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A Biogeographic Account Of the Herpetofauna of Michoacán, México

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TABLE 2.—ECOLOGICAL AND ALTITUDINAL DISTRIBUTION OF AMPHIBIANS AND REPTILES IN MICHOACÁN.

(A, abundant; M, moderately abundant; R, apparently rare; ?, presence not established.)

SPECIES	Arid tropical scrub forest	Tropical semi-deciduous forest	Mesquite-grassland	Pine-oak forest	Fir forest	Altitudinal range in meters
Ambystoma amblycephalum	—	—	—	M	M	2300–2800
Ambystoma dumerili dumerili	—	—	—	R	—	2165
Ambystoma ordinarium	—	—	—	M	A	2400–3000
Ambystoma tigrinum velasci	—	—	—	R	—	2000–2200
Pseudoeurycea belli	—	—	—	A	M	1500–2900
Pseudoeurycea robertsi	—	—	—	—	A	2900–3000
Rhinophrynus dorsalis	R	—	—	—	—	0–10
Scaphiopus hammondi multiplicatus	—	—	A	M	—	1500–2500
Bufo coccifer	M	—	—	—	—	335–640
Bufo compactilis compactilis	—	—	M	—	—	1525–2050
Bufo marinus	A	M	—	—	—	0–1000
Bufo marmoreus	M	A	—	—	—	0–1000
Bufo occidentalis	—	—	—	A	R	900–2400
Bufo perplexus	A	—	—	—	—	180–1630
Leptodactylus labialis	A	—	—	—	—	180–1050
Leptodactylus melanonotus	A	M	—	—	—	0–1050
Leptodactylus occidentalis	—	—	R	—	—	1700
Microbatrachylus hobartsmithi	—	—	—	M	R	1450–2750
Microbatrachylus pygmaeus	—	A	—	—	—	850
Eleutherodactylus augusti cactorum	—	—	—	R	—	945–2350
Eleutherodactylus occidentalis	R	M	—	R	—	20–1500
Eleutherodactylus rugulosus vocalis	—	M	—	—	—	130–1630
Tomodactylus angustidigitorum	—	—	—	A	—	1500–2500
Tomodactylus fuscus	—	—	—	R	—	2100–2200
Tomodactylus nitidus nitidus	—	—	M	R	—	1200–1800
Tomodactylus nitidus orarius	—	M	—	—	—	20–300
Tomodactylus nitidus petersi	M	M	R	M	—	335-1630
Tomodactylus rufescens	—	—	—	M	—	1600–2100
Diaglena reticulata	R	—	—	—	—	120–330
Pternohyla fodiens	R	—	—	—	—	380
Phyllomedusa dacnicolor	A	M	—	—	—	0–1000
Phrynohylas inflata	—	R	—	—	—	90
Hyla arenicolor	R	M	—	M	—	500–2100
Hyla baudini	A	A	—	—	—	0–1200
Hyla bistincta	—	—	—	A	R	1600–2400
Hyla eximia	—	—	A	A	—	1500–2300
Hyla lafrentzi	—	—	—	R	M	2400–2800
Hyla microcephala sartori	—	?	—	—	—	?
Hyla smaragdina	—	M	R	M	—	150–1500
Hyla smithi	A	A	—	—	—	0–1000
Gastrophryne usta usta	?	—	—	—	—	?
Hypopachus caprimimus	M	—	R	—	—	200–1800
Hypopachus oxyrrhinus ovis	—	—	A	—	—	1500–2200
Rana dunni	—	—	M	M	—	2000–2165
Raya megapoda	—	—	M	—	—	1525
Rana montezumae	—	—	M	—	—	1500–2000
Rana pipiens	A	M	A	A	M	0–2800

