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A PRELIMINARY ANALYSIS OF THE HERPETOFAUNA OF COLIMA, MEXICO[1]

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IN comparison with the lowlands of eastern México, the herpetofauna of the coastal regions of western México has received little attention. While this is due, in part, to the relative inaccessibility, until recent years, of large sections of western México, it is more probably owing to the greater diversity of the eastern fauna as contrasted with the smaller and more uniform one of the Pacific coast. It is only within the last decade that the reptiles and amphibians of western México have received much notice from a faunal point of view, as evidenced by the publications of Bogert and Oliver (1945), Duellman (1954), Davis and Smith (1953*a*, *b*, and *c*), Peters (1954, 1955), and Zweifel and Norris (1955).

Although the use of political boundaries in defining a study of a particular group of animals may be entirely unreal, a given political unit is still a precisely definable region for purposes of gathering data. Once the distribution of the reptiles and amphibians is known for each of the states of western México, the time will be ripe for a synthesis of this knowledge based upon physiographic or other natural regions of the whole area. It is with this prospect in mind that I present here data on the herpetofauna of Colima. Because no collections of reptiles and amphibians are available from the high mountains of Colima, however, this report deals only with the herpetofauna of the coastal plain, the escarpment, and the plateau.

This paper is an outgrowth of studies of the herpetofauna of Michoacán, during the course of which it became necessary to examine the materials available from adjacent areas. The herpetofauna of Morelos has been described by Davis and Smith (1953*a*, *b*, and *c*), and Davis is preparing a report on the reptiles and amphibians of Guerrero. Oliver (1937) recorded the reptiles and amphibians which he collected in

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Colima in 1935. Since that time the number of forms known from the state has greatly increased.

Recent additions to the collection of the Museum of Zoology, University of Michigan, provide several noteworthy range extensions and add certain species to the previously known herpetofauna of Colima. Joseph A. Davis, Jr., Edwin Gould, and William Schaldach, Jr., collected in the vicinity of Pueblo Juarez and Ejido de Tepextle in April and May, 1956. In May, 1956, my wife and I collected briefly in the vicinity of Tecomán and La Salada, and in August, accompanied by Richard E. Etheridge, we spent three days collecting between Colima and Tecomán. Other specimens included here for the first time were obtained in the vicinity of Paso del Río by Irving J. Cantrall and Emmet T. Hooper.

The purpose of this paper is twofold: first, to report upon certain species either hitherto unrecorded or little known from Colima, as well as to comment upon species that I believe to be erroneously recorded from the state; second, to give a general picture of the geographical distribution of the component species in western México. In order that the reader may have some conception of the habitats within the state of Colima a short description of the area is presented and also a gazetteer of the localities mentioned in the account of the species.

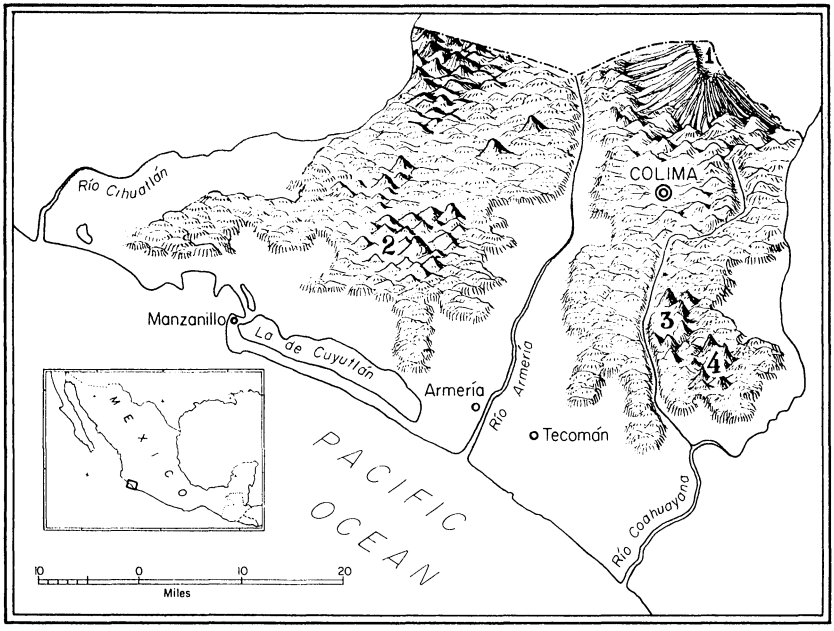
DESCRIPTION OF THE REGION

Physiography

The Pacific coast of Colima is one of long sandy beaches. It is infrequently interrupted by promontories in the northwestern part of the state, never in the southeastern part. There are two large lagoons in the northwest, the Laguna de Cuyutlán, which is over 20 miles long and 4 miles wide, and the much smaller Estero de Potrero Grande. These brackish lagoons are separated from the ocean by a narrow strip of beach. In the northwest the coastal plain is confined to a narrow strip between the montane escarpment and the large lagoons, whereas in the southeast, east of the Río Armería, it becomes much more extensive. In the vicinity of Tecomán the low plains gradually rise to an elevation of about 500 feet above sea level, that is, at a distance of 10 to 15 miles inland. The plains continue considerably further inland, however, along the valleys of the Río Armería and Río Coahuayana (Map 1).

