# VARIATION IN AND DISTRIBUTION OF LIZARDS OF WESTERN MEXICO RELATED TO *CNEMIDOPHORUS SACKI*

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# INTRODUCTION

THE DISTRIBUTION AND VARIATION of no species or subspecies of the *Cnemidophorus sexlineatus* species group that occurs in Mexico have been adequately known. This circumstance is the result of the confusing nature of variation in *Cnemidophorus* and the methods used in the study of the genus. I have focused my attention principally on lizards of the coastal region of western Mexico from southern Sonora to Colima. The application of political boundaries as limits to a study of geographic variation has disadvantages, but I believe circumstances justify the limits adopted here. On five occasions, in 1950, 1953, 1954, 1956, and 1957, I carried on field work in the region outlined, excepting the southernmost part, and have thus been able to see alive and in their natural habitat most of the forms with which I deal. The study of living animals or freshly killed specimens adds the important dimension of color in life to the characters of preserved museum specimens more commonly used. My field experience with *Cnemidophorus* in Mexico outside the region considered here is much less complete; hence my desire to restrict the area of study. Also, the notable lack of success of previous investigators who dealt with all or a large part of the genus *Cnemidophorus* inspires caution.

The region selected is not a purely political one, but is in part outlined by natural features with which the geographic distributions of the various forms coincide. On the west, the Pacific Ocean and Gulf of California form an obvious limit. On the east, the high reaches of the Sierra Madre Occidentál stand as a barrier between plateau and coastal populations throughout much of the length of the region studied. On the north, there is no obvious topographic barrier, but many southern species apparently find their northernmost distributional limits on the Pacific coast in extreme southern Sonora and adjacent Chihuahua, perhaps in response to an increasingly arid environment as the Sonoran Desert is approached. The boundary on the south, Colima, is not a natural one and is adopted for reasons of convenience. Of course it is not possible to confine a study such as the present one to a rigidly defined geographic area, but the most intensive attention has been paid to populations within the area defined, and populations of peripheral regions are considered only when they are pertinent to an understanding of the principal problems.

## ACKNOWLEDGMENTS

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I wish to thank my wife, Frances W. Zweifel, for her careful drawing of figures 3 and 4, and Mr. Charles M. Bogert for his critical reading of the manuscript.

Each specimen examined is cited by museum number (or the number of a private collection), to which the following abbreviations refer:

A.M.N.H., the American Museum of Natural History
A.R.P., field numbers of A. R. Phillips, specimens at the University of Arizona
C.H.L., field numbers of C. H. Lowe, Jr., specimens at the University of Arizona
C.N.H.M., Chicago Natural History Museum
C.P.S., College of Puget Sound
D.L.B., field numbers of David L. Braun, specimens at the University of Arizona

F.A.S., private collection of Fred A. Shannon
M.C.Z., Museum of Comparative Zoölogy at Harvard College
M.V.Z., Museum of Vertebrate Zoölogy, University of California
S.N.H.M., Stanford University Natural History Museum
T.H.L., field numbers of Thomas H. Lewis, specimens at College of Puget Sound
U.A., University of Arizona
U.C.L.A., University of California, Los Angeles
U.C.M., University of Colorado Museum
U.I.M.N.H., University of Illinois Museum of Natural History
U.K.M.N.H., University of Kansas Museum of Natural History
U.M.M.Z., University of Michigan Museum of Natural History
U.S.N.M., United States National Museum

## TYPE MATERIAL

The type specimens (holotypes) of new subspecies described in the present report have been designated in the standard fashion by museum catalogue number and locality. The treatment of paratypes has presented more of a problem. At the present time, the paratype has no legal standing in nomenclature. Some authors consider as paratypes all specimens of a given new form before the author at the time of the preparation of the original description. If this procedure were adopted here, some 400 specimens would be considered paratypes, and anyone who wishes to follow this system may identify his paratypes from the lists of specimens examined. I think that a more reasonable solution is to consider as paratypes only those individuals that are large enough to have developed the diagnostic color pattern of the subspecies, and to restrict further the selection to specimens that are in at least a reasonably good state of preservation; paratypes designated in the species accounts in this paper have been selected according to these criteria.

## SYNONYMIES

In the synonymies that open each species account, I have included all names that have come to my attention that have been applied to the species or subspecies in question. An attempt has been made to cite all papers of significance to the study of distribution and variation, but it is likely that some references may have been overlooked in the confusion of papers on *Cnemidophorus*.

## VARIABLES STUDIED AND THE NATURE OF VARIATION

### SCUTELLATION

From among the numerous variable features of scutellation, the few that seem of taxonomic significance have been selected for most intensive investigation. Other characters mentioned in this section are treated briefly or not at all in the species accounts.

CIRCUMORBITAL SEMICIRCLES: These are small scales that, when fully developed, form a ring separating the enlarged supraoculars from the median head scales. The relative development of this series of scales sometimes differs between species, or between races of the same species. Lowe and Zweifel (1952) were able to show that *Cnemidophorus neomexicanus* differed from the sympatric related forms *C. sacki exsanguis* and *C. inornatus* in having a more extensive row of circumorbitals. Similarly, *Cnemidophorus calidipes* is distinguished from its sympatric relative *C. communis* in the same manner (Duellman, 1955). An example of subspecific differentiation is seen in *Cnemidophorus deppei lineatissimus* and *C. d. duodecemlineatus*.[1]

Among the lizards studied for the present report, variation in the development of the circumorbital scales is relatively unimportant, with only one form being slightly set off from all others.

POSTANTEBRACHIAL SCALES: Some species of *Cnemidophorus* have the posterior surface of the forearm covered by granular scales, while in others (notably most species related to *C. sexlineatus*) there is present a patch of more or less enlarged scales. Though the difference between greatly enlarged and gran-

[1] *Cnemidophorus deppei duodecemlineatus* was described by Lewis (1956) as a subspecies of *C. guttatus*. Examination of numerous specimens from the type locality (San Blas, Nayarit) reveals that the population belongs with *deppei* rather than *guttatus*. Maximum size, ventral pigmentation, and especially dorsal scutellation (average of 124 scales around midbody in *duodecemlineatus*, 170 or more in *guttatus*) all ally *duodecemlineatus* with *deppei*. William E. Duellman is preparing a study that will provide a detailed comparison of the races of *deppei*.

ular scales is obvious upon comparison of individuals that exhibit the two extremes, objective description of scale size such as would facilitate comparison of individuals or samples among the forms studied here has not proved practicable. Individual variation and sexual dimorphism (males tend to have larger scales than females) have been noted by other investigators dealing with this character.

None of the forms studied here differs strikingly from the others in the relative size of the postantebrachial scales. One species (*C. communis*) appears to have relatively smaller scales, which are nevertheless still distinctly larger than the surrounding granular scales.

MESOPTYCHIAL SCALES: In lizards of the *sexlineatus* group, the granular scales of the gular fold are usually preceded by scales (the mesoptychials) that are markedly and abruptly larger than those within the fold. The forms treated in this paper conform to the usual condition in the *sexlineatus* group.

SCALES BEARING FEMORAL PORES: The number of scales bearing femoral pores frequently varies geographically, and adjacent populations of *Cnemidophorus* may differ in average numbers of pores, though the ranges of subspecies and species commonly overlap extensively. In this study I have used the total count of pores on both femora rather than the count from a single leg. The two legs of an individual lizard are often asymmetrical with respect to number of pores; occasionally one leg may have as many as three more pores than the other, without indication of any abnormality of scutellation.

Some species of lizards (including some species of the genus *Cnemidophorus*) exhibit sexual dimorphism in the number of femoral pores. However, I find no evidence that such is the case in the lizards studied here. If differences are present, they are sufficiently small to be masked by individual variation. For example, 14 male specimens of *C. sacki mazatlanensis* have an average of 38.1 pores, range 35–40; 10 females average 38.1, range 36–45. The lack of sexual dimorphism is advantageous in that it permits pooling of males, females, and juveniles to form larger local samples.

The pores of adult male lizards are larger than those of females and are usually made obvious by their exudate. The smaller pores of females are sufficiently distinct from those of the males to allow a rather accurate estimate of the sex of the lizard to be made merely on the basis of the appearance of the pores.

PREANAL SCALES: The size and number of preanal scales are known to show geographic variation in *Cnemidophorus deppei*, a species not closely related to species of the *sexlineatus* group, and in the related teiid genus *Ameiva*. I have not made an extensive search for geographic variation in the populations I have studied, but in a cursory examination I noted no obvious geographic trends.

The typical condition is this: immediately preceding the cloacal opening there are a pair of enlarged scales; anterior to these there is a single enlarged scale that, being located on the midline and not reaching to the outer borders of the posterior two scales, forms the second layer of a pyramid. Three to five successive layers of progressively smaller scales, one or sometimes two to a layer, follow anteriorly to complete the pyramidal effect. Not infrequently the two preanal scales of the first layer are fused; less commonly the scale of the second layer is divided on the midline; rarely a single large scale is found in place of the usual three scales of the first two layers.

DORSAL SCALES: Lizards of the genus *Cnemidophorus* have the dorsal surface of the body from neck to base of tail covered with fine, granular scales. The size of these scales is as a rule relatively constant within a species, and difference in the size of dorsal scales often serves as the surest means of distinguishing between species. The use of the size of dorsal scales as a taxonomic character is discussed on pages 69–70.

A convenient way of expressing the size of the scales is to count a standardized distance on the dorsum, such as a line from the occiput to the base of the tail, or a circumference about midbody (excluding enlarged ventrals). A method that has been favored by workers on some other genera, the counting of the number of scales contained within some standardized body segment, such as one head length or the length of a femur, is rejected here as being too prone to error introduced by ontogenetic changes in the relative size of the member chosen to provide the standard

length. In this work I have elected to use the count of scales around midbody as the basis for the comparison of populations. The count from occiput to rump would theoretically provide finer discrimination, as two to three times as many scales would be involved. Against the advantage of this finer measure of difference must be weighed the increased time and effort expended in making the longer count, and the increased potential for error in the counting of so many more tiny scales. The circumferential count was deemed entirely adequate for the present study, and the majority of data presented refer to this count. A few data on occiput to rump counts were included when available. All counts were made with the specimen seen through a binocular dissecting microscope. In instances in which an individual count seemed unusually high or low for the given sample, the count was checked, and rechecked if necessary. The granular nature of the scales makes for considerable difficulty in counting, and variation of 2 or 3 per cent, or even slightly more, is to be expected on successive counts of the same individual. Fortunately, when differences between populations do occur, they are apparently of such magnitude that counting error does not mask them. Also, the error seems as likely to be over as under the true number, so the average for a large sample should be unaffected.

The count of scales around midbody has been made on approximately 400 specimens of *Cnemidophorus* from within the geographic limits of the present study. For purpose of comparison, I have made counts on approximately 400 additional specimens of *Cnemidophorus* from regions outside the geographic area upon which I have concentrated. My conclusion is that the relative size of dorsal scales is the single most important variable when one is comparing species, and no characterization of a population of *Cnemidophorus* can be considered complete without a statement as to variation in this character.

## Color and Pattern

Dorsal Pattern: Lizards of the *sexlineatus* group have, as hatchlings, a dorsal body pattern of light stripes on a dark, usually immaculate background. The stripes vary in number from five to eight. The primary stripes are the laterals, dorsolaterals, and paravertebrals, the last being those that arise level with the parietal scales, not the median interparietal. In addition to these primary stripes, there may be a single vertebral or a pair of vertebrals, leading to the seven- or eight-lined condition. In five-lined individuals, the single vertebral line is formed by the fusion of the ordinarily paired paravertebrals.

In most, but not all, forms of the *sexlineatus* group, a metamorphosis of pattern takes place as the lizard grows, so that a large adult individual may appear totally different from the juvenile. Male lizards apparently have the potential of growing to a larger size than females, and with this greater size often undergo more complete pattern metamorphosis. Sexual maturity is commonly reached before pattern metamorphosis is complete or, in the case of females, before it has scarcely begun. Individual variation and geographical variation are additional important complicating factors. In spite of the difficulties imposed by individual variation, it is possible to utilize color pattern (especially that of the large male specimens) as a taxonomic tool, one that is most useful on the subspecific level.

An objective description of ontogenetic change in color pattern is difficult, but may be simplified by a division of the patterns encountered into classes. Pattern metamorphosis is, of course, a continuous process, so that the selection of classes, as well as the assignment of individuals to particular classes, is arbitrary. A commonly encountered form of change in pattern is one in which the juvenile lined pattern is partly or completely replaced by light spots on a dark background. For the description of lizards of this type, I have used the following classification:

Class I. Lines prominent on body, all fields dark, with no trace of spotting.

Class II. Lines still prominent, but light areas (incipient spots) developing in lateral and dorsolateral fields (pl. 43, figs. 1, 2).

Class III. Lines still prominent, but distinct light spots (not merely light areas) clearly recognizable in lateral and dorsolateral fields (pl. 43, fig. 3).

Class IV. Lines still distinct, but competing for prominence with the light spots, which

by now have appeared in much of the extent of the vertebral field (pl. 43, fig. 4).

Class V. Lines completely absent, or very indistinct on body (usually more persistent on neck), and subordinate to the pattern of spots (pl. 43, fig. 5).

The classification given above is applicable *in toto* to some of the forms studied, but only in part to others. In one form within the area studied, the light areas in the fields (Class II) are usually resolved into spots only on the posterior part of the body, while anteriorly they participate in the formation of vertical cross bars. In another form, metamorphosis evidently does not progress beyond Class III. Species (and possibly populations of the same species) that differ in maximum size attained may likewise differ in the body size at which a particular stage of pattern development is attained, though the ultimate pattern may be similar.

The greatest differences between populations are to be found among the individuals of largest size. As a rule, smaller individuals are much more abundant and more readily collected, so it should be made clear that even a large sample may be inadequate, if individuals of maximum size are not represented. The seasonal activity of large individuals is much more restricted than that of smaller lizards, and it is usually possible to secure adequate samples only during the warm months. Davis and Smith (1952, p. 97) have commented on the abundance of juveniles and the absences of adults of *C. sacki* and *C. gigas* during the winter months in Morelos and Guerrero, and their observations could be applied with similar force to western Mexico.

Spacing of Paravertebral Stripes: The relative spacing of the stripes arising level with the parietal scales has been used as a taxonomic character to segregate different populations of the *sexlineatus* group of *Cnemidophorus*.

One method of comparison that has been used relates the distance between the paravertebrals to the distance between dorsolateral and lateral stripes (Smith and Taylor, 1950b, p. 178, couplet 33). A somewhat more objective method of comparison, the number of scales separating the paravertebral stripes at midbody, was used by Lowe and Zweifel (1952).

It is apparent that the method of Lowe and Zweifel does not take into consideration another variable, the size of the scales. The counts of two or more populations are not directly comparable unless the numbers of scale rows around the body are highly similar in the populations. A way of circumventing this difficulty is to express the separation of the stripes in terms of the percentage of dorsal scales around midbody (excluding enlarged ventrals). Thus the separation is related to the circumference of the body and divorced from variation in the size of the scales. An example will serve to illustrate the point: In the region of Lake Chapala, Jalisco, *Cnemidophorus scalaris* has an average of 8.8 scales separating the paravertebral stripes; the population of *C. communis* at Colima City averages 14.0 scales for the same count. The difference appears to suggest a considerably closer spacing of the stripes in the Chapala population. However, if the ratio of scales separating paravertebral stripes to scales around midbody is calculated, it is seen that the stripe separation averages 10.1 per cent of scale rows in *communis* and 11.2 per cent in *scalaris*. The difference between the species is one of scutellation, not of pattern. The count of number of scales separating paravertebral stripes may still serve in some instances as a useful key character but has not been emphasized in the present work. The notation PV/SA is used on subsequent pages to identify the ratio of scale rows separating the paravertebral stripes at midbody to the number of scales counted around midbody, exclusive of enlarged ventrals. The separation of paravertebrals has been taken approximately at midbody in all instances, as variation in spacing along the length of the body is sometimes encountered.

Color of Chin: Young individuals of all forms studied agree in having a pale, immaculate chin that is white or very pale blue in life. The color and pattern of the chin of large adult specimens are, however, variable geographically, and serve as important taxonomic characters. Within the geographic area studied, there are four distinct types: (1) pale blue or white, immaculate; (2) pale blue or white, with irregular black spots or

splotches; (3) solid black; and (4) some shade of red or reddish brown, sometimes with a transverse grayish cast.

The four types are quite distinct in life and are usually readily distinguishable in preserved specimens. The slight grayish cast of the individuals in the fourth category is intensified in preservative, and in specimens that have been badly darkened by formalin there may develop a superficial similarity to the black-spotted type of chin. Problems of sexual dimorphism and size at which adult chin color develops are taken up in the individual species accounts.

COLOR OF CHEST AND ABDOMEN: In all forms reported upon here, large individuals may develop a deep, blue-black color over all or much of the chest and abdomen. The situation with respect to variation is at present most confusing. In some instances sexual dimorphism may be operative, but this apparent dimorphism may merely be the result of inadequate numbers of large female specimens; some large females do show a dark venter. Seasonal variation is possible, but a series of specimens captured at one time may show all degrees of darkening in animals of large adult size. Also, captive lizards have maintained the dark coloring through several seasons. Very possibly geographical variation is involved. The ability to produce dark-ventered individuals may be characteristic of certain species or subspecies, but more data (preferably from field studies extending over several seasons) will be needed before the significance of ventral color can be properly evaluated. What data I have accumulated on the several species and subspecies are included in the species accounts.

## SIZE

Species of *Cnemidophorus*, and probably also subspecies of a given species, may differ from one another in the maximum size attained. Though it is perfectly evident that differences do exist, size is a difficult character to use. Collections are often biased towards the smaller and more easily obtained individuals, and at some times of the year in western Mexico juveniles and subadults may be collected in quantity and adults never seen. Even collections made at a favorable time of the year may lack large adults, owing to the relatively low percentage of these in some populations. I indicate in the species accounts what I have been able to determine with regard to maximum size, expressed as length from snout to vent. The reliability of the data from form to form is to a large extent correlated with the number of specimens available, although in cases in which the material studied is weighted in favor of juveniles, this fact is mentioned.

# CLASSIFICATION OF *CNEMIDOPHORUS* OF THE *SEXLINEATUS* GROUP IN WESTERN MEXICO

BURT, IN HIS MONOGRAPH of the genus *Cnemidophorus* (1931a), referred all Mexican *Cnemidophorus* of the *sexlineatus* group, except *C. labialis* of Baja California, to two subspecies: *C. sexlineatus perplexus* of the northwestern desert regions, and *C. sexlineatus gularis* occupying the remaining part of the country. In a paper published subsequent to the monograph, but in the same year, Burt (1931b) proposed that the name *Cnemidophorus sexlineatus sacki* replace *C. s. gularis* by reason of priority. Taylor ("1936" [1938b], pp. 520–521) showed that where *sexlineatus* of eastern North America meets *gularis* in Texas and Oklahoma, there is no intergradation. Hence the name *sexlineatus* was reserved for the only *Cnemidophorus* of the eastern United States, and the name *C. sacki* was applied by Taylor to Mexican lizards. Smith (1949) presented evidence for the restriction of the type locality of *C. sacki* to Cuernavaca, Morelos. Smith and Taylor (1950b) recognized 10 subspecies of *C. sacki* occurring in Mexico, in addition to the related species *C. inornatus*, *C. burti*, *C. gadovi*, and *C. labialis*. One of these, *C. gadovi*, proved to be a synonym of *C. tigris aethiops* (Zweifel, 1956). Lowe (1956) demonstrated that one of the supposed subspecies of *sacki*, *C. s. stictogrammus* is, where it occurs in southern Arizona, a composite of two species. One of these he recognized as *C. stictogrammus*, and the other he named *C. sacki exsanguis*. Both occur in northern Mexico. Duellman (1955) named a new species, *C. calidipes*, from Michoacán, and Peters (1954) revived the name *C. sacki copei* Gadow for some populations formerly referred to *C. s. communis*. Davis and Smith described *C. gigas* in 1952. The net result of this shuffling and naming is that within the confines of Mexico 16 forms of the *sexlineatus* group are currently recognized; 10 of them are treated as subspecies of *sacki*.

In view of this multiplicity of forms, so many of them considered to represent geographic variants of one species, it is somewhat disconcerting to find that intergradation has not been demonstrated to exist between the nominate subspecies, *C. s. sacki*, and any other form! Until a critical study is made of typical *sacki* (which inhabits the valley of the Río Balsas) and the related forms of surrounding regions, the use of the specific name *sacki* for populations other than that of the Río Balsas rests upon a reasonable but as yet unproved assumption that intergradation occurs.

It is certain that more than one species is represented among populations currently referred to as subspecies of *sacki*, and possibly three or more distinct species are involved. When studying such variable animals as *Cnemidophorus*, one is faced with the question of which characters are valid for distinguishing species. Even extreme differences in color and pattern between allopatric populations do not in themselves necessarily imply specific distinctness of the populations. This much is evident from the variation in adult color and pattern that obtains in lizards of southern Sonora, Sinaloa, and Nayarit, lizards that are so similar in size and all aspects of scutellation that they must be considered as belonging to one species. In a like vein, the occurrence of highly similar color and pattern in disjunct populations of *Cnemidophorus* need not be taken to imply conspecificity of these populations. It is virtually certain that the kaleidoscopic variation within the genus *Cnemidophorus* includes several examples of independent evolution of similar patterns.

It appears that the single character most frequently reliable for distinguishing species of the *sexlineatus* group is one of scutellation, namely, the relative size of the dorsal scales. This is conveniently expressed as the number of scales in a midbody circumference (excluding enlarged ventrals, see pp. 65–66). Earlier authors paid only sporadic attention to this character. Taylor ("1936" [1938a], p. 488) noted that "*Cnemidophorus perplexus*" of Sonora differed from the lizards of western Texas and southeastern New Mexico in the larger number of scale rows around the body, and presents data to verify his contention. Sackett (1941), in his description of *C. mota-*

*guae*, mentioned the high scale count of his new species, but he compared the new Guatemalan form only with specimens from southern New Mexico, so the value of the comparison is dubious. Lowe and Zweifel (1952) presented scale counts for three sympatric species of *Cnemidophorus* of the *sexlineatus* group in New Mexico and showed highly significant differences between one of the species and the other two. Two confused and sympatric species in southern Arizona were shown by Lowe (1956) to be distinct on the basis of scale counts (among other characters), and similarly in another paper (Lowe, 1955) he demonstrated the distinctness in scutellation of a species of northern Arizona from a more southerly species with which it had been confused.

Whenever, as in the case of the lizards studied by Lowe and Zweifel (*op. cit.*) and Lowe (1956), there are two or more distinct and well-separated modes in scale counts of lizards from the same area, there can be little question that sympatric species are involved. An example is seen in the lizards *Cnemidophorus gigas* and *C. sacki sacki*. These sympatric species of the Río Balsas region of Mexico were separated by Davis and Smith (1952) on the basis of differences in maximum size, dorsal pattern of adults, relative size of postantebrachial scales, the average number of femoral pores, and the average number of whorls of scales around the base of the tail. All these characters reflect real differences between the species, but involve either a subjective estimate of scale size (postantebrachials), characters of size, color, and pattern restricted to adult lizards, or average (not absolute) differences in scale counts. Had these authors investigated the dorsal body scales, they probably would have found differences of sufficient magnitude to segregate properly all specimens, young and old, for there appears to be no overlap in ranges between the moderate circumferential counts of *sacki* and the high counts of *gigas* (see p. 78). A similar situation may be present in Oaxaca, where a giant form (*C. sacki australis*) with high scale counts coëxists with a smaller form (*C. sacki bocourti*) with fewer scale rows. The situation here is complicated both by the presence of what appears to be an undescribed third species of the *sexlineatus* group, and by geographic variation in the other two forms. Pending additional study, I withhold further comment on these forms, except to mention the obviously close relationship of *gigas* and *australis*.

Throughout most of the region studied in the present work, the numbers of scales around midbody, with the means lying between 100 and 110, are remarkably close in the various populations. At the southern end of the region two divergent populations are encountered, one with a count averaging above 135, the other about 85. The geographic areas in which these three modes occur are, on the basis of present knowledge, largely allopatric. There is only one instance of overlap between populations that have low counts and those that have moderate counts, and no evidence of intergradation exists between the three types.

The simplest solution to the problem would be to recognize all populations in question as representing the species *sacki;* yet the distinctness of the three groups in scutellation leads me to suspect that true species are involved. If, as I propose, three species are recognized within the geographic region studied, the names *Cnemidophorus sacki*, *C. communis*, and *C. scalaris* may be used. Most of the present report deals with *C. sacki;* a smaller portion, with *C. communis*. The third species, *C. scalaris*, is largely peripheral to the region studied and is consequently of less interest in the present study.

## USE OF THE SPECIFIC NAME *SACKI*

The restricted type locality of *Cnemidophorus sacki sacki* is Cuernavaca, Morelos (Smith, 1949, p. 41). A sample of 24 specimens from Morelos, Guerrero, and México has an average of $98.3 \pm 1.2$ scales around midbody, range 91–113. *Cnemidophorus s. sacki* is similar in this and other important aspects to the populations studied in which the average of scales around midbody lies between 100 and 110.

In the absence of information regarding intergradation of typical *sacki* with populations around its periphery, it is reasonable to refer to the northern populations with similar scutellation as subspecies of *sacki*. I realize, of course, that the matter is not firmly settled.

SPECIFIC DIAGNOSIS OF *Cnemidophorus sacki*

The following diagnosis has reference to populations of *Cnemidophorus* that range from the basin of the Balsas River in south-central Mexico north along the Pacific coast to southern Sonora. Several forms occurring in other regions and currently recognized as subspecies of *sacki* do not conform to this diagnosis, and I feel that most or all of these will prove to represent species distinct from *sacki* when they are studied critically.

*Cnemidophorus sacki* is a species of moderate size. A length from snout to vent of over 100 mm. is regularly attained, and the upper limit for most populations seems to lie at about 115 mm. However, one subspecies (*C. s. occidentalis*) reaches 126 mm. The range in number of dorsal scales around midbody is from 91 to 121, and the average for the several subspecies treated in this paper is from 98.2 to 107.2. The postantebrachial scales are usually markedly enlarged.

Greater maximum size (to 135 mm. from snout to vent) and a greater number of scales around midbody (almost always more than 120, and ranging up to 175) serve to distinguish *Cnemidophorus communis* from *C. sacki*. The postantebrachial scales of *communis* appear to be relatively less enlarged than those of *sacki*, but I have not devised a way to demonstrate this objectively.

*Cnemidophorus scalaris* is a smaller species than *C. sacki*, and individuals rarely exceed 100 mm. in snout to vent length. Where the ranges of the two species overlap in southwestern Mexico, *scalaris* averages only about 86 scales around midbody and rarely attains the minimum number seen in *sacki*. The postantebrachial scales are abruptly enlarged, as in *sacki*.

In the diagnoses of the several subspecies of *Cnemidophorus sacki*, I have given the average number of scale rows at midbody. There are no significant differences in this character among the subspecies treated in this paper, but the averages help to distinguish these forms from others associated (erroneously, I suspect) with *C. sacki*.

## USE OF THE SPECIFIC NAME *COMMUNIS*

The name *Cnemidophorus communis* was proposed by Cope (1877, p. 95) for specimens from several localities, with no type specimen or type locality designated: Colima, Colima; Coban, Guatemala; Guadalajara, Jalisco; Córdoba, Veracruz; Guatemala [city?]; and San Antonio, Texas.

Smith and Taylor (1950a, p. 328) restricted the type locality of *communis* to Colima, Colima, and later (1950b, p. 181) these authors reiterated the restriction and applied the name (as *C. sacki communis*) to populations ranging through much of western and central Mexico. This restriction of the type locality was rejected by Peters (1954, pp. 18–19), who suggested an alternative restricted type locality, namely, Guadalajara, Jalisco. The reason for this action was to make available for a coastal population the name *Cnemidophorus communis copei* Gadow, 1906, which also had been restricted to Colima by Smith and Taylor (*op. cit.*). The subspecific name *communis* would then be applied to the population of the southern end of the Mexican Plateau, which would otherwise be without a name.

A digression with regard to *copei* is perhaps in order. The name was first used by Gadow (1906, p. 346) for specimens from Colima and Manzanillo in Colima, and San Domingo de Guzman, Oaxaca. Smith and Taylor (1950b, p. 182) considered the name a synonym of the catch-all *C. s. communis* and chose as lectotype a specimen from Colima in the British Museum. The failure of Gadow to designate single type specimens and type localities for his several new forms has been a source of confusion that will probably continue to plague herpetologists for years. His treatment of *copei* shows another peculiarity that will not endear him to systematists. He stated (1906, p. 350) that he referred to his specimens "as *C. communis copei*, since they seem to conform most completely with Cope's types." It is evident that this nomenclature is the equivalent of what a modern systematist would call *C. communis communis*. Such an equivalence can be even more clearly inferred when it is seen that the name *C. communis communis* does not appear in Gadow's work, though other trinomial combinations with *communis* were used.