TABLE 2.—ECOLOGICAL AND ALTITUDINAL DISTRIBUTION OF AMPHIBIANS AND REPTILES IN MICHOACÁN.—*Continued*

SPECIES	Arid tropical scrub forest	Tropical semi-deciduous forest	Mesquite-grassland	Pine-oak forest	Fir forest	Altitudinal range in meters
Rana pustulosa	—	M	—	M	—	850–2150
Kinosternon hirtipes hirtipes	—	—	M	—	—	1525–2160
Kinosternon integrum	A	M	A	M	—	0–2200
Geoemyda pulcherrima pulcherrima	?	—	—	—	—	?
Geoemyda rubida perixantha	R	—	—	—	—	0–635
Pseudemys scripta ornata	?	—	—	—	—	?
Crocodylus acutus acutus	M	—	—	—	—	0–10
Bipes canaliculatus	?	—	—	—	—	?
Coleonyx elegans nemoralis	?	?	—	—	—	?
Phyllodactylus duellmani	M	—	—	—	—	180–500
Phyllodactylus homolepidurus	—	M	—	—	—	0–500
Phyllodactylus lanei	—	A	—	M	—	0–1100
Phyllodactylus paucituberculatus	R	—	—	—	—	270
Anolis dunni	—	—	—	R	—	700–850
Anolis nebulosus	A	A	R	M	—	0–2100
Anolis schmidti	—	R	—	—	—	0–10
Basiliscus vittatus	M	A	—	—	—	0–350
Iguana iguana rhinolopha	M	M	—	—	—	0–800
Ctenosaura pectinata	A	M	—	—	—	0–1000
Enyaliosaurus clarki	A	—	—	—	—	200–510
Phrynosoma asio	R	—	—	—	—	300–700
Sceloporus aeneus aeneus	—	—	—	A	A	1850–3100
Sceloporus asper	—	R	—	M	—	335–1630
Sceloporus bulleri	—	—	—	A	—	2000–2350
Sceloporus dugesi intermedius	—	—	A	M	—	1500–2200
Sceloporus gadowae	M	—	—	—	—	250–1050
Sceloporus grammicus microlepidotus	—	—	—	A	M	1550–3100
Sceloporus heterolepis	—	—	—	M	R	1800–2700
Sceloporus horridus oligoporus	A	—	—	—	—	0–1600
Sceloporus melanorhinus calligaster	—	A	—	—	—	30–1500
Sceloporus pyrocephalus	A	—	—	—	—	0–1000
Sceloporus scalaris scalaris	—	—	M	M	—	1550–2300
Sceloporus siniferus siniferus	M	—	—	—	—	0–150
Sceloporus spinosus spinosus	—	—	M	—	—	1500–2300
Sceloporus torquatus torquatus	—	—	M	A	M	1450–3000
Sceloporus utiformis	—	M	—	M	—	0–1550
Urosaurus bicarinatus tuberculatus	—	M	—	M	—	0–1700
Urosaurus gadowi	A	—	—	—	—	180–1200
Mabuya brachypoda	M	M	—	—	—	0–1050
Scincella assata taylori	—	R	—	—	—	120–850
Eumeces altamirani	R	—	—	—	—	350–1050
Eumeces colimensis	—	R	—	—	—	130–950
Eumeces copei	—	—	—	R	R	1800–2700
Eumeces dugesi	—	—	—	A	M	1550–1850
Eumeces indubitus	—	—	—	R	—	2750
Eumeces parvulus	—	M	—	—	—	30–500
Ameiva undulata sinistra	—	A	—	—	—	10–950
Cnemidophorus calidipes	A	—	—	—	—	200–650
Cnemidophorus communis communis	A	—	—	—	—	10–950
Cnemidophorus costatus occidentalis	—	—	R	—	—	1570