The main mass of the Sierra Madre Occidental lies to the north of Colima, but numerous lower ranges extend southward from the Sierra

Madre into the state. These small ranges terminate in a rather sharp escarpment that lies near the coast in the northwestern part of the state. Toward the southeast, the escarpment closely follows the northern edge



MAP 1. A generalized physiographic map of Colima. 1, Volcán de Colima; 2, Sierra del Tigre; 3, Sierra de Picila; 4, Sierra de las Tinajas.

of Laguna de Cuyutlán to the Río Armería. East of that river, it is situated much farther inland. From 200 to 500 feet above sea level on the coastal plain, the escarpment rises abruptly to elevations ranging from 1400 to 2000 feet. Its face is deeply eroded into barrancas by the many small streams issuing from the higher land. The topography, therefore, is one of low rocky ridges separating the numerous barrancas. To the north of this escarpment lies a comparatively level plateau, with elevations ranging from 1400 to about 2300 feet. Rising from this plateau or directly from the edge of the escarpment are several small ranges of mountains, as well as numerous isolated hills or low mountains. The majority of these ranges lie below an elevation of 3500 feet, but a few of the highest hills, such as Cerro Chino and Cerro de los Ocotes, rise to elevations exceeding 5000 feet. The principal ranges from west to east are Sierra del Tigre, which includes the main mountain mass to the

west of the Río Armería, Sierra de Picila, and Sierra de las Tinajas. The last two ranges lie east of the Río Armería and are much lower than the first and completely separated from it. The Sierra del Tigre appears to be a disjunct group of low mountains properly belonging to the Sierra de Perote in Jalisco. To the north of the city of Colima, the plateau rises to the base of Volcán de Colima, which reaches an elevation of 12,500 feet. This mountain and its twin peak, the Nevado de Colima, which lies directly north, are the southern terminus of the Sierra de Tapala, extending northward to the Sierra Madre Occidental. The Volcán de Colima is the highest point within the state of Colima. The Nevado de Colima, lying entirely within the state of Jalisco, reaches an elevation of more than 14,000 feet.

There are three principal river systems in the state. The largest is the Río Armería, which arises in the Sierra Madre of Jalisco. Its two main tributaries in Colima are the Río de Juluapan and the Río de Colima. The Río Armería forms the eastern boundary of the Sierra del Tigre, the highest part of the escarpment. The Río Cihuatlan forms the northwestern boundary of the state. The Río Coahuayana, formed by the confluence of the Río Salada and the Río Tuxpan, separates the states of Colima and Michoacán. All of these rivers are broad, rocky, and permanent.

The highland masses of the state are continuous with those in Jalisco to the north and northwest. The coastal plain continues for some distance to the northwest into Jalisco, but in Michoacán it is interrupted by many high granitic promontories extending into the sea. The Río Coahuayana and the Río Tuxpan separate the highlands of Colima from the Sierra de Coalcomán in Michoacán. The low plateau of Colima is continuous to the east into southeastern Jalisco. In this region the Río Barrera and its tributaries, all of which are part of the Coahuayana drainage, are narrowly separated from the Río San Gerónimo, a principal tributary of the Río Tepalcatepec, which flows into the Río Balsas to the south and east. The highest ridges separating the drainages of the Río Coahuayana and the Río Balsas are about 2000 feet above sea level and form a natural pass between the low plateau of Colima and the Tepalcatepec–Balsas Basin.

Climate

The lowland regions of Colima have markedly dry winters and rainy summers. The rains normally begin in June and continue through

October. Data taken from Contreras (1942) show that at the city of Colima (elevation 1625 feet), the average annual rainfall is 876 mm., with an average of 80 rainy days; whereas at Manzanillo on the Pacific it is 1050 mm., with an average of 50 rainy days. Thermal data, likewise from Contreras (1942), show that Colima has an average annual temperature of 24.6° C., with a difference of 13° between the means of the hottest and coldest days. The mean annual temperature for Manzanillo is 26.1° C, with the extremes only 9° apart.

Vegetation

The vegetation of the coastal plain consists of three types, two of which are localized. The borders of the brackish lagoons are surrounded by dense growths of mangrove *(Rhizophora mangle* and *Conocarpus erecta).* Along the Laguna Cuyutlán are also extensive "palmares" *(Attalea?),* reaching heights of about 70 feet. Scattered throughout the dense palm forest are giant figs *(Ficus).* The most extensive type of vegetation on the coastal plain is the deciduous thorn scrub, which reaches a height of about 25 to 30 feet and forms a dense impenetrable mass of branches and thorns. This scrub forest consists almost entirely of Leguminosae, with *Acacia* and *Prosopis* appearing to be the dominant plants. Giant organ cacti *(Lemaireocereus)* rise above the surrounding forest.

In the barrancas of the escarpment and along the river courses is found a broad-leafed vegetation that may be evergreen. The principal trees are *Bombax, Brosium, Castilla, Ficus,* and *Licania,* also the red paper-bark tree commonly called "papellillo" or "palo colorado." These trees, which form an imposing contrast to the low scrub forest, may reach heights of nearly 80 feet, and on them grow epiphytic climbers *(Monstera)* and climbing cactus *(Aporocactus).* Along the streams is the common elephant ear *(Xanthosoma).*

The Colima plateau is covered with a more open type of vegetation, which consists mostly of xerophyllous plants, such as *Acacia, Crescentia,* and *Prosopis,* with an occasional *Ficus* and *Bombax.* Here the scrub is low, usually not exceeding 20 feet, and much more open than in the coastal lowlands.

GAZETTEER

The localities listed below are those referred to in the following account of the species.

Colima.—1625 feet, plateau scrub forest.