However, the question at hand is the legality of the original restriction of the type lo-

cality of *communis* to Colima by Smith and Taylor, and the rejection of this restriction by Peters. In the absence of specific rulings by the International Commission with regard to the restriction of type localities, Dunn and Stuart (1951) did not consider restrictions such as those of Smith and Taylor to be binding. But the additions and modifications of the rules of nomenclature adopted by the 1953 Congress (Hemming, 1953, pp. 26–27) specify that the rule of priority shall apply, with certain exceptions, when two or more authors publish restrictions for the locality of a nominal species. Under strict interpretation of the rules, it seems that the restriction of Smith and Taylor must be held valid.

It may be questioned whether the mere listing of "*Cnemidophorus sacki communis* (by present restriction)" with reference to Colima as the type locality constitutes a revision (Smith and Taylor, 1950a, p. 328). In a subsequent paper (Smith and Taylor, 1950b, p. 182), a more complete treatment was made, and the restriction of type locality was reiterated. Peters (1954), in reviving the name *copei* (as *C. sacki copei*), did not diagnose *copei* or the newly restricted *C. sacki communis* and gave only the barest indication of the geographic distribution of the forms. Somewhat more complete diagnoses and statements of range were given by Duellman (1954, pp. 12–15).

It is my view that restriction of the type locality of *C. communis* Cope to Colima, Colima, proposed by Smith and Taylor (1950a and 1950b), is valid. The name *C. communis copei* Gadow is a synonym of *C. communis* Cope.

The cotypes of *Cnemidophorus communis* Cope were thought to have been lost (Burt, 1931a, p. 105; Smith and Taylor, 1950b, p. 182), but have recently been discovered in the United States National Museum by Dr. D. M. Cochran. Hence it is possible to designate a lectotype for the species, which should effectively settle the matter of the proper use of the name *communis*. This designation of a lectotype is done on page 74. There is evidence that the cotypes of *communis* supposedly from Guadalajara did not actually come from there (see p. 75), so Peter's restriction of *communis* to Guadalajara would also be invalidated on this basis.

### Specific Diagnosis of *Cnemidophorus communis*

This diagnosis is intended to distinguish *communis* from the species with which it might be confused within the geographic limits of the present study. Some supposed subspecies of *Cnemidophorus sacki* that occur south of this region conform to my diagnosis of *communis*, and probably will be shown to be subspecifically related to that form when subjected to careful appraisal (see p. 78).

*Cnemidophorus communis* is a large species that reaches a length from snout to vent of 135 mm. The number of scales around midbody is large, averaging from 133 to 155 in different populations. The total observed range is 118 to 175, but few individuals have fewer than 130. The postantebrachial scales are enlarged, but not so markedly so as in some other species.

Comparison with *C. sacki* is made in the diagnosis of that species in a previous paragraph. Much larger size and a greater number of scales around midbody distinguish *communis* from *C. scalaris*, which rarely exceeds 100 mm. in snout to vent length and does not attain the minimum number of 118 scales around midbody that characterizes *communis*.

## USE OF THE SPECIFIC NAME *SCALARIS*

With the restriction of both the names *copei* and *communis* to a single locality, Colima, there is the question of what name may properly be used for lizards of the southern part of the Mexican Plateau. Throughout the area from the northern and eastern edge of Lake Chapala and the vicinity of Guadalajara northward into New Mexico and western Texas, and eastward at least to Distrito Federal, relatively low scale counts persist, with the averages for scales around midbody all falling below 100. It is probable that the lizards of this region, currently referred to as subspecies of *sacki*, represent one or more species distinct from both *sacki* and *communis*. The study of this plateau group of lizards is beyond the scope of the present paper, but it is necessary that a name be available for purposes of discussion. I refer to the populations with relatively low scale counts that inhabit the southwestern portion of the Mexican Plateau, in particular the region of

Guadalajara and eastern Lake Chapala, simply as *Cnemidophorus scalaris* ssp. The name *Cnemidophorus gularis scalaris* Cope, 1892, with the type locality restricted to Chihuahua, Chihuahua (Smith and Taylor, 1950b, p. 182), seems to provide the available and proper specific name for this complex.

### Specific Diagnosis of *Cnemidophorus scalaris*

This is a moderately small species of the *sexlineatus* group that rarely exceeds 100 mm. in length from snout to vent. The average number of scales around midbody is always fewer than 100, and fewer than 90 in most populations. Among 146 specimens from Chihuahua, Durango, Aguascalientes, and Jalisco, the maximum counts are 100 and 101; each appears once in the series of specimens from Durango. The differences in maximum size and scutellation distinguish *scalaris* from *sacki* and *communis*, which exceed *scalaris* both in size (regularly reaching more than 100 mm. from snout to vent) and in number of scale rows (average about 100 in *sacki*, minimum 118 in *communis*). The postantebrachial scales of *scalaris* are markedly enlarged.

The foregoing diagnosis is concerned mainly with differentiation between *C. scalaris* on the one hand, and *C. sacki* and *C. communis* on the other. Whether *scalaris* is the proper specific name for the whiptail lizards of the southern end of the Mexican Plateau, or not, remains to be verified. The lizards of Jalisco and southern Aguascalientes, a distinct form for which no subspecific name is currently available, probably represent the same species as those inhabiting Durango and southern Chihuahua, to which the name *C. scalaris* is applicable. There is considerable similarity both in size and scutellation between these northern and southern lizards. If a link can be established between *scalaris* and the form currently known as *C. sacki gularis* living to the east, that earlier name (Baird and Girard, 1852) would have priority. There are, however, numerous complications to be ironed out before a settlement of the problem can be reached. For example, the specific status of *C. sacki exsanguis*, which ranges from Sonora and Arizona to west Texas, is as yet uncertain. In the collection of the University of Michigan Museum of Zoölogy, there are specimens of *C. s. gularis* (U.M.M.Z. No. 117512) and one of *C. s. exsanguis* (U.M.M.Z. No. 114270), both from 5½ miles south of Alpine, Brewster County, Texas, collected by Sherman A. Minton. And one need only go a few miles to the south to encounter still another distinct form, *C. sacki semifasciatus*. Differences in the number of scales around midbody distinguish *exsanguis* from the other two, which are similar to each other in scutellation but strikingly different in color and pattern. Whatever the specific status of these various forms is, I doubt that any of them is truly a subspecies of *C. sacki*.

## DIAGNOSTIC KEY TO SPECIES AND SUBSPECIES

The key below is designed to be applicable to populations of *Cnemidophorus* of the *sexlineatus* group in the region from southern Sonora to Colima, including the portions of Chihuahua, Durango, and Zacatecas that belong to the coastal rather than to the physiographic regions of the plateau.

The identification of subspecies is based on the color pattern of large adult individuals. The user of the key should not expect to carry an identification past the specific level without such specimens, unless he is willing to do so largely on the basis of geographical data. Color and pattern are not only variable among individuals of a single population, but often difficult to describe in the brief manner appropriate to a key. Even with samples restricted to large adult individuals, specimens will be encountered that do not key out properly. However, such specimens should be in the minority.

1. Paravertebral stripes (those that arise on a level with the parietal scales) fused or separated by no more than three or four scales; dark fields unmarked in subadults, with faint spots in large adult individuals; ventral surfaces never dark . . . . . *burti*[1]
   Paravertebral stripes not fused, always separated by four or more scales; other characters variable . . . . . 2
2. Scales around midbody (excluding enlarged ventrals) 120 or more . . . . *communis*, 3
   Scales around midbody (excluding enlarged ventrals) fewer than 120 . . . . . 4

[1] This species is not treated in the present paper.

3. Body, base of tail, and hind limbs dark, with numerous small light spots . . . . . *communis communis* (p. 74)
   Light spots present in rump region, but not anteriorly, where there are short dark and light cross bars in the fields . . . . . *communis mariarum* (p. 79)
4. Scales around midbody averaging 86, maximum 91 in specimens from Jalisco . . . . . *scalaris* ssp.[1]
   Scales around midbody averaging 100–110, minimum 91 . . . . . *sacki*, 5
5. Body dark, with an abundance of small, light spots over trunk, spots not restricted to the rump . . . . . 6
   Body not as described above, but with persistent stripes, or cross bars anteriorly and spots on rump. . . . . 8
6. Chin largely or entirely black . . . . . *sacki nigrigularis* (p. 93)
   Chin not as described above . . . . . 7
7. Chin pale blue in life, immaculate. . . . . *sacki griseocephalus* (p. 96)
   Chin pink to brick-red in life, often with a transverse grayish cast that is intensified in preservative . . . . . *sacki huico* (p. 85)
8. Light spots on the dark background of the rump giving way to short, dark cross bars on the anterior part of the body . . . . . *sacki occidentalis* (p. 81)
   Neither spots nor cross bars prominent in pattern, usually juvenile pattern of stripes at least partly retained in adults . . . . . 9
9. Chin pale, with black spots or splotches, rarely totally black, never red or pink . . . . . *sacki mazatlanensis* (p. 89)
   Chin pale and immaculate, or reddish, with a gray transverse wash . . . . . 10
10. Chin pale and immaculate . . . . . *sacki barrancorum* (p. 102)
    Chin pink to brick-red, a grayish cast sometimes intensified in preservative . . . . . *sacki occidentalis* (p. 81)

## ACCOUNTS OF SPECIES AND SUBSPECIES

### **Cnemidophorus communis communis** Cope

Plate 49, figure 2

*Cnemidophorus communis* COPE, 1877, p. 95 (part, specimens from Colima, Colima).

*Cnemidophorus sexlineatus* var. *gularis*, DUMÉRIL, BOCOURT, AND MOCQUARD, 1870–1909, p. 279 (part, specimens from Colima).

*Cnemidophorus sex-lineatus*, GÜNTHER, 1885–1902, p. 25 (part, specimens from Colima).

[1] See pages 72–73.

*Cnemidophorus gularis communis*, COPE, 1892, p. 46.

*Cnemidophorus communis copei* GADOW, 1906, pp. 346–352 (part, specimens from Colima and Manzanillo, Colima).

*Cnemidophorus sexlineatus gularis*, BURT, 1931a, p. 116 (part, specimens from the state of Colima only). OLIVER, 1937, p. 16.

*Cnemdiophorus sexlineatus sackii*, BURT, 1935, p. 176 (part, specimens from Tenacatita and Tenacatita Bay, Jalisco).

*Cnemidophorus sackii communis*, SMITH AND TAYLOR, 1950b, p. 182 (part).

*Cnemidophorus sacki copei*, PETERS, 1954, p. 18. DUELLMAN, 1954, p. 12.

TYPE: No type specimen or type locality was designated by Cope, who listed specimens from several localities. The recent discovery of the type series, which had been presumed lost (see p. 72 and below), permits the selection of a lectotype. I designate as lectotype of *Cnemidophorus communis* Cope U.S.N.M. No. 31542, collected at Colima, Colima, Mexico, by John Xantus, between March and October, 1863.

DESCRIPTION OF LECTOTYPE: The specimen (pl. 49, fig. 2) is an adult male, with a length from snout to vent of 130 mm. The tail is regenerated. There are 140 scales around midbody, and 44 femoral pores (23 left, 21 right). The postantebrachials are moderately enlarged. The striped pattern is distinct on the neck, but posterior to the shoulder region the stripes are broken into spots. The dorsal surface of the trunk, the base of the tail, and the upper surfaces of the hind legs are dark, with an abundance of small, light spots. The spots do not fuse into cross bars on the sides. The chin is pale and probably was reddish in life. The chest is pale, the abdominal region black.

COTYPES: Cope, in his original description of *C. communis*, segregated the species into two varieties. Specimens from Colima and Coban, Guatemala were assigned to variety I, and those from Guadalajara, Jalisco, Córdoba, Veracruz, Guatemala [city?], and San Antonio, Texas, were referred to as variety II. Among the specimens returned to the United States National Museum after the death of Cope were a number of specimens bearing paper labels with "Var. I" or "Var. II" inscribed thereon. The localities, collectors, and assignment to variety agree with

Cope's paper and leave no doubt that these are specimens that he used in formulating his description. Listed as "Var. I" were 92 specimens from Colima (U.S.N.M. Nos. 31506–31527, 31530–31562, 31604–31617). One of the Colima specimens (No. 31542) has been designated lectotype. Four lizards in the series from Colima are *Cnemidophorus deppei lineatissimus* rather than *C. communis* (Nos. 31535, 31540, 31545, 31561).

Specimens assigned by Cope to variety II include one from Córdoba, Veracruz (No. 30240), which I have not examined, and 20 supposedly from Guadalajara, Jalisco (Nos. 24941–24960). The last-mentioned specimens were collected by J. J. Major and sent to the United States National Museum from Guadalajara, as is verified by the original accession record that I have seen through the courtesy of Dr. Cochran. There is nothing in the records to indicate that Major did not collect the specimens at Guadalajara, but the specimens appear to be *C. communis* rather than either of the related forms known to occur in the vicinity of Guadalajara (*C. sacki occidentalis* or *C. scalaris* ssp.). The specimens are all quite small, the largest measuring 65 mm. from snout to vent, and are not very well preserved. Scale counts made on three of them show the large number of scales around midbody (more than 130) characteristic of *communis*. There seems to be a distinct possibility that Major collected these specimens at some distance from Guadalajara, possibly in Colima.

DIAGNOSIS: A subspecies of *Cnemidophorus communis* (see p. 72 for a specific diagnosis) that differs from the other currently recognized subspecies, *C. c. mariarum*, in that the juvenile striped dorsal pattern is replaced by one of small, distinct, light spots on a dark background. The pattern of large adult individuals of *mariarum* has the dark fields, especially on the anterior part of the trunk, fragmented into dark blotches or bars. Spotting is not developed over the entire trunk, as it is in *communis*, but is restricted to the hind legs and posterior part of the body.

## VARIATION

SIZE: The largest specimen that I have measured, U.S.N.M. No. 58758 from Colima, Colima, is a male 135 mm. in length from snout to vent. The cotype series of 88 specimens from Colima includes many large adult individuals, but though several of these are 130 mm. or more in length, none is so large as the individual cited above. The series of 53 specimens in the collection of the American Museum includes only one large adult (132 mm.); the remainder are juveniles or subadults.

SCUTELLATION: The number of scales around midbody varies over a rather wide range (118–175 in 55 specimens), but the range in any one population is not so great. Thirty-four specimens from the vicinity of the city of Colima average $137.8 \pm 1.3$ (118–154), and six specimens from near Alcuzahue average 133.0 (120–142). A sample from near Manzanillo shows a remarkably high average, $155.1 \pm 2.7$ (142–175, $N = 11$). Indications are that this high average is a local condition, rather than one typical of the coastal region as contrasted to more inland localities. The lizards from Alcuzahue, for example, have low counts, and three from Chamela Bay in Jalisco have fewer scales around midbody (140, 143, 144) than most specimens in the Manzanillo series.

Femoral pores vary in a fashion similar to that of the dorsal scales. The Colima sample, 34 specimens, averages $43.9 \pm 0.5$ (39–51), and the sample from Manzanillo, $47.5 \pm 1.1$ (42–53, $N = 11$). The six lizards from Alcuzahue average slightly closer to the Colima mean (45.5, range 41–49), and two of the three Chamela Bay specimens are most similar to those from Colima (44, 44, 50).

There seems to be in *C. c. communis* a tendency for the row of circumorbital scales to extend slightly farther anteriorly than is true of those of *C. sacki*. Among 52 specimens of *communis* from the state of Colima, 23 of these have the third supraocular completely separated from the median head scales; only eight of 131 *sacki* from northern Nayarit to Sonora have such an extensive row of scales. Duellman (1954, p. 13) noted a similar difference between specimens presumably of the same species from Colima and those from Michoacán.

VARIATION AND DEVELOPMENT OF COLOR PATTERN: The smallest specimens examined by me measure 52 mm. from snout to vent and show some light marking in the posterior

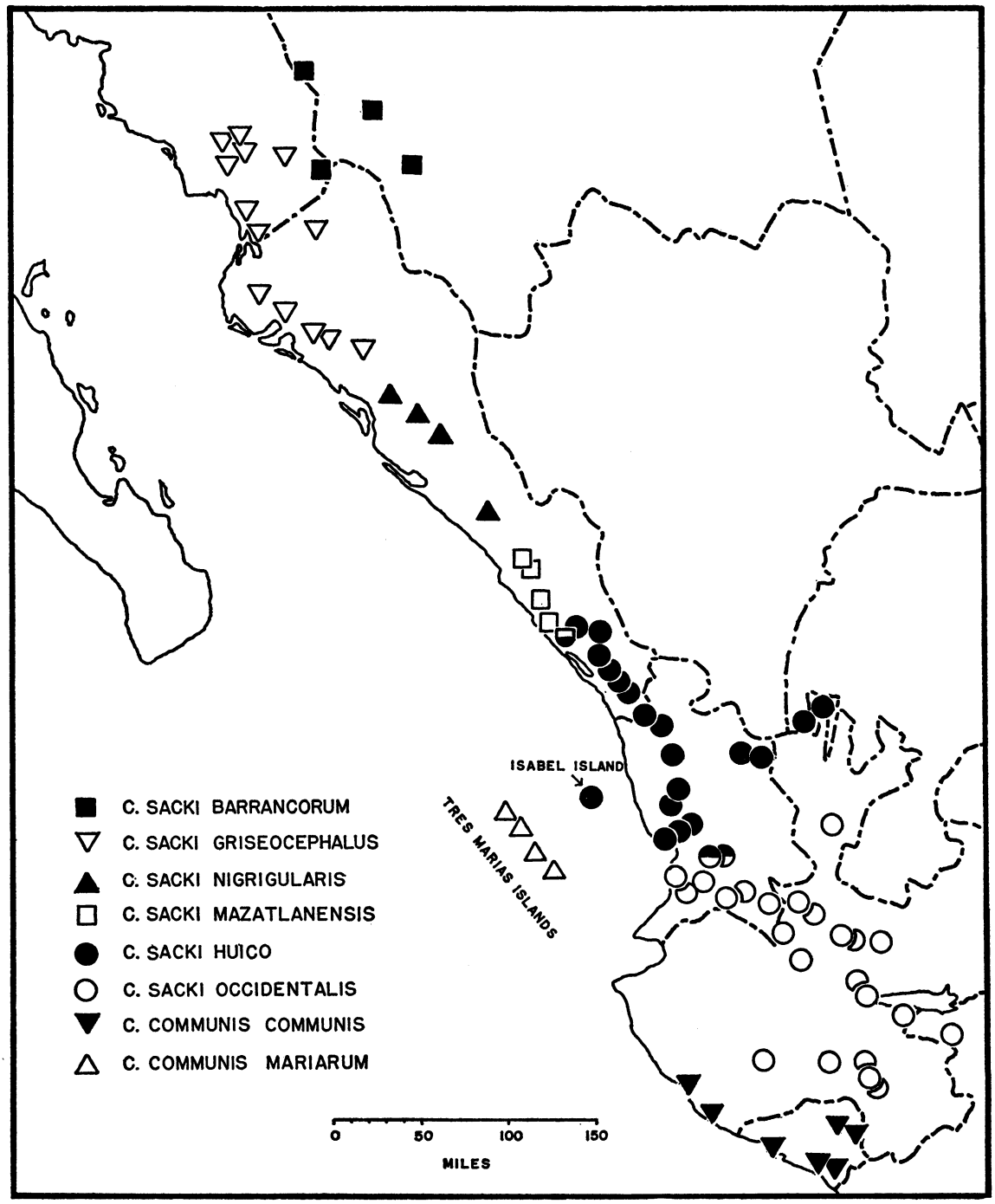


FIG. 1. Distribution of species and subspecies of *Cnemidophorus* in western Mexico. Mixed symbols indicate localities of intergradation.

parts of the dark fields. One individual from Colima measures 89 mm. and is liberally sprinkled from shoulder region to rump with small, distinct dots. The stripes are all still rather distinct, except for the paravertebrals which fade at midbody. Other individuals of similar size from the same locality are much less spotted and have more distinct striping. Large specimens (130 mm. or greater in length) are heavily spotted on the body, hind limbs, and base of tail, but retain the stripes in the neck and shoulder region. Determination of the average size at which spotting begins to predominate in the pattern will require study of more individuals than I have examined in the range from 80 mm. to maximum size.

A description of the color in life of lizards from Coalcomán, Michoacán, was given by Duellman (1954, pp. 13–14), and is quoted here as the population of *Cnemidophorus* in that region very probably represents *C. communis communis:* "(1) Snout–vent length 79 mm.; dorsal ground color dark brown, longitudinal body stripes vivid greenish yellow, belly pale blue. (2) Snout–vent length 101 mm.; dorsal ground color dark brown, dorsal longitudinal lines indistinct, faint spots present in place of stripes, lateral stripes broken into distinct yellow spots, no spots on limbs. (3) Snout–vent length 130 mm.; ground color of back greenish extending onto base of tail and dorsal surfaces of hind limbs, rest of dorsal surfaces brownish, six rows of distinct round yellow spots on back and sides, yellow spots on upper surfaces of hind limbs and yellow flecks on base of tail, throat pink, belly light blue anteriorly but much darker posteriorly, ventral surface of tail cream." Paul Ruthling (field notes on file in the American Museum) observed that the tail color of juvenile specimens from Colima and Alcuzahue was red.

The vertebral field of striped individuals is commonly occupied by a single pale band that varies in width and distinctness in different specimens. Sometimes two irregular stripes may be present. The paravertebral stripes are relatively close together in most specimens: the mean PV/SA ratio is 0.100 $\pm$0.003 (0.057–0.148) for 50 specimens from several localities in Colima. There appears to be no regional differentiation in this character, in contrast to what has been found in some features of scutellation.

### Comparison with Other Forms

The insular populations of *C. communis* on the Tres Marías Islands are worthy of subspecific recognition (as *C. c. mariarum*), though it would be desirable to know more of the variation exhibited by adult lizards from the islands in order better to diagnose the subspecies. Two large individuals of *mariarum* (snout to vent length, 114 and 120 mm.) resemble those described by Slevin (1926, p. 199) and Günther (1885–1902, p. 28, pl. 20) in having dark blotches or short cross bars in the anterior dorsal region. Light spots are few, and are restricted to the posterior part of the trunk and hind limbs, in contrast to the more general distribution of spots in *C. c. communis*. The spacing of the paravertebral stripes averages wider in *mariarum*, but possible inter-island variation may confuse the picture (see p. 80). Twenty specimens of *mariarum* (excluding those from San Juanito Island) have an average PV/SA ratio of 0.138 (0.103–0.173), significantly higher than the average of 0.100 calculated for mainland *communis*. No important differences in scutellation are seen between mainland and island lizards.

The area occupied by *C. communis communis* is bordered on the north by the range of *C. sacki occidentalis*. As far as is presently known, the two forms are allopatric. The average number of scales around midbody is quite different in the two species, and this count will serve to segregate properly almost all individuals. The lower limit of the range of variation of *communis*, 118 scales, is equal to the upper limit seen in *occidentalis*. Out of 117 specimens (55 *communis* and 62 *occidentalis*), only one individual of each species has 118 scales around midbody. The dorsal body pattern of large individuals of *communis*, spots dominating over most of the trunk, is quite different from that of most specimens of *occidentalis*, which are spotted posteriorly and barred anteriorly. The number of femoral pores averages significantly greater in *communis* than in *occidentalis*, but there is enough overlap to render this count of not much use as a key character. Probably *communis* reaches a greater maximum size than *occidentalis*,

though this character is difficult to evaluate. The largest specimens of the two forms examined by me measured, respectively, 135 and 126 mm. from snout to vent.

Inasmuch as geographical overlap has not yet been found between *communis* and *occidentalis*, the case for specific as opposed to subspecific relationship of the forms rests on inference rather than indisputable evidence. The average number of scales around midbody for specimens of *occidentalis* from southern Jalisco is slightly higher than that for the subspecies as a whole (109.5 as against 106.3), but the difference is rather slight, especially when compared to the average count of *communis* at Colima City (137.8). The same southern sample of *occidentalis* has a lower average number of femoral pores (38.5) than is seen in some more northern populations, so the evidence here is negative with respect to intergradation. The differences in scutellation and size between *occidentalis* and *communis* are of the same sort that distinguish the related sympatric species *C. s. sacki* and *C. gigas* in the Balsas Basin, which lends some support to the view that *occidentalis* and *communis* represent distinct species.

There are seven specimens from Apatzingán, Michoacán (U.S.N.M. Nos. 135967–135973), that may represent an instance of overlap between *sacki* and *communis*. Two of these (Nos. 135969 and 135971) have 125 and 126 scales around midbody, while the others range from 101 to 109. All are small specimens (maximum snout to vent length, 71 mm.), so the proper subspecific allocation based on color pattern of adults cannot be determined. The counts of 125 and 126 are somewhat low for *communis* as it occurs in Colima, but are much closer to that form than to *sacki*, with which the lower counts of the remaining specimens from Apatzingán agree very well.

I have not subjected *communis* of Colima to a detailed comparison with similar forms occurring to the southeast in Michoacán, Guerrero, and Morelos. The description of specimens from the coastal sierra of Michoacán given by Duellman (1954, p. 13) suggests that the form there is close to *C. c. communis*, but has fewer femoral pores on the average, a difference of little significance. However, as dorsal scale counts were not given, the specific identity is not yet firmly established. Duellman (1954, p. 14) suggested that "the range of *Cnemidophorus sacki copei* [= *C. c. communis*] extends from lowland areas in southeastern Colima southward and eastward at elevations less than 3500 feet along the coast and through the coastal sierra of Michoacán, as far as Acapulco and Chilpancingo, Guerrero, and inland into the Balsas Basin at least as far as Jorullo Volcano." Probably this view will require some modification when more specimens are critically examined. Two specimens in the collection of the American Museum (A.M.N.H. Nos. 72525 and 72527) from the vicinity of Chilpancingo are *Cnemidophorus gigas*, a "species" that resembles *communis* both in being of large size (to 140 mm. from snout to vent; Davis and Smith, 1952, p. 97) and in having a high number of scales around midbody (136, 156, and 163 in three specimens in the American Museum). *Cnemidophorus gigas* differs from *C. c. communis* in dorsal pattern, showing black bars or reticulations rather than light spots. Probably the two represent subspecies of a widely ranging species that includes the giant forms of southern Mexico and northern Central America as well. Study of the southern members of this complex is beyond the scope of the present paper, but it is worth pointing out that *C. communis* Cope is the oldest name available for this complex.

### Distribution

*Cnemidophorus communis communis* is found in Colima and northward along the coast at least to Chamela Bay, Jalisco. The range of *communis* may extend to Banderas Bay and southern Nayarit, but there are no specimens from the coastal region between Nayarit and Chamela Bay, Jalisco. Burt (1931a, p. 116) reported "*Cnemidophorus sexlineatus gularis*" from Vallarta, Jalisco (presumably Puerto Vallarta, Banderas Bay), based on a specimen (or specimens) in the American Museum of Natural History. I have not been able to locate such a specimen, or any record of such in the Museum files. The southern extent of the range remains to be determined, but the range probably includes the coastal region of Michoacán inland to the Tepalcatepec Valley.

Locality Records: (Fifty-nine specimens, cited by museum number, have been examined). *Jalisco:* Chamela Bay (U.M.M.Z.

No. 84245 (three specimens); Tenacatita and Tenacatita Bay (Burt, 1935, p. 176). *Colima:* Vicinity of Colima City (A.M.N.H. Nos. 5183, 12631–12633, 15431, 15432, 15444, 15724–15727, 15787, 15792, 15794–15802, 15804–15807, 15809, 15813–15837); Colima City (U.S.N.M. Nos. 31542 [lectotype], 58758)[1]; near Alcuzahue (A.M.N.H. Nos. 15784, 15785, 15788–15791); San Pedrito, east of Manzanillo (AM.N.H. Nos. 15820–15830); Tecomán (A.M.N.H. No. 19022); Quesaria, Tecomán, Villa Alvarez, Paso del Río, Salvador, Pascuales (Oliver, 1937, p. 16).

**Cnemidophorus communis mariarum**
Günther, new combination

Plate 49, figure 1

*Cnemidophorus mariarum* GÜNTHER, 1885–1902, p. 28. BOULENGER, 1885, p. 368. STEJNEGER, 1899, p. 67. GADOW, 1906, p. 329. VAN DENBURGH AND SLEVIN, 1914, p. 149. SLEVIN, 1926, p. 199.

*Cnemidophorus gularis mariarum*, COPE, 1892, p. 46.

*Cnemidophorus sexlineatus gularis*, BURT, 1931a, p. 116 (part, specimens from the Tres Marías Islands).

