in the patches of bush on the savannas and on trees about the water holes. The species appeared at the *aguada* which was particularly studied on the first night on which it held water. From this time (May 23) until May 30, it remained in the trees surrounding the *aguada* and did not come to the ground or enter pools of water until the latter date. On June 8, a juvenile with a rudimentary tail and another only recently transformed were collected.

[46] *Op. cit.*: 172–173.

Hylella picta Günther

La Libertad, 7.

Another interesting find made by the expedition was this species, previously known only from Vera Cruz and Tabasco in Mexico. In all the specimens the interorbital width was found to be greater than that mentioned for the type. The head and body length in the males varied from 17.5 mm. to 20 mm., while a single female was 23 mm. in length.

In three of the above specimens the ground color of the dorsum varies from light brown to a dark purplish brown. Superimposed upon this are round spots of a darker hue. A lateral light stripe, bordered below by a darker one, extends from the snout, through the eye, and gradually fades out near the groin. The upper surfaces of the arms and legs are slightly lighter than the dorsum, and are powdered or reticulated with a darker brown. The under surfaces are immaculate. In two of the specimens the dorsal spots are very feeble, in two others they are lacking.

This species was found breeding first on the night of May 28. Its call is very similar to that of *H. culex,* consisting of a series of high-pitched cheeps but lacking the extended trill of that form. In habits it resembles both *culex* and *underwoodi.*

Hypopachus inguinalis Cope

La Libertad, 24.

Although occasionally found in moister situations during the dry season, this species was not abundant until well after the first rains, and was found breeding on May 28. Like *Leptodactylus* it commonly breeds in a shallow excavation generally found beneath the roots of a low plant in small pools on the savannas near an *aguada;* it is very difficult to find.

The males have tiny, pearl-like tubercles on the dorsum, and the ventral reticulations are much less distinct than in the females.

Rana palmipes Spix

Santa Teresa, 2; Zotz, 1.

This species is apparently limited to the bush where it is not uncommon about lakes and streams. It is active throughout the year.

Rana pipiens Schreber

La Libertad, 43; Zotz, 1.

Although active around the *aguadas* throughout the entire year, this species was not abundant until after the first rains. Several specimens were found on the savannas several miles from water soon after the rainy season had begun.

REPTILIA

Sphaerodactylus glaucus Cope

La Libertad, 4.

This species, apparently common about habitations, is rarely met with in the bush. Its small size may enable it to escape observation. With one exception, No. 75183, taken in the high bush to the south of La Libertad, the specimens were secured in the living quarters at La Libertad. At San Andrés the species was reported to be very common in the houses; it is greatly feared by the natives who refer to it as a "scorpion."

Coleonyx elegans Gray

La Libertad, 4.

The four specimens noted above were collected by Harry Malleis in the bush or from the savanna country. It is possible that this species is a wet season form, which may account for my not having secured it during the dry season.

Anolis aureolus Cope[47]

Santa Teresa, 2; La Libertad, 30.

It is only tentatively that the above specimens have been identified as *Anolis aureolus*. Certainly specimens which I have seen from Yucatan are distinct. Those noted above, however, appear to have a longer head than the Yucatan specimens, and are very much like what one would expect in the young of *Anolis biporcatus*. From the latter they differ in having smooth ventral scales and a bright yellow, rather than a red, dewlap. Several of the females contained eggs, and, on the basis of this, I am inclined to consider the specimens as adults and have referred them to *A. aureolus*, though it is possible that they represent intergrades between this and *A. limifrons* Cope.

Ecologically this species occupies the same habitat as *Anolis biporcatus*, but occurs in much smaller numbers. It seems to prefer the larger patches of bush around the *aguadas* and is much less common in the smaller wooded islands on the savannas. It is generally found three to six feet from the ground clinging to the trunks of trees. Females taken in April and May contained one or two fully-developed eggs.

Anolis biporcatus (Wiegmann)

Santa Teresa, 47; San Andrés, 1; Zotz, 3; La Libertad, 136.

This was the most common lizard in the entire region. It appeared to exhibit no particular preference of habitat in the bush areas but was never

[47] I have followed Barbour on *Anolis* nomenclature: T. Barbour, "The Anoles. II. The Mainland Species from Mexico Southward," *Bull. Mus. Comp. Zoöl.*, 77, 4, 1934: 121–155.

found on the open savanna. It was abundant at Santa Teresa in a region of open, partially-cleared forest. Its rare occurrence in the denser forest seems to indicate that it thrives best in more open conditions where sunlight reaches the ground. Like *Anolis aureolus,* it is to be found from three to six feet above the ground, clinging to the trunks of trees. Females taken in April, May, and June contained fully-developed eggs.

Variations in pattern from a broad, light, dorsal stripe to mottlings and dark cross-banding were found. The dewlap was always brilliant red.

Anolis capito Peters

Santa Teresa, 1.

A single juvenile of this species was secured along a trail in the high bush. It was found running on the ground near a large log from which it had jumped. Inasmuch as several specimens of *Anolis ruthveni* were taken at the same time, it is not improbable that the two species are much the same in habits.

Anolis copei Bocourt

Ramate, 1; La Libertad, 4.

This handsome green anole appears to be uncommon, probably due to the fact that it inhabits the higher portions of the bush. One specimen (No. 75179) was observed on the ground, but it immediately sought refuge about thirty feet from the ground on a tree trunk. The other specimens were all secured high up on the trunks of trees.

Anolis ruthveni Stuart[48]

Santa Teresa, 7; La Libertad, 1.

This species is typically a high bush dweller and was not found on the open savanna or small patches of bush in the area (the specimen from La Libertad was taken in the high bush to the northwest). At Santa Teresa it was not uncommon along the trails through the forest, where it was found not far from the ground on logs or clinging to the trunks of trees.