Ejido de Tepextle.—200 feet, 2.5 miles ENE of Manzanillo in the coastal scrub forest at the edge of palm forest.

La Salada.—1400 feet, 11 miles S of Colima in riparian forest in a barranca near the upper edge of the escarpment.

Los Amoles.—1500 feet, 8 miles S of Colima in the plateau scrub forest.

Paso del Río.—150 feet, 1 mile W of Armería in coastal scrub forest and adjacent to limited riparian situations along the Río Armería.

Pueblo Juarez (formerly known as Hacienda Magdalena).—1500 feet, 19 miles SW of Colima in plateau scrub forest and adjacent to riparian forest.

Queseria.—1700 feet, southern base of Volcán de Colima in deciduous hardwood forest.

Tecolapa.—450 feet, 12 miles NNE of Tecomán in coastal scrub forest at the foot of the escarpment.

ACCOUNT OF THE SPECIES

The data presented below pertain to 16 species of the herpetofauna of Colima. Nine of these (designated by an asterisk) are new records for the state; the others have been known from only a few specimens. All specimens are in the collections of the Museum of Zoology, University of Michigan.

Eleutherodactylus occidentalis Taylor

Los Amoles, 1; Pueblo Juarez, 1.

The specimen from Los Amoles is an adult female with a snout-vent length of 44 mm. In life the dorsum was pale pinkish-brown with brownish-black markings. The top of the head was a coppery color, and the anterior and posterior surfaces of the thighs were pale red. The specimen from Pueblo Juarez is similar, but has more extensive dorsal dark markings.

**Eleutherodactylus vocalis* Taylor

1 mi. SW of Pueblo Juarez, 28.

This series of specimens, containing only juveniles and females, is tentatively referred to this species. Although highly variable in dorsal

color pattern, in all of them there is a large dark-brown irregular blotch on a lighter brown or grayish-tan ground color. The blotch begins on the eyelids and extends to the vent; it may be broken by narrow transverse bands of ground color. In most specimens there is a middorsal spot of ground color in the scapular region. The flanks are mottled brown and cream; the anterior and especially the posterior surfaces of the thighs are dark brown with cream mottling. The cream ventral color is mottled with brown on the under surfaces of the hind limbs, and the throat may be spotted with brown or may be almost entirely brown. The tarsal fold, when viewed from above, is cream or light gray.

The largest specimen, a female, has a snout-vent length of 59 mm. One female, with a snout-vent length of 53 mm. has the tibio-tarsal articulation reaching the tip of the snout; heels overlapping when femora are at right angles to the body; a strong tarsal fold extending about two-thirds of the length of the tarsus; a heavy supra-tympanic fold; skin pustulate, especially on the flanks; tympanum slightly more than one-half the diameter of the eye, the diameter of the latter being equal to its distance from the nostril.

Specimens from Estopilas de Salitre, Michoacán, (reported as *E. rugulosus* by Peters, 1954: 6) and from Durazno, La Resolana, and Mazamitla, Jalisco, agree with the series from Colima. These are the northernmost-known specimens of the *rugulosus* group in western México. They differ from the description of *vocalis* (Taylor, 1940*a*: 401) from Uruapan, Michoacán, in that the tibio-tarsal articulation of the adpressed limb reaches to the snout and not to between the eye and nostril, as in *vocalis;* furthermore, *vocalis* was diagnosed as having heels that do not overlap and females with a tympanum less than half the diameter of the eye. The color pattern is essentially the same as shown by Taylor (1940*a*: Pl. 44). The color of the tarsal fold is not given in his description, nor it is evident in the plate. As compared with specimens of *rugulosus* from Veracruz and Chiapas, those from Colima differ in having a much stronger tarsal fold, the tarsal fold light in color, a larger tympanum, and a more pronounced dorsal color pattern. Compared with specimens of *avocalis* from Oaxaca, those from Colima differ in having relatively longer hind legs, a slightly larger tympanum, a light-colored tarsal fold, and a dorsal color pattern. The dorsum in *avocalis* is a nearly uniform dark brown. Thus, the differences between the Colima series and both of the above species are as impressive as the similarities. The absence of adult males from the Colima series precludes use of the presence or absence of vocal

sacs in definitely assigning these specimens to a given species. The three named populations of the *rugulosus* group in southern and western México—*avocalis, rugulosus,* and *vocalis*—are poorly known. Apparently they are allopatric; they may be geographic races. Therefore, it is best to tentatively assign the Colima specimens to the species *vocalis.*

Syrrhophus modestus Taylor

Paso del Río, 2; 4.5 mi. SW of Tecolapa, 4.

On August 9, 1956, this species was found calling from dense cover in bushes and small trees near Tecolapa at an elevation of 450 feet. The call, which is often quickly repeated, is a high, loud chirp, resembling the sound of a hammer hitting a stone chisel. The species also was heard in the vicinity of La Salada at an elevation of 1400 feet. In life the dorsum was dark red-rust with scattered, irregular black spots; the venter was pale gray and the iris light gold.

**Tomodactylus petersi* Duellman

2 mi. SW of Colima, 2; 4.5 mi. SW of Tecolapa, 3.

All individuals were found while calling from branches or leaves of bushes from 2 to 6 feet above the ground on August 9, 1956. The call is a soft "braa" followed or not by three short, high "peeps." In life these specimens were gray above with brown mottling; the venter was a dirty white. The anterior and posterior surfaces of the thighs were a deep yellow; the iris was pale gold.