*Cnemidophorus sexlineatus sackii*, BURT AND MYERS, 1942, p. 46 (part, specimen from María Magdalena Island, Tres Marías).

*Cnemidophorus sackii mariarum*, SMITH AND TAYLOR, 1950a, p. 336; 1950b, p. 183.

TYPE: This form was described by Günther (1885 [1885–1902], p. 28) from five specimens collected by Forrer on the Tres Marías Islands. No museum catalogue numbers were cited by Günther for the specimens, but Smith and Taylor (1950b, p. 183) list British Museum (Natural History) Nos. 1881.10.1.81, 1881.10.1.82, and 1881.10.1.1.86–1881.10.1.88 as the cotypes. No specific type specimen has been designated.

DIAGNOSIS: A subspecies of *Cnemidophorus communis* (see specific diagnosis on p. 72) that differs from the subspecies of the mainland, *C. c. communis*, in that large adult individuals do not develop a pattern of distinct, light spots over the otherwise dark dorsal surface of the trunk, but have dark bars of blotches on a paler background anteriorly and light spots only on the hind limbs and the posterior part of the trunk.

[1] I have not included among the specimens examined 87 cotypes of *communis* from Colima (listed by museum number on p. 75), to which I was able to give only cursory attention.

VARIATION

SIZE: The two largest specimens that I have examined measure 114 and 120 mm. from snout to vent. The length of the adult cotype has been variously given as $4\frac{1}{2}$ inches (=114 mm., Günther, *loc. cit.*), 123 mm. (Boulenger, 1885, p. 369), 121 mm. (Gadow, 1906, p. 328), and 120 mm. (Gadow, *ibid.*, p. 329). Very probably *C. c. mariarum* attains a size comparable to that of *C. c. communis* on the mainland, about 135 mm.

SCUTELLATION: The numerous rows of fine dorsal scales ally *C. c. mariarum* with typical *communis* of the mainland. The mean number of scales around midbody for 24 specimens of *mariarum* from all four islands of the Tres Marías is $144.8 \pm 1.0$, range 136–154. Femoral pores are relatively numerous, as in the lizards of the mainland: mean $43.3 \pm 0.7$, range 36–50, $N = 23$.

The circumorbital semicircles are not well developed in *mariarum*, and in only one of 26 specimens does the row of scales extend far enough anteriorly to separate completely the third supraocular from the median head scales, and on this specimen the separation is true on only one side of the head.

A character of scutellation supposedly unique to *mariarum*, and distinguishing it from the lizards of the mainland, is that the keels of the caudal scales run parallel to the lateral margins of the scale, rather than diagonally upward to the rear. I find that my series of *mariarum* includes individuals with keels that are strictly parallel, as well as other individuals that show varying degrees of divergence from the parallel. It is evident that this character will not serve to segregate insular and mainland populations of *Cnemidophorus;* the same conclusion was reached by Burt (1931a, p. 106).

VARIATION AND DEVELOPMENT OF COLOR PATTERN: Young individuals of *mariarum* show nothing particularly distinctive in their color and pattern. The following description of colors in life (from my field notes) is based on three individuals 50 to 55 mm. in snout to vent length, from María Magadalena Island: "Lateral and dorsolateral stripes light tan, distinct. Paravertebrals less distinct, slightly paler. Lateral field dark brown, immaculate.

Dorsolateral field broken into light brown and dark brown bars, strongest in largest individual. Vertebral field broad and pale; in largest specimen, shows a faint trace of paired vertebral lines. Hind limbs faintly maculated above. Tail bright orange-brown, brightest on under surface. Under side of hind limbs same. Abdomen white with an overcast of iridescent orange-brown. Chin same." The general aspect of these lizards is quite reddish orange in life.

What little information there is on larger individuals of *mariarum* indicates that pattern metamorphosis leads to a condition in which dark blotches or bars predominate, especially in the more dorsal and anterior parts of the trunk. The following description is taken from Slevin (1926, p. 199): "A large male (No. 58846) was colored in life as follows: Grayish above, with two longitudinal rows of black blotches on the sides; top of head light olive; top of limbs grayish with small yellowish dots; belly bluish black with some scales of light blue along the edges; lower surfaces of limbs bluish black; lower surface of tail salmon; gular region salmon, clouded with black." Two adult male individuals in the collection of the American Museum agree well with this description, to which some details may be added: The larger specimen (120 mm. from snout to vent) has well-developed light spots on the rump, but there are no distinct light spots anterior to these. Both individuals have pale vertical bars on the lower sides, best developed anteriorly. The dorsolateral and paravertebral stripes are still present, though weak, on the anterior half of the body of the larger specimen, and are distinct from neck to rump on the smaller (114 mm.). This smaller individual (see pl. 49, fig. 1) was colored in life as follows: The stripes were greenish yellow on the neck, fading to tan on the posterior part of the body. The anterior part of the vertebral field was greenish brown, changing to light brown at midbody. The lateral field was dark brown, the dorsolateral somewhat lighter. Light areas in the fields were light brown. When the lizard was captured on March 31, 1957, the chin and throat were pink, and the rest of the ventral surface was pale blue, with a few darker markings concentrated in the chest region. The lizard was kept alive, and by July 16, 1957, the entire chest and midventral region had become dark blue; there were relatively few pale scales remaining, even along the edges of the abdomen. The dark color did not vary seasonally, but persisted until the lizard was killed in February, 1958. The collar of this individual remained pale, although the other, slightly larger specimen has a dark collar. The presence of a dark collar occasioned astonishment in Gadow ("Collar black in the adult!," 1906, p. 330), and a black collar is given as a key character of the form by Smith and Taylor (1950b, p. 178). I have not examined a sufficient number of large adult specimens of *C. communis* to determine if the color of the collar is of taxonomic significance.

When the total sample of *C. c. mariarum* is considered, the relative spacing of the paravertebral stripes exhibits a wide range of variation. The PV/SA ratio ranges from 0.071 to 0.173. This is a rather wide range compared to that of most other *Cnemidophorus* investigated. An explanation of the situation is afforded by the data on the four specimens from San Juanito Island. These four have the four lowest ratios of any *mariarum:* 0.071, 0.077, 0.083, and 0.098. As the scutellation of these individuals does not differ significantly from the average for all *mariarum*, a somewhat more narrow spacing of stripes is indicated for this population. Possibly the population inhabiting tiny San Juanito Island has differentiated in this respect, but it should be noted that the narrow spacing causes the lizards of San Juanito to resemble the presumed parental mainland population (*C. c. communis*) more than do the other insular populations. The narrow spacing of stripes may, then, represent a relictual rather than a divergent condition. For 20 specimens from islands other than San Juanito, the mean PV/SA ratio is $0.138 \pm 0.005$ (0.103–0.173).

### Comparison with Other Forms

*Cnemidophorus communis mariarum* is compared to its mainland relative, *C. c. communis*, in the account of that subspecies. From *C. sacki huico* of nearby Isabel Island and the adjacent mainland of Nayarit, *mariarum* differs markedly in the dorsal pattern of adults (spotted in *huico*), as well as in the features of scutellation and maximum size that distinguish *C. sacki* from *C. communis*.

## Ecological Notes

My field observations on *Cnemidophorus communis mariarum* were made between March 24 and April 7, 1957, when I visited the Tres Marías Islands as a participant in the Puritan-American Museum Expedition. *Cnemidophorus* was found on all four islands of the group and was not confined to any one particular habitat. The larger islands (María Madre, María Magdalena, and María Cleofas) offer a variety of habitats ranging from Thorn Forest at the beach to Tropical Deciduous Forest, with a canopy height of 70 feet or more in the interior. Lizards were found in all the different vegetation types but seemed most abundant where washes cut openings through the forest. Several lizards were seen on San Juanito Island, which is covered with Thorn Forest about 10 feet high. All lizards seen active during this period were juveniles. A single adult was found, cool and inactive, beneath a stone in a wash.

## Distribution

The four islands of the Tres Marías group constitute the geographic range of *Cnemidophorus communis mariarum*.[1] The following 42 specimens were examined: San Juanito Island (A.M.N.H. Nos. 78684–78687); María Madre Island (A.M.N.H. Nos. 78659–78661, 78739, 78746, 78762, 79046; U.S.N.M. Nos. 24652–24659, 24661–24666); María Magdalena Island (A.M.N.H. Nos. 78698–78708, 78713–78715; U.S.N.M. No. 24660); María Cleofas Island (A.M.N.H. Nos. 78726, 78729); Tres Marías, no specific island (U.S.N.M. No. 14086).

### **Cnemidophorus sacki occidentalis** Gadow, new combination

Plate 47

*Cnemidophorus communis occidentalis*, Gadow, 1906, pp. 339–346 (part, specimens from Ixtlán del Rio, Nayarit, and Zapotlán and Tuxpán, Jalisco).

*Cnemidophorus sexlineatus gularis*, Burt, 1931a, p. 116 (part, specimens from Ameca, Hostotipaquillo, Orendain, San Marcos, Tuxpán, and Zapotlán, Jalisco, and Ixtlán, Nayarit).

*Cnemidophorus gularis*, Smith, 1939, p. 316 (part, specimen from Zapotlán).

*Cnemidophorus sacki communis*, Smith and Taylor, 1950b, p. 182 (part).

Type: British Museum (Natural History) No. 1892.2.8.33 from Ixtlán, Nayarit, was designated as lectotype by Smith and Taylor (1950b, p. 182). The original description by Gadow was based on several specimens from a number of widely scattered localities: Lake Santa Maria, Chihuahua (*C. sacki exsanguis*); Durango and Lerdo, Durango (*C. scalaris scalaris*); Ixtlán, Nayarit (*C. sacki occidentalis*); Sierra de Nayarit (*C. sacki huico*); Presidio, Sinaloa (intergrades between *C. sacki mazatlanensis* and *C. s. huico*); Zapotlán and Tuxpán, Jalisco (*C. sacki occidentalis*); Puebla, Puebla (probably a subspecies of *C. sacki*); Pátzcuaro, Michoacán; Acambaro, Celaya, and Guanajuato, Guanajuato; and San Juan del Rio, Querétaro (all probably *C. scalaris* ssp.).

Diagnosis: A subspecies of *Cnemidophorus sacki* with an average of approximately 106 scales around midbody. Large adult individuals typically have numerous light spots on the dark background of the rump and hind legs, but there are rarely any distinct spots in the anterodorsal region; rather there is a tendency to the formation of cross bars anteriorly. Other subspecies of *C. sacki* with spotting prominent in the adult pattern (*C. s. huico*, *C. s. nigrigularis*, and *C. s. griseocephalus*) show little or no crossbar development anteriorly but are spotted on both anterior and posterior parts of the trunk. The black chin of *nigrigularis* and pale blue chin of *griseocephalus* will serve as an additional way of distinguishing these forms from *C. s. occidentalis*, which has a chin that is reddish in life.

## Variation

Size: The largest of 66 specimens measures 126 mm. from snout to vent. The second largest is 115 mm. long, and there are several others greater than 100 mm. in length.

Scutellation: The average number of

[1] There are three specimens in the collection of the United States National Museum (U.S.N.M. Nos. 73386–73388) purportedly from Mazatlán, Sinaloa, that show the scale counts (more than 140 scales around midbody) and adult pattern of *C. c. mariarum*. Included in the lot of specimens with these *Cnemidophorus* were invertebrates from the Tres Marías Islands collected by the same person, Carlos Stansch. It seems likely that some confusion of locality data took place before the specimens were sent to the United States National Museum from Mexico City by A. L. Herrera.

scales around midbody for 62 specimens is $106.3 \pm 0.6$, range 97–118. Twenty specimens from the west end of Lake Chapala near Jocotepec and Santa Ana, Jalisco, average $103.3 \pm 1.1$ (97–118), and 12 from Autlan to Tuxpán in southern Jalisco average $109.5 \pm 1.3$ (103–116). The difference between the means approaches a level that may be considered statistically significant, but verification by larger series is necessary.

Femoral pore counts vary from sample to sample, but it is difficult to perceive any geographic correlation, and the average differences are probably not significant. The highest average count is seen in a sample of 13 specimens from the vicinity of Ixtlán, Nayarit, $40.1 \pm 0.7$ (37–45). This mean is almost identical with that of the total sample of *C. s. huico* ($40.2 \pm 0.3$). A sample of *occidentalis* from the west end of Lake Chapala in the vicinity of Jocotepec and Santa Ana gives a mean of $39.3 \pm 0.7$ (34–44) for 19 specimens. Twelve individuals from southern Jalisco (Autlan to Tuxpán) average $38.5 \pm 0.7$ (35–44). These three averages would seem to suggest a cline of reducing averages from north to south, but the apparent cline is disrupted by 11 specimens from northern Jalisco between Ixtlán, Nayarit, and Santa Ana, Jalisco. These have the lowest average encountered, $37.4 \pm 0.9$ (32–44). For the total sample of *occidentalis* counted, 67 specimens, the mean is $38.8 \pm 0.3$ (32–45).

VARIATION AND DEVELOPMENT OF COLOR PATTERN: The smallest specimen of *Cnemidophorus sacki occidentalis* examined by me is one from El Sonador in southwestern Nayarit measuring 34 mm. from snout to vent. Even at this small size, there are distinct spots in the dorsolateral fields on the rump. The narrow vertebral field is occupied by a single pale line with irregular margins. Such precocious development of spotting as is seen in this specimen may not be typical, as some other individuals of *occidentalis* of larger size show less distinct marking in the fields. Typically, light areas develop first in the posterior part of the dorsolateral field and gradually make their appearance more and more anteriad. Such light areas appear later in the lateral dark field, and in some individuals, even large ones, may be found only in the posterior part of the field. The light areas that develop anteriorly in the dorsolateral field tend to fuse vertically with the pale vertebral field (and with any light areas in the lateral field), forming light bars that alternate with dark bars formed in a similar fashion from the remaining dark areas of the fields. The dark bars are seldom united across the back. Posteriorly, distinct light spots develop both in the lines and in the fields. Along the lower sides, there are often dark and light vertical bars from axilla to groin. An individual that followed such an idealized development of pattern would end up with the rump, hind legs, and lower back dark, with numerous distinct light spots. The neck and anterior part of the back would be light brown, with short dark bars invading the central region from the sides. The lower side of the body would have alternating dark and light vertical bars. The middorsal region would be an area of transition between distinct light spots and light areas forming cross bars (pl. 47, figs. 1–3).

A point of difference in the development of pattern in *C. s. occidentalis* and in the more northern subspecies of *sacki* (*huico*, *mazatlanensis*, *nigrigularis*, *griseocephalus*, and *barrancorum*) deserves mention here: In *occidentalis*, there is usually no stage at which all lines are clearly present and the lateral and dorsolateral fields are speckled throughout their lengths with sharply defined pale spots. Such a stage is seen regularly in the other subspecies mentioned, as well as in *C. communis communis*.

Persistence of the stripes varies considerably among different individuals of *C. s. occidentalis*. In some specimens, the paravertebral stripes remain after the others have lost their identity; in others, the lateral and dorsolateral stripes are recognizable though the paravertebrals may be gone, or only visible on the neck. Striping may be present to maximum body size, as evidenced by a specimen 126 mm. in snout to vent length that has the lateral and dorsolateral stripes distinct to the groin, though the paravertebrals fade at about midbody (pl. 47, fig. 9).

Perhaps the most striking feature of the pattern of *C. s. occidentalis* is the variation seen among large adult specimens. The majority of specimens seems to attain the "typical" pattern described above, with spots

predominating posteriorly and short cross bars anteriorly, but others fail to lose the stripes and hence develop neither distinct cross bars nor discrete spots. At the other extreme stands a single large female that has large spots present and distinct over the whole of the dorsal surface of the body (pl. 47, fig. 5).

Spacing of paravertebral stripes shows a range of variation about equal to the greatest in other subspecies of the west coast. For the entire sample of 50 specimens of *occidentalis*, the range of variation of the PV/SA ratio is 0.086–0.183, mean $0.130 \pm 0.003$. Among several samples that comprise the series of 50 specimens, the lowest average ($0.113 \pm 0.005$) is seen in nine lizards from the vicinity of Jocotepec and Santa Ana at the western end of Lake Chapala. The highest average is that of the sample from the vicinity of Ixtlán, Nayarit: $0.145 \pm 0.007$ ($N=8$). The spacing of the paravertebral stripes is a highly variable character, and the samples available are too small to permit reliable analysis of possible geographic variation within *C. s. occidentalis*. The average of 0.130 seen for the entire sample does not differ markedly from what is seen in other subspecies (including *C. s. sacki*), except that the populations of *C. s. huico* in the vicinity of San Blas and on Isabel Island have more closely spaced stripes, as discussed in the account of that subspecies.

Adult individuals of this subspecies, at least males, have a throat and chin color that is the same as that of *C. s. huico:* pink to reddish brown. This is apparent from residual color present in comparatively fresh specimens that I have examined, and is verified by field notes of Alan R. Phillips, kindly made available to me by Dr. C. H. Lowe, Jr. The chin is crossed by a grayish wash that is intensified in preservative, as is the case in *C. s. huico*. A large female (snout to vent length, 112 mm.) that I obtained near Jiquilpan, Michoacán, was almost totally white beneath, including the chin and throat as well as the other ventral surfaces. Whether sexual dimorphism or some other factor is responsible for the variation in throat color is not at present clear.

A survey of specimens from the vicinity of Jocotepec and Santa Ana, Jalisco, and Ixtlán, Nayarit, indicates that dark blue pigment becomes dominant on the chest and abdomen of male lizards at a snout to vent length of slightly less than 100 mm. in most individuals. Specimens measuring 87, 90, and 92 mm. are pale beneath, with only the anterior edges of the scales dark. Three measuring 96, 97, and 99 mm. are largely dark beneath. One lizard measuring 100 mm. is largely pale, but 12 others of greater size are largely, and in some instances completely, darkened beneath. None of four female specimens measuring 99, 103, 112, and 113 mm. is predominantly dark on the venter, and only one of these (103 mm.) shows any distinct dark marks. Sexual dimorphism is indicated but by no means proved.

The specimen from Jiquilpan had rather dull yellow-brown lines and spots on darker grounds. The lateral fields were unmarked and very dark brown, the dorsolateral and vertebral fields progressively paler. Phillips (field notes) recorded a prominent green tinge of both fields and stripes in the neck region of specimens from southern Nayarit, but such was not the case in the single living lizard of this subspecies seen by me.

### Comparison with Other Forms

*Cnemidophorus sacki occidentalis* is compared with its adjacent relative to the north, *C. s. huico*, in the account of that subspecies, so the comparison is not repeated here. To the southeast of the range of *occidentalis* lie the valleys of the Tepalcatepec and Balsas rivers in Michoacán and Guerrero. The Balsas drainage in Guerrero and Morelos is inhabited by *C. s. sacki*, but the status of *Cnemidophorus* in the intervening area of Michoacán remains to be determined. There is similarity in the dorsal patterns of typical *sacki* and *occidentalis*, in that the tendency to the formation of cross bars is present in both forms. As far as I have been able to determine, in *sacki* spotting of the rump is not so distinct as in *occidentalis*, so that there is much less anteroposterior differentiation in pattern in *sacki* (pl. 46, fig. 2). The two are similar in scutellation.

Immediately to the east of the range of *C. sacki occidentalis* is found the form that I call *Cnemidophorus scalaris* ssp. This form has been included by other authors in the composite *C. sacki communis* along with

*occidentalis* and several other forms that represent, to my way of thinking, three species. The easternmost specimens of *occidentalis* are those from localities near Jocotepec (Santa Ana, 18 miles north of Jocotepec; 3 miles west and 2 miles east of Jocotepec) at the western end of Lake Chapala in Jalisco; from Orendain, a railroad junction 18 miles west and 4 miles north of Guadalajara, Jalisco; from Atemejac, 4 miles north of Guadalajara; from near San Antonio and Tuxcueca on the south edge of Lake Chapala; and from 4 miles east of Jiquilpan, Michoacán, south of Lake Chapala (museum numbers are given in the list of specimens examined). Localities for *C. scalaris* ssp. in the same general region in Jalisco are 10 miles north of Chapala (A.M.N.H. No. 77579); 11 miles southeast of Guadalajara (U.I.M.N.H. No. 40494); Rio Blanco north of Zapopán (A.M.N.H. No. 18950); Oblatos, northeast of Guadalajara (A.M.N.H. No. 18951); the vicinity of Jamay (A.M.N.H. Nos. 18945–18949, 18990–18994); Barranca Ibarra, north of Guadalajara (U.S.N.M. Nos. 18983–18986, 19493, 19494); Guadalajara (U.S.N.M. No. 19495); and Atemejac (U.S.N.M. Nos. 47894–47896, 47896, 47899).

There is only a single known instance of overlap between the two forms. At Atemejac, about 4 miles north of Guadalajara, Nelson and Goldman collected five typical examples of *scalaris* (84 to 87 scales around midbody) and one *occidentalis* (103 scales around). The specimen of *occidentalis* is a juvenile, so the adult pattern is not known, but the scale counts alone are enough to verify the coexistence of the two species *sacki* and *scalaris*. As far as is presently known, *C. sacki occidentalis* and *C. scalaris* ssp. can always be distinguished by the difference in the number of scales around midbody. The maximum in 24 specimens of *scalaris* from Jalisco is 91; the minimum in 62 *occidentalis* is 97. Few individuals show these extreme counts, and the averages (85.6 and 106.3) are well separated.

## Distribution

*Cnemidophorus sacki occidentalis* is known to range from southern Nayarit and northern Jalisco to northwestern Michoacán. The northernmost specimen assigned to *occidentalis* is one from Bolaños, Jalisco. This is a relatively large individual (96 mm. from snout to vent), with the dark fields unspotted. In the absence of any information on the ultimate pattern attained by lizards of this region, they are considered to represent *occidentalis* because an individual of *C. s. huico* of such size would be expected to show considerable spotting in the fields. Delayed development of spotting is more frequent in *occidentalis*. In Colima and on the coast of Jalisco, *occidentalis* is evidently replaced by *C. communis*. The only localities for *occidentalis* that approach the coast are those from the vicinity of Las Varas, Nayarit; all others are inland and at higher elevations. The majority of localities are above an elevation of 3000 feet, and some are higher than 5000 feet. On the Plateau, to the north and east of Lake Chapala, *C. s. occidentalis* is replaced by *C. scalaris* ssp., as discussed above in the comparison of the two forms. The extent of the range of *C. s. occidentalis* in Michoacán has not been investigated. Intergradation between *C. s. occidentalis* and *C. s. huico* is discussed in the account of the latter form.

Locality Records: (Ninety-one specimens specimens cited by number have been examined). *Nayarit:* Four miles east of Compostela (A.R.P. No. 56-3); 3 miles north of Las Varas (A.R.P. No. 56-11); 3 miles north-northwest of Las Varas (U.K.M.N.H. Nos. 29737, 29740, 29744); 1.4 miles north of Las Varas (A.R.P. No. 56-12); El Sonador, *ca.* 10 miles south-southeast of Las Varas (F.A.S. No. 9166); 1 mile west of San José del Conde, 3000 feet (U.M.M.Z. No. 102047, four specimens); 3 miles north of Santa Isabel, 3800 feet (U.M.M.Z. Nos. 102048–102050); 2 miles north of Ahuacatlán (U.I.M.N.H. Nos. 49405–40497); 11.1 miles west-northwest of Ixtlán del Rio (C.H.L. Nos. 7830–7838); 2 miles west of Ixtlán del Rio (F.A.S. Nos. 7968–7970); Ixtlán del Rio (U.M.M.Z. No. 104747); 2.5 miles east of Ixtlán del Rio (U.I.M.N.H. Nos. 6827, 6967–6973). *Jalisco:* Bolaños (U.S.N.M. No. 46716); El Aguilar Mine, Hostotipaquillo (A.M.N.H. No. 15430); northwest of Hostotipaquillo (A.M.N.H. Nos. 19023, 19024); near Magadelena (U.I.M.N.H. No. 19754); 4.4 miles east-southeast of El Arenal, 4400

feet (U.M.M.Z. No. 114736, two specimens); Orendain (A.M.N.H. No. 19025); Atemejac (U.S.N.M. No. 47897); Ameca (U.S.N.M. No. 47850); 4 miles southeast of Ameca, 4000 feet (U.M.M.Z. No. 102046); 5 miles east of Ameca, 4000 feet (U.M.M.Z. No. 102045); San Marcos (U.S.N.M. Nos. 18981, 18982); Santa Ana, 18 miles north of Jocotepec (U.C.M. Nos. 8606–8622); 3 miles west of Jocotepec (U.C.M. Nos. 8623–8625); 2 miles east of Jocotepec (U.I.M.N.H. No. 6840); 3 miles west of San Antonio (U.I.M.N.H. No. 6837); 4.9 miles east of Tuxcueca (U.I.M.N.H. Nos. 6838, 6839); Zapotlán (C.N.H.M. No. 2535, cotype of *C. communis occidentalis* Gadow); near Zapotiltec (U.I.M.N.H. Nos. 19940, 19941); Tuxpán (C.N.H.M. No. 2533, cotype of *C. communis occidentalis* Gadow); 1 mile north of San Gabriel, 4000 feet (U.M.M.Z. No. 102042); 1 mile west of San Gabriel, 4000 feet (U.M.M.Z. No. 102043); 1.5 miles southwest of San Gabriel, 4000 feet (U.M.M.Z. No. 102040); near Autlan (U.M.M.Z. Nos. 102219–102212); 4 miles northeast of Autlan, 3000 feet (U.M.M.Z. No. 102044); Kilometer 197, near Autlan (U.I.M.N.H. No. 19904); 15 kilometers north of Autlan (U.I.M.N.H. No. 19769). *Michoacán:* Four miles east of Jiquilpan (A.M.N.H. No. 75919).

**Cnemidophorus sacki huico,** new subspecies[1]

Plate 43; plate 44, figures 1, 4

*Cnemidophorus communis occidentalis* GADOW, 1906, p. 342 (part, specimens from Sierra de Nayarit).

*Cnemidophorus mariarum*, VAN DENBURGH, 1897, p. 463 (part, specimens from San Blas and Tepic, Nayarit).

*Cnemidophorus gularis mexicanus*, STEJNEGER, 1899, p. 68.

*Cnemidophorus sexlineatus gularis*, BURT, 1931a, pp. 116–117 (part, specimens from Acaponeta, Isabel Island, La Barrete, Rosamorada, San Blas, Tepic, and west of Santiago Ixcuintla, Nayarit, and Plomosas, Sinaloa).

*Cnemidophorus sexlineatus sackii*, BURT, 1935, p. 176 (part, specimens from Isabel Island).

*Cnemidophorus sackii communis*, SMITH AND TAYLOR, 1950b, p. 182 (part). CHRAPLIWY AND FUGLER, 1955, p. 126 (part, specimen from 7 miles southwest of Concordia, Sinaloa). LEWIS AND JOHNSON, 1955, p. 180.

TYPE: A.M.N.H. No. 75570, adult male, collected by J. Bordaz and E. Goldschmidt at Peñitas, approximately 12 miles south-southeast of Rosamorada, Nayarit, in 1956.

PARATYPES: T.H.L. Nos. 57–229, 57–230; U.M.M.Z. No. 104746 (field no. W.E.D. 5039); S.N.H.M. Nos. 19314, 19319; A.M.N.H. Nos. 74920, 74929, 75567; U.S.N.M. No. 47671.

DIAGNOSIS: A subspecies of *Cnemidophorus sacki* with an average of approximately 104 scales around midbody. Adult individuals usually have the chin and throat pink to brick-red in life, with the posterior part of the chin crossed by a grayish band that may be intensified in preservative. The ultimate dorsal pattern is one of numerous light spots on a dark background, the spots being present anteriorly (in or immediately behind the shoulder region) as well as posteriorly, including the hind legs and base of the tail.

Subspecies with similar scutellation and dorsal pattern are *C. s. griseocephalus*, *C. s. nigrigularis*, and *C. s. occidentalis*. The chin and throat are black in *nigrigularis* and pale blue in *griseocephalus* in contrast to the reddish throat of *huico*. Also, these forms are well removed geographically from *C. s. huico*.

*Cnemidophorus s. huico* is less well differentiated from *C. s. occidentalis*, which tends to develop a cross-barred rather than spotted pattern anteriorly. These forms are compared at greater length below.

DESCRIPTION OF TYPE SPECIMEN: The length from snout to vent is 101 mm.; the tail is incomplete. There are 109 scales around midbody (excluding eight rows of enlarged ventral scutes), and 232 scales from occiput to rump. Femoral pores number 36. Other features of scutellation are typical of *sacki*.