Before the status of this species can be fully established, it will be necessary to make a thorough examination of all the cotypes of *Anolis uniformis* Cope. Certainly the description of the latter and Bocourt's figure of *A. metallicus* Bocourt (= *A. uniformis*) are strongly suggestive of a confusion in nomenclature. From available data I believe that the cotypes of *A. uniformis* represent several species. The specimen from Yucatan is not improbably *A. tropidonotus,* since that species is common in Yucatan, whereas recent collections have failed to reveal anything comparable to the so-called "*A. uniformis*" of recent collections. It is possible that the Guatemalan cotypes may have been taken in Petén (some of Hague's material is thus

[48] L. C. Stuart, "A New *Anolis* from Northern Central America," *op. cit.,* 310: 1.

labeled), where both *A. tropidonotus* and *A. ruthveni* are abundant. Both of these species may appear among the cotypes of *A. uniformis*.

What has been identified as *A. uniformis* in recent collections answers neither Cope's description nor Bocourt's figure. Inasmuch as these collections of "*A. uniformis*" have come from high Guatemala, I suggest that they are referable to *A. crassulus* Cope (type locality Cobán, Guatemala). Certainly the "*A. uniformis*" which I have seen answer the descriptions and figures of *crassulus*.

Anolis sericeus Hallowell

Santa Teresa, 2.

As I have already pointed out,[49] this form is readily confused with *Anolis u. ustus*. Identification of the specimens has been based on my former conclusions, but whether they are correct or not I am unable to say. The above two specimens were collected in a freshly-burned *milpa* on the Arroyo Subín. Others were seen, but, because of the poor light, I was able to secure only two. The species appears to be crepuscular, for, although commonly found sitting on stumps in the evening, search during the day and at night failed to reveal any specimens, nor were any found in the high bush.

Anolis tropidonotus Peters

San Andrés, 3; La Libertad, 1.

As previously noted, Dr. Thomas Barbour of the Museum of Comparative Zoology, Harvard University, believes that this species should be consigned to the genus *Norops*.[50] A reëxamination of a large series from Yucatan and Petén leaves me unconvinced, and I am unable to concur with Dr. Barbour's opinion.

Like *Anolis ruthveni,* it appears to be limited to the high bush. The specimen from La Libertad was secured with *Anolis ruthveni* in the forest to the northwest (as noted above). The form is generally to be found several feet above the ground clinging to the trunks of trees.

Anolis ustus ustus Cope

La Libertad, 12.

It is not improbable that this species replaces *Anolis sericeus* in the more open country. Dr. Van Tyne and Dr. Murie of the Museum of Zoology, University of Michigan, found it at Uaxactun; but it is not certain whether their specimens were collected in the forest or within the very large clearing at that locality. I did not find it in the forest surrounding the savannas, but in the savanna itself it was not uncommon. It was generally found not

[49] *Op. cit.*, 292: 10.

[50] *Ibid.*

far above the ground clinging to tree trunks. The specimens were taken in the small patches of bush.

Corythophanes cristatus (Merrem)

La Libertad, 1.

The single specimen was taken at the edge of a large patch of bush, another was seen in a similar habitat. It is probable that the species is a typical bush form living only in the larger forested areas on the savannas. I have seen this species at Yaxha in the high bush.

Corythophanes hernandezii (Wiegmann)

La Libertad, 3.

The habitat of this species is the same as that of *Corythophanes cristatus*. The specimens were all found only a foot above the ground clinging to the trunks of trees. None made any effort to escape but remained motionless, apparently depending on their color and form for protection. One specimen (No. 75040) was very young and probably of the season's brood; it was collected May 24.

Basiliscus vittatus Wiegmann

Ramate, 7; Santa Teresa, 20; San Andrés, 11; Zotz, 3; La Libertad, 21.

This lizard, because of its size and abundance, was the most conspicuous reptile of the region. Although it showed a decided preference for water-bordering habitats, it was found in localities far from any water. At Santa Teresa it was most commonly on the branches of trees overhanging the Arroyo Subín, and here as many as four or five could be seen on a single limb. At San Andrés it was abundant along the shores of Laguna Petén. In the savanna country it was most common in the small patches of forest around the *aguadas*.

At Ramate, on June 17, shortly after the beginning of the wet season, I secured what appeared to be newly-hatched specimens (No. 75055).

Ctenosaura similis (Gray)

La Libertad, 3.

Of all the lizards occurring in the savanna region, this species alone appears to prefer the open savanna as its habitat. Here it is not uncommonly seen either basking in the sun near a burrow or resting six or seven feet above the ground upon the limbs of a low scrub tree. It is difficult to capture because of its shyness. At San Andrés it was seen in great numbers high up on the wall of a ruined church, and at San José several specimens were seen lying in the sun along the shore of Laguna Petén. The form does not appear to inhabit the high bush. As noted by Bailey,[51] it does not occur around the muddy *aguadas*.

[51] J. W. Bailey, "A Revision of the Lizards of the Genus Ctenosaura," *Proc. U. S. Nat. Mus.*, 73, 12, 1928: 34.

Sceloporus chrysostictus Cope

La Libertad, 21.

This species, one of the more common lizards of the region, was found only on the savanna on the small islands of thin bush, along the edges of the larger patches of bush, and in the several areas of *acahual.* These habitats, while offering protection in the form of larger vegetation, do not approach the forest in character. In studying Santa Cruz Monte I found the lizard along the bush edge, but in the deep forest it was absent. In the center of this forested area there occurred several acres of open scrub growth (possibly resulting from a very rocky condition), and here it was not uncommon.

What appeared to be newly-hatched young were found on May 20, on the day following the first heavy rain of the year. Several were noted within a few feet of each other, but only one was secured.

Sceloporus torquatus serrifer Cope

Zotz, 12.

Two adults and ten juveniles of this species were secured. Many were seen climbing about the rafters and thatched roofs of several deserted houses in the small clearing. One of the adults was taken, ten feet from the ground, on the trunk of a large tree, and another which was frightened readily ascended a tree to the height of about forty feet. In actions the form appears much like *Sceloporus magister* of the southwestern United States; as an adult it is probably largely arboreal.

It is impossible to state whether the young secured were of that season or the preceding one. Two size groups were, however, to be noted, so that I am led to believe that at least some specimens were fairly recently-hatched young. These were taken on May 17–18 just before the first rains of the wet season.