These specimens are only tentatively referred to *petersi.* In structural characters and in color pattern they closely resemble specimens of that species from Michoacán; however, the call is notably different, that of *petersi* being a single "peep."

**Hylella azteca* Taylor

Paso del Río, 2.

These specimens extend the range of this species and the genus northward from Pomaró, Michoacán. The Colima specimens agree with those from coastal Michoacán, but, as noted by Peters (1954: 7), the name is used provisionally for the Pacific coast populations of

Hylella. They differ in many respects from *sumichrasti* in Oaxaca, which has yellowish-brown dorsum, instead of the pale-green dorsum of the Michoacán and Colima specimens. The type and only other known specimen of *azteca* is from Tepoztlan, Morelos, and was described as having a grayish-green dorsum. It is possible that the Pacific coast specimens represent a distinct taxon.

The information found in the literature concerning the life history of these frogs is, I believe, erroneous. Taylor, who found the type specimen of *Hylella azteca* in a bromeliad, stated (1943: 51): "The habitat of this species is in bromeliads. I strongly suspect that its entire life history is largely confined to this type of arboreal habitat." In his discussion of *Hylella sumichrasti,* Kellogg stated (1932: 182): "It has been reported that the eggs of this tree frog are deposited in the axils of the leaves of Spanish beard *(Tillandsia),* where they undergo their whole metamorphosis." My observations are in opposition to these statements. Congregations of *Hylella azteca* were encountered in Michoacán in 1951, during the wet season, and of *sumichrasti* in Oaxaca in 1956. All calling males were found in or along rocky streams; none was heard calling from trees. In the dry season specimens were found in the axils of elephant-ear leaves *(Xanthosoma).* Therefore, *Hylella* appears to be a terrestrial hylid that breeds in rocky streams and not to be a bromeliad frog. The tadpoles are unknown.

Hypopachus oxyrrhinus Boulenger

Queseria, 11.

These specimens, collected by Oliver, were reported by him (1937: 7) as *oxyrrhinus*. Subsequently, Taylor (1940*b*: 516) tentatively assigned these specimens to *ovis,* which he described from Nayarit. The two species were distinguished by Taylor in that *ovis* has darker sides with light flecks and a dark line from the occiput to the groin. The specimens from Queseria have sides the same color as the dorsum, and there are no light flecks. In some there is a continuous dark line from the occiput to the groin, in others the line is fragmented into spots or dashes, and in still others it is absent. The belly is reticulated with brown to form round cream spots. In a few specimens the brown reticulation is barely discernible, whereas in others it is bold.

In comparison with specimens from the Tepalcatepec Valley in Michoacán, the Colima specimens show few differences. The belly reticulations in the Michoacán specimens are stronger. Also, the varia-

tion in the development of the stripe from the occiput to the groin is similar. The specimens from Queseria may represent an intermediate population between *ovis* to the north and *oxyrrhinus* to the south, or the characters used by Taylor to define *ovis* may be examples of individual variation in *oxyrrhinus*.

**Rana sinaloae* Zweifel

Pueblo Juarez, 1.

The *Rana palmipes* group is represented in western México by two closely related species: *sierramadrensis,* in the Sierra del Sur in Guerrero and Oaxaca, and *sinaloae,* previously known only from the vicinity of El Batel, Sinaloa (elevation 4500). It is, therefore, of great interest to find *sinaloae* at an elevation of 1500 feet in Colima, a locality about midway in the 700 miles that separates El Batel, Sinaloa, and the northernmost record for *sierramadrensis* at Agua del Obispo, Guerrero. The specimen is an adult male with a snout-vent length of 58 mm.; tibia length, 32.5 mm.; foot length, 31.0 mm.; head length, 21.5 mm.; head width, 20.0 mm.; diameter of the tympanum, 4.5 mm.; diameter of the eye, 7.0 mm. There is a distinct supra-and post-tympanic fold. Posterior to the sacrum, the dorsolateral fold is broken into a row of low pustules. A light lip stripe passes beneath the tympanum and continues to the groin, where it joins the white ventral color. On the flanks the light stripe is separated from the light ventral color by an irregular dark stripe. In preservative, the dorsum is olive brown, with scattered, irregular black spots. The irregular dark bands on the limbs are subequal in width to the intervening light areas. This specimen differs only slightly from the type series of *sinaloae.* It has a relatively larger tympanum; the tympanum length/head width ratio is 0.225, as compared with 0.18–0.19 for *sinaloae* as given by Zweifel (1954: 133). The tibia length/snout-vent length ratio is 0.560, slightly higher than that of *sinaloae* (0.518–0.555), and lower than that of *sierramadrensis* (0.575–0.630) as given by Zweifel *(loc. cit.).*

Anolis schmidti Smith

Ejido de Tepextle, 1; Pueblo Juarez, 1.

This species has been known only from two specimens: the type from Manzanillo, Colima, and one from La Placita, Michoacán. The speci-

men from Pueblo Juarez is a female with a snout-vent length of 36 mm., and with 20–21 lamellae on the 3d and 4th phalanges of the fourth toes, 3 enlarged supraoculars, 5 rows of loreals, 8–7 upper labials, 8–8 lower labials, 2 small rows of scales between the supraorbital semicircle series and the occipital, supraoculars and semicircle series narrowly in contact, and postanal scales not noticeably enlarged. The specimen from Ejido de Tepextle is a male with a snout-vent length of 40 mm., and with 23–24 toe lamellae, 3 enlarged supraoculars, 5 rows of loreals, 7–7 upper labials, 8–8 lower labials, 1 row of scales between the supraorbital semicircle series and occipital, supraoculars separated from the semicircle series by a row of small scales, and with postanals only slightly enlarged.