The color pattern is in a late stage of metamorphosis from striped to spotted. The lateral stripes have completely disappeared, the dorsolaterals are faintly visible, and the paravertebrals are distinct though faint. Eleven scales separate the paravertebral stripes at midbody, PV/SA = 0.101. A series of light vertical bars on a dark background occupies the lower side; the remainder of the dorsal surface of the body is heavily spotted,

[1] The name *huico* is commonly applied as a colloquial name for lizards of the genus *Cnemidophorus* in western Mexico.

with distinct spots present well anteriorly into the shoulder region and in all fields. The hind legs and the base of the tail are likewise spotted.

The scales of the chin are pale, without discrete darker markings. A grayish wash crosses the region immediately posterior to the angle of the mouth. The scales of the collar are blue-gray, and those of the anterior part of the chest dark blue. Most of the ventral scales are pale blue, with a darker anterior edge. There are irregular dark blue lines arranged longitudinally on the belly, following the lateral edges of the scales. The more lateral ventral scales are alternately solid dark blue and partly pale blue, the colors corresponding in position to the light bars and dark background of the lower lateral surfaces. The under surfaces of the limbs are largely, but not wholly, dark.

### Variation

Size: The largest individuals among 176 specimens examined are two males and a gravid female, all of which measure 106 mm. from snout to vent. Only 10 specimens in the sample are 100 mm. or more in length, but the sample is heavily weighted with juveniles.

Scutellation: The average number of scales around midbody for 90 specimens from Nayarit is $104.4 \pm 0.7$, range 91–118. No strong regional differentiation is evident, but lizards from the northeastern corner of the state average slightly fewer rows: mean $100.5 \pm 1.0$, range 91–116, in a sample of 29 specimens.

Femoral pores among 91 specimens from Nayarit range from 36 to 46, mean $40.2 \pm 0.3$. The lowest average is seen in a sample of 14 lizards from the vicinity of Peñitas, $39.1 \pm 0.6$ (36–43), and the highest in a sample of the same size from Isabel Island, in which the mean is $41.5 \pm 0.6$, range 37–46. The relatively low average in the lizards from the more northern station, Peñitas, is probably an approach to the still lower counts of *C. s. mazatlanensis*, a subspecies that averages $37.8 \pm 0.4$.

Variation and Development of Color Pattern: (See pl. 43). The smallest specimens examined by me are 48 mm. in snout to vent length and show light areas developing in the dark fields, so are referred to Class II. Distinct spots may appear in individuals as small as 52 mm. in snout to vent length and are present in most specimens longer than 60 mm. The vertebral field is most often occupied by a pair of irregular, indistinct, light lines on a dark brown background, though sometimes only a single (midvertebral) line may be present. Only rarely is there a broad, pale band of the sort that is typical of *C. s. mazatlanensis*. In the majority of small specimens the dorsal surfaces of the hind legs are conspicuously mottled with light brown on the dark ground color. This mottling is replaced by a pattern of small spots in larger adults. The metamorphosis to the completely spotted condition (Class V) may be essentially complete at a length of 95 or 96 mm., or may be delayed. For example, two male specimens from northeastern Nayarit (La Vuelta), each measuring 101 mm., have the body heavily spotted and show striping distinctly only in the neck and shoulder regions. A larger individual (105 mm.) from the same locality, also a male, has all stripes distinct from neck to groin. Spotting is present in all fields, including the posterior part of the vertebral field, so the specimen is assigned to pattern Class IV. Another striped individual from northeastern Nayarit lacks spotting in the vertebral field, despite large body size (100 mm.), so is referred to Class III. In contrast, three specimens from the same general region have attained Class V at a length of 95 mm.

The number of large-sized specimens is too few to allow study of *huico* with respect to possible geographic variation in the size at which pattern metamorphosis occurs. However, it appears that throughout the range of subspecies, the majority of the largest individuals do attain the completely spotted dorsal pattern.

Within the subspecies of *C. s. huico* there occur two modes with respect to separation of the paravertebral stripes, and these modes are geographically distinct. As is seen from the data presented in table 3 and figure 6, the average separation of paravertebral stripes is relatively constant in populations of *C. sacki* that inhabit the area from southern Sonora to southern Nayarit, except in the vicinity of San Blas, where a narrowing of stripe place-

ment takes place. A small sample (seven lizards) for 15 miles east of San Blas has an average PV/SA ratio of $0.139 \pm 0.008$. This average does not differ significantly from that of any of the northern populations, so it is remarkable that for 33 specimens from San Blas the average drops to $0.107 \pm 0.002$. An average change of 3.2 per cent may at first consideration not seem great, but in view of the stability of the average over a distance of 550 miles from Sonora to southeastern Nayarit, the change observed is worthy of attention. A scattering of specimens from along the road connecting San Blas with the main north to south highway suggests that the change may take place even more abruptly than is indicated by the samples from San Blas and 15 miles east of San Blas; a specimen from 18 miles (by road) east-northeast of San Blas has a low ratio (0.098), and others from between that point and San Blas fall well within the range of the sample from San Blas. Four specimens from along the main highway approximately 20 miles (airline) east-northeast of San Blas average 0.137 (0.125–0.145), a mean that is typical of northern and inland specimens from Nayarit.

The population of *C. s. huico* of Isabel Island evidently carries the trend seen in lizards from San Blas a step further; the mean ratio for 13 specimens is $0.093 \pm 0.005$. There are no specimens available from the coast opposite Isabel Island, or for many miles north of there. Similarly, the coastal region south of San Blas has as yet yielded no specimens of *Cnemidophorus sacki*. Consequently, the geographical distribution of lizards with narrowly spaced stripes is very imperfectly known. A detailed study of populations of *sacki* is needed before the precise distribution of the two pattern types can be ascertained. Because of rather wide variation encountered in any one population, large samples will be needed.

In life, the chin and throat of larger individuals are a reddish shade, most often a dull brick-red. Among 13 specimens that I collected on Isabel Island in April, 1957, the smallest male showing a reddish tinge to the chin measured 61 mm. from snout to vent. A female measuring 76 mm., from the mainland north of Tepic, had only a faint trace of red, but six males, the smallest 83 mm., from the same general vicinity all had the brick-red color well developed. In adult lizards, there is present a wash of gray pigment across the middle of the chin; in some instances individual gray scales contrast somewhat with the pale background. In living lizards, the gray is almost wholly masked by red, but in preservation the red disappears, and the gray becomes evident. The presence of a grayish cast across the middle of the chin in a preserved specimen seems to be a good indication that in life the throat was red. If a specimen has been darkened by preservation in formalin, it may be difficult to distinguish the artificially darkened gray throat markings from the truly black spots and blotches that are present in *C. s. mazatlanensis*.

The chest and abdomen of larger individuals of *C. s. huico* may be completely dark blue, but this is not always the case. A sample of several specimens 90 mm. or more in length from the same locality may include some individuals with the venter wholly dark blue and others with the dark pigment confined to the anterior edges of the scales, the predominant color being pale blue. The smallest specimen with a dark venter that I have examined is a male measuring 95 mm. from snout to vent; another male 105 mm. in length is largely pale beneath. Material is not adequate to allow reliable assessment of the possible effect of seasonal variation, but specimens of similar size showing both dark and light extremes have been collected at the same time and place on more than one occasion. Almost all large specimens are males, so sexual dimorphism cannot be studied. The only large female (106 mm. from snout to vent) has less than one-half of the venter dark blue.

### Comparison with Other Forms

The range of *Cnemidophorus sacki huico* touches that of *C. s. mazatlanensis* on the north and that of *C. s. occidentalis* on the south. The first of these, *mazatlanensis*, has a pale chin spotted with black and retains stripes in the dorsal pattern throughout life. By contrast, *huico* has a reddish chin and commonly loses the stripes as maximum body size is approached.

Inasmuch as both *C. s. huico* and *C. s. occidentalis* may lose the stripes by the time

maximum size is reached, and as both have spotting as an important component of the pattern, the separation of the two subspecies is less easily made than that between *huico* and *mazatlanensis*. A further complication is added by rather great variation in *occidentalis*. In general, the following contrast will hold true for most adult individuals of large size: spots are present over most of the dorsum of *huico*, whereas in *occidentalis* there are usually well-defined spots in the region of the rump, but none in the anterodorsal area. In *occidentalis*, light areas that develop in the anterior portion of the dorsolateral field do not usually resolve into spots, but tend to merge vertically with the light lines. Similar vertical fusion of dark areas in the dorsolateral and vertebral fields leads to the formation of short, alternating dark and light cross bars. The dark field between the dorsolateral and lateral stripes often may remain immaculate, even in large individuals, and is thus only infrequently involved in cross-bar formation. The vertebral field (pale tan in contrast to the dark brown lateral field) is seldom crossed by dark bars anterior to midbody. The result is that a "typical" *occidentalis* has a middorsal region that is pale anteriorly and is invaded from each side by incomplete dark cross bars. There seldom are any discrete light spots on the middorsum very much anterior to the rump.

*Cnemidophorus sacki huico* requires only brief comparison with two other spotted subspecies that occur to the north. *Cnemidophorus s. griseocephalus* and *C. s. nigrigularis* are similar to *huico* in scutellation, size, and ultimate dorsal pattern. The chief distinguishing characteristic is the color of the chin—pale blue in *griseocephalus*, black in *nigrigularis*, and red in *huico*. The geographic range of *huico* does not touch that of either of these similar forms, but is separated from the closest of the two (*nigrigularis*) by an area occupied by a third and more dissimilar form, *C. s. mazatlanensis*.

## Ecological Notes

Specimens collected at several localities along the highway north of Tepic, Nayarit, were found in dense Thorn Forest. Thomas H. Lewis recorded several individuals collected "at edge of heavy palm forest" near San Blas (field notes). Other localities for the subspecies fall within areas mapped as Tropical Deciduous Forest.

Dr. Lewis has kindly provided me with field notes on the mating of *C. s. huico* as observed at La Vuelta, Nayarit, on August 25, 1957. The male lizard had seized the female by the left flank but was inverted, with his lower jaw applied to the back and upper jaw against the abdomen, and the top of his head against the ground. The body was arched across that of the female, to bring the left hemipenis into play. Probably this extremely contorted position is not the usual one.

Throughout almost all of its range, *C. sacki huico* is the only species of *Cnemidophorus* found. At San Blas, on the extreme southwestern corner of the range, both *C. s. huico* and *C. deppei duodecemlineatus* are present.

## Distribution and Intergradation

Intergradation of *C. s. mazatlanensis* and *C. s. huico* is discussed in the account of the former species. The contact between *huico* and *occidentalis* apparently takes place in Nayarit south of Tepic. Two large male specimens (T.H.L. Nos. 55–85 and 55–86; snout to vent length, 108 and 105 mm., respectively) from 10 miles south of Tepic may be regarded as intermediate between the two subspecies. Both are heavily spotted posteriorly, and the spotting extends anteriorly in the lateral and dorsolateral fields to the level of the foreleg. All stripes are distinct on the neck but lose their clarity before midbody is reached. In spotting, these specimens resemble *huico*, but the pale vertebral field is invaded laterally by black marks that have the appearance of incipient cross bars. A sample of two adult specimens (especially ones somewhat darkened by formalin as these are) can scarcely be regarded as providing adequate evidence of intergradation, and when large series of adults can be accumulated it should be possible to be more definite about the nature and extent of intergradation. Indeed, some specimens from the vicinity of the restricted type locality of *C. s. occidentalis* (Ixtlán del Río) are closer to *huico* and thus suggest a rather broad area of intergradation. A single specimen from 3 miles southeast of Mirador, Nayrit, is tentatively

considered to represent a population of intergrades because of its geographic location.

The geographical distribution of *Cnemidophorus sacki huico* is from the vicinity of Concordia, Sinaloa, south to Tepic, Nayarit. The southernmost coastal localities are in the immediate vicinity of San Blas. Isabel Island, off the coast of Nayarit, is occupied by a population that is referable to *C. s. huico*, though confirmation in the form of fully adult specimens is to be sought. Inland, *huico* ranges to the northeastern corner of Nayarit and to northern Jalisco and adjacent Zacatecas. Intergradation with *G. s. mazatlanensis* apparently occurs in the vicinity of Presidio, Sinaloa, and with *C. s. occidentalis* a few miles south of Tepic, Nayarit.

LOCALITY RECORDS: (One hundred and ninety-three specimens examined): *Sinaloa:* Concordia (U.M.M.Z. No. 102606); 7 miles southwest of Concordia, 350 feet (U.K.M.N.H. No. 33810); 10 miles west of Concordia (U.M.M.Z. No. 102607); Chele, 300 feet (U.M.M.Z. No. 110910, four specimens); 7 miles west-northwest of Rosario (F.A.S. No. 7747); Plomosas (U.S.N.M. Nos. 47668–47670); 7 miles north-northwest of Escuinapa (A.M.N.H. No. 75917); Escuinapa (A.M.N.H. Nos. 1484–1489); 16 miles southeast of Escuinapa (F.A.S. Nos. 8709–8715); 1.5 miles west of La Concha (A.M.N.H. Nos. 75915, 75916). *Nayarit:* Acaponeta (A.M.N.H. No. 62324, U.S.N.M. Nos. 47671, 47672); 1.5 miles south of Rio Acaponeta on Highway 15 (C.P.S. Nos. 7556, 7558); 7.3 miles northwest of Rosamorada (C.H.L. Nos. 7813, 7814); Rosamorada (A.M.N.H. No. 19355); 2 miles south of Rosamorada (A.M.N.H. Nos. 75910–75914); Peñitas (A.M.N.H. Nos. 75567, 75570 [type specimen], 75577, 75760); 3 miles southeast of Peñitas (F.A.S. Nos. 9055–9067); west of Santiago Ixcuintla (A.M.N.H. No. 18995); 25 miles north of Tepic (A.M.N.H. Nos. 75908, 75909); 15.9 miles northwest of Tepic (C.H.L. Nos. 7242–7244); after leaving La Barrete (A.M.N.H. Nos. 15434, 15435); Guaristemba (T.H.L. Nos. 57-45–57-48); 18 miles east-northeast of San Blas (U.M.M.Z. No. 104744); 4 miles above Singuita (T.H.L. Nos. 55-75–55-77); 15 miles east of San Blas (S.N.H.M. Nos., 19317–19319, 19322, 19323, 19326, 19331, 19333); 1 mile north of La Libertad [10 miles east of San Blas] (U.M.M.Z. No. 114700); 6.4 miles east-northeast of San Blas (U.M.M.Z. 104745); 4 miles east-northeast of San Blas (S.N.H.M. No. 193335, C.P.S. No. 7536); ¾ mile east of San Blas (S.N.H.M. No. 19314); within ½-mile radius of San Blas (S.N.H.M. Nos. 19344, 19345); Cerro de Contaduria, San Blas (T.H.L. Nos. 55-25, 55-35, 55-37–55-39); San Blas (C.P.S. No. 7544, S.N.H.M. No. 19341, U.M.M.Z. Nos. 114701 [21 specimens], 114702 [three specimens], 103746 [five specimens], 112652 [three specimens], A.M.N.H. Nos. 15848, 68357); Sierra Alica, south of San Juan Peyotan (T.H.L. Nos. 57-18–57-20); La Vuelta, 15 miles south of San Juan Peyotan (T.H.L. Nos. 57-228–57-231); La Mesa de Nayar (A.M.N.H. No. 74928); Jesus Maria (A.M.N.H. Nos. 74906–74927, 74929–74935); Sierra de Nayarit (Gadow, 1906, p. 342); Isabel Island (A.M.N.H. Nos. 76217, 78746–78757, U.S.N.M. Nos. 24667–24671). *Jalisco:* Heujuquilla (U.S.N.M. Nos. 46717, 46718). *Zacatecas:* San Juan Capistrano (U.S.N.M. Nos. 46719–46722).

Specimens regarded as intergrades between *C. s. huico* and *C. s. occidentalis* have been collected at 10 miles south of Tepic (T.H.L. Nos. 55-85–55-87), and three miles southeast of Mirador (U.K.M.N.H. No. 437743), Nayarit.

### Cnemidophorus sacki mazatlanensis, new subspecies

Plate 44, figures 2, 5

*Cnemidophorus sexlineatus* var. *mexicanus*, BOULENGER, 1885, p. 366 (intergrades with *C. sacki huico* from Presidio, Sinaloa).

*Cnemidophorus sexlineatus*, GÜNTHER, 1885–1902, p. 25 (part, intergrades with *C. sacki huico* from Presidio, Sinaloa).

*Cnemidophorus mariarum*, VAN DENBURGH, 1897, p. 463 (part, specimens from Mazatlán, Sinaloa).

*Cnemidophorus communis occidentalis*, GADOW, 1906, p. 342 (part, intergrades with *C. sacki huico* from Presidio, Sinaloa).

*Cnemidophorus sexlineatus gularis*, BURT, 1931a, p. 117 (part, specimens from the vicinity of Mazatlán, and intergrades with *C. sacki huico* from Presidio, Sinaloa).

*Cnemidophorus sexlineatus sacki*, BURT, 1935, p. 176 (part, specimens from Mazatlán, Sinaloa).

BURT AND MYERS, 1942, p. 45 (part, specimens from Mazatlán, Sinaloa).

*Cnemidophorus sacki*, TAYLOR, "1936" [1938b], p. 522 (specimens from Mazatlán, Sinaloa; intergrades with *C. sacki huico* from the vicinity of Presidio, Sinaloa).

*Cnemidophorus sacki communis*, LEWIS AND JOHNSON, 1956, p. 280.

TYPE: A.M.N.H. No. 75921 (field label R. G. Zweifel No. 3047), adult male, collected by R. G. Zweifel 2 miles north of Coyotitán, Sinaloa, Mexico, on August 19, 1956.

PARATYPES: M.V.Z. Nos. 59183, 58194, 59188, 59190–59195; U.M.M.Z. No. 112653 (two specimens, field number W.E.D. 6812, 6813).

DIAGNOSIS: A subspecies of *Cnemidophorus sacki* with stripes persisting in large adult individuals, chin pale blue, with black spots, and an average of about 105 scales around midbody. Among forms with similar scutellation, *C. s. barrancorum* apparently retains at least a trace of striping to maximum size, but has the throat immaculate. Some individuals of *C. s. occidentalis* may never lose the stripes, but have a pink, unspotted chin. Other striped forms currently referred to as subspecies of *sacki* (*exanguis*, *semifasciatus*, *gularis*) have fewer scale rows, among other differences.

DESCRIPTION OF TYPE SPECIMEN: The length from snout to vent is 98 mm.; the tail is incomplete. There are 101 scales around midbody (excluding eight rows of enlarged ventrals), and 222 from occiput to rump. Postantebrachial and mesoptychial scales are enlarged. There are four supraoculars. The rows of circumorbital scales fail to reach as far forward as the suture between frontoparietal and frontal scales (fig. 2). There are 39 femoral pores.

The paravertebral, dorsolateral, and lateral stripes are strong and continuous, with only the lateral showing periodic accentuation of potential spots. The paravertebral stripes are separated by 11 scales at midbody, PV/SA=0.109. Spots are distinct in the lower lateral and lateral fields, present but faint in the dorsolateral; spots are not a prominent feature of the pattern. Small, distinct spots are evident on the dorsal surface of the lower leg, but are less numerous on the thigh.

In life, the dorsal fields, except the vertebral, were dark brown. The head and limbs were much the same color. The stripes were bright yellow-green (more yellow than green), and the vertebral field is similar but duller. Spots on the body were similar in color to the stripes, but the spots on the hind limbs were less yellow, more tan. The tail was similar in color to the brown of the body, but somewhat paler. The ground color of the chin was pale blue, becoming white anteriorly and in the region of the throat. Numerous small spots on the chin and throat were black. The remaining ventral surfaces, from collar to vent, had a pale blue ground color slightly darker than that of the throat. The anterior edge of each enlarged belly scale was dark blue; only in the chest region did this dark color cover approximately half of each scale, and even here the total impact of color is predominantly light. The lower surfaces of the forelimbs were white. The scales of the

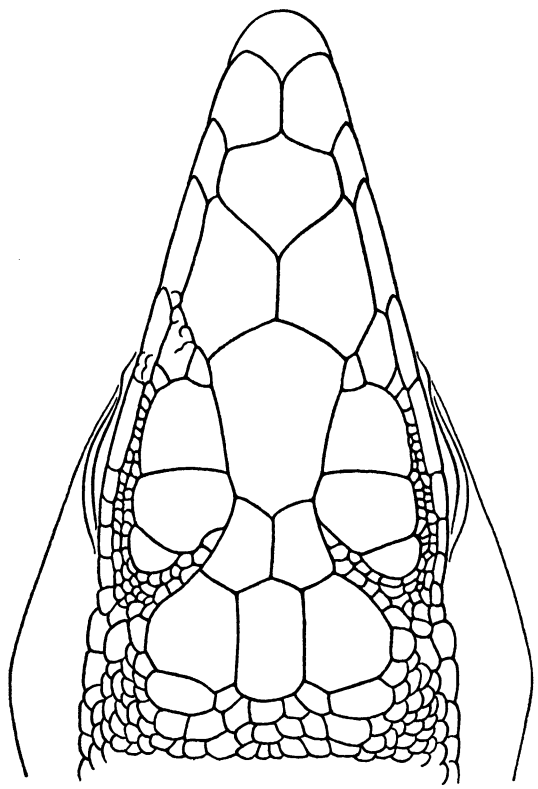

FIG. 2. Scutellation of dorsal surface of head, type specimen of *Cnemidophorus sacki mazatlanensis*, A.M.N.H. No. 75921.

under side of the thighs were pale blue, with darker anterior edges, those of the lower leg largely very pale blue. The ventral surface of the tail was white in the basal portion, changing to reddish brown distally.

## Variation

Size: The largest individual among 49 specimens of *mazatlanensis* examined by me is a male measuring 104 mm. in snout to vent length. The largest female specimen measures 90 mm. Taylor ("1936" [1938b], p. 523) recorded specimens ranging up to 119 mm. from snout to vent, but these apparently represent, in part at least, intergrades with *C. s. huico*. Lewis and Johnson (1956, p. 280) reported specimens in which the "Body length varied from 105 to 117 mm." Evidently total length was meant; the specimens (which I have examined) are juveniles.

Scutellation: The number of scales around midbody averages $105.4 \pm 1.1$ in 34 specimens, range 95–121. The scales from occiput to rump in three specimens are 219, 222, and 223. Femoral pores in 33 specimens range from 33 to 45, mean $37.8 \pm 0.4$. Among 46 specimens, eight (17.4%) have a single scale immediately in front of the cloaca, in place of the more usual pair of scales.

Variation and Development of Color Pattern: Young individuals have bright yellow stripes, a broad, uniform, pale brown or yellowish brown vertebral field, and dark brown, unspotted, dorsolateral and lateral fields. The tail and feet are reddish brown to pink. The ventral surfaces are immaculate; the abdomen and chest are white; the chin is white or very pale blue. (The foregoing notes are based on my personal observations and field notes kindly provided by Dr. T. H. Lewis.) Because there is relatively little difference between the patterns seen in small and large individuals, such ontogenetic change as exists is much less clearly defined than in other subspecies of *C. sacki*. The unspotted juvenile condition (Class I) commonly persists in individuals with a snout to vent length of up to 55 mm., though occasional individuals of smaller size have undergone some pattern metamorphosis. Most individuals 75 mm. or more in length are classified as distinctly spotted (Class III). Notable is the wide range in length (41 to 96 mm.) of animals with light areas (incipient spots) in the lateral and dorsolateral fields (Class II).

No specimen in the sample attained Class IV or Class V; that is, the stripes are always present and are never subordinate to the spots in the total impact of the pattern on the eye. Spots are never present in the vertebral field. I doubt that the absence of specimens in Classes IV and V can be attributed to the paucity of large individuals in the sample. Comparison with the sample of *C. s. nigrigularis* (the spotted subspecies found immediately to the north of the region occupied by *mazatlanensis*) shows that almost all *nigrigularis* 90 mm. or greater in length are completely spotted (Class V), but nine specimens of *mazatlanensis* ranging in length from 90 to 104 mm. fall in Class III, and another, 96 mm. long, falls in Class II.

The chin and throat are immaculate in all specimens less than 70 mm. in length. The first few black spots to appear are usually in the collar region, and spotting is well developed over the whole chin only in individuals greater than 85 mm. long. Most specimens longer than 90 mm. show considerable black on the chin, but in only one specimen is the chin totally black. A wholly black chin is characteristic of larger individuals of *C. s. nigrigularis*, but in that subspecies may appear at a length of only 80 mm. Among nine specimens of *nigrigularis* ranging from 90 to 104 mm. long, six have the chin wholly black. Only one of nine *mazatlanensis* of the same size range has a black chin. I assume that extreme darkening of the chin is not characteristic of *mazatlanensis*.

The only specimen of *C. s. mazatlanensis* with the abdominal surface nearly all black is the specimen with a black chin. The usual condition among the larger specimens (89 to 104 mm.) is largely pale beneath, with only the anterior edges of the scales dark. One individual has the dark pigment arranged in several longitudinal stripes.

In some larger specimens the side of the head may be contrastingly marked with black and white, but such marking is not invariable.

The paravertebral stripes of *C. s. mazatlanensis* are, as in populations of adjacent subspecies, widely spaced. The average PV/SA ratio for 34 specimens is $0.139 \pm 0.003$,

range 0.109–0.196. The number of scales between the paravertebral stripes averages 14.6 (11–20) for 34 specimens.

The vertebral field of *mazatlanensis* is a broad, pale band, which contrasts with the dark brown of the lateral and dorsolateral fields. There appears to be no change in this band from juvenile to adult. In some subspecies of *sacki*, a single or double vertebral line may be present in this field, but such is not the case in *mazatlanensis*.

### Comparison with Other Forms

Among those forms currently recognized as subspecies of *C. sacki*, there appears to be none other than *mazatlanensis* that combines persistent striping with a black-spotted chin and an average of about 105 scales around midbody. The closest similarity is seen in *C. s. barrancorum* of southern Sonora and adjacent Chihuahua. This subspecies does not differ in scutellation and shows a strong tendency to retain at least a suggestion of the juvenile striped pattern. However, the chin of *barrancorum* is immaculate, not spotted as in *mazatlanensis*. The subspecies of *sacki* occurring immediately to the north and south of the area occupied by *mazatlanensis* (*C. s. nigrigularis* and *C. s. huico*) are distinguished by the spotted dorsal pattern attained by large individuals and by differences in throat color.

### Distribution and Intergradation

The northernmost specimens of *C. s. mazatlanensis* are from 2 miles north of Coyotitán, Sinaloa. This is about 30 miles southeast of the nearest locality for *C. s. nigrigularis*, 25 miles northwest of Elota. No truly intermediate population is known, but the close relationship of the two forms is suggested by the appearance in a sample from near Mazatlán of a single individual of *mazatlanensis* with the all-black chin and venter of *nigrigularis*. Also, contrasting black and white facial markings seen in some specimens of *mazatlanensis* are also present in many *nigrigularis*.

Intergradation with *C. sacki occidentalis* apparently takes place on the coastal plain a few miles south and east of Mazatlán. With reference to specimens from Presidio and 10 miles south (southeast?) of Presidio, Taylor ("1936" [1938b], p. 522) wrote: "The ventral surface of chin and throat is bluish-gray in adult males and females, rarely with a trace of pinkish." He noted that larger individuals developed spots in place of the juvenile lines. Referring also to specimens from Presidio, Gadow (1906, pp. 342–343) found that "The throat is sometimes speckled with dark pigment." No breaking-up of lines into spots was seen by Gadow, but his sample included no specimens larger than 85 mm. from snout to vent. The information provided by Taylor and Gadow indicates that the lizards in the vicinity of Presidio (located about 15 miles east-southeast of Mazatlán) are not at all typical of *mazatlanensis*, but deviate strongly towards *huico*. The assumption of a spotted adult pattern, and the "trace of pinkish" seen by Taylor on the throats of some of his specimens, are more than a little suggestive of *huico*. Taylor, incidentally, was aware of the differences between his specimens from Mazatlán and those from Presidio, and in reference to specimens from the tide-water flats near Mazatlán he wrote, "The dorsal linear markings do not break up into dots. . . . The numerous spots on the Presidio specimens are lacking. . . . The chin and throat are more strongly contrasting black and yellow." Taylor's sample evidently included large adult individuals from both localities.

The extent of the area of intergradation cannot be determined precisely with the material at hand, but some rough outlines may be sketched in. A single specimen from 7 miles west-northwest of Rosario (about 19 miles southeast of Presidio) shows strong tendencies towards *huico;* it is 90 mm. in snout to vent length and is heavily spotted, with spots invading the posterior part of the vertebral field. It has therefore reached a higher stage of pattern metamorphosis than any specimen of *mazatlanensis*, including several of greater size. Also, there is a tendency to the formation of paired vertebral lines anteriorly, another character that favors *huico*. There are some black marks on the chin, which would not be present in true *huico*, but these may be gray markings darkened by formalin. As a single specimen, it is best considered as *C. s. huico*, though of course there is no assurance that it is typical of the population of the region in which it was collected.