TABLE 2.—ECOLOGICAL AND ALTITUDINAL DISTRIBUTION OF AMPHIBIANS AND REPTILES IN MICHOACÁN.—*Continued*

SPECIES	Arid tropical scrub forest	Tropical semi-deciduous forest	Mesquite-grassland	Pine-oak forest	Fir forest	Altitudinal range in meters
Cnemidophorus costatus zweifeli	A	—	—	—	—	200–1100
Cnemidophorus deppei deppei	R	—	—	—	—	130–500
Cnemidophorus deppei infernalis	A	—	—	—	—	200–1050
Cnemidophorus lineatissimus exoristus	—	M	—	—	—	170–900
Cnemidophorus lineatissimus lineatissimus	—	R	—	—	—	0–10
Cnemidophorus lineatissimus lividus	—	A	—	—	—	0–500
Cnemidophorus scalaris	—	—	A	—	—	1600–1900
Heloderma horridum horridum	—	R	—	—	—	0–1000
Gerrhonotus imbricatus imbricatus	—	—	—	M	M	1500–3500
Typhlops braminus	R	R	—	—	—	335–850
Leptotyphlops bressoni	R	—	—	—	—	1050
Leptotyphlops gadowi	R	—	—	—	—	800
Leptotyphlops phenops bakewelli	—	R	—	—	—	0–850
Loxocemus bicolor	R	—	—	—	—	0–640
Boa constrictor imperator	M	M	—	—	—	0–1000
Clelia clelia	—	?	—	—	—	?
Coniophanes fissidens dispersus	—	R	—	—	—	850
Coniophanes lateritius lateritius	—	R	—	—	—	900
Conophis vittatus vittatus	M	—	—	—	—	800–1100
Conopsis biserialis	—	—	—	A	A	1550–2800
Conopsis nasus	—	—	—	M	R	1900–2450
Diadophis dugesi	—	—	—	R	—	1900–2200
Dryadophis melanolomus stuarti	—	M	—	—	—	0–50
Drymarchon corais rubidus	M	M	R	R	—	0–1350
Drymobius margaritiferus fistulosus	A	M	—	—	—	0–1150
Elaphe triaspis intermedius	M	—	R	—	—	350–1350
Enulius unicolor	—	M	—	—	—	900–1800
Geagras redimitus	—	R	—	—	—	10
Geatractus tecpanensis	?	—	—	—	—	?
Geophis dugesi	—	—	—	R	—	1750–2050
Geophis incomptus	—	—	—	M	—	2100
Geophis maculiferus	—	—	—	R	—	1630
Geophis nigrocinctus	—	—	—	R	—	2100
Geophis petersi	—	—	—	M	—	950–2350
Geophis tarascae	—	—	—	R	—	1630
Hypsiglena torquata ochrorhyncha	—	—	R	—	—	2300
Hypsiglena torquata torquata	R	—	—	—	—	200–350
Imantodes gemmistratus gracillimus	—	R	—	—	—	10
Imantodes gemmistratus latistratus	R	—	—	—	—	1050
Lampropeltis doliata	M	R	R	R	—	0–1900
Lampropeltis ruthveni	—	—	R	—	—	1900–2200
Leptodeira latifasciata	M	—	—	—	—	335–1050
Leptodeira maculata	A	M	—	—	—	0–1000
Leptodeira septentrionalis polysticta	—	?	—	—	—	?
Leptodeira splendida bressoni	R	M	—	R	—	950–1650
Leptophis diplotropis	—	M	—	R	—	850–1700
Manolepis putnami	—	M	—	—	—	20–120
Masticophis striolatus striolatus	M	—	R	—	—	0–1650
Masticophis taeniatus australis	—	—	R	—	—	1570–2000
Oxybelis aeneus auratus	—	A	—	M	—	0–1700