Sceloporus variabilis Wiegmann

Ramate, 11; Zotz, 15; La Libertad, 7.

Sceloporus variabilis appears to be a species common to both the high bush and the savannas. Superficially it is very similar to *Sceloporus chrysostictus* both in form and habits but is much more plastic than the latter. Along the shores of Laguna Petén at Ramate it was found in considerable numbers in the open, cleared areas. At Zotz it was abundant in the village clearing, and at La Libertad it was found on the open savanna, wooded islands, and *acahual,* and within the larger areas of bush. While the *acahual* and forest margin seem to be the most favored habitat, it is plastic enough to range in both directions from this optimum. Like *S. chrysostictus* it is a ground form, though occasionally it may be found on the lower branches of small bushes.

Ameiva festiva (Lichtenstein)

Ramate, 1; Santa Teresa, 2; Zotz, 1.

This species represents a form limited to the high bush. No specimens were observed on the savannas even in the larger forested areas which were very similar to the actual bush. Along the trail from Benque Viejo to Ramate the species was not uncommon, basking in the sun on large logs. At Santa Teresa it occurred both on the banks of the Arroyo Subín and in the high bush removed from the river. Because of its shyness and speed it is very difficult to secure.

Ameiva undulata (Wiegmann)

Ramate, 3; San Andrés, 10; La Libertad, 26.

The use of the above name for these specimens is purely tentative. Certainly these and specimens from Yucatan differ from typical Mexican *A. undulata,* and it is possible that they represent an undescribed race. Before this can be settled, a thorough examination of *Ameiva u. parva* Barbour and Noble must be made. The specimens at hand differ from typical *A. undulata* in the arrangement and size of the gular scales. In *A. undulata* there is generally a single median row of enlarged scales, while in the specimens from Petén and Yucatan there is an irregularly arranged, enlarged group of gular scales. The dorsal striping of *A. undulata* is not present in the adults, but breaks down to form vertical bars.

Like so many of the species of the region, this form is common to the bush and savannas. It appears to be a forest-margin type. On the savannas it was generally to be found on the small wooded islands, along the edge of the larger patches of bush, and, most abundantly, in the *acahual* areas. At Ramate it was common along the cleared portions of the shore of Laguna Petén, the same condition existed at San Andrés. I found no specimens in the high bush proper.

With relation to habitat preference in *Ameiva* and *Sceloporus* in the region, an interesting contrast has already been noted. *Sceloporus variabilis* and *Ameiva undulata* are common to both savanna and bush, but *Sceloporus chrysostictus* is limited to the savanna and *Ameiva festiva* is a bush form.

Cnemidophorus deppii cozumelus Gadow

Ramate, 4.

My reasons for referring to this species as *C. d. cozumelus* rather than as *C. d. deppii* have already appeared.[52] The form together with *C. gularis* offers another instance of opposing habitat preference in different species of the same genus. *C. d. cozumelus* is limited to the forest, while *C. gularis* is a savanna form. At Ramate I found *cozumelus* along the shore of Laguna

[52] *Op. cit.,* 292: 12–13.

Petén where it occupies the same habitat as *A. undulata* and *Sceloporus variabilis*.

Cnemidophorus gularis Baird and Girard

La Libertad, 18.

Because of the complexity of the *sexlineatus* group and the many differences of opinion, I have followed the most recent check list terminology rather than the trinomial status accorded this form by Burt. Certainly the group needs further investigation.

The species, occurring only on the savannas, shows a marked preference for the forest margin. I found it on the small wooded islands and along the edge of the larger patches of bush; it was common also in the *acahual* habitat.

Mabuya agilis (Raddi)

Zotz, 2.

Here again is a form limited to the high bush. At Zotz a number of specimens were seen, but only two were captured. The form appears to be of a climbing nature. It was quite common among the rafters and thatched roofs of deserted houses. The only specimen seen on the ground was basking in the sun on a stone pile.

Leiolopisma assatum (Cope)

La Libertad, 1.

The single specimen was taken in Santa Cruz Monte shortly after the beginning of the wet season. It was found several feet from the ground basking in a patch of sunlight on the expanded roots of a large tree.

Constrictor constrictor imperator (Daudin)[53]

La Libertad, 2.

One specimen was collected by Harry Malleis. I found the other on the ground in a small wooded island near a larger patch of bush on the savanna. Both specimens are skins.

Number	Sex	Dorsals	Ventrals	Caudals
74924	♂	73	248	55
74925	♀	69	240	56

Drymobius margaritiferus (Schlegel)

Santa Teresa, 1; La Libertad, 22.

This species, which seemed to have no preference for any particular habitat, was the common ground snake of the region. It was collected on the

[53] Except where otherwise stated, I have followed Amaral on ophidian nomenclature: A. do Amaral, "Estudos Sobre Ophidios Neotropicos. XVIII—Lista Remissiva dos Ophidios Da Região Neotropica," *Mem. Inst. Butantan*, 4, 1929: i-viii, 129–271.

open savanna, in the wooded islands, in the larger areas of bush, and around *aguadas;* it was not uncommon in the yards within the town. At Santa Teresa a specimen was found on the bank of the Arroyo Subín. Although, like all the ophidians, the species was rare during the dry season, it appeared in great numbers during the wet season. Some days as many as a dozen were brought in by the natives, but the majority of specimens were in too poor condition to save.

From the stomach of one (No. 74945) a partially digested specimen of *Rhinophrynus dorsalis* was removed. Eggs in the oviducts of females taken in June were small and undeveloped and were not larger than those in the body of specimens collected in April. The following is a list of the specimens (No. 74932 is from Santa Teresa, the others are from La Libertad).