A specimen from 7 miles north-northwest of Escuinapa is too small (snout to vent, 77 mm.) to offer much useful information on dorsal pattern, but the vertebral light area is relatively narrow compared to the condition in *mazatlanensis*. In life, the chin was white, with a few dark gray flecks. A series of seven specimens is available from 16 miles southeast of Escuinapa. Unfortunately, the lizards are badly darkened by formalin, so that some details of pattern are not clearly visible. All apparently have paired, irregular vertebral lines. One lizard 80 mm. in length has spots in the posterior part of the vertebral field. These characters favor assignment to *huico*. The larger individuals (80 and 75 mm.) have no black spots on the chin, though this character is not definitive; *mazatlanensis* of less than 85 mm. rarely show spots. I assign these specimens from the vicinity of Escuinapa to *C. sacki huico*.

A small number of specimens from the foothills to the east of Mazatlán appear closer to *huico* than to *mazatlanensis*. A large adult (snout to vent, 103 mm.) from Concordia is heavily spotted, with only the paravertebral stripes remaining visible. There is no spotting on the chin. A specimen from 7 miles southwest of Concordia was possibly of the same size, but suffered in collection to the extent that the body from shoulder region to rump is thoroughly mangled. The chin is typical of *huico*—unspotted. The hind legs are quite heavily spotted, as would be the case in a large individual of *huico*.

Other specimens from this region are subadult, and of less use for a determination of the subspecies represented. One from 10 miles west of Concordia has a broad, pale, vertebral field, as is seen typically in *C. s. mazatlanensis* and occasionally in *C. s. huico*. Also, the hind legs do not show the spotted or mottled pattern of *huico*. Four small specimens from Chele (12.5 miles east-southeast of Concordia), 46 to 60 mm. in length, have the dark fields broken up by light areas (distinct spots in the 60-mm. specimen), and some irregularity of the vertebral field is present in two. The light areas in the dark fields are perhaps more highly developed than would be expected in typical *mazatlanensis* of similar size.

Clearly, the material from the foothill region east of Mazatlán is not adequate for the determination of the taxonomic status of the populations, but indications point strongly in favor of *huico* over *mazatlanensis*. I regard the specimens from this region as *C. sacki huico*, recognizing that an adequate sample of adult lizards is yet needed to help settle the problem.

As presently known, then, *C. sacki mazatlanensis* occupies approximately 60 miles of coastal plain from Mazatlán to Coyotitán. No great extension of range is to be expected, as intergradation with *C. s. occidentalis* occurs 15 miles east-southeast of Mazatlán, and *C. s. nigrigularis* is found about 30 miles northeast of the northernmost locality for *mazatlanensis*. Presumably *C. s. mazatlanensis* ranges eastward into the barrancas east of its range on the plain, at least in the north, though the foothill region east of Mazatlán appears to be occupied by *C. s. occidentalis*.

LOCALITY RECORDS: (Forty-nine specimens examined). *Sinaloa:* Two miles north of Coyotitán (A.M.N.H. Nos. 75921 [type specimen], 75921, 75923); 9 miles south of Coyotitán (A.M.N.H. No. 75920); 20 miles north of Mazatlán (C.P.S. Nos. 7516, 7518); 11 miles north and 1.5 miles east of Mazatlán (U.M.M.Z. No. 112653, four specimens); 9 miles north of Mazatlán (M.V.Z. Nos. 59181–59195); 3 miles north-northwest of Mazatlán (U.K.M.N.H. Nos. 29736, 29741); 2.6 miles north-northwest of Mazatlán (U.M.M.Z. No. 114699); 2.6 miles north and 1.4 miles west of Mazatlán (F.A.S. No. 8476); north of Mazatlán (A.M.N.H. Nos. 20718–20723); Mazatlán (C.P.S. No. 7561); Rincón de Urias, east of Mazatlán (A.M.N.H. Nos. 20724–20732); 1 mile southeast of Mazatlán (U.K.M.N.H. No. 29749); 2.3 miles east and 1.5 miles south of Mazatlán (F.A.S. No. 7721); 5.4 miles southeast of Mazatlán (C.H.L. No. 7201, D.L.B. No. 116).

**Cnemidophorus sacki nigrigularis,**
new subspecies

Plate 44, figures 3, 6

TYPE: A.M.N.H No. 75925 (field label R. G. Zweifel No. 3058), adult male, collected by R. G. Zweifel 10.5 miles northwest of Culiacán, Sinaloa, Mexico, on August 20, 1956.

PARATYPES: A.M.N.H. Nos. 62325, 75924; F.A.S. Nos. 8501, 8504, 8531–8534, 9086; M.V.Z. Nos. 59916, 59197, 59203, 50205.

DIAGNOSIS: A subspecies of *Cnemidophorus sacki* with an average of about 107 scales around midbody. Large individuals are without stripes and have a dorsal pattern of numerous light spots on a dark background, and a black chin. *Cnemidophorus sacki griseocephalus* and *C. s. huico* are similar in scutellation and dorsal pattern, but *griseocephalus* has a pale blue chin, and *huico* a red chin.

DESCRIPTION OF TYPE SPECIMEN: The length from snout to vent is 94 mm.; the tail is incomplete, with a regenerated tip. There are 106 scales around midbody (excluding enlarged ventrals), and 201 from occiput to rump. Thirty-three femoral pores are present. Other features of scutellation (enlarged postantebrachials and mesoptychials, four supraoculars) are typical of *sacki*.

The type specimen is an individual in a late stage of metamorphosis from striped to spotted pattern. The stripes are distinct and continuous on the neck, but much less so on the body. The paravertebral stripes are represented by rows of spots connected by a very faint trace of the original line. The dorsolateral line is almost non-existent, but the lateral line is still fairly strong. The vertebral field is faintly paler than fields lateral to it. All fields are heavily spotted, and spots are likewise present on the base of the tail and the dorsal surfaces of the hind limbs. The ground color of the dorsum was, in life, brown, with only slight differences in shade among the head, neck, and body. The spots were yellow. The paravertebral stripes are separated by 15 scales at midbody, PV/SA $=0.141$.

The sublabial scales are pale, as are the enlarged mesoptychials. All other chin and throat scales are black. The chest and lower surfaces of the forelimbs are black, and the abdomen is pale but clouded with gray. The lower surfaces of the thighs and the preanal scales are darkened.

## VARIATION

SIZE: Among the 45 specimens assigned to this subspecies, the largest is a male 114 mm. in snout to vent length. There are 10 specimens 100 mm. or more in length, all males. The two largest females measure 84 mm.

SCUTELLATION: The scales around midbody average $107.2 \pm 1.0$ (95–120), $N=44$. Six specimens show an average of 218.3 (201–241) scales from occiput to rump. Femoral pores for specimens from all parts of the range average $36.8 \pm 0.4$ (32–41), $N=45$. No regional differentiation is evident in number of femoral pores. A sample of 19 specimens from the vicinity of Culiacán averages $36.7 \pm 0.5$ (33–40), and a sample of 26 specimens from the southern end of the range, 25 to 37 miles northwest of Elota, averages $36.8 \pm 0.5$ (32–41). The sample localities are about 45 miles apart.

VARIATION AND DEVELOPMENT OF COLOR PATTERN: A hatchling 38 mm. in snout to vent length has dark fields, without indication of spotting. Obscure spots are present in the lateral and dorsolateral fields at least by the time the lizard has reached a snout to vent length of approximately 60 to 70 mm., and perhaps at a smaller size. Most specimens in the 70–80-mm. size class have fairly distinct spots in all but the vertebral field. Probably the transition from this condition to the totally spotted pattern is fairly rapid. In the 80–90-mm. size class there are similar numbers of specimens in Classes III (all fields but vertebral spotted), IV (spots prominent in vertebral field), and V (stripes indistinct or gone). Sixteen of 17 specimens greater than 90 mm. in length belong to the last category. Briefly, then, obscure spotting is present in individuals measuring as little as 61 mm. from snout to vent. The spots gradually become more discrete, and between a body length of approximately 80 to 90 mm. most individuals lose the stripes and become wholly spotted. Rarely, the metamorphosis of pattern may be complete in an individual as short as 80 mm. At the other extreme, a specimen measuring 92 mm. has all stripes distinct and no spots in the vertebral field.

VENTRAL SURFACES: Excluding for the moment a series of nine specimens from 36.8 miles northwest of Elota, Sinaloa, the following generalizations may be made: All specimens (eight) greater than 100 mm. in snout to vent length have the ventral surfaces totally black. All 85 mm. or more in length (19 specimens) have at least the chin and chest largely or wholly black. All specimens (nine) less than 80 mm. in length are largely or wholly pale beneath. In an individual lizard

the transition from pale to dark venter takes place at a snout to vent length of between 80 and 100 mm. One male only 80 mm. long has a totally black venter, but another 100 mm. has only the chin and chest darkened. All female specimens are pale beneath, which may merely reflect the lack of large females in the sample, as the two largest measure only 84 mm. In general, it appears that dark coloration of the ventral surfaces becomes evident at about the same time that spotting begins to predominate in the pattern of the dorsum. Individuals with the dorsal stripes indistinct or absent may be expected to have the chin, chest, and abdomen largely or wholly black. Inasmuch as virtually all specimens were collected in the months of July and August, the possible effect of seasonal variation on ventral coloration is not known.

Nine specimens from 36.8 miles northwest of Elota are not in complete agreement with the picture outlined above. Two females 69 and 77 mm. in length are pale beneath, which is as expected. Similarly, a male (86 mm.) and a female (85 mm.) have the chin and chest largely black. Three male specimens measuring 79, 82, and 84 mm. show some blackening of the chest, but the throat is gray, without the obvious darkening that usually accompanies the dark chest. Two large males (96 and 104 mm.) have completely dark chest and abdomen, but the throat is deep gray in one and gray weakly spotted with black in the other. Were these specimens from the northern end of the range, I would suspect intergradation with *C. s. griseocephalus*, but such an interpretation is out of the question for geographic reasons. The hypothesis that intergradation with *C. s. mazatlanensis* may explain the situation meets with the following difficulty: a series of specimens from 25 miles northwest of Elota, some 10 miles closer to the range of *mazatlanensis*, is typical of *nigrigularis*. There may be some interdigitation of ranges not evident in the material presently available to me, but for the present I classify the lizards from 36.8 miles northwest of Elota as an aberrant population of *nigrigularis*.

The spacing of the paravertebral stripes is relatively wide. The PV/SA ratio for 28 specimens of *nigrigularis* averages 0.148 $\pm$0.004, range 0.100–0.198. The number of scales separating the paravertebral stripes was counted on 23 specimens: mean 15.9, range 10–20.

### Comparison with Other Forms

*Cnemidophorus sacki nigrigularis* is most closely similar to *C. s. griseocephalus* and is compared with that subspecies in the account of *griseocephalus*. The black throat of *nigrigularis* is almost unique, as far as I have been able to determine, among species and subspecies of the *sexlineatus* group. One specimen among several *C. s. mazatlanensis* has the throat entirely black, but the usual condition for that subspecies in a pale blue throat spotted with black. Too, *mazatlanensis* apparently never attains the completely spotted dorsal pattern characteristic of larger specimens of *nigrigularis*. The pink or rusty thoat color of *C. s. huico*, a subspecies that, as *nigrigularis*, becomes completely spotted in larger individuals, will separate the two forms. It is worth noting that the ranges of the spotted forms *nigrigularis* and *huico* are not in contact but are separated by the area occupied by the striped *mazatlanensis*.

Specimens suggestive of intergradation between *nigrigularis* and *griseocephalus* are mentioned in the account of the latter form on page 100. No obvious intergradation is yet known to exist between *nigrigularis* and the form to the south, *mazatlanensis*, but some similarities are discussed in the account of *mazatlanensis*.

### Ecological Notes

The Thorn Forest of the coastal plain is the habitat of *C. s. nigrigularis*. This subspecies may perhaps range into the Tropical Deciduous Forest of the barranca region, but that part of central Sinaloa is as yet virtually unknown from the herpetological standpoint. As far as is presently known, *C. s. nigrigularis* shares its range with no other species of *Cnemidophorus*.

The smallest gravid female examined measures 62 mm. in snout to vent length, and contains ova 8 mm. in diameter. This individual was captured on July 18. Another, taken at the same time and place, had ova only 5 mm. in diameter. Still another, with ova only 4 mm. in diameter, was taken on August 20. Evidently the breeding season

extends over much of the summer. No female specimens collected in months other than July and August are available.

### Distribution

*Cnemidophorus sacki nigrigularis* is known only from the coastal plain of central Sinaloa, though the range may extend eastward into the barrancas. The northernmost locality for the subspecies in 23.3 miles south of Caitme, approximately 32 miles southeast of the closest locality for *griseocephalus*, 7 miles west of Guamuchil. The specimens of *nigrigularis* are typical of the subspecies (an adult male is wholly black beneath), but the specimen of *griseocephalus* possibly shows some tendency towards *nigrigularis* in dorsal coloration in that the head and body color are not strongly contrasting. The southernmost known population of *nigrigularis* is found at 25 miles northwest of Elota, giving the subspecies a total linear range of about 85 miles. No specimens have yet been taken in the distance of 30 miles that separate this southernmost locality for *nigrigularis* from the closest *mazatlanensis* at 2 miles north of Coyotitán.

Locality Records: (Fourty-seven specimens examined). *Sinaloa:* Twenty-three and three-tenths miles south of Caitme (F.A.S. Nos. 8501, 8504); 20 miles northwest of Culiacán (U.M.M.Z. No. 113067); 16.5 miles northwest of Culiacán (A.M.N.H. Nos. 75926–75929); 15.6 miles northwest of Culiacán (F.A.S. Nos. 8524–8535); 10.5 miles northwest of Culiacán (A.M.N.H. No. 75925, type specimen); 4 miles south of Culiacán (A.M.N.H. No. 62325); 36.8 miles northwest of Elota (C.H.L. Nos. 7804–7812); 25–26 miles northwest of Elota (F.A.S. Nos. 9081–9086, A.M.N.H. No. 75924, M.V.Z. Nos. 59196–59205).

### Cnemidophorus sacki griseocephalus, new subspecies

Plate 45, figures 1, 3

*Cnemidophorus sackii sackii*, Bogert and Oliver, 1945, p. 348 (part, specimens from Alamos), p. 402.

*Cnemidophorus sacki communis*, Zweifel and Norris, 1955, p. 236 (part, specimens from Alamos and Navojoa).

Type: A.M.N.H. No. 75930 (field label R. G. Zweifel No. 3070), adult male, collected by R. G. Zweifel 11.4 miles east of Navojoa, Sonora, Mexico, on August 21, 1956.

Paratypes: F.A.S. Nos. 7835, 7902,10427–10429; M.C.Z. Nos. 43382, 43384, 43387; M.V.Z. Nos. 50719, 50721.

Diagnosis: A subspecies of *Cnemidophorus sacki* with an average of about 107 scales around midbody. Large individuals are without stripes and have a dorsal pattern of numerous light spots on a dark background, and a pale blue chin. Forms similar in dorsal pattern and in scutellation are *C. sacki nigrigularis*, which has a black chin, and *C. sacki huico*, in which the chin is pink to brick-red. *Cnemidophorus stictogrammus* has the scutellation and pattern similar to those of *griseocephalus*, but shows a closer spacing of the paravertebral lines in juveniles and subadults (PV/SA averages 0.076 in *stictogrammus*, 0.153 in *griseocephalus*). More extensive comparison of the various forms is made in subsequent paragraphs.

Description of Type Specimen: (See pl. 45, figs. 1, 3). The length from snout to vent is 101 mm.; total length is 286 mm., 100 mm. of which is regenerated tail. There are 104 scales around midbody (excluding enlarged ventrals), and 237 from the occiput to rump. Femoral pores number 32. The postantebrachial scales are conspicuously enlarged. The head scales (fig. 3) are typical of *sacki*, except for an incomplete longitudinal division of the interparietal, an individual anomaly.

A faint trace on the neck of the dorsolateral line is the only remnant of the striped juvenile pattern. In life, the top and sides of the head were blue-gray, passing into gray-brown on the neck and shoulder region. Posteriorly, to the base of the tail, the ground color was black. Contrasting with the black background are 14 rows of spots that were bright yellow. The 14 rows represent the six primary stripes, one row of spots in each of three lateral fields on each side, and two rows in the vertebral field. There is very little fusion of spots to form vertical bars. The forelimbs were blue-gray and unmarked dorsally, the hind limbs black, with numerous yellow spots. Yellow spotting on a black background was present at the base of the tail, but the remainder of the unregenerated portion was blue-gray.

The enlarged scales bordering the infra-

labials were white, the remaining scales of the chin and throat (including the enlarged mesoptychials) very pale blue. The chest and lower surfaces of the forelimbs were very dark blue, almost black. The majority of the ventral scales were largely pale blue, but dark blue longitudinal lines follow the edges of scales to form irregular stripes. The pre-anal scales and adjacent scales of the under surfaces of the femora (about one-half of the area of the under surface) were deep blue, and this color continued a short distance anteriorly in the midventral region.

### Variation

Size: The largest of 71 specimens assigned to this subspecies measures 110 mm. from snout to vent, and is a male from Alamos, Sonora. There are 10 individuals 100 mm. or more in length, all males. The largest female

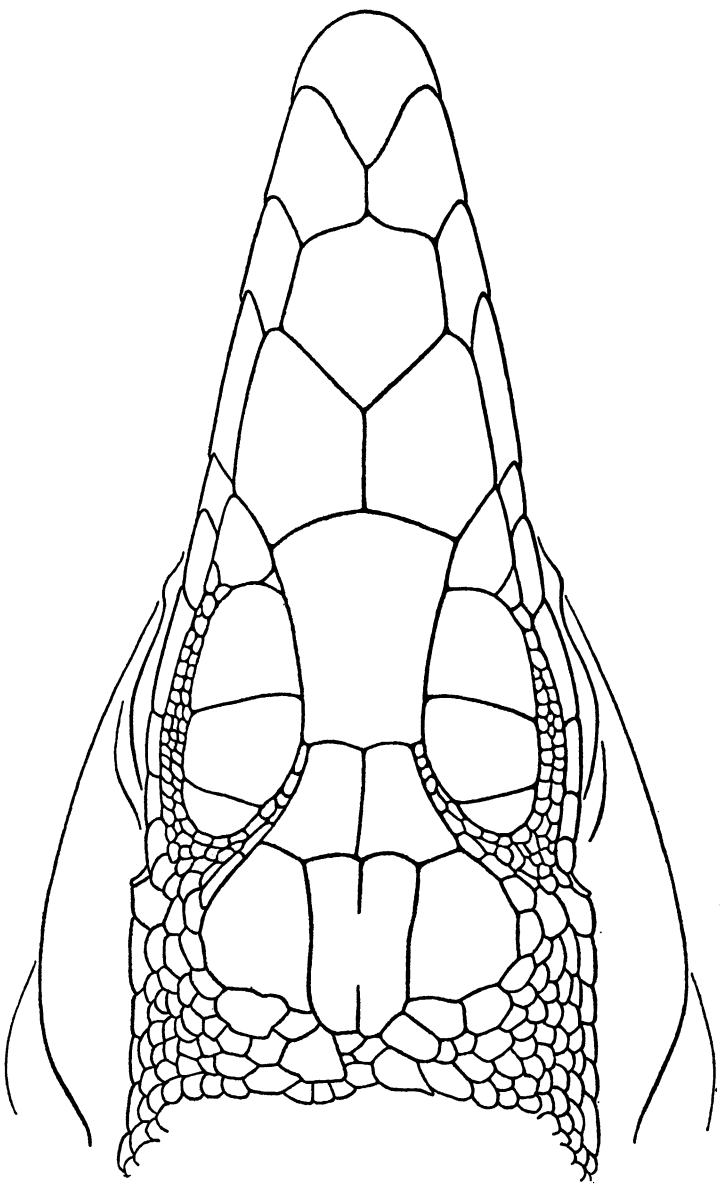

Fig. 3. Scutellation of dorsal surface of head, type specimen of *Cnemidophorus sacki griseocephalus*, A.M.N.H. No. 75930.

measures 99 mm., but only five of 19 specimens in the 90–99-mm. size range are females.

SCUTELLATION: The sample of 24 specimens from Alamos, Sonora, has an average of $106.9 \pm 1.3$ (97–119) scale rows around midbody. Twenty-eight specimens from the balance of the range in southern Sonora and northern Sinaloa average $107.5 \pm 0.8$ (100–118) and thus do not differ significantly from the lizards at Alamos. The average for the total of 52 specimens is $107.2 \pm 0.7$ (97–119). The number of scales from occiput to rump averages 240.4 (226–257) in 15 specimens. Femoral pores in the Alamos series average $34.7 \pm 0.5$ (31–39, $N = 24$), in the remainder, $33.7 \pm 0.3$ (30–38, $N = 28$). Average for all specimens is $34.2 \pm 0.3$ (30–39, $N = 52$).

COLOR PATTERN: Presented first is a description of the ontogenetic development of color pattern of lizards of the coastal plain in southern Sonora and northern Sinaloa. A similar presentation for the population in the foothills at Alamos follows.

This description is based on a sample of 30 specimens (16 males and 12 females ranging in snout to vent length from 64 to 107 mm. and two juveniles 48 mm. in length). The juveniles have ill-defined light spots in the lateral and dorsolateral fields and may be placed in pattern Class II. The vertebral field is occupied by a light band with wavy edges. The light band is nearly resolved into two parallel lines.

Eight males 66 to 85 mm. in snout to vent length all have all six primary stripes present and unbroken. In all individuals the dark fields (excepting the vertebral) are spotted. In the smaller specimens (66, 70, 72 mm.), the light markings in the dark fields, while clearly spots, are not sharply defined (Class II). Definition of the spots improves in the larger specimens, and the clearest spots are usually in the lower lateral field.

There are no male specimens between 85 and 91 mm. in snout to vent length. The 91-mm. individual, and seven larger ones ranging up to 107 mm., show no trace of a lined pattern on the body, so belong in Class V. The head and neck are gray to gray-brown, and the dorsal surface of the body is provided with a liberal scattering of distinct light spots on a dark background. On the side of the body the spots often fuse to form vertical light bars.

The 12 female specimens range in length from 64 to 88 mm. from snout to vent. The two largest specimens, 88 and 85 mm., retain distinct stripes on the neck, but have the body spotted, with no striping remaining (Class V). An 84-mm. specimen belongs in Class IV, as all stripes are present, but the fields are well spotted, including a few spots in the vertebral field. Another 84-mm. specimen has a very obscure dorsal pattern, with both stripes and spots indistinct. Specimens shorter than 80 mm. from snout to vent all have spotting in the dark fields, but the spots are not clearly defined, and in the smallest individual (64 mm.) are confined to the posterior parts of the dark fields.

The chest is dark (deep blue in life) in all specimens, male and female, 85 mm. or greater in length, excepting one 85-mm. male with a completely pale venter. A male 81 mm. in length shows slight blackening of the chest, and a 77-mm. male has a very slight darkening of the side of the chest region. The entire ventral surface from chest to preanal scales is dark in some large males, but not completely so in others.

The PV/SA ratio averages $0.142 \pm 0.006$ (0.100–0.178) in 17 specimens.

Alamos, Sonora, lies in the foothills roughly midway between the type locality of *C. s. griseocephalus* and that of *C. s. barrancorum*. Forty specimens are available from Alamos and its immediate environs and clearly show a close relationship to *griseocephalus* of the coastal plain. All lizards greater than 94 mm. in snout to vent length (14 specimens) are completely spotted, with traces of lines present only on the neck if at all (Class V). All specimens 83 mm. or less in length (15 specimens) have all six primary stripes present. Specimens measuring between 86 and 94 mm. show not only the intermediate pattern, but also both extremes. As intermediates may be cited two males of 86 and 92 mm., and a female of 92 mm., that retain the paravertebral stripes but are otherwise wholly spotted. Three males 87, 88, and 94 mm. in length are wholly spotted, while six specimens measuring 86 to 94 mm. retain all stripes. The latter group includes a 94-mm. female, two males and a female measuring 90 mm., and a male

and a female each 86 mm. in length. One smaller specimen 57 mm. long shows no spotting, but only the striped pattern.

The ventral surfaces, the chest in particular, are frequently dark in these lizards. Five of six males of 100 mm. or more in length have the ventral surfaces (exluding the chin) totally (four individuals) or partially dark, while only one is light. Individuals in the 90–99-mm. size range are about equally divided between dark and light venters (seven dark, eight light), and totally dark venters are seen in specimens as small as 86 mm.

The PV/SA ratio averages $0.163 \pm 0.006$ (0.130–0.225) in 17 specimens from Alamos.

The absence of stripes in large adults, and their replacement by well-defined spots contrasting with a dark background color, direct assignment of the population of Alamos to *griseocephalus*, despite the geographic intermediacy of the locality with respect to the over-all ranges of *griseocephalus* and *barrancorum*. Zweifel and Norris (1955, p. 236) suggested the possibility that lizards of the foothills and coastal plain of southern Sonora represented two distinct subspecies, but erroneously included the Alamos population (on the basis of only a single specimen examined) with the inland form (here called *barrancorum*). The presence in the Alamos sample of three lizards 90 to 94 mm. in length that retain all stripes might be regarded as the result of a genetic influence from *barrancorum*, as persistently striped individuals of *griseocephalus* of such large size were not seen in the sample from the coastal plain of southern Sonora and Sinaloa. However, the situation might just as well be attributed to the more adequate sample (40 *vs.* 28 specimens) including more variation.

To summarize, the development of pattern in *C. sacki griseocephalus* follows this general pattern: The young lizards are striped, with unspotted dark lateral fields separating the six primary stripes, and a slightly lighter vertebral field. By the time the lizard reaches a snout to vent length of 64 mm., indistinct spots have begun to appear in the posterior parts of the dark fields. The spots become more clearly defined as growth progresses and appear in the vertebral field shortly before the lines on the body break up into rows of spots. This occurs at a length of between 85 and 90 mm. in most individuals, though striping on the body may rarely persist to a length of 94 mm. Stripes remain evident for a longer time on the neck but are all but gone in most individuals greater than 90 mm. in length. In some large individuals, the spots on the sides may fuse to form light vertical bars. The chest and often the entire venter (excluding the pale blue chin) are very dark blue, almost black, in most large individuals, and may reach the extreme condition in individuals measuring as little as 86 mm. from snout to vent. However, some individuals of near-maximum size may be completely pale beneath. Females as well as males attain the completely spotted condition and dark venter, but relatively few females attain a size at which complete pattern metamorphosis takes place.

The PV/SA ratio for 34 specimens of *griseocephalus* averages $0.153 \pm 0.005$ (0.100–0.225). The number of scale rows between the paravertebral stripes ranges from 11 to 23, mean $16.2 \pm 0.5$.

### Comparison with Other Forms

*Cnemidophorus sacki griseocephalus* is most closely similar to *C. s. nigrigularis*, a form that inhabits the adjoining region to the south of the range of *griseocephalus*. The two subspecies are virtually identical in number of scale rows about midbody, the averages being: *griseocephalus*, $107.2 \pm 0.7$ (97–119, $N = 52$); and *nigrigularis*, $107.2 \pm 1.0$ (95–120, $N = 44$). A statistically significant difference in femoral pores is present, apparently part of a step-cline involving other races as well: *griseocephalus*, $34.2 \pm 0.3$ (30–39, $N = 52$); *nigrigularis*, $36.8 \pm 0.4$ (32–41, $N = 45$).

The most striking difference between the subspecies lies in the pigmentation of the chin. In typical large specimens of *nigrigularis*, all smaller scales of the chin and throat (excluding the enlarged sublabial series) are black, in marked contrast to the pale blue chin of *griseocephalus*. The side of the head and the neck of *nigrigularis* are often, especially in the largest specimens, boldly patterned in black and white, whereas this region in *griseocephalus* is unicolored blue-gray. The relatively sharp gradation from light head to black body that characterizes *griseocephalus* is not so evident in *nigrigularis*.

In this form the head and neck are, on the average, relatively darker and the body is lighter than in *griseocephalus*. The southernmost specimens assigned to *griseocephalus* are two from 7 miles west of Guamuchil, Sinaloa. One of these is an adult male with spotted dorsum and pale, immaculate chin. On the basis of chin color, the lizards are regarded as *griseocephalus*, but the male lacks the contrast between the color of the head and that of the body, and in this respect may show intergradation with *nigrigularis*.

About 250 miles to the south of the southernmost locality for *C. s. griseocephalus* is the northernmost locality for *C. s. huico*, another form with an adult pattern of spots. (The intervening 250 miles are inhabited by *C. s. nigrigularis* and the striped *C. s. mazatlanensis*.) The pink to brick-red throat of *huico* will distinguish this subspecies from *C. s. griseocephalus*. The more southern form resembles *nigrigularis* and differs from *griseocephalus*, too, in lacking the contrast between the color of head and body seen in *griseocephalus*.