The female has a light middorsal band with irregular zigzag edges. On the nape a narrow stripe diverges from the middorsal band and passes anteriorly to the posterior edge of the orbit. There is a narrow, dark, interorbital bar but no dark bars on the labials. The dorsum of the male is lighter than the flanks and bears six indistinct dark chevrons. There is a wide, dark interorbital bar and irregular dark bars on the labials.

Elaphe triaspis intermedia Boettger

Pueblo Juarez, 2.

One specimen is a juvenile with distinct dorsal and lateral dark blotches. It contained a *Mus musculus* in the stomach.

**Imantodes gracillimus* Günther

2.1 mi. NNE of La Salada, 1.

An adult female with 240 ventrals and 143 caudals was found dead on the road at night on August 10, 1956. The color pattern consists of 69 chocolate-brown blotches edged with black on a tan background. On the anterior part of the body the blotches extend onto the ventrals; posteriorly the lateral parts are separated from the dorsal part of the blotch.

This species has been reported previously only from the coastal region of Guerrero, Las Tres Marías, Nayarit, and Guirocoba, Sonora.

Oxybelis aeneus auratus Bell

Pueblo Juarez, 1.

One specimen was found in a tree near town.

Pseudoficimia frontalis Cope

La Salada, 1.

The single specimen of this rare species obtained was found dead on the road on August 10, 1956. It is a male with 155 ventrals and 34 caudals, and with 34 reddish-brown blotches on the body and 9 on the tail. There is a Y-shaped dark mark on the parietals, with two parallel dark stripes extending posteriorly to connect with the first body blotch. A dark interorbital stripe is situated on the anterior parts of the supraoculars and frontal and posterior edges of the prefrontals. There is a dark suborbital stripe passing posteroventrally across upper labials 4 and 5 from the lower edge of the orbit to the mouth. The ventral surfaces are an immaculate creamy white.

**Pseudoleptodeira latifasciata* Günther

1.5 mi. NNE of La Salada, 1.

A badly smashed specimen of this species was found in May, 1956. This is the first record for the species from beyond the Balsas Basin.

**Sibon nebulatus* Linnaeus

La Salada, 1.

The specimen is an adult female with 191 ventrals and 91 caudals. The body length is 582 mm., that of the tail 212 mm. This is the northernmost record for the genus on the Pacific coast of México, the closest locality being Aquila, Michoacán (Peters, 1954: 30).

**Trimorphodon latifascia* Peters

4.3 mi. SE of Colima, 1.

The specimen is an adult female with 226 ventrals, 65 caudals, and 13 body blotches. It agrees with those from Morelos described by Davis and Smith (1953*a*: 140). Heretofore, this species has been known only from the arid interior basin of the Río Balsas and Río Tepalcatepec and the adjacent slopes in Guerrero, Morelos, Michoacán, and Puebla.

**Micrurus laticollaris* Peters

2.3 mi. NNE of La Salada, 1; 2.3 mi. N of Los Amoles, 1; 1.4 mi. SSW of Los Amoles, 1.

The top of the head is black; the nape, chin, and lower parts of the upper labials and the tip of the snout are white. There are 6 or 7 crimson bands from 5 to 20 scales in length. The scales of the crimson bands are tipped with black; the posterior ventrals may or may not have the edges tipped with black. Two males have 211 and 212 ventrals and 45 and 44 caudals, respectively; one female has 215 ventrals and 38 caudals. These data agree with those for specimens from Morelos given by Davis and Smith (1953*a*: 140).

These specimens extend the range westward beyond the area of the Balsas Basin.

COMPOSITION OF THE HERPETOFAUNA

There are 16 species of reptiles and amphibians reported from Colima for which I can find no authentication. Ten of these have been recorded from Nevado de Colima, which lies entirely within the state of Jalisco; doubtless it is because of the misleading name of this volcano that these species have been incorrectly assigned to the herpetofauna of Colima. They include *Batrachoseps attenuatus, Sceloporus bulleri, S. dugesi dugesi, S. formosus, S. grammicus microlepidotus, S. torquatus, Phrynosoma orbiculaire dugesi, Eumeces lynxe furcirostris, Thamnophis melanogaster canescens,* and *Crotalus triseriatus triseriatus.* The records of *Sceloporus formosus* and *Eumeces lynxe furcirostris* (Gadow, 1905: 194) probably are based upon misidentifications or upon specimens with incorrect locality data, since neither of these species is known from the Sierra Madre Occidental. *Sceloporus formosus* occurs in the mountains of Oaxaca, Puebla, and southern Veracruz; *Eumeces lynxe furcirostris* is found in the Sierra Madre Oriental in Hidalgo, Puebla, and Veracruz.

The port of Manzanillo was a shipping point for many early collections, most of the specimens of which bore the locality data "Colima." That such data are often unreliable is illustrated by the reports of *Crocodylus moreleti* and *Laemanctus longpipes* from Colima. Both species are otherwise known in México only from the eastern part. The specimen of *Coluber oaxaca* supposedly from Colima was shipped to the United States from that state; the authenticity of this record has been questioned previously by the late E. R. Dunn (1933: 214). The type locality of *Geophis semiannulatus* was given in error as Colima (Smith, 1942: 259); the species otherwise is known only from the mountains of eastern México. Gadow (1905: 194) recorded *Hylodes (= Eleuthero-*

TABLE I

DISTRIBUTION OF COMPONENT SPECIES
OF COLIMA HERPETOFAUNA IN WESTERN MEXICO

The subspecies occurring in Colima is given in parentheses.