Number	Sex	Dorsals	Ventrals	Caudals
74931	♀	17	144	.....
74932	♂	17	155	.....
74933	♂	17	147	.....
74934	♀	17	148	110
74935	♀	17	147	115
74936	♂	17	149	.....
74937	♂	17	151	118
74938	♀	17	154	.....
74939	♂	17	152	.....
74940	♀	17	148	.....
74941	♂	17	156	116 + tip
74942	♀	17	150	109
74943	♀	17	149	109 + tip
74944	♀	17	155	112
74945	♀	17	153	112
74946	♂	17	148	.....
74947	♀	17	147	112
74948	♀	17	149	108
74949	♂	17	152	119
74950	♀	17	148	.....
74951	♀	17	151	112
74952	♂	17	149	.....
74953	♂	17	153	105 + tip

It is interesting to note the very slight variation in the number of ventral scutes, 147–156, in the twenty-three specimens. My studies on this species show the same condition existing throughout the entire range of the form.

Eudryas boddaertii melanolomus (Cope) × *laevis* (Fischer)

La Libertad, 1.

One of the most interesting specimens secured in the region was this intergrade. In a previous paper,[54] I have plotted the range of the forms of

[54] L. C. Stuart, "Studies on Neotropical Colubrinae. II. Some New Species and Subspecies of *Eudryas* Fitzinger With an Annotated List of the Forms of *Eudryas boddaertii* (Sentzen)," *op. cit.*, 254, 1933: 3.

Eudryas boddaertii. Although in the text it was stated correctly that *E. b laevis* occurs in the Alta Vera Paz region in the vicinity of Cobán, the map shows the distribution of the form as extending north of this. A specimen in the British Museum (Natural History) had led me to suspect intergradation of *E. b. laevis* and *E. b. melanolomus* in the Petén region, and the specimen now before me (No. 74897) confirms that opinion. While in scutellation this snake more closely resembles *E. b. melanolomus,* its pattern is far too dilute to be considered typical. The specimen is a female with 17 dorsals, 188 ventrals, and 116 caudals. I found it basking in the sun at the edge of a rather large patch of bush on the savanna.

Masticophis mentovarius (Duméril and Bibron)

La Libertad, 1.

The specimen (No. 74930) was secured on the open savanna. It proved to be a female; dorsals 17, ventrals 202, tail broken.

Coluber ortenburgeri Stuart[55]

La Libertad, 1.

The single specimen of this species (the type) was found on the open savanna where it appears to occupy the same niche as *M. mentovarius.*

Phrynonax poecilonotus poecilonotus (Günther)

La Libertad, 2.

The specimens were secured in two of the larger bush areas on the savanna. The species was not observed on the open savanna, thus differing from *Masticophis mentovarius* and *Drymarchon corais melanurus* in its preference for the bush habitat.

Number	Sex	Dorsals	Ventrals	Caudals
74912	♀	23	205	127
74913	♀	25	217	133

Drymarchon corais melanurus (Duméril and Bibron)

La Libertad, 1.

The specimen (No. 74929) was taken at the edge of the village. Another was seen on the open savanna, but not captured. Like *Masticophis mentovarius* the species appears to prefer the open savanna. I was told that it is not uncommon in the yards and around the houses in La Libertad. The specimen is a female with 17 dorsals, 198 ventrals; the tail is broken.

[55] L. C. Stuart, "Studies on Neotropical Colubrinae. IV. An Apparently New Species of *Coluber* from Guatemala," *op. cit.,* 284, 1934: 1.

Lampropeltis polyzona polyzona Cope[56]

La Libertad, 2.

One specimen was collected by Harry Malleis. The other was secured on one of the rocky, bush-covered hills which dot the savanna. Because of its coloration the natives fear this species as a "coral."

Number	Sex	Dorsals	Ventrals	Caudals
74927	♂	23	233	56
74928	♂	23	236	49 +

Leptophis mexicanus Duméril and Bibron

Santa Teresa, 1; La Libertad, 8.

With one exception (No. 74853), which was secured on the open savanna, all of the specimens were taken either in the bush proper or along the edge of the forested areas. The form was most generally found in the branches of the bushes and only occasionally was it seen on the ground. When alarmed it attempts to escape in the bushes rather than across the forest floor.

One (No. 75854) was found some six feet from the ground part way down a hole in a stump. It was trying to secure a specimen of *Triprion petesatus* (No. 75300). Inasmuch as the frog had crawled to the bottom of the hollow and was using its hard casque-like head as a plug (see page 37), it is doubtful that the *Leptophis* could have captured it. The following specimens are at hand (all from La Libertad except No. 74851, which is from Santa Teresa):

Number	Sex	Dorsals	Ventrals	Caudals
74850	♀	15	163	149 + tip
74851	♀	15	174	140 + tip
74852	♀	15	160	156
74853	♂	15	160	.....
74854	♂	15	161	151
74855	♂	15	163	162
74856	♀	15	163	148
74857	♂	15	153	151 + tip
74858	♀	15	160	139 + tip

Leptophis occidentalis occidentalis (Günther)

La Libertad, 1.

Because of its form, this species is probably similar in habits to *L. mexicanus*. The single specimen, a female (No. 74904), was found in one of the largest forested areas on the savanna. It has 15 dorsal scale rows (2 on each side of the mid-dorsal row keeled), 178 ventrals, and 156 caudals.

[56] L. C. Stuart, "Studies on Neotropical Colubrinae. V. A New Snake of the Genus *Lampropeltis* from Yucatan," *op. cit.*, 309, 1935: 5.

Ficimia olivacea Gray

La Libertad, 1.

This specimen was on the ground in a *milpa.* I know nothing of its habits but assume that it is a bush form because of its presence in the newly-felled forest. The specimen, a male, has 135 ventrals and 36 caudals.

Adelphicos quadrivirgatus Jan[57]

La Libertad, 1.

Harry Malleis collected the only specimen of this species obtained in the region. It is a female (No. 74887) with 15 dorsals, 149 ventrals, and 41 caudals.

Xenodon colubrinus Günther[58]

La Libertad, 3.

This species represents another form belonging to the forest habitat. The specimens secured were all taken on the ground in the heaviest portion of the bush on the savanna. All were sluggish in their movements and were quite easily captured. Because of the body form, coloration, and habits, the natives confuse this species with *Bothrops atrox,* and both are recognized as poisonous under the name *"barba amarilla."* The following specimens are at hand:

Number	Sex	Dorsals	Ventrals	Caudals
74919	♂	19	125	.....
74920	♂	19	124	43
74921	♀	19	133	38

Ninia sebae (Duméril and Bibron)[59]

La Libertad, 6.