COMPARISON WITH *Cnemidophorus stictogrammus:* The greater size and "aberrant" pattern attained by a species of *Cnemidophorus* in southern Arizona compared to what was seen in other parts of the range presented a puzzle that was unsolved for many years. No better explanation of the situation was available than the suggestion of Ruthven (1907, p. 559) that "environmental conditions at Tucson may be more favorable for this species than those composing its habitat at Alamogordo [New Mexico], and thus be directly or indirectly the cause of the larger size attained by individuals in this locality." The status of the lizards of southern Arizona was not improved when Burger (1950, p. 5) described *Cnemidophorus sacki stictogrammus* from southern Arizona, including in the range southern New Mexico, extreme western Texas, and northwestern Mexico. It remained for Lowe (1956) to demonstrate that two sympatric species of *Cnemidophorus* were involved in the snarl. The smaller of these he named *C. sacki exsanguis*, recognizing the other as *C. stictogrammus*. He (1956, p. 150) suggested that *stictogrammus* was related to several Mexican forms now treated under the species, *Cnemidophorus sacki*.

Because *C. stictogrammus* is similar in many respects to *C. sacki griseocephalus*, it is well to compare the two forms. First of all, there is no question that the two represent recognizably distinct populations. The contrast between light color of head and dark body so conspicuous in large adult *griseocephalus* is much less in *stictogrammus*, in which the head is lighter and brigher brown than the body (pl. 46, fig. 3). The under surfaces of *stictogrammus* are immaculate white to cream, never with the chest or entire venter darkened as is frequently the case in *griseocephalus*. Another point of difference is the spacing of the paravertebral stripes in young individuals and adults with stripes. The PV/SA ratio averages about 0.076 in *stictogrammus*, 0.153 in *griseocephalus*. Probably *stictogrammus* is a larger form, as it exceeds 130 mm. in length from snout to vent (Lowe, 1956, p. 147), as compared to the maximum of 110 mm. known for *griseocephalus*.

The differences mentioned are, I feel, quite sufficient to justify nomenclatorial recognition of the two populations. In an earlier section of this paper, I explained my viewpoint on the use of the name *sacki:* I am recognizing as subspecies of *sacki* the several forms from southern Sonora to Jalisco that have an average count of dorsal scales around midbody similar to that of typical *sacki*, that is, approximately 100 scales. Inasmuch as *stictogrammus* has an average of $104.7 \pm 1.2$ (98–115) scales around midbody (Lowe, 1956, p. 140) and resembles some races of *sacki* in assuming a spotted, unstriped, dorsal pattern, it would seem reasonable to refer *strictogrammus* to *sacki*, along with the chain of west coast subspecies dealt with here. I am not yet ready to take this action. There is no evidence of intergradation between *stictogrammus* and *griseocephalus*, but little significance can be attached to this fact, as much of Sonora is virtually unknown ground with respect to lizards of the genus *Cnemidophorus*. I have examined only 10 specimens from Sonora that I consider to be *stictogrammus*, but five of these have fewer than 100 scales around midbody (91–95). This may prove to be a significant departure from the average of 104.7 (98–115) given by Lowe for specimens from Arizona. If there is truly a reduction in the average number of scale rows

of *stictogrammus* in the southern part of its range, this would be a trend away from *griseocephalus*. The southernmost specimen of *stictogrammus* that I have examined is one from 5 miles north of Hermosillo (U.C.M. No. 8605), a locality about 160 miles northwest of the northernmost station for *griseocephalus*. This specimen is 95 mm. in length from snout to vent and is heavily spotted, with, however, distinct stripes on the neck and traces of stripes to the rump. The paravertebral stripes are separated by only four scales, there is relatively little contrast between the color of head and body, and the venter is pale. There are only 91 scales around midbody.

The pale ventral surfaces of *Cnemidophorus stictogrammus* and narrow separation of the paravertebral stripes are characters that ally this species with its sympatric congener *C. sacki exsanguis*. It may be that *stictogrammus* and *exsanguis* have developed from a different stock from *griseocephalus*, and that the resemblance of *stictogrammus* to *griseocephalus* is secondary. Proper treatment of the problem must include a survey of *C. sacki exsanguis* and its relationships to the forms of the Mexican Plateau. If *stictogrammus* were to be assigned to the species *sacki*, the anomaly of sympatric subspecies of *sacki* would be created, unless *C. sacki exsanguis* were reassigned. Such changes would contribute little or nothing at our present stage of knowledge, and the matter may best be left in abeyance until a sufficiently exhaustive study can be made.

## Ecological Notes

All known localities for *C. sacki griseocephalus*, with the exception of Alamos, fall within the Thorn Forest of the coastal plain, a type of vegetation characterized by Leopold (1950, p. 516) as "a dense but scrubby forest, dominated by thorny leguminous trees, particularly acacias." The town of Alamos, slightly higher and more inland than other localities for the subspecies, is within the Tropical Deciduous Forest. On the coastal plain north of Navojoa, the Thorn Forest gradually merges into vegetation of the part of the Sonoran Desert called by Shreve (1951) the Foothills of Sonora. It will be of interest to see if additional collections substantiate the apparent coincidence of lizard distribution with vegetation. I have hunted in the vicinity of Ciudad Obregon, in the desert 30 to 40 miles northwest of the northernmost locality for *griseocephalus*, and found only *Cnemidophorus tigris*.

Throughout most of its range, *C. s. griseocephalus* is apparently the only species of *Cnemidophorus* present. Only at the northern edge of the range, along the road between Navojoa and Alamos, has another species (*C. tigris*) been found to occur in the same region.

The smallest sexually mature female (with enlarged ova) examined by me is one that measures 69 mm. from snout to vent. Bogert and Oliver (1945, p. 402) mention gravid females between 65 and 70 mm. in snout to vent length. The limited data available suggest that ovoposition takes place in the late summer. A specimen taken July 19 contained ova 6.5 mm. in diameter; three taken on August 5 had ova with the greatest dimensions measuring 9.0, 12.6, and 14.6 mm. A female of maximum size (95 mm. from snout to vent) taken on August 26 contained only tiny, immature ova. Another found on August 22 had ova 7.0 mm. in diameter. Bogert and Oliver (*loc. cit.*) present data on this subspecies, showing a positive correlation between number of eggs and snout to vent length.

## Distribution

*Cnemidophorus sacki griseocephalus* is known to occur in southern Sonora and northern Sinaloa. The northernmost locality is 12.4 miles northwest of Navojoa. Inland, the subspecies ranges to Alamos, but it is replaced by *C. s. barrancorum* at Guirocoba, about 20 miles southeast of Alamos. The southernmost locality for *griseocephalus* is 7 miles west of Guamuchil, Sinaloa. The specimens from both northern and southern extremes of the known range were collected by the author, in company with Kenneth S. Norris and William J. Riemer. A hiatus of approximately 35 miles lies between the southernmost locality for *griseocephalus* and the northernmost for *nigrigularis* (23.3 miles south of Caitme, Sinaloa). As presently known, the range of *C. s. griseocephalus* consists of a 150-mile stretch of the coastal plain in southern Sonora and northern Sinaloa, and

extends inland into the edge of the foothills, at least in the north.

LOCALITY RECORDS: (Seventy-eight specimens that have been examined are cited by museum number). *Sonora:* Alamos (F.A.S. Nos. 10633–10635; M.C.Z. Nos. 43380–43387; A.M.N.H. Nos. 64209–64218, plus seven untagged; U.A., five specimens, unnumbered); 1 mile south of Alamos (F.A.S. Nos. 8142, 8143); 1 mile northwest of Alamos (M.V.Z. No. 28923); 8 miles southwest of Alamos (U.C.L.A. Nos. 4345, 4346; M.V.Z. Nos. 28922, 50714); 2.4 miles northwest of Alamos (F.A.S. Nos. 7835–7839); Camoa (M.V.Z. No. 28921); foothills between Navojoa and Alamos (S.N.H.M. Nos. 16610, 16611); 14.6 miles east of Navojoa (C.H.L. No. 7168); 11.4 miles east of Navojoa (A.M.N.H. No. 75930, type specimen); 10 miles east of Navojoa (C.H.L. No. 7176); 13 miles east of Navojoa (D.L.B. No. 97); 1 mile east of Navojoa (F.A.S. No. 10418); 12.4 miles northwest of Navojoa (M.V.Z. Nos. 50715–50721, 50723); 2.4 miles south of Navojoa (F.A.S. No. 7834); 5.6 miles south of Navojoa (F.A.S. No. 10415); 42 miles (by road) south-southeast of Navojoa (F.A.S. Nos. 7802, 7902); Highway 15, 8.7 miles from the Sonora-Sinaloa boundary (F.A.S. Nos. 10420, 10427, 10428, 10435, 10439). *Sinaloa:* One mile northeast of El Fuerte (C.N.H.M. No. 71528; U.I.M.N.H. Nos. 40511–40513); Ahome (Bogert and Oliver, 1945, p. 402); 10.1 miles southeast of Los Mochis (F.A.S. Nos. 10417, 10429); 29.2 miles southeast of Los Mochis (F.A.S. No. 10419); 37 miles southeast of Los Mochis (F.A.S. No. 10421); 7 miles west of Guamuchil (M.V.Z. Nos. N. 59206, 59207).

### Cnemidophorus sacki barrancorum, new subspecies[1]

Plate 45, figures 2, 4

*Cnemidophorus communis*, COPE, 1879, p. 261.

*Cnemidophorus sexlineatus gularis*, BURT, 1931a, p. 116 (part, specimens from Batopilas, Chihuahua).

*Cnemidophorus sackii sackii*, BOGERT AND OLIVER, 1945, p. 348 (part, specimens from Guirocoba, Sonora).

*Cnemidophorus sacki communis*, ZWEIFEL AND NORRIS, 1955, p. 236 (part, specimens from Guirocoba, Sonora).

TYPE: M.V.Z. No. 50724 (field label R. G. Zweifel No. 1049), adult male, collected by R. G. Zweifel at Rancho Guirocoba, about 20 miles southeast of Alamos, Sonora, Mexico, on August 7, 1950.

PARATYPES: A.M.N.H. No. 63697; M.C.Z. Nos. 43377, 43378; M.V.Z. Nos. 50725, 50727, 50734.

DIAGNOSIS: A subspecies of *Cnemidophorus sacki* that differs from other described races of the species having approximately 100 scales around midbody in that large adult specimens retain at least a trace of the juvenile striped pattern, and have the chin and throat pale and immaculate.

DESCRIPTION OF TYPE SPECIMEN: The length from snout to vent is 99 mm.; the total length (tail complete), 352 mm. There are 109 scales around midbody (excluding enlarged ventrals), and 201 scales from occiput to rump. There are 37 femoral pores; postantebrachials are markedly enlarged. The scutellation of the head is typical of *sacki;* four supraoculars are present; the fourth is entirely separated from the median head scales by the short row of circumorbital scales, which penetrate anteriorly only along about one-half of the inner margin of the third supraocular. There are three enlarged parietals, followed by a series of smaller, irregular scales that grade abruptly into the dorsal granules.

The paravertebral lines are weak but continuous from the nape to above the groin, and are separated by 16 rows of scales at midbody (PV/SA = 0.147). The upper and lower lateral lines are faintly evident on the neck but are broken into rows of spots on the body. Spots are present in the lower lateral, upper lateral, and dorsolateral fields, as well as on the dorsal surfaces of the hind limbs. A faint suggestion of spotting is seen in the posterior portion of the vertebral field, which otherwise features a broad band, slightly paler than the narrow edge of ground color that separates it from the paravertebral stripes. The tail is unmarked, save for an irregular, light trace in the basal region that presumably represents the vestige of a juvenile stripe (pl. 45, fig. 2).

The scales of the chin and throat are pale,

[1] The subspecific name refers to the presence of this form in the barranca region of Sonora and Chihuahua.

with only a faint darker cast to a band of enlarged gulars. There are no discrete dark markings. The remainder of the ventral surfaces (chest, abdomen, legs, and tail) is predominantly pale, though most of the scales have dark anterior edges (pl. 45, fig. 4).

### Variation

Size: Among 28 individuals from Guirocoba, Sonora, and Guasaremos, Chihuahua, assigned to this subspecies, the largest is a male that measures 107 mm. from snout to vent. One male is 100 mm. in length, and there are five in the 90–99-mm. range. The four largest females measure 87 (one), 86 (two), and 85 mm. (one). Male and female lizards are represented in the sample in approximately equal numbers, so the probability of sexual dimorphism in size is evident.

Scutellation: In 21 specimens from Guirocoba, the number of scales around midbody averages $103.1 \pm 1.4$, range 91–119. The number of scales from the occiput to the rump in six specimens averages 216.3 (201–247). The femoral pores in 22 specimens from the same locality average $35.4 \pm 0.6$, range 30–40. Four specimens from Guasaremos, Chihuahua, have an average of 103.0 (95–110) scales around midbody and 36.0 (33–38) femoral pores, so closely resemble the lizards from Guirocoba in these respects.

Development of and Variation in Color Pattern: The sample on which this description is based consists of 24 specimens from Guirocoba, equally divided between males and females. Young individuals are not present in the sample, which includes specimens ranging in snout to vent length from 71 to 107 mm. Presumably the juvenile lizards have six primary light lines, with one or two additional lines sometimes present in the vertebral field. The dorsolateral, upper lateral, and lower lateral fields probably are unspotted.

The two smallest males, 77 mm. in snout to vent length, have all six stripes distinct. One of these specimens has ill-defined spots in all but the vertebral field, while the other lizard shows no spots at all, but only some indefinite lighter pigmentation in the upper and lower lateral fields. In specimens that measure 81, 84, 89, 90, and 90 mm., the six primary stripes are distinct. In none of these specimens is the spotting very well marked; one of the two largest has only a faint suggestion of spotting in the dorsolateral fields.

The larger males measure 93, 99, 99, 100, and 107 mm. The paravertebral stripes are present as distinct stripes in the 100-mm. individual and in one of the 99-mm. individuals; the latter also has fairly distinct upper lateral stripes. The other three specimens show less distinct, but still discernible paravertebrals. Spotting is well developed in all but the largest specimen, which has some spots in the dorsolateral and posterior vertebral fields and dark bars on the sides.

The 12 female specimens, ranging from 71 to 87 mm. in snout to vent length, all have the primary six stripes distinct. In none is the spotting well defined, and one as large as 78 mm. has only faint traces of light areas in the dark fields.

The larger males show little tendency to darkening of the chest. A specimen 90 mm. in length has the chest scales largely dark but not wholly black. Even such degree of darkening is not reached by the specimens larger than 90 mm. The chin and throat are pale, without discrete darker markings.

The PV/SA ratio averages $0.150 \pm 0.005$ for 20 specimens, range 0.103–0.193. In 21 specimens, there are from 10 to 23 scales between the paravertebral stripes, average 15.7.

To summarize, this population is characterized by a tendency to retain at least a trace of the linear pattern to maximum size. Development of spotting is belated and obscure. All individuals 90 mm. or less in length retain all stripes. The paravertebral stripes remain discernible even in the largest males. Spotting is slow to develop, and individuals as large as 90 mm. may have few and obscure spots. Even in cases in which spotting is well developed in some of the large males, the general appearance of the lizard is somewhat dull owing to low contrast between the spots and the ground color. Possibly black chest coloration is not a characteristic of this population, as only one male (not the largest) shows much darkening of the chest. However, there may be a factor of seasonal variation unaccounted for here.

Four specimens from Guasaremos, Chihuahua, are somewhat darkened by preservation, but nevertheless enough of the pattern may be seen to warrant comment. There are three males measuring 97, 93, and 79 mm.

from snout to vent, and one female with a length of 79 mm. All primary stripes are distinct in all four specimens. The dark fields of the largest specimen show light central regions, but there are no distinct spots. Spotting likewise is absent from the pattern of the other specimens, although faint traces may have been present and lost. These four lizards show a notably closer spacing of the paravertebral lines than was found in the sample from Guirocoba. The PV/SA average is 0.109, range 0.088–0.127; the average is only very slightly greater than the minimum seen in the larger Guirocoba series.

As far as one can determine from a small sample, the lizards from Guasaremos show less tendency to lose the stripes than those of Guirocoba, and less development of spotting. The apparent closer spacing of paravertebral stripes may be indicative of intergradation with northern populations of *Cnemidophorus* characterized by a narrow interval between stripes. This subject is discussed at more length below.

### Comparison with Other Forms

The form bearing closest similarity to *barrancorum* is *C. sacki mazatlanensis* of southern Sinaloa. This form, too, apparently retains at least a vestige of striping to maximum size, in contrast to all other known races of *sacki* with a similar average number of scales around midbody. One important point of difference between *barrancorum* and *mazatlanensis* is in the pigmentation of the throat, which in *barrancorum* appears to be always immaculate, but which shows dark spots (or rarely is wholly black) in adults of the southern form. There is an indication in the specimens that a greater amount of dark pigment is present on the chest and abdomen of *mazatlanensis*, but this cannot be verified because of an inability to account for the possible influence of seasonal variation on the samples. The spacing of the paravertebral stripes shows no statistically significant difference between the subspecies. The average PV/SA ratios are: *barrancorum* (from Guirocoba), $0.150 \pm 0.005$; *mazatlanensis*, $0.139 \pm 0.003$.

The two forms are closely similar in the number of scales around midbody, the averages being $103.1 \pm 1.4$ for *barrancorum* and $105.4 \pm 1.1$ for *mazatlanensis*. There is evidently no difference between the samples in this feature of scutellation. A very slight but statistically significant difference exists in the average number of femoral pores: *barrancorum*, $34.5 \pm 0.6$; *mazatlanensis*, $37.8 \pm 0.4$.

These subspecies are highly similar in most aspects of pattern and scutellation, but adult individuals may be segregated with 100 per cent success (as far as present samples go) on the basis of one character of pattern—the immaculate versus spotted throat. Were the populations geographically contiguous, I would hesitate to afford them separate subspecific recognition. However, with a distance of approximately 250 miles between the closest known localities for the two forms, and with the presence in this intervening region of two other well-differentiated subspecies of *sacki*, there is no reasonable alternative to recognition of two races.

To the north of the range of *barrancorum*, the geographically closest relative is *Cnemidophorus sacki exsanguis*. This subspecies was described by Lowe (1956), who contrasted it with *C. stictogrammus*. Lowe gave details of the distribution of *exsanguis* in Arizona but presented no specific information on the extent of the range in Mexico. The southernmost typical examples of *exsanguis* that I have examined are five specimens (M.V.Z. Nos. 59172–59176) collected by William J. Riemer and me at Miñaca, Chihuahua. This locality is at the edge of the barranca region on the Mexican Plateau, about 130 miles northeast of Guirocoba and 95 miles eastnortheast of Guasaremos. The lizards have 66 to 75 scales around midbody, six to eight scales separating the paravertebral stripes (PV/SA range, 0.091–0.107), and an adult pattern that consists of persistent stripes and numerous small distinct spots. This sample shows no approach to *barrancorum* in pattern or scutellation.

A single peculiar specimen (U.M.M.Z. No. 111503) comes from Maguarichic, Chihuahua, some 45 miles east of Guasaremos and 65 miles northeast of Guirocoba. This individual, 82 mm. in snout to vent length, resembles *barrancorum* of similar size in having distinct stripes and no spots. By way of comparison, four specimens of *exsanguis* from Miñaca of similar size, 78–85 mm., are well spotted. The scale rows of the Maguarichic specimen are 85, six less than the minimum

known for the population of *barrancorum* at Guirocoba, and equal to the maximum seen in 28 Chihuahuan specimens of *exsanguis* before me (including other localities with Miñaca). With respect to scale rows, the specimen in question is intermediate between the two forms but closer to the average for *exsanguis*. The paravertebral spacing is narrow (PV/SA = 0.082), resembling that seen in *exsanguis* and in *barrancorum* from Guasaremos. It would be most desirable to have additional specimens from this locality so that the variation might become known.

Two specimens (U.C.L.A. Nos. 6361 and 6362) from 12 miles west of Cuiteco, Chihuahua, in the barranca region about 38 miles east-southeast of Guasaremos and 45 miles northeast of Guirocoba, are also pertinent to the discussion. They are too small to be of value in pattern determination, except to note the relatively wide paravertebral spacing: PV/SA = 0.128 and 0.135. Scale rows are 89 and 94, thus very low for *barrancorum* but even more out of line for *exsanguis*.

It is highly possible that the lizards of Guirocoba represent a population intermediate in pattern characters between *C. sacki griseocephalus* of a more coastwise distribution and a striped, unspotted form of the barranca region, which in addition may differ in having a lower average number of dorsal scale rows. With this possibility in mind, I have nevertheless chosen Guirocoba as the type locality of *barrancorum*, as it is the only locality in the region from which an adequate sample of specimens is available. There is no question of the distinctness of the population at Guirocoba from *griseocephalus*, so the application of the name *barrancorum* will not be in question, even if the population of the type locality should prove to be somewhat atypical of the subspecies as a whole.

The question of possible intergradation of *C. sacki exsanguis* and *C. sacki barrancorum* must be withheld until more material becomes available. At present, there is no good evidence that any two forms in the *sexlineatus* group with average scale count differences as great as between *exsanguis* and typical *barrancorum* are connected by intermediate populations. On the contrary, similar differences are associated in several instances with sympatric species, which implies, of course, that I regard *exsanguis* and *barrancorum* as belonging to different species. The proof of the relationship must await not only studies on additional material from the region between Guirocoba and the Plateau, but also a general survey of *Cnemidophorus* on the Mexican Plateau, and with emphasis on the relationship of the populations of the Plateau to those of lower elevations to the south.

*Cnemidophorus stictogrammus* (see Lowe, 1956), which ranges from southern Arizona into northern Sonora, resembles *barrancorum* in scutellation, and the two may prove to be subspecifically related. The loss of striped pattern and its replacement by spotting will distinguish adults of *stictogrammus* from *barrancorum*. *Cnemidophorus stictogrammus* is discussed at more length in the account of *C. sacki griseocephalus*.

## Ecological Notes

The specimens from Guasaremos, Chihuahua, were collected by H. S. Gentry, who (1942, p. 22) characterized the locality as "situated in a picturesque valley . . . at the upper limits of the Short-tree Forest [Tropical Deciduous Forest of Leopold, 1950] . . . bordered by oak hills." The other principal locality for the subspecies, Guirocoba, also lies within the Tropical Deciduous Forest.

Two specimens collected at Guirocoba on August 10 and 11, 1950, each contained three eggs measuring approximately 14 by 9 mm. Presumably three eggs constituted the full complement of each of these relatively small lizards (both measure 71 mm. from snout to vent), though some eggs may have been lost subsequent to preservation.

## Distribution

*Cnemidophorus sacki barrancorum* is at present known only from a limited area in southwestern Chihuahua and adjacent Sonora, in the barranca region where the rivers (in this instance, the Rio Mayo, Rio Fuerte, and their tributaries) have eaten back into the Sierra Madre Occidentál.

Locality Records: (Thirty specimens cited by museum number have been examined). *Sonora*: Rancho Guirocoba, about 20 miles southeast of Alamos (M.V.Z. Nos. 50724 [type specimen], 50722, 50725–50734; A.M.N.H. Nos. 63686–63697). *Chihuahua:* Guasaremos (M.C.Z. Nos. 43376–43379); 12 miles west of Cuiteco (U.C.L.A. Nos. 6361, 6362); Batopilas (Cope, 1879, p. 261).

## GEOGRAPHIC VARIATION

THE PRINCIPAL CHARACTERS selected for study from the aspect of geographic variation are (1) two features of scutellation (number of scales around midbody; number of femoral pores), (2) three of color pattern (spacing of paravertebral stripes; dorsal pattern of large specimens; color and pattern of chin), and (3) maximum size. The majority of data upon which the following analyses are based are presented in the accounts of species and subspecies. Particular attention has been paid to the possibility of clinal variation.

### VARIATION IN SCUTELLATION

SCALES AROUND MIDBODY: In previous sections of this paper, emphasis is placed on the value of this character as an index of relationship, the proposition being that populations of the same species are likely to have dorsal scales of highly similar size, and hence similar number, around midbody. The greatest portion of the area covered in this report is inhabited by lizards that I refer to the species *Cnemidophorus sacki*. It is particularly noteworthy that little variation occurs within this group in this aspect of scutellation In a linear distance of 660 miles from southern Sonora to southern Jalisco, the average number of scales around midbody does not differ significantly from locality to locality. The range of variation for 307 specimens from the whole area, 91 to 120 scales around midbody, is approached closely within several restricted samples (see table 1). Indeed, specimens of *sacki* from the basin of the Río Balsas another 250 miles to the southeast fall within the same range of variation. Though the average number of scales in this sample is slightly lower (98.3) than the average of any sample in more northern *sacki* (lowest, 100.5), the number of scales is clearly of the same order of magnitude and not easily confused with the averages for other species in the same general region.

*Cnemidophorus scalaris* ssp. of the southern end of the Mexican Plateau has relatively

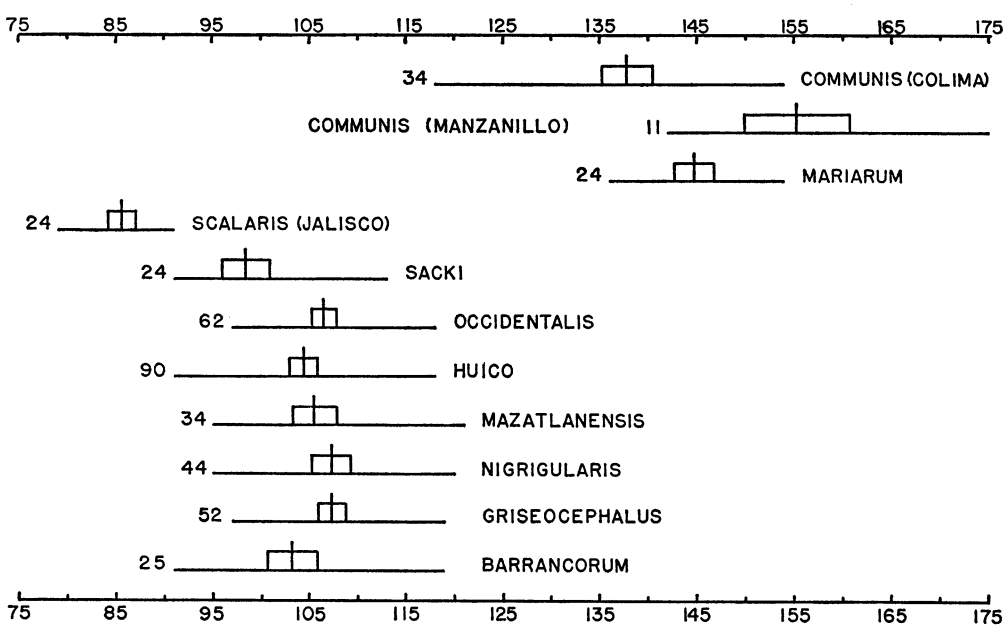


FIG. 4. Number of scales around midbody in several populations of *Cnemidophorus* in western Mexico. The horizontal bar indicates the range of variation in a given sample; the vertical bar, the mean; and the rectangle, two standard errors of the mean on either side of the mean. The species or subspecies (with locality in parentheses where pertinent) and number of specimens comprising the sample are indicated for the individual graphs.

TABLE 1

NUMBER OF SCALES AROUND MIDBODY IN SPECIES AND SUBSPECIES OF *Cnemidophorus* OF WESTERN MEXICO

| Species | *N* | Mean | Range |
|---|---|---|---|
| *C. communis communis* | | | |
| Vicinity of Colima, Colima | 34 | 137.8±1.3 | (118–154) |
| Manzanillo | 11 | 155.1±2.7 | (142–175) |
| *C. communis mariarum* | 24 | 144.8±1.0 | (136–154) |
| *C. scalaris* ssp.[a] | 24 | 85.6±0.7 | (79–91) |
| *C. sacki sacki* | 24 | 98.3±1.2 | (91–113) |
| *C. sacki occidentalis* | | | |
| Total sample | 62 | 106.3±0.6 | (97–118) |
| Southern Jalisco | 12 | 109.5±1.3 | (103–116) |
| Vicinity of Jocotepec and Santa Ana, Jalisco | 20 | 103.3±1.1 | (97–118) |
| Vicinity of Ixtlán, Nayarit | 13 | 108.1±1.4 | (99–114) |
| *C. sacki huico* | | | |
| Total sample | 90 | 104.4±0.7 | (91–118) |
| San Blas, Nayarit | 35 | 106.7±0.6 | (95–118) |
| Isabel Island, Nayarit | 13 | 105.6±1.9 | (98–117) |
| Vicinity of Peñitas, Nayarit | 13 | 105.6±1.4 | (99–117) |
| Northeastern Nayarit | 29 | 100.5±1.0 | (91–116) |
| *C. sacki mazatlanensis* | 34 | 105.4±1.1 | (95–121) |
| *C. sacki nigrigularis* | 44 | 107.2±1.0 | (95–120) |
| *C. sacki griseocephalus* | | | |
| Total sample | 52 | 107.2±0.7 | (97–119) |
| Alamos, Sonora | 24 | 106.9±1.3 | (97–119) |
| Balance of range | 28 | 107.5±0.8 | (100–118) |
| *C. sacki barrancorum*[b] | 25 | 103.1±1.3 | (91–119) |

[a] Specimens from Jalisco only.
[b] Excluding two individuals from Cuiteco, Chihuahua.

large scales, with an average of 85.6 in a sample of 24 specimens from Jalisco. The change from lizards with the scutellation of *sacki* to the *scalaris* type takes place quite abruptly in the vicinity of Guadalajara and Lake Chapala. There is no evidence of intergradation, and one instance of overlap between the two species (see p. 84).