TABLE 2.—ECOLOGICAL AND ALTITUDINAL DISTRIBUTION OF AMPHIBIANS AND REPTILES IN MICHOACÁN.—*Concluded*

SPECIES	Arid tropical scrub forest	Tropical semi-deciduous forest	Mesquite-grassland	Pine-oak forest	Fir forest	Altitudinal range in meters
Pituophis deppei deppei	—	—	M	—	—	1900–2200
Pituophis lineaticollis lineaticollis	—	—	R	M	—	1500–2300
Pseudoficimia frontalis	M	—	—	—	—	330–1050
Pseudoficimia pulcherrima	R	—	—	—	—	330
Rhadinaea hesperia hesperia	R	M	R	—	—	850–1500
Rhadinaea laureata	—	—	—	A	—	1800–2300
Rhadinaea taeniata	—	—	—	R	—	1850
Salvadora bairdi	—	—	A	M	—	1550–2500
Salvadora mexicana	A	—	—	—	—	0–1000
Sibon nebulatus	—	R	—	—	—	150
Sonora michoacanensis michoacanensis	M	—	—	—	—	330–1000
Tantilla bocourti	—	—	—	M	R	2000–2200
Tantilla calamarina	R	—	—	—	—	20–330
Toluca lineata lineata	—	—	—	A	M	1550–2800
Trimorphodon biscutatus biscutatus	A	—	—	—	—	20–1050
Trimorphodon latifascia	M	—	—	—	—	300–1430
Trimorphodon tau	—	—	R	—	—	1600–2000
Tropidodipsas occidentalis	—	R	—	—	—	950
Natrix valida isabelleae	M	—	—	—	—	0–10
Storeria storerioides	—	—	—	M	R	1550–2800
Thamnophis dorsalis cyclides	—	—	M	A	R	1550–2800
Thamnophis dorsalis postremus	A	R	—	—	—	200–1550
Thamnophis eques eques	—	—	A	M	—	1550–2300
Thamnophis melanogaster canescens	—	—	M	—	—	1550–2200
Thamnophis scalaris scaliger	—	—	—	R	R	1800–3400
Micrurus distans michoacanensis	M	—	—	—	—	350
Micrurus laticollaris	R	—	—	—	—	500–1050
Agkistrodon bilineatus bilineatus	M	—	—	—	—	300–1500
Crotalus basiliscus basiliscus	M	—	—	—	—	20–1070
Crotalus durissus culminatus	M	—	—	—	—	1050
Crotalus intermedius intermedius	—	—	—	R	—	2200
Crotalus molossus nigrescens	—	—	—	M	—	1550–2300
Crotalus polystictus	—	—	R	—	—	1450–2400
Crotalus pusillus	—	—	—	A	—	1550–2300
Crotalus triseriatus aquilus	—	—	M	M	—	1600–2000
Crotalus triseriatus triseriatus	—	—	—	A	—	1600–3270

In the same habitat on the Pacific coastal plain the following species are characteristic:

Bufo marinus
Bufo marmoreus
Leptodactylus melanonotus
Hyla baudini
Hyla smithi
Anolis nebulosus
Basiliscus vittatus
Ctenosaura pectinata
Sceloporus horridus
Sceloporus pyrocephalus
Sceloporus siniferus
Leptodeira maculata

Characteristically the species inhabiting the arid tropical scrub forest are adapted for life in open, subhumid conditions. Diurnal species usually are fast and agile, such as *Drymobius margaritiferus, Masticophis striolatus, Salvadora mexicana, Basiliscus vittatus, Sceloporus siniferus,* and the various species

Pseudoeurycea belli
Scaphiopus hammondi
Microbatrachylus hobartsmithi
Tomodactylus angustidigitorum
Tomodactylus rufescens
Hyla bistincta
Sceloporus grammicus
Eumeces dugesi
Gerrhonotus imbricatus
Conopsis biserialis
Toluca lineata
Storeria storerioides
Crotalus molossus
Crotalus pusillus

Also included in this group are species inhabiting the Mexican Plateau, which in Michoacán descends to an elevation of about 1500 meters. Plateau inhabitants reaching the lower limits of their distributions at this elevation include:

Bufo compactilis
Hypopachus oxyrrhinus
Rana megapoda
Rana montezumae
Kinosternon hirtipes
Sceloporus spinosus
Cnemidophorus scalaris
Masticophis taeniatus
Trimorphodon tau
Thamnophis melanogaster
Crotalus polystictus

A small group of species reach the lower limits of their distributions at about 1900 meters; most of these are species that inhabit the cool montane forests, such as *Ambystoma tigrinum, Tomodactylus fuscus, Sceloporus bulleri, Conopsis nasus, Diadophis dugesi,* and *Tantilla bocourti.*

Pseudoeurycea robertsi, which insofar as is known is restricted to the fir forest, reaches its lower limits at 2900 meters. All other species in the state occur at lower elevations.

The upper limits of distribution of nine species are at about 100 meters; these species are restricted to the coastal plain and include:

Rhinophrynus dorsalis
Phrynohyas inflata
Crocodylus acutus
Anolis schmidti
Dryadophis melanolomus
Geagras redimitus
Manolepis putnami
Natrix valida

The small group of species having their upper altitudinal limits between 300 and 500 meters are mostly those inhabiting only the lower parts of the Balsas-Tepalcatepec Basin and include:

Diaglena reticulata
Phyllodactylus duellmani
Enyaliosaurus clarki
Pseudoficimia pulcherrima
Tantilla calamaria
Micrurus distans

The upper limits of altitudinal distribution for the greatest number of species (35) is between 900 and 1100 meters, where the arid tropical scrub forest of lower elevations is replaced at higher elevations by pine-oak forest. Typical of the species that characteristically inhabit the lowlands and reach the upper limits of distribution at this altitude are:

Bufo marinus
Leptodactylus melanonotus
Phyllomedusa dacnicolor
Hyla smithi
Phyllodactylus lanei
Ctenosaura pectinata
Sceloporus pyrocephalus
Mabuya brachypoda
Ameiva undulata
Cnemidophorus communis
Cnemidophorus deppei
Heloderma horridum
Boa constrictor
Drymobius margaritiferus
Leptodeira maculata
Salvadora mexicana
Trimorphodon biscutatus

Ten species reach the upper limits of their distributions at about 1600 meters; most of these species inhabit the lowlands and invade the lower parts

of the Mexican Plateau. Included in this group are *Tomodactylus nitidus, Hyla smaragdina, Hypopachus caprimimus, Urosaurus bicarinatus,* and *Masticophis striolatus.* Another group of species reaches the upper limits of their distributions at about 2200 meters. Most of these are inhabitants of the Mexican Plateau; included in this group are:

Ambystoma tigrinum
Hypopachus oxyrrhinus
Rana montezumae
Kinosternon hirtipes
Sceloporus dugesi
Sceloporus scalaris
Lampropeltis ruthveni
Pituophis deppei
Trimorphodon tau
Thamnophis eques
Thamnophis melanogaster

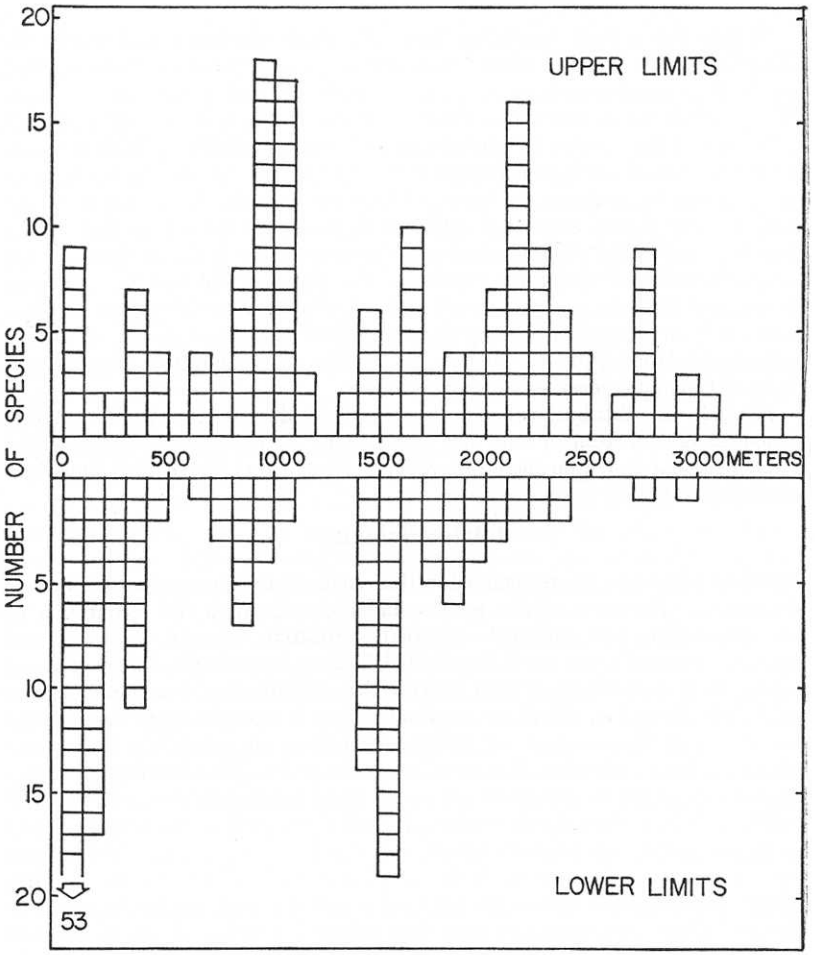

FIG. 4. Numbers of species of amphibians and reptiles reaching their upper and lower altitudinal limits at various elevations in Michoacán.