Three specimens were gifts from Mr. O. A. Taintor. Of the others, two were found under boards in La Libertad, and one was taken from a small wooded island on the savanna.

Number	Sex	Dorsals	Ventrals	Caudals
74898	♀	19	136	41
74899	♂	19	138	49
74900	♂	19	141	51
74901	♀	19	147	44
74902	♀	19	147	45
74903	♀	19	139	45

[57] E. R. Dunn, "Some Central American Snake Genera," *Copeia,* 4, 1931: 163.

[58] C. L. Hubbs, "The Use of the Generic Name *Ophis* for an Eel, a Snake, and a Mollusk," *Copeia,* 1, 1932: 26–27.

[59] E. R. Dunn, "The Snakes of the Genus Ninia," *Proc. Nat. Acad. Sci.,* 21, 1, 1935: 11.

Sibon sibon (Linnaeus)

La Libertad, 2.

Both specimens were collected by Harry Malleis. I know nothing of the habits of this species.

Number	Sex	Dorsals	Ventrals	Caudals
74895	♀	15	176	.....
74896	♀	15	194	107

Imantodes cenchoa (Linnaeus)

La Libertad, 3.

The three specimens were taken by Harry Malleis. They are labeled merely "La Libertad."

Number	Sex	Dorsals	Ventrals	Caudals
74869	J	17	252	159
74870	♂	17	248	155
74871	♀	17	238	153

Leptodeira annulata polysticta (Günther)

La Libertad, 9.

Of the above specimens two were presented to me by Mr. O. A. Taintor and were collected by Harry Malleis. Of the others, three were taken in La Libertad, and the rest in the savanna region. This species was found to be strictly nocturnal; it appears to prefer moist habitats. Specimens secured during the day were found beneath boards, and the others were all taken at night near *aguadas*. Of those found on the savanna all were along the edges of *aguadas,* and one was found in a bromeliad about twenty feet above the ground. In the evening they were generally discovered lying in the lower branches of bushes along the water's edge. The stomachs of specimens 74879–74880 were filled with newly-metamorphosed frogs, probably *Hyla culex*. In using the above name for this species I have followed Dr. E. R. Dunn's nomenclature received through correspondence.

Number	Sex	Dorsals	Ventrals	Caudals
74872	♀	23	201	89
74873	♀	23	198	85
74874	♀	23	204	95
74875	♀	23	204	86
74876	♂	23	200	87
74877	♂	23	199	93
74878	♀	23	201	85
74879	♂	23	207	101
74880	♂	23	195	98

Leptodeira yucatanensis malleisi Dunn and Stuart[60]

La Libertad, 6.

With the exception of two specimens received from Mr. O. A. Taintor, all were taken in much the same habitat as *L. a. polysticta,* and like the latter are strictly nocturnal. One was found in a hole in a decayed stump on the edge of an *aguada.* This specimen had eaten a *Triprion* and several unidentified frogs. A female (No. 74883), collected April 19, contained seven mature eggs.

Number	Sex	Dorsals	Ventrals	Caudals
74881	♀	21	184	79
74882	♂	21	185	.....
74883	♀	21	186	.....
74884	♂	21	174	79
74885	♀	21	176	71
74886	♂	21	182	81

Oxybelis acuminatus (Wied)

La Libertad, 1.

The specimen was collected in the bush just west of La Libertad. It is a male with 190 ventrals and 178 caudals.

Coniophanes imperialis (Baird and Girard)

La Libertad, 4.

Three of these specimens were secured under rubbish about La Libertad, and the fourth was taken in the bush to the west of the village. This species appears to prefer the open savanna-like habitat in preference to the rain-forest. The genus is represented in the bush proper by *C. piceivitus.*

Number	Sex	Dorsals	Ventrals	Caudals
74889	♂	19	127	.....
74890	♂	19	118	.....
74891	♂	19	122	about 85
74892	♂	19	131	.....

Coniophanes piceivitus Cope

La Libertad, 1; Santa Teresa, 1.

I believe that this form is limited to the high bush and does not occur on the savanna. The specimen from La Libertad was collected by Harry Malleis in an unknown habitat, and was a gift from Mr. O. A. Taintor.

Number	Sex	Dorsals	Ventrals	Caudals
74893	♀	25	163	83
74894	♂	25	146	.....

[60] E. R. Dunn and L. C. Stuart, "A New Race of *Leptodeira* from Guatemala," *op. cit.,* 313, 1935: 1.

Stenorhina degenhardtii (Berthold)

La Libertad, 10.

This more or less secretive form was found to be fairly common in the region. Three specimens were received from Mr. O. A. Taintor, and the others were found generally distributed in the area. The species appears to prefer the forested regions and a moist habitat, as the majority of specimens were taken under logs near *aguadas*.

Adult females were found to contain from four to six fully developed eggs during the month of April. Considerable variation in the color was noted, some were bright red, and others were grey and answer the pattern description B. a. in Boulenger.[61]

Number	Sex	Dorsals	Ventrals	Caudals
74859	♀	17	175	28
74860	♀	17	169	32
74861	♂	17	167	35
74862	♂	17	162	34
74863	♀	17	172	28
74864	♀	17	169	29
74865	♀	17	168	28
74866	♀	17	177	30
74867	♂	17	167	35
74868	♂	17	164	34

Micrurus affinis alienus Werner

La Libertad, 2.

Of the two specimens of this species secured, one was found in a house in La Libertad, and the other was taken on the savanna close to a patch of bush.

Mr. K. P. Schmidt has informed me, in recent correspondence, that his *Micrurus a. stantoni* is a strict synonym of *Micrurus affinis alienus* Werner, and as a result the latter name must be applied to the Petén specimens.

Number	Sex	Dorsals	Ventrals	Caudals
74909	♀	15	216	36
74910	♀	15	214	39

Bothrops atrox (Linnaeus)

La Libertad, 2.