In Colima, in coastal Jalisco, and on the Tres Marías Islands are found lizards (*Cnemidophorus communis*) with exceptionally fine scales. The range of variation is rather wide (118–175), but overlap with *sacki* in numbers of scales is minimal, with only one out of over 70 specimens of *communis* falling below 121 and hence in the upper limit of the range of *sacki*. Specimens of *communis* from Colima City have a relatively low average (137.8), and a small series of 11 lizards from Manzanillo has a very high average (155.1). The insular subspecies *mariarum* falls between, with an average of 144.8. Whether these differences reflect geographic trends or merely sporadic variation of various populations is not evident from the data available to me. There is no evidence of intergradation between the forms *sacki* and *communis*, and none is expected to be found, but the existence of geographic sympatry has not yet been established in the region I have studied. In view of the apparent stability of scale counts in *sacki* from Sonora to the Balsas Basin, it seems unlikely that the change from a *sacki* type of scutellation to the high counts characteristic of *communis* would take place in the short distance of about 35 miles that separates the closest localities for the two forms.

Similar reasoning may be applied to the relationship between *C. sacki griseocephalus* and *C. burti*, although the distance involved here is somewhat greater (about 100 miles),

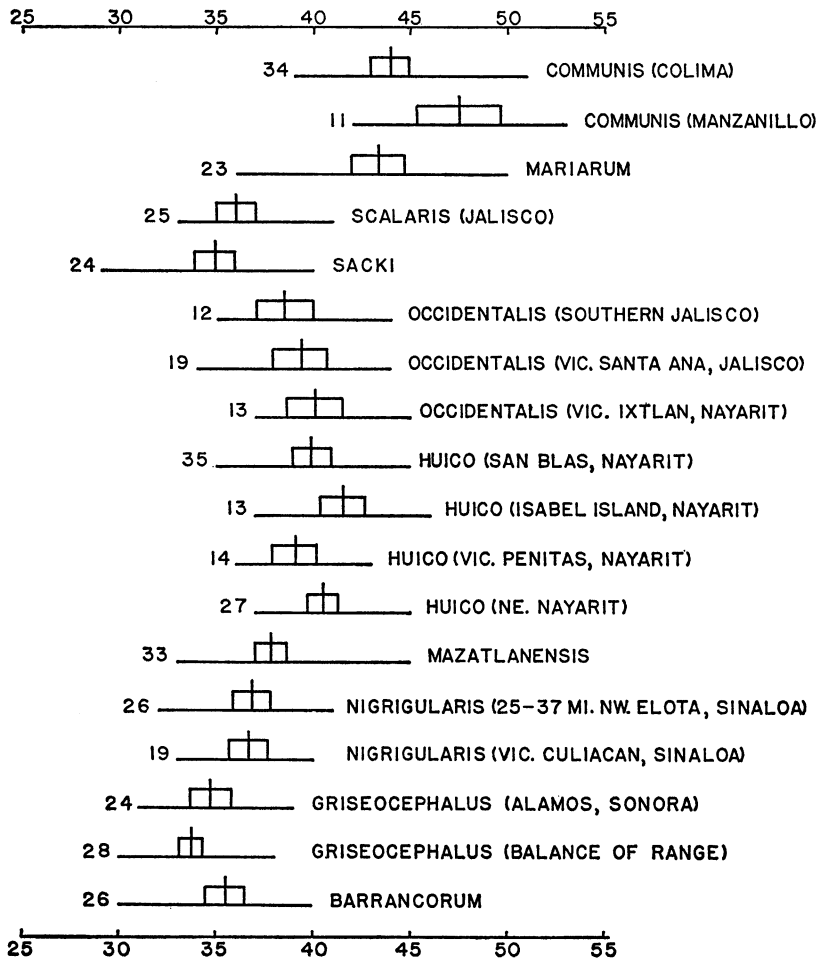


FIG. 5. Number of femoral pores in several populations of *Cnemidophorus* in western Mexico. Method of presentation is as in figure 4.

and the difference between the scale counts somewhat less (mean 92.7 in *burti*, 107.2 in *griseocephalus*). As *C. burti* is known only from a very restricted region, nothing can be said of geographic variation in this form.

In summary, the species that covers the widest area, *C. sacki*, shows no variation of a clinal sort. The variability that is seen is slight and in most cases can probably be attributed to sampling error. *Cnemidophorus scalaris* barely enters the region under consideration and has not been studied over a wide enough area to permit analysis. *Cnemidophorus communis* within a relatively small area shows differences between populations that appear to be of statistical significance, but no geographic pattern is evident.

FEMORAL PORES: Among 338 specimens of *C. sacki*, including the subspecies *sacki* as well as other races within the area of study, the total range of variation in femoral pores is 29–46. Within any one subspecies, the range is from nine to 13 scales. The lowest average, 33.7, is for a northern sample (*C. s. griseocephalus*, excluding specimens from Alamos, Sonora), and the highest, 41.5, is attained by the lizards (*C. s. huico*) from Isabel Island. As may be seen in figure 5, there appears to be a trend to increasing numbers of pores from southern Sonora south into Nayarit, with lower counts again encountered in Jalisco. Lizards of the subspecies *sacki* from Guerrero

TABLE 2

NUMBER OF FEMORAL PORES IN SPECIES AND SUBSPECIES OF *Cnemidophorus* OF WESTERN MEXICO

| Species | *N* | Mean | Range |
|---|---|---|---|
| *C. communis communis* | | | |
| Vicinity of Colima, Colima | 34 | 43.9±0.5 | (39–51) |
| Manzanillo, Colima | 11 | 47.5±1.1 | (42–53) |
| *C. communis mariarum* | 23 | 43.3±0.7 | (36–50) |
| *C. scalaris* ssp.[a] | 25 | 36.0±0.5 | (33–41) |
| *C. sacki sacki* | 24 | 34.9±0.5 | (29–40) |
| *C. sacki occidentalis* | | | |
| Total sample | 67 | 38.8±0.3 | (32–45) |
| Southern Jalisco | 12 | 38.5±0.7 | (35–44) |
| Vicinity of Jocotepec and Santa Ana, Jalisco | 19 | 39.3±0.7 | (34–44) |
| Vicinity of Ixtlán, Nayarit | 13 | 40.1±0.7 | (37–45) |
| *C. sacki huico* | | | |
| Total sample | 91 | 40.2±0.3 | (36–46) |
| San Blas, Nayarit | 35 | 39.9±0.5 | (35–45) |
| Isabel Island, Nayarit | 13 | 41.5±0.6 | (37–46) |
| Vicinity of Peñitas, Nayarit | 14 | 39.1±0.6 | (36–43) |
| Northeastern Nayarit | 29 | 40.5±0.4 | (37–45) |
| *C. sacki mazatlanensis* | 33 | 37.8±0.4 | (33–45) |
| *C. sacki nigrigularis* | | | |
| Total sample | 45 | 36.8±0.4 | (32–41) |
| 25–37 miles northwest of Elota, Sinaloa | 26 | 36.8±0.5 | (32–41) |
| Vicinity of Culiacán, Sinaloa | 19 | 36.7±0.5 | (33–40) |
| *C. sacki griseocephalus* | | | |
| Total sample | 52 | 34.2±0.3 | (30–39) |
| Alamos, Sonora | 24 | 34.7±0.5 | (31–39) |
| Balance of range | 28 | 33.7±0.3 | (30–38) |
| *C. sacki barrancorum*[b] | 26 | 35.5±0.5 | (30–40) |

[a] Specimens from Jalisco only.
[b] Excluding two individuals from Cuiteco, Chihuahua.

and Morelos have still lower counts than those (*C. s. occidentalis*) in Jalisco, but the intervening area has not been sampled.

There is some evidence that the changes, at least in Sinaloa, do not take place in a smooth, clinal fashion but rather in a stepcline, the steps of which are concurrent geographically with the changes in color pattern that are diagnostic of the subspecies. Northern and southern samples of *C. s. nigrigularis*, taken from areas about 60 miles apart, are virtually identical in femoral pore means and ranges. To the north, the sample of *C. s. griseocephalus* from the coastal plain (excluding specimens from Alamos, Sonora) has a significantly lower average, and to the south, *C. s. mazatlanensis* averages higher, though the difference from *nigrigularis* is less and doubtfully significant.

Variation within *C. communis* with respect to femoral pores is similar to that seen in dorsal scutellation. The small sample from Manzanillo exhibits a higher mean than either the Colima or Tres Marías samples; the latter two are nearly identical. The averages for *communis* are notably higher than seen in any sample of *sacki*, but overlap in range of variation is extensive.

*Cnemidophorus scalaris* ssp. has a lower average than is encountered in most populations of *C. sacki*, but again overlap in range is extensive.

It is evident that, while femoral pore counts may tend to give weight to specific or sub-

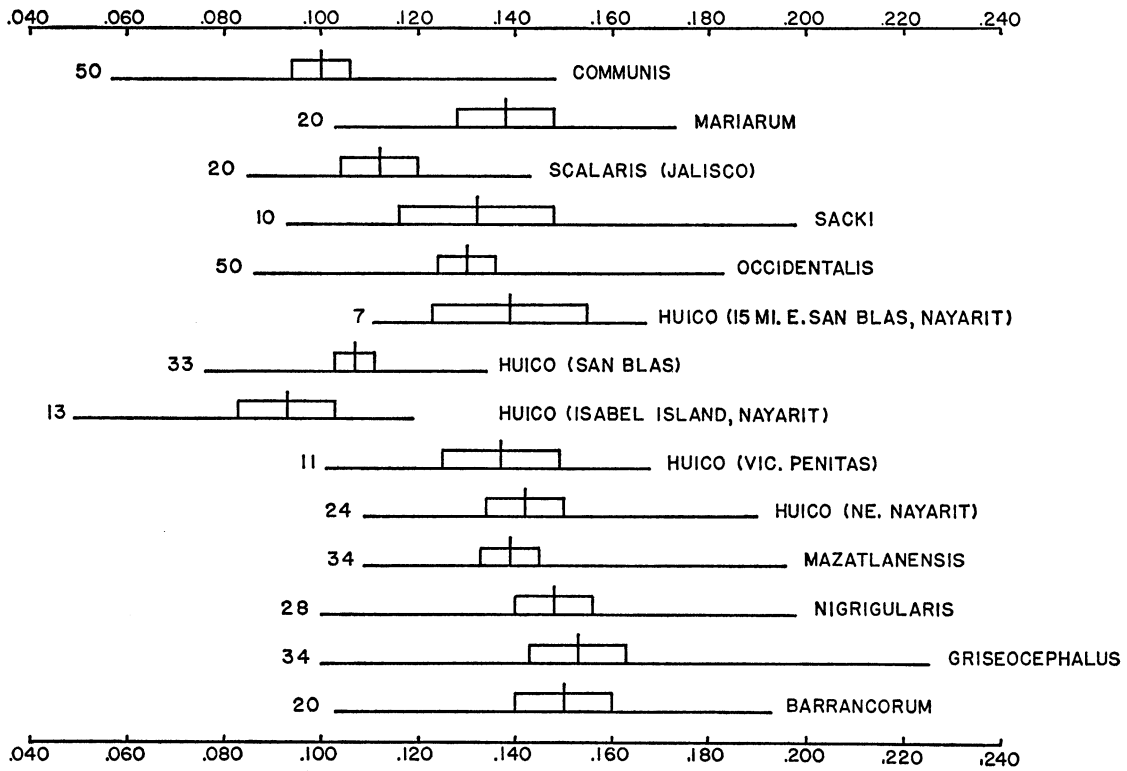


FIG. 6. Ratio of number of scales separating paravertebral stripes at midbody to number of scales around midbody (PV/SA) in several populations of *Cnemidophorus* in western Mexico. Method of presentation is as in figure 4.

specific separations made on the basis of other characters, the overlap in ranges of variation between species and subspecies is generally great enough to make the femoral pore count of little taxonomic utility.

## VARIATION IN COLOR PATTERN

SPACING OF PARAVERTEBRAL STRIPES: Among the populations studied, the PV/SA ratio of individual lizards ranges from 0.049 in *C. s. huico* to 0.225 in one individual of *C. sacki griseocephalus*. Considerable variation is seen among individuals of every sample, even geographically restricted ones. Within *C. sacki* (including the typical subspecies) the averages for several samples range from about 0.14 to 0.16. A notable exception occurs within the subspecies *C. s. huico*, in which the averages drop to 0.107 at San Blas, Nayarit, and 0.093 on Isabel Island; see the account of that subspecies. These populations with narrowly spaced stripes do not differ otherwise from others assigned to the same subspecies, and there is no apparent change in average paravertebral spacing from subspecies to subspecies in the species *sacki*.

The samples of *C. communis communis* from Colima and Manzanillo do not differ in average paravertebral spacing (mean for the polled samples, 0.100), in contrast to their differences in dorsal scales and femoral pores. The average for *C. c. mariarum*, 0.138, is significantly higher than that seen for the mainland subspecies, though overlap in ranges is again extensive.

*Cnemidophorus scalaris* ssp. has an average spacing similar to that of *C. c. communis* (0.112 in *scalaris*) and shows extensive overlap with all samples of *sacki*.

Because of the wide range of variation encountered in all samples, differences in the paravertebral spacing of various populations are not of much use on a taxonomic basis. As is the case with femoral pore counts, the data

on paravertebral spacing may supplement other more distinctive differences between species and subspecies.

COLOR PATTERN OF DORSUM: The ultimate color pattern attainable by large individuals is the most important character for defining subspecies in *Cnemidophorus*. With some exceptions, the pattern appears to be relatively stable for a given population and often changes abruptly from one population to the next. For example, the coastal region around Mazatlán, Sinaloa, and for a distance of about 60 miles north is occupied by a subspecies (*C. sacki mazatlanensis*) that, as far as is known, never loses all of the juvenile stripes and thus never attains the completely spotted dorsum seen in some other subspecies. Inland, some 20 miles to the east of Mazatlán, spotted lizards of the more southern subspecies *C. s. huico* are found. Similarly, a distance of less than 30 miles separates the northernmost record for *mazatlanensis* from a locality where another spotted form, *C. sacki nigrigularis*, is found. In southern Sonora, the brilliantly spotted *C. sacki griseocephalus* occurs at Alamos, while less than 20 miles away at Guirocoba is found the dull-colored, more persistently striped *C. s. barrancorum*.

*Cnemidophorus sacki occidentalis* is, as presently understood, a highly variable form. Whether the variability is the result of a large amount of gene exchange with other forms or is merely an inherent characteristic of the subspecies remains to be seen. In view of the abrupt transitions between other subspecies, the situation in *occidentalis* is of particular interest and deserving of additional study.

The variation of dorsal pattern in *sacki* appears to be sporadic. A striped race (*mazatlanensis*) is sandwiched between two spotted races (*huico* and *nigrigularis*); another striped form (*barrancorum*) is separated by hundreds of miles from the southern form which it most closely resembles (*mazatlanensis*).

Within the region of study, *C. communis* is represented by a spotted form on the mainland and one in which short, dark cross bars dominate on the Tres Marías Islands. *Cnemidophorus scalaris* ssp. attains a completely spotted dorsum.

Of particular interest and significance is the

TABLE 3

RATIO OF NUMBER OF SCALES SEPARATING PARAVERTEBRAL STRIPES TO SCALES AROUND MIDBODY (PV/SA) IN SPECIES AND SUBSPECIES OF *Cnemidophorus* IN WESTERN MEXICO

| Species | *N* | Mean | Range |
|---|---|---|---|
| *C. communis communis* | 50 | 0.100±0.003 | (0.057–0.148) |
| *C. communis mariarum*[a] | 20 | 0.138±0.005 | (0.103–0.173) |
| *C. scalaris*[b] | 20 | 0.112±0.004 | (0.085–0.143) |
| *C. sacki sacki* | 10 | 0.132±0.008 | (0.093–0.198) |
| *C. sacki occidentalis* | 50 | 0.130±0.003 | (0.086–0.183) |
| *C. sacki huico* | | | |
| San Blas, Nayarit | 33 | 0.107±0.002 | (0.076–0.134) |
| Isabel Island, Nayarit | 13 | 0.093±0.005 | (0.049–0.119) |
| 15 miles east of San Blas, Nayarit | 7 | 0.139±0.008 | (0.111–0.167) |
| Vicinity of Peñitas, Nayarit | 11 | 0.137±0.006 | (0.101–0.168) |
| Northeastern Nayarit | 24 | 0.142±0.004 | (0.109–0.190) |
| *C. sacki mazatlanensis* | 34 | 0.139±0.003 | (0.109–0.196) |
| *C. sacki nigrigularis* | 28 | 0.148±0.004 | (0.100–0.198) |
| *C. sacki griseocephalus* | | | |
| Total sample | 34 | 0.153±0.005 | (0.100–0.225) |
| Alamos, Sonora | 17 | 0.163±0.006 | (0.130–0.225) |
| Balance of range | 17 | 0.142±0.006 | (0.100–0.178) |
| *C. sacki barrancorum*[c] | 20 | 0.150±0.005 | (0.103–0.193) |

[a] Excluding specimens from San Juanito Island (see p. 80).
[b] Jalisco only.
[c] Guirocoba, Sonora, only.

similarity in color pattern of populations of different species. The completely spotted condition is attained by three subspecies of *C. sacki* within the area of study, and by *C. communis communis* and *C. scalaris* ssp. as well. The pattern of *C. communis mariarum* is highly similar to that of some individuals of *C. sacki occidentalis*. It is precisely this sort of convergence in color pattern that has proved so confusing to students of the genus *Cnemidophorus* and has resulted in the exceedingly tangled taxonomic picture both inherited and contributed to by the present generation of systematists.

COLOR PATTERN OF CHIN: The color and pattern of the chin of large specimens resemble in their variation the situation seen in dorsal pattern, in that a given population is relatively constant in pigmentation, and the same pattern may be common to several species; populations of two species may resemble each other more closely than each does another population of its own species.

The northern forms of *C. sacki* (*barrancorum* and *griseocephalus*) resemble each other and *C. burti* in having a pale, immaculate chin. To the south, *griseocephalus* is replaced by *nigrigularis* with its solid black chin. Rarely in *mazatlanensis* a solid black chin is seen, but the usual pattern is one of black markings on a pale background. In *huico*, the black-spotted chin of *mazatlanensis* is replaced by a pink to brick-red chin, sometimes with a pale gray wash but without discrete black markings. The chin in *occidentalis* is similar to that of *huico*, at least in some individuals. In some instances, a change in color of chin from one population to another is concurrent with a change in dorsal pattern. The change from the black chin of *nigrigularis* to the spotted chin of *mazatlanensis* coincides with that from spotted dorsum to striped. Similarly, the shift from spotted chin to the red chin of *huico* coincides with the change from striped to spotted dorsum.

The chin color and pattern of *Cnemidophorous communis* (both insular and mainland subspecies) and *C. scalaris* ssp. are reddish, highly similar if not identical to those of *C. sacki huico* and *C. s. occidentalis*.

As is the case with dorsal pattern, variation in chin color and pattern appears to be sporadic. The pale, black-spotted chin is not geographically intermediate between completely pale populations and solid black ones, as might be expected, but is situated between solid black populations and red populations.

## VARIATION IN MAXIMUM SIZE

As explained in an introductory section to this paper, maximum size is a difficult character to assess. It is apparent, though, that *Cnemidophorus communis* regularly reaches a larger size than *C. sacki*, which is in turn a larger species than *C. scalaris*. The maximum snout to vent measurement for all subspecies of *sacki* investigated, except *C. s. occidentalis*, lies between 104 and 114 mm. A single individual of *occidentalis* measures 126 mm., and several specimens measure more than 100 mm. I think that *occidentalis* is truly a larger form than other subspecies of *sacki*.

The maximum known size of *C. communis communis*, 135 mm., is well above that for most *sacki*, though slightly less well set off from *C. s. occidentalis*. There is, so far, only one very large *occidentalis*, but there are many specimens of *communis* that exceed this unique specimen of *occidentalis* in size. There are so few large specimens of *C. c. mariarum* that the maximum size must yet be unknown. The largest measured by me, 120 mm., exceeds all *sacki* except the single specimen of *C. s. occidentalis* mentioned above.

*Cnemidophorus scalaris* ssp. is evidently a smaller form than *C. sacki*. Although the

TABLE 4

MAXIMUM BODY SIZE (IN MILLIMETERS) ATTAINED BY SPECIES AND SUBSPECIES OF *Cnemidophorus* OF WESTERN MEXICO

| Species | *N* | Maximum Size |
|---|---|---|
| *C. communis communis* | 56 | 135 |
| *C. communis mariarum* | 26 | 120 |
| *C. scalaris* ssp.[a] | 111 | 103 |
| *C. sacki sacki* | 24 | 110 |
| *C. sacki occidentalis* | 66 | 126 |
| *C. sacki huico* | 176 | 106 |
| *C. sacki mazatlanensis* | 49 | 104 |
| *C. sacki nigrigularis* | 45 | 114 |
| *C. sacki griseocephalus* | 71 | 110 |
| *C. sacki barrancorum* | 30 | 107 |

[a] Specimens from Jalisco and Aguascalientes.

largest measurement (103 mm.) is almost as large as the smallest *sacki* of maximum size (104 mm.), there are only two specimens of *scalaris* out of over 100 from Jalisco and Aguascalientes that are as long as 100 mm., and this length is often exceeded in all subspecies of *sacki*.

## Comment and Summary

A semblance of clinal variation is seen only in the femoral pore averages of *Cnemidophorus sacki*, in which highest counts are seen in *C. s. huico* and progressively lower counts are encountered in subspecies to the north and south. There is some evidence for a stepwise cline in at least a segment of the coastal region. Other characters appear to vary either sporadically or not at all. No geographic trends are evident within the highly variable color pattern of *C. sacki*. Dorsal scutellation is quite constant over a large range in *C. sacki* but varies somewhat over a smaller area in *C. communis*. Information on *communis* is not sufficient to reveal whether there is a pattern to the apparent variation in scutellation.

The insular isolation of *C. c. mariarum* can be called to account for the existence of this subspecies, but it is difficult to see any correlation of topography or habitat with at least some of the subspecific boundaries in *C. sacki*. The coastal plain Thorn Forest is the habitat of *C. s. griseocephalus*. This form ranges into the Tropical Deciduous Forest in the foothills at Alamos, Sonora, but nearby at Guirocoba under conditions highly similar to those at Alamos, *C. s. barrancorum* is found. There is no great change evident in the vegetation or topography as one passes south from the range of *griseocephalus* into that of *nigrigularis*. The region occupied by *C. s. mazatlanensis* is clothed by perhaps a heavier growth of Thorn Forest (indicative of more rainfall) than is characteristic of the ranges of the more northern forms, but if other differences exist they are not apparent to me. *Cnemidophorus sacki occidentalis* occupies an area that is for the most part at a higher elevation (3000 feet or above) than the majority of stations for the other subspecies and in this respect is delimited physiographically from the other subspecies. Unfortunately, the distribution of this form is much less well known than that of the other subspecies. If the subspecific differentiation in *Cnemidophorus sacki* is an adaptive response to environmental conditions, the conditions producing this response are not obvious to this worker. I presume that a sufficiently ingenious biogeographer could devise a pattern of isolation and recontact that would explain the subspecific fragmentation of *sacki* on the west coast of Mexico. I have not assayed to produce such an explanation.

## SUMMARY

THE LIZARDS OF THE GENUS *Cnemidophorus* related to *C. sacki* occupying the region from southern Sonora to western Jalisco and Colima, Mexico, are studied with respect to variation and distribution. With the use of the relative size of the dorsal scales (expressed as the number of scales around midbody) as the most important character for distinguishing species, and the color pattern of large adult lizards as the most important intraspecific variable, it is possible to recognize three species and a total of nine forms (species and subspecies) within the area of study. In the following tabulation, the forms recognized in this paper are listed on the left, with the nomenclature currently in use on the right:

| | |
|---|---|
| *Cnemidophorus sacki barrancorum*, new subspecies | *C. sacki communis* Cope |
| *Cnemidophorus sacki griseocephalus*, new subspecies | *C. sacki communis* Cope |
| *Cnemidophorus sacki nigrigularis*, new subspecies | *C. sacki communis* Cope |
| *Cnemidophorus sacki mazatlanensis*, new subspecies | *C. sacki communis* Cope |
| *Cnemidophorus sacki huico*, new subspecies | *C. sacki communis* Cope |
| *Cnemidophorus sacki occidentalis* Gadow | *C. sacki communis* Cope |
| *Cnemidophorus scalaris* ssp. | *C. sacki communis* Cope |
| *Cnemidophorus communis communis* Cope | *C. sacki copei* Gadow (*fide* Peters, 1954) |
| *Cnemidophorus communis mariarum* Günther | *C. sacki mariarum* Günther |