Species	Lowlands of Colima	Lowlands South of Colima	Lowlands North of Colima	Balsas Basin	Western Plateau
Bufo horribilis	X	X	X	X	.....
Bufo marmoreus	X	X	X	X	.....
Bufo occidentalis	X	.....	.....	.....	X
Eleutherodactylus occidentalis	X	X	X	X	X
Eleutherodactylus vocalis	X	X	.....	X	.....
Leptodactylus melanonotus	X	X	X	X	.....
Syrrhophus modestus	X	.....	X	.....	.....
Tomodactylus petersi	X	X	X	X	.....
Agalychnis dacnicolor	X	X	X	X	.....
Hyla baudini	X	X	X	X	.....
Hyla smithi	X	X	X	X	.....
Hylella azteca	X	X	.....	X	.....
Phrynohyas inflata	X	X	.....	.....	.....
Pternohyla fodiens	X	.....	X	.....	X
Gastrophryne usta usta	X	X	X	.....	X
Hypopachus oxyrrhinus	X	.....	X	X	X
Rana pipiens	X	X	X	X	X
Rana pustulosa	X	.....	.....	.....	X
Rana sinaloae	X	.....	.....	.....	X
Geoemyda pulcherrima (pulcherrima)	X	X	X	.....	.....
Geoemyda rubida (perixantha)	X	X	.....	X	.....
Kinosternon integrum	X	X	X	X	X
Crocodylus acutus (acutus)	X	X	X	.....	.....
Coleonyx elegans (nemoralis)	X	X	.....	X	.....

TABLE I (Cont.)

DISTRIBUTION OF COMPONENT SPECIES
OF COLIMA HERPETOFAUNA IN WESTERN MEXICO

The subspecies occurring in Colima is given in parentheses.

Species	Lowlands of Colima	Lowlands South of Colima	Lowlands North of Colima	Balsas Basin	Western Plateau
Leptotyphlops phenops (bakewelli)	X	X	X	X	.....
Boa constrictor (imperator)	X	X	X	X	.....
Loxocemus sumichrasti	X	X	.....	X	.....
Clelia clelia (immaculata)	X	.....	.....	.....	X
Coniophanes lateritus	.....	.....	X	X	X
Conophis vittatus (vittatus)	X	X	X	X	.....
Dipsas gaigeae	X	.....	.....	.....	.....
Dryadophis melanolomus (stuarti)	X	X	.....	.....	.....
Drymarchon corais (rubidus)	X	X	X	X	X
Drymobius margaritiferus (fistulosus)	X	X	X	X	.....
Elaphe triaspis (intermedia)	X	X	X	X	X
Hypsiglena torquata	X	.....	X	X	.....
Imantodes gemmistratus (oliveri)	X	X	X	.....	.....
Imantodes gracillimus	X	X	X	.....	.....
Imantodes latistratus	.....	.....	X	X	X
Lampropeltis doliata (nelsoni)	X	X	X	X	X
Leptodeira annulata (polysticta)	X	X	X	.....	.....
Leptodeira bressoni	X	.....	X	X	.....
Leptodeira maculata ..	X	X	X	X	.....
Leptophis diplotropis	.....	X	X	X	.....
Manolepis putnami	X	X	X	.....	.....
Masticophis bilineatus (bilineatus)	X	.....	X	.....	X
Masticophis flagellum (lineatus)	X	X	X	X	X

TABLE I (Cont.)

DISTRIBUTION OF COMPONENT SPECIES
OF COLIMA HERPETOFAUNA IN WESTERN MEXICO

The subspecies occurring in Colima is given in parentheses.

Species	Lowlands of Colima	Lowlands South of Colima	Lowlands North of Colima	Balsas Basin	Western Plateau
Phyllodactylus lanei	X	X	X	X	.....
Anolis nebulosus	X	X	X	X	X
Anolis schmidti	X	X	.....	.....	.....
Basiliscus vittatus	X	X	.....	X	.....
Ctenosaura pectinata	X	X	X	X	.....
Iguana iguana (rhinolopha)	X	X	X	X	.....
Phrynosoma asio	X	X	.....	X	.....
Sceloporus horridus (oligoporus).....	X	X	X	X	.....
Sceloporus melanorhinus (calligaster)	X	X	X	X	.....
Sceloporus pyrocephalus.....	X	X	X	X	.....
Sceloporus utiformis ..	X	X	X	X	.....
Urosaurus bicarinatus (tuberculatus)	X	X	X	X	.....
Eumeces colimensis ..	X	X	.....	.....	.....
Eumeces parvulus.....	X	X	X	.....	.....
Mabuya mabouia (alliacea)	X	X	.....	X	.....
Scincella assata (taylori)	X	X	.....	.....	.....
Ameiva undulata (sinistra).....	X	X	X	X	.....
Cnemidophorus deppei (lineatissimus)	X	X	X	X	.....
Cnemidophorus guttatus (immutabilis).....	X	X	.....	.....	.....
Cnemidophorus sacki (copei)	X	X	X	X	.....
Heloderma horridum (horridum).....	X	X	X	X	X
Leptotyphlops humilis (dugesi)	X	.....	X	.....	.....