One of the specimens of this species was received from Mr. O. A. Taintor, and the other was collected in some rubbish at the edge of town. Another was seen on a wooded hill on the savanna. The species is said to be fairly common both in the bush areas and on the open savannas during the wet season.

[61] G. A. Boulenger, *Catalogue of the Snakes in the British Museum (Natural History)*, London, 3, 1896: 230.

Number	Sex	Dorsals	Ventrals	Caudals
74914	♀	25	200	64
74915	♀	27	218	60

Bothrops nummifera (Ruppell)

La Libertad, 1.

Mr. Lundell secured the only specimen of this species taken in the region. It was found in the high bush to the west of the savanna and does not appear on the savannas. The natives readily distinguish this form from *B. atrox* and recognize the difference in its habitat. The above specimen has 126 ventrals and 30 caudals.

Crotalus terrificus durissus (Cope)

La Libertad, 2.

The specimens were collected by Harry Malleis on the open savanna north of La Libertad on the same day in the same locality. They are scarce in the region and are believed to occur only on the savannas.

Number	Sex	Dorsals	Ventrals	Caudals
74917	♂	29	about 180	31
74918	♂	27	179	33

Kinosternon berendtianum Cope

La Libertad, 12.

As has already been noted, this species is a wet season form. It was not found during the dry season, but a week after the first rains it made its appearance and was very common. It was, at the first of the rainy season, widely distributed in the bush proper, the open savanna, the savanna bush, and in the *aguadas*. It is wholly probable that when taken on land it was migrating from some *aguada* which had previously dried up. I do not know where it passes the dry season.

Kinosternon cruentatum Duméril

La Libertad, 22; San Andrés, 1.

Like *K. berendtianum* this form appears to be active only during the wet season. Three specimens were found during the dry season, but of these one was in an *aguada* and the other two, one from San Andrés (No. 75191) and one from La Libertad, were taken in front of fires, so that it is not improbable that these were driven from their dry season refuge by the heat and flames. Following the first rains, the species was very common in the *aguadas* and on the open savanna.

Kinosternon leucostomum Duméril

La Libertad, 3.

The three specimens have been tentatively identified as *K. leucostomum*. Two of the specimens were taken during the dry season and the third after

the first rains. Although the species seems to be rare, it appears to be active throughout the year.

Dermatemys mawii Gray

La Libertad, 1.

The single specimen was taken from an *aguada* which later in the season became dry. The form is probably purely aquatic. Inasmuch as the rains had filled few of the *aguadas* before the studies were completed in the region, it is not surprising that the species was not again secured.

Pseudemys ornata (Gray)

La Libertad, 11; Zotz, 2.

This species is practically entirely aquatic though occasionally it may be found on the savanna or in the bush in the immediate proximity of an *aguada.* The form is distributed throughout the region wherever water occurs. It is common in the rivers and larger lakes. It is highly prized as food by the natives, and shells are common about the dwellings. Natives at Ramate reported that the species is becoming scarce in Laguna Petén where it was formerly very abundant.

Geoemyda areolata (Duméril)

La Libertad, 33; San Andrés, 13.

Although this species, by far the most common in the region, was generally distributed and was active throughout the dry season, it was found most abundantly on the open savanna, following the first rains, and no specimens were ever taken in water. I have counted as many as a dozen within a radius of only a few yards on the savanna. Many of the specimens lacked feet; these may have been burned off during one of the annual fires which sweep the savannas. Although not generally noticed by the natives, the species was sought for food during the very dry season in 1933.

Crocodylus moreletii Duméril

La Libertad, 2.

This common species was very difficult to secure because of the soft muddy bottoms of the *aguadas.* It was found to be abundant in all the permanent water holes, but was only occasionally present in the intermittent pools. One specimen, presumably migrating from a temporary to a permanent *aguada,* was secured (and badly damaged) on the open savanna by a native. Although the species was formerly hunted for its skin, the necessity of a government license has almost completely stopped its exploitation. The largest specimen I saw appeared to be six feet in length.

PLATE I

FIG. 1. A typical trail in the Subín bush south of the La Libertad savannas. The photograph was made in April, during the height of the dry season. *Ameiva festiva, Anolis biporcatus,* and *Eleutherodactylus rhodopis* were common along this trail.

FIG. 2. A stretch of quiet water in the Arroyo Subín within the high bush. Along the banks *Ameiva festiva* and *Drymobius margaritiferus* were common, while on the trees overhanging the water *Basiliscus vittatus* was very abundant. Photographed in April.

FIG. 1

FIG. 2

PLATE II

FIG. 1. The open savanna west of La Libertad in June following the breaking of the rains. Note the short new grass and the *nanze* tree in the foreground. In the background are several conical, bush-covered, limestone hills.

FIG. 2. San Francisco savanna south of La Libertad in early April before the burning of the savannas. The tall grasses and scattered *nanze* trees occupy the foreground. In the background is a small wooded island, beyond which lies a range of limestone hills.