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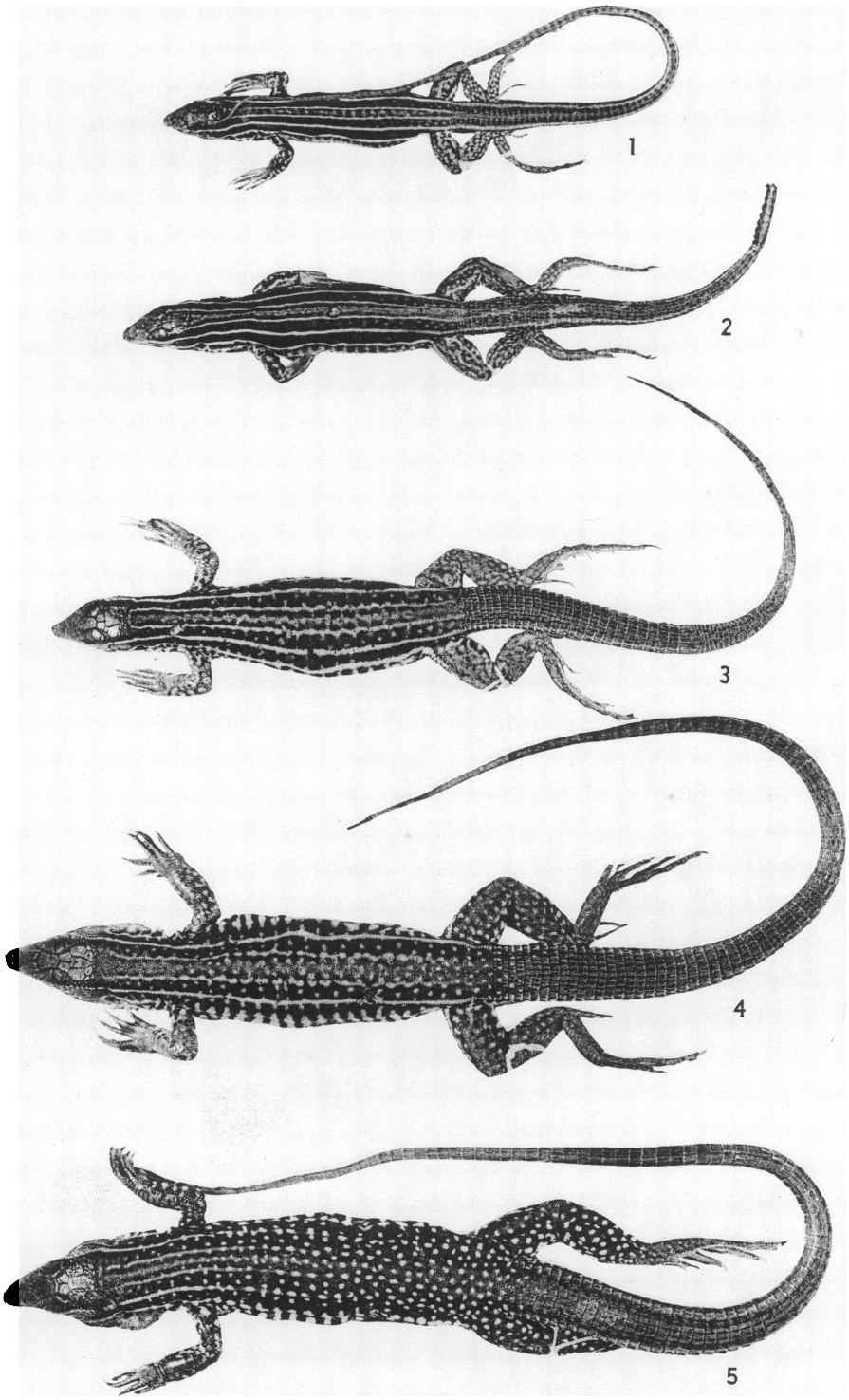
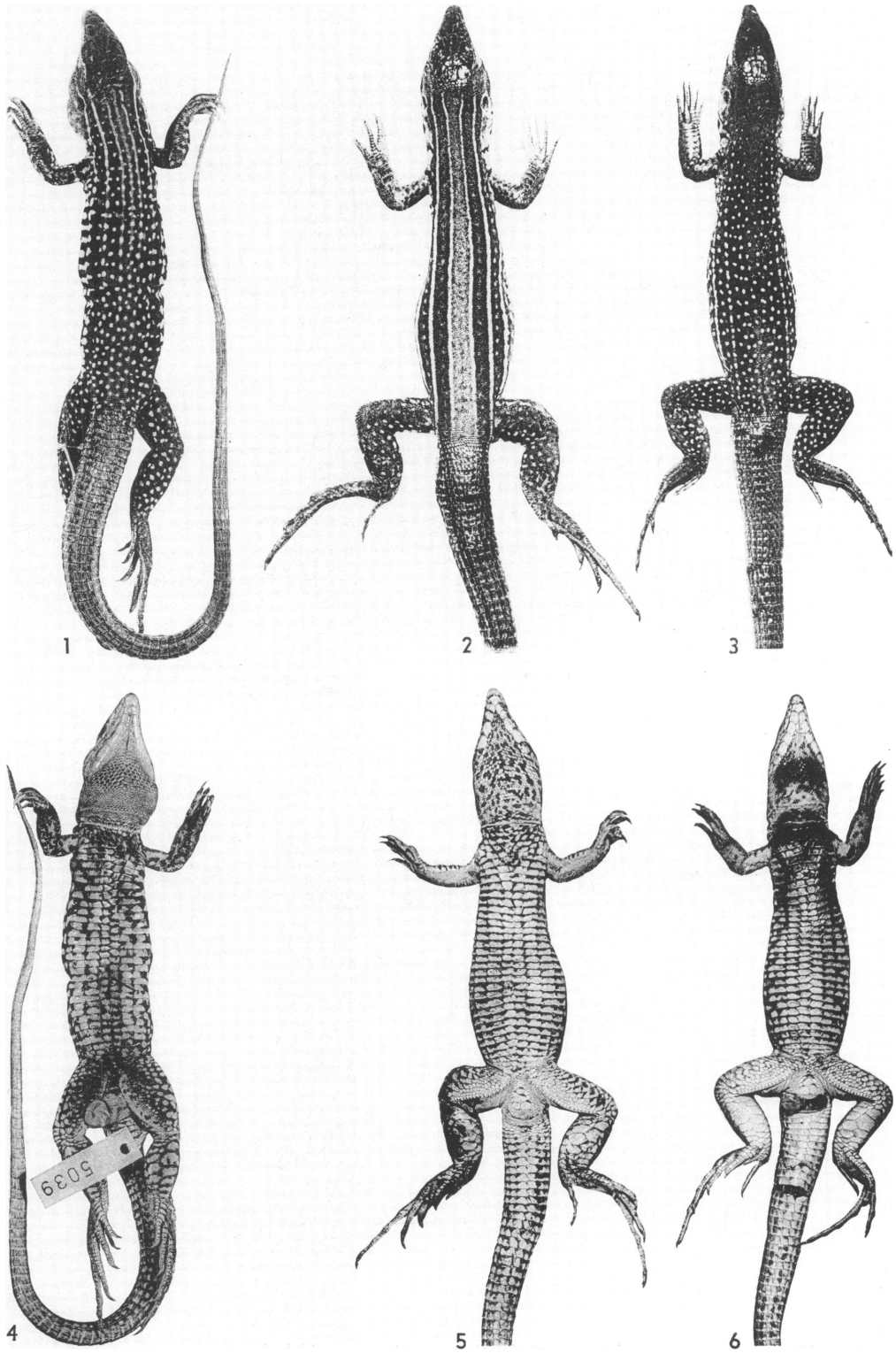
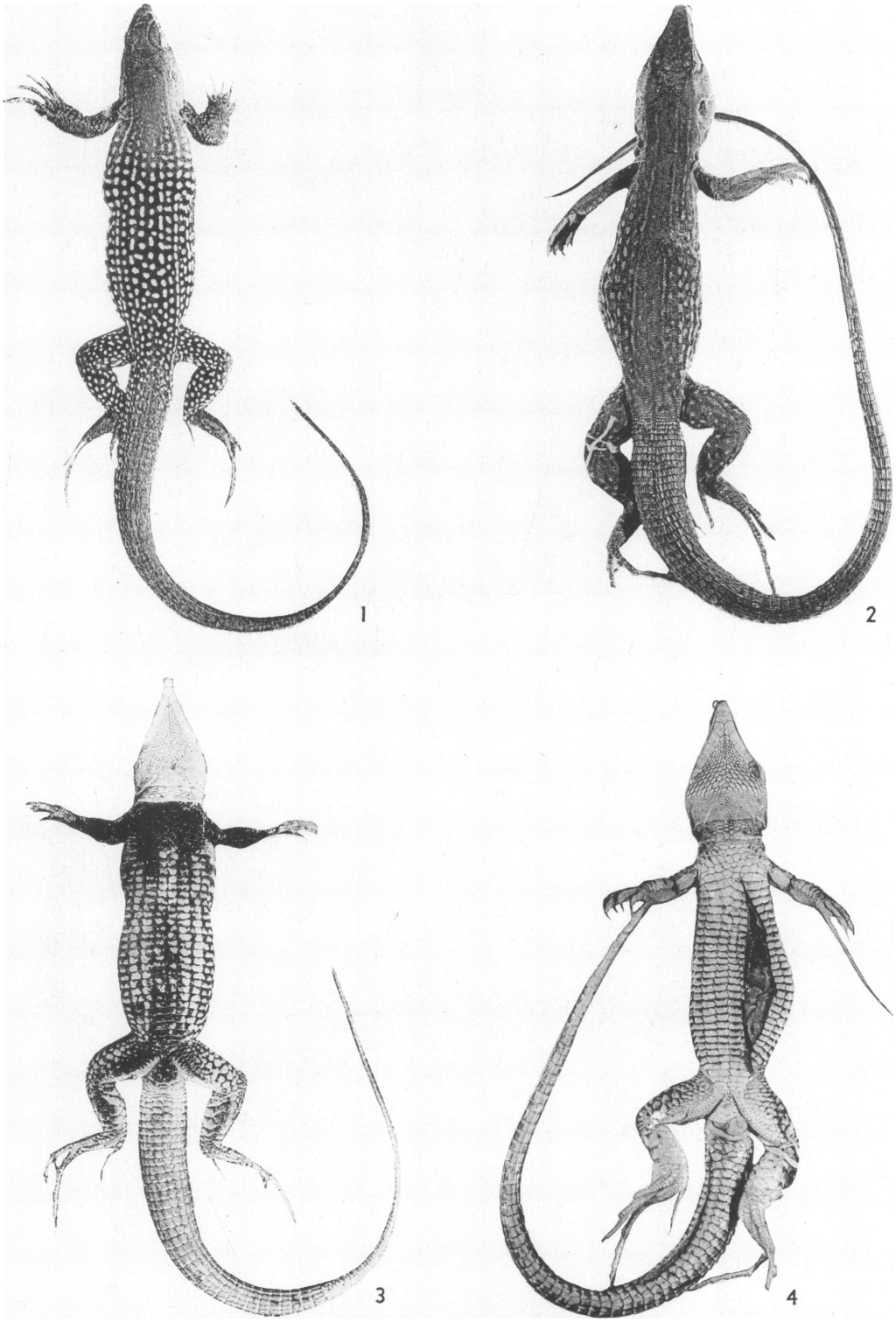


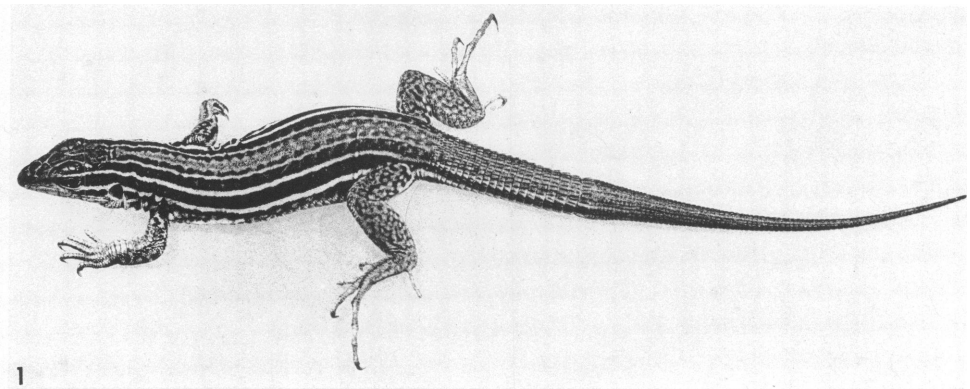

Change in pattern with growth in *Cnemidophorus sacki huico*. All specimens in the University of Michigan Museum of Natural History collection, from the immediate vicinity of San Blas, Nayarit. 1, 2. Pattern Class II, light areas but not discrete spots present in fields. 3. Pattern Class III, distinct spots present except in vertebral field. 4. Pattern Class IV, stripes present, but spots prominent in all fields including the vertebral. 5. Pattern Class V, body spotted, stripes present only on neck. Pattern Class I, fields totally dark, is not illustrated




Dorsal and ventral surfaces of typical adult individuals of three subspecies of *Cnemidophorus sacki*. 1. *C. s. huico*, U.M.M.Z. No. 104746 (W.E.D. No. 5039), San Blas, Nayarit. 2. *C. s. mazatlanensis*, type specimen, A.M.N.H. No. 75921, 2 miles north of Coyotitán, Sinaloa. 3. *C. s. nigrigularis*, A.M.N.H. No. 75924, 25 miles northwest of Elota, Sinaloa. 4, 5, 6. Ventral surfaces of above specimens in same order




Dorsal and ventral surfaces of typical adult individuals of two subspecies of *Cnemidophorus sacki*. 1. *C. s. griseocephalus*, type specimen, A.M.N.H. No. 75930, 11.4 miles east of Navojoa, Sonora. 2. *C. s. barrancorum*, type specimen, M.V.Z. No. 50724, Guirocoba, Sonora. 3, 4. Ventral surfaces of above specimens in same order



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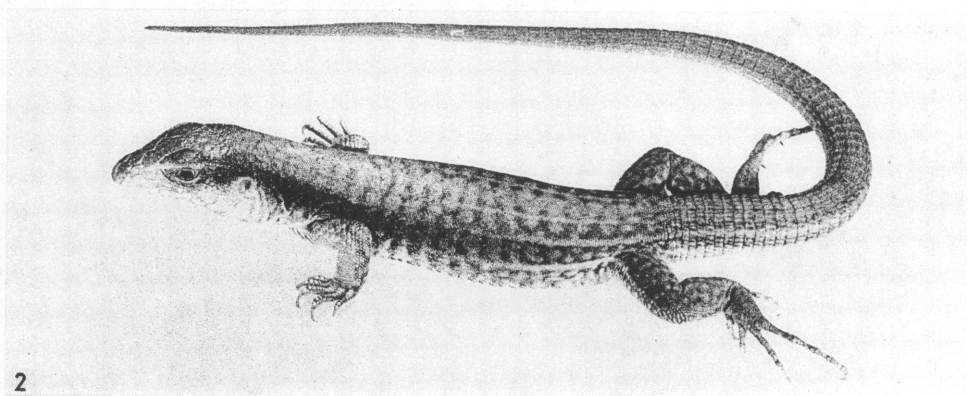

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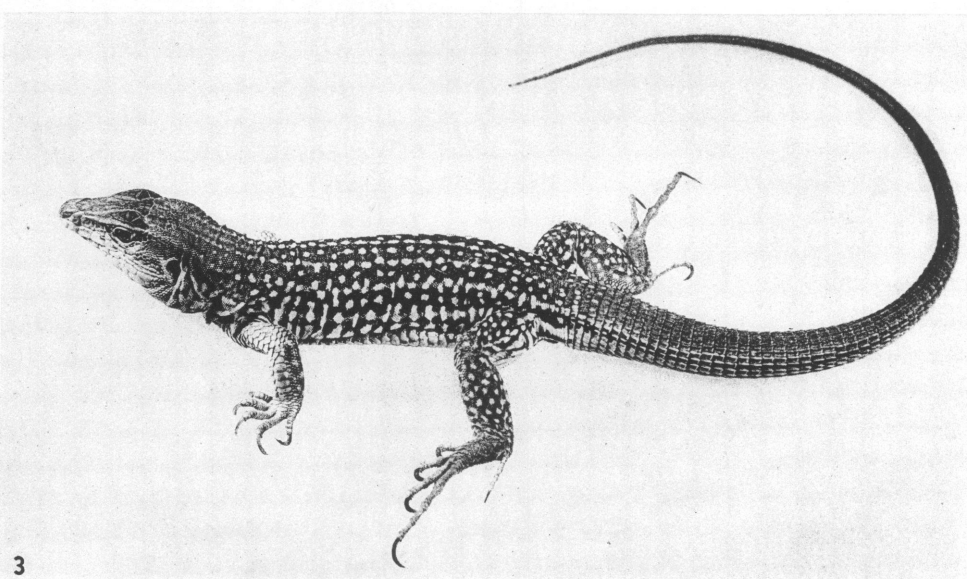
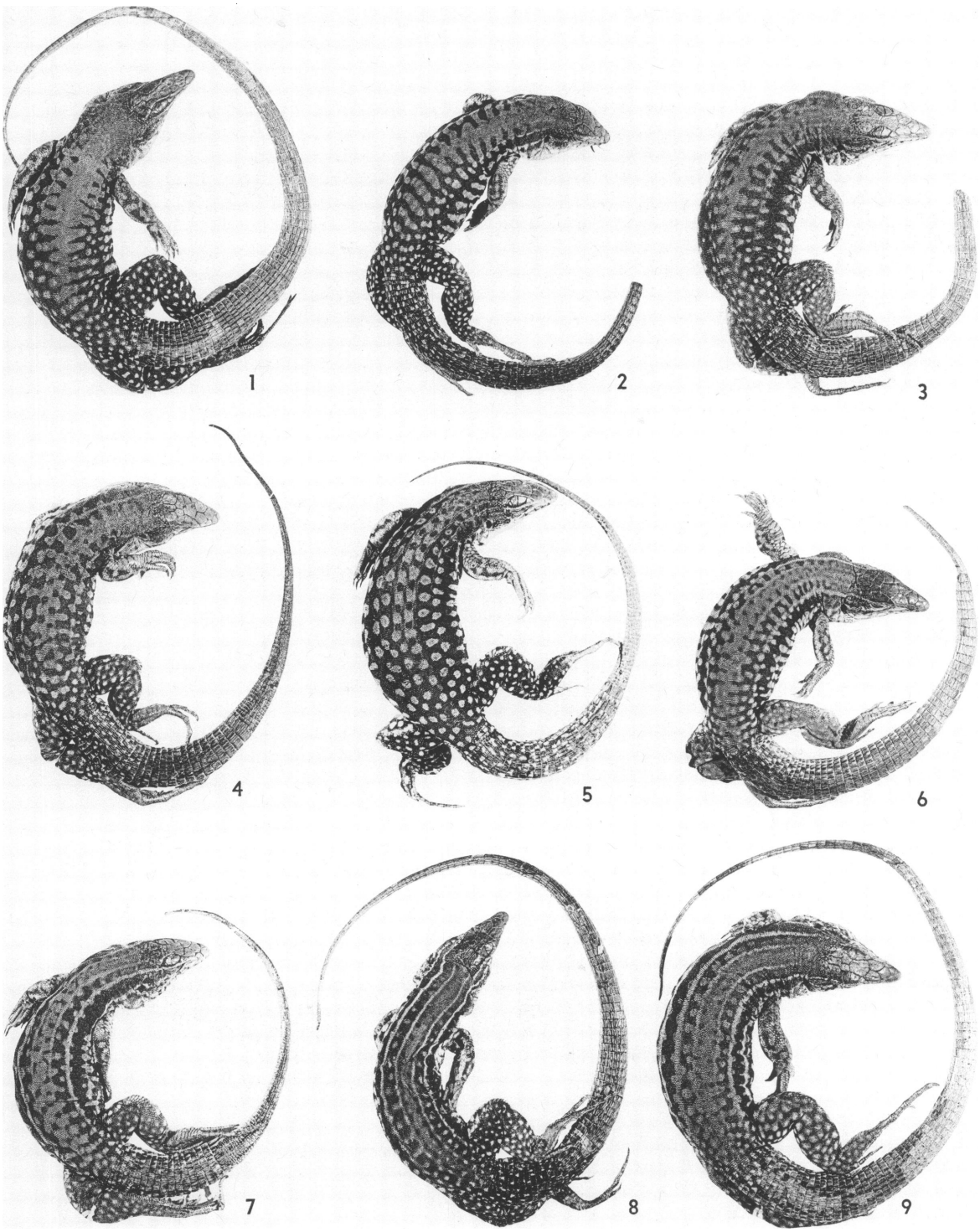
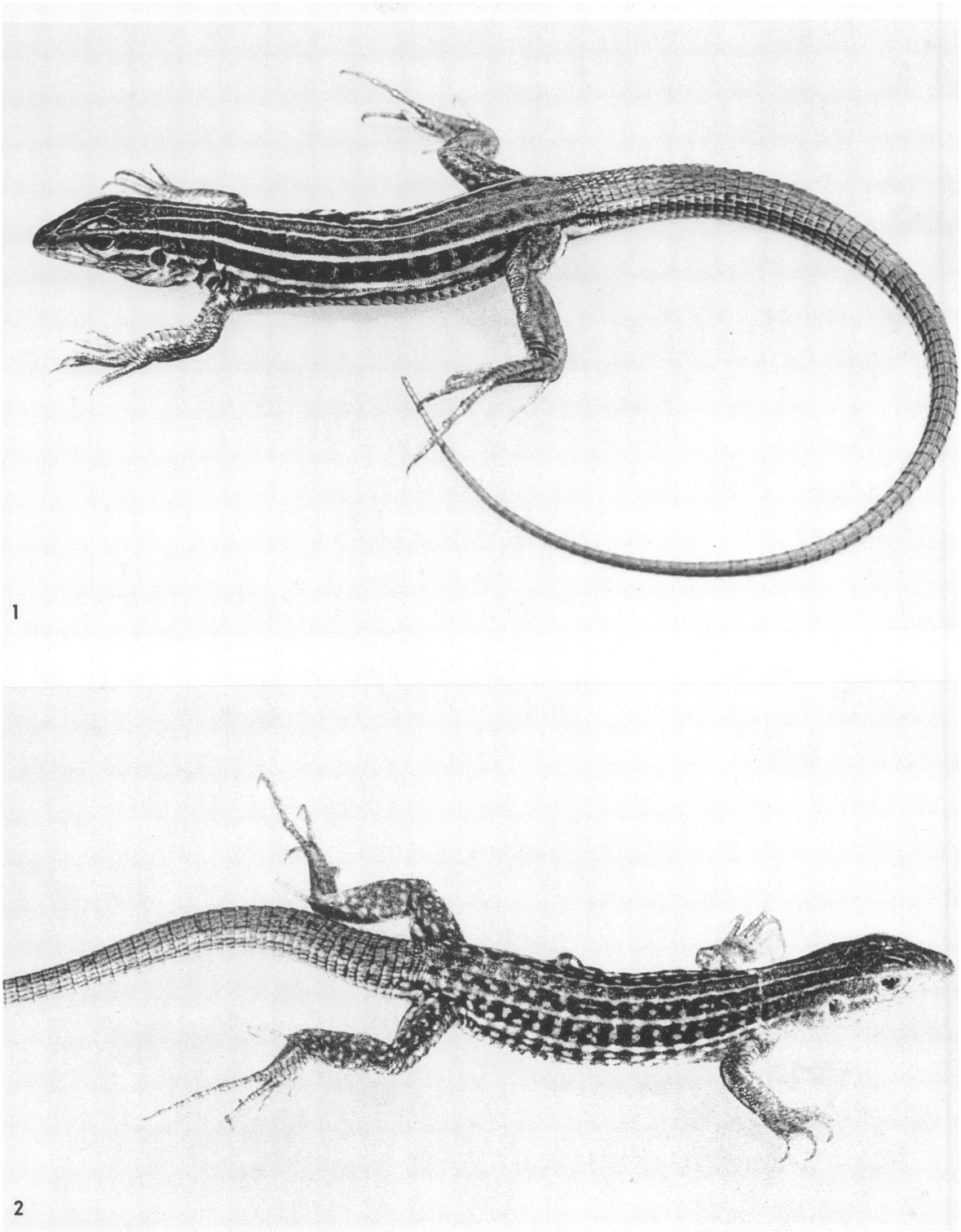


3

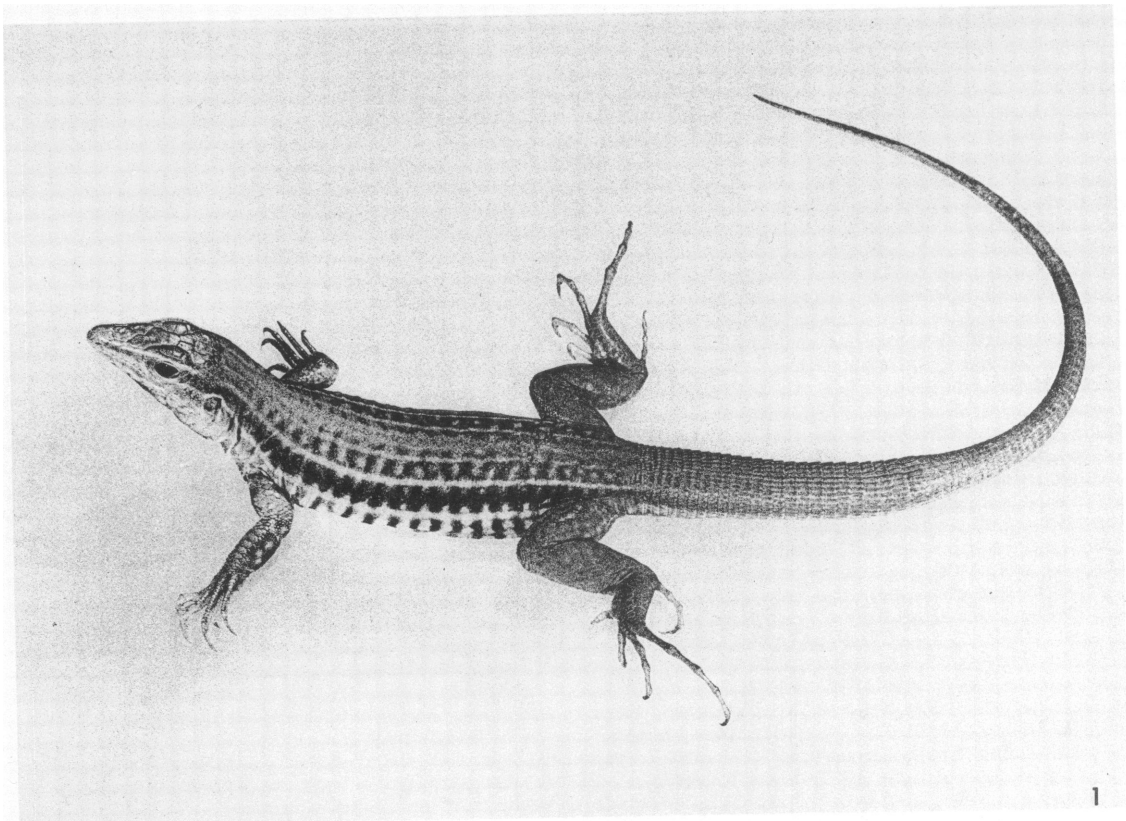
1. *Cnemidophorus sacki sacki*, A.M.N.H. No. 77116 (skeleton), 10 miles north and 3 miles east of Taxco, Guerrero, illustrating juvenile pattern with light areas beginning to form in the fields. 2. *C. s. sacki*, A.M.N.H. No. 79917, 2 miles southeast of Iguala, Guerrero, illustrating pattern of an adult individual of near-maximum size. 3. *C. stictogrammus*, A.M.N.H. No. 76129 (skeleton), Sabino Canyon, Pima County, Arizona, illustrating pattern of an adult individual of near-maximum size

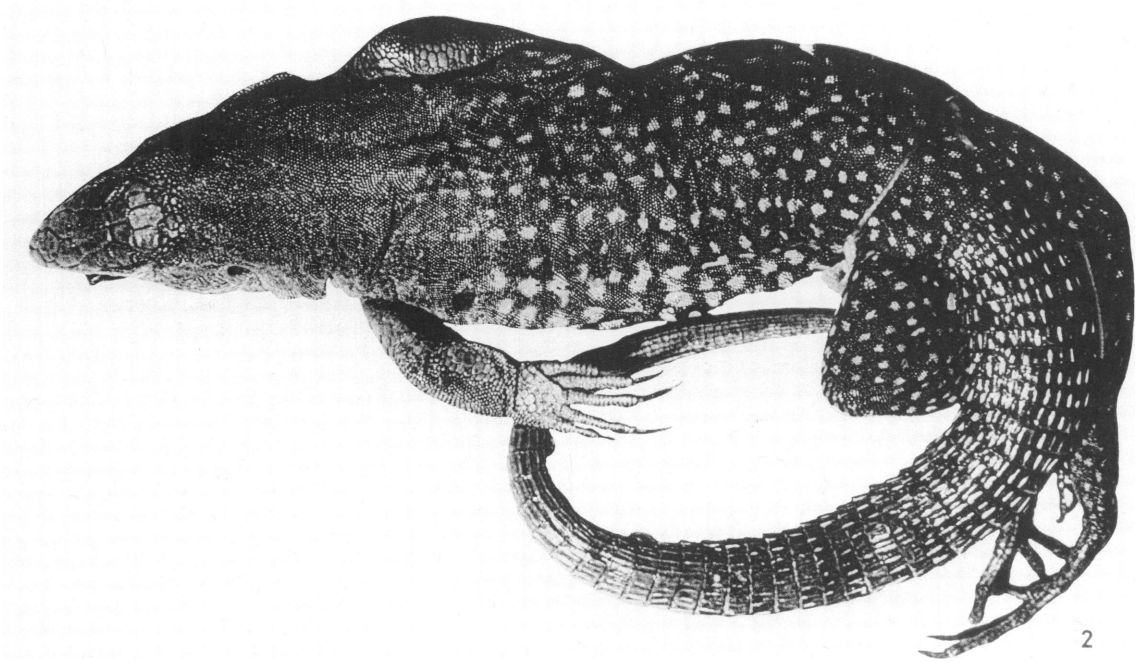



Pattern variation in large adult specimens of *Cnemidophorus sacki occidentalis*. All from Santa Ana, Jalisco, except 5 and 9 which are from 3 miles west of Jocotepec, Jalisco. All measurements are from snout to vent. 1. U.C.M. No. 8616, 114 mm. 2. U.C.M. No. 8618, 102 mm. 3. U.C.M. No. 8620, 115 mm. 4. U.C.M. No. 8615, 109 mm. 5. U.C.M. No. 8625, 113 mm. 6. U.C.M. No. 8611, 108 mm. 7. U.C.M. No. 8619, 104 mm. 8. U.C.M. No. 8612, 112 mm. 9. U.C.M. No. 8624, 126 mm.



1. *Cnemidophorus scalaris* ssp., A.M.N.H. No. 77579, 10 miles north of Chapala, Jalisco, photographed February 22, 1957, showing light areas (not yet distinct spots) appearing in dark fields. 2. Same individual, photographed September 30, 1957, showing development of distinct spots over body and hind limbs




1. *Cnemidophorus communis mariarum*, A.M.N.H. No. 79046, snout to vent length, 114 mm., María Magdalena Island, Tres Marias Islands. 2. *C. c. communis*, lectotype, U.S.N.M. No. 31542, Colima, Colima