Eleutherodactylus calcitrans
Eleutherodactylus saltator
Tomodactylus albolabris
Tomodactylus dilatus
Hyla arboricola
Hyla melanomma
Rana sierramadrensis
Anolis liogaster
Anolis microlepidotus
Anolis omiltemanus
Phrynosoma taurus
Chersodromus annulatus
Geophis omiltemanus
Rhadinaea aemula
Rhadinaea omiltemana
Tantilla coronadoi
Tropidodipsas guerreroensis
Micrurus browni
Bothrops barbouri

Desert and Plains Herpetofauna

The central table-land or Mexican Plateau grades into the Chihuahuan Desert at elevations of about 1200 meters. Southward the plateau gradually rises to elevations of about 1900 meters in Michoacán and México. The western part of the Mexican Plateau is bordered on the south by the high mountains of the Cordillera Volcánica, but in the east the plateau continues past such formidable peaks as Popocatépetl and Ixtaccíhuatl and forms a broad plain at elevations from 1800 to 2000 meters in southern Puebla. The continuous high ridges of the Sierra Madre Oriental effectively eliminate faunal interchange between the Atlantic lowlands and the Mexican Plateau. In western México the mountains are not continuous; low passes and gradual slopes from the plateau to the lowlands allow faunal interchange between the lowlands of the Pacific coast and the Balsas Basin with the Mexican Plateau. The most conspicuous areas of faunal interchange are:

1. Western Jalisco, where the Sierra Madre Occidental is represented only by isolated volcanoes rising from the western edge of the plateau, which gradually diminishes in elevation to the coastal lowlands.
2. Upper Tepalcatepec Valley, where streams drain from the edge of the plateau south of Lago de Chapala into the lowland interior basin.
3. Tuxpan Valley in eastern Michoacán, where the Río Tuxpan drains southward into the Balsas Basin.
4. Upper Balsas Basin, where the lowland basin gradually merges with the plateau in southern Puebla.

Of the 45 species of amphibians and reptiles known to occur on the Mexican Plateau in Michoacán, 18 (40 per cent) are wide-ranging members of the Desert and Plains Herpetofauna; these species are:

Ambystoma tigrinum
Scaphiopus hammondi
Bufo compactilis
Hyla eximia
Rana pipiens
Kinosternon hirtipes
Sceloporus dugesi
Sceloporus spinosus
Cnemidophorus scalaris
Hypsiglena torquata
Lampropeltis doliata
Masticophis taeniatus
Pituophis deppei
Salvadora bairdi
Trimorphodon tau
Thamnophis dorsalis
Thamnophis eques
Thamnophis melanogaster

The ranges of twelve of the above species extend northward into the United States, and the ranges of three (*Ambystoma tigrinum, Rana pipiens,* and *Lampropeltis doliata*) extend to northeastern United States. Six of the species listed above (*Bufo compactilis, Cnemidophorus scalaris, Hypsiglena torquata, Masticophis taeniatus, Thamnophis eques,* and *Thamnophis melanogaster*) reach the southern limits of their distributions on the plateau in Michoacán.

Seven species (16 per cent of the fauna) are members of the Desert and

Plains Herpetofauna, but are endemic to the southern part of the plateau; these are:

Ambystoma dumerili	*Rana megapoda*
Tomodactylus angustidigitorum	*Rana montezumae*
Rana dunni	*Geophis dugesi*

Lampropeltis ruthveni

Ambystoma dumerili and the three species of *Rana* are restricted to lakes on the southern part of the plateau. *Rana montezumae* is the most widespread of these species, but in Lago de Pátzcuaro it apparently is replaced by *Rana dunni*. In Lago de Chapala *R. montezumae* and *R. megapoda* exist together to the apparent exclusion of *R. dunni*.

Pituophis lineaticollis and *Crotalus polystictus*, comprising four per cent of species on the plateau, range southward in the mountains and on the plateau; they reach the northern limits of their distributions in Michoacán.