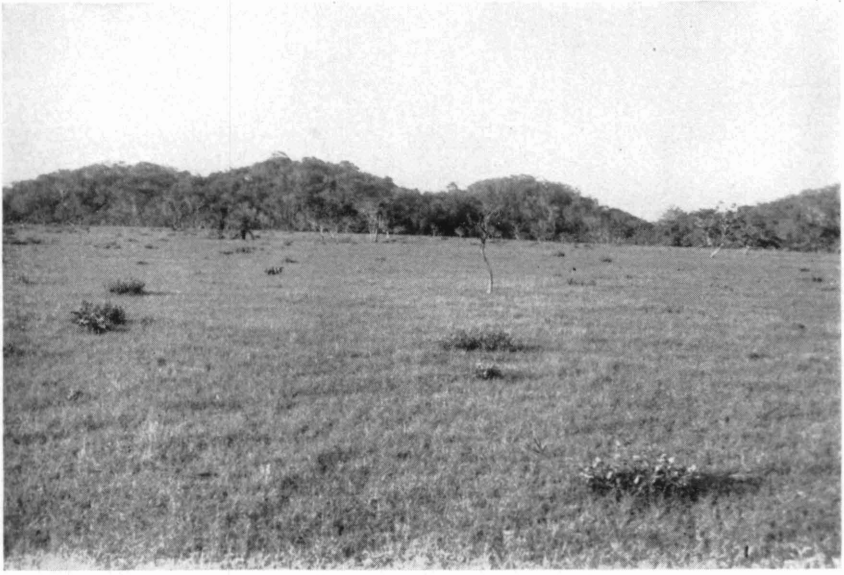


FIG. 1

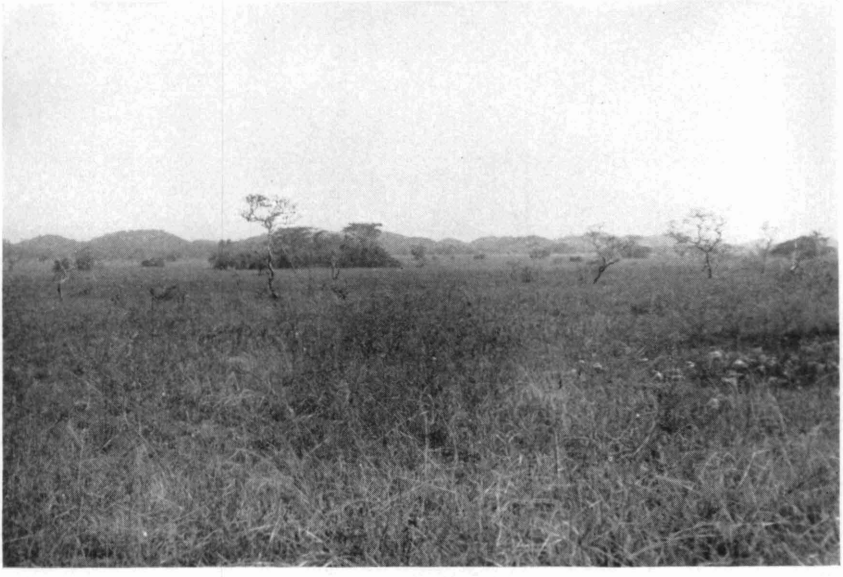


FIG. 2

PLATE III

FIG. 1. Savannas southeast of La Libertad photographed in June following the rains. The *nanze* trees in the foreground are in blossom; in the background lies the Arroyo Subín bush.

FIG. 2. A small wooded island on the savannas west of La Libertad. Note in particular the depression so characteristic of these islands of bush. Photographed in April.

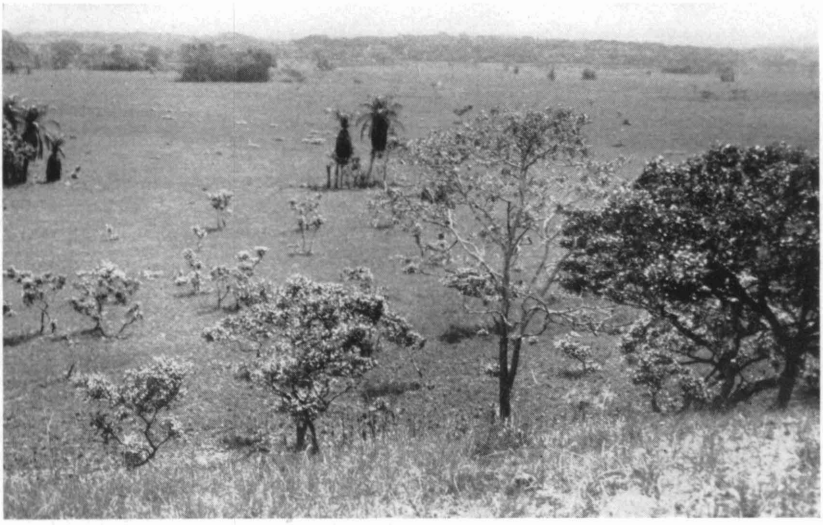


FIG. 1

FIG. 2

PLATE IV

FIG. 1. Chachaclún *Aguada* south of La Libertad is entirely inclosed by the savanna forest, the character of which is well brought out in the background. In this intermittent *aguada* the water has just begun to accumulate. Photographed shortly after the first rains in May.

FIG. 2. Chayaxnic *Aguada* southeast of La Libertad. The lack of vegetation along the water's edge is the result of the frequent visits made by mules and cattle. This is a typical permanent *aguada* not inclosed by a savanna forest. The bush in the background covers a limestone hill. Photographed early in May.