TABLE I (Cont.)

DISTRIBUTION OF COMPONENT SPECIES
OF COLIMA HERPETOFAUNA IN WESTERN MEXICO

The subspecies occurring in Colima is given in parentheses.

Species	Lowlands of Colima	Lowlands South of Colima	Lowlands North of Colima	Balsas Basin	Western Plateau
Natrix valida (isabelleae)	X	X	X	.....	.....
Oxybelis aeneus (auratus)	X	X	X	X	.....
Pseudoficimia frontalis	X	X	X	X	.....
Pseudoleptodeira latifasciata	X	.....	.....	X	.....
Rhadinaea hesperia (hesperioides)	X	X	X	X	X
Salvadora mexicana	X	X	X	X	.....
Sibon nebulatus	X	X	.....	.....	.....
Tantilla calamarina	X	.....	X	X	X
Trimorphodon biscutatus (biscutatus)	X	X	.....	X	.....
Trimorphodon latifascia	X	.....	.....	X	.....
Tropidodipsas occidentala	X	X	.....	.....	.....
Tropidodipsas philippi	X	.....	X	.....	.....
Micrurus diastema (diastema)	X	X	X	X	.....
Micrurus laticollaris	X	.....	.....	X	.....
Agkistrodon bilineatus (bilineatus)	X	X	X	X	.....
Crotalus basiliscus	X	X	X	X	.....

dactylus) rhodopis from Colima, a record probably based upon a specimen of *Eleutherodactylus occidentalis; E. rhodopis* is unknown on the Pacific slopes of México north of the Isthmus of Tehuantepec. The record of *Kinosternon hirtipes* from "Colima" is based upon a specimen of *K. integrum.*

The inclusion of certain species as unauthenticated in the above list does not preclude their presence in the state of Colima. It is logical to assume that at least some of the species found on the Nevado de Colima

will occur on the southern slopes of the adjacent Volcán de Colima, part of which is situated in the state of Colima.

Colima lies in the midst of the range of three species of snakes that have not been collected in that state. These are *Coniophanes lateritus, Imantodes latistratus,* and *Leptophis diplotropis.* In all probability they will be added in the future to the state list. On this assumption they are included in the following discussion of the fauna. Several species that have not been found in Colima are known to occur along the coast of Michoacán or in the western reaches of the Tepalcatepec Valley. Among these are *Bufo coccifer, Diaglena reticulata, Leptodactylus labialis, Cnemidophorus calidipes, Enyaliosaurus clarki, Sceloporus siniferus siniferus,* and *Thamnophis cyrtopsis cyclides.* Since there is no evidence that these species extend farther north than Michoacán, they are not considered here to be constituents of the Colima herpetofauna.

GEOGRAPHICAL ANALYSIS OF THE HERPETOFAUNA

Excluding the sea snake *Pelamis platurus* and the sea turtles *Chelonia mydas* and *Lepidochelys olivacea,* the lowland herpetofauna of the state of Colima consists of 82 species definitely recorded plus 3 others that undoubtedly occur there. The distribution of these 85 species in western México is shown in Table I.

There are three principal herpetofaunal assemblages in Colima—one inhabiting the coastal lowlands and the Balsas Basin, one solely in the coastal lowlands, and one in the lowlands and extending onto the western part of the Mexican Plateau. In each group there are certain species that do not fit the set pattern of distribution, but in general the three groups are apparent.

The largest assemblage consists of those species inhabiting the coastal lowlands and the Balsas Basin. This group contains 58 species, or 68 per cent of the herpetofauna of Colima. Of the 58 species, 40 range north and south along the coast, 6 to the north only, 9 to the south only, and 3 reach the coastal lowlands only in Colima. Most of these species are widely distributed in the lowlands of western México; many are inhabitants of arid habitats, but a few, such as *Eleutherodactylus vocalis, Hylella azteca,* and *Leptodeira bressoni,* exist only in the scattered riparian habitats found in both regions. Aside from the large percentage of the species inhabiting both the lowlands of Colima and the Balsas Basin, the factor that best shows their close biogeographic relationship is the presence of three snakes *(Pseudoleptodeira latifasciata, Trimorphodon*

latifascia, and *Micrurus laticollaris)* in the arid, low plateau of Colima. These species range through the Balsas Basin and occur out of the basin only in Colima. Fourteen of the species that occur in the lowlands and the Balsas Basin also occur on the western part of the Mexican Plateau.

The second geographic assemblage consists of 20 species that inhabit only the coastal lowlands; they do not enter the Balsas Basin or extend onto the Mexican Plateau. Of these, 8 range to the north and to the south, 3 range to the north only, 8 to the south only, and 1 is endemic. The endemic species, *Dipsas gaigeae,* is known from a single specimen collected at Paso del Río. This group includes species that, for the most part, have their relationships with species to the south, e.g.: *Geoemyda pulcherrima, Crocodylus, Dryadophis, Manolepis,* and *Leptodeira annulata.*