Twelve (27 per cent) of the species occurring on the plateau are properly members of the lowland fauna, but these species have invaded the plateau, where in some places they are a conspicuous part of the herpetofauna. They are:

Leptodactylus occidentalis	*Anolis nebulosus*
Tomodactylus nitidus	*Urosaurus bicarinatus*
Hyla smaragdina	*Cnemidophorus costatus*
Hypopachus caprimimus	*Drymarchon corais*
Hypopachus oxyrrhinus	*Elaphe triaspis*
Kinosternon integrum	*Masticophis striolatus*

On the basis of their over-all distributions it is possible to ascertain where all but one of these species gain access to the plateau. *Leptodactylus occidentalis* and *Hypopachus oxyrrhinus* reach the southern limits of their distributions on the plateau in Michoacán; otherwise, they are found to the north at lower elevations. Apparently they reached the plateau via the Jalisco route. *Hyla smaragdina, Drymarchon corais, Elaphe triaspis,* and *Masticophis striolatus* are found on the southern part of the plateau in the area south of Lago de Chapala; evidently these species reached the plateau *via* the Tepalcatepec route. *Hypopachus caprimimus* occurs on the plateau only in the Tuxpan Valley, which it doubtless reached by way of the Río Tuxpan from the Balsas Basin, where the species is widespread. *Tomodactylus nitidus, Anolis nebulosus,* and *Urosaurus bicarinatus* occur on the plateau in the Chapala area and in the Tuxpan Valley, which they probably reach *via* the Tepalcatepec and Tuxpan routes, respectively. *Cnemidophorus costatus* apparently evolved in the Balsas Basin, from whence it dispersed *via* the Tepalcatepec route onto the plateau and thence northward to lower elevations via the Jalisco route. *Kinosternon integrum* is found in many areas on the plateau and could have gained access to the plateau by any one, or all, of the routes.

Six species (13 per cent) occurring on the plateau are more or less widely distributed in mountains bordering, or rising from, the plateau. Apparently, due to their wide ranges of tolerance, these species are able to descend onto the plateau:

Bufo occidentalis	*Sceloporus scalaris*
Eleutherodactylus occidentalis	*Sceloporus torquatus*
Hyla arenicolor	*Crotalus triseriatus*

entered the Sierra de Coalcomán from the Sierra Madre Occidental *via* the Ahuijullo depression. Probably *Sceloporus heterolepis* and *Sceloporus bulleri* arrived there from the Sierra Madre Occidental. Environments were not sufficiently depressed to permit the interchange of inhabitants of coniferous forest between the Sierra Madre del Sur and the Sierra de Coalcomán. Evidently a continuity of tropical semi-deciduous forest existed between the two ranges, for some species, such as *Microbatrachylus pygmaeus* and *Anolis dunni,* apparently entered the Sierra de Coalcomán from the Sierra Madre del Sur. The absence of such fir forest inhabitants as *Hyla lafrentzi, Sceloporus aeneus, Eumeces copei, Eumeces indubitus, Conopsis biserialis, Conopsis nasus, Tantilla bocourti,* and *Toluca lineata* in the Sierra de Coalcomán suggests that the depression of environments at the time of the Glacial Maximum was insufficient to allow the development of forests of cool pine and fir in the Ahuijullo depression and therefore did not provide a suitable environment for the dispersal of these species into the Sierra de Coalcomán.

Probably at the time of lowered vegetation zones a coniferous forest was continuous from the Sierra Madre Occidental throughout the Cordillera Volcánica to the Sierra Madre Oriental. The presence in all three ranges of such montane species as *Pseudoeurycea belli, Bufo occidentalis, Eleutherodactylus augusti, Sceloporus scalaris, Gerrhonotus imbricatus,* and *Toluca lineata* supports this hypothesis. However, climatic fluctuation served to separate and restrict the coniferous forests in these ranges, resulting in restricted distributions of certain species. For example, a major center of differentiation in salamanders of the genera *Chiropterotriton* and *Pseudoeurycea* seems to have been in the highlands of eastern México; no *Chiropterotriton* and only two species of *Pseudoeurycea* invaded the mountains to the west of the Valley of México. Contrariwise, none of the several species of *Tomodactylus* that apparently differentiated in the southwestern highlands reached the Sierra Madre Oriental.

Little, if any, interchange in the highland species seems to have taken place directly between the Cordillera Volcánica and the Sierra Madre del Sur. The latter has a herpetofauna composed of species either endemic to the area or distributed southward in the highlands of Oaxaca and in the Sierra Madre Oriental.