FIG. 1

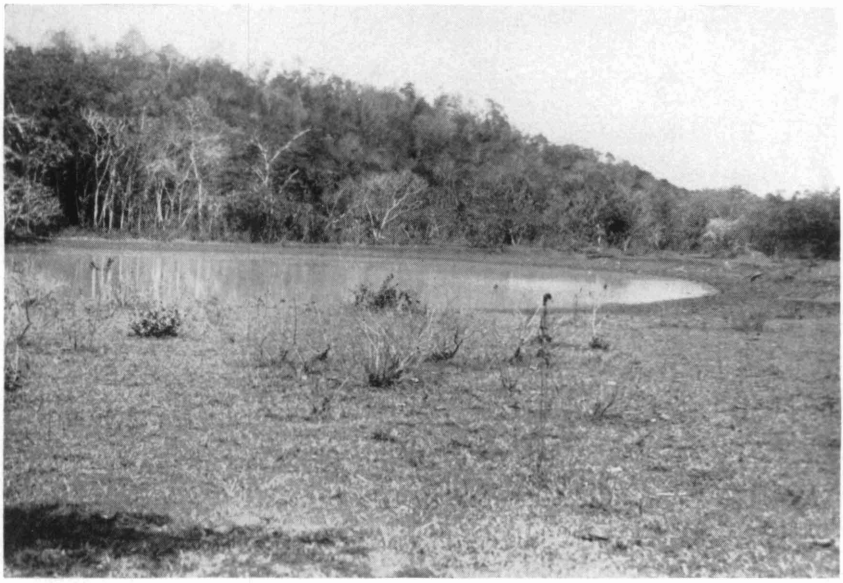
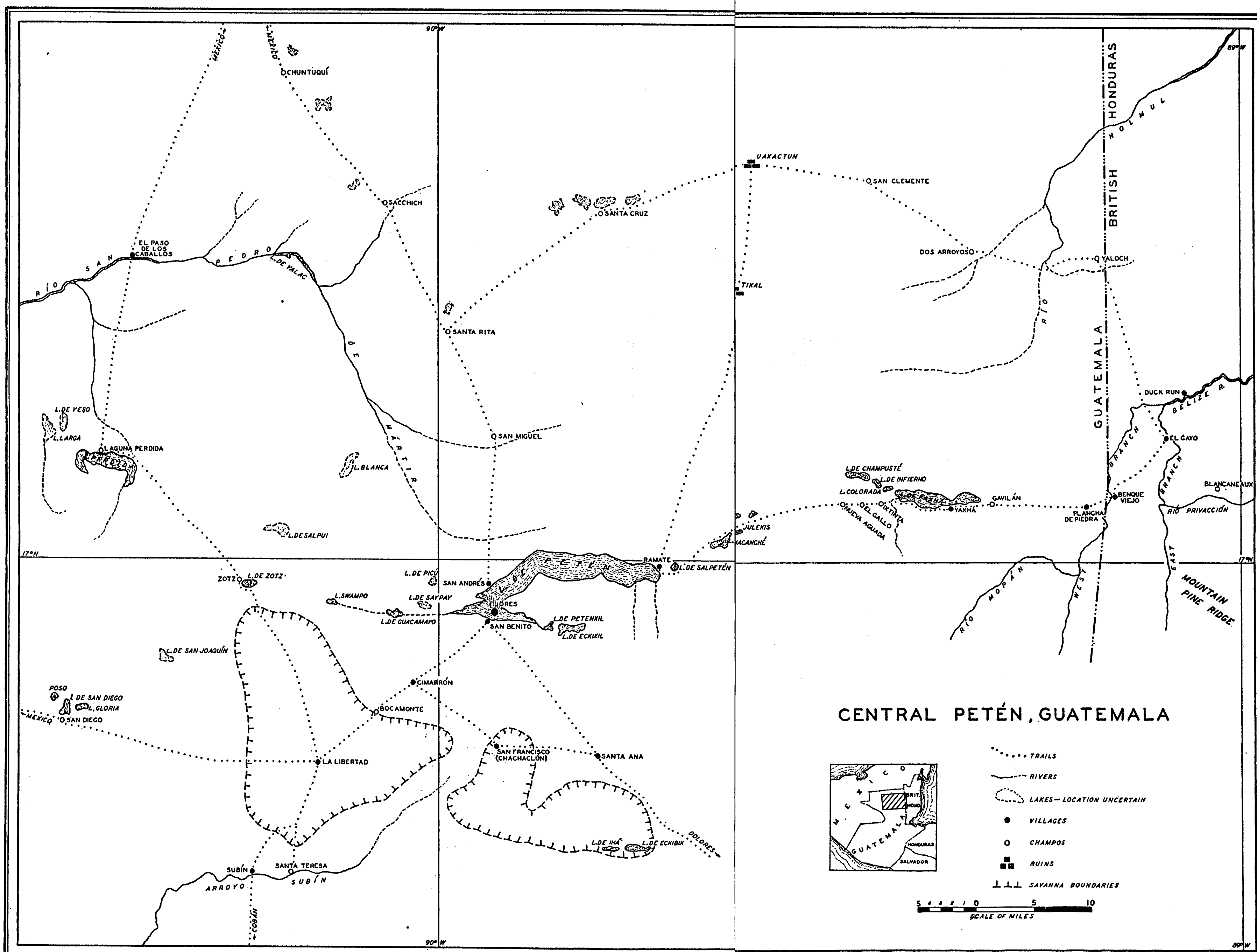


FIG. 2


CENTRAL PETÉN, GUATEMALA
TRAILS
RIVERS
LAKES—LOCATION UNCERTAIN
VILLAGES
CHAMPOS
RUINS
SAVANNA BOUNDARIES
SCALE OF MILES
5
0
5
10
90° W
89° W
17° N
MEXICO
GUATEMALA
BRIT. HOND.
HONDURAS
SALVADOR
BRITISH HONDURAS
CHUNTUQUÍ
SACCHICH
EL PASO DE LOS CABALLOS
RÍO SAN PEDRO
L. DE YALAC
DE MÁRTIR
SANTA RITA
SAN MIGUEL
SANTA CRUZ
UAXACTUN
SAN CLEMENTE
TIKAL
DOS ARROYOS
YALOCH
RÍO HOLMUL
L. DE YESO
L. LARGA
LAGUNA PERDIDA
L. BLANCA
L. DE SALPUI
ZOTZ
L. DE ZOTZ
L. DE PICÚ
SAN ANDRÉS
L. SWAMPO
L. DE SAYPAY
L. DE GUACAMAYO
FLORES
SAN BENITO
L. DE PETENXIL
L. DE ECKIXIL
RAMATE
L. DE SALPETÉN
JULEKIS
MACANCHÉ
L. DE CHAMPUSTÉ
L. DE INFIERNO
L. COLORADA
IXTINTA
EL GALLO
NUEVA AGUADA
YAXHA
GAVILÁN
PLANCHA DE PIEDRA
BENQUE VIEJO
DUCK RUN
BELIZE R.
EL CAYO
BLANCANEAUX
RÍO PRIVACCIÓN
EAST BRANCH
WEST BRANCH
RÍO MOPÁN
MOUNTAIN PINE RIDGE
L. DE SAN JOAQUÍN
POSO
L. DE SAN DIEGO
L. GLORIA
SAN DIEGO
CIMARRÓN
BOCAMONTE
LA LIBERTAD
SAN FRANCISCO (CHACHACLÚN)
SANTA ANA
L. DE IHÁ
L. DE ECKIBIX
DOLORES
SUBÍN
SANTA TERESA
ARROYO SUBÍN
COBÁN