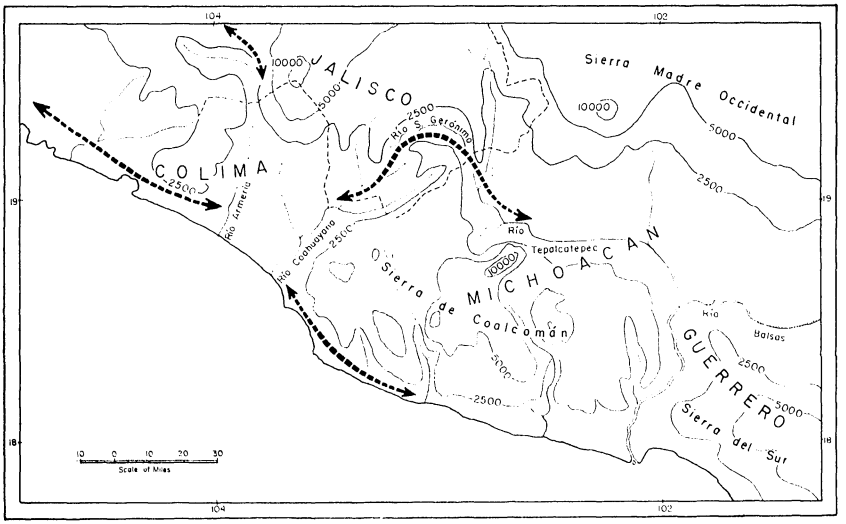
The third assemblage consists of 21 species that occur in the lowlands as well as on the western part of the Mexican Plateau. Fourteen of these range into the Balsas Basin; of the other seven, 1 ranges to the north and south in the lowlands, 2 to the north only, and 4 are found in the lowlands only in Colima. The species in this last group are *Bufo occidentalis, Rana pustulosa, Rana sinaloae,* and *Clelia clelia immaculata.* The three amphibians are plateau species that reach low elevations only in Colima and adjacent parts of Jalisco. The status of the disjunct population of *Clelia* is puzzling, for the closest records to those from Colima and Guadalajara are from southern Veracruz. Of the 21 species that range from the lowlands onto the plateau, 5 are essentially highlanders in their distribution, 10 are chiefly lowland, and 6 are widely distributed in both areas and include such species as *Rana pipiens* and *Kinosternon integrum.*

The northern limit of distribution is reached by 19 species in the state of Colima, whereas the southern limit is reached only by 5. This would seem to indicate the presence of some sort of barrier, either physiographic or ecological. The only physiographic barriers in the state are rivers, none of which are of the magnitude to stop the dispersal of most reptiles or amphibians. Ecologically, the conditions present in Colima are much the same as those in the lowlands of Michoacán and Jalisco. There is a gradual decrease in rainfall towards the north in Sinaloa, with a corresponding poorer development of the scrub forest. The actual factors that may be responsible for the apparent termination of range in Colima are not known. It is, however, probable that many of these species do occur to the north or to the south but have not yet been discovered. Peters (1955) discussed the distribution of reptiles and am-

phibians in western México. Since he was considering not only the lowland assemblage of species but species inhabiting the Sierra de Coalcomán and Sierra Madre del Sur, his figures are different considerably from those given above.

DISPERSAL OF THE HERPETOFAUNA

An analysis of the distribution of the reptiles and amphibians in the state of Colima on the basis of the general physiography of the state and adjacent areas, makes it possible to arrive at certain conclusions concerning probable routes of dispersal through the area. There appear to be three main dispersal routes (Map 2). The first of these is along the



MAP 2. Southwestern México showing possible dispersal routes of the lowland herpetofauna. The contour lines show the elevations in feet.

arid Pacific lowlands extending from the Isthmus of Tehuantepec into Sonora. Throughout the xerophytic lowland scrub forest are isolated patches of broad-leaf forest that provide a mesic habitat. Many species of reptiles and amphibians found in the coastal lowlands occur only in these areas. This forest type may be a relic of a time when the climatic conditions were such that this mesic habitat was much more widespread. If this is true, it would readily explain the present distribution of many species that appear to be restricted to the isolated patches of this habitat along the Pacific coast.

The similarity of the herpetofaunas of the Tepalcatepec–Balsas Basin and the lowlands of Colima strongly suggests a dispersal route between the two areas. The lower valley of the Río Balsas, which separates the states of Michoacán and Guerrero, provides a route between the coastal region and the interior basin. However, the presence of many species only in Colima, or to the north of Colima and in the interior basin, indicate that there is a more direct pathway. Thus, the highway that must have been used by at least some of the species, especially those that do not range to the south of Colima in the coastal region, is the low pass separating the headwaters of the Río Tepalcatepec and the Río Coahuayana in southeastern Jalisco. This connection between the Sierra de Coalcomán in Michoacán and the Sierra Madre Occidental in Jalisco and Michoacán is a low ridge about 2000 feet above sea level. The dominant habitat in the region of the pass is low scrub forest with scarcely any riparian habitats. The ridge, under present climatic conditions, is probably not a barrier to the majority of lowland species. There are exceptions, for apparently the environmental conditions of the area are not favorable to certain species. Examples of such species are *Cnemidophorus calidipes* and *Enyaliosaurus clarki,* both of which are restricted to the most arid parts of the Tepalcatepec Valley and are usually found in a habitat characterized by palo verde *(Cercidium),* a habitat that is absent in the region of the pass as well as on the low plateau of Colima.

To the north of Colima interchange of plateau and lowland species is possible because of the absence of a highland mass separating the lowlands from the Mexican Plateau. Although there are scattered high volcanos, in southern Jalisco the mountainous rim of the plateau is missing; consequently, numerous species appear to utilize this area to gain access to the plateau or the lowlands.

Thus, the importance of Colima in the distribution of the herpetofauna in western México is that the area is one without important barriers and that there is a mingling of faunal elements from the coastal region, the interior basin of the Río Tepalcatepec, and the western part of the Mexican Plateau.

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