The herpetofauna of the southern part of the Mexican Plateau is composed primarily of wide-ranging components of the Desert and Plains Herpetofauna, and secondarily of species derived from the former. Except for a few species that apparently are recent invaders from the lowlands, the majority of species inhabiting the plateau probably arrived there from the north. The presence of the relictual populations of *Ambystoma dumerili, Rana dunni, Rana megapoda, Rana montezumae, Kinosternon hirtipes,* and *Thamnophis melanogaster,* all characteristic of aquatic and riparian habitats, indicates that mesic and pluvial conditions must have been more prevalent in postglacial times than at present.

Speciation in Southwestern México

Approximately 55 species of amphibians and reptiles are endemic to southwestern México. Of these, 13 are in the Balsas-Tepalcatepec Basin, five on the southern part of the Mexican Plateau, and 37 in the various mountain ranges. Available information concerning the phylogenies of the various

species, Pleistocene biogeography, and the known dispersal routes, provide clues as to the geographical and ecological factors that contributed to the isolation of populations that have subsequently differentiated. The following discussion pertains to the distributional phenomena involved in speciation in southwestern Mexico and is based on the premise that many species had similar geographic histories.

Of the 13 species endemic to the Balsas-Tepalcatepec Basin, seven (*Bufo perplexus, Hypopachus caprimimus, Bipes canaliculatus, Phyllodactylus duellmani, Phyllodactylus paucituberculatus, Urosaurus gadowi,* and *Leptotyphlops bressoni*) are inland vicariants of coastal species that do not inhabit the basin. Three other species apparently differentiated in the basin from coastal populations that reinvaded the basin after the inland populations had differentiated; the inland species and their respective parental species are *Sceloporus gadowae* and *S. pyrocephalus, Leptotyphlops gadowi* and *L. phenops,* and *Pseudoficimia pulcherrima* and *P. frontalis. Cnemidophorus calidipes* apparently differentiated in the Tepalcatepec Valley from a stock that also gave rise to *Cnemidophorus parvisocius* in the upper Balsas Basin. The two remaining endemics are relicts. *Enyaliosaurus clarki* is widely separated from its closest relative, *E. defensor* in the Yucatan Peninsula, although an apparently more distantly related species, *E. quinquecarinatus,* occurs on the Plains of Tehuantepec. Likewise, *Eumeces altamirani* is widely separated from its only Middle American relative, *E. schwartzei,* which is restricted to the Yucatan Peninsula. The present distributions and geographical histories of these two species cannot be explained, but the other endemics in the Balsas-Tepalcatepec Basin seemingly differentiated there from stocks of coastal species that invaded the basin. Possibly those endemics that occur sympatrically in the basin with their ancestral species became isolated there at an earlier time than were those species whose coastal relatives do not occur in the basin. Subspecific, as opposed to specific differentiation in the basin from coastal populations has occurred in three species of *Cnemidophorus—costatus, deppei,* and *lineatissimus.*

Of the five species endemic to the southern part of the Mexican Plateau, four are restricted to the aquatic and riparian habitats. *Ambystoma dumerili* apparently is a relict. *Rana dunni, R. megapoda,* and *R. montezumae,* all members of the widespread *R. pipiens* complex, are closely related, and their ranges are partly sympatric. Apparently they differentiated through isolation in different drainage basins on the southern part of the plateau. The information on each of these species suggests that formerly pluvial conditions were much more widespread than at present. *Lampropeltis ruthveni,* a member of the widespread *Lampropeltis doliata* group, apparently differentiated through isolation from an earlier *L. doliata* stock. At present *L. ruthveni* and *L. doliata* are sympatric on the southern part of the Mexican Plateau.

The vertical shifts in climate and vegetation in the high mountains of southwestern México in Pleistocene and postglacial times have resulted in migrations and isolation of many populations of various animal stocks. Often this isolation and subsequent differentiation have resulted in the formation of species pairs on isolated mountain ranges. For example, in the Sierra de Coalcomán *Geophis incomptus* and *G. nigrocinctus* are members of different species pairs that in the Sierra de los Tarascos are represented by *G. maculiferus* and *G. tarascae,* respectively. The *Tomodactylus angustidigitorum* group is represented by *T. angustidigitorum* in the Sierra de los Tarascos, *T. fuscus* in the Sierra de Temazcaltepec, and *T. grandis* in the Sierra Ajusco, whereas the *T. dilatus*